Appendix F: Best Available Retrofit Technology

Appendix to Section Chapter 10 of the State Implementation Plan

Regional Haze Rules and Negotiated Rule Making Summary

Negotiated Regional Haze Rule

IDAPA 58 - DEPARTMENT OF ENVIRONMENTAL QUALITY

58.01.01 - RULES FOR THE CONTROL OF AIR POLLUTION IN IDAHO

DOCKET NO. 58-0101-0601

NOTICE OF RULEMAKING - PROPOSED RULEMAKING

AUTHORITY: In compliance with Section 67-5221(1), Idaho Code, notice is hereby given that this agency has proposed rulemaking. The action is authorized by Sections 39-105 and 39-107, Idaho Code.

PUBLIC HEARING SCHEDULE: A public hearing concerning this proposed rulemaking will be held as follows:

September 6, 2006 at 4:00 p.m.
Department of Environmental Quality Conference Center
1410 N. Hilton, Boise, Idaho

The hearing site(s) will be accessible to persons with disabilities. Requests for accommodation must be made no later than five (5) days prior to the hearing. For arrangements, contact the undersigned at (208) 373-0418.

DESCRIPTIVE SUMMARY: The Department of Environmental Quality (DEQ) is tasked with developing a plan to address Regional Haze in Class I Wilderness Areas within Idaho and other Class I areas impacted by Idaho by December 17, 2007 as required by the Federal Clean Air Act, Regional Haze Rule, 40 CFR 51.308. The intent of the Regional Haze Rule is to reduce the impacts of man-made visibility impairing pollutants on Class I areas by 2064. The first implementation plan will cover the time period from 2008 through 2018. The plan will set "Reasonable Progress Goals" and develop control strategies to attain the progress goals.

Through the negotiated rule process, rules were drafted that provide DEQ with the authority to develop "Long-Term Strategies" for making reasonable progress toward improving visibility in mandatory Class I Federal Areas. The proposed rule also provides DEQ with the authority to establish "Reasonable Progress Goals," based on emission reduction control strategies identified through the "Long-Term Strategies" and the implementation of Best Available Retrofit Technologies, in order to obtain the goals and satisfy other requirements under 40 CFR 51.308 and Subpart P -- Protection of Visibility requirements.

The text of this rule was developed by DEQ in conjunction with a negotiating committee made up of persons having an interest in the development of this rule including industry representatives, federal land managers, and public officials. BART-eligible and other sources of air pollution may be affected by this rulemaking and may wish to submit comment. Representatives of the industrial community, special interest groups, public officials, federal land managers, metropolitan planning organizations, or members of the public who have an interest in the air quality in Idaho may also wish to comment on this proposed rule. The proposed rule text is in legislative format. Language the agency proposes to add is underlined. Language the agency proposes to delete is struck out. It is these additions and deletions to which public comment should be addressed.

After consideration of public comments, DEQ intends to present the final proposal to the Board of Environmental Quality in October 2006 for adoption of a pending rule. The rule is expected to be final and effective upon the adjournment of the 2007 legislative session if adopted by the Board and approved by the Legislature.

IDAHO CODE 39-107D STATEMENT: This proposed rule does not regulate an activity not regulated by the federal government, nor is it broader in scope or more stringent than federal regulations.

FISCAL IMPACT: The following is a specific description, if applicable, of any negative fiscal impact on the state general fund greater than ten thousand dollars ($10,000) during the fiscal year: N/A

NEGOTIATED RULEMAKING: The text of the rule has been drafted based on discussions held and concerns raised during negotiations conducted pursuant to Idaho Code Section 67-5220 and IDAPA 04.11.01.812-815. The Notice of Negotiated Rulemaking was published in the Idaho Administrative Bulletin, January 4, 2006, Vol. 06-1, page 296.

GENERAL INFORMATION: For more information about DEQ's programs and activities, visit DEQ's web site at www.deq.idaho.gov.

ASSISTANCE ON TECHNICAL QUESTIONS AND SUBMISSION OF WRITTEN COMMENTS: For assistance on technical questions concerning this rulemaking, contact Mike Edwards at (208) 373-0438, mike.edwards@deq.idaho.gov.

Anyone may submit written comments by mail, fax or e-mail at the address below regarding this proposed rule. DEQ will consider all written comments received by the undersigned on or before September 6, 2006.

DATED this 30th day of June, 2006.

Paula J. Wilson
Hearing Coordinator
Department of Environmental Quality
1410 N. Hilton
Boise, Idaho 83706-1255
(208)373-0418/Fax No. (208)373-0481
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THE FOLLOWING IS THE TEXT OF DOCKET NO. 58-0101-0601

006. GENERAL DEFINITIONS.

01. Accountable. Any SIP emission trading program must account for the aggregate effect of the emissions trades in the demonstration of reasonable further progress, attainment, or maintenance. (4-5-00)

02. Act. The Environmental Protection and Health Act of 1972 as amended (Sections 39-101 through 39-130, Idaho Code). (5-1-94)

03. Actual Emissions. The actual rate of emissions of a pollutant from an emissions unit as determined in accordance with the following: (4-5-00)

a. In general, actual emissions as of a particular date shall equal the average rate, in tons per year, at which the unit actually emitted the pollutant during a two-year period which precedes the particular date and which is representative of normal source operation. The Department shall allow the use of a different time period upon a determination that it is more representative of normal source operation. Actual emissions shall be calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period. (4-5-00)

b. The Department may presume that the source-specific allowable emissions for the unit are equivalent to actual emissions of the unit. (4-5-00)

c. For any emissions unit (other than an electric utility steam generating unit as specified below) which has not yet begun normal operations on the particular date, actual emissions shall equal the potential to emit of the unit on that date. (4-5-00)

d. For an electric utility steam generating unit (other than a new unit or the replacement of an existing unit) actual emissions of the unit following the physical or operational change shall equal the representative actual annual emissions of the unit, provided the source owner or operator maintains and submits to the Department, on an annual basis for a period of five (5) years from the date the unit resumes regular operation, information demonstrating that the physical or operational change did not result in an emissions increase. A longer period, not to exceed ten (10) years may be required by the Department if it determines such a period to be more representative of normal source post-change operations. (4-5-00)

04. **Adverse Impact on Visibility**. Visibility impairment which interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the Federal Class I Area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency, and time of visibility impairments, and how these factors correlate with: (   )

a. Times of visitor use of the Federal Class I Area; and (   )

b. The frequency and timing of natural conditions that reduce visibility. (   )

c. This term does not include affects on integral vistas when applied to 40 CFR 51.307. (   )

0~~4~~5. **Air Pollutant/Air Contaminant**. Any substance, including but not limited to, dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon or particulate matter or any combination thereof. (4-5-00)

0~~5~~6. **Air Pollution**. The presence in the outdoor atmosphere of any air pollutant or combination thereof in such quantity of such nature and duration and under such conditions as would be injurious to human health or welfare, to animal or plant life, or to property, or to interfere unreasonably with the enjoyment of life or property. (4-5-00)

0~~6~~7. **Air Quality**. The specific measurement in the ambient air of a particular air pollutant at any given time. (5-1-94)

0~~7~~8. **Air Quality Criterion**. The information used as guidelines for decisions when establishing air quality goals and air quality standards. (5-1-94)

0~~8~~9. **Allowable Emissions**. The allowable emissions rate of a stationary source or facility calculated using the maximum rated capacity of the source or facility (unless the source or facility is subject to federally enforceable limits which restrict the operating rate, or hours of operation, or both) and the most stringent of the following: (4-5-00)

a. The applicable standards set forth in 40 CFR part 60 and 61; (4-5-00)

b. Any applicable State Implementation Plan emissions limitation including those with a future compliance date; or (4-5-00)

c. The emissions rate specified as a federally enforceable permit condition, including those with a future compliance date. (4-5-00)

~~09~~10. **Ambient Air**. That portion of the atmosphere, external to buildings, to which the general public has access. (5-1-94)

1~~0~~1. **Ambient Air Quality Violation**. Any ambient concentration that causes or contributes to an exceedance of a national ambient air quality standard as determined by 40 CFR Part 50. (4-11-06)

1~~1~~2. **Atmospheric Stagnation Advisory**. An air pollution alert declared by the Department when air pollutant impacts have been observed and/or meteorological conditions are conducive to additional air pollutant buildup. (4-11-06)

1~~2~~3. **Attainment Area**. Any area which is designated, pursuant to 42 U.S.C. Section 7407(d), as having ambient concentrations equal to or less than national primary or secondary ambient air quality standards for a particular air pollutant or air pollutants. (4-11-06)

14. **BART-Eligible Source**. Any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit two hundred fifty (250) tons per year or more of any air pollutant. In determining potential to emit, fugitive emissions, to the extent quantifiable, must be counted. ( )

a. Fossil-fuel fired steam electric plants of more than two hundred fifty (250) million BTU's per hour heat input; ( )

b. Coal cleaning plants (thermal dryers); ( )

c. Kraft pulp mills; ( )

d. Portland cement plants; ( )

e. Primary zinc smelters; ( )

f. Iron and steel mill plants; ( )

g. Primary aluminum ore reduction plants; ( )

h. Primary copper smelters; ( )

i. Municipal incinerators capable of charging more than two hundred fifty (250) tons of refuse per day; ( )

j. Hydrofluoric, sulfuric, and nitric acid plants; ( )

k. Petroleum refineries; ( )

l. Lime plants; ( )

m. Phosphate rock processing plants; ( )

n. Coke oven batteries; ( )

o. Sulfur recovery plants; ( )

p. Carbon black plants (furnace process); ( )

q. Primary lead smelters; ( )

r. Fuel conversion plants; ( )

s. Sintering plants; ( )

t. Secondary metal production facilities; ( )

u. Chemical process plants; ( )

v. Fossil-fuel boilers of more than two hundred fifty (250) million BTU's per hour heat input; ( )

w. Petroleum storage and transfer facilities with a capacity exceeding three hundred thousand (300,000) barrels; ( )

x. Taconite ore processing facilities; ( )

y. Glass fiber processing plants; and ( )

z. Charcoal production facilities. ( )

1~~3~~5. **Baseline (Area, Concentration, Date)**. See Section 579. (5-1-94)

16. **Best Available Retrofit Technology (BART)**. Means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. ( )

1~~4~~7. **Board**. Idaho Board of Environmental Quality. (5-1-94)

1~~5~~8. **Breakdown**. An unplanned failure of any equipment or emissions unit which may cause excess emissions. (4-5-00)

1~~6~~9. **BTU**. British thermal unit. (5-1-94)

~~17~~20. **Clean Air Act**. The federal Clean Air Act, 42 U.S.C. Sections 7401 through 7671q. (5-1-94)

~~18~~21. **Collection Efficiency**. The overall performance of the air cleaning device in terms of ratio of materials collected to total input to the collector unless specific size fractions of the contaminant are stated or required. (5-1-94)

~~19~~22. **Commence Construction or Modification**. In general, this means initiation of physical on-site construction activities on an emissions unit which are of a permanent nature. Such activities include, but are not limited to, installation of building supports and foundations, laying of underground pipework, and construction of permanent storage structures. With respect to a change in method of operation, this term refers to those on-site activities, other than preparatory activities, which mark the initiation of the change. (4-5-00)

2~~0~~3. **Complete**. A determination made by the Department that all information needed to process a permit application has been submitted for review. (5-1-94)

2~~1~~4. **Construction**. Fabrication, erection, installation, or modification of a stationary source or facility. (5-1-94)

2~~2~~5. **Control Equipment**. Any method, process or equipment which removes, reduces or renders less noxious, air pollutants discharged into the atmosphere. (5-1-94)

2~~3~~6. **Controlled Emission**. An emission which has been treated by control equipment to remove all or part of an air pollutant before release to the atmosphere. (5-1-94)

2~~4~~7. **Criteria Air Pollutant**. Any of the following: PM-10; sulfur oxides; ozone, nitrogen dioxide; carbon monoxide; lead. (4-5-00)

28. **Deciview**. A measurement of visibility impairment. A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired. The deciview haze index is calculated based on the following equation (for the purposes of calculating deciview, the atmospheric light extinction coefficient must be calculated from aerosol measurements): Deciview Haze Index = $10 \ln_e (b_{ext}/10Mm^{-1})$ where b_{ext} = the atmospheric light extinction coefficient, expressed in inverse megameters (Mm^{-1}). ( )

2~~5~~9. **Department**. The Department of Environmental Quality. (5-1-94)

~~26~~30. **Designated Facility**. Any of the following facilities: (5-1-94)

a. Fossil-fuel fired steam electric plants of more than two hundred fifty (250) million BTU's per hour heat input; (5-1-94)

b. Coal cleaning plants (thermal dryers); (5-1-94)

c. Kraft pulp mills; (5-1-94)

d. Portland cement plants; (5-1-94)

e. Primary zinc smelters; (5-1-94)

f. Iron and steel mill plants; (5-1-94)

g. Primary aluminum ore reduction plants; (5-1-94)

h. Primary copper smelters; (5-1-94)

i. Municipal incinerators capable of charging more than two hundred and fifty (250) tons of refuse per day; (5-1-94)

j. Hydrofluoric, sulfuric, and nitric acid plants; (5-1-94)

k. Petroleum refineries; (5-1-94)

l. Lime plants; (5-1-94)

m. Phosphate rock processing plants; (5-1-94)

n. Coke oven batteries; (5-1-94)

o. Sulfur recovery plants; (5-1-94)

p. Carbon black plants (furnace process); (5-1-94)

q. Primary lead smelters; (5-1-94)

r. Fuel conversion plants; (5-1-94)

s. Sintering plants; (5-1-94)

t. Secondary metal production facilities; (5-1-94)

u. Chemical process plants; (5-1-94)

v. Fossil-fuel boilers (or combination thereof) of more than two hundred and fifty (250) million BTU's per hour heat input; (5-1-94)

w. Petroleum storage and transfer facilities with a capacity exceeding three hundred thousand (300,000) barrels; (5-1-94)

x. Taconite ore processing facilities; (5-1-94)

y. Glass fiber processing plants; and (5-1-94)

z. Charcoal production facilities. (5-1-94)

~~27~~31. **Director**. The Director of the Department of Environmental Quality or his designee. (5-1-94)

~~28~~32. **Effective Dose Equivalent**. The sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. It is generally calculated as an annual dose. (5-1-94)

~~29~~33. **Emission**. Any controlled or uncontrolled release or discharge into the outdoor atmosphere of any air pollutants or combination thereof. Emission also includes any release or discharge of any air pollutant from a stack, vent, or other means into the outdoor atmosphere that originates from an emission unit. (5-1-94)

3~~0~~4. **Emission Standard**. A permit or regulatory requirement established by the Department or EPA which limits the quantity, rate, or concentration of emissions of air pollutants on a continuous basis, including any requirements which limit the level of opacity, prescribe equipment, set fuel specifications, or prescribe operation or maintenance procedures for a source to assure continuous emission reduction. (4-5-00)

3~~1~~5. **Emissions Unit**. An identifiable piece of process equipment or other part of a facility which emits or may emit any air pollutant. This definition does not alter or affect the term “unit” for the purposes of 42 U.S.C. Sections 7651 through 7651o. (5-1-94)

3~~2~~6. **EPA**. The United States Environmental Protection Agency and its Administrator or designee. (5-1-94)

3~~3~~7. **Environmental Remediation Source**. A stationary source that functions to remediate or recover any release, spill, leak, discharge or disposal of any petroleum product or petroleum substance, any hazardous waste or hazardous substance from any soil, ground water or surface water, and shall have an operational life no greater than five (5) years from the inception of any operations to the cessation of actual operations. Nothing in this definition shall be construed so as to actually limit remediation projects to five (5) years or less of total operation. (5-1-95)

3~~4~~8. **Excess Emissions**. Emissions that exceed an applicable emissions standard established for any facility, source or emissions unit by statute, regulation, rule, permit, or order. (4-11-06)

3~~5~~9. **Existing Stationary Source or Facility**. Any stationary source or facility that exists, is installed, or is under construction on the original effective date of any applicable provision of this chapter. (5-1-94)

~~36~~40. **Facility**. All of the pollutant-emitting activities which belong to the same industrial grouping, are located on one (1) or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control). Pollutant-emitting activities shall be considered as part of the same industrial grouping if they belong to the same Major Group (i.e. which have the same two-digit code) as described in the Standard Industrial Classification Manual. The fugitive emissions shall not be considered in determining whether a permit is required unless required by federal law. (4-11-06)

~~37~~41. **Federal Class I Area**. Any federal land that is classified or reclassified “Class I” ~~pursuant to Section 580~~. ~~(5-1-94)~~(   )

~~38~~42. **Federal Land Manager**. The Secretary of the ~~federal~~ department with authority over ~~any federal lands in the United States~~ the Federal Class I Area (or the Secretary's designee). ~~(5-1-94)~~(   )

43. **Federally Enforceable**. All limitations and conditions which are enforceable by the Department under the Clean Air Act, including those requirements developed pursuant to 40 CFR Parts 60 and 61 requirements within any applicable State Implementation Plan, and any permit requirements established pursuant to 40 CFR 51.21 or under regulations approved pursuant to 40 CFR Parts 51, 52, or 60. (   )

~~39~~44. **Fire Hazard**. The presence or accumulation of combustible material of such nature and in sufficient quantity that its continued existence constitutes an imminent and substantial danger to life, property, public welfare or adjacent lands. (5-1-94)

4~~0~~5. **Fuel-Burning Equipment**. Any furnace, boiler, apparatus, stack and all appurtenances thereto, used in the process of burning fuel for the primary purpose of producing heat or power by indirect heat transfer. (5-1-94)

4~~1~~6. **Fugitive Dust**. Fugitive emissions composed of particulate matter. (5-1-94)

4~~2~~7. **Fugitive Emissions**. Those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening. (5-1-94)

4~~3~~8. **Garbage**. Any waste consisting of putrescible animal and vegetable materials resulting from the handling, preparation, cooking and consumption of food including, but not limited to, waste materials from households, markets, storage facilities, handling and sale of produce and other food products. (5-1-94)

49. **Geographic Enhancement for the Purpose of 40 CFR 51.308**. A method, procedure, or process to allow a broad regional strategy, such as an emissions trading program designed to achieve greater reasonable progress than BART for regional haze, to accommodate BART for reasonable attributable impairment. ( )

~~44~~50. **Grain Elevator**. Any plant or installation at which grain is unloaded, handled, cleaned, dried, stored, or loaded. (5-1-94)

~~4~~51. **Grain Storage Elevator**. Any grain elevator located at any wheat flour mill, wet corn mill, dry corn mill (human consumption), rice mill, or soybean extraction plant which has a permanent grain storage capacity of thirty five thousand two hundred (35,200) cubic meters (ca. 1 million bushels). (5-1-94)

~~46~~52. **Grain Terminal Elevator**. Any grain elevator which has a permanent storage capacity of more than eighty-eight thousand one hundred (88,100) cubic meters (ca. 2.5 million bushels), except those located at animal food manufacturers, pet food manufacturers, cereal manufacturers, breweries, and livestock feedlots. (5-1-94)

~~47~~53. **Hazardous Air Pollutant (HAP)**. Any air pollutant listed pursuant to Section 112(b) of the Clean Air Act. Hazardous Air Pollutants are regulated air pollutants. (4-11-06)

~~48~~54. **Hazardous Waste**. Any waste or combination of wastes of a solid, liquid, semisolid, or contained gaseous form which, because of its quantity, concentration or characteristics (physical, chemical or biological) may: (5-1-94)

a. Cause or significantly contribute to an increase in deaths or an increase in serious, irreversible, or incapacitating reversible illnesses; or (5-1-94)

b. Pose a substantial threat to human health or to the environment if improperly treated, stored, disposed of, or managed. Such wastes include, but are not limited to, materials which are toxic, corrosive, ignitable, or reactive, or materials which may have mutagenic, teratogenic, or carcinogenic properties; provided that such wastes do not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are allowed under a national pollution discharge elimination system permit, or source, special nuclear, or by-product material as defined by 42 U.S.C. Sections 2014(e),(z) or (aa). (5-1-94)

~~49~~55. **Hot-Mix Asphalt Plant**. Those facilities conveying proportioned quantities or batch loading of cold aggregate to a drier, and heating, drying, screening, classifying, measuring and mixing the aggregate and asphalt for the purpose of paving, construction, industrial, residential or commercial use. (5-1-94)

5~~0~~6. **Incinerator**. Any source consisting of a furnace and all appurtenances thereto designed for the destruction of refuse by burning. "Open Burning" is not considered incineration. For purposes of these rules, the destruction of any combustible liquid or gaseous material by burning in a flare stack shall be considered incineration. (5-1-94)

5~~1~~7. **Indian Governing Body**. The governing body of any tribe, band, or group of Indians subject to the jurisdiction of the United States and recognized by the United States as possessing power of self-government.

(5-1-94)

58. **Integral Vista**. A view perceived from within the mandatory Class I Federal Area of a specific landmark or panorama located outside the boundary of the mandatory Class I Federal Area. ( )

5~~2~~9. **Kraft Pulping**. Any pulping process which uses, for a cooking liquor, an alkaline sulfide solution containing sodium hydroxide and sodium sulfide. (5-1-94)

60. **Least Impaired Days**. The average visibility impairment (measured in deciviews) for the twenty percent (20%) of monitored days in a calendar year with the lowest amount of visibility impairment. ( )

~~53~~61. **Lowest Achievable Emission Rate (LAER)**. For any source, the more stringent rate of emissions based on the following: (4-5-00)

a. The most stringent emissions limitation which is contained in any State Implementation Plan for such class or category of facility, unless the owner or operator of the proposed facility demonstrates that such limitations are not achievable; or (4-5-00)

b. The most stringent emissions limitation which is achieved in practice by such class or category of facilities. This limitation, when applied to a modification, means the lowest achievable emissions rate for the new or modified emissions units within the facility. In no event shall the application of the term permit a proposed new or modified facility to emit any pollutant in excess of the amount allowable under an applicable new source standard of performance. (4-5-00)

62. **Mandatory Class I Federal Area.** Any area identified in 40 CFR 81.400 through 81.437. ( )

~~54~~63. **Member of the Public**. For purposes of Subsection 006.~~89~~103.a.xvi., a person located at any off-site point where there is a residence, school, business or office. ~~*(4-11-06)*~~( )

~~55~~64. **Modification**. (4-11-06)

a. Any physical change in, or change in the method of operation of, a stationary source or facility which results in an emission increase as defined in Section 007 or which results in the emission of any regulated air pollutant not previously emitted. (4-11-06)

b. Any physical change in, or change in the method of operation of, a stationary source or facility which results in an increase in the emissions rate of any state only toxic air pollutant, or emissions of any state only toxic air pollutant not previously emitted. (4-11-06)

c. Fugitive emissions shall not be considered in determining whether a permit is required for a modification unless required by federal law. (4-11-06)

d. For purposes of ~~*Subsections 006.55.a. and 006.55.b.*~~ this definition of modification, routine maintenance, repair and replacement shall not be considered physical changes and the following shall not be considered a change in the method of operation: ~~*(4-11-06)*~~( )

i. An increase in the production rate if such increase does not exceed the operating design capacity of the affected stationary source, and if a more restrictive production rate is not specified in a permit; (5-1-94)

ii. An increase in hours of operation if more restrictive hours of operation are not specified in a permit; and (5-1-94)

iii. Use of an alternative fuel or raw material if the stationary source is specifically designed to accommodate such fuel or raw material and use of such fuel or raw material is not specifically prohibited in a permit. (4-5-00)

~~5~~65. **Monitoring**. Sampling and analysis, in a continuous or noncontinuous sequence, using techniques which will adequately measure emission levels and/or ambient air concentrations of air pollutants. (5-1-94)

66. **Most Impaired Days**. The average visibility impairment (measured in deciviews) for the twenty percent (20%) of monitored days in a calendar year with the highest amount of visibility impairment. ( )

~~5~~67. **Multiple Chamber Incinerator**. Any article, machine, equipment, contrivance, structure or part of a structure used to dispose of combustible refuse by burning, consisting of three (3) or more refractory lined combustion furnaces in series physically separated by refractory walls, interconnected by gas passage ports or ducts and employing adequate parameters necessary for maximum combustion of the material to be burned. (5-1-94)

68. **Natural Conditions**. Includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration. ( )

~~58~~69. **New Stationary Source or Facility**. (5-1-94)

a. Any stationary source or facility, the construction or modification of which is commenced after the original effective date of any applicable provision of this chapter; or (5-1-94)

b. The restart of a nonoperating facility shall be considered a new stationary source or facility if: (5-1-94)

i. The restart involves a modification to the facility; or (5-1-94)

ii. After the facility has been in a nonoperating status for a period of two (2) years, and the Department receives an application for a Permit to Construct in the area affected by the existing nonoperating facility, the Department will, within five (5) working days of receipt of the application notify the nonoperating facility of receipt of the application for a Permit to Construct. Upon receipt of this Departmental notification, the nonoperating facility will comply with the following restart schedule or be considered a new stationary source or facility when it does restart: Within thirty (30) working days after receipt of the Department's notification of the application for a Permit to Construct, the nonoperating facility shall provide the Department with a schedule detailing the restart of the facility. The restart must begin within sixty (60) days of the date the Department receives the restart schedule. (5-1-94)

~~59~~70. **Nonattainment Area**. Any area which is designated, pursuant to 42 U.S.C. Section 7407(d), as not meeting (or contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant. (5-1-94)

~~60~~71. **Noncondensibles**. Gases and vapors from processes that are not condensed at standard temperature and pressure unless otherwise specified. (5-1-94)

~~61~~72. **Odor**. The sensation resulting from stimulation of the human sense of smell. (5-1-94)

~~62~~73. **Opacity**. A state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view, expressed as percent. (5-1-94)

~~63~~74. **Open Burning**. The burning of any matter in such a manner that the products of combustion resulting from the burning are emitted directly into the ambient air without passing through a stack, duct or chimney. (5-1-94)

~~64~~75. **Operating Permit**. A permit issued by the Director pursuant to Sections 300 through 386 and/or 400 through 461. (4-5-00)

~~65~~76. **Particulate Matter**. Any material, except water in uncombined form, that exists as a liquid or a solid at standard conditions. (5-1-94)

~~66~~77. **Particulate Matter Emissions**. All particulate matter emitted to the ambient air as measured by an applicable reference method, or any equivalent or alternative method in accordance with Section 157. (4-5-00)

~~6~~78. **Permit to Construct**. A permit issued by the Director pursuant to Sections 200 through 228. (7-1-02)

~~68~~79. **Person**. Any individual, association, corporation, firm, partnership or any federal, state or local governmental entity. (5-1-94)

~~69~~80. **PM-10**. All particulate matter in the ambient air with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers as measured by a reference method based on Appendix J of 40 CFR Part 50 and designated in accordance with 40 CFR Part 53 or by an equivalent method designated in accordance with 40 CFR Part 53. (5-1-94)

~~70~~81. **PM-10 Emissions**. All particulate matter, including condensible particulates, with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers emitted to the ambient air as measured by an applicable reference method, or an equivalent or alternative method in accordance with Section 157. (4-5-00)

~~71~~82. **Potential to Emit/Potential Emissions**. The maximum capacity of a facility or stationary source to emit an air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the facility or source to emit an air pollutant, ~~*provided the limitation or its effect on emissions is state or federally enforceable, shall be treated as part of its design. Limitations may include, but are not limited to,*~~ including air pollution control equipment~~,~~ and restrictions on hours of operation ~~*and restrictions*~~ or on the type or amount of material combusted, stored or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is state or federally enforceable. ~~*This definition does not alter or affect the term "capacity factor" as defined in 42 U.S.C. Sections 7651 through 7651o.*~~ Secondary emissions do not count in determining the potential to emit of a facility or stationary source. ~~*(4-5-00)*~~(   )

~~72~~83. **Portable Equipment**. Equipment which is designed to be dismantled and transported from one (1) job site to another job site. (5-1-94)

~~73~~84. **PPM (parts per million)**. Parts of a gaseous contaminant per million parts of gas by volume. (5-1-94)

~~74~~85. **Prescribed Fire Management Burning**. The controlled application of fire to wildland fuels in either their natural or modified state under such conditions of weather, fuel moisture, soil moisture, etc., as will allow the fire to be confined to a predetermined area and at the same time produce the intensity of heat and rate of spread required to accomplish planned objectives, including: (5-1-94)

a. Fire hazard reduction; (5-1-94)

b. The control of pests, insects, or diseases; (5-1-94)

c. The promotion of range forage improvements; (5-1-94)

d. The perpetuation of natural ecosystems; (5-1-94)

e. The disposal of woody debris resulting from a logging operation, the clearing of rights of way, a land clearing operation, or a driftwood collection system; (5-1-94)

f. The preparation of planting and seeding sites for forest regeneration; and (5-1-94)

g. Other accepted natural resource management purposes. (5-1-94)

~~75~~86. **Primary Ambient Air Quality Standard**. That ambient air quality which, allowing an adequate margin of safety, is requisite to protect the public health. (5-1-94)

~~76~~87. **Process or Process Equipment**. Any equipment, device or contrivance for changing any materials whatever or for storage or handling of any materials, and all appurtenances thereto, including ducts, stack, etc., the use of which may cause any discharge of an air pollutant into the ambient air but not including that equipment specifically defined as fuel-burning equipment or refuse-burning equipment. (5-1-94)

~~77~~88. **Process Weight**. The total weight of all materials introduced into any source operation which may cause any emissions of particulate matter. Process weight includes solid fuels charged, but does not include liquid and gaseous fuels charged or combustion air. Water which occurs naturally in the feed material shall be considered part of the process weight. (5-1-94)

~~7~~89. **Process Weight Rate**. The rate established as follows: (5-1-94)

a. For continuous or long-run steady-state source operations, the total process weight for the entire period of continuous operation or for a typical portion thereof, divided by the number of hours of such period or portion thereof; (4-5-00)

b. For cyclical or batch source operations, the total process weight for a period that covers a complete cycle of operation or an integral number of cycles, divided by the hours of actual process operation during such a period. Where the nature of any process or operation or the design of any equipment is such as to permit more than one (1) interpretation of this definition, the interpretation that results in the minimum value for allowable emission shall apply. (4-5-00)

~~7~~90. **Quantifiable**. The Department must be able to determine the emissions impact of any SIP trading programs requirement(s) or emission limit(s). (4-5-00)

~~80~~91. **Radionuclide**. A type of atom which spontaneously undergoes radioactive decay. (5-1-94)

92. **Reasonably Attributable**. Attributable by visual observation or any other technique the state deems appropriate. ( )

93. **Regional Haze**. Visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources. ( )

~~81~~94. **Regulated Air Pollutant**. (4-11-06)

a. For purposes of determining applicability of major source permit to operate requirements, issuing, and modifying permits pursuant to Sections 300 through 397, and in accordance with Title V of the federal Clean Air Act amendments of 1990, 42 U.S.C. Section 7661 et seq., "regulated air pollutant" shall have the same meaning as in Title V of the federal Clean Air Act amendments of 1990, and any applicable federal regulations promulgated pursuant to Title V of the federal Clean Air Act amendments of 1990, 40 CFR Part 70; (4-11-06)

b. For purposes of determining applicability of any other operating permit requirements, issuing, and modifying permits pursuant to Sections 400 through 410, the federal definition of "regulated air pollutant" as defined in Subsection 006.~~81~~94.a. shall also apply; ~~(4-11-06)~~( )

c. For purposes of determining applicability of permit to construct requirements, issuing, and modifying permits pursuant to Sections 200 through 228, except Section 214, and in accordance with Part D of Subchapter I of the federal Clean Air Act, 42 U.S.C. Section 7501 et seq., "regulated air pollutant" shall mean those air contaminants that are regulated in non-attainment areas pursuant to Part D of Subchapter I of the federal Clean Air Act and applicable federal regulations promulgated pursuant to Part D of Subchapter I of the federal Clean Air Act, 40 CFR 51.165; and (4-11-06)

d. For purposes of determining applicability of any other major or minor permit to construct requirements, issuing, and modifying permits pursuant to 200 through 228, except Section 214, "regulated air pollutant" shall mean those air contaminants that are regulated in attainment and unclassifiable areas pursuant to Part C of Subchapter I of the federal Clean Air Act, 40 CFR 52.21, and any applicable federal regulations promulgated pursuant to Part C of Subchapter I of the federal Clean Air Act, 42 U.S.C. Section 7470 et seq. (4-11-06)

~~82~~95. **Replicable.** Any SIP procedures for applying emission trading shall be structured so that two (2) independent entities would obtain the same result when determining compliance with the emission trading provisions. (4-5-00)

~~83~~96. **Responsible Official.** One (1) of the following: (5-1-94)

a. For a corporation: a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one (1) or more manufacturing, production, or operating facilities applying for or subject to a permit and either: (5-1-94)

i. The facilities employ more than two hundred fifty (250) persons or have gross annual sales or expenditures exceeding twenty-five million dollars ($25,000,000) (in second quarter 1980 dollars); or (4-5-00)

ii. The delegation of authority to such representative is approved in advance by the Department. (5-1-94)

b. For a partnership or sole proprietorship: a general partner or the proprietor, respectively. (5-1-94)

c. For a municipality, State, Federal, or other public agency: either a principal executive officer or ranking elected official. For the purposes of Section 123, a principal executive officer of a Federal agency includes the chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., a Regional Administrator of EPA). (4-5-00)

d. For Phase II sources: (5-1-94)

i. The designated representative in so far as actions, standards, requirements, or prohibitions under 42 U.S.C. Sections 7651 through 7651o or the regulations promulgated thereunder are concerned; and (5-1-94)

ii. The designated representative for any other purposes under 40 CFR Part 70. (5-1-94)

~~84~~97. **Safety Measure.** Any shutdown (and related startup) or bypass of equipment or processes undertaken to prevent imminent injury or death or severe damage to equipment or property which may cause excess emissions. (4-5-00)

~~85~~98. **Salvage Operation.** Any source consisting of any business, trade or industry engaged in whole or in part in salvaging or reclaiming any product or material, such as, but not limited to, reprocessing of used motor oils, metals, chemicals, shipping containers, or drums, and specifically including automobile graveyards and junkyards. (5-1-94)

~~86~~99. **Scheduled Maintenance.** Planned upkeep, repair activities and preventative maintenance on any air pollution control equipment or emissions unit, including process equipment, and including shutdown and startup of such equipment. (3-20-97)

~~87~~100. **Secondary Ambient Air Quality Standard.** That ambient air quality which is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air. (5-1-94)

101. **Secondary Emissions**. Emissions which would occur as a result of the construction, modification, or operation of a stationary source or facility, but do not come from the stationary source or facility itself. Secondary emissions must be specific, well defined, quantifiable, and affect the same general area as the stationary source, facility, or modification which causes the secondary emissions. Secondary emissions include emissions from any offsite support facility which would not be constructed or increase its emissions except as a result of the construction or operation of the primary stationary source, facility or modification. Secondary emissions do not include any emissions which come directly from a mobile source regulated under 42 U.S.C. Sections 7521 through 7590. (   )

~~88~~102. **Shutdown**. The normal and customary time period required to cease operations of air pollution control equipment or an emissions unit beginning with the initiation of procedures to terminate normal operation and continuing until the termination is completed. (5-1-94)

~~89~~103. **Significant**. In reference to a net emissions increase or the potential of a source to emit any of the following pollutants, a rate of emissions that would equal or exceed any of the following: (4-11-06)

a. Pollutant and emissions rate: (4-11-06)

i. Carbon monoxide, one hundred (100) tons per year; (5-1-94)

ii. Nitrogen oxides, forty (40) tons per year; (5-1-94)

iii. Sulfur dioxide, forty (40) tons per year; (5-1-94)

iv. Particulate matter, twenty-five (25) tons per year of particulate matter emissions; fifteen (15) tons per year of PM_{10} emissions; (4-11-06)

v. Ozone, forty (40) tons per year of volatile organic compounds; (4-11-06)

vi. Lead, six-tenths (0.6) of a ton per year; (5-1-94)

vii. Fluorides, three (3) tons per year; (5-1-94)

viii. Sulfuric acid mist, seven (7) tons per year; (5-1-94)

ix. Hydrogen sulfide (H2S), ten (10) tons per year; (5-1-94)

x. Total reduced sulfur (including H2S), ten (10) tons per year; (5-1-94)

xi. Reduced sulfur compounds (including H2S), ten (10) tons per year; (5-1-94)

xii. Municipal waste combustor organics (measured as total tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans), thirty-five ten-millionths (0.0000035) tons per year; (5-1-94)

xiii. Municipal waste combustor metals (measured as particulate matter), fifteen (15) tons per year; (5-1-94)

xiv. Municipal waste combustor acid gases (measured as sulfur dioxide and hydrogen chloride), forty (40) tons per year; (5-1-94)

xv. Municipal solid waste landfill emissions (measured as nonmethane organic compounds), fifty (50) tons per year; or (4-11-06)

xvi. Radionuclides, a quantity of emissions, from source categories regulated by 40 CFR Part 61, Subpart H, that have been determined in accordance with 40 CFR Part 61, Appendix D and by Department approved methods, that would cause any member of the public to receive an annual effective dose equivalent of at least one tenth (0.1) mrem per year, if total facility-wide emissions contribute an effective dose equivalent of less than three (3) mrem per year; or any radionuclide emission rate, if total facility-wide radionuclide emissions contribute an effective dose equivalent of greater than or equal to three (3) mrem per year. (5-1-95)

b. In reference to a net emissions increase or the potential of a source or facility to emit a regulated air pollutant not listed in Subsection 006.~~89~~103.a. above and not a toxic air pollutant, any emission rate; or ~~(4-11-06)~~(____)

c. For a major facility or major modification which would be constructed within ten (10) kilometers of a Class I area, the emissions rate which would increase the ambient concentration of an emitted regulated air pollutant in the Class I area by one (1) microgram per cubic meter, twenty-four (24) hour average, or more. (4-5-00)

~~*90*~~104. **Significant Contribution**. Any increase in ambient concentrations which would exceed the following: (5-1-94)

a. Sulfur dioxide: (5-1-94)

i. One (1.0) microgram per cubic meter, annual average; (5-1-94)

ii. Five (5) micrograms per cubic meter, twenty-four (24) hour average; (5-1-94)

iii. Twenty-five (25) micrograms per cubic meter, three (3) hour average; (5-1-94)

b. Nitrogen dioxide, one (1.0) microgram per cubic meter, annual average; (5-1-94)

c. Carbon monoxide: (5-1-94)

i. One-half (0.5) milligrams per cubic meter, eight (8) hour average; (5-1-94)

ii. Two (2) milligrams per cubic meter, one (1) hour average; (5-1-94)

d. PM-10: (5-1-94)

i. One (1.0) microgram per cubic meter, annual average; (5-1-94)

ii. Five (5.0) micrograms per cubic meter, twenty-four (24) hour average. (5-1-94)

~~*91*~~105. **Small Fire.** A fire in which the material to be burned is not more than four (4) feet in diameter nor more than three (3) feet high. (5-1-94)

~~*92*~~106. **Smoke**. Small gas-borne particles resulting from incomplete combustion, consisting predominantly, but not exclusively, of carbon and other combustible material. (5-1-94)

~~*93*~~107. **Smoke Management Plan**. A document issued by the Director to implement Sections 606 through 616, Categories of Allowable Burning. (5-1-94)

~~*94*~~108. **Smoke Management Program**. A program whereby meteorological information, fuel conditions, fire behavior, smoke movement and atmospheric dispersal conditions are used as a basis for scheduling the location, amount and timing of open burning operations so as to minimize the impact of such burning on identified smoke sensitive areas. (5-1-94)

~~*95*~~109. **Source**. A stationary source. (5-1-94)

~~*96*~~110. **Source Operation**. The last operation preceding the emission of air pollutants, when this operation: (5-1-94)

a. Results in the separation of the air pollutants from the process materials or in the conversion of the process materials into air pollutants, as in the case of fuel combustion; and (5-1-94)

b. Is not an air cleaning device. (5-1-94)

~~*97*~~111. **Stack.** Any point in a source arranged to conduct emissions to the ambient air, including a chimney, flue, conduit, or duct but not including flares. (5-1-94)

~~*98*~~112. **Standard Conditions.** Except as specified in Subsection 576.02 for ambient air quality standards, a dry gas temperature of twenty degrees Celsius (20C) sixty-eight degrees Fahrenheit (68F) and a gas pressure of seven hundred sixty (760) millimeters of mercury (14.7 pounds per square inch) absolute. (4-5-00)

~~99~~113. **Startup**. The normal and customary time period required to bring air pollution control equipment or an emissions unit, including process equipment, from a nonoperational status into normal operation. (5-1-94)

1~~00~~14. **Stationary Source**. Any building, structure, facility, emissions unit, or installation which emits or may emit any air pollutant. The fugitive emissions shall not be considered in determining whether a permit is required unless required by federal law. (4-11-06)

1~~0~~15. **Tier I Source**. Any of the following: (5-1-94)

a. Any source located at any major facility as defined in Section 008; (4-5-00)

b. Any source, including an area source, subject to a standard, limitation, or other requirement under 42 U.S.C. Section 7411 or 40 CFR Part 60, and required by EPA to obtain a Part 70 permit; (4-11-06)

c. Any source, including an area source, subject to a standard or other requirement under 42 U.S.C. Section 7412, 40 CFR Part 61 or 40 CFR Part 63, and required by EPA to obtain a Part 70 permit, except that a source is not required to obtain a permit solely because it is subject to requirements under 42 U.S.C. Section 7412(r); (4-11-06)

d. Any Phase II source; and (5-1-94)

e. Any source in a source category designated by the Department. (5-1-94)

1~~02~~16. **Total Suspended Particulates**. Particulate matter as measured by the method described in 40 CFR 50 Appendix B. (4-5-00)

1~~03~~17. **Toxic Air Pollutant**. An air pollutant that has been determined by the Department to be by its nature, toxic to human or animal life or vegetation and listed in Section 585 or 586. (5-1-94)

1~~04~~18. **Toxic Air Pollutant Carcinogenic Increments**. Those ambient air quality increments based on the probability of developing excess cancers over a seventy (70) year lifetime exposure to one (1) microgram per cubic meter (1 ug/m3) of a given carcinogen and expressed in terms of a screening emission level or an acceptable ambient concentration for a carcinogenic toxic air pollutant. They are listed in Section 586. (5-1-94)

1~~05~~19. **Toxic Air Pollutant Non-carcinogenic Increments**. Those ambient air quality increments based on occupational exposure limits for airborne toxic chemicals expressed in terms of a screening emission level or an acceptable ambient concentration for a non-carcinogenic toxic air pollutant. They are listed in Section 585. (5-1-94)

1~~06~~20. **Toxic Substance**. Any air pollutant that is determined by the Department to be by its nature, toxic to human or animal life or vegetation. (5-1-94)

1~~07~~21. **Trade Waste**. Any solid, liquid or gaseous material resulting from the construction or demolition of any structure, or the operation of any business, trade or industry including, but not limited to, wood product industry waste such as sawdust, bark, peelings, chips, shavings and cull wood. (5-1-94)

1~~08~~22. **TRS (Total Reduced Sulfur)**. Hydrogen sulfide, mercaptans, dimethyl sulfide, dimethyl disulfide and any other organic sulfide present. (5-1-94)

1~~09~~23. **Unclassifiable Area**. An area which, because of a lack of adequate data, is unable to be classified pursuant to 42 U.S.C. Section 7407(d) as either an attainment or a nonattainment area. (5-1-94)

1~~10~~24. **Uncontrolled Emission**. An emission which has not been treated by control equipment. (5-1-94)

1~~11~~25. **Upset**. An unplanned disruption in the normal operations of any equipment or emissions unit which may cause excess emissions. (4-5-00)

126. **Visibility Impairment**. Any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions. ( )

127. **Visibility in Any Mandatory Class I Federal Area**. Includes any integral vista associated with that area. ( )

1128. **Wigwam Burner**. Wood waste burning devices commonly called teepee burners, silos, truncated cones, and other such burners commonly used by the wood product industry for the disposal by burning of wood wastes. (5-1-94)

11329. **Wood Stove Curtailment Advisory**. An air pollution alert issued through local authorities and/or the Department to limit wood stove emissions during air pollution episodes. (5-1-94)

007. DEFINITIONS FOR THE PURPOSES OF SECTIONS 200 THROUGH 228 AND 400 THROUGH 461.

~~01. Adverse Impact on Visibility. Visibility impairment which interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the Federal Class I area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency, and time of visibility impairments, and how these factors correlate with: (4-5-00)~~

~~a. Times of visitor use of the Federal Class I area; and (4-5-00)~~

~~b. The frequency and timing of natural conditions that reduce visibility. (4-5-00)~~

~~c. This term does not include affects on integral vistas. (4-5-00)~~

021. **Agricultural Activities and Services**. For the purposes of Subsection 222.02.f., the usual and customary activities of cultivating the soil, producing crops and raising livestock for use and consumption. Agricultural activities and services do not include manufacturing, bulk storage, handling for resale or the formulation of any agricultural chemical listed in Sections 585 or 586. (5-1-94)

032. **Baseline Actual Emissions**. The rate of emissions, in tons per year, of a regulated air pollutant as determined by the following provisions: (4-11-06)

a. For any existing electric utility steam generating unit, baseline actual emissions means the average rate, in tons per year, at which the unit actually emitted the regulated air pollutant during any consecutive twenty-four (24) month period selected by the owner or operator within the five (5) year period immediately preceding when the owner or operator begins actual construction of the project. The Director shall allow the use of a different time period upon a determination that it is more representative of normal source operation. (4-11-06)

i. The average rate shall include fugitive emissions to the extent quantifiable, and emissions associated with startups, shutdowns, and malfunctions. (4-11-06)

ii. The average rate shall be adjusted downward to exclude any non-compliant emissions that occurred while the source was operating above any emission limitation that was legally enforceable during the consecutive twenty-four (24) month period. (4-11-06)

iii. For a regulated air pollutant, when a project involves multiple emissions units, only one (1) consecutive twenty-four (24) month period must be used to determine the baseline actual emissions for all the emissions units being changed. A different consecutive twenty-four (24) month period can be used for each regulated air pollutant. (4-11-06)

iv. The average rate shall not be based on any consecutive twenty-four (24) month period for which there is inadequate information for determining annual emissions, in tons per year, and for adjusting this amount if required by Subsection 007.032.a.ii. ~~(4-11-06)~~( )

b. For an existing emissions unit (other than an electric utility steam generating unit), baseline actual emissions means the average rate, in tons per year, at which the emissions unit actually emitted the regulated air pollutant during any consecutive twenty-four (24) month period selected by the owner or operator within the ten (10) year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the Director for a permit required under these rules, whichever is earlier, except that the ten (10) year period shall not include any period earlier than November 15, 1990. (4-11-06)

i. The average rate shall include fugitive emissions to the extent quantifiable, and emissions associated with startups, shutdowns, and malfunctions. (4-11-06)

ii. The average rate shall be adjusted downward to exclude any non-compliant emissions that occurred while the source was operating above an emission limitation that was legally enforceable during the consecutive twenty-four (24) month period. (4-11-06)

iii. The average rate shall be adjusted downward to exclude any emission limitation with which the source must currently comply, had such source been required to comply with such limitations during the consecutive twenty-four (24) month period; however, if an emission limitation is part of a standard or other requirement under 40 CFR Part 63, the baseline actual emissions need only be adjusted if the Department has taken credit for such emissions reductions in an attainment demonstration or maintenance plan. (4-11-06)

iv. For a regulated air pollutant, when a project involves multiple emissions units, only one (1) consecutive twenty-four (24) month period must be used to determine the baseline actual emissions for all the emissions units being changed. A different consecutive twenty-four (24) month period can be used for each regulated air pollutant. (4-11-06)

v. The average rate shall not be based on any consecutive twenty-four (24) month period for which there is inadequate information for determining annual emissions, in tons per year, and for adjusting this amount if required by Subsections 006.03.b.ii. and 006.03.b.iii. (4-11-06)

c. For a new emissions unit, the baseline actual emissions for purposes of determining the emissions increase that will result from the initial construction and operation of such unit shall equal zero (0); and, thereafter, for all other purposes, shall equal the unit's potential to emit. (4-11-06)

d. For a plantwide applicability limit (PAL) for a stationary source, the baseline actual emissions shall be calculated for existing electric utility steam generating units in accordance with the procedures contained in Subsection 007.0~~3~~2.a, for other existing emissions units in accordance with the procedures contained in Subsection 007.0~~3~~2.b, and for a new emissions unit in accordance with the procedures contained in Subsection 007.0~~3~~2.c.
~~(4-11-06)~~(   )

0~~4~~3. **Begin Actual Construction**. Commence construction. (4-11-06)

0~~5~~4. **Emissions Increase**. The amount by which projected actual emissions exceed baseline actual emissions of an emissions unit. (4-11-06)

0~~6~~5. **Innovative Control Technology**. Any system of air pollution control that has not been adequately demonstrated in practice, but would have a substantial likelihood of achieving greater continuous emissions reduction than any control system in current practice, or of achieving at least comparable reductions at lower cost in terms of energy, economics, or non-air quality environmental effects. (5-1-94)

~~***07.*** ***Integral Vista***. *A view perceived from within the mandatory federal Class I area of a specific landmark or panorama located outside the boundary of the mandatory federal Class I area. Integral vistas are identified by the responsible federal land manager in accordance with criteria adopted pursuant to 40 CFR Part 51.304(a).* *(5-1-94)*~~

~~***08.*** ***Mandatory Federal Class I Area***. *Any area designated under 42 U.S.C. Section 7472(a) as Class I and never to be redesignated.* *(5-1-94)*~~

0~~9~~6. Net Emissions Increase. For purposes of Sections 204 and 205, a net emissions increase shall be defined by the federal regulations incorporated by reference. For purposes of Section 210, a net emissions increase shall be an emissions increase from a particular modification plus any other increases and decreases in actual emissions at the facility that are creditable and contemporaneous with the particular modification, where: (4-11-06)

a. A creditable increase or decrease in actual emissions is contemporaneous with a particular modification if it occurs between the date five (5) years before the commencement of construction or modification on the particular change and the date that the increase from the particular modification occurs. Any replacement unit that requires shakedown becomes operational only after a reasonable shakedown period, not to exceed one hundred and eighty (180) days; (4-5-00)

b. A decrease in actual emissions is creditable only if it satisfies the requirements for emission reduction credits (Section 460) and has approximately the same qualitative significance for public health and welfare as that attributed to the increase from the particular modification, and is federally enforceable at and after the time that construction of the modification commences. (4-5-00)

c. The increase in toxic air pollutant emissions from an already operating or permitted source is not included in the calculation of the net emissions increase for a proposed new source or modification if: (5-1-95)

i. The already operating or permitted source commenced construction or modification prior to July 1, 1995; or (5-1-95)

ii. The uncontrolled emission rate from the already operating or permitted source is ten per cent (10%) or less of the applicable screening emissions level listed in Section 585 or 586; or (6-30-95)

iii. The already operating or permitted source is an environmental remediation source subject to or regulated by the Resource Conservation and Recovery Act (42 U.S.C. Sections 6901-6992k) and "Idaho Rules and Standards for Hazardous Waste," (IDAPA 58.01.05.000 et seq.) or the Comprehensive Environmental Response, Compensation and Liability Act (42 U.S.C. 6901-6992k) or a consent order. (6-30-95)

~~1~~07. Pilot Plant. A stationary source located at least one quarter (1/4) mile from any sensitive receptor that functions to test processing, mechanical, or pollution control equipment to determine full-scale feasibility and which does not produce products that are offered for sale except in developmental quantities. (5-1-94)

~~11~~08. Projected Actual Emissions. (4-11-06)

a. The maximum annual rate, in tons per year, at which an existing emissions unit is projected to emit a regulated air pollutant in any one (1) of the five (5) years (twelve (12) month period) following the date the unit resumes regular operation after the project, or in any one (1) of the ten (10) years following that date, if the project involves increasing the emissions unit's design capacity or its potential to emit that regulated air pollutant and full utilization of the unit would result in a significant emissions increase or a significant net emissions increase at an existing major stationary source. (4-11-06)

b. In determining the projected actual emissions, the owner or operator of the stationary source: (4-11-06)

i. Shall consider all relevant information including, but not limited to, historical operational data, the company's own representations, the company's expected business activity and the company's highest projections of business activity, the company's filings with state or federal regulatory authorities, and compliance plans under the approved state implementation plan; and (4-11-06)

ii. Shall include fugitive emissions to the extent quantifiable and emissions associated with startups, shutdowns, and malfunctions; and (4-11-06)

iii. Shall exclude, in calculating any increase in emissions that results from the particular project, that portion of the unit's emissions following the project that an existing unit could have accommodated during the consecutive twenty-four (24) month period used to establish the baseline actual emissions and that are also unrelated to the particular project, including any increased utilization due to product demand growth; or (4-11-06)

iv. In lieu of using the method set out in Subsections 007.11.b.i. through 007.11.b.iii., may elect to use the emissions unit's potential to emit, in tons per year. (4-11-06)

~~12~~09. **Reasonable Further Progress (RFP)**. Annual incremental reductions in emissions of the applicable air pollutant as identified in the SIP which are sufficient to provide for attainment of the applicable ambient air quality standard by the required date. (4-11-06)

~~*13. **Secondary Emissions**. Emissions which would occur as a result of the construction, modification, or operation of a stationary source or facility, but do not come from the stationary source or facility itself. Secondary emissions must be specific, well defined, quantifiable, and affect the same general area as the stationary source, facility, or modification which causes the secondary emissions. Secondary emissions include emissions from any offsite support facility which would not be constructed or increase its emissions except as a result of the construction or operation of the primary stationary source, facility or modification. Secondary emissions do not include any emissions which come directly from a mobile source regulated under 42 U.S.C. Sections 7521 through 7590. (4-5-00)*~~

1~~4~~0. **Sensitive Receptor**. Any residence, building or location occupied or frequented by persons who, due to age, infirmity or other health based criteria, may be more susceptible to the deleterious effects of a toxic air pollutant than the general population including, but not limited to, elementary and secondary schools, day care centers, playgrounds and parks, hospitals, clinics and nursing homes. (5-1-94)

1~~5~~1. **Short Term Source**. Any new stationary source or modification to an existing source, with an operational life no greater than five (5) years from the inception of any operations to the cessation of actual operations. (5-1-94)

1~~6~~2. **Toxic Air Pollutant Reasonably Available Control Technology (T-RACT)**. An emission standard based on the lowest emission of toxic air pollutants that a particular source is capable of meeting by the application of control technology that is reasonably available, as determined by the Department, considering technological and economic feasibility. If control technology is not feasible, the emission standard may be based on the application of a design, equipment, work practice or operational requirement, or combination thereof. (5-1-94)

~~*17. **Visibility Impairment**. Any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions. (4-5-00)*~~

(BREAK IN CONTINUITY OF SECTIONS)

107. INCORPORATIONS BY REFERENCE.

01. General. Unless expressly provided otherwise, any reference in these rules to any document identified in Subsection 107.03 shall constitute the full incorporation into these rules of that document for the purposes of the reference, including any notes and appendices therein. The term "documents" includes codes, standards or rules which have been adopted by an agency of the state or of the United States or by any nationally recognized organization or association. (5-1-94)

02. Availability of Referenced Material. Copies of the documents incorporated by reference into these rules are available at the following locations: (5-1-94)

a. All federal publications: U.S. Government Printing Office, http://www.gpoaccess.gov/index.html; and (3-20-04)

b. All documents herein incorporated by reference: (7-1-97)

i. Department of Environmental Quality, 1410 N. Hilton, Boise, Idaho 83706-1255 at (208) 373-0502. (7-1-97)

ii. State Law Library, 451 W. State Street, P.O. Box 83720, Boise, Idaho 83720-0051, (208) 334-3316. (7-1-97)

03. Documents Incorporated by Reference. The following documents are incorporated by reference into these rules: (5-1-94)

a. Requirements for Preparation, Adoption, and Submittal of Implementation Plans; Appendix W to Part 51--Guideline on Air Quality Models. 40 CFR Parts 51 and 52 revised as of July 1, 2005. (4-11-06)

b. Implementation Plan for the Control of Air Pollution in the State of Idaho (SIP), Department of Environmental Quality, November 1996. (3-19-99)

c. National Primary and Secondary Ambient Air Quality Standards, 40 CFR Part 50, revised as of July 1, 2005. (4-11-06)

d. Requirements for Preparation, Adoption, and Submittal of Implementation Plans, Protection of Visibility, ~~*Identification of Integral Vistas, Subsection a,*~~ 40 CFR ~~*Part*~~ 51.301, 51.304(a), 51.307, and 51.308, revised as of July 1, 2005. ~~*(4-11-06)*~~(____)

e. Approval and Promulgation of Implementation Plans, 40 CFR Part 52, revised as of July 1, 2005. (4-11-06)

f. Ambient Air Monitoring Reference and Equivalent Methods, 40 CFR Part 53, revised as of July 1, 2005. (4-11-06)

g. Ambient Air Quality Surveillance, Quality Assurance Requirements for Prevention of Significant Deterioration (PSD Air Monitoring), 40 CFR Part 58, Appendix B, revised as of July 1, 2005. (4-11-06)

h. Standards of Performance for New Stationary Sources, 40 CFR Part 60, revised as of July 1, 2005. (4-11-06)

i. National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, revised as of July 1, 2005. (4-11-06)

j. National Emission Standards for Hazardous Air Pollutants for Source Categories, 40 CFR Part 63, revised as of July 1, 2005. (4-11-06)

k. Compliance Assurance Monitoring, 40 CFR Part 64, revised as of July 1, 2005. (4-11-06)

l. Permits, 40 CFR Part 72, revised as of July 1, 2005. (4-11-06)

m. Sulfur Dioxide Allowance System, 40 CFR Part 73, revised as of July 1, 2005. (4-11-06)

n. Protection of Stratospheric Ozone, 40 CFR Part 82, revised as of July 1, 2005. (4-11-06)

o. Clean Air Act, 42 U.S.C. Sections 7401 through 7671g (1997). (3-19-99)

p. Determining Conformity of Federal Actions to State or Federal Implementation Plans: Conformity to State or Federal Implementation Plans of Transportation Plans, Programs and Projects Developed, Funded or Approved Under Title 23 U.S.C. or the Federal Transit Laws, 40 CFR Part 93, Subpart A, Sections 93.100 through 93.129, revised as of July 1, 2005, except that Sections 93.102(c), 93.104(d), 93.104(e)(2), 93.105, 93.109(c)-(f), 93.118(e), 93.119(f)(3), 93.120(a)(2), 93.121(a)(1), and 93.124(b) are expressly omitted from the incorporation by reference. (4-11-06)

q. The final rule for Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 70 Fed. Reg. 28,606 (May 18, 2005), corrected at 70 Fed. Reg. 51,267, is expressly excluded from any incorporation by reference into these rules. (4-11-06)

(BREAK IN CONTINUITY OF SECTIONS)

204. PERMIT REQUIREMENTS FOR NEW MAJOR FACILITIES OR MAJOR MODIFICATIONS IN NONATTAINMENT AREAS.
New major facilities or major modifications proposed for location in a nonattainment area and which would be major for the nonattainment regulated air pollutant are considered nonattainment new source review (NSR) actions and are subject to the requirements in Section 204. Section 202 contains application requirements and Section 209 contains processing requirements for nonattainment NSR permitting actions. The intent of Section 204 is to incorporate the federal nonattainment NSR rule requirements. (4-6-05)

01. Incorporated Federal Program Requirements. Requirements contained in the following subparts of 40 CFR 51.165, revised as of July 1, 2005, are hereby incorporated by reference. Requirements contained in the following subparts of 40 CFR 52.21, revised as of July 1, 2005, are hereby incorporated by reference. These CFR sections have been codified in the electronic CFR which is available at www.gpoaccess.gov/ecfr.

40 CFR Reference	40 CFR Reference Title
40 CFR 51.165(a)(1)	Definitions
40 CFR 51.165(a)(2)(ii)(A) - (J)	Applicability Provisions
40 CFR 51.165(a)(6)(i) - (v)	Applicability Provisions
40 CFR 51.165(c)	Clean Unit Test for Emission Units that are Subject to LAER
40 CFR 51.165(d)	Clean Unit Provisions for Emission Units that Achieve an Emission Limitation Comparable to LAER
40 CFR 52.21(z)(1) - (3) and (6)	PCP Exclusion Procedural Requirements
40 CFR 52.21(aa)	Actual PALs

(4-11-06)

02. Additional Requirements. The applicant must demonstrate to the satisfaction of the Department the following: (4-6-05)

a. LAER. Except as otherwise provided in Section 204, the new major facility or major modification would be operated at the lowest achievable emission rate (LAER) for the nonattainment regulated air pollutant, specifically: (4-6-05)

i. A new major facility would meet the lowest achievable emission rate at each new emissions unit which emits the nonattainment regulated air pollutant; and (4-5-00)

ii. A major modification would meet the lowest achievable emission rate at each new or modified emissions unit which has a net emissions increase of the nonattainment regulated air pollutant. (4-5-00)

b. Required offsets. Allowable emissions from the new major facility or major modification are offset by reductions in actual emissions from stationary sources, facilities, and/or mobile sources in the nonattainment area so as to represent reasonable further progress. All offsetting emission reductions must satisfy the requirements for emission reduction credits (Section 460) and provide for a net air quality benefit which satisfies the requirements of Section 208. If the offsets are provided by other stationary sources or facilities, a permit to construct shall not be issued for the new major facility or major modification until the offsetting reductions are made enforceable through the issuance of operating permits. The new major facility or major modification may not commence operation, and an operating permit for the new major facility or major modification shall not be effective before the date the offsetting reductions are achieved. (4-5-00)

c. Compliance status. All other sources in the State owned or operated by the applicant, or by any entity controlling, controlled by or under common control with such person, are in compliance with all applicable emission limitations and standards or subject to an enforceable compliance schedule. (5-1-94)

d. Effect on visibility. The effect on visibility of any federal Class I area, Class I area designated by the Department, or integral vista of a mandatory ~~federal~~ Class I Federal ~~a~~Area, by the new major facility or major modification, is consistent with making reasonable progress toward ~~remedying existing and preventing future visibility impairment~~ the national visibility goal referred to in 40 CFR 51.300(a). The Department may take into account the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance and the useful life of the source. Any integral vista which the Federal Land Manager has not identified at least six (6) months prior to the submittal of a complete application, or which the Department determines was not identified in accordance with the criteria adopted pursuant to 40 CFR ~~Part~~ 51.304(a), may be exempted from Section 204 by the Department. ~~(4-6-05)~~(____)

03. Nonmajor Requirements. If the proposed action meets the requirements of an exemption or exclusion under the provisions of 40 CFR 51.165 or 40 CFR 52.21 incorporated in Section 204, the nonmajor facility or stationary source permitting requirements of Sections 200 through 228 apply, including the exemptions in Sections 220 through 223. (4-6-05)

205. PERMIT REQUIREMENTS FOR NEW MAJOR FACILITIES OR MAJOR MODIFICATIONS IN ATTAINMENT OR UNCLASSIFIABLE AREAS.

The prevention of significant deterioration (PSD) program is a construction permitting program for new major facilities and major modifications to existing major facilities located in areas in attainment or in areas that are unclassifiable for any criteria air pollutant. Section 202 contains application requirements and Section 209 contains processing requirements for PSD permit actions. The intent of Section 205 is to incorporate the federal PSD rule requirements. (4-6-05)

01. Incorporated Federal Program Requirements. Requirements contained in the following subparts of 40 CFR 52.21, revised as of July 1, 2005, are hereby incorporated by reference. These CFR sections have been codified in the electronic CFR which is available at www.gpoaccess.gov/ecfr.

40 CFR Reference	40 CFR Reference Title
40 CFR 52.21(a)(2)	Applicability Procedures
40 CFR 52.21(b)	Definitions
40 CFR 52.21(i)	Review of Major Stationary Sources and Major Modifications - Source Applicability and Exempting
40 CFR 52.21(j)	Control Technology Review
40 CFR 52.21(k)	Source Impact Analysis
40 CFR 52.21(r)	Source Obligation
40 CFR 52.21(v)	Innovative Control Technology
40 CFR 52.21(w)	Permit Rescission
40 CFR 52.21(x)	Clean Unit Test
40 CFR 52.21(y)	Clean Unit Provisions for Emissions Units that Achieve an Emission Limit Comparable to BACT
40 CFR 52.21(z)(1) - (3) and (6)	PCP Exclusion Procedural Requirements

40 CFR Reference	40 CFR Reference Title
40 CFR 52.21(aa)	Actual PALS

(4-11-06)

02. Effect on Visibility. The applicant must demonstrate that the effect on visibility of any federal Class I area, Class I area designated by the Department, or integral vista of a mandatory Class I Federal Area, by the new major facility or major modification, is consistent with making reasonable progress toward the national visibility goal referred to in 40 CFR 51.300(a). The Department may take into account the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance and the useful life of the source. Any integral vista which the Federal Land Manager has not identified at least six (6) months prior to the submittal of a complete application, or which the Department determines was not identified in accordance with the criteria adopted pursuant to 40 CFR 51.304(a), may be exempted from this requirement by the Department. ( )

0~~2~~3. Exception to Incorporation by Reference of 40 CFR 52.21. Every use of the word Administrator in 40 CFR 52.21 means the Department except for the following: (4-6-05)

a. In 40 CFR 52.21(b)(17), the definition of federally enforceable, Administrator means the EPA Administrator. (4-6-05)

b. In 40 CFR 52.21(l)(2), air quality models, Administrator means the EPA Administrator. (4-6-05)

c. In 40 CFR 52.21(b)(43), permit program approved by the Administrator, Administrator means the EPA Administrator. (4-6-05)

d. In 40 CFR 52.21(b)(48)(ii)(c), MACT standard that is proposed or promulgated by the Administrator, Administrator means the EPA Administrator. (4-6-05)

e. In 40 CFR 52.21(b)(50)(i), regulated NSR pollutant as defined by Administrator, Administrator means the EPA Administrator. (4-6-05)

f. In 40 CFR 52.21(y)(4)(i), Administrator for BACT, LAER and RACT clearinghouse, Administrator means the EPA Administrator. (4-6-05)

0~~3~~4. Nonmajor Requirements. If the proposed action meets the requirements of an exemption or exclusion under the provisions of 40 CFR 52.21 incorporated in Section 205, the nonmajor facility or stationary source permitting requirements of Sections 200 through 228 apply, including the exemptions in Sections 220 through 223. (4-6-05)

(BREAK IN CONTINUITY OF SECTIONS)

600. RULES FOR CONTROL OF OPEN BURNING.

The purpose of Sections 600 through 617 is to reduce the amount of emissions and minimize the impact of open burning to protect human health and the environment from air pollutants resulting from open burning as well as to reduce the visibility impairment in mandatory Class I Federal Areas in accordance with the regional haze long-term strategy referenced at Section 667. ~~(3-21-03)~~( )

(BREAK IN CONTINUITY OF SECTIONS)

651. GENERAL RULES.

All reasonable precautions shall be taken to prevent particulate matter from becoming airborne. In determining what is reasonable, consideration will be given to factors such as the proximity of dust emitting operations to human habitations and/or activities, the proximity to mandatory Class I Federal Areas and atmospheric conditions which might affect the movement of particulate matter. Some of the reasonable precautions may include, but are not limited to, the following: ~~*(5-1-94)*~~(   )

01. Use of Water or Chemicals. Use, where practical, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads, or the clearing of land. (5-1-94)

02. Application of Dust Suppressants. Application, where practical, of asphalt, oil, water or suitable chemicals to, or covering of dirt roads, material stockpiles, and other surfaces which can create dust. (5-1-94)

03. Use of Control Equipment. Installation and use, where practical, of hoods, fans and fabric filters or equivalent systems to enclose and vent the handling of dusty materials. Adequate containment methods should be employed during sandblasting or other operations. (5-1-94)

04. Covering of Trucks. Covering, when practical, open bodied trucks transporting materials likely to give rise to airborne dusts. (5-1-94)

05. Paving. Paving of roadways and their maintenance in a clean condition, where practical. (5-1-94)

06. Removal of Materials. Prompt removal of earth or other stored material from streets, where practical. (5-1-94)

652. -- 6~~7~~64. (RESERVED).

665. REGIONAL HAZE RULES.

The purpose of Sections 665 through 668 is to address regional haze visibility impairment in mandatory Class I Federal Areas. The intent of Sections 665 through 668 is to incorporate the federal protection of visibility definitions and regional haze program requirements. (   )

666. REASONABLE PROGRESS GOALS.

The Department will establish reasonable progress goals, expressed in deciviews for each mandatory Class I Federal Area located within Idaho. These goals will provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period. The reasonable progress goals are not directly enforceable, but will be implemented through enforceable strategies in the long-term strategy. (   )

01. Process for Setting Reasonable Progress Goals. In establishing a reasonable progress goal for any mandatory Class I Federal Area within Idaho, the Department shall: (   )

a. Consider the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected sources, and include a demonstration showing how these factors were taken into consideration in selecting the goal. (   )

b. Analyze and determine the rate of progress needed to attain natural visibility conditions by the year 2064. To calculate this rate of progress, the Department will compare baseline visibility conditions to natural visibility conditions in the mandatory Class 1 Federal Area and determine the uniform rate of visibility improvement (measured in deciviews) that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064. In establishing the reasonable progress, the Department will consider the uniform rate of improvement in visibility and the emission reduction measures needed to achieve it for the period covered by the implementation plan. (   )

c. Consult with those states which may reasonably be anticipated to cause or contribute to visibility impairment in the mandatory Class I Federal Area. ( )

02. Justification for Reasonable Progress Goals. If the Department establishes a reasonable progress goal that provides for a slower rate of improvement in visibility than the rate that would be needed to attain natural conditions by 2064, the Department will demonstrate, based on the factors in Subsection 666.01.a., that the rate of progress for the implementation plan to attain natural conditions by 2064 is not reasonable; and that the progress goal adopted by the Department is reasonable. The Department will provide to the public for review, as part of its implementation plan, an assessment of the number of years it would take to attain natural conditions if visibility improvement continues at the rate of progress selected by the Department as reasonable. ( )

667. LONG-TERM STRATEGY FOR REGIONAL HAZE.

The purpose of Section 667 is to develop a long-term strategy for making reasonable progress toward the national goal of preventing any future and remedying any existing impairment of visibility in mandatory Class I Federal Areas in which impairment results from man-made air pollution. ( )

01. Submittal of Long-Term Strategy. The Department will submit a long-term strategy that addresses regional haze visibility impairment for each mandatory Class I Federal Area within the state and for each mandatory Class I Federal Area located outside the state which may be affected by emissions from the state. ( )

02. Enforceable Emission Limitations. The long-term strategy must include enforceable emissions limitations, compliance schedules, and other measures as necessary to achieve the reasonable progress goals established by the Department. ( )

03. Requirements for Long-Term Strategy. In establishing long-term strategy for regional haze, the Department will meet the following requirements: ( )

a. The Department will document the technical basis, including modeling, monitoring and emissions information, on which the state is relying to determine its apportionment of emission reduction obligations necessary for achieving reasonable progress in each mandatory Class I Federal Area it affects. The Department may meet this requirement by relying on technical analyses developed by the regional planning organization and approved by all state participants. The Department will identify the baseline emission inventory on which its strategies are based. The baseline emissions inventory year is presumed to be the most recent year of the consolidated periodic emissions inventory. ( )

b. The Department will identify all anthropogenic sources of visibility impairment considered by the Department in developing its long-term strategy. The Department should consider major and minor stationary sources, mobile sources, and area sources. ( )

c. The Department will consider, at a minimum, the following factors in developing its long-term strategy: ( )

i. Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment; ( )

ii. Measures to mitigate the impacts of construction activities; ( )

iii. Emissions limitations and schedules for compliance to achieve the reasonable progress goal; ( )

iv. Source retirement replacement schedules; ( )

v. Smoke management techniques for agricultural and forestry management purposes including plans as currently exist with the state for these purposes; ( )

vi. Enforceability of emissions limitations and control measures; and ( )

vii. The anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy. ( )

04. **Interstate Consultation**. The Department will undertake the following process in developing the long-term strategy where interstate consultation is required. ( )

a. Where Idaho has emissions that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal Area located in another state or states, the Department will consult with the other state(s) in order to develop coordinated emission management strategies. ( )

b. The Department will consult with any other state having emissions that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal Area within Idaho. ( )

c. Where other states cause or contribute to impairment in a mandatory Class I Federal Area, the Department must demonstrate that the state has included in its implementation plan all measures necessary to obtain its share of the emission reductions needed to meet the progress goal for the area. If the state of Idaho has participated in a regional planning process, the Department must ensure the state has included all measures needed to achieve its apportionment of emission reduction obligations agreed upon through that process. ( )

668. BART REQUIREMENT FOR REGIONAL HAZE.

The purpose of Section 668 is to implement the BART requirements in 40 CFR 51.308(e). The following analysis and documentation is required for each BART-eligible source: ( )

01. **BART-Eligible Sources**. The Department shall identify a list of all BART-eligible sources within the state. ( )

02. **BART Determination**. The Department shall complete a determination of BART for each BART-eligible source in the state that emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any mandatory Class 1 Federal Area. All such sources are subject to BART. ( )

a. A single source that is responsible for a one (1.0) deciview change or more in any mandatory Class I Federal Area is considered to "cause" visibility impairment. ( )

b. A single source that is responsible for a one-half (0.5) deciview change or more in any mandatory Class I Federal Area is considered to "contribute" to visibility impairment. ( )

c. The determination of BART must be based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable for each BART-eligible source that is subject to BART within the state. In this analysis, the following must be taken into consideration: ( )

i. Costs of compliance; ( )

ii. Energy and non-air quality environmental impacts of compliance; ( )

iii. Any pollution control equipment in use at the source; ( )

iv. The remaining useful life of the source; and ( )

v. The degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. ( )

d. The Department may determine that a BART determination is not required: ( )

i. For sulfur dioxide (SO_2) or for nitrogen oxides (NO_x) if a BART-eligible source has the potential to emit less than forty (40) tons per year of such pollutant(s); or ( )

ii. For PM10 if a BART-eligible source emits less than fifteen (15) tons per year of such pollutant. ( )

03. Alternative to Infeasible Emission Standards. If the Department determines in establishing BART that technological or economic limitations on the applicability of measurement methodology to a particular source would make the imposition of an emission standard infeasible, it may instead prescribe a design, equipment, work practice, or other operational standard, or combination thereof, to require the application of BART. Such standard, to the degree possible, is to set forth the emission reduction to be achieved by implementation of such design, equipment, work practice, or operation and must provide for compliance by means which achieve equivalent results. (   )

04. BART Installation and Operation Due Date. Each source subject to BART is required to install and operate BART as expeditiously as practicable, but in no event later than five (5) years after approval of the implementation plan. (   )

05. Maintenance of BART Equipment. Each source subject to BART is required to maintain the control equipment required by the Department and establish procedures to ensure such equipment is properly operated and maintained. (   )

06. BART Alternative. As an alternative to the installation of BART for a source or sources, the Department may approve a BART alternative. If the Department approves source grouping as a BART alternative, only sources (including BART-eligible and non-BART eligible sources) causing or contributing to visibility impairment to the same mandatory Class I Federal Area may be grouped together. (   )

a. If a source(s) proposes a BART alternative, the resultant emissions reduction and visibility impacts must be compared with those that would result from the BART options evaluated for the source(s). (   )

b. Source(s) proposing a BART alternative must demonstrate that this BART alternative will achieve greater reasonable progress than would be achieved through the installation and operation of BART. (   )

c. Source(s) proposing a BART alternative shall include in the BART analysis an analysis and justification of the averaging period and method of evaluating compliance with the proposed emission limitation. (   )

07. Reasonable Progress Goal Requirements for BART-Eligible Sources. Once the Department has met the requirements for BART or BART alternative, as identified in Subsection 668.06, BART-eligible sources will be subject to the requirements of reasonable progress goals, as defined in 40 CFR 51.308(d), in the same manner as other sources. (   )

669. -- 674. (RESERVED).

BART Modeling

BART Modeling Protocol

Modeling Protocol for
Washington, Oregon, and Idaho:
Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation

1. Introduction and Protocol Objective

1.1 Background

Under the Regional Haze Regulations, the U.S. Environmental Protection Agency (EPA) issued the final Guidelines for Best Available Retrofit Technology (BART) Determinations (July 6, 2005) (BART Guideline). According to the Regional Haze Rule, States are required to use these guidelines for establishing BART emission limitations for fossil fuel fired power plants having a capacity in excess of 750 megawatts. The use of these guidelines is optional for states establishing BART emission limitations for other BART-eligible sources. However, according to EPA, the BART Guideline was designed to help states and others do the following: (1) identify those sources that must comply with the BART requirement, and (2) determine the level of control technology that represents BART for each source.

This modeling protocol is a cooperative effort among Idaho Department of Environmental Quality (IDEQ), Oregon Department of Environmental Quality (ODEQ), and Washington Department of Ecology (WDOE) to develop an analysis that will be applied consistently to Idaho, Washington, and Oregon BART-eligible sources. The U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service, and U.S. EPA Region 10 were consulted during the development of this protocol (EPA 2006a, b, c). This protocol adopts the BART Guideline and addresses both the BART exemption modeling as well as the BART determination modeling. The three agencies are also collaborating on the development of a consistent three-year meteorological data set. Collaboration on the protocol and meteorological data set helps ensure modeling consistency and the sharing of resources and workload.

1.2 Objectives

The protocol describes the modeling methodology that will be used for the following purposes:

- **BART Exemption modeling –** Evaluating whether a BART-eligible source is exempt from BART controls because it is not reasonably anticipated to cause or contribute to impairment of visibility in Class I areas

- **BART Determination modeling –** Quantifying the visibility improvements of BART control options

The objectives of this protocol are to provide the following:

- A streamlined and consistent approach in determining which BART-eligible sources are subject to BART
- A clearly delineated modeling methodology
- A common CALMET/CALPUFF/POSTUTIL/CALPOST modeling configuration

2. Modeling Approach

2.1 Bart-Eligible Source List

BART-eligible source refers to the entire facility that has BART-eligible emission units.

Oregon, Washington, and Idaho are in the process of finalizing lists of BART-eligible sources. Table 1 presents the BART-eligible lists, as of July 21, 2006. Sources may be added/removed as additional information is reviewed.

Table 1. BART-eligible sources.

Washington	Oregon	Idaho
Intalco Aluminum	Amalgamated Sugar	Amalgamated Sugar – Nampa
Conoco-Phillips	PGE Boardman	Amalgamated Sugar – Paul
Centralia Powerplant (TransAlta)	Boise Cascade	Amalgamated Sugar – Twin Falls
Longview Fibre	Fort James	J.R. Simplot Don Siding Plant
Weyerhaeuser – Longview	Pope & Talbot	Potlatch Pulp and Paper
BP Cherry Point	Weyerhaeuser	Monsanto
Tesoro NW	PGE Beaver	NuWest (Agrium)
Lafarge	Georgia Pacific	
Georgia Pacific (Fort James) Camas	Smurfit	
Port Townsend Paper		
Simpson Tacoma Kraft		
Shell (Puget Sound Refining Co)		
Graymont Western		
Alcoa-Wenatchee		
Columbia		

2.2 Class I Areas

The mandatory Class I federal areas in Idaho, Oregon, and Washington, as well as neighboring states that could be impacted by BART-eligible sources, are presented in Appendix A. Figure A-1 graphically presents the BART-eligible source locations with respect to the Class I areas.

All federally mandatory Class I areas within 300 kilometers (km) of a BART-eligible source will be included in the BART exemption modeling analysis. Section 6.1(c) of the Guideline on Air Quality Models states, "It was concluded from these case studies that the CALPUFF dispersion model had performed in a reasonable manner, and had no apparent bias toward over or under prediction, so long as the transport distance was limited to less than 300km" (40 CFR 51, Appendix W). If the 300km extends into a neighboring state, visibility impairment shall also be quantified at those Class I areas. Furthermore, if it lies within the 300km radius, visibility impairment at the Columbia River Gorge Scenic Area will also be quantified for information purposes only.

2.3 Pollutants to Consider

The BART Guideline specifies that sulfur dioxide (SO_2), oxides of nitrogen (NO_x) and direct particulate matter (PM) emissions, including both PM_{10} and $PM_{2.5}$ should be included for both the BART exemption and BART determination modeling analyses.

The BART Guideline also discusses the inclusion of volatile organic compound (VOC), ammonia and ammonia compounds as visibility impairing pollutants. These pollutants will be included in the BART analysis if it is determined that they are reasonably anticipated to cause or contribute to visibility impairment. For sources that are selected to evaluate VOC emissions, the first criterion is the emission level. The VOC emissions will be included in the BART exemption analysis if the greater-than-six-carbon VOC gases exceed 250 tons-per-year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms. Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds which require a full BART exemption analysis.

2.4 Emissions and Stack Data

The BART Guideline states, "*the emission estimates used in the models are intended to reflect steady-state operating conditions during periods of high capacity utilization.*" These emissions should not generally include start-up, shutdown, or malfunction emissions. The BART Guideline recommends that states use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled. The meteorological period is 2003 – 2005.

Depending on the availability of emissions data, the following emissions information (listed in order of priority) should be used with CALPUFF for BART exemption modeling:

- 24-hour average actual emission rate from the highest emitting day within the modeling period (2003 – 2005) (preferred). Actual emissions may be calculated using emission factors specified in Title V permits or representative stack test; or
- Allowable emissions (maximum 24-hour allowable).

States will work with the BART-eligible sources to develop an appropriate emission inventory.

If plant-wide emissions from all BART eligible units for SO_2, NO_x, and PM_{10} are less than the significant emission rate (SER) used for Prevention of Significant Deterioration, emissions of that pollutant will not be included in the BART exemption modeling. However, if plant-wide emissions from all BART eligible units exceed the SERs for these pollutants, then all emissions of that pollutant from individual emission units will be evaluated even if emissions are below the SER for an individual emission unit.

The states have the option of determining how to include small emission units in the BART exemption analysis. Fugitive dust sources at a distance greater than 10km from any Class I area are exempt from the analysis. Emission units with emissions less than the SER will be quantified, if possible, and added to the stack emissions from an emission unit that is already being evaluated. Thus, the emissions from these small units will be included in the total from the plant, but will not have to be modeled separately.

2.5 Natural Background

The natural visibility background is defined as the 20% best days. This definition of natural background is consistent with the intent of the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125). The natural background values for Class I areas used in this protocol are based on EPA's "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule" (EPA 2003). The natural background for the Columbia River Gorge Scenic Area is based on IMPROVE monitoring data, and was supplied by Scott Copeland of CIRA (Cooperative Institute for Research in the Atmosphere). These background data for Class I areas and the Columbia River Gorge are presented in Appendix B. The option presented in EPA's guidance for refining the default visibility background is not to be used in this protocol.

2.6 Visibility Calculation

The CALPUFF modeling techniques presented in this protocol will provide ground level concentrations of visibility impairing pollutants. The concentration estimates from CALPUFF are used with the current FLAG equation to calculate the extinction coefficient, as shown below.

$b_{ext} = 3\ f(RH)\ [(NH_4)_2SO_4] + 3\ f(RH)\ [NH_4NO_3] + 4[OC] + 1[Soil] + 0.6[Coarse\ Mass] + 10[EC] + b_{Ray}$

As described in the IWAQM Phase 2 Report, the change in visibility for the BART exemption analysis is compared against background conditions. The delta-deciview, Δdv, value is calculated from the source's contribution to extinction, $b_{ext\,(source)}$, and background extinction, $b_{ext(bkg)}$, as follows:

$$\Delta dv = 10\, ln\, [\, (\, b_{ext(bkg)} + b_{ext\,(source)}\,) / (\, b_{ext(bkg)}\,)\,]$$

2.7 Model Execution

2.7.1 BART Exemption Analysis

The BART exemption modeling determines which BART-eligible sources are reasonably anticipated to cause or contribute to visibility impairment at any Class I area. This protocol adopts Option 1 in Section III of the BART Guideline. This option is the Individual Source Attribution Approach. With this approach, each BART-eligible source is modeled separately and the impact on visibility impairment in any Class I area is determined. However, this protocol also allows the state or other authority to include all BART-eligible sources in a single analysis and determine whether or not all sources together are exempt from BART if the total impact on visibility impairment at any Class I area is below the "contribute" threshold.

Sources, or in some cases groups of sources, that exceed the threshold will be considered subject to BART. Sources or groups of sources with modeled impairment below the threshold will be exempt and excused from further analyses.

For determining the visibility threshold, the recommendations in the BART Guideline are followed to assess whether a BART-eligible source is reasonably anticipated to cause or contribute to any visibility impairment in a Class I area. According to the BART Guideline:

"A single source that is responsible for a 1.0 deciview change or more should be considered to "cause" visibility impairment; a source that causes less than a 1.0 deciview change may still contribute to visibility impairment and thus be subject to BART… As a general matter, any threshold that you used for determining whether a source "contributes" to visibility impairment should not be higher than 0.5 deciviews.

In setting a threshold for "contribution," you should consider the number of emissions sources affecting the Class I areas at issue and the magnitude of the individual sources' impacts. In general, a larger number of sources causing impacts in a Class I area may warrant a lower contribution threshold. States remain free to use a threshold lower than 0.5 deciviews if they conclude that the location of a large number of BART-eligible sources within the State and in proximity to a Class I area justify this approach."

As a result, this protocol has determined that if a single source causes a 0.5 deciview or greater change from natural background, then that source is determined to be reasonably anticipated to contribute to any visibility impairment in a Class I area and will be subject to BART. For this single source analysis, the BART exemption modeling will not consider the frequency, magnitude, and duration of impairment.

In addition, as suggested by the BART Guideline, if multiple BART-eligible sources impact a given Class I area on the same day, then a lower, individual, contribution threshold may be considered. For BART-eligible sources in Oregon and Washington, the following steps will be used to address this condition: 1) after all BART-eligible sources have completed their individual BART exemption modeling, the modeled visibility impairment from all sources will be aggregated for each Class I area receptor for each day; 2) if the total for any receptor exceeds 0.5 deciview, all sources responsible for visibility impairment at that receptor for that day will be considered for further evaluation. This evaluation will include an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each of the sources in the multi-source group. The inclusion of these qualifying factors in the multi-source analysis follows the direction given in the BART Guideline for interpreting the refined modeling results in the determination phase of the BART process and recommendations for sources subject to PSD analyses given in the FLAG Phase I Final Report (FLAG 2000). There is no set individual source visibility threshold for these multi-source assessments. After the multi-source evaluation, a determination will be made as to which sources, if any, from a multi-source group will be considered to have contributed to visibility impairment and be subject to BART.

2.7.2 BART Determination Analysis

The BART Determination analysis determines the degree of visibility improvement for each control option. The BART Guideline states:

"Assess the visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios. You have the flexibility to assess visibility improvement due to BART controls by one or more methods. You may consider the frequency, magnitude, and duration components of impairment."

In order to quantify the degree of visibility improvement due to BART controls, the modeling system is executed in a similar manner as for the BART exemption analysis. Model execution and results are needed for both pre-BART control and post-BART control scenarios to allow for comparison of CALPOST delta-deciview predictions for both scenarios. The only difference between the modeling runs will be modifications to the CALPUFF inputs associated with control devices (emissions, stack parameters). In contrast to the BART exemption analysis that predicts pre-control impacts from all BART-eligible units at a source together, BART determination analyses evaluates each emission unit independently of each other after control options are in place. As explained in the BART Guideline, the states may consider the frequency, magnitude, and duration of impairment for the determination analysis.

2.7.3 Implementing BART Modeling Analysis

Each state will implement the BART analysis separately, as follows:

- Idaho – DEQ will perform both the BART exemption and BART determination modeling, working closely with the facilities and providing the facilities with the modeling analysis if they too want to perform the analysis.

- Oregon – DEQ will perform the BART exemption analysis and the individual BART-subject facilities will perform the BART determination analysis. Oregon DEQ will perform any cumulative analysis required.

- Washington – The Washington BART-eligible sources will conduct the BART exemption modeling and the BART determination analysis. Ecology and EPA will conduct any cumulative analysis required.

3. Visibility Modeling System

In general, the BART exemption modeling using the CALPUFF suite of programs will follow the procedures and recommendations outlined in two documents: the IWAQM (Interagency Workgroup on Air Quality Models) and the FLAG (Federal Land Managers Air Quality Related Values Workgroup) reports (EPA 1998, FLAG 2000). Exceptions to these procedures are explicitly described in the appropriate sections below. Tables listing the modeling parameters for each CALPUFF module are located in the Appendices.

The specific CALPUFF programs and their version numbers that will be used in both the exemption modeling and determination modeling (control evaluation) are presented in Table 2.

The CALMET meteorological domain, as described below, covers the full three-state area. The computational domains, which will be unique for each source or group of sources undergoing modeling, will be a subset of the meteorological domain. As a result, a consistent meteorological data set will be used in all analyses, but the computational domains will be tailored to suit the modeling requirements for each individual source and the Class I areas within a radius of 300km.

Table 2. CALPUFF Modeling System

Program	Version	Level
CALMET	6.211	060414
CALPUFF	6.112	060412
CALPOST	6.131	060410
POSTUTIL	1.52	060412

3.1 CALMET

The dispersion modeling will use CALMET windfields for the three-year period 2003-2005. These windfields cover the three-state area of Washington, Oregon, and Idaho, and also extend into adjacent states sufficiently to encompass all Class I areas within 300km of any BART-eligible facility included in this analysis (Figure 1). As part of the three-state collaboration on a BART protocol, it was decided to support the development of a consistent meteorological data set for use in both the BART exemption and determination analyses. Therefore, the states contracted with a consulting firm, Geomatrix, to provide this set of meteorological data for use in CALPUFF for determining whether a BART-eligible source is reasonably anticipated to cause or contribute to haze in a Federal Class I area.

One of the deliverables of that contract is a final CALMET modeling protocol that provides details on the methodology used to develop the data sets. Therefore, this BART modeling protocol only summarizes the development of the CALMET data set. For additional detail, the reader is referred to the "*Modeling Protocol for BART CALMET Datasets*" in Attachment 1.

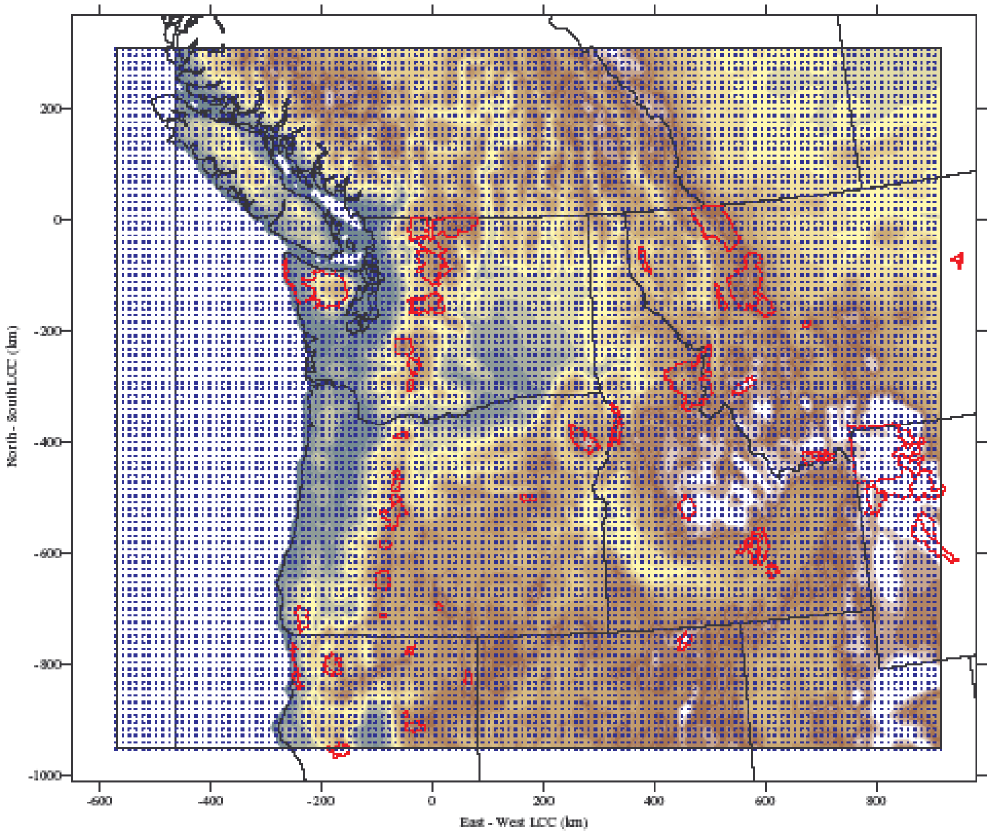

Figure 1. CALMET Meteorological Domain.

3.2 ***Meteorological Data***

3.2.1 Mesoscale Model Data

It was the judgment of Idaho, Oregon, Washington, and EPA Region 10 that the use of three years of MM5 data developed by Western Regional Air Partnership (WRAP) would not adequately capture the meteorology in the Pacific Northwest. WRAP had run MM5 using 36-km and 12-km grids. The states and EPA Region 10 preferred a 4-km grid as it would more adequately capture the meteorology and the influences of complex terrain that characterizes the Region 10 area. Furthermore, WRAP had selected some physics options that are more appropriate for the dry southwest and not the wet northwest.

As a result, the three states contracted a consulting firm (Geomatrix) to process calendar year 2003 to 2005 forecast 12-km MM5 output files archived at the University of Washington (UW). The 12-km MM5 domain includes all of Idaho, Oregon and Washington. Portions of Montana, Wyoming, Utah, Nevada and California are also included in the domain so that BART-eligible sources near these state borders that could impact Class I areas outside of Region 10 are considered in the analysis.

The MM5 data was evaluated for model performance using the statistical evaluation tool METSTAT. CALMET Version 6.211, including a new over-water algorithm, was used to interpolate the 12-km data down to 4-km for the entire domain. The CALMET outputs were also evaluated to determine the model performance of the CALMET wind fields. At this time, METSTAT is unable to evaluate CALMET files. The statistical benchmarks listed in the WRAP Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States (ENVIRON and UCR, 2005) served as a guide for the acceptability of the MM5 data and CALMET output.

CALMET allows the user to adjust the MM5 wind fields in varying degree by the introduction of observational data, including surface, over-water, and upper air data (using the so-called NOOBS parameter). Idaho, Oregon, and Washington have determined that the observed cloud cover should be used, but that observed surface and upper air winds should not be included in CALMET as they locally distort the MM5 wind fields and have no significant effect on long range transport. As a result, the three states have judged that the MM5 simulations more than adequately characterize the regional wind patterns. It should also be noted that CALMET uses the finer scale land use and digital elevation model (DEM) data to interpolate the MM5 winds down to 4km, which improve the wind flow patterns in complex terrain within the modeling domain.

3.2.2 CALMET Control File Settings

These CALMET wind fields will be used by all BART-eligible sources within the three states for both BART exemption and BART determination modeling. The wind fields have been computed by Geomatrix using CALMET Version 6.211. Details of the parameter settings in CALMET are provided in Appendix C; however, the major assumptions are summarized below.

1) The initial-guess fields used the 12-km MM5 outputs, forecast hours 13 – 24 from every 00Z and 12Z initialization, taken from UW archives, for the three years, January 2003 – December, 2005.

2) Both the BART exemption and determination modeling will utilize the wind fields at 4km resolution.

3) The meteorological data was evaluated in two stages using the extensive database of surface observations maintained by UW. First, the MM5 12-km data was evaluated prior to running CALMM5 using the METSTAT software program and secondly, the wind fields generated by CALMET was evaluated using standard statistical evaluation techniques.

4) There are 10 vertical layers with face heights of 0, 20, 40, 65, 120, 200, 400, 700, 1200, 2200, and 4000 meters.

5) CALMET was run using NOOBS = 1. Upper air, precipitation, and relative humidity data were taken from MM5.

6) The surface wind observations were ignored by setting the relative weight of surface winds to essentially zero (R1 = 1.0E-06). The only surface observation data that was effectively used in CALMET is cloud cover. This is essentially a no-observation approach. This method is specified in this protocol because previous modeling in the Pacific Northwest shows that the radius of influence of a typical surface wind observation must be set at a small number because of the presence of local topographic features. As a result, the adjustment to or distortion of wind fields by surface observations is extremely localized, on the order of 10-15km, and has no effect on long range transport to Class I areas.

7) Precipitation data was obtained from MM5, so MM5NPSTA = -1

8) No weighting of surface and upper air observations, and BIAS = 0, and ICALM = 0

9) The terrain scale factor TERRAD = 12

10) Land use and terrain data were developed using the North American 30-arc-second data

3.3 ***CALPUFF***

The CALPUFF modeling will use Version 6.112. This protocol generally follows the recommendation of the IWAQM and FLAG guidance documents. Details of the parameter settings in CALPUFF are provided in Appendix D; however, the major features are summarized below:

1) The three-year CALMET input files will be developed by Geomatrix and be provided as input-ready to CALPUFF.

2) The BART exemption modeling will examine the visibility impairment on Class I areas within 300km of each single source. Where BART-eligible sources are grouped or where their emissions could collectively impair visibility in a Class I area, the exemption modeling will also group these sources in order to examine their cumulative impact. The computational modeling domain will be sufficient to include all Class I areas within a 300km radius of a source or sources.

3) Pasquill-Gifford Dispersion coefficients will be used.

4) MESOPUFF-II chemistry algorithm will be used.

5) Building downwash will be ignored for cases with source-to-receptor distances greater than 50km, as recommended by the Federal Land Managers (FLMs) (US Fish and Wildlife, National Park Service, and U.S. Forest Service) who were consulted for this protocol.

6) Puff splitting will not be used, following the recommendations of the FLMs.

7) Source elevations that will be entered in CALPUFF will not use actual elevations but will be based on the modeled terrain surface used in CALMET for developing wind fields. The same algorithm in CALMET that determines the elevations of the observational stations will be used to make this calculation. These modified source elevations will be provided to the BART eligible sources.

3.3.1 Emissions

Section 2.4 above presents the emissions and stack data that is required from the facilities. This section only discusses the emissions estimates needed in CALPUFF.

Primary emission, species will include the input species PM, SO_2, SO_4, and NO_x; and the additional modeled species HNO_3 and NO_3. Emissions of H_2SO_4 will be included, if known, and used for estimation of SO_4 emissions. SO_2 emissions will be reviewed to ensure “double-counting” is avoided.

The primary PM species will be treated as follows:

- BART-eligible sources are required to include both filterable and condensable fractions of PM.

  Filterable:
  Elemental Carbon (EC) (<2.5 µm)
  PM Fine (PMF) (<2.5 µm)
  PM Coarse (PMC) (2.5 – 10 µm)
  Condensable:
  Organic Carbon (SOA)
  Inorganic Aerosol (SO_4)
  Non-SO_4 inorganic aerosol

- The condensable fraction will be treated as primary emissions in the CALPUFF input file and assumed to be 100% in the $PM_{2.5}$ fraction (see NPS Web site listed below).

The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions. The following information sources may be used in the development of the speciation and fractions:

- U.S. National Park Service (NPS) – the NPS has developed both PM speciation and size fractions for several source categories. The information is located at http://www2.nature.nps.gov/air/Permits/ect/index.cfm

- U.S. EPA – the EPA has developed generic PM speciation for all source categories located at http://www.epa.gov/ttn/chief/emch/speciation/.

- If size fraction is not known, the following default values, based on information in the CALPUFF User's Guide, CALPUFF GUI, and AP-42 will be used:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.50 microns	1.5
PMC	5.00 microns	1.5

3.3.2 Ozone Background

Due to the number of BART-eligible sources and Class I areas being analyzed, a single value of 60ppb (parts per billion) is used for all months and all three states. This value was determined based on a review of available ozone data for Idaho, Oregon, and Washington.

3.3.3 Ammonia Background

As with the ozone background, a single value of 17ppb is used for the ammonia background. This value is supported by measurements made in 1996 – 1997 at Abbotsford in the Frazier River Valley of British Columbia. This value has also been commonly used as background for Prevention of Significant Deterioration modeling in the Pacific Northwest and will ensure that for BART exemption modeling, conditions are not ammonia limited. It is recognized that ammonia values may be lower in Class I areas; however, the BART analysis must account for transport through ammonia-rich areas.

3.3.4 Receptor Locations

Visibility impacts will be computed at all Class I areas and the Columbia River Gorge Scenic Area if they lie within a 300-km radius of the BART eligible source. The geolocations of the receptor points and their elevations for the Class I areas that will be used in the modeling are available for download from the National Park Service Web site at http://www2.nature.nps.gov/air/Maps/Receptors/index.cfm>.

Receptor points and elevations for the Columbia River Gorge Scenic Area will be provided by Oregon and Washington.

3.4 CALPOST and VISIBILITY POST-PROCESSING

The following assumptions will be used in CALPOST and POSTUTIL to calculate the visibility impairment:

1) For the visibility calculation, Method 6 will be employed. This method uses monthly average relative humidity and f(RH) values for each Class I area as provided in Appendix B, which are based on the EPA Guidance for Regional Haze analysis (EPA 2003).

2) Particulate species for the visibility analysis will include SO_4, NO_3, EC, OC, PMF, and PMC, as reported in the CALPOST output files.

3) POSTUTIL will not be used to speciate modeled PM_{10} concentrations, as PM_{10} will be speciated into its components (PMF, PMC, SOA, EC, SO_4) and entered as primary emissions in CALPUFF. In addition, HNO_3/NO_3 partition option in POSTUTIL will not be used for ammonia limiting.

4) Natural background extinction calculations will use the 20% best days for each Class I area in the three-state region. The natural background for the 20% best days has been refined from that which is in "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule" (EPA 2003). The extinction

coefficients for the 20% best days have been calculated following the approach taken in the Draft Montana BART modeling protocol. This procedure uses the haze index (HI) in deciviews at the 10th percentile (median of the 20% best days) and an activity factor that is calculated for each Class I area. Tables providing the monthly f(RH) and 20% best days coefficients are provided in Appendix B, and are based on data from EPA (2003). For the exemption modeling, the Rayleigh scattering value will be 10 Mm-1 for all Class I areas.

- The 98th percentile value will be calculated for all BART-eligible sources at each mandatory Class I area.

5) The CALPOST "LST" output files will be used to determine the 98th percentile of visibility impairment for each receptor in CLASS I areas.

6) The contribution threshold has the implied level of precision equal to the level of precision reported by CALPOST. Therefore, the 98th percentile value will be reported to three decimal places.

4. Interpretation of Results

The change in visibility impairment for the BART exemption modeling is based on the increase in HI from a BART-eligible source or sources relative to natural background, defined as the 20% best visibility days for each Class I area. This definition of natural background is consistent with the intent of the BART guideline (Federal Register Vol. 70, No. 128, pf 39125).

The U.S. EPA recommends using the 98th percentile value from the distribution of values containing the highest modeled delta-deciview (Δdv) value for each day of the simulation from all modeled receptors at a given Class I area. The 98th percentile Δdv value will be determined in the following ways:

- The 8th highest value for each year modeled
- The 22nd highest value for the 3-year modeling period

Both methods will be used and the highest value of the two will be compared to the contribution threshold ($\Delta dv \geq 0.5$ dv). If there are more than 7 days with values greater than the contribution threshold in any single meteorological year for any Class I area, or more than 21 days in three years, then the source is considered Subject-to-BART.

5. References

40 CFR Part 51, Appendix W. *Guidelines on Air Quality Models*

ENVIRON and UCR 2005. Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States. Available at http://pah.cert.ucr.edu/aqm/308/reports/mm5/DrftFnl_2002MM5_FinalWRAP_Eval.pdf. ENVIRON International Corporation and University of California Riverside). March, 2005.

EPA (U.S. Environmental Protection Agency) 1998. *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*, EPA-454/R-98-019, December 1998.

EPA 2003. *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule*, EPA-454/B-03-005, September, 2003.

EPA 2006a. Conference call with Fish and Wildlife and U.S. EPA Region 10, and the states of ID, OR and WA. January 17, 2006.

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EPA 2006c. Conference call with the Fish and Wildlife and U.S. EPA Region 10, and the states of ID, OR and WA. January 20, 2006.

Federal Land Managers' Air Quality Related Values Workgroup (FLAG) 2000. *Phase I Report*. December 2000.

Federal Register, Vol. 70, No. 128. *Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations*. pp. 39104 – 30172, July 6, 2005.

Appendix A

Mandatory Class I Federal Areas

and

Columbia River Gorge Scenic Area

Figure A-1

Map of BART-Eligible Sources and Class I Areas

Posted on Idaho DEQ's Regional Haze BART Website

http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_bart.cfm.

Appendix A: Mandatory Class I Federal Areas and Columbia River Gorge Scenic Area

Table 1. Federal Mandatory Class I Areas.	
Class I Area	**Federal Land Manager**
Idaho	
Craters of the Moon National Monument	Park Service
Hells Canyon Wilderness	Forest Service
Sawtooth Wilderness	Forest Service
Selway-Bitterroot Wilderness	Forest Service
Yellowstone National Park	Park Service
Oregon	
Crater Lake National Park	Park Service
Diamond Peak Wilderness	Forest Service
Eagle Cap Wilderness	Forest Service
Gearhart Mountain Wilderness	Forest Service
Hells Canyon Wilderness	Forest Service
Kalmiopsis Wilderness	Forest Service
Three Sisters Wilderness	Forest Service
Mount Hood Wilderness	Forest Service
Mount Jefferson Wilderness	Forest Service
Mount Washington Wilderness	Forest Service
Mountain Lakes Wilderness	Forest Service
Strawberry Mountain Wilderness	Forest Service
Washington	
Alpine Lakes Wilderness	Forest Service
Goat Rocks Wilderness	Forest Service
Glacier Peak Wilderness	Forest Service
Mount Adams Wilderness	Forest Service
Mount Ranier National Park	Park Service
North Cascades National Park	Park Service
Olympic National Park	Park Service
Pasayten Wilderness	Forest Service
Neighboring States	
Anaconda-Pintler Wilderness (MT)	Forest Service
Bob Marshall Wilderness (MT)	Forest Service
Cabinet Mountains Wilderness (MT)	Forest Service
Gates of the Mountain Wilderness (MT)	Forest Service
Glacier National Park (MT)	Park Service
Missions Mountain Wilderness (MT)	Forest Service
Scapegoat Wilderness (MT)	Forest Service
Red Rock Lakes Refuge (MT)	Fish & Wildlife Service
Bridger Wilderness (WY)	Forest Service
Fitzpatrick Wilderness (WY)	Forest Service
Grand Teton National Park (WY)	Park Service
North Absaroka Wilderness (WY)	Forest Service
Teton Wilderness (WY)	Forest Service
Washakie Wilderness (WY)	Forest Service
Caribous Wilderness (CA)	Forest Service
Lassen Volcanic National Park (CA)	Park Service

Table 1. Federal Mandatory Class I Areas.	
Class I Area	**Federal Land Manager**
Lava Beds National Monument (CA)	Park Service
Marble Mountain Wilderness (CA)	Forest Service
Redwood National Park (CA)	Park Service
South Warner Wilderness (CA)	Forest Service
Thousand Lakes Wilderness (CA)	Forest Service
Yolla Bolly-Middle Eel Wilderness (CA)	Forest Service
Jarbridge Wilderness (NV)	Forest Service

Hells Canyon is located in Idaho and Oregon.
Yellowstone is located in Idaho, Montana and Wyoming.

Appendix B

Natural Visibility Background

and

Monthly Relative Humidity f(RH)

Appendix B: Natural Visibility Background and Monthly Relative Humidity f(RH)

Adjustment to speciated particulate (Western States) to reflect 20% Best Visibility Days conditions

Monthly f(RH) are from *Appendix A of Draft Guidance for Estimating Natural Visibility Conditions under the RHR (Sept. 2003* ***).***

Background extinction coefficients (20% Best Days) have been calculated using Annual Avg bext, Best 20% bext, and activity factors.

		CALPOST Input Group 2 Monthly extinction coefficients for hygroscopic species (RHFAC)												CALPOST Input Group 2 Background extinction coefficients (20% Best Days)					
Class I Area	State	Jan. f(RH)	Feb. f(RH)	Mar. f(RH)	Apr. f(RH)	May f(RH)	June f(RH)	July f(RH)	Aug. f(RH)	Sep. f(RH)	Oct. f(RH)	Nov. f(RH)	Dec. f(RH)	BKSO4 ug/m3	BKNO3 ug/m3	BKPMC ug/m3	BKOC ug/m3	SOIL ug/m3	BKEC ug/m3
CaribouWilderness	CA	3.69	3.13	2.83	2.45	2.37	2.17	2.07	2.13	2.20	2.38	3.01	3.41	0.048	0.040	1.20	0.188	0.200	0.008
LassenVolcanic	CA	3.81	3.19	2.91	2.53	2.42	2.19	2.09	2.14	2.23	2.43	3.13	3.53	0.048	0.040	1.21	0.189	0.201	0.008
Lava Beds NP	CA	3.98	3.36	3.07	2.70	2.62	2.43	2.31	2.34	2.42	2.72	3.52	3.81	0.050	0.042	1.26	0.197	0.210	0.008
MarbleMountain	CA	4.44	3.79	3.74	3.33	3.37	3.24	3.18	3.19	3.24	3.37	4.12	4.15	0.052	0.043	1.30	0.204	0.217	0.009
RedwoodNP	CA	4.42	3.91	4.56	3.91	4.50	4.70	4.86	4.72	4.31	3.66	3.81	3.40	0.054	0.045	1.34	0.210	0.224	0.009
SouthWarner	CA	3.62	3.08	2.72	2.35	2.29	2.12	1.90	1.92	1.97	2.30	3.05	3.44	0.048	0.040	1.21	0.190	0.202	0.008
ThousandLakes	CA	3.81	3.19	2.91	2.53	2.42	2.19	2.09	2.14	2.23	2.43	3.13	3.53	0.048	0.040	1.21	0.190	0.202	0.008
Yolla Bolly Middle Eel Wilderr	CA	3.95	3.35	3.14	2.76	2.68	2.47	2.44	2.50	2.56	2.70	3.31	3.62	0.049	0.041	1.24	0.194	0.206	0.008
Craters of the Moon	ID	3.13	2.74	2.28	2.02	2.01	1.81	1.43	1.42	1.57	1.97	2.77	3.04	0.046	0.038	1.15	0.180	0.192	0.008
HellsCanyon	ID	3.70	3.12	2.51	2.17	2.12	2.00	1.63	1.58	1.79	2.41	3.45	3.87	0.048	0.040	1.21	0.190	0.202	0.008
SawtoothWilderness	ID	3.34	2.87	2.32	2.01	2.00	1.84	1.43	1.40	1.50	1.96	2.94	3.31	0.046	0.039	1.16	0.182	0.193	0.008
Selway-BitterrootWilderness	ID	3.50	3.02	2.59	2.34	2.36	2.31	1.93	1.86	2.09	2.55	3.30	3.50	0.048	0.040	1.21	0.190	0.202	0.008
Anaconda-PintlerWilderness	MT	3.32	2.88	2.54	2.35	2.36	2.31	1.96	1.88	2.10	2.52	3.15	3.29	0.048	0.040	1.20	0.188	0.200	0.008
BobMarshall	MT	3.57	3.10	2.77	2.59	2.66	2.70	2.34	2.23	2.58	2.92	3.47	3.54	0.049	0.041	1.22	0.191	0.203	0.008
CabinetMountains	MT	3.81	3.27	2.85	2.61	2.66	2.68	2.30	2.18	2.56	2.98	3.70	3.86	0.050	0.041	1.24	0.195	0.207	0.008
Gates of the Mountain	MT	2.89	2.57	2.42	2.30	2.30	2.27	2.03	1.94	2.12	2.41	2.75	2.81	0.047	0.039	1.18	0.185	0.197	0.008
GlacierNP	MT	4.01	3.47	3.18	3.06	3.24	3.39	2.76	2.60	3.19	3.45	3.82	3.89	0.051	0.043	1.28	0.200	0.213	0.009
MissionMountain	MT	3.60	3.13	2.73	2.52	2.60	2.62	2.27	2.19	2.50	2.87	3.51	3.59	0.049	0.041	1.23	0.193	0.205	0.008
RedRock Lakes	MT	2.73	2.46	2.28	2.12	2.10	1.91	1.67	1.58	1.77	2.07	2.56	2.68	0.046	0.039	1.16	0.181	0.193	0.008
ScapegoatWilderness	MT	3.19	2.81	2.57	2.43	2.45	2.44	2.14	2.04	2.28	2.61	3.08	3.14	0.048	0.040	1.20	0.188	0.200	0.008
Crater Lake NP	OR	4.57	3.92	3.68	3.36	3.22	2.99	2.84	2.87	3.05	3.59	4.57	4.56	0.053	0.044	1.32	0.206	0.219	0.009
DiamondPeak	OR	4.52	3.96	3.64	3.66	3.16	3.12	2.90	2.93	3.05	3.67	4.55	4.57	0.053	0.044	1.33	0.208	0.222	0.009
Eagle Cap	OR	3.77	3.16	2.47	2.10	2.04	1.87	1.61	1.56	1.61	2.25	3.44	3.97	0.049	0.041	1.22	0.191	0.203	0.008
Gearhart Mountain	OR	3.96	3.38	3.06	2.75	2.65	2.48	2.28	2.30	2.38	2.84	3.65	3.84	0.050	0.042	1.25	0.196	0.208	0.008
Kalmiopsis Wilderness	OR	4.54	3.90	3.83	3.45	3.46	3.32	3.20	3.20	3.29	3.56	4.39	4.32	0.053	0.044	1.32	0.206	0.219	0.009
Mount Hood	OR	4.29	3.81	3.46	3.87	2.95	3.15	2.85	3.00	3.10	3.86	4.53	4.55	0.053	0.044	1.33	0.209	0.222	0.009
Mount Jefferson	OR	4.41	3.90	3.56	3.74	3.07	3.11	2.89	2.91	3.03	3.78	4.55	4.54	0.054	0.045	1.34	0.210	0.223	0.009
Mountain Lakes	OR	4.29	3.62	3.32	2.98	2.86	2.64	2.49	2.50	2.64	3.10	4.12	4.26	0.051	0.043	1.28	0.201	0.214	0.009
MountWashington	OR	4.44	3.93	3.58	3.73	3.09	3.11	2.98	2.91	3.02	3.76	4.56	4.56	0.054	0.045	1.36	0.213	0.227	0.009
StrawberryMountain	OR	3.89	3.33	2.75	2.93	2.27	2.39	1.98	1.97	1.87	2.63	3.69	4.07	0.050	0.042	1.26	0.197	0.210	0.008
ThreeSisters	OR	4.47	3.95	3.61	3.72	3.11	3.11	3.00	2.91	3.03	3.79	4.60	4.57	0.054	0.045	1.35	0.212	0.226	0.009
AlpineLakes	WA	4.25	3.79	3.47	3.90	2.93	3.22	2.92	3.12	3.25	3.91	4.47	4.51	0.054	0.045	1.35	0.212	0.225	0.009
GlacierPeak	WA	4.16	3.72	3.42	3.75	2.91	3.16	2.88	3.14	3.33	3.90	4.42	4.43	0.054	0.045	1.34	0.210	0.223	0.009
GoatRocks	WA	4.25	3.75	3.36	4.24	2.83	3.38	3.03	3.19	3.07	3.77	4.42	4.55	0.054	0.045	1.34	0.210	0.224	0.009
Mount Adams	WA	4.29	3.80	3.44	4.40	2.92	3.49	3.12	3.27	3.13	3.86	4.49	4.56	0.053	0.044	1.33	0.209	0.222	0.009
MountRainier	WA	4.42	3.96	3.64	4.65	3.06	3.69	3.30	3.50	3.40	4.11	4.66	4.66	0.055	0.045	1.36	0.214	0.227	0.009
NorthCascades NP	WA	4.10	3.69	3.43	3.74	2.93	3.20	2.93	3.23	3.45	3.93	4.39	4.38	0.053	0.044	1.33	0.209	0.222	0.009
OlympicNP	WA	4.51	4.08	3.82	4.08	3.17	3.46	3.12	3.48	3.71	4.38	4.83	4.75	0.054	0.045	1.36	0.213	0.226	0.009
PasaytenWilderness	WA	4.17	3.72	3.41	3.72	2.89	3.16	2.88	3.15	3.32	3.86	4.42	4.46	0.053	0.044	1.33	0.208	0.222	0.009
BridgerWilderness	WY	2.52	2.35	2.34	2.19	2.10	1.80	1.50	1.49	1.74	2.00	2.44	2.42	0.046	0.038	1.14	0.178	0.190	0.008
FitzpatrickWilderness	WY	2.51	2.33	2.24	2.13	2.09	1.80	1.51	1.46	1.73	1.98	2.39	2.44	0.046	0.038	1.14	0.179	0.190	0.008
Grand Teton NP	WY	2.62	2.39	2.24	2.10	2.06	1.79	1.52	1.47	1.72	2.00	2.43	2.55	0.046	0.038	1.14	0.178	0.190	0.008
NorthAbsaroka	WY	2.43	2.27	2.24	2.17	2.14	1.93	1.69	1.56	1.76	2.04	2.35	2.40	0.046	0.038	1.14	0.178	0.190	0.008
TetonWilderness	WY	2.53	2.35	2.24	2.12	2.10	1.85	1.59	1.51	1.74	2.02	2.40	2.48	0.046	0.038	1.14	0.178	0.190	0.008
WashakieWilderness	WY	2.50	2.34	2.23	2.12	2.11	1.84	1.56	1.49	1.75	2.00	2.38	2.46	0.046	0.038	1.14	0.179	0.190	0.008
YellowstoneNP	WY	2.54	2.36	2.27	2.16	2.15	1.94	1.69	1.59	1.79	2.08	2.45	2.51	0.046	0.038	1.15	0.180	0.192	0.008
JarbridgeWilderness	NV	2.95	2.60	2.08	2.12	2.21	2.17	1.58	1.40	1.35	1.63	2.44	2.80	0.046	0.038	1.14	0.179	0.190	0.008
Columbia River Gorge	OR-WA	5.03	5.03	2.59	2.59	2.59	2.11	2.11	2.11	3.51	3.51	3.51	5.03	0.569	0.231	4.85	1.05	0.217	0.205

Appendix C

CALMET Parameter Values

Appendix C: CALMET Parameter Values

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
0	DIADAT	Input file: preprocessed surface temperature data (DIAG.DAT)	User Defined	
0	GEODAT	Input file: Geophysical data (GEO.DAT)	User Defined	User Define
0	LCFILES	Convert file name to lower case	User Defined	
0	METDAT	Output file (CALMET.DAT)	User Defined	
0	METLST	Output file (CALMET.LST)	User Defined	
0	MM4DAT	Input file: MM4 data (MM4.DAT)	User Defined	
0	NOWSTA	Input files: Names of NOWSTA overwater stations	User Defined	0
0	NUSTA	Number of upper air data sites	User Defined	0
0	PACDAT	Output file: in Mesopuff II format (PACOUT.DAT)	User Defined	
0	PRCDAT	Input file: Precipitation data (PRECIP.DAT)	User Defined	
0	PRGDAT	Input file: CSUMM prognostic wind data (PROG.DAT)	User Defined	
0	SEADAT	Input files: Names of NOWSTA overwater stations (SEAn.DAT)	User Defined	
0	SRFDAT	Input file: Surface data (SURF.DAT)	User Defined	
0	TSTFRD	Output file (TEST.FRD)	User Defined	
0	TSTKIN	Output file (TEST.KIN)	User Defined	
0	TSTOUT	Output file (TEST.OUT)	User Defined	
0	TSTPRT	Output file (TEST.PRT)	User Defined	
0	TSTSLP	Output file (TEST.SLP)	User Defined	
0	UPDAT	Input files: Names of NUSTA upper air data files (UPn.DAT)	UPn.DAT	
0	WTDAT	Input file: Terrain weighting factors (WT.DAT)	User Defined	
1	CLDDAT	Input file: Cloud data (CLOUD.DAT)	User Defined	Not used
1	IBDY	Beginning day	User Defined	
1	IBHR	Beginning hour	User Defined	
1	IBMO	Beginning month	User Defined	
1	IBTZ	Base time zone	User Defined	8
1	IBYR	Beginning year	User Defined	
1	IRLG	Number of hours to simulate	User Defined	User Define
1	IRTYPE	Output file type to create (must be 1 for CALPUFF)	1	1
1	ITEST	Flag to stop run after Setup Phase	2	2
1	LCALGRD	Are w-components and temperature needed?	T	T
2	DATUM	WGS-G, NWS-27, NWS-84, ESR-S,…		NWS84
2	DGRIDKM	Grid spacing	User Defined	4
2	IUTMZN	UTM Zone	User Defined	User Define
2	LLCONF	When using Lambert Conformal map coordinates - rotate winds from true north to map north?	F	F
2	NX	Number of east-west grid cells	User Defined	373
2	NY	Number of north-south grid cells	User Defined	316
2	NZ	Number of vertical layers	User Defined	10
2	RLAT0	Latitude used if LLCONF = T	User Defined	49.0N
2	RLON0	Longitude used if LLCONF = T	User Defined	121.0W
2	XLAT0	Southwest grid cell latitude	User Defined	User Define
2	XLAT1	Latitude of 1st standard parallel	User Defined	30
2	XLAT2	Latitude of 2nd standard parallel	User Defined	60
2	XORIGKM	Southwest grid cell X coordinate	User Defined	-572
2	YLON0	Southwest grid cell longitude	User Defined	-956
2	YORIGKM	Southwest grid cell Y coordinate	User Defined	User Define
2	ZFACE	Vertical cell face heights (NZ+1 values)	User Defined	0,20,40,65,120,200,400, 700,1200,2200,4000
3	IFORMO	Format of unformatted file (1 for CALPUFF)	1	1
3	LSAVE	Save met. data fields in an unformatted file?	T	T
4	ICLOUD	Is cloud data to be input as gridded fields? (0 = No)	0	0
4	IFORMC	Format of cloud data (2 = formatted)	2	2
4	IFORMP	Format of precipitation data (2 = formatted)	2	2
4	IFORMS	Format of surface data (2 = formatted)	2	2
4	NOOBS	Use or non-use of surface, overwater, upper observations		1

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
4	NPSTA	Number of stations in PRECIP.DAT	User Defined	-1
4	NSSTA	Number of stations in SURF.DAT file	User Defined	115
5	ALPHA	Empirical factor triggering kinematic effects	0.1	0.1
5	BIAS	Surface/upper-air weighting factors (NZ values)	NZ*0	NZ*0
5	CRITFN	Critical Froude number	1	1
5	DIVLIM	Maximum acceptable divergence	5.00E-06	5.00E-06
5	FEXTR2	Multiplicative scaling factor for extrap surface obs to uppr layrs	NZ*0.0	
5	ICALM	Extrapolate surface calms to upper layers? (0 = No)	0	0
5	IDIOPT1	Compute temperatures from observations (0 = True)	0	0
5	IDIOPT2	Compute domain-average lapse rates? (0 = True)	0	0
5	IDIOPT3	Compute internally inital guess winds? (0 = True)	0	0
5	IDIOPT4	Read surface winds from SURF.DAT? (0 = True)	0	0
5	IDIOPT5	Read aloft winds from UPn.DAT? (0 = True)	0	0
5	IEXTRP	Extrapolate surface winds to upper layers? (-4 = use similarity theory and ignore layer 1 of upper air station data)	-4	-1
5	IFRADJ	Adjust winds using Froude number effects? (1 = Yes)	1	1
5	IKINE	Adjust winds using kinematic effects? (1 = Yes)	0	0
5	IOBR	Use O'Brien procedure for vertical winds? (0 = No)	0	0
5	IPROG	Using prognostic or MM-FDDA data? (0 = No)	0	14
5	ISLOPE	Compute slope flows? (1 = Yes)	1	1
5	ISTEPPG	Timestep (hours) of the prognostic model input data	1	1
5	ISURFT	Surface station to use for surface temperature (between 1 and NSSTA)	User Defined	98
5	IUPT	Station for lapse rates (between 1 and NUSTA)	User Defined	1
5	IUPWND	Upper air station for domain winds (-1 = 1/r**2 interpolation of all stations)	-1	-1
5	IWFCOD	Generate winds by diagnostic wind module? (1 = Yes)	1	1
5	KBAR	Level (1 to NZ) up to which barriers apply	NZ	10
5	LLBREZE	Use Lake Breeze module	F	F
5	LVARY	Use varying radius to develop surface winds?	F	F
5	METBXID	Station IDs in the region	User Defined	
5	NBAR	Number of Barriers to interpolation	User Defined	0
5	NBOX	Number of Lake Breeze regions	User Defined	0
5	NINTR2	Max number of stations for interpolations (NA values)	99	99
5	NITER	Max number of passes in divergence minimization	50	50
5	NLB	Number of stations in region	User Defined	0
5	NSMTH	Number of passes in smoothing (NZ values)	2, 4*(NZ-1)	1,2,2,3,3,4,4,4,4,4
5	R1	Relative weight at surface of Step 1 field and obs	User Defined	1.00E-06
5	R2	Relative weight aloft of Step 1 field and obs	User Defined	1.00E-06
5	RMAX1	Max surface over-land extrapolation radius (km)	User Defined	200
5	RMAX2	Max aloft over-land extrapolation radius (km)	User Defined	200
5	RMAX3	Maximum over-water extrapolation radius (km)	User Defined	200
5	RMIN	Minimum extrapolation radius (km)	0.1	0.1
5	RMIN2	Distance (km) around an upper air site where vertical extrapolation is excluded (Set to -1 if IEXTRP = ±4)	4	-1
5	RPROG	Weighting factor for CSUMM prognostic wind data	User Defined	0
5	TERRAD	Radius of influence of terrain features (km)	User Defined	12
5	XBBAR	X coordinate of Beginning of each barrier	User Defined	0
5	XBCST	X Point defining the coastline (straight line)	User Defined	0
5	XEBAR	X coordinate of Ending of each barrier	User Defined	0
5	XECST	X Point	User Defined	0
5	XG1	X Grid line 1 defining region of interest	User Defined	0
5	XG2	X Grid line 2	User Defined	0
5	YBBAR	Y coordinate of Beginning of each barrier	User Defined	0
5	YBCST	Y Point	User Defined	0
5	YEBAR	Y coordinate of Ending of each barrier	User Defined	0
5	YECST	Y Point	User Defined	0
5	YG1	Y Grid line 1	User Defined	0

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
5	YG2	Y Grid Line 2	User Defined	0
5	ZUPT	Depth of domain-average lapse rate (m)	200	200
5	ZUPWND	Bottom and top of layer for 1st guess winds (m)	1, 1000	1.,1000.
6	CONSTB	Neutral mixing height B constant	1.41	1.41
6	CONSTE	Convective mixing height E constant	0.15	0.15
6	CONSTN	Stable mixing height N constant	2400	2400
6	CONSTW	Over-water mixing height W constant	0.16	0.16
6	CUTP	Minimum cut off precip rate (mm/hr)	0.01	0.01
6	DPTMIN	Minimum capping potential temperature lapse rate	0.001	0.001
6	DSHELF	Coastal/shallow water length scale	0	0
6	DZZI	Depth for computing capping lapse rate (m)	200	200
6	FCORIOL	Absolute value of Coriolis parameter	1.00E-04	1.00E-04
6	HAFANG	Half-angle for looking upwind (degrees)	30	30
6	IAVET	Conduct spatial averaging of temperature? (1 = True)	1	1
6	IAVEZI	Spatial averaging of mixing heights? (1 = True)	1	1
6	ICOARE	Overwater surface fluxes method and parameters	10	10
6	ICOOL	COARE cool skin layer computation	0	0
6	ILEVZI	Layer to use in upwind averaging (between 1 and NZ)	1	1
6	ILUOC3D	Land use category ocean in 3D.DAT datasets	16	16
6	IMIXH	Method to compute the convective mixing height	1	1
6	IRAD	Form of temperature interpolation (1 = 1/r)	1	1
6	IRHPROG	3D relative humidity from observations or from prognostic data	0	1
6	ITPROG	3D temps from obs or from prognostic data?	0	2
6	ITWPROG	Option for overwater lapse rates used in convective mixing height growth	0	2
6	IWARM	COARE warm layer computation	0	0
6	JWAT1	Beginning landuse type defining water	999	55
6	JWAT2	Ending landuse type defining water	999	55
6	MNMDAV	Max averaging radius (number of grid cells)	1	1
6	NFLAGP	Method for precipitation interpolation (2 = 1/r**2)	2	2
6	NUMTS	Max number of stations in temperature interpolations	5	10
6	SIGMAP	Precip radius for interpolations (km)	100	12
6	TGDEFA	Default over-water capping lapse rate (K/m)	-0.0045	-0.0045
6	TGDEFB	Default over-water mixed layer lapse rate (K/m)	-0.0098	-0.0098
6	THRESHL	Threshold buoyancy flux required to sustain convective mixing height growth overland	0.05	0.05
6	THRESHW	Threshold buoyancy flux required to sustain convective mixing height growth overwater	0.05	0.05
6	TRADKM	Radius of temperature interpolation (km)	500	500
6	ZIMAX	Maximum over-land mixing height (m)	3000	3000
6	ZIMAXW	Maximum over-water mixing height (m)	3000	3000
6	ZIMIN	Minimum over-land mixing height (m)	50	50
6	ZIMINW	Minimum over-water mixing height (m)	50	50

Appendix D

CALPUFF Parameter Values

Appendix D: CALPUFF Parameter Values

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.

Input Group	Group Description	Sequence	Variable	Description	Default Value[a]	Recommended Value
1	Run Control	1	METRUN	Do we run all periods (1) or a subset (0)?	0	
1		2	IBYR	Beginning year	User Defined	
1		3	IBMO	Beginning month	User Defined	
1		4	IBDY	Beginning day	User Defined	
1		5	IBHR	Beginning hour	User Defined	
1		5	IRLG	Length of run (hours)	User Defined	
1		5	NSECDT	Length of modeling time step (seconds)	3600	3600
1		6	NSPEC	Number of species modeled (for MESOPUFF II chemistry)	5	
1		7	NSE	Number of species emitted	3	
1		8	ITEST	Flag to stop run after Setup Phase	2	
1		9	MRESTART	Restart options (0 = no restart) allows splitting runs into smaller segments	0	
1		10	NRESPD	Number of periods in Restart	0	
1		11	METFM	Format of input meteorology (1 = CALMET, 2 = ISC)	1	
1		12	AVET	Averaging time lateral dispersion parameters (minutes)	60	60
1		13	PGTIME	PG Averaging time	60	60
2	Tech Options	1	MGAUSS	Near-field vertical distribution (1 = Gaussian)	1	1
2		2	MCTADJ	Terrain adjustments to plume path (3 = Plume path)	3	3
2		3	MCTSG	Do we have subgrid hills? (0 = No) allows CTDM-like treatment for subgrid scale hills	0	0
2		4	MSLUG	Near-field puff treatment (0 = No slugs)	0	0
2		5	MTRANS	Model transitional plume rise? (1 = Yes)	1	1
2		6	MTIP	Treat stack tip downwash? (1 = Yes)	1	1
2		7	MBDW	Method to simulate downwash (1=ISC,2=PRIME)		not used
2		8	MSHEAR	Treat vertical wind shear? (0 = No)	0	0
2		9	MSPLIT	Allow puffs to split? (0 = No)	0	0
2		10	MCHEM	MESOPUFF-II Chemistry? (1 = Yes)	1	1
2		11	MAQCHEM	Aqueous phase transformation	0	0
2		12	MWET	Model wet deposition? (1 = Yes)	1	1
2		13	MDRY	Model dry deposition? (1 = Yes)	1	1
2		13	MTILT	Plume Tilt (gravitational settling)	0	0
2		14	MDISP	Method for dispersion coefficients (2=micromet,3 = PG)	3	3
2		15	MTURBVW	Turbulence characterization? (Only if MDISP = 1 or 5)	3	3
2		16	MDISP2	Backup coefficients (Only if MDISP = 1 or 5)	3	3
2		16	MTAULY	Method for Sigma y Lagrangian timescale	0	0
2		16	MTAUADV	Method for Advective-Decay timescale for Turbulence	0	0
2		16	MCTURB	Method to compute sigma v,w using micromet variables	1	1
2		17	MROUGH	Adjust PG for surface roughness? (0 = No)	0	0
2		18	MPARTL	Model partial plume penetration? (0 = No)	1	1
2		19	MTINV	Elevated inversion strength (0 = compute from data)	0	0
2		20	MPDF	Use PDF for convective dispersion? (0 = No)	0	0

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.

Input Group	Group Description	Sequence	Variable	Description	Default Value[a]	Recommended Value
2		21	MSGTIBL	Use TIBL module? (0 = No) allows treatment of subgrid scale coastal areas	0	0
2		22	MBCON	Boundary conditions modeled	0	0
2		23	MFOG	Configure for FOG model output	0	0
2		24	MREG	Regulatory default checks? (1 = Yes)	1	1
3	Species List	1	CSPECn	Names of species modeled (for MESOPUFF II must be SO2-SO4-NOX-HNO3-NO3)	User Defined	
3		2	Specie Names	Manner species will be modeled	User Defined	
3		3	Specie Groups	Grouping of species if any	User Defined	
3		4	CGRUP			
3		5	CGRUP			
4	MapProjection		XLAT1	Latitude of 1st standard parallel		
4			XLAT2	Latitude of 2nd standard parallel		
4			DATUM			NWS84
4		1	NX	Number of east-west grids of input meteorology	User Defined	
4		2	NY	Number of north-south grids of input meteorology	User Defined	
4		3	NZ	Number of vertical layers of input meteorology	User Defined	
4		4	DGRIDKM	Meteorology grid spacing (km)	User Defined	
4		5	ZFACE	Vertical cell face heights of input meteorology	User Defined	
4		6	XORIGKM	Southwest corner (east-west) of input User	Defined meteorology	
4		7	YORIGIM	Southwest corner (north-south) of input User	Defined meteorology	
4		8	IUTMZN	UTM zone	User Defined	
4		9	XLAT	Latitude of center of meteorology domain	User Defined	
4		10	XLONG	Longitude of center of meteorology domain	User Defined	
4		11	XTZ	Base time zone of input meteorology	User Defined	
4		12	IBCOMP	Southwest X-index of computational domain	User Defined	
4		13	JBCOMP	Southwest Y-index of computational domain	User Defined	
4		14	IECOMP	Northeast X-index of computational domain	User Defined	
4		15	JECOMP	Northeast Y-index of computational domain	User Defined	
4		16	LSAMP	Use gridded receptors? (T = Yes)	F	F
4		17	IBSAMP	Southwest X-index of receptor grid	User Defined	
4		18	JBSAMP	Southwest Y-index of receptor grid	User Defined	
4		19	IESAMP	Northeast X-index of receptor grid	User Defined	
4		20	JESAMP	Northeast Y-index of receptor grid	User Defined	
4		21	MESHDN	Gridded recpetor spacing = DGRIDKM/MESHDN	1	
5	Output Options	1	ICON	Output concentrations? (1 = Yes)	1	1
5		2	IDRY	Output dry deposition flux? (1 = Yes)	1	1
5		3	IWET	Output west deposition flux? (1 = Yes)	1	1
5		4	IT2D	2D Temperature	0	0
5		5	IRHO	2D Density	0	0
5		6	IVIS	Output RH for visibility calculations (1 = Yes)	1	1
5		7	LCOMPRS	Use compression option in output? (T = Yes)	T	T
5		8	ICPRT	Print concentrations? (0 = No)	0	0
5		9	IDPRT	Print dry deposition fluxes (0 = No)	0	0

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
5		10	IWPRT	Print wet deposition fluxes (0 = No)	0	0
5		11	ICFRQ	Concentration print interval (1 = hourly)	1	24
5		12	IDFRQ	Dry deposition flux print interval (1 = hourly)	1	24
5		13	IWFRQ	West deposition flux print interval (1 = hourly)	1	24
5		14	IPRTU	Print output units (1 = g/m**3; g/m**2/s; 3 = ug/m3, ug/m2/s)	1	3
5		15	IMESG	Status messages to screen? (1 = Yes)	1	2
5		16	LDEBUG	Turn on debug tracking? (F = No)	F	F
5		16	IPFDEB	First puff to track	1	1
5		17	NPFDEB	(Number of puffs to track)	(1)	1
5		18	NN1	(Met. Period to start output)	(1)	1
5		19	NN2	(Met. Period to end output)	(10)	10
7	Dry Dep Chem		Dry Gas Dep	Chemical parameters of gaseous deposition species	User Defined	defaults
8	Dry Dep Size		Dry Part. Dep	Chemical parameters of particulate deposition species	User Defined	defaults
9	Dry Dep Misc	1	RCUTR	Reference cuticle resistance (s/cm)	30	30
9		2	RGR	Reference ground resistance (s/cm)	10	10
9		3	REACTR	Reference reactivity	8	8
9		4	NINT	Number of particle-size intervals	9	9
9		5	IVEG	Vegetative state (1 = active and unstressed; 2=active and stressed)	1	1
10	Wet Dep		Wet Dep	Wet deposition parameters	User Defined	defaults
11	Chemistry	1	MOZ	Ozone background? (0 = constant background value; 1 = read from ozone.dat)	0	0
11		2	BCKO3	Ozone default (ppb) (Use only for missing data)	80	60
11		3	BCKNH3	Ammonia background (ppb)	10	17
11		4	RNITE1	Nighttime SO2 loss rate (%/hr)	0.2	0.2
11		5	RNITE2	Nighttime NOx loss rate (%/hr)	2	2
11		6	RNITE3	Nighttime HNO3 loss rate (%/hr)	2	2
11		7	MH2O2	H2O2 data input option	1	1
11		8	BCKH2O2	Monthly H2O2 concentrations	1	12*1
			BKPMF	Fine particulate concentration	12 * 1.00	not used
			OFRAC	Organic fraction of Fine Particulate	2*0.15, 9*0.20, 1*0.15	not used
			VCNX	VOC / NOX ratio	12 * 50.00	not used
12	Dispersion	1	SYTDEP	Horizontal size (m) to switch to time dependence	550	550
12		2	MHFTSZ	Use Heffter for vertical dispersion? (0 = No)	0	0
12		3	JSUP	PG Stability class above mixed layer	5	5
12		4	CONK1	Stable dispersion constant (Eq 2.7-3)	0.01	0.01
12		5	CONK2	Neutral dispersion constant (Eq 2.7-4)	0.1	0.1
12		6	TBD	Transition for downwash algorithms (0.5 = ISC)	0.5	0.5
12		7	IURB1	Beginning urban landuse type	10	10
12		8	IURB2	Ending urban landuse type	19	19
12		9	ILANDUIN	Land use type (20 = Unirrigated agricultural land)	20	20
12		10	ZOIN	Roughness length (m)	0.25	0.25
12		11	XLAIIN	Leaf area index	3.0	3.0
12		12	ELEVIN	Met. Station elevation (m above MSL)	0.0	0.0
12		13	XLATIN	Met. Station North latitude (degrees)	-999.0	-999.0
12		14	XLONIN	Met. Station West longitude (degrees)	-999.0	-999.0

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
12		15	ANEMHT	Anemometer height of ISC meteorological data (m)	10.0	10.0
12		16	ISIGMAV	Lateral turbulence (Not used with ISC meteorology)	1	1
12		17	IMIXCTDM	Mixing heights (Not used with ISC meteorology)	0	0
12		18	XMXLEN	Maximum slug length in units of DGRIDKM	1.0	1
12		19	XSAMLEN	Maximum puff travel distance per sampling step (units of DGRIDKM)	1.0	1
12		20	MXNEW	Maximum number of puffs per hour	99	99
12		21	MXSAM	Maximum sampling steps per hour	99	99
12		22	NCOUNT	Iterations when computing Transport Wind (Calmet & Profile Winds)	2	2
12		23	SYMIN	Minimum lateral dispersion of new puff (m)	1.0	1
12		24	SZMIN	Minimum vertical dispersion of new puff (m)	1.0	1
12		25	SVMIN	Array of minimum lateral turbulence (m/s)	6 * 0.50	6 * 0.50
12		26	SWMIN	Array of minimum vertical turbulence (m/s)	0.20,0.12,0.08, 0.06,0.03,0.01 6	
12		27	CDIV (1), (2)	Divergence criterion for dw/dz (1/s)	0.01 (0.0,0.0)	0.0,0.0
12		28	WSCALM	Minimum non-calm wind speed (m/s)	0.5	0.5
12		29	XMAXZI	Maximum mixing height (m)	3000	3000
12		30	XMINZI	Minimum mixing height (m)	50	50
12		31	WSCAT	Upper bounds 1st 5 wind speed classes (m/s)	1.54,3.09,5.14, 8. 23,10.8	1.54,3.09,5.14,8. 23,10.8
12		32	PLX0	Wind speed power-law exponents	0.07,0.07,0.10, 0.15,0.35,0.55	0.07,0.07,0.10,0. 15,0.35,0.55
12		33	PTGO	Potential temperature gradients PG E and F (deg/km)	0.020,0.035	0.020,0.035
12		34	PPC	Plume path coefficients (only if MCTADJ = 3)	0.5,0.5,0.5,0.5, 0.35,0.35	0.5,0.5,0.5,0.5,0. 35,0.35
12		35	SL2PF	Maximum Sy/puff length	10.0	10.0
12		36	NSPLIT	Number of puffs when puffs split	3	3
12		37	IRESPLIT	Hours when puff are eligible to split	User Defined	
12		38	ZISPLIT	Previous hour’s mixing height(minimum)(m)	100.0	100.0
12		39	ROLDMAX	Previous Max mix ht/current mix ht ratio must be less then this value for puff to split	0.25	0.25
12		40	NSPLITH	Number of puffs when puffs split horizontally	5	5
12		41	SYSPLITH	Min sigma-y (grid cell units) of puff before horiz split	1.0	1.0
12	12	42	SHSPLITH	Min puff elongation rate per hr from wind shear before horiz split	2.0	2.0
12		43	CNSPLITH	Min conc g/m3 before puff may split horizontally	1.0E-07	1.0E-07
12		44	EPSSLUG	Convergence criterion for slug sampling integration	1.00E-04	1.00E-04
12		45	EPSAREA	Convergence criterion for area source integration	1.00E-06	1.00E-06
12		46	DSRISE	Step length for rise integration	1.0	1.0
12		47	HTMINBC		500.0	500.0
12		48	RSAMPBC		10.0	10.0
12		49	MDEPBC		1	1
13	Point Source	1	NPT1	Number of point sources	User Defined	
13		2	IPTU	Units of emission rates (1 = g/s)	1	
13		3	NSPT1	Number of point source-species combinations	0	

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
13		4	NPT2	Number of point sources with fully variable emission rates	0	
13			Point Sources	Point sources characteristics	User Defined	
14	Area Source		Area Sources	Area sources characteristics	User Defined	
15	Volume Source		Volume	Volume sources characteristics	User Defined Sources	
16	Line Source		Line Sources	Buoyant lines source characteristics	User Defined	
17	Receptors		NREC	Number of user defined receptors	User Defined	
17			Receptor Data	Location and elevation (MSL) of receptors	User Defined	

Appendix E

CALPOST Parameter Value

Appendix E: CALPOST Parameter Values

Input Group	Variable	Description	Default Value	Recommended Value
		Table F-1. Recommended CALPOST parameter values chosen by the Region 10 states for use in BART modeling		
1	ASPEC	Species to process	VISIB	VISIB
1	ILAYER	Layer/deposition code (1 = CALPUFF concentrations; -3 = wet+dry deposition fluxes)	1	1
1	LBACK	Add Hourly Background Concentrations/Fluxes?	F	F
1	MFRH	Particle growth curve for hygroscopic species	2	2
2	RHMAX	Maximum relative humidity (%) used in particle growth curve	98	95
2	LDRING	Report results by Discrete receptor Ring, if Discrete Receptors used. (T = true)	T	
		Modeled species to be included in computing the light extinction		
2	LVSO4	Include SO4?	T	T
2	LVNO3	Include NO3?	T	T
2	LVOC	Include Organic Carbon?	T	T
2	LVPMC	Include Coarse Particles?	T	T
2	LVPMF	Include Fine Particles?	T	T
2	LVEC	Include Elemental Carbon?	T	T
2	LVBK	when ranking for TOP-N, TOP-50, and Exceedance tables Include BACKGROUND?	T	T
2	SPECPMC	Species name used for particulates in MODEL.DAT file: COARSE =	PMC	PMC
2	SPECPMF	Species name used for particulates in MODEL.DAT file: FINE =	PMF	PMF
		Extinction Efficiencies (1/Mm per ug/m**3)		
2	EEPMC	PM COARSE =	0.6	0.6
2	EEPMF	PM FINE =	1.0	1.0
2	EEPMCBK	Background PM COARSE	0.6	0.6
2	EESO4	SO4 =	3.0	3.0
2	EENO3	NO3 =	3.0	3.0
2	EEOC	Organic Carbon =	4.0	4.0
2	EESOIL	Soil =	1.0	1.0
2	EEEC	Elemental Carbon =	10.0	10.0
2	LAVER	Method used for 24-hr avg % change light extinction	F	F
2	MVISBK	Method used for background light extinction (2 = Hourly RH adjustment; 6 = FLAG seasonal f(RH))	2 or 6	6
2	RHFAC	Monthly RH adjustment factors from FLAG (unique for each Class I area)	Yes if 6	EPA
		Background monthly extinction coefficients (FLAG) unique for each Class I area		
2	BKSO4	Assume all hygroscopic species as SO4 (raw extinction value without scattering efficiency adjustment)		*see table*
2	BKNO3			*see table*
2	BKPMC			*see table*
2	BKOC			*see table*
2	BKSOIL	Assume all non-hygroscopic species as Soil		*see table*
2	BKEC			*see table*
2	BEXTRAY	Extinction due to Rayleigh scattering	10.0	10.0
		Averaging time(s) reported		
3	L1PD	Averaging period of model output	F	F
3	L1HR	1-hr averages	F	F
3	L3HR	3-hr averages	F	F
3	L24HR	24-hr averages	T	T
3	LRUNL	Run lengtyh (annual)	F	F
3	LT50	Top 50 table for each averaging time selected	T	F
3	LTOPN			1
3	NTOP			1
3	ITOP			

Modeling Protocol Response to Comments

ID-OR-WA BART Modeling Protocol: Summary of Comments and Responses

The BART modeling protocol developed by Washington, Oregon, and Idaho was distributed to BART-eligible sources in the three-state region, the Federal Land Managers (FLMs), and EPA Region 10 in early June 2006. Comments were received in the period up to June 30, 2006. Many comments have been addressed by clarifications or modifications to the protocol, and the protocol is greatly improved with these changes. Significant comments relating to modeling and technical issues are summarized below, together with responses.

Comments Grouped by Topic

General Comments 1: Class I areas and Columbia River Gorge National Scenic Area (CRGNSA).

Comments: The CRGNSA and all Class I areas beyond 200 km should not be included in the analysis.

Response: Inclusion of CRGNSA in the analysis is for information purposes only. The inclusion of all Class I areas within 300 km is based on EPA "Guidelines on Air Quality Modeling" (Section 6.1 of Appendix W).

General Comments 2: Ozone and ammonia backgrounds.

Comments: 1) Provide justification for backgrounds; 2) Use an OZONE.DAT file to allow CALPUFF to choose the ozone concentration at each computational grid point based on the nearest monitoring value; 3) Use monthly or seasonally varying O_3 background; 4) Vary ammonia background by Class I area; 5) Use the ammonia limiting method in POSTUTIL; 6) Use ammonia data from WRAP.

Response: Ozone data in Washington, Oregon and Idaho were analyzed, and an annual background concentration of 60 ppb for domain was determined to be representative. Using varying ozone concentrations for each grid point, including the use of an OZONE.DATA file, is not considered suitable for conditions in the modeling domain. An ammonia background concentration of 17 ppb was determined to be appropriate based on the presence of high ammonia-emitting areas in the three-state region that are not adequately represented in the WRAP modeling. It is recognized that ammonia values may be lower in Class I areas, but the analysis must account for plume transport through ammonia-rich areas. Clarification was added to Section 3.6.3.

General Comments 3: Natural Background and Class I areas.

Comments: 1) Clarify the basis for determining natural background (20% best days or annual average); 2) Provide basis for the 20% best-days natural background numbers that are given in Appendix B; 3) Clarify the use of the alternative method in the EPA Guidance on Developing Natural Background to refine the background values used in the modeling; 4) The natural background is too low (conservative), and should be adjusted to include the contribution of natural carbon and sea salt; 5) Use the new IMPROVE Rayleigh scattering estimates developed in November 2005, instead of the default value of 10; 6) Add the Jarbidge Wilderness area in Nevada to the list of Class I areas in the modeling.

Response: 1) The 20% best days natural background will be used and is consistent with the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125).   The protocol was clarified to reflect these comments. The use of the new IMPROVE formula for calculating visibility extinction, including the addition of sea salt, has not been approved by the FLMs for the BART analysis. The new Rayleigh scattering formula will also not be used, which is consistent with FLM recommendations. The Jarbidge Wilderness was added to the Class I area list.

General Comments 4: BART Exemption thresholds.

Comments: 1) Multiple or grouped sources should be compared to the 1.0 dv (“cause” threshold) not to the 0.5 dv (“contribute” threshold); 2) Provide information on how the multi-source analysis will be managed, including data sharing among states; 3) Clarify the use of the 98th percentile dv change versus the highest dv change, and how this metric is linked to the method for estimating natural background; 4) Calculate the change in visibility on a receptor-by-receptor basis, not on the Class I area.

Response: Following the BART modeling guidance, the contribution threshold is 0.5 dv and will be applied to individual sources. In the multi-source assessment, the 0.5 dv value is used only as a marker to indicate that a further analysis of these sources will be carried out; it is not considered a contribution threshold. The additional analysis of these multiple sources will look at the frequency, magnitude, duration, and other factors to determine if these sources, if any, will be considered significant and Subject to BART. Section 2.7.1 has been clarified regarding these multi-source assessments. Emissions and modeled concentration data will be shared among the three states. The 98^{th} percentile change in dv will be used in conjunction with the 20% best days natural background and is based on the EPA BART guidelines and comments of the FLMs. The assessment of visibility change will be based on a receptor-by-receptor basis.

General Comments 5: Multi-source modeling and assessment methodology.

Comments: 1) The reference to FLAG and the use of “magnitude, frequency, duration” in Exemption modeling should be removed as these factors only apply in the Determination phase of the modeling; 2) Clarify the difference between the BART Exemption modeling and Determination modeling; (for example, if a source is determined to be Subject to BART based on the multi-source analysis, should not the BART Determination also be based on group analysis?).

Response: Consistent with the EPA BART Guidelines, the FLAG and IWAQM reports will be used as general guidance for the visibility assessment. The single-source BART Exemption analyses will be based on the 0.5 dv contribution threshold and will not consider the frequency, magnitude, and duration of impairment (consistent with BART Guideline). For the evaluation of multi-source impacts, the BART Exemption analyses will consider an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each sources in the multi-source group. Section 2.7.2 has been clarified for the Determination phase.

<u>General Comments 6: Inclusion of VOC and ammonia-emitting sources in the BART modeling.</u>

Comments: 1) Remove VOCs and ammonia from the visibility analysis; 2) If VOCs are modeled, justify basis for VOC speciation.

Response: Section 2.3 in the protocol has been modified to read, "Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds that require a full BART exemption analysis." For Washington, "VOC emissions will be included in the BART exemption analysis if the greater-than-six carbon VOC gases exceed 250 tons/year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms."

<u>General Comments 7: Definition of Bart-eligible sources.</u>

Comments: Confusion on definition of BART-eligible source.

Response: Section 2.1 in protocol has been clarified to show that a "BART-eligible source" refers to the entire facility that has BART-eligible emission units."
<u>General Comments 8: Characterization of facility emissions</u>.

Comment: 1) Clarify under what conditions emission units and pollutants can be excluded in the BART Exemption modeling; 2) Do not include fugitive emissions; 3) Describe how different operating scenarios might be included; 4) Clarify the modeling of HNO_3.

Response: Section 2.4 was clarified on the exemption of pollutants and individual emission units and specifically the exemption of fugitive emissions for sources that are greater than 10km from a Class I area. Different operating scenarios are not addressed in the protocol; if this is a significant issue for an individual source, it will be addressed on a case-by-case basis. HNO_3.modeling is addressed in Section 3.6.1.

General Comments 9: PM speciation.

Comments: 1) Clarify how PM will be speciated, especially the inclusion of the condensable fraction of emissions and scavenging coefficients for PM species; 2) Address the possible double-counting of SO_4 in PM_{10} condensables with gaseous SO_2; 3) Correct the problem with the speciation references in the appendices; 4) Add additional sources of speciation data than those listed in the appendices; 5) Make reference to the NPS Web site for speciation information.

Response: Section 3.6.1 was modified to give a better description of PM speciation, size fractionation, treatment of condensables, and the modeling of SO_2 and $H2SO_4$ to ensure no double-counting. The statement "The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions" was added. Appendix G was removed and three information sources were included in Section 3.6.1. A chart showing the default PM size fractions to be used in CALPUFF was included in the protocol:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.48	2
PMC	2.5	5

General Comments 10: CALMET modeling.

Comments: 1) The CALMET modeling protocol was not available for public review, yet the work is already under way; 2) Make clear that states, not Geomatrix, is responsible for the protocol for developing the CALMET data set; 3) Correct the years of CALMET data that is shown in section 3.1.2; 4) Clarify how the 12-km CALMET data will be used; 5) Describe how the CALMET data will be provided; 6) Describe how the MM5 will be evaluated.

Response: Clarification was added to Section 3.5. Due to time and resource constraints, an initial CALMET protocol and the development of the data set was started prior to the finalizing of the protocol. The FLMs and EPA were consulted throughout this process, and the initial draft of the CALMET protocol was reviewed and approved before the work began. The years of CALMET data given in the protocol have been corrected. Only the 4-km CALMET data will be used for BART modeling, but both the 4 km and 12 km met data will be available for other air quality analyses. Individual facilities will contact the appropriate state agency to discuss options for obtaining the CALMET data. The MM5 data was evaluated using METSTAT, a publicly available statistical program.

General Comments 11: CALPUFF model versions.

Comments: 1) Clarify reasons for using Version 6 as this is not consistent with other RPO protocols; 2) Correct the listing of versions in the protocol; 3) Update the protocol and the appendices to reflect the use of Version 6.

Response: Version 6 is the most recent version of CALPUFF and was made available after other protocols in other regions were completed. It was felt important that the most recent version be used, in part because of the improved over-water algorithm. The protocol was corrected to show Version 6 of the CALPUFF modeling system. Appendices were updated to include the new parameters in Version 6.

General Comments 12: CALPUFF modeling parameters.

Comments: Comments on CALPUFF: 1) Clarify the meaning of the phrase "protocol will generally follow FLAG and IWAQM;" 2) Use puff-splitting; 3) Use building downwash; 4) Base source elevations on the same terrain files as the receptor elevations.

Response: The FLAG and IWAQM reports were used as guidance documents during the development of the protocol, and are specifically referenced in the EPA BART guidelines. Puff-splitting and building downwash will not be used in CALPUFF based on the recommendations from FLMs. Clarification was added to Section 3.6.4 to state that source and receptor elevations will be the actual elevations, and will not be based on the DEM data used for the development of the windfields in CALMET.

General Comments 13: CALPOST

Comments: 1) Describe how OC (SOA) is treated in CALPUFF, POSTUTIL, and CALPOST.

Response: Clarification was added to Sections 3.6 and 3.7.

General Comments 14: BART modeling implementation.

Comments: 1) Clarify if the protocol is required for all BART-eligible sources, or can the use of higher resolution met data, or other refined model options, be used to address local conditions; 2) Show the BART schedule, including the estimated time and resources required by IDEQ and WRAP; 3) Describe the process for determining and prioritizing BART control measures, including the sensitivity of the visibility modeling to PM, SO_2, and NO_x emissions; 4) Comment on the observation that control technologies that do not produce visibility improvements will not be determined to be BART.

Response: These local or state-specific issues are not addressed in the protocol, and should be discussed separately with each state agency. In addition, this response to comments is intended only to address the modeling and technical analysis issues of the BART process and not to respond to questions or comments of a legal nature.

Specific Comments

Specific Comment 1: Terminology.

Comment: The term “BART exemption modeling” is not used in the BART Guidelines (40 CFR part 51, Appendix Y). It is suggested that a term that is more directly tied to Appendix Y be used.

Response: The terms in the BART Guidelines are not clear; therefore, the modeling protocol distinguishes between “BART Exemption modeling” (a process to exempt sources from being Subject to BART) and “BART Determination modeling” (a process to determine the level of controls, together with other factors, necessary to meet BART).

Specific Comment 2: Typo

Comment: Put “or” between two bullets in Section 2.4.

Response: The change was incorporated in the protocol.

Specific Comment 3: BART-eligible emission units

Comment: Include a list of all BART-eligible units.

Response: A listing of all BART-eligible units was not included in the protocol as there are potentially a large number of individual emission units, and there may be changes in the actual units included in the modeling as the analysis proceeds. Only a list of BART-eligible sources is included in the protocol.

Specific Comment 4: Model performance evaluation.

Comment: 1) In the protocol, include a section on performance evaluation that addresses the accuracy of the estimated visibility compared to monitored visibility impairment; 2) In the modeling reports, include a summary of a model performance evaluation using the PM_{10} SIP evaluation as guidance; 3) Describe why the protocol and analysis will not result in an overly conservative result, even as a screening approach.

Response: A section on model performance evaluation was not included in the protocol because it is not appropriate for the type of modeling analysis. In order to complete a model evaluation, several data sets are required covering the same time period: meteorological data, actual emissions data from all source types, and monitoring data. The purpose of the BART analysis is to determine the impact on a Class I area of an individual source or a group of sources. All other emissions that are present in the modeling domain that would contribute to impairment at a monitor are not included in the analysis. As a result, the BART modeled visibility impairment can not be compared to monitoring data. Also, the metrological data and emissions data must be in the same time period as the monitoring data.

The mesoscale meteorological data (MM5) is being evaluated against actual meteorological observation data as well as the CALMET output files.

The protocol is based on recommendations in the BART Guideline, FLAG report, and IWAQM report. In addition, the BART Exemption modeling approach that is described in this protocol is virtually identical to visibility analyses that have been a part of NSR for sources in the Pacific NW for over five years, and is not considered overly protective of visibility.

Modeling Protocol for BART CALMET datasets, Idaho Oregon and Washington

Modeling Protocol for BART CALMET datasets

Idaho, Oregon and Washington

Prepared for:

Idaho Department of Environmental Quality
1410 North Hilton
Boise ID 83706

July 12, 2006

Project No. 012173.000.0

Modeling Protocol for BART CALMET datasets

Idaho, Oregon and Washington

Prepared for:

Idaho Department of Environmental Quality
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1. INTRODUCTION

EPA published the Best Available Retrofit Technology (BART) standards under the Regional Haze Rule on July 6, 2005. Appendix Y, "Guideline for Best available Retrofit Technology Determination" (the *BART Guideline*) details EPA's recommendations to states for conducting BART analyses. According to the *BART Guideline*, each state may determine which BART-eligible sources are actually subject to BART using the CALPUFF dispersion model. The CALPUFF model is run using a meteorological data set developed with the CALMET program.

The Idaho Department of Environmental Quality (IDEQ), in cooperation with the Washington Department of Ecology (DOE) and Oregon Department of Environmental Quality (ODEQ) issued a contract to Geomatrix Consultants (Geomatrix) for the development of CALMET meteorological datasets. These datasets will provide consistent meteorology for the dispersion modeling that will be conducted by each state to determine which sources are subject to BART.

The CALMET dataset will be based on Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) runs performed at the University of Washington (UW). Two 3-year CALMET datasets will be produced, one using a 12 km mesh size and another using a 4 km mesh size.

Statistical analyses will be performed, assessing both the performance of the UW MM5 runs themselves, and the two CALMET datasets. CALMET adjusts the MM5 data using empirical algorithms and the statistical analyses will assess both the validity of the initial MM5 predictions and the CALMET objective procedures.

2. MODEL SELECTION

The air quality related value (AQRV) of concern for BART modeling assessments is regional haze in Class I areas and modeling needs to estimate the potential contributions of individual industrial sources to regional haze. The *BART Guideline* recommends the use of CALPUFF to establish whether a stationary source is reasonably anticipated to cause or contribute to haze in a Federal Class I area. Features of the CALPUFF modeling system include the ability to consider: secondary aerosol formation; gaseous and particle deposition; wet and dry deposition processes; complex three-dimensional wind regimes; and the effects of humidity on regional visibility. The CALPUFF modeling system is also currently recommended for evaluating impacts to *all* AQRVs in Class I areas affected by long-range transport from a source. In the case of BART, potential impacts are characterized based on predicted changes to light extinction.

3. MODELING DOMAIN

Geomatrix will use the modeling domain shown in Figure 1 for the CALMET datasets. The 1488 km-by-1260 km domain is essentially the entire usable 12 km MM5 domain, except for a portion that extends out over the Pacific Ocean. The 12 km UW MM5 domain is a nested domain, with feedback between the 36 km domain and the 12 km domain. This requires a smoothing or blending of the fields (both terrain and predicted quantities) along the boundary of the nested (inner) domain. The first few points near the edge of a nested domain should therefore be discarded.

We will extract UW MM5 grid points (X,Y) = (24,4) to (148,109), of a possible maximum (151,112). Here X is the "east-west" direction, not the X of internal MM5 nomenclature (which is the north-south direction). This domain discards 23 points on the western edge, and 3 points along the northern, eastern and southern edges of the UW MM5 12 km grid.

A Lambert Conformal Conic (LCC) coordinate system will be used, with parameters selected to match the coordinate system used by the UW for their MM5 simulations (centered at 49°N, 121°W). The proposed domain, given in terms of the centers of each CALMET grid cell, extends from LCC coordinates (-570,-954) to (918,306) km.

Land use and terrain data will be prepared from the North American 30 second data sets that accompany the CALPUFF modeling system using the tools included in the system, resulting in 12 km and 4 km mesh size fields, depending on the product.

4. METEOROLOGICAL DATA

Geomatrix has archived meteorological data sets from the University of Washington (UW) based on numerical simulations of Pacific Northwest weather with MM5. The proposed dataset for the BART CALMET analysis will use three calendar years of hourly MM5 output data from January 2003 through December 2005, computed on a 12-km mesh size with 38 vertical sigma levels.

MM5 is run by UW in "forecast mode", not "prognostic mode" or "hindcast mode", and is initialized twice per day at 00Z and 12Z. The first few simulated hours of an MM5 run, when divergence and vertical motion at scales smaller than the initialization dataset are still developing, should be discarded. On the other hand, predictions typically stray from reality with time as the simulations proceeds. The compromise is to use forecast hours 12 to 24 from each run for the CALMET dataset. Since MM5 simulations are initiated twice per day, only 12 hours from each run are needed to create a dataset with no gaps in time. However, an additional hour of MM5 output (forecast hour 12) is needed to convert forecast hour 13's accumulated precipitation to an hourly precipitation rate.

Observational data are needed by both CALMET (to provide cloud cover and ceiling height) and METSTAT (to provide verification data). The UCAR dataset ds472.0, *TDL U.S. and Canada Surface Hourly Observations*, will be used for both. These data are available from UCAR[1].

5. MISSING DATA

The initial data recovery for the MM5 archive is greater than 99 percent. The UW saves their MM5 output data in a compressed format using the Linux utility *gzip*, and occasionally a compressed file becomes corrupted during data transfer and storage. Additionally, the UW MM5 runs are initialized from the National Center for Environmental Prediction's (NCEP) GFS model. On a few occasions, NCEP was performing a backup test and the GFS model was not run for that time period. With no data to serve as initial conditions, MM5 was not run for that initialization time. This leaves occasional 12-hour gaps in the data coverage.

Missing periods (when the GFS initialization data were not available) will be re-run using UK Meteorological Office (UKMO) data to provide the initial conditions to MM5. Shorter missing periods (when data transfer and storage corrupts the file) will be filled by extracting the data from the UW tape archive, or re-running MM5 (using GFS initialization data) when tape extraction is not possible. The final data recover rate for the MM5 archive will be 100 percent: no missing data in the three-year time span.

6. CALMM5 PROCEDURES

The CALMM5 program is used to convert raw MM5 output to a format readable by CALMET. CALMM5 version 2.6, level 060330, will be used. This version of CALMM5 can read

[1] See http://dss.ucar.edu/datasets/ds472.0

MM5v3 format files directly, and performs the conversion from accumulated to hourly precipitation as it runs, but cannot tolerate any missing data. The output is the newer 3D.DAT/2D.DAT format. A truncated sample CALMM5 "3D.DAT" is included in Appendix A. We will include a few extra hours at the end of each file, to facilitate its use in time zones other than GMT-8. The 3D.DAT files will include all MM5 sigma levels up to and including 0.26 (the lowest 31 of 38 levels).

Since we will have no missing data, one CALMM5 run will be performed for each month. The files for forecast hours 12-24 from each run will be included in each CALMM5 input file. Although this results in two MM5 files with data valid for the same time period (i.e. forecast hour 24 from the previous run, and forecast hour 12 from the current run both represent the same hour) CALMM5 uses forecast hour 12 data only to convert forecast hour 13's precipitation field from "accumulated precipitation" to "hourly precipitation" as required by CALMET. Forecast hour 13's precipitation field is then subtracted from hour 14's precipitation field, and so on to the end of the CALMM5 run.

7. CALMET PROCEDURES

The proposed modeling procedures follow the recommendations of the Interagency Agency Workgroup on Air Quality Modeling (IWAQM) and the Federal Land Managers Air Quality Related Values Workgroup (FLAG), outlined in the FLAG Phase I Report. EPA endorsed these procedures in advance in the IWAQM Phase II report.

The CALPUFF modeling system is equipped with a host of modeling options, but Geomatrix proposes to use the procedures and defaults recommended by the FLAG Phase I Report except where noted in the following discussion, and summarized in Table 1. A sample CALMET input file can be found in Appendix B.

CALMET, the meteorological preprocessor component of the CALPUFF system, will be used to combine the MM5 simulation data, surface observations, terrain elevations, and land use data into the format required by the dispersion modeling component CALPUFF. In addition to specifying the three-dimensional wind field, CALMET also estimates the boundary layer parameters used to characterize diffusion and deposition by the dispersion model. CALMET default options will be used except where noted in Table 1.

The CALPUFF modeling system is in the process of being upgraded. The most recent "beta" release of CALMET (version 6.211, level 060414) will be used. There were substantial improvements made to the CALPUFF modeling system with the release of version 6, including better algorithms over water and improved mixing height algorithms.

Major features of the CALMET application and input data preparation are as follows:

- The 12-km MM5 winds for January 2003 through December 2005 will be used to initialize the three-dimensional wind field predictions. Forecast hours 13-24 from each 00Z and 12Z MM5 run will be used (see precipitation discussions below).

- CALMET objective procedures will be used with local terrain and land use data to adjust the MM5 12-km wind fields to 12 km and 4 km mesh size grids. The pressure-based vertical level MM5 fields will be reduced and layer-averaged resulting in 10 vertical levels from the surface to 4,000 m.

- The "no observations" option (NOOBS=1) in the beta version of CALMET will be used to extract hourly precipitation and upper air temperature lapse rates from the MM5 data set.

- Local observed wind speed and wind direction will not be used in the preparation of the wind fields. The wind fields used will depend solely on the MM5 winds and the objective procedure applied by CALMET. This will be accomplished be selecting the non-default interpolation options $R1=R2=10^{-6}$.

- The relative humidity data will be extracted from the MM5 simulations (rather than using the nearest observation, generally from lowland areas) by setting IRHPROG=1.

- Surface observations from within the study domain will be used to provide hourly cloud cover and ceiling height data. The source of surface meteorological data will be the ds472.0 dataset used by the METSTAT analysis. Stations selected from the archive are shown in Figure 2 and listed in Table 2. Only those stations with greater than 90% data recovery rates for ceiling height will be used. This criterion eliminates 91 of the 206 available stations.

- Based on advice from the CALPUFF model author,[2,3] we will select ICOARE=10 to use the COARE algorithm for surface fluxes over water. Related options include setting IWARM=ICOOL=0, since MM5's sea surface temperature (SST) is a skin temperature.

- Based on guidance from IDEQ, we will set IMIXH=1 to use the default Maul-Carson scheme rather than the new Batchvarova and Gryning scheme. In addition,

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[2] Joseph Scire, personal communication, 4/14/2006

[3] Joseph Scire et al., 2005. Evaluation of Enhancements to the CALPUFF Model for Offshore and Coastal Applications, *Proceedings of the 10th International Conference on Harmonisation with Atmospheric Dispersion Modelling for Regulatory Purposes. Sissi (Malia), Crete, Greece, 17-20 October 2005.*

the minimum and maximum allowed mixing heights over water will be the same as for over land.

- To take advantage of the new over-water mixing height (and surface flux) schemes, land use category JWAT1=JWAT2=55 will be used. In the absence of an extensive buoy data set, it was previously customary to disable CALMET's schemes for over water by selecting JWAT1=JWAT2=100.

- The datum used for MM5 data by CALMET is "NWS84". The CALMET coordinate system will also be based on this datum so CALMET grid points at 12-km intervals will align with the MM5 grid points.

Two datasets will be produced, with 4 km and 12 km mesh sizes, respectively. The CALMET applications will use the same terrain adjustment procedure options only the mesh sizes and grid definitions will differ. We estimate that three years of the 12 km CALMET files will occupy about 70 gigabytes (GB), and the 4 km CALMET files will occupy about 600 GB.

8. PRECIPITATION CORRECTION

MM5 outputs "accumulated [since the beginning of the MM5 run] precipitation", but CALMET requires hourly (accumulated over an hour) precipitation. Using previous versions of CALMM5 to process multiple UW MM5 simulations into a single CALMM5 data set has sometimes result in spikes in precipitation at 00Z and 12Z. Versions of the CALMM5 program after version 2.0 can make this correction if it encounters more than one hour of MM5 data. We will process a full month of MM5 data in one CALMM5 run, making sure to include enough hours in the beginning of the run to produce a valid precipitation field for even the first hour.

To double-check the precipitation corrections, Geomatrix will plot hourly time series of precipitation and verify that there is no "spike" of rain at 00Z and 12Z.

9. STATISTICAL ANALYSIS

Geomatrix will perform statistical analyses of both the MM5 output and the CALMET output. If possible, both analyses will use the METSTAT software, to facilitate fair comparisons of "before" and "after" CALMET. Bret Anderson (EPA) is developing a version of METSTAT that reads CALMET files. If this version is available before the conclusion of the project, Geomatrix will perform a METSTAT analysis of the CALMET output. If Mr. Anderson's version is not available in time, we will perform a statistical analysis using PRTMET and typical statistical metrics.

The MM5 statistical analysis will closely follow the WRAP analysis[4], and the reader is referred to the cited publication for details. For observational data, METSTAT can read both UCAR's DS472 formatted files and ASCII formatted files. We will use the DS472 data.

The CALMET statistical analysis will use METSTAT for certain features (if available) but will also include the more traditional wind rose plots at several key sites. METSTAT will be useful for evaluating wind speed and direction, temperature, humidity, etc. over the entire domain. By selecting sub-domains and which CALMET files to process, regional and seasonal trends can be investigated. Diurnal trends may require some code alterations to filter the input by hour of the day, but can be accomplished. If the METSTAT program is unavailable, we will perform a more traditional evaluation using the utility PRTMET to extract data from the CALMET files.

[4] *Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States* (March 2005). Available at http://pah.cert.ucr.edu/aqm/308/reports/mm5/DrftFnl_2002MM5_FinalWRAP_Eval.pdf.

TABLES

TABLE 1

NON DEFAULT CALMET OPTIONS
Modeling Protocol BART CALMET Project
Idaho, Oregon and Washington

CALMET Variable	**Selected Value**	**Rationale**
NOOBS	1	Use MM5 upper air data.
NPSTA	-1	Use MM5 precipitation data.
IEXTRP	-1	Since we will use MM5 for upper levels, do not extrapolate observed surface winds aloft. (Note, the similarity profile method (iextrp = -4) also is not applicable in complex terrain.)
RMIN2	-1	Not used, since iextrp=-1 and noobs=1
IPROG	14	Use MM5 as a first guess but allow CALMET to adjust for terrain. Note CALMET terrain for the same mesh size is more resolved than the MM5 terrain, because the later is smoothed to reduce the noise in the numerical solutions.
TERRAD	12	Allow CALMET to adjust winds to local terrain for about 1 MM5 grid point (12 km).
R1 & R2	1.e-6	Do not allow CALMET to use the observed winds. We will use the MM5 solutions and CALMET terrain adjustment procedures. We could also do this with noobs=2, but we do not want the CALMET algorithm for cloud cover.
NSMTH	1, 2, 2, 3, 3, 4, 4, 4, 4, 4	With MM5-based wind fields, it is not necessary to smooth the winds to the extent indicated by the CALMET defaults.
ITWPROG	2	Use MM5 lapse rates and air-sea temperature difference over water.
IRHPROG	1	Use MM5 relative humidity.
ITPROG	2	Use MM5 surface temperature.
SIGMAP	12	A larger default radius of interpolation results in “bull-eyes” of precipitation due to the CALMET weighting scheme applied to the MM5 precipitation predictions. Set the radius to the MM5 mesh size.

TABLE 2

METEOROLOGICAL STATIONS
Modeling Protocol BART CALMET Project
Idaho, Oregon and Washington

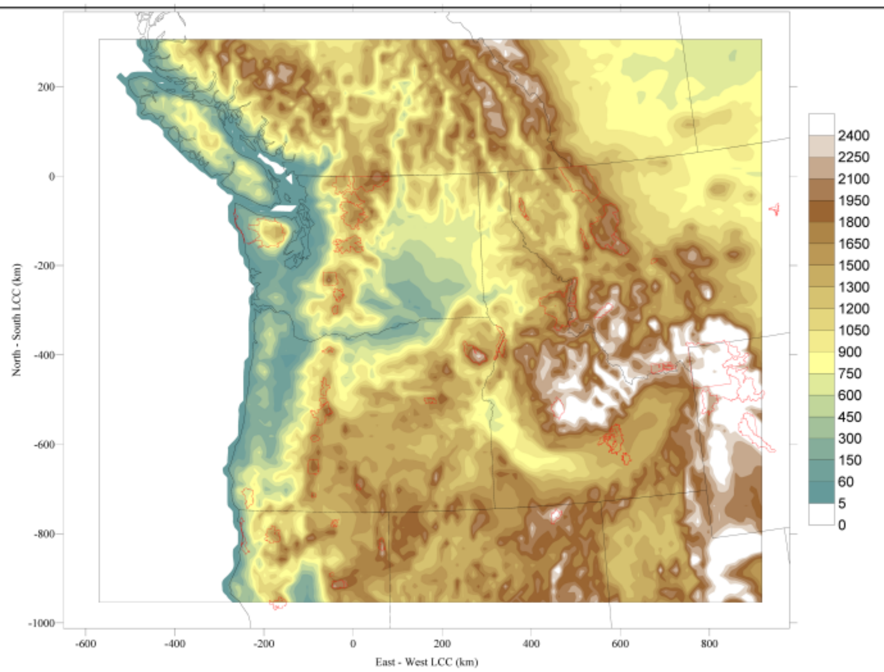
Site	USAF ID[(a)]	X_{LCC} (km)	Y_{LCC} (km)	Lat (°N)	Lon (°W)	Elev (m)	Name
CWCL	714740	-33.918	231.62	51.15	121.5	3468	Clinton (Auto)
CWLY	718910	-40.274	132.855	50.233	121.583	846	Lytton
CYKA	718870	37.462	183.122	50.7	120.45	1135	Kamloops
CYLW	712030	111.874	105.13	49.967	119.383	1411	Kelowna
CYQL	718740	570.498	97.354	49.633	112.8	3048	Lethbridge
CYQQ	718930	-271.392	83.695	49.717	124.9	79	Comox
CYRV	718820	191.16	215.11	50.967	118.183	1453	Revelstoke
CYVR	718920	-153.574	21.788	49.183	123.183	9	Vancouver
CYXC	718800	363.404	78.17	49.617	115.783	3081	Cranbrook
CYXH	718720	709.459	155.009	50.017	110.717	2352	Medicine Hat
CYXX	711080	-96.449	4.384	49.033	122.367	190	Abbotsford
CYYC	718770	472.149	248.529	51.117	114.017	3556	Calgary
CYYF	718890	97.81	51.039	49.467	119.6	1122	Penticton
CYYJ	717990	-172.887	-35.026	48.65	123.433	62	Victoria Intl Ap
CYYN	718700	912.299	214.141	50.283	107.683	2684	Swift Current
CYZT	711090	-434.428	198.47	50.683	127.367	72	Port Hardy
CZPC	718755	489.487	77.029	49.517	113.983	3904	Pincher Creek Arp
KAAT	999999	35.037	-806.628	41.491	120.564	4366	Alturas
KACV	725495	-252.585	-856.977	40.979	124.106	200	Arcata
KALW	999999	202.125	-308.128	46.1	118.283	1207	Walla Walla
KAST	727910	-214.499	-302.33	46.15	123.883	22	Astoria ASOS
KAWO	727945	-83.937	-88.631	48.17	122.17	138	Arlington Muni
KBFI	999999	-94.364	-156.883	47.533	122.3	16	Boeing Field
KBKE	726886	242.819	-441.691	44.843	117.809	3367	Baker
KBLI	999999	-108.675	-20.486	48.8	122.533	159	Bellingham
KBNO	726830	159.432	-579.755	43.583	118.95	4170	Burns ASOS
KBOI	726810	372.045	-572.462	43.567	116.217	2868	Boise
KBPI	726710	860.382	-632.392	42.567	110.1	6969	Big Piney (AMOS)
KBTM	726785	633.019	-292.451	45.965	112.501	5539	Butte
KBYI	725867	572.204	-667.869	42.542	113.766	4156	Burley
KBZN	999999	735.54	-300.255	45.783	111.15	4462	Bozeman ASOS
KCEC	725946	-259.451	-770.072	41.783	124.233	56	Crescent City
KCLM	999999	-179.411	-92.172	48.117	123.5	290	Port Angeles
KCOD	726700	914.052	-413.015	44.517	109.017	5095	Cody (AMOS)
KCOE	999999	301.859	-124.686	47.767	116.817	2158	Coeur Dalene AWOS
KCTB	727796	611.128	-8.312	48.617	112.383	3837	Cutbank
KCVO	999999	-174.945	-480.847	44.5	123.283	241	Corvallis (AWOS)
KDEW	999999	258.087	-104.945	47.97	117.41	2205	Deer_Park
KDLN	999999	637.435	-369.143	45.25	112.55	5240	Dillon
KDLS	726988	-12.957	-363.142	45.619	121.171	235	The Dalles

Site	USAF ID[a]	X_{LCC} (km)	Y_{LCC} (km)	Lat (°N)	Lon (°W)	Elev (m)	Name
KEAT	727825	57.976	-171.913	47.398	120.201	1229	Wenatchee
KEKO	725825	424.565	-864.508	40.826	115.787	5049	Elko Regional Airprt
KELN	999999	35.311	-214.818	47	120.517	1705	Ellensburg/Bowers
KENV	725810	568.031	-863.635	40.733	114.033	4239	Wendover (AUTOB)
KEPH	727826	108.077	-180.833	47.308	119.515	1259	Ephrata
KEUG	726930	-170.985	-522.137	44.117	123.217	373	Eugene ASOS
KEUL	726813	339.553	-567.509	43.63	116.63	2428	Caldwell
KEVW	999999	804.446	-779.878	41.275	111.032	6601	Evanston
KFCA	727790	480.75	-55.044	48.3	114.267	2973	Kalispell ASOS
KFHR	999999	-143.67	-50.173	48.517	123.017	126	Friday Harbor
KGEG	727850	250.792	-141.475	47.633	117.533	2365	Spokane ASOS
KGTF	727750	697.527	-121.003	47.483	111.367	3657	Great Falls ASOS
KHIO	999999	-147.016	-369.017	45.548	122.954	229	Hillsboro/Portland
KHLN	727720	662.505	-220.599	46.6	112	3898	Helena ASOS
KHQM	727923	-214.76	-213.917	46.973	123.93	12	Hoquiam
KHRI	999999	129.999	-339.584	45.826	119.261	646	Hermiston
KHVR	727770	796.66	7.579	48.55	109.767	2599	Havre ASOS
KIDA	999999	694.475	-550.166	43.517	112.067	4744	Idaho Falls
KJAC	999999	796.471	-528.866	43.6	110.733	6444	Jackson
KJER	999999	516.349	-652.638	42.728	114.453	4047	Jerome
KKLS	999999	-141.479	-308.088	46.117	122.9	16	Kelso (AWOS)
KLGU	999999	732.501	-733.406	41.783	111.85	4452	Logan
KLKV	999999	47.747	-733.885	42.167	120.4	4728	Lakeview (AWOS)
KLLJ	727833	518.689	-459.56	44.517	114.217	5072	Challis ASOS
KLMT	999999	-58.563	-735.592	42.15	121.733	4091	Klamath Falls
KLVM	726798	789.408	-302.553	45.698	110.441	4652	Livingston
KLWS	727830	294.823	-273.806	46.383	117.017	1437	Lewiston ASOS
KLWT	726776	840.925	-148.881	47.05	109.467	4144	Lewistown
KMEH	999999	195.533	-372.798	45.5	118.4	3726	Meacham (AMOS)
KMFR	725970	-148.391	-710.826	42.367	122.867	1329	Medford
KMHS	999999	-106.558	-824.655	41.317	122.317	3543	Mt Shasta ASOS
KMLP	999999	386.772	-153.263	47.454	115.67	6000	Mullan Pass Vor.
KMMV	999999	-161.387	-406.453	45.196	123.132	160	Mcminnville
KMSO	727730	506.635	-201.97	46.917	114.083	3189	Missoula
KMWH	999999	122.738	-192.155	47.2	119.317	1188	Moses Lake
KMYL	999999	372.465	-430.781	44.883	116.1	5025	McCall (RAMOS)
KNUW	999999	-117.935	-68.685	48.35	122.65	47	Whidbey Island.NAS
KOGD	999999	726.441	-799.096	41.183	112.017	4456	Ogden
KOLM	727920	-139.314	-216.848	46.967	122.9	200	Olympia
KOMK	727890	105.458	-56.95	48.461	119.519	1301	Omak
KONO	999999	307.459	-527.592	44.017	117.017	2190	Ontario
KONP	999999	-233.295	-469.954	44.583	124.05	161	Newport
KOTH	999999	-253.664	-594.549	43.417	124.25	17	North Bend
KPAE	999999	-92.493	-115.72	47.917	122.283	604	Everett
KPDT	726880	161.157	-354.13	45.683	118.85	1495	Pendleton ASOS
KPDX	726980	-120.265	-364.038	45.6	122.6	39	Portland

Site	USAF ID[a]	X_{LCC} (km)	Y_{LCC} (km)	Lat (°N)	Lon (°W)	Elev (m)	Name
KPIH	725780	659.92	-618.775	42.917	112.6	4478	Pocatello
KPSC	999999	139.686	-292.018	46.267	119.117	404	Pasco
KPUW	999999	285.776	-235.486	46.744	117.114	2551	Pullman-Moscow Rgnl
KPVU	999999	762.646	-899.785	40.217	111.717	4492	Provo
KPWT	999999	-128.323	-161.604	47.483	122.767	482	Bremerton AWOS
KRBG	999999	-185.351	-616.663	43.233	123.367	525	Roseburg ASOS
KRBL	725910	-103.127	-950.438	40.15	122.25	353	Red Bluff ASOS
KRDD	999999	-106.636	-912.642	40.5	122.3	499	Redding
KRDM	999999	-11.622	-508.383	44.267	121.15	3084	Redmond
KRNT	999999	-88.377	-160.554	47.5	122.217	72	Renton
KRXE	999999	710.772	-514.258	43.832	111.806	4858	Rexburg
KSEA	727930	-94.509	-165.829	47.45	122.3	450	Seattle-Tacoma
KSFF	999999	265.091	-137.246	47.667	117.333	1952	Spokane/Felts
KSHN	999999	-156.812	-185.972	47.25	123.15	279	Shelton
KSKA	999999	242.351	-141.834	47.633	117.65	2461	Fairchild Afb
KSLC	725720	735.52	-843.229	40.767	111.967	4227	Salt Lake City
KSLE	726940	-152.137	-436.699	44.917	123	201	Salem ASOS
KSMN	999999	538.403	-393.179	45.117	113.883	3970	Salmon
KSPB	999999	-137.845	-344.331	45.78	122.84	56	Scappoose
KTCM	742060	-108.418	-197.813	47.15	122.483	285	Mcchord Afb
KTIW	999999	-115.473	-185.142	47.267	122.583	292	Tacoma
KTTD	999999	-106.005	-369.556	45.551	122.409	29	Portland/Troutdale
KTWF	999999	516.107	-679	42.483	114.483	4150	Twin Falls
KUAO	726959	-133.863	-401.335	45.25	122.77	197	Aurora State
KUIL	727970	-255.48	-107.22	47.95	124.55	205	Quillayute
KVUO	999999	-123.976	-361.815	45.62	122.65	20	Vancouver (ASOS)
KWMC	725830	260.408	-865.2	40.9	117.8	4314	Winnemuca ASOS
KYKM	727810	34.366	-261.351	46.567	120.533	1066	Yakima
KSIY	725955	-117.765	-774.232	41.783	122.467	2634	Montague/Ssk AWOS

(a) Sites with no USAF ID number are assigned “999999”.

FIGURES

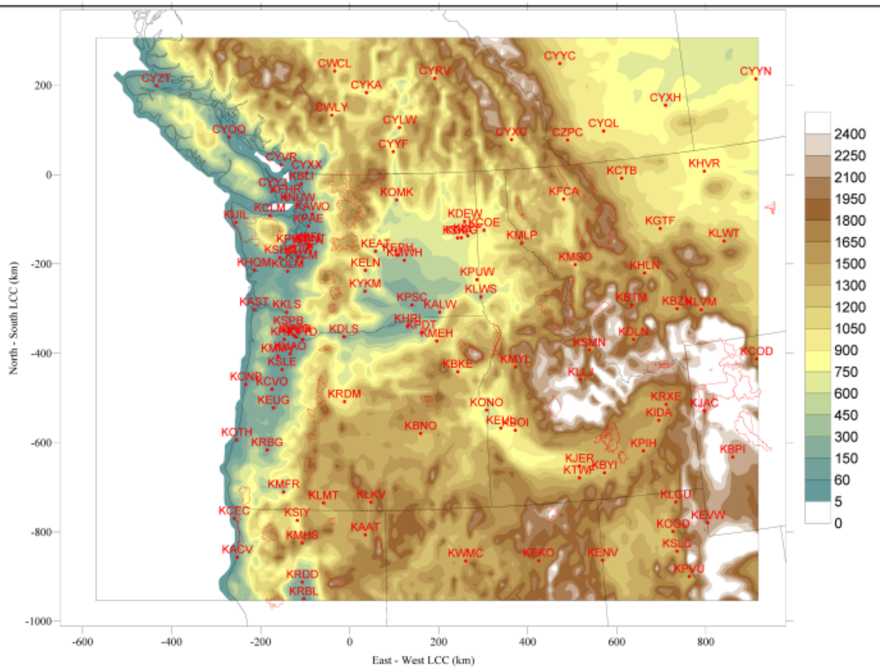


GEOMATRIX

MODELING DOMAIN, WITH 12KM CALMET TERRAIN (M) AND CLASS I AREAS
BART CALMET Dataset Project
Idaho, Oregon and Washington

Proposal No.
012173.000

Figure
1



GEOMATRIX

METEOROLOGICAL STATIONS INCLUDED
BART CALMET Dataset Project
Idaho, Oregon and Washington

Proposal No.
012173.000

Figure
2

Appendix A

SAMPLE CALMM5 OUTPUT "3D.DAT" FILE

```
3D.DAT          2.1             Header Structure with Comment Lines
   1
Produced by CALMM5 Version: 2.6     , Level: 060330
  1  1  1  0  0  1
LCC   49.0000 -121.0000  30.00  60.00  -846.000  -990.000  12.000 151 112 37
  1  4  6  5  2  1  0  0  1  1  1  1  1  1  1  1  1  1  1  1 25
2003010101  768 125 106  31
  24   4 148 109   1  31 -129.5095 -107.3765  39.5357  51.8399
0.9975
0.9925
0.9875
0.9825
0.9750
0.9650
0.9550
0.9450
0.9350
0.9250
0.9150
0.9050
0.8900
0.8700
0.8450
0.8150
0.7850
0.7550
0.7250
0.6950
0.6600
0.6200
0.5800
0.5400
0.5000
0.4600
0.4200
0.3800
0.3400
0.3000
0.2600
  24   4  39.8966 -127.8947    0 16   39.9568 -127.8286    0
  25   4  39.9061 -127.7502    0 16   39.9662 -127.6840    0
  26   4  39.9154 -127.6057    0 16   39.9754 -127.5394    0
  27   4  39.9244 -127.4612    0 16   39.9844 -127.3947    0
  28   4  39.9333 -127.3166    0 16   39.9931 -127.2499    0
  29   4  39.9420 -127.1720    0 16   40.0017 -127.1052    0
  30   4  39.9504 -127.0273    0 16   40.0101 -126.9603    0
  31   4  39.9587 -126.8826    0 16   40.0182 -126.8155    0
...
... (truncated) ...
...
140 109  51.2576 -108.7779  667  2   51.3041 -108.6764  663
 141 109  51.2406 -108.6023  659  2   51.2869 -108.5007  656
 142 109  51.2233 -108.4268  652  2   51.2695 -108.3251  647
 143 109  51.2058 -108.2514  645  2   51.2519 -108.1496  640
 144 109  51.1880 -108.0762  640  2   51.2340 -107.9742  635
 145 109  51.1700 -107.9011  637  5   51.2158 -107.7990  631
```

```
 146 109  51.1518 -107.7261  635  5   51.1974 -107.6239  627
 147 109  51.1333 -107.5512  632  5   51.1788 -107.4489  624
 148 109  51.1146 -107.3765  629  2   51.1600 -107.2740  620
2003010101 24  4 1021.5 0.00 0      0.0   343.2   286.1    6.27   218.7
5.4   2
85.8
1019    18 286.0 219  5.8  0.00 62 5.64-2.000
1015    54 285.7 219  6.1  0.00 61 5.45-2.000
1011    91 285.4 220  6.3  0.00 61 5.34-2.000
1006   128 285.0 220  6.4  0.00 61 5.27-2.000
 999   183 284.5 221  6.6  0.00 62 5.18-2.000
 991   257 283.8 222  6.8  0.00 63 5.11-2.000
 982   331 283.1 223  7.0  0.00 65 5.04-2.000
 973   407 282.4 224  7.1  0.00 67 4.99-2.000
 964   482 281.7 225  7.3  0.00 69 4.95-2.000
 955   559 281.0 226  7.4  0.00 71 4.90-2.000
 946   636 280.3 227  7.6  0.00 73 4.86-2.000
 937   713 279.5 228  7.7  0.00 76 4.82-2.000
 924   831 278.4 230  8.0  0.00 80 4.76-2.000
 906   990 277.0 232  8.5  0.00 85 4.67-2.000
 884  1192 275.3 238  9.3  0.00 89 4.48-2.000
 857  1441 274.5 248  9.9  0.01 68 3.30-2.000
 830  1696 274.1 255 10.5  0.01 45 2.20-2.000
 803  1959 273.7 258 11.2  0.01 30 1.51-2.000
 777  2229 273.0 259 11.7  0.01 24 1.17-2.000
 750  2506 271.9 264 12.3  0.01 24 1.10-2.000
 719  2841 270.2 268 14.6  0.01 37 1.58-2.000
 684  3239 267.5 270 17.7  0.00 84 3.05-2.000
 649  3655 267.5 277 20.7  0.00 95 3.68 0.012 0.013
 613  4091 266.0 281 22.1  0.01 95 3.44 0.012 0.010
 578  4548 263.9 283 23.9  0.00 92 3.01 0.010 0.002
 543  5030 261.3 283 26.0 -0.01 89 2.53-2.000
 508  5540 258.4 283 28.2 -0.02 85 2.04-2.000
 473  6081 254.9 282 29.1 -0.02 81 1.56-2.000
 437  6658 251.1 280 29.3 -0.02 77 1.15-2.000
 402  7276 247.0 278 29.7 -0.02 73 0.82-2.000
 366  7943 242.2 276 30.1 -0.02 70 0.56-2.000
2003010101 25  4 1021.6 0.00 0      0.0   342.9   286.0    6.24   219.7
5.2   2
85.7
1019    18 285.9 220  5.6  0.00 62 5.61-2.000
1015    54 285.6 220  5.9  0.00 61 5.42-2.000
1011    91 285.3 221  6.1  0.00 61 5.31-2.000
1006   128 285.0 222  6.2  0.00 61 5.24-2.000
1000   183 284.5 222  6.4  0.00 62 5.15-2.000
 991   257 283.8 224  6.6  0.00 63 5.08-2.000
 982   331 283.1 225  6.7  0.00 65 5.01-2.000
 973   407 282.4 226  6.8  0.00 67 4.96-2.000
 964   482 281.6 227  7.0  0.00 69 4.91-2.000
 955   559 280.9 228  7.1  0.00 71 4.87-2.000
 946   636 280.2 229  7.3  0.00 73 4.83-2.000
 938   713 279.5 230  7.4  0.00 76 4.79-2.000
 924   831 278.4 231  7.7  0.00 79 4.72-2.000
 906   990 276.9 234  8.1  0.00 84 4.63-2.000
 884  1192 275.2 240  9.0  0.00 89 4.43-2.000
 857  1441 274.4 251  9.6  0.01 68 3.29-2.000
```

```
 830  1696 274.0 257 10.3  0.01 44 2.16-2.000
 804  1959 273.7 260 11.1  0.01 29 1.44-2.000
 777  2229 273.0 261 11.6  0.01 24 1.15-2.000
 750  2506 271.9 266 12.3  0.01 25 1.15-2.000
 719  2841 270.0 269 14.7  0.01 41 1.74-2.000
 684  3239 267.4 271 17.8  0.00 87 3.15 0.001 0.007
 649  3655 267.5 278 20.5  0.00 95 3.67 0.012 0.018
 613  4091 265.9 281 22.0  0.01 95 3.41 0.013 0.014
 578  4548 263.8 283 23.9  0.00 92 2.99 0.011 0.002
 543  5030 261.3 283 25.9 -0.01 89 2.52-2.000
 508  5540 258.4 283 28.0 -0.02 85 2.03-2.000
 473  6081 254.9 283 29.1 -0.02 81 1.56-2.000
 437  6658 251.1 281 29.4 -0.02 76 1.14-2.000
 402  7276 247.0 278 29.7 -0.02 72 0.81-2.000
 366  7943 242.2 277 30.1 -0.01 69 0.55-2.000
... (truncated) ...
```

Appendix B

SAMPLE CALMET INPUT FILE

```
CALMET.INP      2.1            Hour Start and End Times with Seconds
BART CALMET dataset, 373x316x4km mesh, Jan 2003 4km Run
12 km MM5 used for temp, rh, prec and all winds (Note, LCC coord)
ds472.0 surface obs for cloud cover, ceiling height, etc.
---------------- Run title (3 lines) ------------------------------------------

                    CALMET MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names


Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT= geo/geo.4km.dat    !
SURF.DAT      input    ! SRFDAT= sfc/pacnw.2003.sfc !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    * PRCDAT=            *
WT.DAT        input    * WTDAT=             *

CALMET.LST    output   ! METLST= 2003.01.4km.out  !
CALMET.DAT    output   ! METDAT= 2003.01.4km.met  !
PACOUT.DAT    output   * PACDAT=            *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA =  0   !
    Number of overwater met stations
                                 (NOWSTA) No default     ! NOWSTA =  0  !

NUMBER OF PROGNOSTIC and IGF-CALMET FILEs:

    Number of MM4/MM5/3D.DAT files
                                 (NM3D) No default       ! NM3D =  1  !

    Number of IGF-CALMET.DAT files
                                 (NIGF)   No default     ! NIGF =  0  !

                       !END!
--------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  * UPDAT=UP1.DAT*    *END*
UP2.DAT       input     2  * UPDAT=UP2.DAT*    *END*
UP3.DAT       input     3  * UPDAT=UP3.DAT*    *END*
--------------------------------------------------------------------------------
Subgroup (c)
-----------------------------------------
Overwater station files (one per station)
```

```
-----------------------------------------
Default Name  Type       File Name
------------  ----       ---------
SEA1.DAT       input     1  * SEADAT=SEA1.DAT*    *END*
SEA2.DAT       input     2  * SEADAT=SEA2.DAT*    *END*
SEA3.DAT       input     3  * SEADAT=SEA3.DAT*    *END*
-------------------------------------------------------------------------------
Subgroup (d)
------------------------------------------------
MM4/MM5/3D.DAT files (consecutive or overlapping)
------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
MM51.DAT       input   1 ! M3DDAT=/home/mm5/monthly/2003.01.12km.m3d ! !END!
-------------------------------------------------------------------------------
Subgroup (e)
-------------------------------------------------
IGF-CALMET.DAT files (consecutive or overlapping)
-------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
IGFn.DAT       input     1  * IGFDAT=CALMET0.DAT *    *END*
-------------------------------------------------------------------------------
Subgroup (f)
----------------
Other file names
----------------

Default Name  Type       File Name
------------  ----       ---------
DIAG.DAT      input      * DIADAT=                  *
PROG.DAT      input      * PRGDAT=                  *

TEST.PRT      output     * TSTPRT=                  *
TEST.OUT      output     * TSTOUT=                  *
TEST.KIN      output     * TSTKIN=                  *
TEST.FRD      output     * TSTFRD=                  *
TEST.SLP      output     * TSTSLP=                  *
DCST.GRD      output     * DCSTGD=                  *

-------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (f) must have ONE 'END' (surrounded by
           delimiters) at the end of the group
       (3) Subgroups (b) through (e) are included ONLY if the corresponding
           number of files (NUSTA, NOWSTA, NM3D, NIGF) is not 0, and each must have
           an 'END' (surround by delimiters) at the end of EACH LINE

                         !END!


------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:    Year   (IBYR)  --    No default   ! IBYR  =  2003 !
                       Month  (IBMO)  --    No default   ! IBMO  =  01 !
                       Day    (IBDY)  --    No default   ! IBDY  =  1  !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR  =  0  !
                       Second (IBSEC) --    No default   ! IBSEC =  0  !
```

```
     Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  2003 !
                       Month  (IEMO)  --    No default   ! IEMO  =  02 !
                       Day    (IEDY)  --    No default   ! IEDY  =  1  !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR  =  0  !
                       Second (IESEC) --    No default   ! IESEC =  0  !

      UTC time zone         (ABTZ) -- No default      ! ABTZ = UTC-0800 !
         (character 8)
         PST = UTC-0800, MST = UTC-0700 , GMT = UTC-0000
         CST = UTC-0600, EST = UTC-0500

     Length of modeling time-step (seconds)
     Must divide evenly into 3600 (1 hour)
     (NSECDT)                         Default:3600     ! NSECDT =  3600  !
                                      Units: seconds

     Run type           (IRTYPE) -- Default: 1       ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular           Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)

      Flag to stop run after
      SETUP phase (ITEST)            Default: 2       ! ITEST=  2   !
      (Used to allow checking
      of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of
                  COMPUTATIONAL phase after SETUP

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                    Default: UTM    ! PMAP = LCC  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                   Default=0.0     ! FEAST  = 0.000  !
     (FNORTH)                  Default=0.0     ! FNORTH = 0.000  !
```

```
UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                   No Default      ! IUTMZN =  10 !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                   Default: N      ! UTMHEM = N  !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                    No Default      ! RLAT0 =  49.0N !
(RLON0)                    No Default      ! RLON0 = 121.0W !

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1)                    No Default      ! XLAT1 = 30.0N !
(XLAT2)                    No Default      ! XLAT2 = 60.0N !

    LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
    PS  :  Projection plane slices through Earth at XLAT1
           (XLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E


Datum-region
------------

The Datum-Region for the coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-84).  Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters is provided by the National Imagery and
Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84    NWS 6370KM Radius, Sphere
ESR-S     ESRI REFERENCE 6371KM Radius, Sphere
```

```
     Datum-region for output coordinates
     (DATUM)                    Default: WGS-G     ! DATUM = NWS-84  !
                                                *** Same as UW MM5 ***


     Horizontal grid definition:
     ---------------------------

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =   373  !
            No. Y grid cells (NY)      No default     ! NY =   316  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 4. !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = -572. !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = -956. !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ = 10 !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE =0.,20.,40.,65.,120.,200.,400.,700.,1200.,2200.,4000. !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options
--------------


    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?            (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                          Default: 1    ! IFORMO =  1  !

            1 = CALPUFF/CALGRID type file (CALMET.DAT)
            2 = MESOPUFF-II type file     (PACOUT.DAT)


    LINE PRINTER OUTPUT OPTIONS:

       Print met. fields ?  (LPRINT)       Default: F     ! LPRINT = F !
       (F = Do not print, T = Print)
```

```
(NOTE: parameters below control which
       met. variables are printed)

Print interval
(IPRINF) in hours                   Default: 1     ! IPRINF = 12  !
(Meteorological fields are printed
 every  1  hours)


Specify which layers of U, V wind component
to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T)        Defaults: NZ*0
! IUVOUT =  1 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
-----------------------


Specify which levels of the W wind component to print
(NOTE: W defined at TOP cell face --  6  values)
(IWOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! IWOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !


Specify which levels of the 3-D temperature field to print
(ITOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! ITOUT =  1 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

Specify which meteorological fields
to print
(used only if LPRINT=T)             Defaults: 0 (all variables)
-----------------------


  Variable            Print ?
                 (0 = do not print,
                  1 = print)
  --------       ------------------

!  STABILITY  =          1           ! - PGT stability class
!  USTAR      =          0           ! - Friction velocity
!  MONIN      =          0           ! - Monin-Obukhov length
!  MIXHT      =          1           ! - Mixing height
!  WSTAR      =          0           ! - Convective velocity scale
!  PRECIP     =          1           ! - Precipitation rate
!  SENSHEAT   =          0           ! - Sensible heat flux
!  CONVZI     =          0           ! - Convective mixing ht.


Testing and debug print options for micrometeorological module

   Print input meteorological data and
   internal variables (LDB)         Default: F       ! LDB = F !
   (F = Do not print, T = print)
   (NOTE: this option produces large amounts of output)
```

```
     First time step for which debug data
     are printed (NN1)               Default: 1       ! NN1 =  1  !

     Last time step for which debug data
     are printed (NN2)               Default: 1       ! NN2 =  1  !

     Print distance to land
     internal variables (LDBCST)     Default: F       ! LDBCST = F !
     (F = Do not print, T = print)
     (Output in .GRD file DCST.GRD, defined in input group 0)

  Testing and debug print options for wind field module
  (all of the following print options control output to
   wind field module's output files: TEST.PRT, TEST.OUT,
   TEST.KIN, TEST.FRD, and TEST.SLP)

     Control variable for writing the test/debug
     wind fields to disk files (IOUTD)
     (0=Do not write, 1=write)       Default: 0       ! IOUTD =  0  !

     Number of levels, starting at the surface,
     to print (NZPRN2)               Default: 1       ! NZPRN2 =  1  !

     Print the INTERPOLATED wind components ?
     (IPR0) (0=no, 1=yes)            Default: 0       !  IPR0 =  0  !

     Print the TERRAIN ADJUSTED surface wind
     components ?
     (IPR1) (0=no, 1=yes)            Default: 0       !  IPR1 =  0  !

     Print the SMOOTHED wind components and
     the INITIAL DIVERGENCE fields ?
     (IPR2) (0=no, 1=yes)            Default: 0       !  IPR2 =  0  !

     Print the FINAL wind speed and direction
     fields ?
     (IPR3) (0=no, 1=yes)            Default: 0       !  IPR3 =  0  !

     Print the FINAL DIVERGENCE fields ?
     (IPR4) (0=no, 1=yes)            Default: 0       !  IPR4 =  0  !

     Print the winds after KINEMATIC effects
     are added ?
     (IPR5) (0=no, 1=yes)            Default: 0       !  IPR5 =  0  !

     Print the winds after the FROUDE NUMBER
     adjustment is made ?
     (IPR6) (0=no, 1=yes)            Default: 0       !  IPR6 =  0  !

     Print the winds after SLOPE FLOWS
     are added ?
     (IPR7) (0=no, 1=yes)            Default: 0       !  IPR7 =  0  !

     Print the FINAL wind field components ?
     (IPR8) (0=no, 1=yes)            Default: 0       !  IPR8 =  0  !

!END!

-------------------------------------------------------------------------------
```

```
INPUT GROUP: 4 -- Meteorological data options
--------------

    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS =  1   !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM4/MM5/3D for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM4/MM5/3D for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA = 115  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5/3D precip data)
                                    (NPSTA)  No default     ! NPSTA = -1  !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
                                   (ICLOUD)  Default: 0     ! ICLOUD =  0  !
       ICLOUD = 0 - Gridded clouds not used
       ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
       ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
       ICLOUD = 3 - Gridded cloud cover computed from prognostic fields

    FILE FORMATS

       Surface meteorological data file format
                                   (IFORMS)  Default: 2     ! IFORMS =  2  !
       (1 = unformatted (e.g., SMERGE output))
       (2 = formatted   (free-formatted user input))

       Precipitation data file format
                                   (IFORMP)  Default: 2     ! IFORMP =  2  !
       (1 = unformatted (e.g., PMERGE output))
       (2 = formatted   (free-formatted user input))

       Cloud data file format
                                   (IFORMC)  Default: 2     ! IFORMC =  2  !
       (1 = unformatted - CALMET unformatted output)
       (2 = formatted   - free-formatted CALMET output or user input)

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


    WIND FIELD MODEL OPTIONS
       Model selection variable (IWFCOD)     Default: 1      ! IWFCOD =  1  !
          0 = Objective analysis only
          1 = Diagnostic wind module

       Compute Froude number adjustment
       effects ? (IFRADJ)                    Default: 1      ! IFRADJ =  1  !
       (0 = NO, 1 = YES)

       Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE  =  0  !
```

```
(0 = NO, 1 = YES)

Use O'Brien procedure for adjustment
of the vertical velocity ? (IOBR)     Default: 0      ! IOBR =  0  !
(0 = NO, 1 = YES)

Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE  =  1  !
(0 = NO, 1 = YES)

Extrapolate surface wind observations
to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = -1  !
(1 = no extrapolation is done,
 2 = power law extrapolation used,
 3 = user input multiplicative factors
     for layers 2 - NZ used (see FEXTRP array)
 4 = similarity theory used
 -1, -2, -3, -4 = same as above except layer 1 data
     at upper air stations are ignored

Extrapolate surface winds even
if calm? (ICALM)                      Default: 0      ! ICALM  =  0  !
(0 = NO, 1 = YES)

Layer-dependent biases modifying the weights of
surface and upper air stations (BIAS(NZ))
  -1<=BIAS<=1
Negative BIAS reduces the weight of upper air stations
  (e.g. BIAS=-0.1 reduces the weight of upper air stations
by 10%; BIAS= -1, reduces their weight by 100 %)
Positive BIAS reduces the weight of surface stations
  (e.g. BIAS= 0.2 reduces the weight of surface stations
by 20%; BIAS=1 reduces their weight by 100%)
Zero BIAS leaves weights unchanged (1/R**2 interpolation)
Default: NZ*0
         ! BIAS =  -1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1  !
*** If you leave BIAS(1..NZ) = 0, you get a warning. ***

Minimum distance from nearest upper air station
to surface station for which extrapolation
of surface winds at surface station will be allowed
(RMIN2: Set to -1 for IEXTRP = 4 or other situations
 where all surface stations should be extrapolated)
                                      Default: 4.     ! RMIN2 = -1.0 !

Use gridded prognostic wind field model
output fields as input to the diagnostic
wind field model (IPROG)              Default: 0      ! IPROG =  14  !
(0 = No, [IWFCOD = 0 or 1]
 1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
 2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
 3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
 4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
 5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
 13 = Yes, use winds from MM5/3D.DAT file as Step 1 field [IWFCOD = 0]
 14 = Yes, use winds from MM5/3D.DAT file as initial guess field [IWFCOD = 1]
 15 = Yes, use winds from MM5/3D.DAT file as observations [IWFCOD = 1]

Timestep (hours) of the prognostic
model input data   (ISTEPPG)          Default: 1      ! ISTEPPG =  1   !

Use coarse CALMET fields as initial guess fields (IGFMET)
(overwrites IGF based on prognostic wind fields if any)
```

```
                                        Default: 0      ! IGFMET =  0  !

RADIUS OF INFLUENCE PARAMETERS

   Use varying radius of influence      Default: F      ! LVARY =  F !
   (if no stations are found within RMAX1,RMAX2,
    or RMAX3, then the closest station will be used)

   Maximum radius of influence over land
   in the surface layer (RMAX1)         No default      ! RMAX1 = 200. !
                                        Units: km
   Maximum radius of influence over land
   aloft (RMAX2)                        No default      ! RMAX2 = 200. !
                                        Units: km
   Maximum radius of influence over water
   (RMAX3)                              No default      ! RMAX3 = 200. !
                                        Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)  Default: 0.1    ! RMIN = 0.1 !
                                        Units: km
   Radius of influence of terrain
   features (TERRAD)                    No default      ! TERRAD = 12. !
                                                    *** MM5 grid mesh **

                                        Units: km
   Relative weighting of the first
   guess field and observations in the
   SURFACE layer (R1)                   No default      ! R1 = 1.00E-6 !
   (R1 is the distance from an          Units: km
   observational station at which the
   observation and first guess field are
   equally weighted)

   Relative weighting of the first
   guess field and observations in the
   layers ALOFT (R2)                    No default      ! R2 = 1.00E-6 !
   (R2 is applied in the upper layers   Units: km
   in the same manner as R1 is used in
   the surface layer).

   Relative weighting parameter of the
   prognostic wind field data (RPROG)   No default      ! RPROG = 0. !
   (Used only if IPROG = 1)             Units: km
   ------------------------

   Maximum acceptable divergence in the
   divergence minimization procedure
   (DIVLIM)                             Default: 5.E-6  ! DIVLIM= 5.0E-06 !

   Maximum number of iterations in the
   divergence min. procedure (NITER)    Default: 50     ! NITER =  50  !

   Number of passes in the smoothing
   procedure (NSMTH(NZ))
   NOTE: NZ values must be entered
        Default: 2,(mxnz-1)*4

   ! NSMTH =  1 ,  2 ,  2 ,  3 ,  3 ,  4 ,  4 ,  4 ,  4 ,  4  !
```

```
   Maximum number of stations used in
   each layer for the interpolation of
   data to a grid point (NINTR2(NZ))
   NOTE: NZ values must be entered       Default: 99.

   ! NINTR2 =  99,  99,  99,  99,  99,  99,  99,  99,  99,  99  !

   Critical Froude number (CRITFN)       Default: 1.0    ! CRITFN = 1. !

   Empirical factor controlling the
   influence of kinematic effects
   (ALPHA)                               Default: 0.1    ! ALPHA = 0.1 !

   Multiplicative scaling factor for
   extrapolation of surface observations
   to upper layers (FEXTR2(NZ))          Default: NZ*0.0
   ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0., 0. !
   (Used only if IEXTRP = 3 or -3)


BARRIER INFORMATION

   Number of barriers to interpolation
   of the wind fields (NBAR)             Default: 0      ! NBAR =  0  !

   Level (1 to NZ) up to which barriers
   apply (KBAR)                          Default: NZ     ! KBAR =  10  !

   THE FOLLOWING 4 VARIABLES ARE INCLUDED
   ONLY IF NBAR > 0
   NOTE: NBAR values must be entered     No defaults
         for each variable               Units: km

      X coordinate of BEGINNING
      of each barrier (XBBAR(NBAR))      ! XBBAR = 0. !
      Y coordinate of BEGINNING
      of each barrier (YBBAR(NBAR))      ! YBBAR = 0. !

      X coordinate of ENDING
      of each barrier (XEBAR(NBAR))      ! XEBAR = 0. !
      Y coordinate of ENDING
      of each barrier (YEBAR(NBAR))      ! YEBAR = 0. !


DIAGNOSTIC MODULE DATA INPUT OPTIONS

   Surface temperature (IDIOPT1)         Default: 0      ! IDIOPT1 =  0  !
      0 = Compute internally from
          hourly surface observations
      1 = Read preprocessed values from
          a data file (DIAG.DAT)

      Surface met. station to use for
      the surface temperature (ISURFT)   No default     ! ISURFT =  98 !
      (Must be a value from 1 to NSSTA)
      (Used only if IDIOPT1 = 0)
      --------------------------

   Domain-averaged temperature lapse
   rate (IDIOPT2)                        Default: 0     ! IDIOPT2 =  0  !
      0 = Compute internally from
```

```
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       from a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale lapse rate (IUPT) No default     ! IUPT   =  1  !
   (Must be a value from 1 to NUSTA)
   (Used only if IDIOPT2 = 0)
   --------------------------

   Depth through which the domain-scale
   lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
   (Used only if IDIOPT2 = 0)         Units: meters
   --------------------------

Domain-averaged wind components
(IDIOPT3)                             Default: 0     ! IDIOPT3 =  0  !
   0 = Compute internally from
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale winds (IUPWND)    Default: -1    ! IUPWND = -1  !
   (Must be a value from -1 to NUSTA)
   (Used only if IDIOPT3 = 0)
   --------------------------

   Bottom and top of layer through
   which the domain-scale winds
   are computed
   (ZUPWND(1), ZUPWND(2))        Defaults: 1., 1000. ! ZUPWND= 1., 1000. !
   (Used only if IDIOPT3 = 0)    Units: meters
   --------------------------

Observed surface wind components
for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 =  0  !
   0 = Read WS, WD from a surface
       data file (SURF.DAT)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

Observed upper air wind components
for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 =  0  !
   0 = Read WS, WD from an upper
       air data file (UP1.DAT, UP2.DAT, etc.)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

LAKE BREEZE INFORMATION

   Use Lake Breeze Module  (LLBREZE)
                                    Default: F      ! LLBREZE = F !

    Number of lake breeze regions (NBOX)            ! NBOX =  0  !

 X Grid line 1 defining the region of interest
                                                 ! XG1 = 0. !
 X Grid line 2 defining the region of interest
                                                 ! XG2 = 0. !
 Y Grid line 1 defining the region of interest
                                                 ! YG1 = 0. !
```

```
       Y Grid line 2 defining the region of interest
                                                  ! YG2 = 0. !

        X Point defining the coastline (Straight line)
                  (XBCST)  (KM)   Default: none    ! XBCST = 0. !

        Y Point defining the coastline (Straight line)
                  (YBCST)  (KM)   Default: none    ! YBCST = 0. !

        X Point defining the coastline (Straight line)
                  (XECST)  (KM)   Default: none    ! XECST = 0. !

        Y Point defining the coastline (Straight line)
                  (YECST)  (KM)   Default: none    ! YECST = 0. !


      Number of stations in the region     Default: none ! NLB =  0 !
      (Surface stations + upper air stations)

      Station ID's  in the region   (METBXID(NLB))
      (Surface stations first, then upper air stations)
        ! METBXID =  0 !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                           Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                           Default: 0.15   ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                           Default: 2400.  ! CONSTN = 2400.!
       Overwater mixing ht. equation
       (CONSTW)                           Default: 0.16   ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                Default: 1.E-4  ! FCORIOL = 1.0E-04!
                                          Units: (1/s)

    SPATIAL AVERAGING OF MIXING HEIGHTS

       Conduct spatial averaging
       (IAVEZI)  (0=no, 1=yes)            Default: 1      ! IAVEZI =  1  !

       Max. search radius in averaging
       process (MNMDAV)                   Default: 1      ! MNMDAV =  1  !
                                          Units: Grid
                                                 cells
       Half-angle of upwind looking cone
       for averaging (HAFANG)             Default: 30.    ! HAFANG = 30. !
                                          Units: deg.
       Layer of winds used in upwind
       averaging (ILEVZI)                 Default: 1      ! ILEVZI =  1  !
       (must be between 1 and NZ)
```

```
CONVECTIVE MIXING HEIGHT OPTIONS:
   Method to compute the convective
   mixing height(IMIHXH)              Default: 1      ! IMIXH =  1  !
       1: Maul-Carson for land and water cells
      -1: Maul-Carson for land cells only -
          OCD mixing height overwater
       2: Batchvarova and Gryning for land and water cells
      -2: Batchvarova and Gryning for land cells only
          OCD mixing height overwater

   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overland (THRESHL)                 Default: 0.05   ! THRESHL = 0.05 !
   (expressed as a heat flux          units: W/m3
    per meter of boundary layer)


   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overwater (THRESHW)                Default: 0.05   ! THRESHW = 0.05 !
   (expressed as a heat flux          units: W/m3
    per meter of boundary layer)


   Option for overwater lapse rates used
   in convective mixing height growth
   (ITWPROG)                          Default: 0      ! ITWPROG =  2  !
   0 : use SEA.DAT lapse rates and deltaT (or assume neutral
       conditions if missing)
   1 : use prognostic lapse rates (only if IPROG>2)
       and SEA.DAT deltaT (or neutral if missing)
   2 : use prognostic lapse rates and prognostic delta T
       (only if iprog>12 and 3D.DAT version# 2.0 or higher)

   Land Use category ocean in 3D.DAT datasets
   (ILUOC3D)                          Default: 16     ! ILUOC3D =  16  !
   Note: if 3D.DAT from MM5 version 3.0, iluoc3d = 16
         if MM4.DAT,           typically iluoc3d = 7


OTHER MIXING HEIGHT VARIABLES

   Minimum potential temperature lapse
   rate in the stable layer above the
   current convective mixing ht.      Default: 0.001  ! DPTMIN = 0.001 !
   (DPTMIN)                           Units: deg. K/m
   Depth of layer above current conv.
   mixing height through which lapse  Default: 200.   ! DZZI = 200.   !
   rate is computed (DZZI)            Units: meters

   Minimum overland mixing height     Default:  50.   ! ZIMIN = 50.   !
   (ZIMIN)                            Units: meters
   Maximum overland mixing height     Default: 3000.  ! ZIMAX = 3000. !
   (ZIMAX)                            Units: meters
   Minimum overwater mixing height    Default:  50.   ! ZIMINW = 50.  !
   (ZIMINW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height    Default: 3000.  ! ZIMAXW = 3000.!
   (ZIMAXW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)
```

```
OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                        Default: 10      ! ICOARE =  10   !
       0: original deltaT method (OCD)
      10: COARE with no wave parameterization (jwave=0, Charnock)
      11: COARE with wave option jwave=1 (Oost et al.)
          and default wave properties
     -11: COARE with wave option jwave=1 (Oost et al.)
          and observed wave properties (must be in SEA.DAT files)
      12: COARE with wave option 2 (Taylor and Yelland)
           and default wave properties
     -12: COARE with wave option 2 (Taylor and Yelland)
          and observed wave properties (must be in SEA.DAT files)

      Coastal/Shallow water length scale (DSHELF)
      (for modified z0 in shallow water)
      ( COARE fluxes only)
                                   Default : 0.        ! DSHELF = 0. !
                                   units: km

       COARE warm layer computation (IWARM)            ! IWARM =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)              Default: 0

       COARE cool skin layer computation (ICOOL)       ! ICOOL =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)              Default: 0

RELATIVE HUMIDITY PARAMETERS

   3D relative humidity from observations or
   from prognostic data? (IRHPROG)      Default:0       ! IRHPROG =  1 !

      0 = Use RH from SURF.DAT file
          (only if NOOBS = 0,1)
      1 = Use prognostic RH
          (only if NOOBS = 0,1,2)

TEMPERATURE PARAMETERS

   3D temperature from observations or
   from prognostic data? (ITPROG)       Default:0       ! ITPROG =  2  !

      0 = Use Surface and upper air stations
          (only if NOOBS = 0)
      1 = Use Surface stations (no upper air observations)
          Use MM5/3D for upper air data
          (only if NOOBS = 0,1)
      2 = No surface or upper air observations
          Use MM5/3D for surface and upper air data
          (only if NOOBS = 0,1,2)

   Interpolation type
   (1 = 1/R ; 2 = 1/R**2)               Default:1        ! IRAD =  1  !

   Radius of influence for temperature
   interpolation (TRADKM)               Default: 500.    ! TRADKM = 500. !
                                        Units: km

   Maximum Number of stations to include
   in temperature interpolation (NUMTS) Default: 5       ! NUMTS = 10  !

   Conduct spatial averaging of temp-
```

```
       eratures (IAVET)  (0=no, 1=yes)       Default: 1        ! IAVET =  1  !
       (will use mixing ht MNMDAV,HAFANG
        so make sure they are correct)

       Default temperature gradient          Default: -.0098   ! TGDEFB = -0.0098 !
       below the mixing height over          Units: K/m
       water (TGDEFB)

       Default temperature gradient          Default: -.0045   ! TGDEFA = -0.0045 !
       above the mixing height over          Units: K/m
       water (TGDEFA)

       Beginning (JWAT1) and ending (JWAT2)
       land use categories for temperature                    ! JWAT1 =  55  !
       interpolation over water -- Make                       ! JWAT2 =  55  !
       bigger than largest land use to disable

   PRECIP INTERPOLATION PARAMETERS

       Method of interpolation (NFLAGP)      Default: 2       ! NFLAGP =  2  !
        (1=1/R,2=1/R**2,3=EXP/R**2)
       Radius of Influence  (SIGMAP)         Default: 100.0   ! SIGMAP = 12. !
        (0.0 => use half dist. btwn          Units: km   *** MM5 grid mesh ***
         nearest stns w & w/out
         precip when NFLAGP = 3)
       Minimum Precip. Rate Cutoff (CUTP)    Default: 0.01    ! CUTP = 0.01 !
        (values < CUTP = 0.0 mm/hr)          Units: mm/hr
!END!


-------------------------------------------------------------------------------

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  NSSTA  records in all)


             1     2
         Name   ID           X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ----------------------------------------------------------
! SS1  ='CWCL'  714740     -33.918     231.620  8 10.0 !
! SS2  ='CWLY'  718910     -40.254     132.822  8 10.0 !
! SS3  ='CYKA'  718870      37.462     183.122  8 10.0 !
! SS4  ='CYLW'  712030     111.894     105.162  8 10.0 !
! SS5  ='CYQL'  718740     570.501      97.322  7 10.0 !
! SS6  ='CYQQ'  718930    -271.390      83.727  8 10.0 !
! SS7  ='CYRV'  718820     191.179     215.143  8 10.0 !
! SS8  ='CYVR'  718920    -153.554      21.755  8 10.0 !
! SS9  ='CYXC'  718800     363.423      78.204  8 10.0 !
! SS10 ='CYXH'  718720     709.434     155.038  7 10.0 !
! SS11 ='CYXX'  711080     -96.471       4.353  8 10.0 !
! SS12 ='CYYC'  718770     472.126     248.559  7 10.0 !
! SS13 ='CYYF'  718890      97.809      51.071  8 10.0 !
! SS14 ='CYYJ'  717990    -172.866     -35.027  8 10.0 !
! SS15 ='CYYN'  718700     912.324     214.112  6 10.0 !
! SS16 ='CYZT'  711090    -434.451     198.439  8 10.0 !
! SS17 ='CZPC'  718755     489.505      77.062  7 10.0 !
! SS18 ='KAAT'  999999      35.069    -806.671  8 10.0 !
! SS19 ='KACV'  725495    -252.603    -856.997  8 10.0 !
```

```
! SS20 ='KALW'  999999     202.148    -308.127  8 10.0 !
! SS21 ='KAST'  727910    -214.477    -302.331  8 10.0 !
! SS22 ='KAWO'  727945     -83.937     -88.631  8 10.0 !
! SS23 ='KBFI'  999999     -94.365    -156.915  8 10.0 !
! SS24 ='KBKE'  726886     242.788    -441.671  8 10.0 !
! SS25 ='KBLI'  999999    -108.653     -20.486  8 10.0 !
! SS26 ='KBNO'  726830     159.432    -579.787  8 10.0 !
! SS27 ='KBOI'  726810     372.019    -572.431  7 10.0 !
! SS28 ='KBPI'  726710     860.378    -632.360  7 10.0 !
! SS29 ='KBTM'  726785     632.986    -292.422  7 10.0 !
! SS30 ='KBYI'  725867     572.209    -667.836  7 10.0 !
! SS31 ='KBZN'  999999     735.544    -300.287  7 10.0 !
! SS32 ='KCEC'  725946    -259.428    -770.105  8 10.0 !
! SS33 ='KCLM'  999999    -179.410     -92.139  8 10.0 !
! SS34 ='KCOD'  726700     914.025    -412.987  7 10.0 !
! SS35 ='KCOE'  999999     301.836    -124.656  8 10.0 !
! SS36 ='KCTB'  727796     611.146      -8.278  7 10.0 !
! SS37 ='KCVO'  999999    -174.922    -480.848  8 10.0 !
! SS38 ='KDEW'  999999     258.087    -104.945  8 10.0 !
! SS39 ='KDLN'  999999     637.435    -369.143  7 10.0 !
! SS40 ='KDLS'  726988     -12.926    -363.185  8 10.0 !
! SS41 ='KEAT'  727825      58.006    -171.891  8 10.0 !
! SS42 ='KEKO'  725825     424.608    -864.548  8 10.0 !
! SS43 ='KELN'  999999      35.289    -214.818  8 10.0 !
! SS44 ='KENV'  725810     568.059    -863.665  7 10.0 !
! SS45 ='KEPH'  727826     108.056    -180.845  8 10.0 !
! SS46 ='KEUG'  726930    -171.008    -522.104  8 10.0 !
! SS47 ='KEUL'  726813     339.553    -567.509  7 10.0 !
! SS48 ='KEVW'  999999     804.462    -779.876  7 10.0 !
! SS49 ='KFCA'  727790     480.729     -55.045  7 10.0 !
! SS50 ='KFHR'  999999    -143.690     -50.141  8 10.0 !
! SS51 ='KGEG'  727850     250.815    -141.506  8 10.0 !
! SS52 ='KGTF'  727750     697.509    -121.037  7 10.0 !
! SS53 ='KHIO'  999999    -146.987    -369.028  8 10.0 !
! SS54 ='KHLN'  727720     662.505    -220.599  7 10.0 !
! SS55 ='KHQM'  727923    -214.737    -213.896  8 10.0 !
! SS56 ='KHRI'  999999     130.006    -339.562  8 10.0 !
! SS57 ='KHVR'  727770     796.639       7.576  7 10.0 !
! SS58 ='KIDA'  999999     694.449    -550.137  7 10.0 !
! SS59 ='KJAC'  999999     796.494    -528.863  7 10.0 !
! SS60 ='KJER'  999999     516.353    -652.584  7 10.0 !
! SS61 ='KKLS'  999999    -141.478    -308.056  8 10.0 !
! SS62 ='KLGU'  999999     732.505    -733.438  7 10.0 !
! SS63 ='KLKV'  999999      47.747    -733.852  8 10.0 !
! SS64 ='KLLJ'  727833     518.664    -459.530  7 10.0 !
! SS65 ='KLMT'  999999     -58.539    -735.592  8 10.0 !
! SS66 ='KLVM'  726798     789.397    -302.586  7 10.0 !
! SS67 ='KLWS'  727830     294.803    -273.839  8 10.0 !
! SS68 ='KLWT'  726776     840.903    -148.884  7 10.0 !
! SS69 ='KMEH'  999999     195.533    -372.798  8 10.0 !
! SS70 ='KMFR'  725970    -148.414    -710.793  8 10.0 !
! SS71 ='KMHS'  999999    -106.581    -824.622  8 10.0 !
! SS72 ='KMLP'  999999     386.752    -153.286  8 10.0 !
! SS73 ='KMMV'  999999    -161.372    -406.464  8 10.0 !
! SS74 ='KMSO'  727730     506.654    -201.936  7 10.0 !
! SS75 ='KMWH'  999999     122.716    -192.156  8 10.0 !
! SS76 ='KMYL'  999999     372.467    -430.814  7 10.0 !
! SS77 ='KNUW'  999999    -117.935     -68.685  8 10.0 !
! SS78 ='KOGD'  999999     726.421    -799.131  7 10.0 !
! SS79 ='KOLM'  727920    -139.313    -216.816  8 10.0 !
! SS80 ='KOMK'  727890     105.473     -56.993  8 10.0 !
! SS81 ='KONO'  999999     307.434    -527.561  7 10.0 !
```

```
! SS82 ='KONP'  999999    -233.296    -469.986  8 10.0 !
! SS83 ='KOTH'  999999    -253.662    -594.516  8 10.0 !
! SS84 ='KPAE'  999999     -92.470    -115.688  8 10.0 !
! SS85 ='KPDT'  726880     161.158    -354.163  8 10.0 !
! SS86 ='KPDX'  726980    -120.265    -364.038  8 10.0 !
! SS87 ='KPIH'  725780     659.917    -618.742  7 10.0 !
! SS88 ='KPSC'  999999     139.663    -291.986  8 10.0 !
! SS89 ='KPUW'  999999     285.747    -235.477  8 10.0 !
! SS90 ='KPVU'  999999     762.617    -899.756  7 10.0 !
! SS91 ='KPWT'  999999    -128.346    -161.636  8 10.0 !
! SS92 ='KRBG'  999999    -185.376    -616.694  8 10.0 !
! SS93 ='KRBL'  725910    -103.127    -950.438  8 10.0 !
! SS94 ='KRDD'  999999    -106.636    -912.642  8 10.0 !
! SS95 ='KRDM'  999999     -11.622    -508.351  8 10.0 !
! SS96 ='KRNT'  999999     -88.400    -160.554  8 10.0 !
! SS97 ='KRXE'  999999     710.776    -514.224  7 10.0 !
! SS98 ='KSEA'  727930     -94.509    -165.829  8 10.0 !
! SS99 ='KSFF'  999999     265.111    -137.213  8 10.0 !
! SS100='KSHN'  999999    -156.812    -185.972  8 10.0 !
! SS101='KSKA'  999999     242.353    -141.866  8 10.0 !
! SS102='KSLC'  725720     735.491    -843.200  7 10.0 !
! SS103='KSLE'  726940    -152.136    -436.667  8 10.0 !
! SS104='KSMN'  999999     538.423    -393.145  7 10.0 !
! SS105='KSPB'  999999    -137.845    -344.331  8 10.0 !
! SS106='KTCM'  742060    -108.396    -197.813  8 10.0 !
! SS107='KTIW'  999999    -115.450    -185.111  8 10.0 !
! SS108='KTTD'  999999    -106.013    -369.567  8 10.0 !
! SS109='KTWF'  999999     516.133    -679.030  7 10.0 !
! SS110='KUAO'  726959    -133.863    -401.335  8 10.0 !
! SS111='KUIL'  727970    -255.480    -107.220  8 10.0 !
! SS112='KVUO'  999999    -123.976    -361.815  8 10.0 !
! SS113='KWMC'  725830     260.408    -865.200  8 10.0 !
! SS114='KYKM'  727810      34.388    -261.319  8 10.0 !
! SS115='KSIY'  725955    -117.790    -774.263  8 10.0 !
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit integer for station ID

!END!


--------------------------------------------------------------------------------

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  3  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        -----------------------------------------------
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)
```

Initial Metstat Report

INITIAL METSTAT REPORT
CALMET Fields for BART
Idaho, Oregon and Washington

1.0 INTRODUCTION

EPA published the Best Available Retrofit Technology (BART) standards under the Regional Haze Rule on July 6, 2005. Appendix Y, "Guideline for Best available Retrofit Technology Determination" (the BART Guideline) details EPA's recommendations to states for conducting BART analyses. According to the BART Guideline, each state may determine which BART-eligible sources are actually subject to BART using the CALPUFF dispersion model. The CALPUFF model is run using a meteorological data set developed with the CALMET program.

The Idaho Department of Environmental Quality (IDEQ), in cooperation with the Washington Department of Ecology (DOE) and Oregon Department of Environmental Quality (ODEQ) issued a contract to Geomatrix Consultants for the development of CALMET meteorological datasets. These datasets will provide consistent meteorology for the dispersion modeling that will be conducted by each state to determine which sources are subject to BART.

The CALMET dataset will be based on Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) runs performed at the University of Washington (UW). Although the UW performs many MM5 runs operationally, at several grid spacings, this project will use only the 12 km grid-spacing runs that have been initialized from the NCEP GFS product. MM5 is run in a forecast mode for these runs, not in "hindcast" mode with nudging and both beginning and ending boundary conditions.

This report is an initial attempt to quantify the quality of the UW 12 km MM5 forecast data using the METSTAT[1] analysis package. Although there are many statistical techniques and statistical packages available, the METSTAT package was specified by IDEQ in the contract for this project. It was developed by ENVIRON for WRAP, and has been widely used by RPOs to assess the quality of MM5 data.

[1] The February 15, 2005 version of METSTAT from http://www.camx.com/down/support.php was used.

The METSTAT package pairs observations with MM5 predictions in space and in time, then performs various statistical manipulations and aggregates the results for output. This approach is appropriate when the problem at hand relies on pairings in space/time for its accuracy. If the desire is to predict the wind speed at a particular receptor for a particular hour (e.g. for wind power generation) then this method of first pairing in space/time and then assessing statistics is appropriate.

CALPUFF is *not* such a model. We do not ask CALPUFF to predict the concentration at a particular Class I area on a particular hour or day. Instead, we ask that CALPUFF predict a range of concentrations for a period of time (3 years, in most cases). Then we evaluate that distribution using some statistical technique (find the 98^{th} percentile value, or the 100^{th} percentile value) and compare the result to a regulatory threshold.

The pairing in time is irrelevant to our application. It does not matter whether the wind speed predicted at a particular location matches each hour observed at that location. What matters is whether the distribution of predictions at a location matches the distribution of observations at that location. We want to be assured that the range of dispersion conditions we model is similar to the range of conditions we observe. We should be computing statistics from each of the full distributions, then comparing those statistics to find the differences between the predictions and observations. It does not matter whether the modeled worst dispersion conditions occurred on the same day as observed, only that it occurred at some time during the multi-year period.

Nonetheless, we wish to compare the UW 12 km MM5 prognostic data with other MM5 runs using a common method, namely METSTAT.

1.1 VERIFICATION DATA

The NCAR/UCAR dataset ds472.0 was used for this test. The METSTAT package includes a program, ds472fdda, to reformat the ds472 data to "RALPH" version 2 format used by the RAMS system and the METSTAT program. This program was run as needed for the months in each analysis. Although METSTAT does not output a report on which stations it found in the specified domain, a plot showing the ds472 stations in the domain is shown in Figure 1. A full listing is given in Appendix A.

1.2 MISSING DATA

The MM5 runs initialized 2002071500 and 2002072512 are missing (i.e. a total of 24 hours of missing data) and have not, as of this writing, yet been re-run by UW. It is not expected that the METSTAT results with and without the two missing initializations would differ significantly.

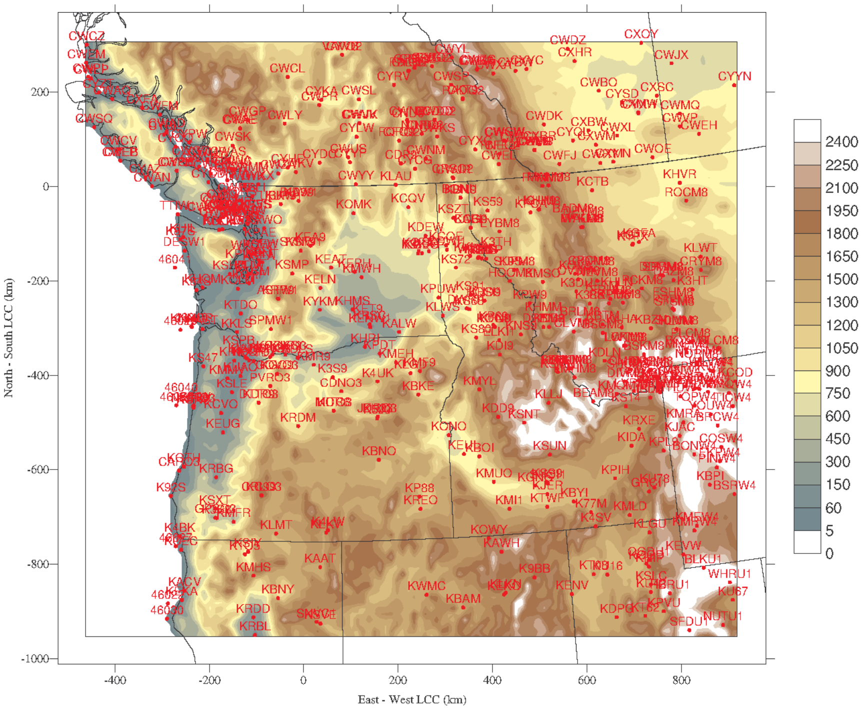


Figure 1. Stations from ds472 in the Pacific NW BART domain

1.3 STATISTICAL PERFORMANCE BENCHMARKS

The METSTAT package statistical methods are summarized in Section 3 of the WRAP 2002 MM5 report[2]. The relevant statistical parameters include root mean square error (RMSE), mean bias, gross error, and index of agreement (IOA). The first two are relatively

[2] Kemball-Cook et al., 2005. "Draft Final Report, Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States." Prepared for the Western Regional Air Partnership (WRAP), by Environ International Corporation.

straightforward. Note that for RMSE, larger errors are weighted more heavily due to the squaring.

The gross error is the mean of the absolute value of the prediction minus the observation, and is elsewhere called the mean absolute error. The index of agreement is a measure of the match between the departure of each prediction from the observed mean and the departure of each observation from the observed mean. Thus, the correspondence between predicted and observed values across the domain at a given time may be quantified in a single metric and displayed as a time series. The index of agreement has a theoretical range of 0 to 1, the latter score suggesting perfect agreement. The WRAP 2002 MM5 report gives statistical benchmarks for evaluating meteorological model performance, shown in Table 1.

Table 1. Statistical benchmarks

	Wind Speed	Wind Direction	Temperature	Humidity
RMSE	≤ 2 m/s			
Mean Bias	≤ ± 0.5 m/s	≤ ± 10º	≤ ± 0.5K	≤ ± 1 g/kg
Gross Error		≤ 30º	≤ 2 K	≤ 2 g/kg
IOA[(a)]	≥ 0.6		≥ 0.8	≥ 0.6

(a) In the WRAP 2002 MM5 report, Table 3 uses "≤" instead of "≥", which is presumably a typo.

These benchmarks were suggested by Emery and Tai (2001)[3] and are not necessarily intended to give a passing or failing grade to any particular meteorological model application, but rather to put its results into the proper context. For example, expectations for meteorological model performance for the U.S. west coast might not be as high as a simpler domain located over the Midwest. The key to the benchmarks is to understand how poor or good the results are relative to the universe of other model applications run for various areas of the U.S.

2.0 PREVIOUS STATISTICAL PERFORMANCE RESULTS

The quality of the MM5 data has been studied by UW[4]. They have a website[5] that features recent (90 days) and long-term (2 years) statistics for 12, 24, 36, and 48 hour forecasts. They do not give numerical results, only graphs of mean absolute error (MAE) and bias time series. One feature of their verification system is their observation quality control procedures. A

[3] Emery, C.A. and E. Tai. 2001. "Enhanced meteorological modeling and performance evaluation for two Texas ozone episodes." Prepared for the Texas Natural Resource Conservation Commission, by ENVIRON International Corporation.
[4] Mass, C., D. Ovens, M. Albright, and K. Westrick, 2002: "Does Increasing Horizontal Resolution Produce Better Forecasts?: The Results of Two Years of Real-Time Numerical Weather Prediction in the Pacific Northwest." *Bull. Amer. Meteor. Soc.,* **83**, 407-430.
[5] http://www.atmos.washington.edu/mm5rt/verify.html

series of tests are performed on the raw data, including a range check (reasonable minima and maxima), a step check ("spike" removal), persistence check (constant data removal), and a spatial check (remove outliers compared to nearby stations). There are no such Q/A checks in the METSTAT program, nor is the ds472 dataset filtered or subject to extra Q/A procedures.

Approximate (estimated by eye) statistical quantities for the UW 12 km MM5 data, for the 12-hour and 24-hour forecasts, are shown in Table 2. The table is similar in organization to the METSTAT results that follow, though mean absolute error (MAE) takes the place of the root mean square error (RMSE) for wind speed. The METSTAT definition of gross error is the same as the UW's definition of mean absolute error.

Table 2. Approximate statistical performance from the UW verification web site.

Parameter	Statistic	Benchmark	12-hr Fcst	24-hr Fcst
Wind Speed	MAE, m/s	N/A	3.3	3.5
	Mean Bias, m/s	$\leq \pm 0.5$	-0.1	-0.1
	IOA	≥ 0.6	N/A	N/A
Wind Direction	Mean Bias, º	$\leq \pm 10$	12	8
	Gross Error, º	≤ 30	50	48
Temperature	Mean Bias, K	$\leq \pm 0.5$	0.5	-0.8
	Gross Error, K	≤ 2	2.4	2.2
	IOA	≥ 0.8	N/A	N/A
Relative Humidity	Mean Bias, %	$\leq \pm 1$	3	4
	Gross Error, %	N/A	14	15
	IOA	≥ 0.6	N/A	N/A

3.0 METSTAT RESULTS

Please see the accompanying Microsoft Excel spreadsheets for the customary METSTAT graphs, and accompanying data tables. We present selected results, focusing on the WRAP benchmarks.

3.1 JANUARY AND JULY 2002

Initially, METSTAT was run using the January and July 2002 MM5 and ds472 data. A sub-set of the stations were used, based upon declared locations (in latitude and longitude) in the station tables available on the UCAR ds472 page[6] and the modeling domain. All stations listed as within the domain were used.

[6] Station libraries (listings) are available at http://dss.ucar.edu/datasets/ds472.0/station_libraries.

Table 3 shows the benchmark results of the METSTAT analysis for January and July 2002. Statistical parameters which meet the benchmarks are shown in bold text.

Table 3. Initial METSTAT results for Jan and Jul 2002

Parameter	Statistic	Benchmark	Jan 2002	Jul 2002
Wind Speed	RMSE, m/s	≤ 2	2.59	2.28
	Mean Bias, m/s	≤ ± 0.5	**0.08**	**-0.46**
	IOA	≥ 0.6	**0.64**	**0.62**
Wind Direction	Mean Bias, º	≤ ± 10	12.2	**8.0**
	Gross Error, º	≤ 30	52.7	53.9
Temperature	Mean Bias, K	≤ ± 0.5	-0.54	-0.59
	Gross Error, K	≤ 2	2.54	2.71
	IOA	≥ 0.8	**0.91**	**0.91**
Humidity	Mean Bias, g/kg	≤ ± 1	**0.05**	**0.13**
	Gross Error, g/kg	≤ 2	**0.49**	**1.30**
	IOA	≥ 0.6	**0.92**	**0.72**

As can be seen, several of the statistical measures fail to meet the benchmark goals. The RMSE of the wind speed exceed the benchmark by 14-30%, but the mean bias and IOA of the wind speed are in the acceptable range. The mean bias of the wind direction for July is acceptable, but exceeds the benchmark for January. The gross error of the wind direction is more than 25% higher than the benchmark, but the IOA meets the benchmark. Humidity is perhaps the best-performing parameter, as it meets all benchmark criteria.

3.2 JANUARY AND JULY 2004

The UW MM5 data from 2002 was run using MM5 version 3-4. It is possible that the later version of MM5 performs better. In particular, the UW started running MM5 version 3-6-3 in January 2004. A METSTAT analysis of January and July 2004 was performed, and the results presented in Table 4. This analysis also used all the stations within the domain.

The behavior of the latest version of MM5 is about the same as for the 2002 runs. Most statistical parameters exceed their benchmark values. Except for perhaps the gross error of the wind direction, most statistical parameters do not wildly exceed the benchmarks.

Table 4. Initial METSTAT results for Jan and Jul 2004

Parameter	Statistic	Benchmark	Jan 2004	Jul 2004
Wind Speed	RMSE, m/s	≤ 2	2.64	2.16
	Mean Bias, m/s	≤ ± 0.5	**0.11**	**-0.41**
	IOA	≥ 0.6	**0.67**	**0.63**
Wind Direction	Mean Bias, º	≤ ± 10	13.9	**7.9**
	Gross Error, º	≤ 30	55.2	53.6
Temperature	Mean Bias, K	≤ ± 0.5	0.69	-1.16
	Gross Error, K	≤ 2	3.06	2.61
	IOA	≥ 0.8	**0.89**	**0.91**
Humidity	Mean Bias, g/kg	≤ ± 1	**0.36**	**0.12**
	Gross Error, g/kg	≤ 2	**0.63**	**1.23**
	IOA	≥ 0.6	**0.90**	**0.74**

3.3 JANUARY AND JULY 2002, REDUCED VERIFICATION SET

As a rough Q/A check of the ds472 data, we removed from consideration all stations whose WBAN number does not start with a "2". The ds472 station list has a column for the WMO station number and another column for the WBAN number, as well as columns for the call sign. For example, the station at Seattle-Tacoma airport has the call sign "KSEA", the WMO number 727930, and the WBAN number 24233. In contrast, "Rainier Paradise" has the call sign "ASFW1", has no WMO number, and no WBAN number.

We sorted the list and performed a METSTAT analysis using only these selected stations (WBAN numbers 24XXX [US] or 25XXX [Canada]), eliminating sites like Nutters Ranch, UT and Salmon KRSA, ID from consideration. This reduced the number of observation sites from 468 sites to 113 sites, which are presumably of higher quality.

Table 5 shows the benchmark results of the METSTAT analysis for January and July 2002 for the reduced set of stations. Statistical parameters which meet the benchmarks are again shown in bold text. It is striking how similar the results are to the full run with all sites. In several cases, the metric for the reduced set was actually worse, presumably due to less statistical power (fewer data points).

Table 5. METSTAT results for Jan and Jul 2002, using selected surface stations

Parameter	Statistic	Benchmark	Jan 2002	Jul 2002
Wind Speed	RMSE, m/s	≤ 2	2.46	2.28
	Mean Bias, m/s	≤ ± 0.5	**-0.39**	-0.79
	IOA	≥ 0.6	**0.66**	**0.61**
Wind Direction	Mean Bias, º	≤ ± 10	10.9	**9.4**
	Gross Error, º	≤ 30	52.3	53.5
Temperature	Mean Bias, K	≤ ± 0.5	**-0.43**	**-0.49**
	Gross Error, K	≤ 2	2.44	2.61
	IOA	≥ 0.8	**0.90**	**0.93**
Humidity	Mean Bias, g/kg	≤ ± 1	**0.06**	**0.22**
	Gross Error, g/kg	≤ 2	**0.50**	**1.34**
	IOA	≥ 0.6	**0.91**	**0.70**

3.3 JANUARY AND JULY 2002, DIURNAL CYCLE

To investigate the performance of the MM5 model at different times of the day, we limited the MM5 data to forecast hours 19-23. By choosing either all the 00Z initializations or all the 12Z initializations, and since local standard time is GMT-8, we effectively limited the input data to METSTAT to 11:00 – 15:00 or 23:00 – 03:00 PST.

The results are shown in Table 6. All sites were used for this run, not just the “reduced set”. Again, the statistics are remarkably stable. About the only conclusion that can be drawn is that the mean wind speed is under-predicted during the day and over-predicted during the night (insufficient diurnal range); more so during the summer than during the winter. The wind direction prediction was improved for the daytime during summer.

Table 6. METSTAT results for Jan and Jul 2002, using selected surface stations

Parameter	Statistic	Benchmark	Jan 2004		Jul 2004[b]	
			11-15[a]	**23-03**	**11-15**	**23-03**
Wind Speed	RMSE, m/s	≤ 2	2.78	2.56	2.48	2.15
	Mean Bias, m/s	≤ ± 0.5	**-0.08**	**0.25**	-1.00	**0.10**
	IOA	≥ 0.6	**0.64**	**0.64**	0.59	**0.61**
Wind Direction	Mean Bias, º	≤ ± 10	13.38	12.3	**7.33**	10.53
	Gross Error, º	≤ 30	53.71	53.46	49.57	60.14
Temperature	Mean Bias, K	≤ ± 0.5	**-0.49**	-0.52	-0.83	**-0.26**
	Gross Error, K	≤ 2	2.50	2.67	2.78	2.53
	IOA	≥ 0.8	**0.89**	**0.91**	**0.93**	**0.92**
Humidity	Mean Bias, g/kg	≤ ± 1	**-0.08**	**0.13**	**-0.78**	**0.80**
	Gross Error, g/kg	≤ 2	**0.52**	**0.51**	**1.35**	**1.26**
	IOA	≥ 0.6	**0.90**	**0.92**	**0.71**	**.07**

(a) Local hour, e.g. "11-15" means 11:00 AM to 3:00 PM PST (but never PDT).

(b) July has two missing initializations, which caused METSTAT to calculate erroneous statistics. The July numbers were calculated by hand from the available data.

4.0 CONCLUSIONS

Overall, the UW MM5 12 km prognostic data meets most of the benchmark criteria. The mean biases and gross errors (mean absolute error) of most parameters either meet or are close to the benchmarks. The RMSE of the wind speed, which may not be the best measure due to the heavy weighting of large errors, and the gross error of the wind direction were the only two parameters that were relatively far from their respective benchmarks. From a visual inspection of the hourly plot of temperature, it is clear that most of the gross error in the temperature comes from insufficient diurnal range. The daytime highs are not high enough, and the lows are not low enough. This is a well-known feature of the MM5 model, at least when using the simpler soil parameterizations. Considering that temperature is not a crucial parameter for CALPUFF, perhaps less attention should be paid to the relatively high gross errors. The wind direction is not too heavily biased, and the relatively high gross errors could be a result of a mismatch in the timing of weather fronts in MM5. This could be an artifact of the "pairing in time" issue of the METSTAT program discussed above. Overall, the MM5 data is acceptable.

APPENDIX A: Surface Stations from ds472 in the Pacific NW BART domain

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
46010	COLUMBIA	46.2	124.2	-237.823	-296.071
46022	EEL RIVER	40.72	124.52	-287.466	-883.48
46027	ST GEORGES	41.85	124.38	-270.909	-762.416
46029	COL RIVER BAR	46.12	124.51	-261.217	-303.687
46030	BLUNTS REEF	40.42	124.53	-289.707	-915.745
46040	BUOY C FOULWEATHER	44.8	124.4	-259.054	-445.629
46041	CAPE ELIZABETH	47.34	124.75	-272.926	-172.02
46050	YAQUINA BAY	44.62	124.53	-269.801	-464.509
ASFW1	RAINIER PARADISE	46.7861	121.7422	-54.657	-237.641
BADM8	BADGER PASS	48.1333	113.0333	570.34	-64.786
BEAM8	BEAGLE SPRINGS	44.4667	112.9833	613.263	-456.186
BEVM8	BEAVER CREEK	44.95	111.35	731.432	-390.889
BLBM8	BLACK BEAR	44.5	111.1167	754.978	-436.682
BLKU1	BLACKS FORK COMM.	40.9667	110.55	847.47	-807.835
BLOM8	BLODDY DICK	45.1667	113.5	566.821	-385.187
BLTW4	BEARTOOTH LAKE	44.7833	109.5667	868.315	-390.816
BLWW4	BLACK WATER	44.3833	109.8	856.7	-435.852
BONI1	BONNERS FERRY	48.6958	116.3222	331.683	-23.034
BONO3	BONNEVILLE	45.6333	121.95	-71.403	-361.24
BONW4	BONDURANT SCHOOL DCP	43.2006	110.405	827.458	-568.085
BOXM8	BOX CANYON	45.2833	110.25	809.552	-344.807
BRCW4	BURROUGHS CREEK	43.7	109.6667	877.182	-507.072
BRLM8	BARKER LAKE	46.1	113.1333	584.624	-282.813
BSCM8	BASIN CREEK	45.8	112.5167	633.694	-310.161
BSKM8	LONE MOUNTAIN	45.2833	111.4333	720.883	-356.117
BSRW4	FARSON DCP	42.3167	109.4833	912.592	-652.182
CABI1	CABINET GORGE	48.0856	116.0583	354.422	-87.369
CANW4	CANYON	44.7167	110.5333	796.268	-407.949
CARO3	CAPE ARAGO	43.34	124.38	-264.148	-602.362
CDNO3	CONDON	44.95	119.95	79.7	-434.5
CDP9	DEER PARK	49.4167	118.05	206.356	48.607
CFE9	FERNIE	49.5	115.05	415.343	69.209
CFQ9	FAUQUIER	49.8667	118.0833	202.263	96.919
CGL9	GLA ROGRS PASS	51.2833	117.5167	234.909	251.007
CKT9	KOOTNAI WESTGATE	50.6333	116.0667	336.941	186.19
CLCM8	COLE CREEK	45.2	109.35	878.172	-344.177
CLVM8	CALVERT CREEK	45.8833	113.3333	572.029	-307.413
CMDM8	CLOVER MEADOW	45.0225	111.8478	692.978	-387.587
CND9	NEW DENVER	49.9833	117.3833	250.23	111.441
CNU9	NAKUSP	50.2333	117.8	220.33	137.114
COPM8	COPPER BOTTOM	47.05	112.6	613.44	-177.344
COSW4	COLD SPRING	43.2667	109.65	885.043	-552.974
COWI1	COEUR D'ALENE	47.6789	116.8017	303.435	-134.049
CPCM8	COPPER CAMP	47.0833	112.7333	603.37	-174.8
CRLO3	CRATER LAKE	42.8967	122.1328	-89.283	-654.944

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
CRRM8	CARROT BASIN	44.9667	111.2833	736.247	-388.497
CRSQ2	CRESTON	49.1	116.5167	315.471	19.572
CRYM8	CRYSTAL LAKE	46.7903	109.5122	841.617	-176.959
CWAD	CAPE MUDGE LIGHT HOU	50	125.2	-290.644	115.206
CWAE	WHISTLER	50.13	122.95	-134.695	123.222
CWAN	AMPHITRITE_POINT	48.92	125.55	-321.432	0.51
CWAQ	ALERT_BAY	50.58	126.93	-405.516	185.08
CWAS	PAM ROCKS	49.5	123.3	-160.798	56.075
CWBA	BANFF	51.1833	115.5667	367.029	247.567
CWBO	BROOKS (AUTO)	50.55	111.85	625.073	202.587
CWCL	CLINTON (AUTO)	51.15	121.5	-33.918	231.62
CWCV	NOOTKA LIGHTSTATION	49.6	126.62	-391.759	78.278
CWCZ	ADDENBROKE_ISL_(LH)	51.6	127.87	-460.209	299.824
CWDD	DUNCANDAM	50.25	116.9667	277.594	141.503
CWDK	CLARESHOLM (AUTO)	50	113.6333	509.06	131.023
CWDZ	DRUMHELLER_EAST	51.43	112.67	559.405	290.854
CWEB	ESTEVAN PT.(AUTO)	49.3833	126.55	-388.503	54.677
CWEH	E.END CYP.(AUTO)	49.45	108.9833	837.349	111.345
CWEL	ENTRANCE ISLAND	49.2167	123.8	-196.788	26.727
CWEL	ELKO	49.3	115.1	413.443	47.491
CWEM	EGG ISLAND LGT_STN	51.25	127.83	-460.755	261.96
CWEZ	SATURNA	48.7833	123.05	-145.307	-21.462
CWFJ	CARDSTON_(AUT)	49.2	113.28	541.693	47.63
CWFM	CHATHAM POINT	50.3333	125.4333	-304.781	151.917
CWGB	BALLENAS ISLAND	49.35	124.16	-221.5	41.997
CWGP	PEMBERTON ARPT	50.3	122.7333	-119.343	141.183
CWGT	SISTERS ISLAND	49.4833	124.4333	-240.023	57.114
CWGW	SPARWOOD AUTO	49.75	114.8833	424.906	96.912
CWHC	VANCOUVER HARBOUR	49.3	123.1167	-148.562	34.211
CWJR	CRESTON CAMPBELL	49.08	116.5	316.766	17.491
CWJV	VERNON AUTOB	50.2333	119.2833	118.182	133.976
CWJX	LEADER AIRPORT	50.9	109.5	779.241	260.616
CWKH	MALAHAT	48.5833	123.5333	-180.213	-41.973
CWKS	KASLO	49.9167	116.9167	282.862	105.832
CWKV	HOPE SLIDE	49.2833	121.2333	-16.458	30.476
CWLM	VICTORIA	48.4167	123.3167	-165.335	-60.34
CWLP	HERBERT ISLAND	50.95	127.64	-450.649	228.637
CWLY	LYTTON	50.2333	121.5833	-40.274	132.855
CWMM	P._MEADOWS_CS_AUTO8	49.2	122.68	-118.16	22.73
CWMP	PINCHER CK (AUTO)	49.5167	114	488.324	76.927
CWMQ	MAPLECREEK_(AUTO8)	49.9	109.47	796.72	154.288
CWMR	MERRY ISLAND	49.47	123.92	-204.221	54.261
CWNM	NELSON AUTO.	49.49	117.3	258.443	58.665
CWNP	NAKUSP AUTOB	50.2667	117.8167	219.037	140.663
CWOE	ONEFOUR	49.12	110.47	739.037	61.558
CWPC	PINCHER CK (AUTO)	49.5167	114	488.324	76.927
CWPF	ESQUIMALT HARBOUR	48.4333	123.4333	-173.594	-58.31

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
CWPI	PINE_ISLAND_(MAPS)	50.98	127.73	-456.471	232.37
CWPR	PRINCETON AUTO8	50.6	120.5167	32.974	172.315
CWQC	PORT_ALBERNI_(MARS)	49.25	124.83	-268.927	33.301
CWQK	RACE ROCKS	48.3	123.5333	-181.176	-72.408
CWRT	CROWSNEST	49.63	114.48	453.918	86.251
CWRY	MILK RIVER (AUTO)	49.1333	112.05	628.477	49.484
CWSK	SQUAMISH ARPT	49.7833	123.1667	-150.661	86.293
CWSL	SALMON ARM AUTOB	50.7	119.2833	117.104	184.25
CWSP	SHERINGHAM POINT	48.3833	123.9167	-208.246	-62.529
CWSP	SPILLAMACHEEN	50.9167	116.4	312.443	215.334
CWSQ	SPRING ISLAND	50	127.4167	-443.724	125.37
CWSW	SPARWOOD/ELK_VALLEY	49.75	114.88	425.135	96.93
CWUS	SUMMERLAND AUTO	49.5667	119.65	94.132	61.738
CWVF	SAND HEADS LIGHTH	49.1	123.3	-162.034	13.061
CWVG	VICTORIA/GONZALES	48.4167	123.3167	-165.335	-60.34
CWVK	VERNON	50.2333	119.2833	118.182	133.976
CWVP	CYPRESS_HILLS_PARK	49.65	109.52	797.134	127.157
CWVV	VIC._HARTLAND_AUTO8	48.53	123.47	-175.89	-47.84
CWWA	WEST VANCOUVER	49.3333	123.1833	-153.134	37.918
CWWK	WHITE ROCK	49.0167	122.7667	-124.688	3.151
CWXA	BOW VALLEY(AUTO)	51.0833	115.0667	401.552	239.208
CWXL	BOW_ISLAND	49.63	111.45	664.064	107.41
CWYJ	VICTORIA UNIV	48.45	123.3	-164.041	-56.796
CWYL	YOHO PARK	51.45	116.3333	313.619	273.027
CWYY	OSOYOOS	49.0333	119.4333	110.377	4.643
CWZA	AGASSIZ AMOS	49.25	121.7667	-53.923	27.128
CWZG	BANFF_(MARS)	51.2	115.55	368.033	249.441
CXBR	BROCKET AGDM	49.62	113.82	499.855	89.11
CXBW	BARNWELL AGDM	49.8	112.3	603.211	118.861
CXFA	FANNY ISLAND	50.45	125.99	-342.212	166.716
CXHR	HUSSAR AGDM	51.18	112.5	573.639	265.232
CXMN	MASINASIN AGDM	49.13	111.66	655.787	52.259
CXMW	MEDICINE HAT RCS	50.03	110.72	709.049	156.4
CXOY	OYEN AGDM	51.38	110.35	715.127	303.964
CXSC	SCHULER AGDM	50.31	110.09	748.15	192.025
CXWM	WRENTHAM AGDM	49.5	112.12	619.215	88.143
CYAE	ALTA LAKE	50.1167	122.95	-134.73	121.79
CYAZ	TOFINO	49.0833	125.7667	-335.674	18.931
CYBA	BANFF	51.1833	115.5667	367.029	247.567
CYBL	CAMPBELL RIVER	49.95	125.2667	-295.541	110.075
CYBW	CALGARY/SPRINGBAN	51.1	114.3667	448.685	244.721
CYCD	NANAIMO	49.05	123.8667	-202.113	8.975
CYCG	CASTLEGAR	49.3	117.6333	236.029	37.213
CYDC	PRINCETON	49.4667	120.5167	33.71	50.286
CYEP	ESTEVAN POINT	49.3833	126.55	-388.503	54.677
CYGC	MT.FIDELITY	51.2333	117.7	222.773	245.093
CYGE	GOLDEN	51.3	116.9667	271.895	254.548

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
CYHE	HOPE	49.3667	121.4833	-33.947	39.526
CYKA	KAMLOOPS	50.7	120.45	37.462	183.122
CYLW	KELOWNA	49.9667	119.3833	111.874	105.13
CYPB	PORT ALBERNI	49.25	124.8333	-269.158	33.312
CYPW	POWELL RIVER	49.8167	124.5	-243.114	93.163
CYQL	LETHBRIDGE	49.6333	112.8	570.498	97.354
CYQQ	COMOX	49.7167	124.9	-271.392	83.695
CYRV	REVELSTOKE	50.9667	118.1833	191.16	215.11
CYSD	SUFFIELD_AIRPORT	50.27	111.18	674.318	178.069
CYVB	VAVENBY	51.5833	119.7833	81.527	278.891
CYVR	VANCOUVER	49.1833	123.1833	-153.574	21.788
CYWH	VICTORIA MAR.RAD.	48.3667	123.3875	-170.543	-65.563
CYXC	CRANBROOK	49.6167	115.7833	363.404	78.17
CYXH	MEDICINE HAT	50.0167	110.7167	709.459	155.009
CYXX	ABBOTSFORD	49.0333	122.3667	-96.449	4.384
CYYC	CALGARY	51.1167	114.0167	472.149	248.529
CYYF	PENTICTON	49.4667	119.6	97.81	51.039
CYYJ	VICTORIA INTL AP	48.65	123.4333	-172.887	-35.026
CYYN	SWIFT CURRENT	50.2833	107.6833	912.299	214.141
CYZT	PORT HARDY	50.6833	127.3667	-434.428	198.47
CZPC	PINCHER CREEK ARP	49.5167	113.9833	489.487	77.029
CZPN	PINCHER CREEK AUT	49.5167	114	488.324	76.927
DAZM8	DAISY PEAK	46.6667	110.3333	783.589	-198.438
DCDQ2	DUNCAN DAM	50.25	116.97	277.367	141.491
DDMM8	DEADMAN CREEK	46.8	110.6833	756.18	-187.613
DESW1	DESTRUCTION IS.	47.68	124.49	-252.43	-136.39
DHLM8	DARKHORSE LAKE	45.1667	113.5833	560.543	-385.774
DIAW1	DIABLO DAM	48.7167	121.15	-10.727	-30.471
DIVM8	DIVIDE	44.8	112.05	680.395	-413.058
DPYM8	DUPUYER CREEK	48.0667	112.75	591.291	-69.85
DRBM8	DARBY	46.0247	114.1769	507.946	-297.984
DTTO3	DETROIT DAM	44.7244	122.2536	-95.721	-458.497
DWRI1	DWORSHAK DAM	46.5028	116.3233	345.357	-258.221
EKPW4	ELKHEART PARK	43	109.75	881.31	-582.453
ELKI1	ELK CITY	45.8358	115.4581	414.123	-325.583
FDLQ2	FIDELITY MOUNTAIN	51.23	117.72	221.437	244.682
FNEQ2	FERNIE	49.5	115.05	415.343	69.209
FQRQ2	FAUQUIRE	49.8667	118.0833	202.263	96.919
FRHM8	FROHNER MEADOWS	46.45	112.2	649.607	-238.244
FSHM8	FISHER CREEK	46.2667	110.4333	781.936	-241.986
FTMM8	FLATTOP MOUNTAIN	48.8	113.85	505.638	1.07
GEBQ2	GOLDEN	51.3	116.9667	271.895	254.548
GOVO3	GOVERNMENT CAMP	45.3014	121.7411	-56.051	-397.037
GPSO3	GRANTS PASS	42.4372	123.3578	-187.175	-702.219
GRCI1	GRACE	42.5833	111.7333	731.867	-646.863
GRPQ2	ROGERS PASS	51.2833	117.5167	234.909	251.007
HBRU1	SNAKE CRK POWERHOUSE	40.55	111.5	776.114	-862.018

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
HGHM8	HUNGRY HORSE DAM	48.3428	114.0217	497.802	-48.963
HOOM8	HOODOO BASIN	46.9833	115.0333	436.644	-200.438
HOXO3	HOOD RIVER	45.6847	121.5175	-38.9	-356.02
HQSI1	HEADQUARTERS	46.6311	115.8097	382.351	-242.137
IPDI1	ISLAND PARK	44.4167	111.4	734.509	-448.196
ISLI1	ISLAND PARK	44.4167	111.4	734.509	-448.196
JDRO3	JOHN DAY	44.4233	118.9594	156.401	-489.583
K1O5	MONTAGUE/ROHRER	41.7333	122.55	-124.553	-779.485
K20S	BONNEVILLE DAM	45.6333	121.95	-71.403	-361.24
K27U	SALMON	45.1833	113.9	536.51	-386.169
K38S	DEER LODGE	46.4	112.8	606.019	-248.287
K3DU	DRUMMOND	46.6667	113.15	577.431	-222.382
K3HT	HARLOWTON	46.4333	109.8333	823.574	-218.247
K3S8	GRANTS PASS	42.4333	123.3167	-183.927	-702.733
K3S9	CONDON	45.2333	120.1833	61.663	-404.292
K3TH	THOMPSON FALLS	47.6	115.3667	407.627	-136.135
K4BK	BROOKINGS	42.05	124.2833	-262.284	-741.24
K4HA	WHITEHALL	45.8667	111.9667	673.809	-298.552
K4LW	LAKE VIEW	42.2167	120.35	51.69	-728.476
K4SV	STREVELL	42.0167	113.25	618.366	-720.245
K4UK	UKIAH	45.1333	118.9333	156.435	-413.323
K53S	POINT WILSON LS	48.15	122.75	-125.546	-90.022
K5J0	JOHN_DAY_STATE_ARPT	44.4	118.97	155.652	-492.105
K75S	BURLINGTON	48.4667	122.4167	-101.052	-56.463
K76S	OAK HARBOR	48.25	122.6667	-119.352	-79.405
K77M	MALTA	42.3	113.3333	608.826	-690.554
K84S	GRAY'S HARBOR	46.9167	124.1	-227.419	-219.469
K87S	QUILLAYUTE R LS	47.9	124.6333	-261.712	-112.318
K92S	CAPE BLANCO	42.8333	124.5667	-281.15	-656.129
K95S	YAQUINA BAY	44.6167	124.05	-233.159	-466.37
K9BB	WELLS	41.1167	114.9667	488.962	-828.633
K9S4	SUPERIOR	47.2	114.8833	445.826	-176.406
KAAT	ALTURAS	41.4914	120.5644	35.037	-806.628
KACV	ARCATA	40.9792	124.1058	-252.585	-856.977
KALW	WALLA WALLA	46.1	118.2833	202.125	-308.128
KAST	ASTORIA ASOS	46.15	123.8833	-214.499	-302.33
KAWH	ELKO/WILD HORSE RSV	41.6667	115.7833	419.015	-774.2
KAWO	ARLINGTON_MUNI	48.17	122.17	-83.937	-88.631
KBAM	BATTLE MOUNTAIN	40.6167	116.8667	337.899	-892.205
KBFI	BOEING FIELD	47.5333	122.3	-94.364	-156.883
KBKE	BAKER	44.8428	117.8086	242.819	-441.691
KBLI	BELLINGHAM	48.8	122.5333	-108.675	-20.486
KBN9	BONNERS FERRY	48.6833	116.3167	332.151	-24.353
KBNO	BURNS ASOS	43.5833	118.95	159.432	-579.755
KBNY	BURNEY	40.8833	121.6667	-54.388	-871.978
KBOI	BOISE	43.5667	116.2167	372.045	-572.462
KBPI	BIG PINEY (AMOS)	42.5667	110.1	860.382	-632.392

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KBTM	BUTTE	45.9647	112.5006	633.019	-292.451
KBVS	SKAGIT RGNL ARPT	48.4708	122.4208	-101.336	-56.017
KBYI	BURLEY	42.5417	113.7661	572.204	-667.869
KBZN	BOZEMAN ASOS	45.7833	111.15	735.54	-300.255
KC99	CRATER LAKE HQ	42.9	122.1333	-89.318	-654.589
KCEC	CRESCENT CITY	41.7833	124.2333	-259.451	-770.072
KCG9	CABINET GORGE	48.0833	116.0667	353.835	-87.653
KCLM	PORT ANGELES	48.1167	123.5	-179.411	-92.172
KCOD	CODY (AMOS)	44.5167	109.0167	914.052	-413.015
KCOE	COEUR DALENE AWOS	47.7667	116.8167	301.859	-124.686
KCQV	COLVILLE MUNICIPAL	48.55	117.8833	221.643	-44.086
KCTB	CUTBANK	48.6167	112.3833	611.128	-8.312
KCVO	CORVALLIS (AWOS)	44.5	123.2833	-174.945	-480.847
KCZK	CASCADE LOCKS	45.6833	121.8833	-66.337	-355.93
KD15	WOODLAND PARK	47.5	115.8833	370.977	-149.365
KD99	DIABLO DAM	48.7167	121.15	-10.727	-30.471
KDB9	DARBY	46.0167	114.0167	519.919	-297.811
KDD9	DEADWOOD DAM	44.3167	115.6333	411.972	-489.21
KDEW	DEER_PARK	47.97	117.41	258.087	-104.945
KDI9	DIXIE	45.55	115.4667	415.6	-356.237
KDLN	DILLON	45.25	112.55	637.435	-369.143
KDLS	THE DALLES	45.6194	121.1714	-12.957	-363.142
KDPG	DUGWAY PRV GNDS	40.2	112.9333	663.233	-912.41
KDR9	DETROIT DAM	44.7167	122.25	-95.459	-459.328
KEA9	LAKE WENATCHEE	47.8333	120.8	14.338	-125.403
KEAT	WENATCHEE	47.3978	120.2014	57.976	-171.913
KEKA	EUREKA	40.8	124.1667	-258.298	-876.072
KEKO	ELKO REGIONAL AIRPRT	40.8264	115.7875	424.565	-864.508
KELN	ELLENSBURG/BOWERS	47	120.5167	35.311	-214.818
KENV	WENDOVER (AUTOB)	40.7333	114.0333	568.031	-863.635
KENW1	KENNEWICK	46.2111	119.1011	140.985	-297.958
KEPH	EPHRATA	47.3081	119.5147	108.077	-180.833
KET9	ELTOPIA	46.4	119.1667	135.648	-277.796
KETM	ELLISTON	46.5667	112.4333	631.112	-227.653
KEUG	EUGENE ASOS	44.1167	123.2167	-170.985	-522.137
KEUL	CALDWELL	43.63	116.63	339.553	-567.509
KEVW	EVANSTON	41.275	111.0322	804.446	-779.878
KFCA	KALISPELL ASOS	48.3	114.2667	480.75	-55.044
KFHR	FRIDAY HARBOR	48.5167	123.0167	-143.67	-50.173
KFN9	FENN PASS	46.1	115.55	405.336	-297.756
KGEG	SPOKANE ASOS	47.6333	117.5333	250.792	-141.475
KGFA	MALMSTROM AFB	47.5	111.1833	710.523	-117.61
KGNG	GOODING	42.9167	114.7667	490.082	-634.337
KGO9	GOVERNMENT CAMP	45.3	121.75	-56.725	-397.181
KGRF	FORT LEWIS	47.0833	122.5833	-115.862	-204.834
KGTF	GREAT FALLS ASOS	47.4833	111.3667	697.527	-121.003
KHD9	HEADQUARTERS	46.6333	115.8	383.05	-241.855

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KHH9	HUNGREY HORSE DAM	48.35	114	499.279	-48.057
KHIF	HILL AFB	41.1167	111.9667	731.276	-805.767
KHIO	HILLSBORO/PORTLAND	45.5481	122.9544	-147.016	-369.017
KHLN	HELENA ASOS	46.6	112	662.505	-220.599
KHMM	HAMILTON/RAVALLI_CO	46.25	114.15	507.877	-273.713
KHMS	HANFORD	46.5667	119.6	103.258	-260.548
KHQM	HOQUIAM	46.9728	123.9303	-214.76	-213.917
KHR9	HOOD R EXP STA	45.6833	121.5167	-38.841	-356.17
KHRI	HERMISTON	45.8258	119.2611	129.999	-339.584
KHVR	HAVRE ASOS	48.55	109.7667	796.66	7.579
KIDA	IDAHO FALLS	43.5167	112.0667	694.475	-550.166
KJAC	JACKSON	43.6	110.7333	796.471	-528.866
KJER	JEROME	42.7275	114.4531	516.349	-652.638
KJNW	NEWPORT SAWRS PT	44.6333	124.05	-233.091	-464.589
KKLG	KELLOGG	47.5333	116.1333	352.652	-146.925
KKLS	KELSO (AWOS)	46.1167	122.9	-141.479	-308.088
KLAU	LAURIER	49	118.2333	195.083	3.353
KLGD	LA GRANDE (AWOS)	45.28	118	226.5	-395.348
KLGU	LOGAN	41.7833	111.85	732.501	-733.406
KLKN	ELKO WFO	40.86	115.7425	427.988	-860.656
KLKV	LAKEVIEW (AWOS)	42.1667	120.4	47.747	-733.885
KLLJ	CHALLIS ASOS	44.5167	114.2167	518.689	-459.56
KLMT	KLAMATH FALLS	42.15	121.7333	-58.563	-735.592
KLVM	LIVINGSTON	45.6983	110.4408	789.408	-302.553
KLWS	LEWISTON ASOS	46.3833	117.0167	294.823	-273.806
KLWT	LEWISTOWN	47.05	109.4667	840.925	-148.881
KMEH	MEACHAM (AMOS)	45.5	118.4	195.533	-372.798
KMEW4	KEMMERER DCP	41.8	110.5833	833.148	-719.237
KMF9	MT.FANNY	45.3167	117.7333	246.472	-390.623
KMFR	MEDFORD	42.3667	122.8667	-148.391	-710.826
KMHS	MT SHASTA ASOS	41.3167	122.3167	-106.558	-824.655
KMI1	SAYLOR CREEK AFR	42.5	115.5	435.589	-683.252
KMLD	MALAD CITY	42.1667	112.3167	690.821	-696.565
KMLP	MULLAN_PASS_VOR	47.4542	115.6697	386.772	-153.263
KMMV	MCMINNVILLE	45.1961	123.1322	-161.387	-406.453
KMQM	MONIDA	44.5667	112.3167	662.909	-440.194
KMR9	MORO	45.4833	120.7167	21.239	-377.729
KMRA	MORAN S. WNW	43.85	110.5833	804.56	-500.734
KMRW4	KEMMERER	41.7167	110.6667	827.667	-728.99
KMSO	MISSOULA	46.9167	114.0833	506.635	-201.97
KMUO	MOUNTAIN HOME AFB	43.05	115.8667	402.795	-626.181
KMWH	MOSES LAKE	47.2	119.3167	122.738	-192.155
KMYL	MCCALL (RAMOS)	44.8833	116.1	372.465	-430.781
KNNCR	COLUMBIA R LS	46.1833	124.1833	-236.654	-297.913
KNOW	PORT ANGELES CGAS	48.1333	123.4	-172.187	-90.608
KNS9	NO. STAR RANCH	45.9167	114.8333	460.066	-313.51
KNUW	WHIDBEY IS.NAS	48.35	122.65	-117.935	-68.685

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KOGD	OGDEN	41.1833	112.0167	726.441	-799.096
KOLM	OLYMPIA	46.9667	122.9	-139.314	-216.848
KOMK	OMAK	48.4614	119.5192	105.458	-56.95
KONO	ONTARIO	44.0167	117.0167	307.459	-527.592
KONP	NEWPORT	44.5833	124.05	-233.295	-469.954
KOOI1	FENN RANGER STATION	46.1033	115.5486	405.416	-297.396
KOR6	MITCHELL	44.5667	120.1667	63.662	-475.847
KORS	ORCAS ISLAND ARPT	48.7081	122.9103	-135.605	-29.79
KOTH	NORTH BEND	43.4167	124.25	-253.664	-594.549
KOTX	SPOKANE WFO	47.6808	117.6278	243.742	-136.668
KOV9	OVANDO	47.0167	113.1333	574.969	-184.859
KOWY	OWYHEE	41.95	116.1	391.741	-745.381
KP60	YELLOWSTONE(AMOS)	44.55	110.4167	807.447	-424.526
KP69	LOWELL	46.1442	115.5964	401.57	-293.255
KP88	ROME (RAMOS)	42.8333	117.8833	245.536	-657.609
KPAE	EVERETT	47.9167	122.2833	-92.493	-115.72
KPDT	PENDLETON ASOS	45.6833	118.85	161.157	-354.13
KPDX	PORTLAND	45.6	122.6	-120.265	-364.038
KPIH	POCATELLO	42.9167	112.6	659.92	-618.775
KPL9	PALISADES DAM	43.35	111.2167	762.431	-560.221
KPQR	PORTLAND WFO	45.5606	122.5369	-115.608	-368.359
KPSC	PASCO	46.2667	119.1167	139.686	-292.018
KPUW	PULLMAN-MOSCOW RGNL	46.7439	117.1136	285.776	-235.486
KPVU	PROVO	40.2167	111.7167	762.646	-899.785
KPW9	POWELL	46.5167	114.5167	478.43	-247.437
KPWT	BREMERTON AWOS	47.4833	122.7667	-128.323	-161.604
KRBG	ROSEBURG ASOS	43.2333	123.3667	-185.351	-616.663
KRBL	RED BLUFF ASOS	40.15	122.25	-103.127	-950.438
KRDD	REDDING	40.5	122.3	-106.636	-912.642
KRDM	REDMOND	44.2667	121.15	-11.622	-508.383
KREO	ROME	42.59	117.87	247.606	-683.703
KRNT	RENTON	47.5	122.2167	-88.377	-160.554
KRR9	RAINIER PARADISE	46.7833	121.7333	-54.005	-237.948
KRXE	REXBURG	43.8317	111.8061	710.772	-514.258
KS06	MULLAN AWRS	47.4667	115.8	377.241	-152.545
KS14	SPENCER	44.3	112.1	682.565	-466.84
KS47	TILLAMOOK	45.42	123.82	-212.553	-380.821
KS59	LIBBY	48.4	115.5333	389.724	-51.213
KS68	OROFINO	46.4833	116.25	350.889	-259.993
KS72	ST.MARIES	47.3167	116.5667	322.561	-171.978
KS80	GRANGEVILLE	45.9167	116.1	365.68	-320.043
KS91	ELK RIVER	46.7667	116.1833	353.983	-229.324
KSEA	SEATTLE-TACOMA	47.45	122.3	-94.509	-165.829
KSEW	STANWOOD WFO	47.6872	122.2553	-90.863	-140.405
KSFF	SPOKANE/FELTS	47.6667	117.3333	265.091	-137.246
KSHN	SHELTON	47.25	123.15	-156.812	-185.972
KSIY	MONTAGUE/SSK AWOS	41.7833	122.4667	-117.765	-774.232

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KSKA	FAIRCHILD AFB	47.6333	117.65	242.351	-141.834
KSLC	SALT LAKE CITY	40.7667	111.9667	735.52	-843.229
KSLE	SALEM ASOS	44.9167	123	-152.137	-436.699
KSMN	SALMON	45.1167	113.8833	538.403	-393.179
KSMP	STAMPEDE PASS ASOS	47.2833	121.3333	-24.37	-184.45
KSNT	STANLEY_RANGER_STN	44.17	114.93	467.068	-501.064
KSPB	SCAPPOOSE	45.78	122.84	-137.845	-344.331
KSS9	SHOSHONE	42.9667	114.4333	515.802	-626.886
KST9	STEVENS PASS	47.7333	121.0833	-6.105	-136.161
KSUN	HAILEY	43.5	114.3	521.46	-568.913
KSVE	SUSANVILLE	40.3833	120.5667	35.497	-925.991
KSXT	SEXTON SMT ASOS	42.6167	123.3667	-187.31	-682.907
KSZT	SANDPOINT ARPT	48.2994	116.56	317.197	-66.538
KT08	HILL/EAGLE TACR	41.0833	113.4167	614.604	-821.533
KT62	TOOELE/ARMY DEPOT	40.1667	112.2	723.693	-909.63
KTCM	MCCHORD AFB	47.15	122.4833	-108.418	-197.813
KTDO	TOLEDO	46.4833	122.8	-133.154	-268.91
KTFX	GREAT FALLS WFO	47.4597	111.3847	696.533	-123.676
KTIW	TACOMA	47.2667	122.5833	-115.473	-185.142
KTTD	PORTLAND/TROUTDALE	45.5511	122.4089	-106.005	-369.556
KTWF	TWIN FALLS	42.4833	114.4833	516.107	-679
KU16	EAGLE RANGE	41.05	113.0667	643.238	-822.353
KU33	JOHN DAY	44.4333	118.95	157.095	-488.491
KU42	SALT LAKE CITY MUNI	40.62	111.99	735.405	-859.15
KU67	ROOSEVELT	40.2667	109.9167	908.924	-875.646
KU78	SODA SPRINGS	42.65	111.5833	742.82	-638.359
KUAO	AURORA STATE	45.25	122.77	-133.863	-401.335
KUIL	QUILLAYUTE	47.95	124.55	-255.48	-107.22
KUP9	UPPER BAKER DAM	48.65	121.6833	-48.617	-37.445
KVUO	VANCOUVER_(ASOS)	45.62	122.65	-123.976	-361.815
KWEY	W.YELLOWSTONE WSO	44.65	111.1	754.261	-420.54
KWMC	WINNEMUCA ASOS	40.9	117.8	260.408	-865.2
KWYS	WEST YELLOWSTONE	44.6833	111.1167	752.555	-417.149
KYKM	YAKIMA	46.5667	120.5333	34.366	-261.351
LCKM8	LICK CREEK	45.5	111.9667	678.241	-337.67
LMHM8	LEMHI RIDGE	44.9833	113.4333	573.706	-404.316
LTWW4	LITTLE WARM	44.5	109.75	858.745	-422.908
LVRM8	LAKEVIEW RIDGE	44.5833	111.8333	699.458	-434.309
LWTM8	LOWER TWIN	45.5	111.9167	681.979	-337.245
LYBM8	LIBBY 32 SSE	47.9739	115.2253	414.948	-95.342
MANM8	MANY GLACIER	48.8	113.6667	518.566	2.242
MITO3	MITCHELL	44.5667	120.1667	63.662	-475.847
MNPM8	MONUMENT PEAK	45.2167	110.2333	811.761	-351.724
MPLM8	MADISON PLATEAU	44.5833	111.1167	753.876	-427.805
MRQW4	MARQUETTE CREEK	44.3	109.2333	901.057	-438.485
MTKM8	MOUNT LOCKART	47.9167	112.8167	588.17	-86.374
NDRQ2	NEW DENVER	49.9833	117.3833	250.23	111.441

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
NEVM8	NEVADA CREEK	46.8333	112.5167	621.962	-199.842
NORM8	NORTHEAST ENTERANCE	45	110	832.429	-372.38
NUTU1	NUTTERS RANCH	39.8	110.25	888.494	-929.261
NWPO3	NEWPORT	44.61	124.07	-234.714	-467.031
OGDU1	OGDEN PIONEER	41.2439	111.9475	731.278	-791.982
OVDM8	OVANDO 9SSE	46.8969	113.0619	581.445	-197.146
PCKM8	PICKFOOT CREEK	46.5833	111.2667	716.452	-216.064
PINW4	PINEDALE DCP	42.8833	109.85	875.267	-595.97
PLCM8	PLACER BASIN	45.4167	110.1	818.837	-329.091
PRKW4	PARKER PEAK	44.7333	109.9167	842.644	-399.872
PRPM8	PORCUPINE	46.1167	110.4667	781.591	-258.277
PVRO3	PEAVINE RIDGE	45.05	121.9333	-70.879	-423.874
RADQ2	KOOTENAY NATL PARK	50.62	116.0667	337.03	184.76
RKPM8	ROCKER PEAK	46.3667	112.25	646.906	-247.539
ROCM8	ROCKY BOY	48.1833	109.65	810.45	-30.271
SDMM8	SADDLE MOUNTAIN	45.7	110.4333	789.942	-302.297
SFDU1	SCOFIELD DAM	39.7858	111.1189	817.242	-940.037
SFSM8	SOUTH FORK SHIELDS	46.0833	110.4333	784.527	-261.504
SHCM8	SHORT CREEK	44.9667	111.95	685.948	-394.419
SHOI1	SHOSHONE	42.9383	114.4169	517.338	-629.822
SISW1	SMITH ISLAND	48.32	122.84	-131.577	-71.613
SLNI1	SALMON KSRA	45.1875	113.9008	536.409	-385.725
SNVC1	SUSANVILLE 2SW	40.4167	120.6631	27.565	-922.428
SPMW1	SPENCER MEADOWS	46.1833	121.9333	-69.461	-302.211
SPRM8	SPUR PARK	46.7833	110.6167	761.267	-188.76
SUPM8	SUPERIOR	47.1931	114.8908	445.337	-177.187
SVNW1	STEVENS PASS	47.733	121.0833	-6.105	-136.193
SYLW4	SYLVAN LAKE	44.4833	110.15	828.642	-428.9
SYRW4	SYLVAN ROAD	44.4667	110.0333	837.743	-429.451
THUW4	THUMB DIVIDE	44.3667	110.5667	798.624	-445.545
TIBM8	TIZER BASIN	46.35	111.85	676.561	-246.014
TICW4	TIMBER CREEK	44.0333	109.1833	909.07	-466.252
TOPW4	TWO OCEAN PLATEAU	44.15	110.2167	828.384	-465.056
TPEM8	TEPEE CREEK	44.7833	111.7	707.097	-411.807
TTIW1	TATOOSH ISLAND	48.39	124.74	-266.931	-59.367
UBKW1	UPPER BAKER DAM	48.65	121.6833	-48.617	-37.445
VAVQ2	VAVENBY	51.5833	119.7833	81.527	278.891
WALM8	WALDRON	47.9167	112.7833	590.563	-86.128
WEYM8	W. YELLOWSTONE 9WNW	44.7867	111.1317	750.053	-406.272
WHRU1	WHITEROCKS	40.6131	109.9286	902.808	-838.797
WHTM8	WHITE MILL	45.05	109.9	839.207	-366.018
WLVW4	WOLVERINE	44.8	109.65	861.777	-389.941
WPOW1	WEST POINT	47.66	122.44	-104.271	-143.102
WSKM8	WHISKEY CREEK MT	44.6	111.15	751.129	-426.339
WWPI1	WALLACE WOODLAND	47.4794	115.9089	369.264	-151.692
YOUW4	YOUNTS PEAK	43.9333	109.8167	862.159	-483.889

ID-OR-WA BART Modeling Protocol:

Summary of Comments and Responses

The BART modeling protocol developed by Washington, Oregon, and Idaho was distributed to BART-eligible sources in the three-state region, the Federal Land Managers (FLMs), and EPA Region 10 in early June 2006. Comments were received in the period up to June 30, 2006. Many comments have been addressed by clarifications or modifications to the protocol, and the protocol is greatly improved with these changes. Significant comments relating to modeling and technical issues are summarized below, together with responses.

Comments Grouped by Topic

General Comments 1: Class I areas and Columbia River Gorge National Scenic Area (CRGNSA).

Comments: The CRGNSA and all Class I areas beyond 200 km should not be included in the analysis.

Response: Inclusion of CRGNSA in the analysis is for information purposes only. The inclusion of all Class I areas within 300 km is based on EPA "Guidelines on Air Quality Modeling" (Section 6.1 of Appendix W).

General Comments 2: Ozone and ammonia backgrounds.

Comments: 1) Provide justification for backgrounds; 2) Use an OZONE.DAT file to allow CALPUFF to choose the ozone concentration at each computational grid point based on the nearest monitoring value; 3) Use monthly or seasonally varying O_3 background; 4) Vary ammonia background by Class I area; 5) Use the ammonia limiting method in POSTUTIL; 6) Use ammonia data from WRAP.

Response: Ozone data in Washington, Oregon and Idaho were analyzed, and an annual background concentration of 60 ppb for domain was determined to be representative. Using varying ozone concentrations for each grid point, including the use of an OZONE.DATA file, is not considered suitable for conditions in the modeling domain. An ammonia background concentration of 17 ppb was determined to be appropriate based on the presence of high ammonia-emitting areas in the three-state region that are not adequately represented in the WRAP modeling. It is recognized that ammonia values may be lower in Class I areas, but the analysis must account for plume transport through ammonia-rich areas. Clarification was added to Section 3.6.3.

General Comments 3: Natural Background and Class I areas.

Comments: 1) Clarify the basis for determining natural background (20% best days or annual average); 2) Provide basis for the 20% best-days natural background numbers that are given in Appendix B; 3) Clarify the use of the alternative method in the EPA Guidance on Developing Natural Background to refine the background values used in the modeling; 4) The natural background is too low (conservative), and should be adjusted to include the contribution of natural carbon and sea salt; 5) Use the new IMPROVE Rayleigh scattering estimates developed in November 2005, instead of the default value of 10; 6) Add the Jarbidge Wilderness area in Nevada to the list of Class I areas in the modeling.

Response: 1) The 20% best days natural background will be used and is consistent with the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125). The protocol was clarified to reflect these comments. The use of the new IMPROVE formula for calculating visibility extinction, including the addition of sea salt, has not been approved by the FLMs for the BART analysis. The new Rayleigh scattering formula will also not be used, which is consistent with FLM recommendations. The Jarbidge Wilderness was added to the Class I area list.

General Comments 4: BART Exemption thresholds.

Comments: 1) Multiple or grouped sources should be compared to the 1.0 dv ("cause" threshold) not to the 0.5 dv ("contribute" threshold); 2) Provide information on how the multi-source analysis will be managed, including data sharing among states; 3) Clarify the use of the 98th percentile dv change versus the highest dv change, and how this metric is linked to the method for estimating natural background; 4) Calculate the change in visibility on a receptor-by-receptor basis, not on the Class I area.

Response: Following the BART modeling guidance, the contribution threshold is 0.5 dv and will be applied to individual sources. In the multi-source assessment, the 0.5 dv value is used only as a marker to indicate that a further analysis of these sources will be carried out; it is not considered a contribution threshold. The additional analysis of these multiple sources will look at the frequency, magnitude, duration, and other factors to determine if these sources, if any, will be considered significant and Subject to BART. Section 2.7.1 has been clarified regarding these multi-source assessments. Emissions and modeled concentration data will be shared among the three states. The 98th percentile change in dv will be used in conjunction with the 20% best days natural background and is based on the EPA BART guidelines and comments of the FLMs. The assessment of visibility change will be based on a receptor-by-receptor basis.

General Comments 5: Multi-source modeling and assessment methodology.

Comments: 1) The reference to FLAG and the use of "magnitude, frequency, duration" in Exemption modeling should be removed as these factors only apply in the Determination phase of the modeling; 2) Clarify the difference between the BART Exemption modeling and Determination modeling; (for example, if a source is determined to be Subject to BART based on the multi-source analysis, should not the BART Determination also be based on group analysis?).

Response: Consistent with the EPA BART Guidelines, the FLAG and IWAQM reports will be used as general guidance for the visibility assessment. The single-source BART Exemption analyses will be based on the 0.5 dv contribution threshold and will not consider the frequency, magnitude, and duration of impairment (consistent with BART Guideline). For the evaluation of multi-source impacts, the BART Exemption analyses will consider an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each sources in the multi-source group. Section 2.7.2 has been clarified for the Determination phase.

General Comments 6: Inclusion of VOC and ammonia-emitting sources in the BART modeling.

Comments: 1) Remove VOCs and ammonia from the visibility analysis; 2) If VOCs are modeled, justify basis for VOC speciation.

Response: Section 2.3 in the protocol has been modified to read, "Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds that require a full BART exemption analysis." For Washington, "VOC emissions will be included in the BART exemption analysis if the greater-than-six carbon VOC gases exceed 250 tons/year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms."

General Comments 7: Definition of Bart-eligible sources.

Comments: Confusion on definition of BART-eligible source.

Response: Section 2.1 in protocol has been clarified to show that a "BART-eligible source" refers to the entire facility that has BART-eligible emission units."

General Comments 8: Characterization of facility emissions.

Comment: 1) Clarify under what conditions emission units and pollutants can be excluded in the BART Exemption modeling; 2) Do not include fugitive emissions; 3) Describe how different operating scenarios might be included; 4) Clarify the modeling of HNO_3.

Response: Section 2.4 was clarified on the exemption of pollutants and individual emission units and specifically the exemption of fugitive emissions for sources that are greater than 10km from a Class I area. Different operating scenarios are not addressed in the protocol; if this is a significant issue for an individual source, it will be addressed on a case-by-case basis. HNO_3.modeling is addressed in Section 3.6.1.

General Comments 9: PM speciation.

Comments: 1) Clarify how PM will be speciated, especially the inclusion of the condensable fraction of emissions and scavenging coefficients for PM species; 2) Address the possible double-counting of SO_4 in PM_{10} condensables with gaseous SO_2; 3) Correct the problem with the speciation references in the appendices; 4) Add additional sources of speciation data than those listed in the appendices; 5) Make reference to the NPS Web site for speciation information.

Response: Section 3.6.1 was modified to give a better description of PM speciation, size fractionation, treatment of condensables, and the modeling of SO_2 and H2SO_4 to ensure no double-counting. The statement "The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions" was added. Appendix G was removed and three information sources were included in Section 3.6.1. A chart showing the default PM size fractions to be used in CALPUFF was included in the protocol:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.48	2
PMC	2.5	5

General Comments 10: CALMET modeling.

Comments: 1) The CALMET modeling protocol was not available for public review, yet the work is already under way; 2) Make clear that states, not Geomatrix, is responsible for the protocol for developing the CALMET data set; 3) Correct the years of CALMET data that is shown in section 3.1.2; 4) Clarify how the 12-km CALMET data will be used; 5)

Describe how the CALMET data will be provided; 6) Describe how the MM5 will be evaluated.

Response: Clarification was added to Section 3.5. Due to time and resource constraints, an initial CALMET protocol and the development of the data set was started prior to the finalizing of the protocol. The FLMs and EPA were consulted throughout this process, and the initial draft of the CALMET protocol was reviewed and approved before the work began. The years of CALMET data given in the protocol have been corrected. Only the 4-km CALMET data will be used for BART modeling, but both the 4 km and 12 km met data will be available for other air quality analyses. Individual facilities will contact the appropriate state agency to discuss options for obtaining the CALMET data. The MM5 data was evaluated using METSTAT, a publicly available statistical program.

General Comments 11: CALPUFF model versions.

Comments: 1) Clarify reasons for using Version 6 as this is not consistent with other RPO protocols; 2) Correct the listing of versions in the protocol; 3) Update the protocol and the appendices to reflect the use of Version 6.

Response: Version 6 is the most recent version of CALPUFF and was made available after other protocols in other regions were completed. It was felt important that the most recent version be used, in part because of the improved over-water algorithm. The protocol was corrected to show Version 6 of the CALPUFF modeling system. Appendices were updated to include the new parameters in Version 6.

General Comments 12: CALPUFF modeling parameters.

Comments: Comments on CALPUFF: 1) Clarify the meaning of the phrase "protocol will generally follow FLAG and IWAQM;" 2) Use puff-splitting; 3) Use building downwash; 4) Base source elevations on the same terrain files as the receptor elevations.

Response: The FLAG and IWAQM reports were used as guidance documents during the development of the protocol, and are specifically referenced in the EPA BART guidelines. Puff-splitting and building downwash will not be used in CALPUFF based on the recommendations from FLMs. Clarification was added to Section 3.6.4 to state that source and receptor elevations will be the actual elevations, and will not be based on the DEM data used for the development of the windfields in CALMET.

General Comments 13: CALPOST

Comments: 1) Describe how OC (SOA) is treated in CALPUFF, POSTUTIL, and CALPOST.

Response: Clarification was added to Sections 3.6 and 3.7.

General Comments 14: BART modeling implementation.

Comments: 1) Clarify if the protocol is required for all BART-eligible sources, or can the use of higher resolution met data, or other refined model options, be used to address local conditions; 2) Show the BART schedule, including the estimated time and resources required by IDEQ and WRAP; 3) Describe the process for determining and prioritizing BART control measures, including the sensitivity of the visibility modeling to PM, SO_2, and NO_x emissions; 4) Comment on the observation that control technologies that do not produce visibility improvements will not be determined to be BART.

Response: These local or state-specific issues are not addressed in the protocol, and should be discussed separately with each state agency. In addition, this response to comments is intended only to address the modeling and technical analysis issues of the BART process and not to respond to questions or comments of a legal nature.

Specific Comments

Specific Comment 1: Terminology.

Comment: The term “BART exemption modeling” is not used in the BART Guidelines (40 CFR part 51, Appendix Y). It is suggested that a term that is more directly tied to Appendix Y be used.

Response: The terms in the BART Guidelines are not clear; therefore, the modeling protocol distinguishes between “BART Exemption modeling” (a process to exempt sources from being Subject to BART) and “BART Determination modeling” (a process to determine the level of controls, together with other factors, necessary to meet BART).

Specific Comment 2: Typo

Comment: Put “or” between two bullets in Section 2.4.

Response: The change was incorporated in the protocol.

Specific Comment 3: BART-eligible emission units

Comment: Include a list of all BART-eligible units.

Response: A listing of all BART-eligible units was not included in the protocol as there are potentially a large number of individual emission units, and there may be changes in the actual units included in the modeling as the analysis proceeds. Only a list of BART-eligible sources is included in the protocol.

Specific Comment 4: Model performance evaluation.

Comment: 1) In the protocol, include a section on performance evaluation that addresses the accuracy of the estimated visibility compared to monitored visibility impairment; 2) In the modeling reports, include a summary of a model performance evaluation using the PM_{10} SIP evaluation as guidance; 3) Describe why the protocol and analysis will not result in an overly conservative result, even as a screening approach.

Response: A section on model performance evaluation was not included in the protocol because it is not appropriate for the type of modeling analysis. In order to complete a model evaluation, several data sets are required covering the same time period: meteorological data, actual emissions data from all source types, and monitoring data. The purpose of the BART analysis is to determine the impact on a Class I area of an individual source or a group of sources. All other emissions that are present in the modeling domain that would contribute to impairment at a monitor are not included in the analysis. As a result, the BART modeled visibility impairment can not be compared to monitoring data. Also, the metrological data and emissions data must be in the same time period as the monitoring data.

The mesoscale meteorological data (MM5) is being evaluated against actual meteorological observation data as well as the CALMET output files.

The protocol is based on recommendations in the BART Guideline, FLAG report, and IWAQM report. In addition, the BART Exemption modeling approach that is described in this protocol is virtually identical to visibility analyses that have been a part of NSR for sources in the Pacific NW for over five years, and is not considered overly protective of visibility.

Subject to BART Modeling Analysis

Subject-to-BART Analysis

For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Table of Contents

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[1]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[2], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

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[1] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[2] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: Nu-West, Pocatello, Idaho

The East Sulfuric Acid Plant of Nu-West in Agrium, Idaho has been determined to be BART-eligible. The *Potential to Emit* (PTE) for the unit listed in Table 1 exceeds 250 tons per year (tn/yr) for the haze-causing pollutants SO_2, and the source was put in service between August 7, 1962 and August 7, 1977, so the source is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers. (Particulate emissions were not provided but visibility impacts due to SO2 are so low that particulates are unlikely to influence the conclusion anyway).

Table 1. Emissions rates used for BART modeling.

Facility	Emission Unit	BART Category	Year Installed	Maximum 24-hour emission rate (lb/hr)		
				PM_{10}	SO_2	NO_x
Agrium						
	East Sulfuric Acid Plant	10	1973		258	

Speciation of Emissions

PM10 emissions were not addressed in this analysis, therefore, no speciation was needed.

Table 2. Facility information, stack parameters, and speciation of emissions.

Facility Information	**Facility_ID**	**ID-6**
	Facility_Name	Nu-West (Agrium)
Unit Information	Unit_ID	220
	Unit_Description	East Sulfuric Acid Plant
Control Information	Control_ID	1
	Control_Description	Existing Control - Ver. 2
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	12
	Longitude_Easting (km)	455.658
	Latitude_Northing (km)	4724.52
	Base_Elevation (m)	1882
Stack Parameter	Stack_Height (m)	33.5
	Stack_Diameter (m)	2.3
	Stack_Exit_Temperature (K)	347.6
	Stack_Exit_Velocity (m/s)	11.5
Emission Rate (lb/hr)	SO_2	258
	SO_4	0
	NO_X	0
	HNO_3	0
	NO_3	0
	PMC	0
	PMF	0
	EC	0
	SOA	0

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 1:

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas. The eastern edge of several Class I areas did not retain a 50 km buffer, because the MM5 domain does not extend for enough east, but visibility impacts for those areas are10% or less of the threshold, so this is not a significant problem.

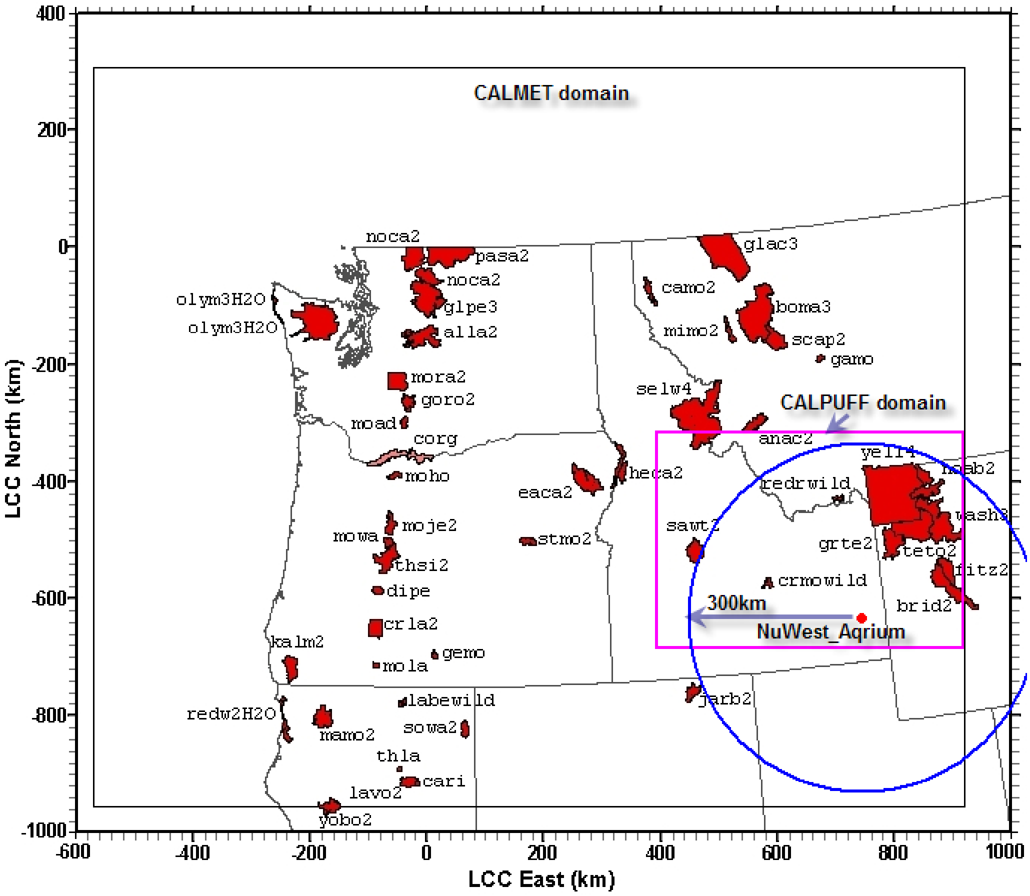

Figure 1. Modeling domain for Nu-West, Agrium, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the East Sulfuric Acid Plant are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 3. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the Nu-West East Sulfuric Acid Plant.

Source Name: ID6, Nu-West East Sulfuric Acid Plant								
Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003-2005)
Sawtooth Wilderness, ID	0.012	0	0.029	0	0.035	0	0.027	0
Red Rock Lakes Wilderness, MT	0.051	0	0.069	0	0.059	0	0.057	0
North Absaroka Wilderness, WY	0.024	0	0.038	0	0.044	0	0.038	0
Craters of the Moon Wilderness, ID	0.048	0	0.056	0	0.08	0	0.073	0
Bridger Wilderness, WY	0.046	0	0.044	0	0.051	0	0.049	0
Fitzpatrick Wilderness	0.032	0	0.022	0	0.038	0	0.032	0
Grand Teton National Park, WY	0.099	0	0.114	0	0.126	0	0.120	0
Teton Wilderness, WY	0.057	0	0.072	0	0.073	0	0.069	0
Washakie Wilderness, WY	0.026	0	0.041	0	0.045	0	0.038	0
Yellowstone National Park, WY	0.062	0	0.102	0	0.11	0	0.101	0

Class I Area of Greatest Impact

The East Sulfuric Acid Plant had the greatest impact on the Grand Teton National Park. Details of the 22 highest calculated changes in deciview for Grand Teton National Park for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the East Sulfuric Acid Plant. Secondary sulfate is the only pollutant that impacts the visibility in Class I areas.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2.

The top 22 delta-deciview values predicted for the Grand Teton Nation Park are plotted in Figure 3.

Table 4. The top 22 highest Delta-deciview values and related modeling output data at Grand Teton National Park.

Rank	YEAR	DAY	DV(Total)	DV(BKG)	DELTA_DV	F(RH)	%_SO4	%_NO3	%_OC	%_EC	%_PMC	%_PMF
1	2004	18	2.454	2.091	0.362	2.62	100	0	0	0	0	0
2	2005	28	2.32	2.091	0.228	2.62	100	0	0	0	0	0
3	2003	11	2.291	2.091	0.199	2.62	100	0	0	0	0	0
4	2004	8	2.285	2.091	0.193	2.62	100	0	0	0	0	0
5	2005	25	2.283	2.091	0.191	2.62	100	0	0	0	0	0
6	2004	22	2.278	2.091	0.187	2.62	100	0	0	0	0	0
7	2005	358	2.259	2.077	0.182	2.55	100	0	0	0	0	0
8	2005	17	2.246	2.091	0.155	2.62	100	0	0	0	0	0
9	2004	323	2.205	2.053	0.153	2.43	100	0	0	0	0	0
10	2003	8	2.243	2.091	0.151	2.62	100	0	0	0	0	0
11	2003	334	2.2	2.053	0.148	2.43	100	0	0	0	0	0
12	2005	23	2.235	2.091	0.144	2.62	100	0	0	0	0	0
13	2003	46	2.188	2.044	0.144	2.39	100	0	0	0	0	0
14	2005	19	2.232	2.091	0.141	2.62	100	0	0	0	0	0
15	2004	15	2.233	2.091	0.141	2.62	100	0	0	0	0	0
16	2005	58	2.178	2.044	0.134	2.39	100	0	0	0	0	0
17	2004	16	2.221	2.091	0.13	2.62	100	0	0	0	0	0
18	2003	350	2.206	2.077	0.129	2.55	100	0	0	0	0	0
19	2005	63	2.14	2.013	0.126	2.24	100	0	0	0	0	0
20	2005	24	2.213	2.091	0.121	2.62	100	0	0	0	0	0
21	2004	10	2.213	2.091	0.121	2.62	100	0	0	0	0	0
22	2003	14	2.212	2.091	0.12	2.62	100	0	0	0	0	0

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

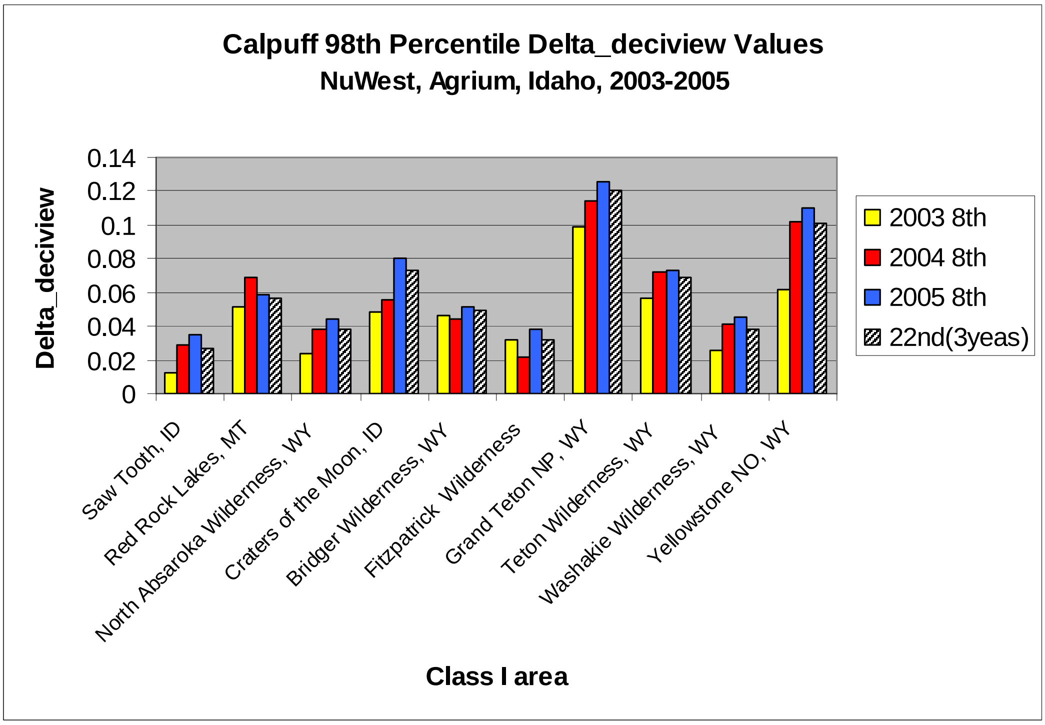

Figure 2. 98th percentile values of Delta-deciview in the Class I areas. Source is Nu-WestEast Sulfuric Acid Plant at Agrium, Idaho.

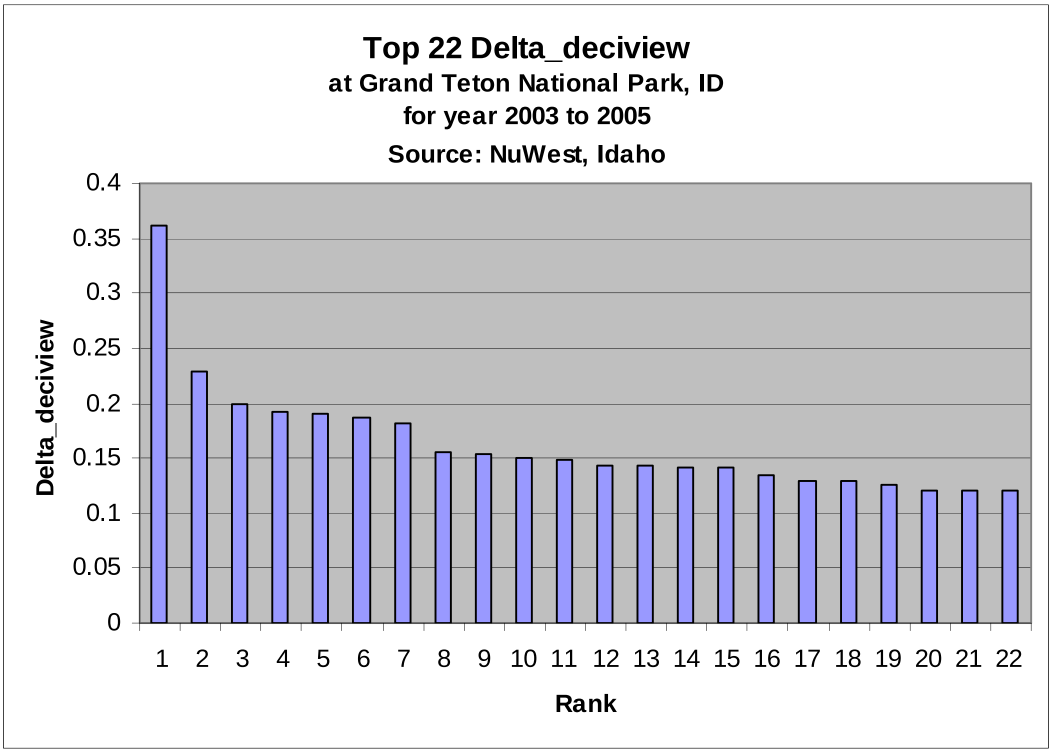

Figure 3. Top 22 highest Delta-deciview values at the Grand Teton National Park. Source is Nu-West East Sulfuric Acid Plant at Agrium, Idaho.

Dominating Pollutants for Visibility Impact

Figure 4 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days. Sulfate is the only pollutant modeled for this facility.

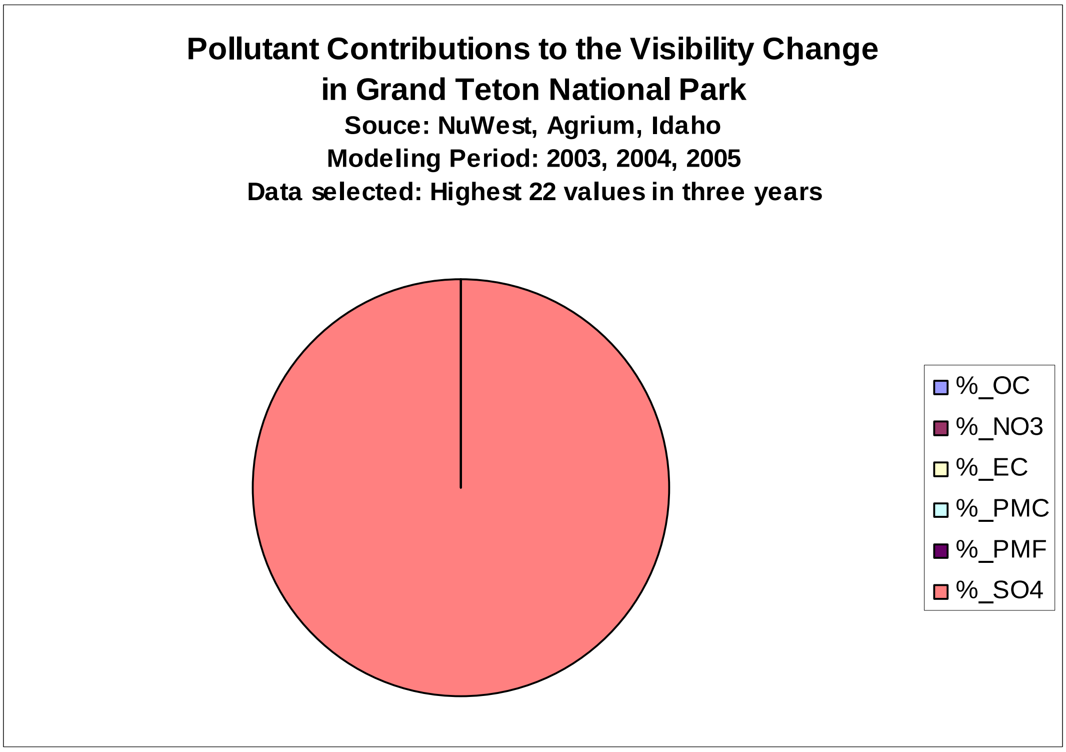

Figure 4. The pollutant contribution from Nu-West-Agrium East Sulfuric Acid Plant to visibility change at the Grand Teton National Park, WY. Secondary sulfate is the only contributor.

Seasonal Variation of Visibility Degradation

The analyses showed that the most significant impact to the visibility occurs in the cold season, between November and February. In the modeling period from year 2003 to 2005, significant seasonal variations are observed for the Nu-West East Sulfuric Acid Plant. When the winter meteorological conditions are favorable for hygroscopic aerosols formation, the delta-deciview dramatically increase, however the effect is minimal in the dry and hot summertime. The degree of the variation depends on the relative location of the source and the Class I areas, and the meteorological conditions as well. The modeling results for Grand Teton (where the highest values were predicted) are shown in Figure 5.

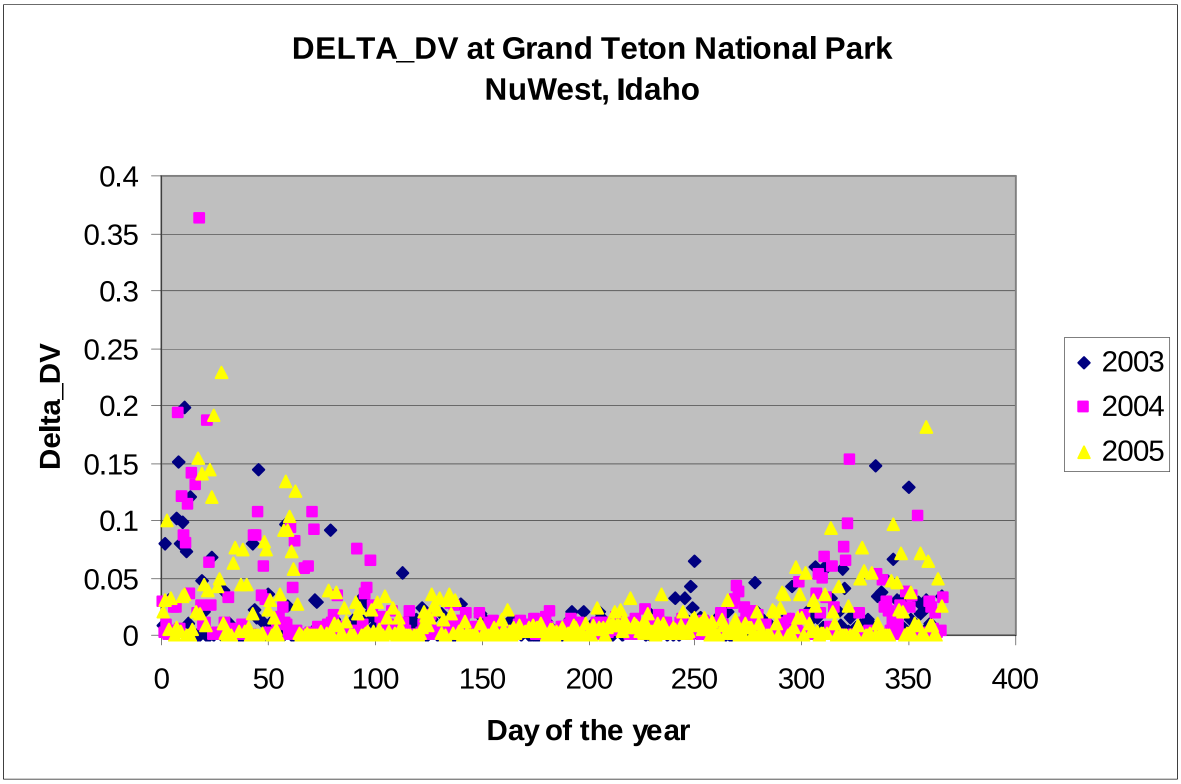

Figure 5. Seasonal impact from Nu-West East Sulfuric Acid Plant at Agrium, ID, to the Grand Teton Nation Park. Higher days are predicted for January 2004.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 6 shows the stagnation conditions in south Idaho during the episode in January 2004. Under such conditions, pollutants pool up in the valleys and slowly transport to the Class I areas with very little dispersion.

Figure 7 shows a contour map of the number of days of impact higher than or equal to 0.5 deciview in the three-year period. The results show minimal dispersion and transport and the pollutants are limited in a small area due to the geological and meteorological conditions and relatively low emission rate.

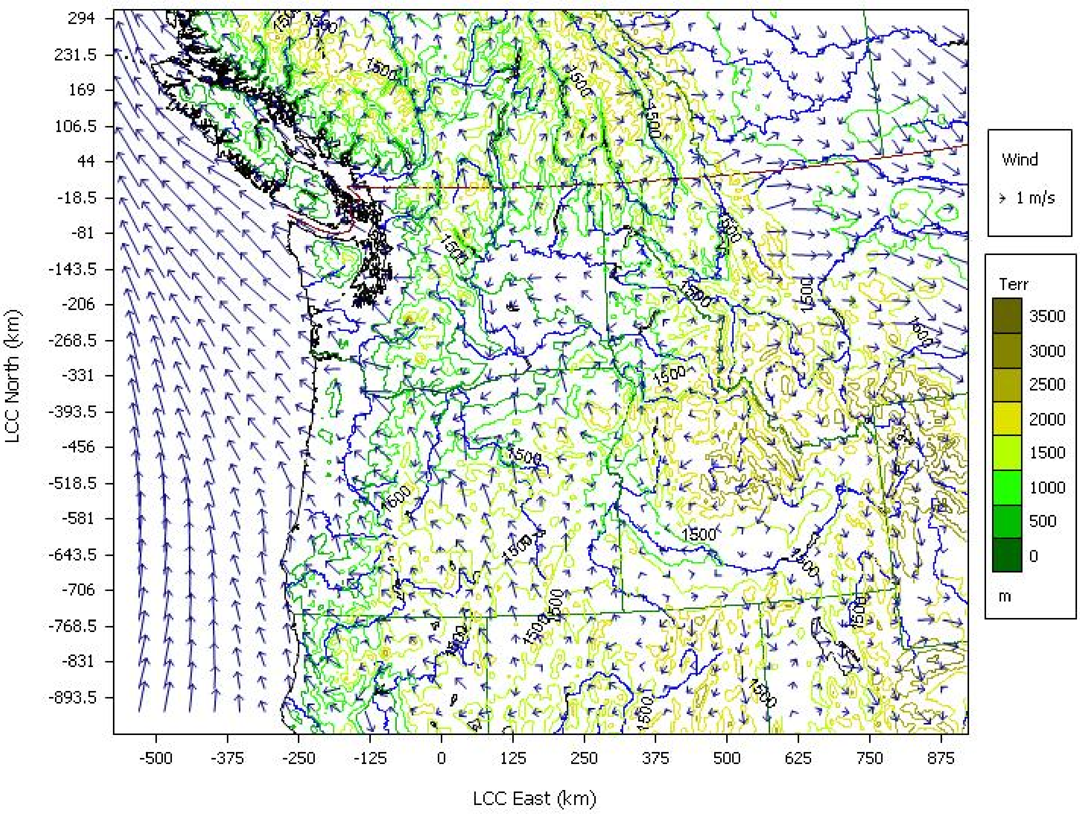

Figure 6. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Grand Teton National Park. A strong stagnation system persisted in the Snake River Valley for more than 2 weeks. However, the pollutants are limited in a small area (see Figure 7) due to the geological conditions.

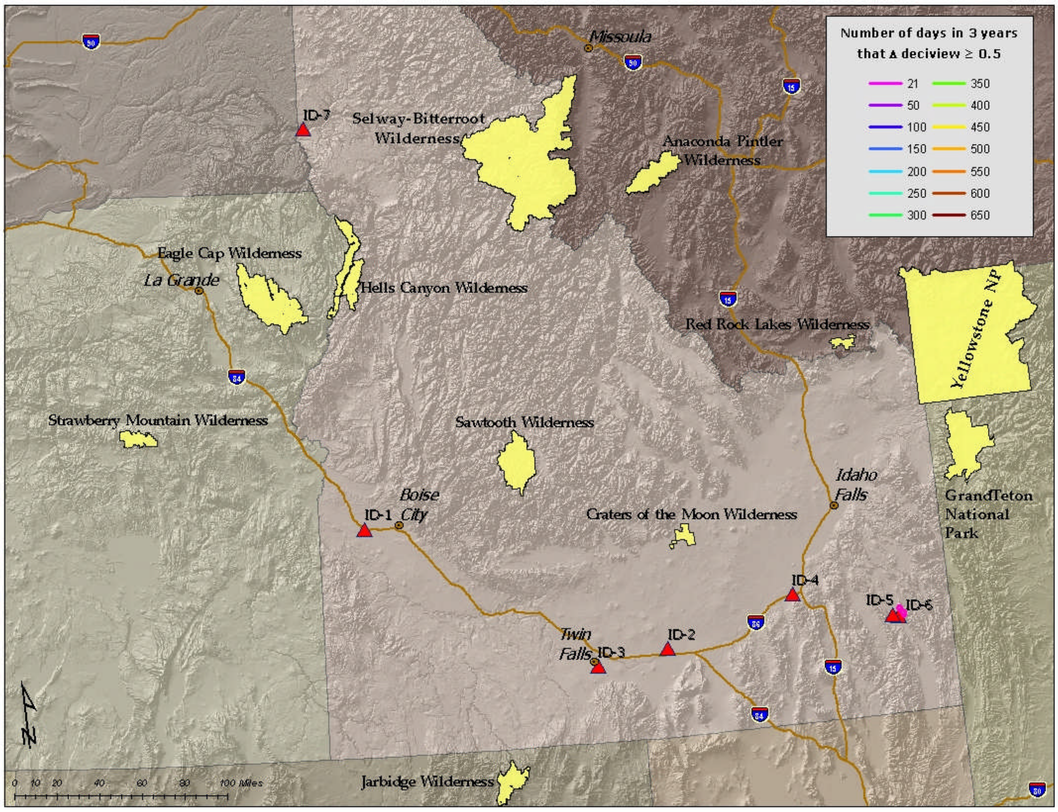

Figure 7. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: Nu-West East Sulfuric Acid Plant at Agrium, Idaho (ID-2). The Grand Teton National Park is the most significantly impacted area by the source because of its location, however, contours do not extend beyond the immediate vicinity of the facility because the impact is so low.

Summary and Conclusions

The CALPUFF model demonstrated that during the period from year 2003 to 2005, the Nu-West **East Sulfuric Acid Plant** Agrium facility, had no impacts to visibility with the 8^{th} annual highest value higher than or equal to 0.5 deciview in any Class I area within a distance of 300 km from the source.

The highest delta-deciview value of 0.362 was predicted in the Grand Teton National Park on January 18, 2004. The 3-year 22^{nd} highest value was 0.12, predicted for January 22, 2003 in the Grand Teton National Park. The 1-year eighth-highest delta-deciview value was 0.126 on March 4, 2005, also in the Grand Teton National Park.

The major contributor is secondary sulfate, SO_4, the pollutant is limited to a small area near the source, and the impact occurs mostly in winter time when a high pressure system persists in the area, and the atmosphere is stagnant with poor dispersion.

The results showed that the Nu-West East Sulfuric Acid Plant Agrium facility is not subject to BART.

Appendix: CALPUFF Modeling Setup for Nu-West, Agrium, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI60444	
Title:	ID-6 4km Existing Control version 3; 2004 through 2005 corrected	

Scenario Description: ID-6; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID:	1	
Number of Species:	9	
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA	

Calpuff Working Directory

Working Directory:	Y:\airmodel\calpuff\runs\bart\wzI60444	

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1	
Source_Elevation_Option:	Model	

Source 1

Source Category

Category:	Point

Facility Information

Facility ID:	ID-6
Facility Name:	NuWest (Agrium)

Unit Information

Subject-to-bart analysis
For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Unit ID:	220
Unit Description:	East Sulfuric Acid Plant

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	455.658
Northing (km):	4724.52
Base Elevation (m):	1882

Source Location under Domain Projection and Datum

XEasting (km):	745.828
YNorthing (km):	-635.426

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1888.830
bar_12km (m):	1946.845

Stack Parameters

Height (m):	33.5
Diameter (m):	2.3
Exit Temperature (K):	347.6
Exit Velocity (m/s):	11.5

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	258.00000
SO4 (lb/hr):	0.00000
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.00000
PMF (lb/hr):	0.00000
EC (lb/hr):	0.00000
SOA (lb/hr):	0.00000

Emission Rate (Unit: g/s)

SO2 (g/s):	32.50745
SO4 (g/s):	0.00000
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.00000
PMF (g/s):	0.00000
EC (g/s):	0.00000
SOA (g/s):	0.00000

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	10
ID:	brid2

Subject-to-bart analysis
For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Name:	Bridger Wilderness
State:	WY
# Total Receptors:	684
# Receptors In Calmet Domain:	585
Position In Receptor List:	1 - 585
ID:	crmowild
Name:	Craters of the Moon NM - Wilderness
State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	586 - 856
ID:	fitz2
Name:	Fitzpatrick Wilderness
State:	WY
# Total Receptors:	316
# Receptors In Calmet Domain:	316
Position In Receptor List:	857 - 1172
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	1173 - 1678
ID:	noab2
Name:	North Absaroka Wilderness
State:	WY
# Total Receptors:	567
# Receptors In Calmet Domain:	567
Position In Receptor List:	1679 - 2245
ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	2246 - 2467
ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2468 - 2820
ID:	teto2
Name:	Teton Wilderness
State:	WY
# Total Receptors:	940
# Receptors In Calmet Domain:	940
Position In Receptor List:	2821 - 3760
ID:	wash3

Subject-to-bart analysis
For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Name:	Washakie Wilderness
State:	WY
# Total Receptors:	509
# Receptors In Calmet Domain:	508
Position In Receptor List:	3761 - 4268

ID:	yell4
Name:	Yellowstone NP
State:	WY
# Total Receptors:	915
# Receptors In Calmet Domain:	915
Position In Receptor List:	4269 - 5183

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	373
Beginning Row:	68
Ending Row	160

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Table of Contents

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Introduction

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One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

- The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.
- The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[3]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

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DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[4], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

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[3] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[4] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

BART Eligible Source: Potlatch Pulp and Paper Mill, Lewiston, Idaho

Three units of the Potlatch **Pulp and Paper Mill** in Lewiston, Idaho have been determined to be BART-eligible, as shown in Table 1. The *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants PM_{10}, SO_2 and NO_x, and the source has been put in service between August 7, 1962 and August 7, 1977, so the source is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Table 5. Emissions rates used for BART modeling.

Facility	Emission Unit	BART Category	Year Installed	Maximum 24-hour emission rate (lb/hr)		
				PM_{10}	SO_2	NO_x
Potlatch Pulp & Paper - Lewiston		Facility 3				
	No. 4 Recovery Furnace		1970	40.63	184.0	39.50
	No. 4 Smelt Dissolving Tank		1970	8.28	0.14	0.85
	Lime Kiln 4		1976	5.20	3.42	25.80

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* ($PM_{2.5}$), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF).

Source Classification Codes, unit identifiers, and PMC and $PM_{2.5}$ fractions are taken from the 2005 National Emission Inventory submittal from Facilities, $PM_{2.5}$ speciation was taken from SMOKE2.1 for SAPRC99.

Detailed, speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 6. Facility information, stack parameters, and speciation of emissions.

Facility Information	Facility_ID	ID-7	ID-7	ID-7
	Facility_Name	Potlatch Pulp and Paper	Potlatch Pulp and Paper	Potlatch Pulp and Paper
Unit Information	Unit_ID	189	157	512
	Unit Description	No. 4 Recovery Furnace (Boiler)	No. 4 Smelt Dissolving Tank	Lime Kiln #4
Control Information	Control ID	41	41	41
	Control Description	Existing Control - Ver. 3	Existing Control - Ver. 3	Existing Control - Ver. 3
Datum, Projection, Source Location and Base Elevation	Datum	NAD27	NAD27	NAD27
	Projection	UTM	UTM	UTM
	UTM Zone	11	11	11
	Longitude Easting (km)	502.063	502.079	502.172
	Latitude Northing (km)	5141.662	5141.661	5141.572
	Base Elevation (m)	238	238	238
Stack Parameter	Stack Height m)	99.1	65.5	46.8
	Stack Diameter (m)	2.7	0.9	1.13
	Stack_Exit Temperature (K)	449.8	344.3	463.7
	Stack_Exit Velocity (m/s)	13.1	14.3	24.1
Emission Rate (lb/hr)	SO_2	184	0.143	3.42
	SO_4[a]	11.27	2.89142	2.07433
	NO_X[a]	39.5	0.85	25.8
	HNO_3	0	0	0
	NO_3	0.07668	0.01966596	0.01411
	PMC	12.36777	1.031688	0
	PMF[b]	10.4542	2.681151	1.92348
	EC	0.432412	0.110899	0.07956
	SOA	1.774868	0.455194	0.32656

a. It is assumed that all Sulfate is ammonium sulfate, and all nitrate is ammonium nitrate. Ammonium Sulfate = 1.375 x SO4, and Ammonium Nitrate = 1.29 X NO3.
b. PMF is the fine particulate matter other than SO4, NO3, EC and SOA

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 1:

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

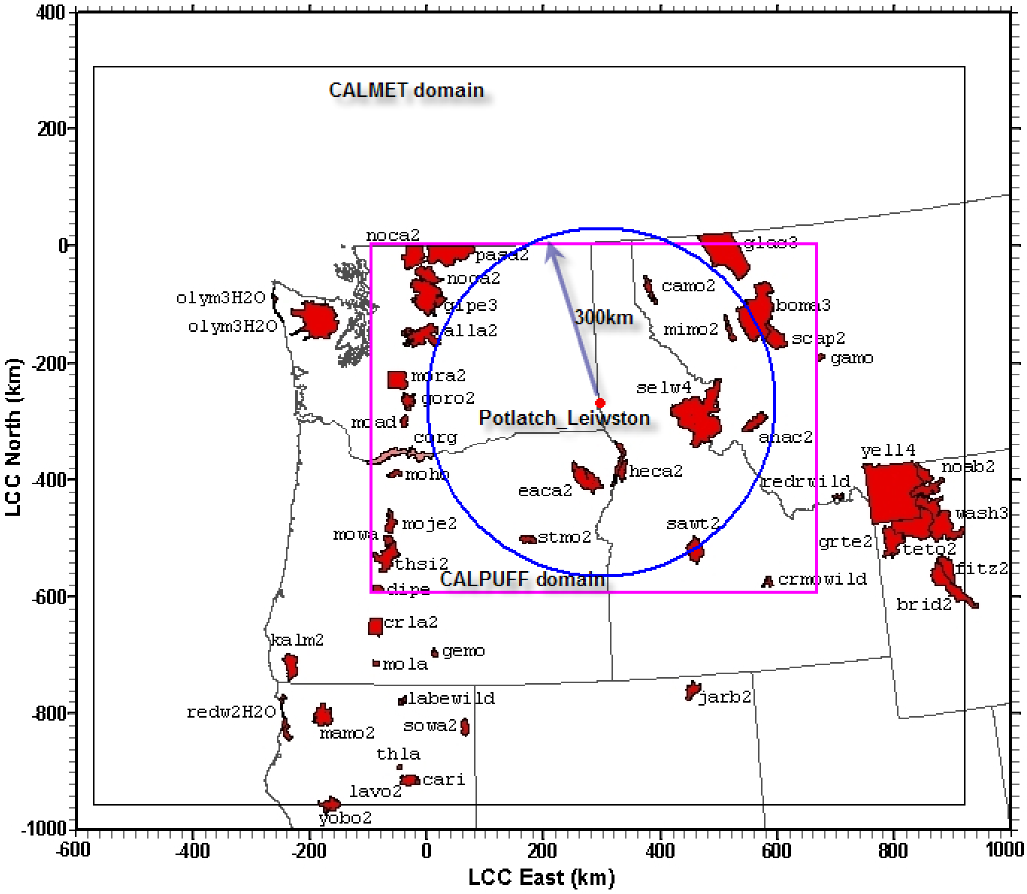

Figure 6. Modeling domain for the Potlatch Pulp Mill No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho
The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the Potlatch **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Source Name: ID7 Potlatch, ID								
Class I Area	**Change in Visibility Compared Against 20% Best Days Natural Background Conditions**							
	Delta-Deciview Value larger than 0.5 from one year period						**Delta-Deciview Value larger than 0.5 from 3 year period**	
	2003		**2004**		**2005**		**2003-2005**	
	8th highest	**Total days**	**8th highest**	**Total days**	**8th highest**	**Total days**	**22nd Highest**	**Number of Days**
Alpine Lakes Wilderness, WA	0.115	0	0.176	0	0.166	0	0.159	0
Anaconda-Pintler Wilderness, WY	0.058	0	0.057	0	0.051	0	0.057	0
Bob Marshall Wilderness, MT	0.056	0	0.065	0	0.049	0	0.057	0
Cabinet Mountains Wilderness, MT	0.101	0	0.137	0	0.1	0	0.109	0
Eagle Cap, OR	0.14	0	0.17	1	0.209	0	0.171	1
Hells Canyon, ID	0.31	2	0.323	5	0.213	1	0.292	8
Mission Mountain Wilderness, MT	0.08	0	0.08	0	0.056	0	0.078	0
Saw Tooth, ID	0.023	0	0.033	0	0.028	0	0.028	0
Scapegoat Wilderness, MT	0.036	0	0.056	0	0.039	0	0.044	0
Seway-Bitteroot, ID	0.196	0	0.224	1	0.173	1	0.207	2
Strawberry Mountain, OR	0.064	0	0.055	0	0.1	0	0.07	0

Table 7. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho.

Class I Area of Greatest Impact

The Potlatch **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** had the greatest impact on the Hells Canyon Wilderness. Details of the 22 highest calculated changes in deciview for Hells Canyon Wilderness for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Secondary aerosols of sulfate and nitrate formed from SO_2 and NO_2 emissions are the dominating pollutants impacting the visibility in Class I areas.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 7. The top 22 delta-deciview values predicted for the Hells Canyon Wilderness area are plotted in Figure 8. Greater variation was predicted for Hells Canyon area, but less in the other areas.

Table 8. The top 22 highest Delta-deciview values and related modeling output data at Hells Canyon Wilderness.

22 highest values at the Hells Canyon Wilderness area by source: Potlatch, ID											
Rank	**YEAR**	**DV(Total)**	**DV(BKG)**	**DELTA_DV**	**F(RH)**	**%_SO_4**	**%_NO_3**	**%_OC**	**%_EC**	**%_PMC**	**%_PMF**
1	2004	3.314	2.373	0.94	3.45	70.96	26.59	0.71	0.43	0.27	1.04
2	2004	3.149	2.373	0.775	3.45	75.7	22.1	0.65	0.39	0.2	0.95
3	2004	3.145	2.373	0.772	3.45	66.32	30.43	0.92	0.56	0.41	1.36
4	2004	2.927	2.305	0.623	3.12	67.86	26.7	1.41	0.86	1.1	2.08
5	2005	2.981	2.425	0.556	3.7	64.19	32.07	1.04	0.63	0.54	1.53
6	2003	2.706	2.155	0.552	2.41	72.74	20.49	1.81	1.1	1.18	2.67
7	2004	2.888	2.373	0.514	3.45	62.05	34.46	1.03	0.63	0.32	1.51
8	2003	2.811	2.305	0.506	3.12	62.35	33.86	1.04	0.63	0.59	1.53
9	2003	2.795	2.305	0.49	3.12	66.51	29.58	1.1	0.67	0.53	1.61
10	2004	2.555	2.103	0.451	2.17	56.38	33.48	2.61	1.59	2.09	3.85
11	2003	2.481	2.103	0.377	2.17	62.56	29.35	2.23	1.36	1.23	3.28
12	2004	2.502	2.155	0.348	2.41	61.52	32.45	1.68	1.02	0.86	2.47
13	2003	2.407	2.067	0.34	2	62.5	27.15	2.77	1.69	1.81	4.08
14	2004	2.39	2.067	0.323	2	73.51	17.1	2.56	1.56	1.49	3.78
15	2004	2.476	2.155	0.321	2.41	62.55	31.63	1.64	1	0.77	2.41
16	2004	2.419	2.103	0.316	2.17	64.14	28.42	2.02	1.23	1.2	2.98
17	2003	2.417	2.103	0.313	2.17	70.66	24	1.46	0.89	0.85	2.15
18	2003	2.298	1.987	0.311	1.63	72.39	16.71	2.94	1.79	1.84	4.33
19	2003	2.377	2.067	0.31	2	64.65	26.02	2.49	1.52	1.66	3.67
20	2005	2.327	2.022	0.305	1.79	68.45	24.04	2.13	1.3	0.94	3.14
21	2004	2.396	2.103	0.292	2.17	65.61	28.02	1.71	1.04	1.09	2.53
22	2003	2.467	2.176	0.292	2.51	62.47	31.44	1.66	1.01	0.98	2.44

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

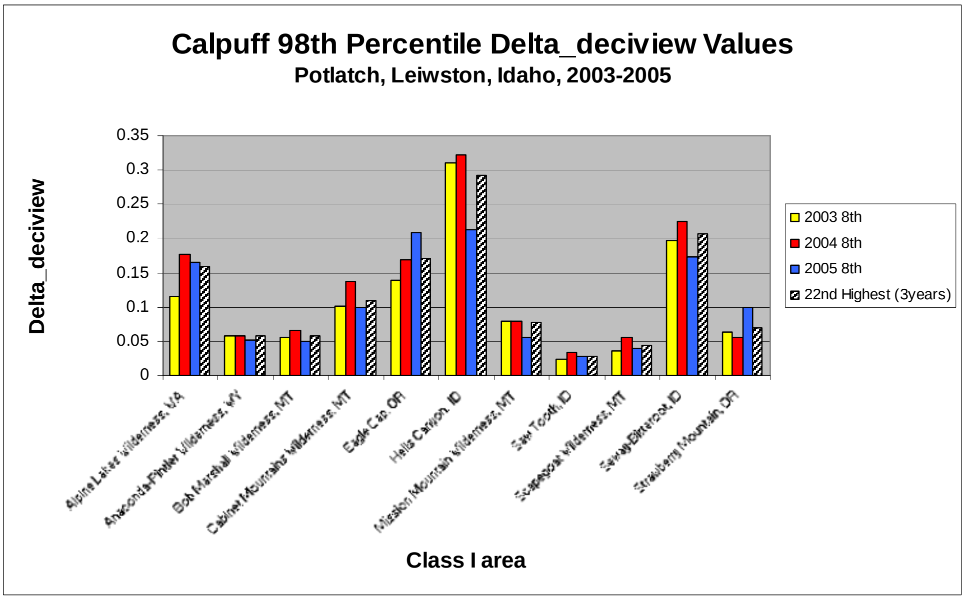

Figure 7. 98th percentile values of Delta-deciview in the Class I areas. Sources are Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 at Lewiston, Idaho.

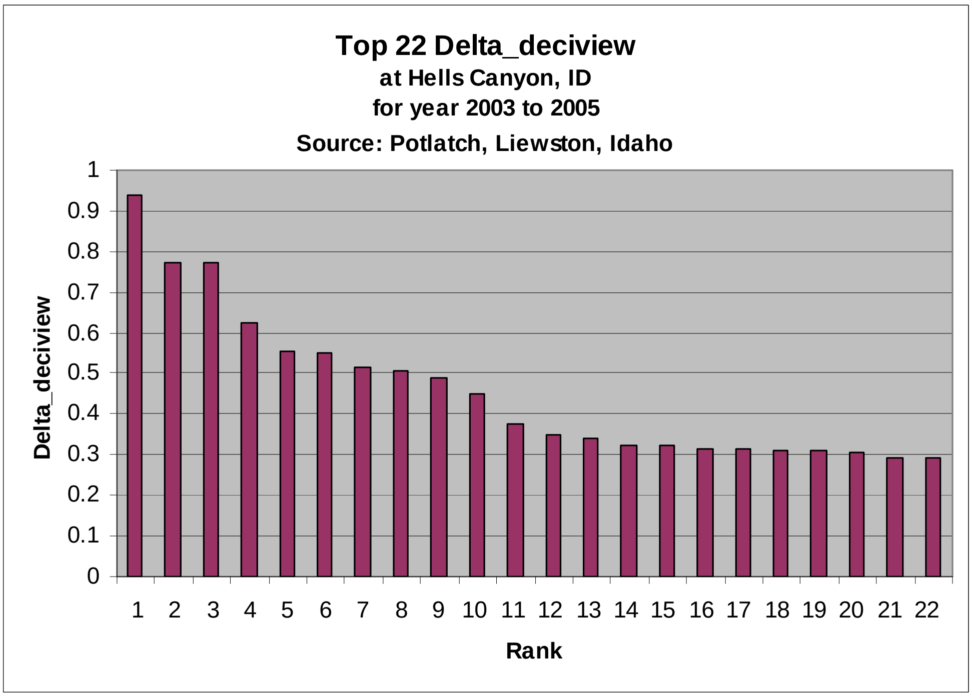

Figure 8. Top 22 highest Delta-deciview values at the Hells Canyon Wilderness area. Sources are Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 at Lewiston, Idaho.

Dominating Pollutants for Visibility Impact

Figure 4 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days.

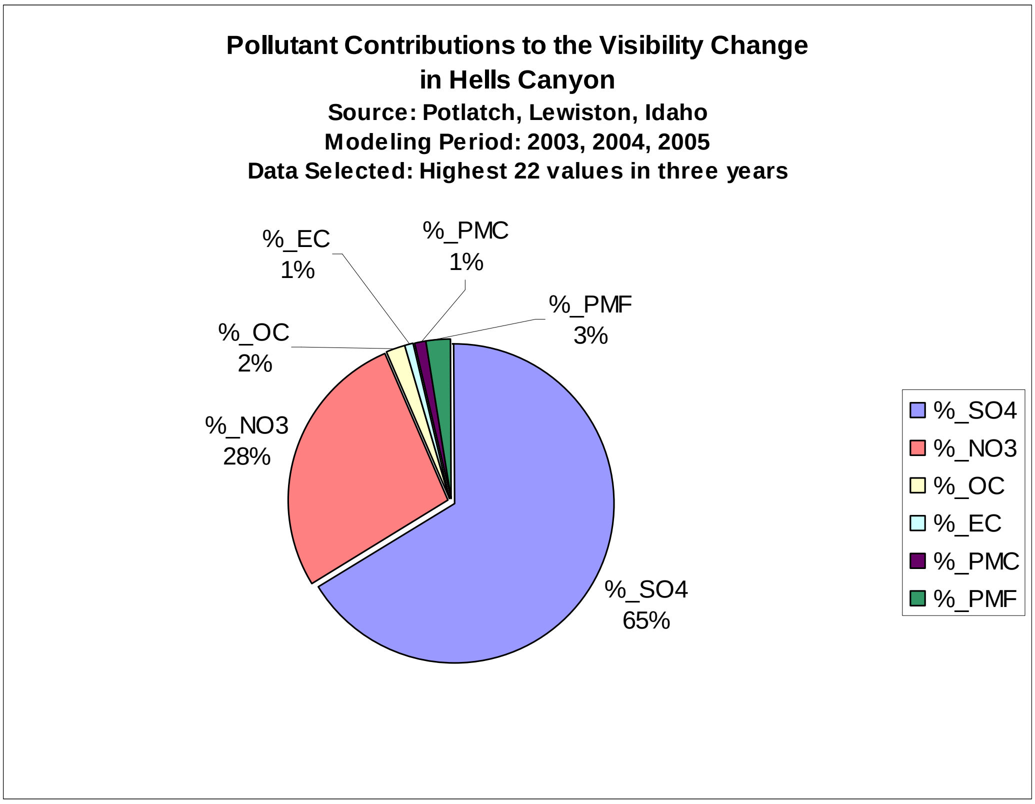

Figure 9. The pollutant contribution from Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 to visibility change at the Hells Canyon Wilderness area, Idaho.

Seasonal Variation of Visibility Degradation

The analyses showed that the higher impact to the visibility occurs in the cold season, as shown in Figure 5, however, the variation is less significant compared to the sources in the other areas modeled by DEQ. When the winter meteorological conditions are favorable for hygroscopic aerosols formation, the delta-deciview dramatically increase, however the effect is minimal in the dry and hot summertime. The degree of the variation depends on the relative location of the source and the Class I areas, and the meteorological conditions as well.

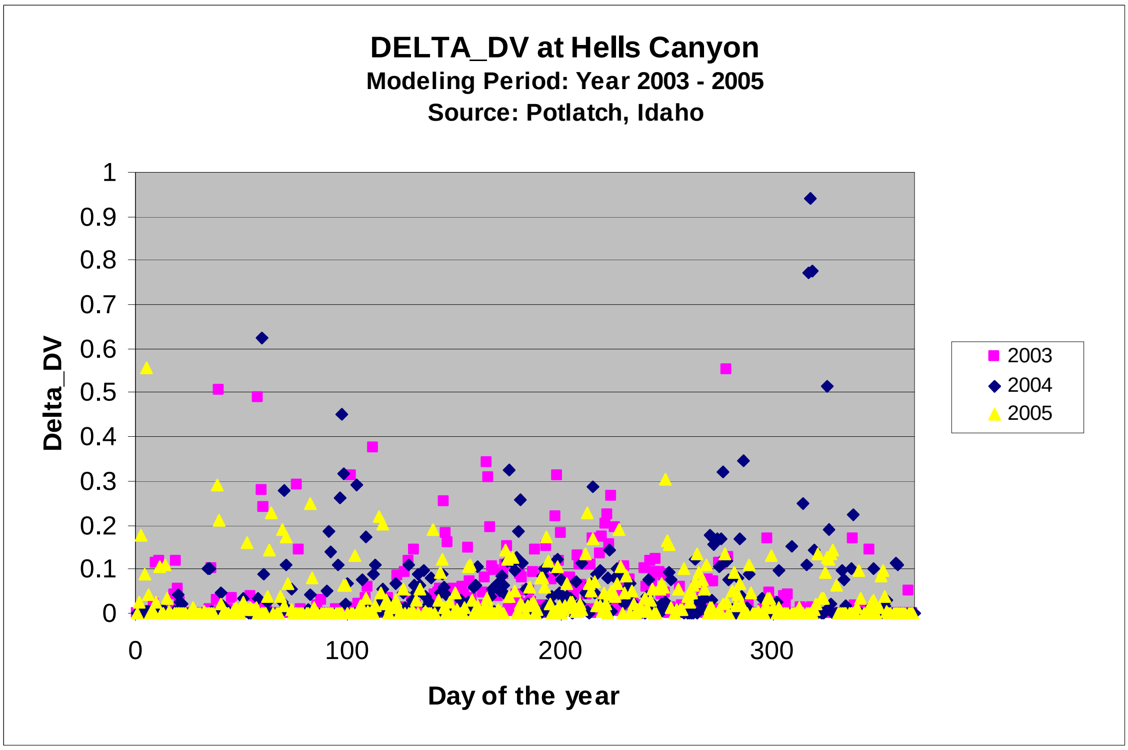

Figure 10. Seasonal impact from Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 to the Hells Canyon Wilderness area, Idaho. Higher days are predicted in colder seasons.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 6 shows the strong stagnation conditions during the episode in January 2004. Pollutants pool up in the valley and slowly transport to the Class I areas with very little dispersion. Figure 7 is the contour map of the number of days of impact higher than or equal to 0.5 deciview in the three year period, clearly showing the effects of the terrain.

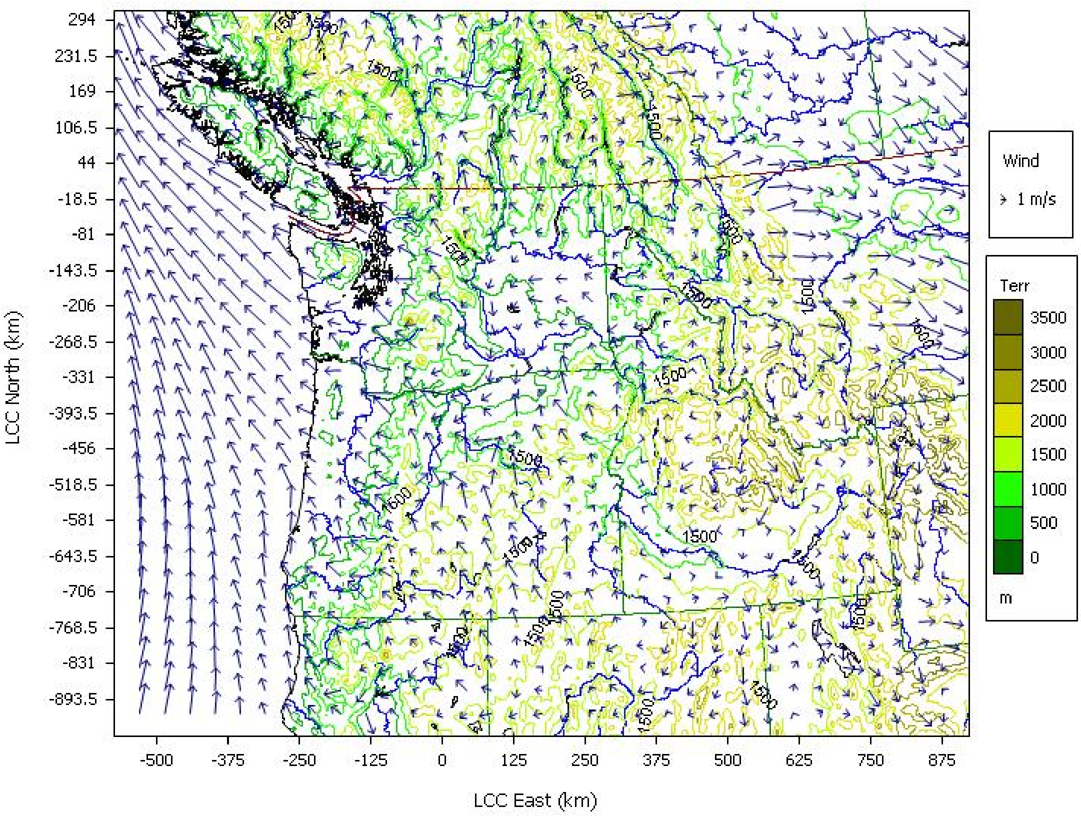

Figure 6. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Hells Canyon. A strong stagnation system persisted in the area for more than 2 weeks. The pollutants were elevated near the sources, slowly dispersed and transported to the Class I areas.

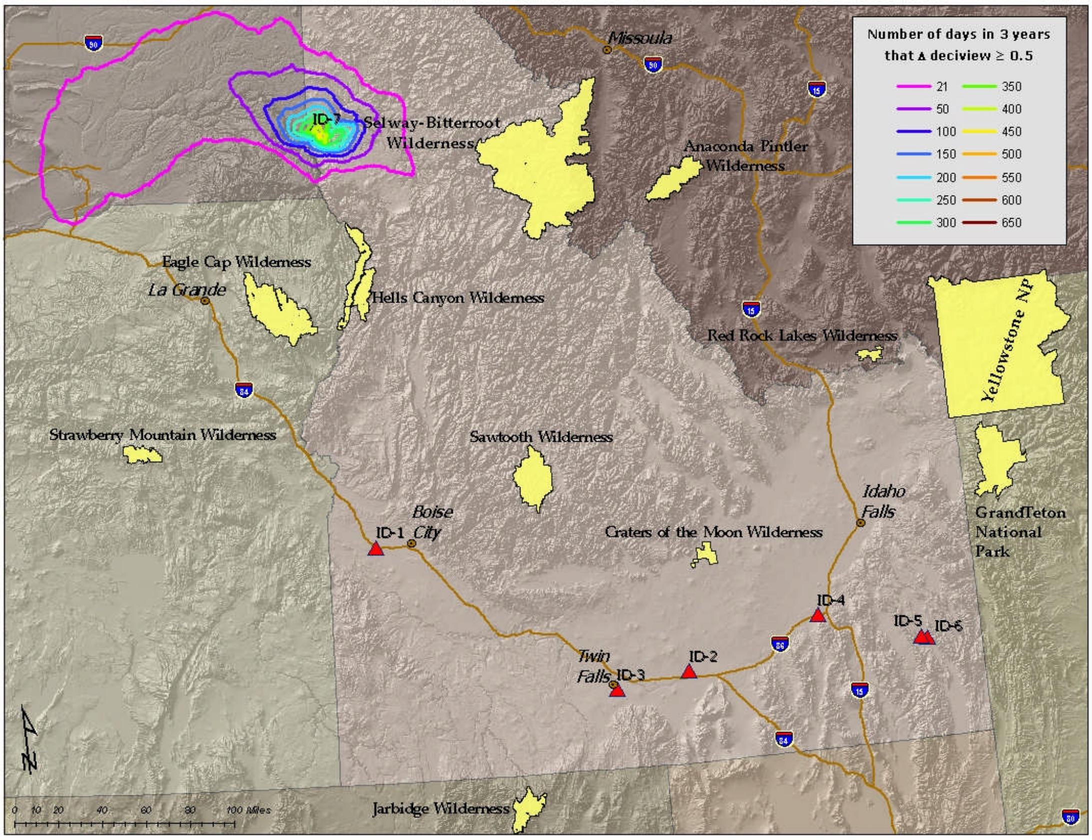

Figure 7. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 at Lewiston, Idaho (ID-2). The pattern of dispersion strongly indicates the effects of the terrain. The Hells Canyon Wilderness area is the nearest and most impacted by the source because of its location (Table 3).

Summary and Conclusions

The CALPUFF model predicted no impact during 2003 to 2005 from the Potlatch **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** at Lewiston, Idaho, to visibility with the 8^{th} annual highest value or the 22^{nd} 3-year highest value higher than or equal to 0.5 deciview in any Class I area within the 300 km from the facility.

Hells Canyon Wilderness had the highest delta-deciview value (0.94), and the highest number of days of visibility degradation (8 days, 2003-2005). The eighth-highest delta-deciview value was 0.323.

The major contributors are SO_2 and NO_x, precursors of sulfate and nitrate aerosols formed in wintertime under the conditions of low temperatures and high relative humidity. The impact occurs mostly in wintertime when a high-pressure system persists in the area for a long period (3-4 days or more), the atmosphere is stagnant with poor dispersion, and the pollutants may be transported to the certain Class I areas relatively undiluted.

The results have demonstrated that the Potlatch facility with units of **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** is not subject to BART.

Appendix: CALPUFF Modeling Setup for Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Scenario Summary

Scenario Information
Scenario Name: wzI70444
Title: ID-7 4km Existing Control version 3; 2004 through 2005 corrected
Scenario Description: ID-7; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information
Species Group ID: 1
Number of Species: 9
Species Names: SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory
Working Directory: Y:\airmodel\calpuff\runs\bart\wzI70444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources
Number of Sources: 3
Source_Elevation_Option: Model

Source 1

Source Category
Category: Point

Facility Information
Facility ID: ID-7
Facility Name: Potlatch Pulp and Paper

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Unit Information

Unit ID:	157
Unit Description:	No. 4Smelt Dissolving Tank

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	502.079
Northing (km):	5141.661
Base Elevation (m):	238

Source Location under Domain Projection and Datum

XEasting (km):	297.806
YNorthing (km):	-268.584

Model Source Base Elevation In Calmet Domain

bar_4km (m):	360.164
bar_12km (m):	470.846

Stack Parameters

Height (m):	65.5
Diameter (m):	0.9
Exit Temperature (K):	344.3
Exit Velocity (m/s):	14.3

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.14300
SO4 (lb/hr):	2.89142
NOX (lb/hr):	0.85000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.01967
PMC (lb/hr):	1.03169
PMF (lb/hr):	2.68115
EC (lb/hr):	0.11090
SOA (lb/hr):	0.45519

Emission Rate (Unit: g/s)

SO2 (g/s):	0.01802
SO4 (g/s):	0.36431
NOX (g/s):	0.10710
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00248
PMC (g/s):	0.12999
PMF (g/s):	0.33782
EC (g/s):	0.01397
SOA (g/s):	0.05735

Source 2

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Source Category

Category:	Point

Facility Information

Facility ID:	ID-7
Facility Name:	Potlatch Pulp and Paper

Unit Information

Unit ID:	189
Unit Description:	No. 4 Recovery Furnace (Boiler)

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	502.063
Northing (km):	5141.662
Base Elevation (m):	238

Source Location under Domain Projection and Datum

XEasting (km):	297.790
YNorthing (km):	-268.584

Model Source Base Elevation In Calmet Domain

bar_4km (m):	360.198
bar_12km (m):	470.828

Stack Parameters

Height (m):	99.1
Diameter (m):	2.7
Exit Temperature (K):	449.8
Exit Velocity (m/s):	13.1

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	184.00000
SO4 (lb/hr):	11.27406
NOX (lb/hr):	39.50000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.07668
PMC (lb/hr):	12.36777
PMF (lb/hr):	10.45420
EC (lb/hr):	0.43241
SOA (lb/hr):	1.77487

Emission Rate (Unit: g/s)

SO2 (g/s):	23.18361
SO4 (g/s):	1.42051
NOX (g/s):	4.97692
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00966
PMC (g/s):	1.55831

PMF (g/s):	1.31721
EC (g/s):	0.05448
SOA (g/s):	0.22363

Source 3

Source Category

Category:	Point

Facility Information

Facility ID:	ID-7
Facility Name:	Potlatch Pulp and Paper

Unit Information

Unit ID:	512
Unit Description:	Lime Kiln #4

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	502.172
Northing (km):	5141.572
Base Elevation (m):	238

Source Location under Domain Projection and Datum

XEasting (km):	297.900
YNorthing (km):	-268.666

Model Source Base Elevation In Calmet Domain

bar_4km (m):	357.075
bar_12km (m):	468.407

Stack Parameters

Height (m):	46.8
Diameter (m):	1.13
Exit Temperature (K):	463.7
Exit Velocity (m/s):	24.1

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	3.42000
SO4 (lb/hr):	2.07433
NOX (lb/hr):	25.80000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.01411
PMC (lb/hr):	0.00000
PMF (lb/hr):	1.92348
EC (lb/hr):	0.07956
SOA (lb/hr):	0.32656

Emission Rate (Unit: g/s)

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

SO2 (g/s):	0.43091
SO4 (g/s):	0.26136
NOX (g/s):	3.25075
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00178
PMC (g/s):	0.00000
PMF (g/s):	0.24235
EC (g/s):	0.01002
SOA (g/s):	0.04115

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	11
ID:	alla2
Name:	Alpine Lakes Wilderness
State:	WA
# Total Receptors:	693
# Receptors In Calmet Domain:	693
Position In Receptor List:	1 - 693
ID:	anac2
Name:	Anaconda-Pintler Wilderness
State:	MT
# Total Receptors:	267
# Receptors In Calmet Domain:	267
Position In Receptor List:	694 - 960
ID:	boma3
Name:	Bob Marshall Wilderness
State:	MT
# Total Receptors:	788
# Receptors In Calmet Domain:	788
Position In Receptor List:	961 - 1748
ID:	camo2
Name:	Cabinet Mountains Wilderness
State:	MT
# Total Receptors:	167
# Receptors In Calmet Domain:	167
Position In Receptor List:	1749 - 1915
ID:	eaca2
Name:	Eagle Cap Wilderness
State:	OR
# Total Receptors:	596
# Receptors In Calmet Domain:	596
Position In Receptor List:	1916 - 2511
ID:	heca2
Name:	Hells Canyon Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2512 - 2864

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

ID:	mimo2
Name:	Mission Mountain Wilderness
State:	MT
# Total Receptors:	130
# Receptors In Calmet Domain:	130
Position In Receptor List:	2865 - 2994
ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2995 - 3347
ID:	scap2
Name:	Scapegoat Wilderness
State:	MT
# Total Receptors:	423
# Receptors In Calmet Domain:	423
Position In Receptor List:	3348 - 3770
ID:	selw4
Name:	Selway-Bitterroot Wilderness
State:	ID
# Total Receptors:	575
# Receptors In Calmet Domain:	575
Position In Receptor List:	3771 - 4345
ID:	stmo2
Name:	Strawberry Mountain Wilderness
State:	OR
# Total Receptors:	114
# Receptors In Calmet Domain:	114
Position In Receptor List:	4346 - 4459

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	120
Ending Column:	310
Beginning Row:	91
Ending Row	240

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For the J.R. Simplot Siding Plant, Pocatello, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Table of Contents

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[5]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[6], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

[5] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[6] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: J.R. Simplot Siding Plant, Pocatello, Idaho

Five units of the **J.R. Simplot Siding Plant** in Pocatello, Idaho have been determined to be BART-eligible, as shown in Table 9.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 9. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Five units of the **J.R. Simplot Siding Plant** in Pocatello, Idaho have been determined to be BART-eligible (Table 1). The *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants PM_{10} and NO_x, and the source was put in service between August 7, 1962 and August 7, 1977, so the source is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Table 9. Emissions rates used for BART modeling.

Facility	Emission Unit	BART Category	Year Installed	Maximum 24-hour emission rate (lb/hr)		
				PM_{10}	SO_2	NO_x
Simplot – Don Siding Facility		Facility 13				
	Granulation No. 2 plant, ID240		1964	14.1		
	East Reclaim Cooling Tower, ID372		1966	91.6		
	West Reclaim Cooling Tower, ID371		1976	86.6		
	Ammonium sulfate plant, ID1		1964	2.7		
	Ammonia Plant, ID2					60

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* (PM2.5), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$), ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF) (see Table 2).

Source classification codes, unit identifiers and PMC and PM2.5 fractions are taken from the 2005 National Emission Inventory submitted from Facilities; PM2.5 speciation is taken from SMOKE2.1 for SAPRC99.

PM size fractions used are as follows: Fine : mean diameter = 0.5 µm, standard deviation = 1.5 µm. Coarse: mean diameter = 5µm, standard deviation = 1.5µm.

Detailed, speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 10. Facility information, stack parameters, and speciation of emissions.

	Facility_ID	**ID-4**	**ID-4**	**ID-4**	**ID-4**	**ID-4**
Facility Information	Facility_Name	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant
Unit Information	Unit_ID	240	372	371	1	2
	Unit Description	Granulation 2	East Reclaim Cooling Towers	West Reclaim Cooling Towers	Ammonium Sulfate Plant	Ammonia Plant
Control Information	Control_ID	41	41	41	41	41
	Control Description	Existing Control - Ver.3	Existing Control - Ver.3	Existing Control - Ver.3	Existing Control - Ver.3	Existing Control - Ver.3
Datum, Projection, Source Location and Base Elevation	Datum	NAD27	NAD27	NAD27	NAD27	NAD27
	Projection	UTM	UTM	UTM	UTM	UTM
	UTM_Zone	12	12	12	12	12
	Longitude Easting (km)	375.401	375.789	375.789	375.422	375.493
	Latitude Northing (km)	4751.567	4751.509	4751.509	4751.62	4751.477
	Base_Elevation (m)	1355	1355	1355	1355	1355
Stack Parameter	Stack_Height (m)	45.7	10.7	11.6	23.2	18.3
	Stack_Diameter (m)	1.8	10.7	10.7	0.5	1.2
	Stack_Exit_ Temperature (K)	310.9	297	297	311	505
	Stack_Exit_ Velocity (m/s)	12.7	11.9	11.9	14.9	20
Emission Rate (lb/hr)	SO_2	0	0	0	0	0
	SO_4 [a]	0.53	3.76	3.55	0	0
	NO_X	0	0	0	0	60
	HNO_3	0	0	0	0	0
	NO_3	0.047	0.63	0.60	0	0
	PMC	0	0	0	0	0
	PMF [b]	11.38	73.77	69.81	2.7	0
	EC	0.66	1.50	1.42	0	0
	SOA	1.3	10.31	9.76	0	0

a. All of sulfate particulates are assumed to be ammonium sulfate,
(NH4)2SO4 = 1.375*SO4 (Mass)
All of nitrate particulates are assumed to be ammonium nitrate
(NH4)NO3 = 1.29*NO3 (Mass)
b. Fine particulate particles (<2.5µm) other than SO4, NO3, EC and SOA. (PMF includes condensable particulate matters)

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 11:

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

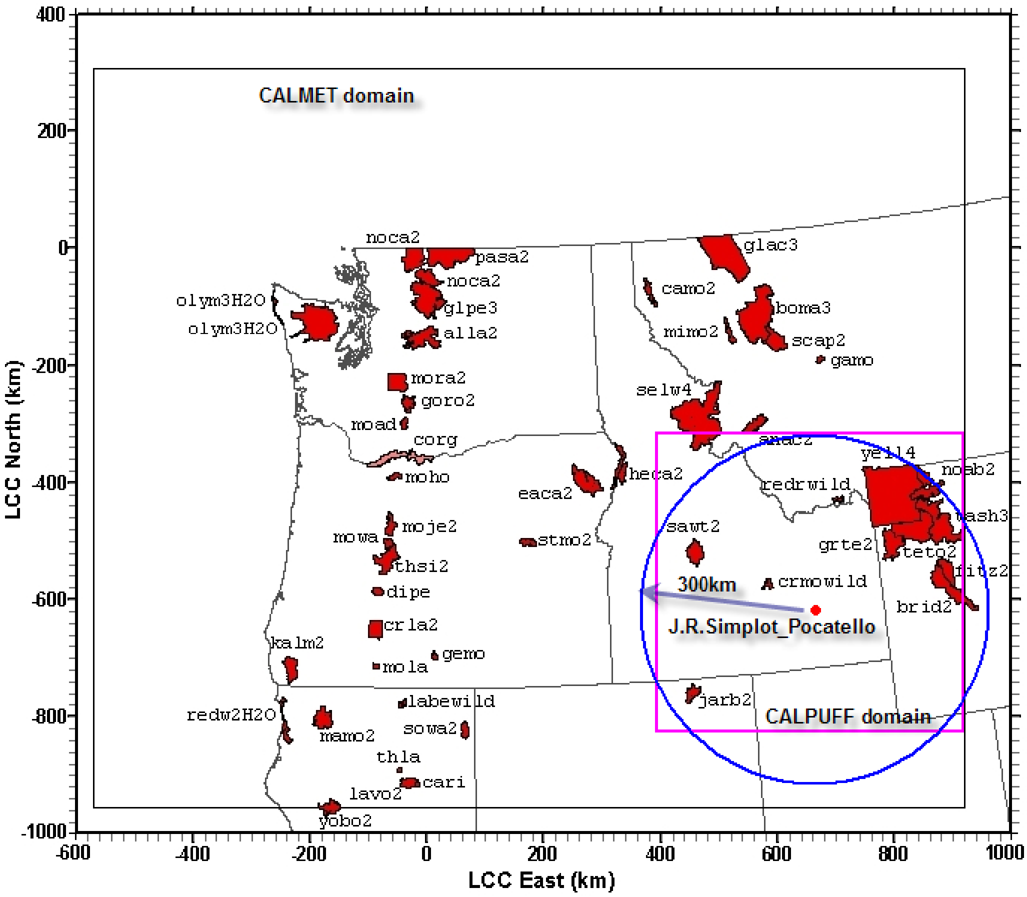

Figure 11. Modeling domain for J.R. Simplot Siding Plant, Pocatello, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix Inc. under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the **J.R. Simplot Siding Plant**, Pocatello are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 11. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the J.R. Simplot Pocatello facility, Idaho.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days
Bridger Wilderness, WY	0.048	0	0.033	0	0.041	0	0.041	0
Craters of the Moon, ID	0.237	0	0.376	4	0.244	0	0.278	4
Fitzpatrick Wilderness	0.036	0	0.027	0	0.03	0	0.031	0
Grand Teton NP, WY	0.121	0	0.084	0	0.101	0	0.105	0
Jarbidge Winderness, NV	0.026	0	0.015	0	0.039	0	0.028	0
North Absaroka Wilderness, WY	0.035	0	0.025	0	0.034	0	0.033	0
Red Rock Lakes, MT	0.11	0	0.11	0	0.107	0	0.11	0
Sawtooth, ID	0.024	0	0.038	0	0.039	0	0.038	0
Teton Wilderness, WY	0.06	0	0.055	0	0.063	0	0.06	0
Washakie Wilderness, WY	0.038	0	0.031	0	0.038	0	0.037	0
Yellowstone NP, WY	0.117	0	0.106	0	0.139	0	0.116	0

Class I Area of Greatest Impact

The units had the greatest impact on the Craters of the Moon. Details of the 22 highest calculated changes in deciview for Craters of the Moon for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Sulfate and nitrate are the main contributors.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2, which shows that the 8th highest value varies significantly from year to year in the Craters of the Moon areas, but less in the other class I areas.

The top 22 delta-deciview values predicted for the Craters of the Moon are plotted in Figure 3

Table 12. The top 22 highest Delta-deciview values and related modeling output data at Craters of the Moon.

22nd Highest values at Grand Teton National Park by J.R. Simplot at Pocatello, ID											
Rank	**YEAR**	**DV (Total)**	**DV (BKG)**	**DELTA DV**	**F(RH)**	**% SO_4**	**% NO_3**	**% OC**	**% EC**	**% PMC**	**% PMF**
1	**2004**	2.995	2.208	0.787	3.13	14.59	44.98	12.3	5.28	0	22.84
2	**2004**	2.851	2.19	0.661	3.04	11.57	55.07	10.01	4.58	0	18.77
3	**2004**	2.834	2.19	0.644	3.04	12.62	51.18	10.93	4.85	0	20.42
4	**2004**	2.79	2.19	0.6	3.04	14.09	45.84	12.23	5.26	0	22.59
5	**2005**	2.699	2.208	0.491	3.13	18.07	32.51	15.29	6.16	0	27.97
6	**2005**	2.677	2.208	0.469	3.13	18.94	29.44	16.04	6.37	0	29.21
7	**2004**	2.635	2.19	0.445	3.04	17.88	31.76	15.55	6.41	0	28.4
8	**2004**	2.604	2.19	0.414	3.04	16.4	37.06	14.26	5.98	0	26.3
9	**2004**	2.62	2.208	0.412	3.13	15.4	42.15	13	5.49	0	23.96
10	**2005**	2.577	2.19	0.387	3.04	23.85	10.12	20.87	7.72	0	37.44
11	**2003**	2.592	2.208	0.383	3.13	5.8	76.73	4.77	2.94	0	9.76
12	**2005**	2.59	2.208	0.382	3.13	10.89	58.35	9.13	4.31	0	17.32
13	**2004**	2.584	2.208	0.376	3.13	18.44	30.97	15.58	6.41	0	28.6
14	**2005**	2.579	2.208	0.371	3.13	17.82	33.32	15.06	6.2	0	27.61
15	**2005**	2.504	2.135	0.369	2.77	13.7	43.44	13.05	5.63	0	24.18
16	**2004**	2.497	2.135	0.362	2.77	12.37	48.54	11.75	5.3	0	22.04
17	**2004**	2.566	2.208	0.358	3.13	15.71	40.97	13.26	5.6	0	24.47
18	**2004**	2.479	2.135	0.344	2.77	14.48	40.42	13.81	5.86	0	25.42
19	**2004**	2.552	2.208	0.343	3.13	22.73	15.82	19.29	7.35	0	34.81
20	**2004**	2.336	2.035	0.301	2.28	14.56	30.29	16.87	7.11	0	31.17
21	**2003**	2.475	2.19	0.285	3.04	16.68	35.92	14.49	6.16	0	26.75
22	**2004**	2.487	2.208	0.278	3.13	8.23	67.7	6.85	3.63	0	13.59

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

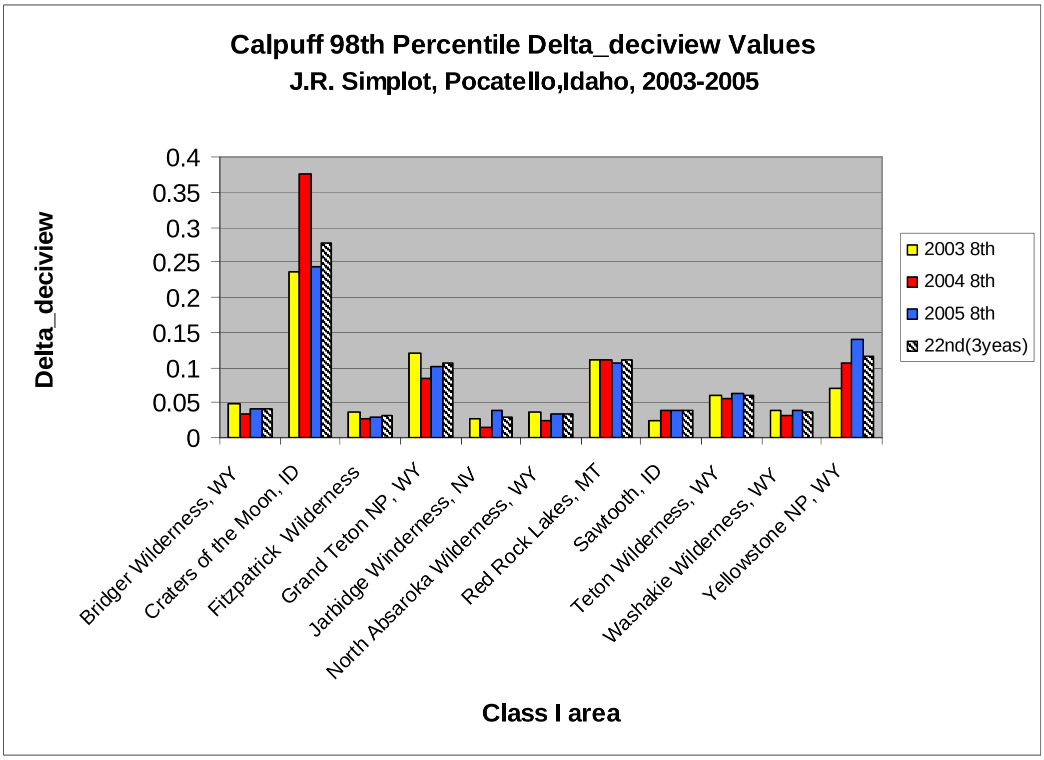

Figure 12. 98th percentile values of delta-deciview in Class I areas for J.R. Simplot, Pocatello, Idaho.

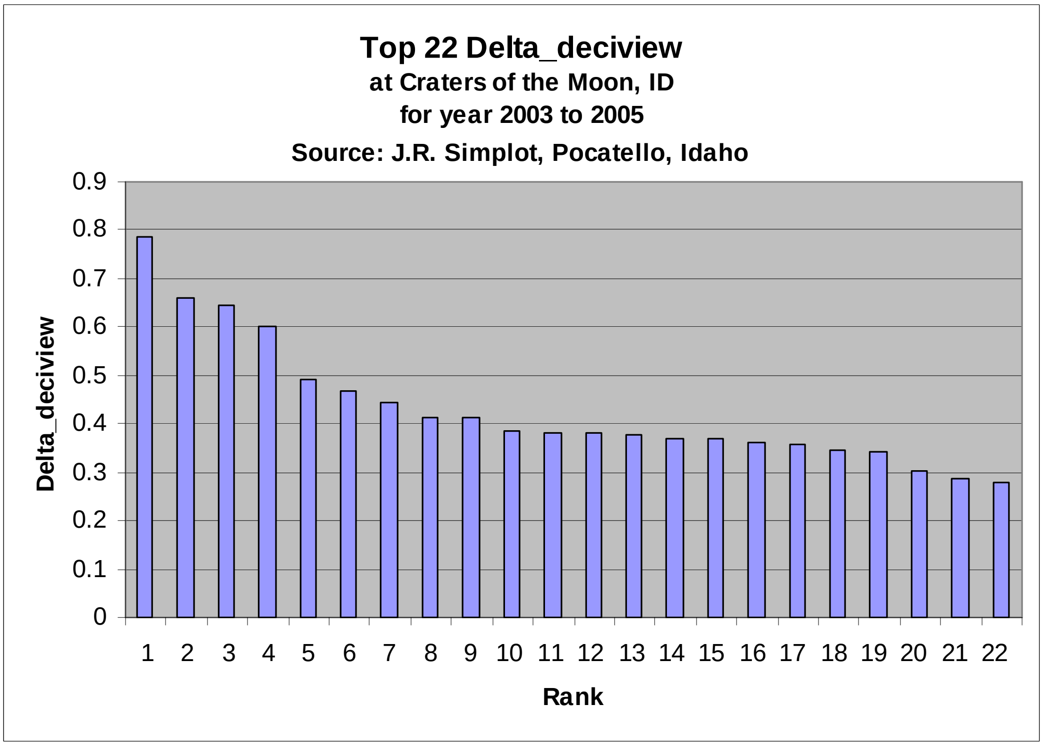

Figure 13. Top 22 highest Delta-deciview values (yeqr 2003 to 2005) at Craters of the Moon. Emission source: J.R. Simplot, Pocatello, Idaho.

Dominating Pollutants for Visibility Impact

Figure 4 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days.

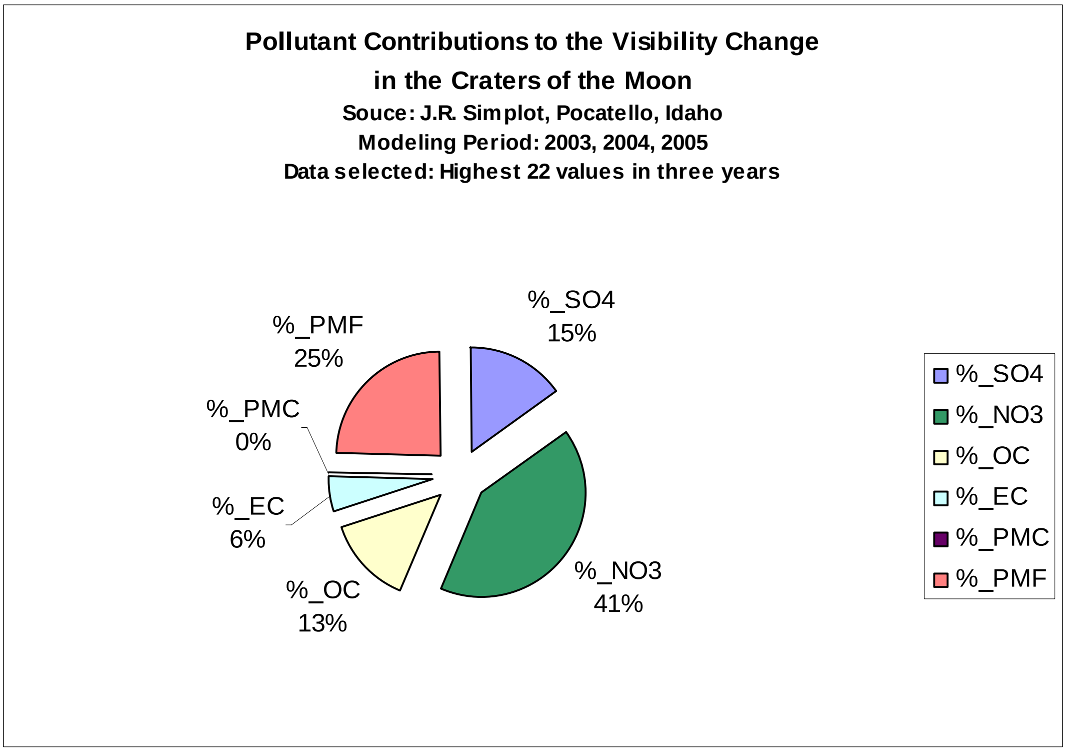

Figure 14. The pollutant contribution from J.R. Simplot Siding Plant, Pocatello, Idaho, to visibility change at Craters of the Moon.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for Craters of the Moon occurs between November and February.

The 2004 peak impact appears to have been the result of winter meteorological conditions favorable for hygroscopic aerosol formation, as discussed in the following section. The effect is minimal in the dry, hot summertime.

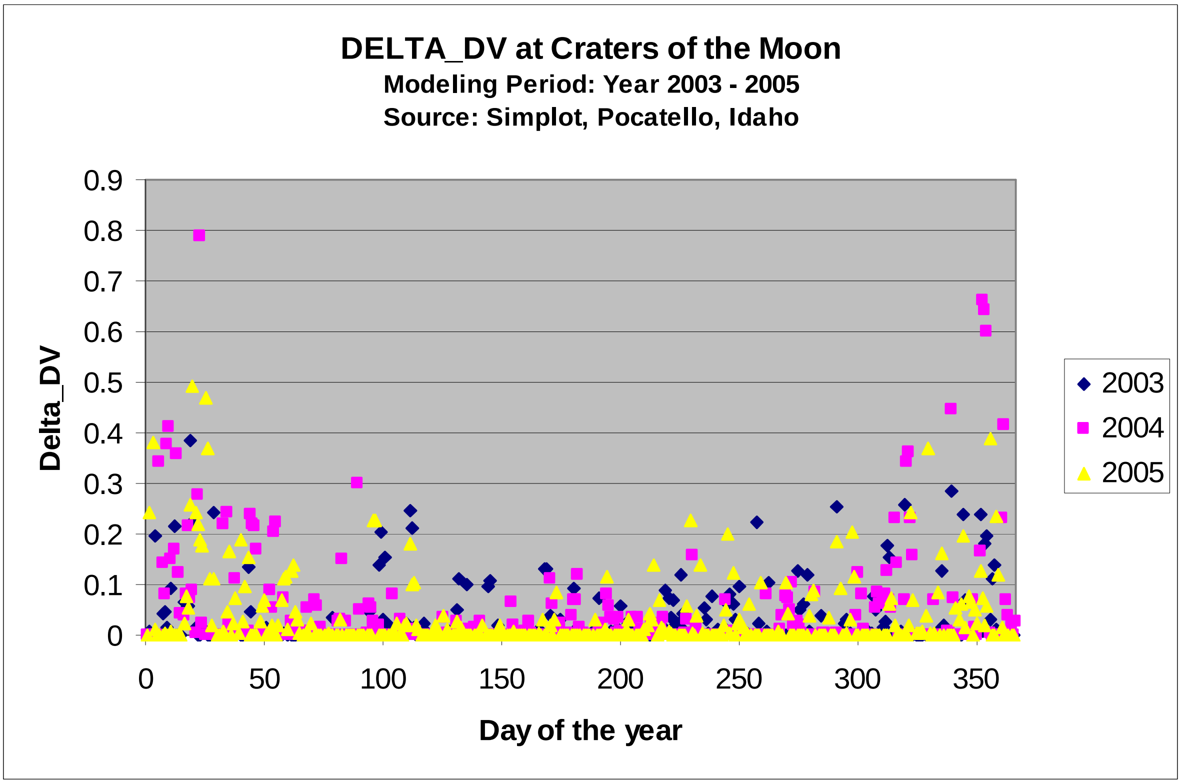

Figure 15. Seasonal impact from J.R. Simplot Siding Plant, Pocatello, Idaho to Craters of the Moon. Greater impacts are predicted in colder weather.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 6 shows the strong stagnation conditions during the episode in January 2004. Pollutants pool up in the valley and slowly transport to the Class I areas with very little dispersion.

Figure 7 shows contour map of the number of days of impact higher than or equal to 0.5 deciview in the three year period, clearly showing the effect of the terrain.

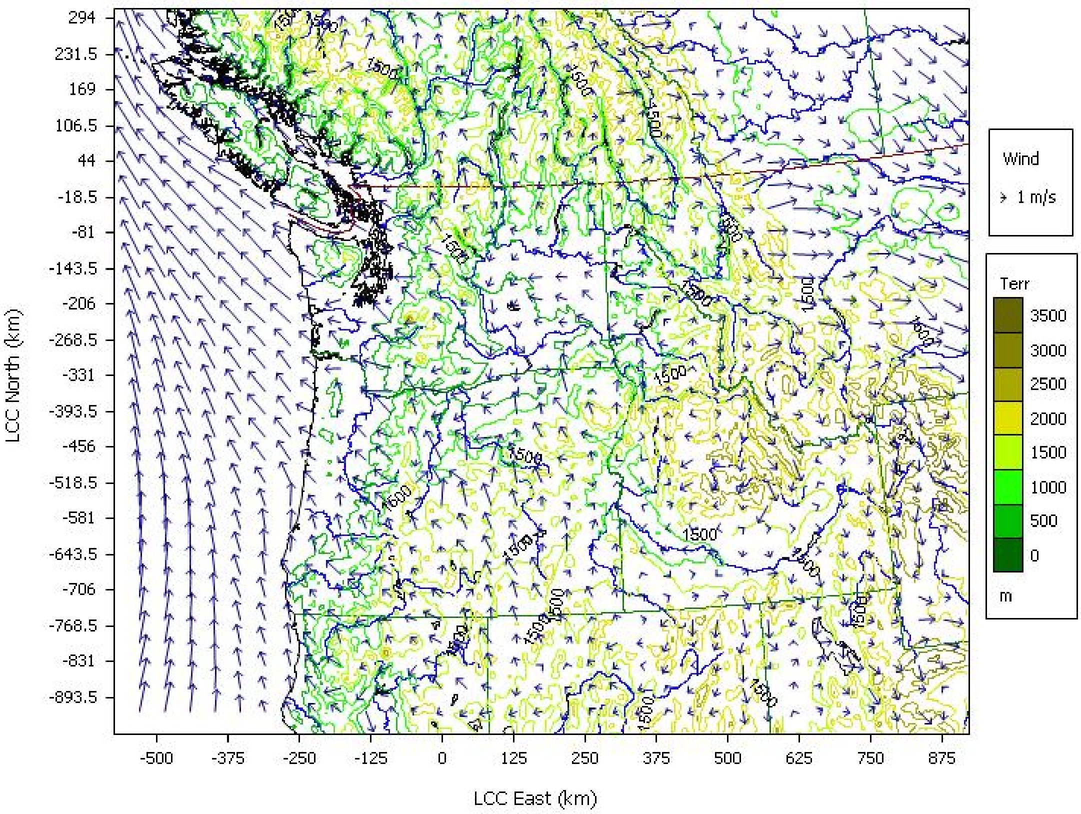

Figure 6. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Craters of the Moon. A strong stagnation system persisted in the Snake River Valley for more than 2 weeks. The pollutants were elevated near the sources, slowly dispersed and transported to the Class I areas.

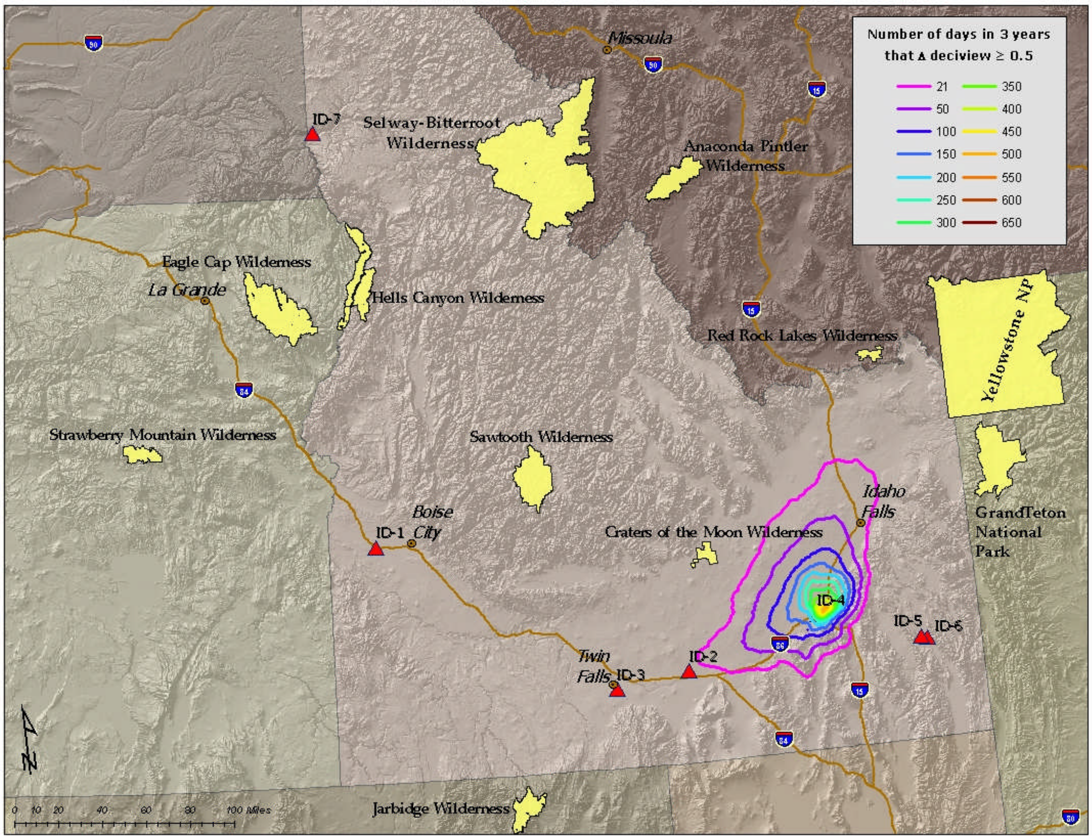

Figure 7. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: J.R. SIMPLOT at Pocatello, Idaho (ID-4). The pattern of dispersion strongly indicates the effects of the terrain. The Craters of the Moon Wilderness area is the nearest and most significantly impacted area by the source because of its location, but still below the threshold.

Summary and Conclusions

The CALPUFF model showed that during the period of year 2003 to 2005, the impact to visibility from the **J.R. Simplot Siding Plant** in Pocatello, Idaho, does not exceed the threshold of the 8th annual highest or 22nd 3-year highest value of 0.5 deciview in any Class I areas within 300 km from the source.

Craters of the Moon had the highest delta-deciview value (0.787 in the year 2004) and the highest number of days of visibility degradation (4 days, 2004). The eighth-highest delta-deciview value was 0.376 (in the year of 2004).

The impact is higher in winter, when a high pressure system persists in the area for a long period (3-4 days or more), the atmosphere is stagnant with poor dispersion, and the pollutants may be transported to Class I areas relatively undiluted.

The analysis has demonstrated that the **J.R. Simplot Siding Plant** is not subject to BART.

Appendix: CALPUFF Modeling Setup for J.R. Simplot, Pocatello, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI40444
Title:	ID-4 4km Existing Control version 3 all units; 2004 through 2005 corrected
Scenario Description:	ID-4; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); all units; 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory:	Y:\airmodel\calpuff\runs\bart\wzI40444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	5
Source_Elevation_Option:	Model

Source 1

Source Category

Category:	Point

Facility Information

Facility ID:	ID-4
Facility Name:	J.R. Simplot Don Siding Plant

Unit Information

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Unit ID:	1
Unit Description:	Ammonium Sulfate Plant

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.422
Northing (km):	4751.62
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	665.793
YNorthing (km):	-618.990

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1415.065
bar_12km (m):	1423.761

Stack Parameters

Height (m):	23.2
Diameter (m):	0.5
Exit Temperature (K):	311
Exit Velocity (m/s):	14.9

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	0.00000
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.00000
PMF (lb/hr):	2.70000
EC (lb/hr):	0.00000
SOA (lb/hr):	0.00000

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.00000
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.00000
PMF (g/s):	0.34019
EC (g/s):	0.00000
SOA (g/s):	0.00000

Source 2

Source Category

Category:	Point

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Facility Information

Facility ID:	ID-4
Facility Name:	J.R. Simplot Don Siding Plant

Unit Information

Unit ID:	2
Unit Description:	Ammonia Plant

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.493
Northing (km):	4751.477
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	665.878
YNorthing (km):	-619.119

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1422.260
bar_12km (m):	1427.879

Stack Parameters

Height (m):	18.3
Diameter (m):	1.2
Exit Temperature (K):	505
Exit Velocity (m/s):	20

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	0.00000
NOX (lb/hr):	60.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.00000
PMF (lb/hr):	0.00000
EC (lb/hr):	0.00000
SOA (lb/hr):	0.00000

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.00000
NOX (g/s):	7.55987
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.00000
PMF (g/s):	0.00000
EC (g/s):	0.00000
SOA (g/s):	0.00000

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Source 3

Source Category
Category: Point

Facility Information
Facility ID: ID-4
Facility Name: J.R. Simplot Don Siding Plant

Unit Information
Unit ID: 240
Unit Description: Granulation 2

Control Strategy Applied
Control ID: 41
Control Description: Existing Control - Ver. 3

Source Location and Base Elevation
Datum: NAD27
Projection: UTM
UTM Zone: 12
Easting (km): 375.401
Northing (km): 4751.567
Base Elevation (m): 1355

Source Location under Domain Projection and Datum
XEasting (km): 665.779
YNorthing (km): -619.043

Model Source Base Elevation In Calmet Domain
bar_4km (m): 1417.514
bar_12km (m): 1425.123

Stack Parameters
Height (m): 45.7
Diameter (m): 1.8
Exit Temperature (K): 310.9
Exit Velocity (m/s): 12.7

Emission Rate (Unit: lb/hr)
SO2 (lb/hr): 0.00000
SO4 (lb/hr): 0.53091
NOX (lb/hr): 0.00000
HNO3 (lb/hr): 0.00000
NO3 (lb/hr): 0.04651
PMC (lb/hr): 0.00000
PMF (lb/hr): 11.38000
EC (lb/hr): 0.66000
SOA (lb/hr): 1.30000

Emission Rate (Unit: g/s)
SO2 (g/s): 0.00000
SO4 (g/s): 0.06689
NOX (g/s): 0.00000
HNO3 (g/s): 0.00000
NO3 (g/s): 0.00586

PMC (g/s):	0.00000
PMF (g/s):	1.43386
EC (g/s):	0.08316
SOA (g/s):	0.16380

Source 4

Source Category

Category:	Point

Facility Information

Facility ID:	ID-4
Facility Name:	J.R. Simplot Don Siding Plant

Unit Information

Unit ID:	371
Unit Description:	West Reclaim Cooling Towers

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.789
Northing (km):	4751.509
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	666.157
YNorthing (km):	-619.053

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1419.012
bar_12km (m):	1429.917

Stack Parameters

Height (m):	11.6
Diameter (m):	10.7
Exit Temperature (K):	297
Exit Velocity (m/s):	11.9

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	3.55382
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.59775
PMC (lb/hr):	0.00000
PMF (lb/hr):	69.80585
EC (lb/hr):	1.42090
SOA (lb/hr):	9.75566

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.44777
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.07532
PMC (g/s):	0.00000
PMF (g/s):	8.79539
EC (g/s):	0.17903
SOA (g/s):	1.22919

Source 5

Source Category

Category: Point

Facility Information

Facility ID: ID-4
Facility Name: J.R. Simplot Don Siding Plant

Unit Information

Unit ID: 372
Unit Description: East Reclaim Cooling Towers

Control Strategy Applied

Control ID: 41
Control Description: Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.789
Northing (km):	4751.509
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km): 666.157
YNorthing (km): -619.053

Model Source Base Elevation In Calmet Domain

bar_4km (m): 1419.012
bar_12km (m): 1429.917

Stack Parameters

Height (m):	10.7
Diameter (m):	10.7
Exit Temperature (K):	297
Exit Velocity (m/s):	11.9

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	3.75562
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.63169
PMC (lb/hr):	0.00000

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

PMF (lb/hr):	73.76989
EC (lb/hr):	1.50158
SOA (lb/hr):	10.30966

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.47320
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.07959
PMC (g/s):	0.00000
PMF (g/s):	9.29485
EC (g/s):	0.18920
SOA (g/s):	1.29899

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	11
ID:	brid2
Name:	Bridger Wilderness
State:	WY
# Total Receptors:	684
# Receptors In Calmet Domain:	585
Position In Receptor List:	1 - 585
ID:	crmowild
Name:	Craters of the Moon NM - Wilderness
State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	586 - 856
ID:	fitz2
Name:	Fitzpatrick Wilderness
State:	WY
# Total Receptors:	316
# Receptors In Calmet Domain:	316
Position In Receptor List:	857 - 1172
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	1173 - 1678
ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	1679 - 1852
ID:	noab2
Name:	North Absaroka Wilderness

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

State:	WY
# Total Receptors:	567
# Receptors In Calmet Domain:	567
Position In Receptor List:	1853 - 2419

ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	2420 - 2641

ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2642 - 2994

ID:	teto2
Name:	Teton Wilderness
State:	WY
# Total Receptors:	940
# Receptors In Calmet Domain:	940
Position In Receptor List:	2995 - 3934

ID:	wash3
Name:	Washakie Wilderness
State:	WY
# Total Receptors:	509
# Receptors In Calmet Domain:	508
Position In Receptor List:	3935 - 4442

ID:	yell4
Name:	Yellowstone NP
State:	WY
# Total Receptors:	915
# Receptors In Calmet Domain:	915
Position In Receptor List:	4443 - 5357

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	373
Beginning Row:	33
Ending Row	160

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For the TASCO Riley Boiler, Nampa, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Table of Contents

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). A BART determination is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Six BART-eligible sources have been identified in Idaho.

The source is *subject to BART* if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews* (delta-deciview)—a measure of visibility impairment[7]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[8], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

Refer to the *BART Modeling Protocol* for details on the modeling methodology used in this subject-to-BART analysis.

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[7] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[8] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: TASCO Riley Boiler, Nampa

The **Riley Boiler** of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Nampa, Idaho has been determined to be BART-eligible. Rated at 350 million BTUs per hour, the **Riley Boiler** is classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input, was installed in 1969, and was put into service between August 7, 1962 and August 7, 1977.

The **Riley Boiler's** *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 2,770 tn/yr), nitrogen oxide (NO_x, 1,708 tn/yr), and particulate matter (PM, 55 tn/yr), so this emission unit is eligible for inclusion in the subject-to-BART analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period (2003 – 2005) over which CALPUFF modeling for this emission unit was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Table 13. Emissions rates used for subject-to-BART analysis.

Facility/Unit	Maximum 24-hour emission rate (lb/hr)		
TASCO-Nampa	SO_2	NO_x	PM_{10}*
Riley Boiler, Unit 30	632.5	390	12.61
* See note in the Table 2			

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* ($PM_{2.5}$), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF) (see Table 2).

Particulate speciation for the coal-fired **Riley Boiler** was calculated using the Microsoft Excel workbook prepared by the National Park Service for dry bottom pulverized coal-fired boilers with fabric filtration:

http://www2.nature.nps.gov/air/Permits/ect/ectCoalFiredBoiler.cfm

PM size fractions used are as follows: Fine: mean diameter = 0.5 µm, standard deviation = 1.5 µm. Coarse: mean diameter = 5µm, standard deviation = 1.5µm.

Detailed speciated emissions, stack parameters, and location used in the analysis are presented in Table 2.

Table 14. Emission unit information, stack parameters, and speciation of emissions.

Facility Information	Facility_ID	ID-1
	Facility_Name	Amalgamated Sugar – Nampa
Emission Unit Information	Unit_ID	30
	Unit_Description	Riley Boiler
Control Information	Control_ID	41
	Control_Description	Existing Control - Ver. 3
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	11
	Longitude_Easting (km)	534.391
	Latitude_Northing (km)	4828.031
	Base_Elevation (m)	753
Stack Parameter	Stack_Height (m)	65
	Stack_Diameter (m)	2.1
	Stack_Exit_Temperature (K)	427
	Stack_Exit_Velocity (m/s)	16
Emission Rate (lb/hr)	SO_2 (sulfur dioxide)	632.5
	SO_4 (sulfate)	6.415[a]
	NO_X (nitrogen oxides)	390
	HNO_3 (nitric acid)	0
	NO_3 (nitrate)	0[a]
	PMC (coarse particulate matter)	0.79
	PMF (fine particulate matter)	0.76[b]
	EC (elemental carbon)	0.03
	SOA (secondary organic aerosol)	2.21

a. All of sulfate particulates are assumed to be ammonium sulfate,
(NH4)2SO4 = 1.375*SO4 (Mass)
All of nitrate particulates are assumed to be ammonium nitrate
(NH4)NO3 = 1.29*NO3 (Mass)
b. The fine particulates other than SO4, NO3, EC and SOA.

CALPUFF Model Setup

Modeling of the BART-eligible emission unit was performed in accordance with the *BART Modeling Protocol* and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 16.

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA guidance and the *BART Modeling Protocol*, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

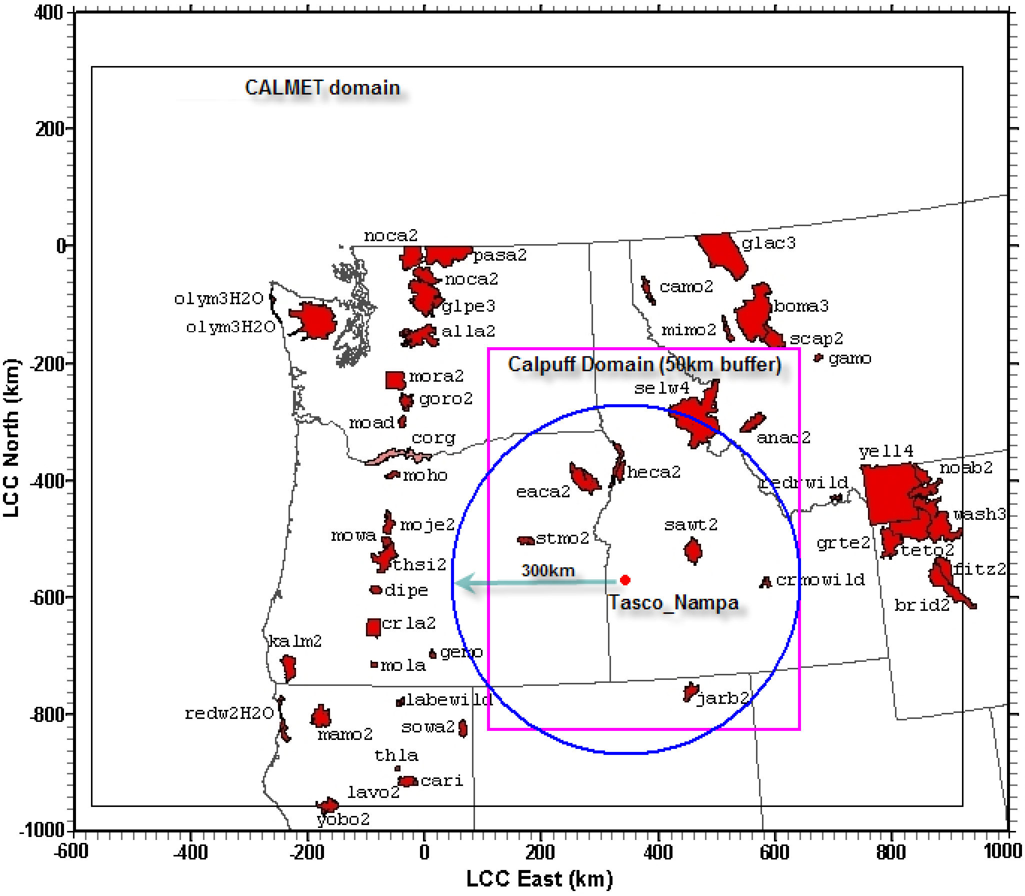

Figure 16. Modeling domain for TASCO Riley Boiler, Nampa, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF subject-to-BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc. under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in Appendix 1 .

Results

Subject-to-BART analysis results for the TASCO **Riley Boiler**, Nampa are shown in Table 3, which highlights the following two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for delta-deciview in the each year.

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for delta-deciview over three years.

For both threshold values, the determining criterion is a delta-deciview of at least 0.5 deciview.

Table 15. Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the TASCO Riley Boiler, Nampa.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Craters of the Moon	0.161	2	0.224	2	0.153	0	0.196	2
Eagle Cap Wilderness, OR	0.87	20	1.355	46	1.302	46	1.325	112
Hells Canyon National Recreation Area, ID	0.772	13	1.031	27	0.9	21	0.936	61
Jarbidge Wilderness, NV	0.151	0	0.198	1	0.201	1	0.179	2
Sawtooth Wilderness, ID	0.239	2	0.294	4	0.265	0	0.271	6
Selway-Bitterroot Wilderness, ID and MT	0.186	0	0.305	1	0.264	2	0.243	3
Strawberry Mountain Wilderness, OR	0.782	12	0.639	13	1.596	31	0.943	56

a. The 8th highest delta-deciview for the calendar year.
b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
c. The 22nd highest delta-deciview value for the 3-year period.
d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Class I Areas Affected

Based on the analysis, the TASCO **Riley Boiler** impacted the following Class I areas with the 98th percentile highest delta-deciview greater than 0.5 during the modeling period 2003-2005:

Eagle Cap Wilderness, Oregon

Hells Canyon National Recreation Area, Idaho

Strawberry Mountain Wilderness, Oregon

The 98th percentile highest values for the all Class I areas are plotted in Figure 2.

Area of Greatest Impact

The **Riley Boiler** had the greatest impact on the Strawberry Mountain Wilderness in December 2005 (1.596, the 8th highest in 2005) and the highest 22nd (1.325) on the Eagle Cap Wilderness in January, 2004. Details of the 22 highest calculated changes, ranked in order of delta-deciview (change from 20% best days natural background), for Eagle Cap for the three-year modeling period are listed in Table 16. Table 16 also shows the relative contributions to visibility degradation for each of the emission species for the BART-eligible emission unit. Sulfate and nitrate are the main contributors.

Total of 112 days with delta-deciview higher than or equal to 0.5 were predicted for Eagle Cap Wilderness, the highest in the all Class I areas, followed by 61 days in the Hells Canyon Wilderness, and 56 days in the Strawberry Mountain Wilderness, during the modeling period.

The number of impacted days in 3 years for the concerned Class I areas are plotted in Figure 19.

Table 16. The 22 highest Delta-deciview values and related modeling output data at Eagle Cap Wilderness area.

Rank	YEAR	DAY	RECEPTOR	DV(Total)	DV(BKG)	DELTA_DV	F(RH)	%_SO4	%_NO3	%_OC	%_EC	%_PMC	%_PMF
1	2003	21	753	5.052	2.466	2.586	3.77	57.66	42.18	0.14	0	0	0.01
2	2004	22	716	4.691	2.466	2.225	3.77	63.09	36.75	0.13	0	0	0.01
3	2004	335	735	4.534	2.396	2.137	3.44	44.75	54.96	0.25	0.01	0.01	0.02
4	2004	338	753	4.578	2.508	2.07	3.97	57.23	42.6	0.15	0	0	0.01
5	2005	55	716	4.318	2.337	1.982	3.16	53.95	45.83	0.19	0.01	0.01	0.02
6	2005	16	716	4.324	2.466	1.857	3.77	49.9	49.9	0.17	0.01	0	0.01
7	2004	16	753	4.314	2.466	1.848	3.77	62.51	37.34	0.13	0	0	0.01
8	2003	38	716	3.998	2.337	1.661	3.16	44.11	55.6	0.24	0.01	0.01	0.02
9	2005	33	716	3.923	2.337	1.586	3.16	56.18	43.6	0.2	0.01	0.01	0.02
10	2003	345	861	4.068	2.508	1.56	3.97	40.64	59.1	0.22	0.01	0	0.02
11	2003	318	716	3.913	2.396	1.516	3.44	44.63	55.13	0.2	0.01	0.01	0.02
12	2005	322	550	3.911	2.396	1.514	3.44	53.14	46.67	0.16	0.01	0	0.01
13	2003	18	716	3.963	2.466	1.497	3.77	57.1	42.74	0.14	0	0	0.01
14	2004	18	716	3.947	2.466	1.48	3.77	55.17	44.64	0.16	0.01	0	0.01
15	2004	13	550	3.936	2.466	1.469	3.77	52.01	47.77	0.2	0.01	0.01	0.02
16	2004	322	753	3.798	2.396	1.402	3.44	54.34	45.45	0.18	0.01	0.01	0.02
17	2005	15	716	3.861	2.466	1.395	3.77	50.72	49.1	0.15	0.01	0	0.01
18	2005	56	273	3.703	2.337	1.366	3.16	50.44	49.32	0.21	0.01	0.01	0.02
19	2003	11	550	3.826	2.466	1.36	3.77	53.84	45.96	0.17	0.01	0.01	0.01
20	2004	19	753	3.821	2.466	1.355	3.77	53.75	46.04	0.18	0.01	0	0.02
21	2005	27	716	3.805	2.466	1.339	3.77	60.71	39.17	0.1	0	0	0.01
22	2004	14	550	3.791	2.466	1.325	3.77	55.94	43.86	0.17	0.01	0.01	0.01

Day: Ordinal day of year
RECEPTOR ID: Identifier for modeled air receptor
DV(total): total deltadeciview including background and change due to the modeled emission source.
DV(BKG): Background deltadeciview.
DELTA_DV: Change in the 20% best days natural background (in deciviews) due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller) other than SO4, NO3, EC and OC.

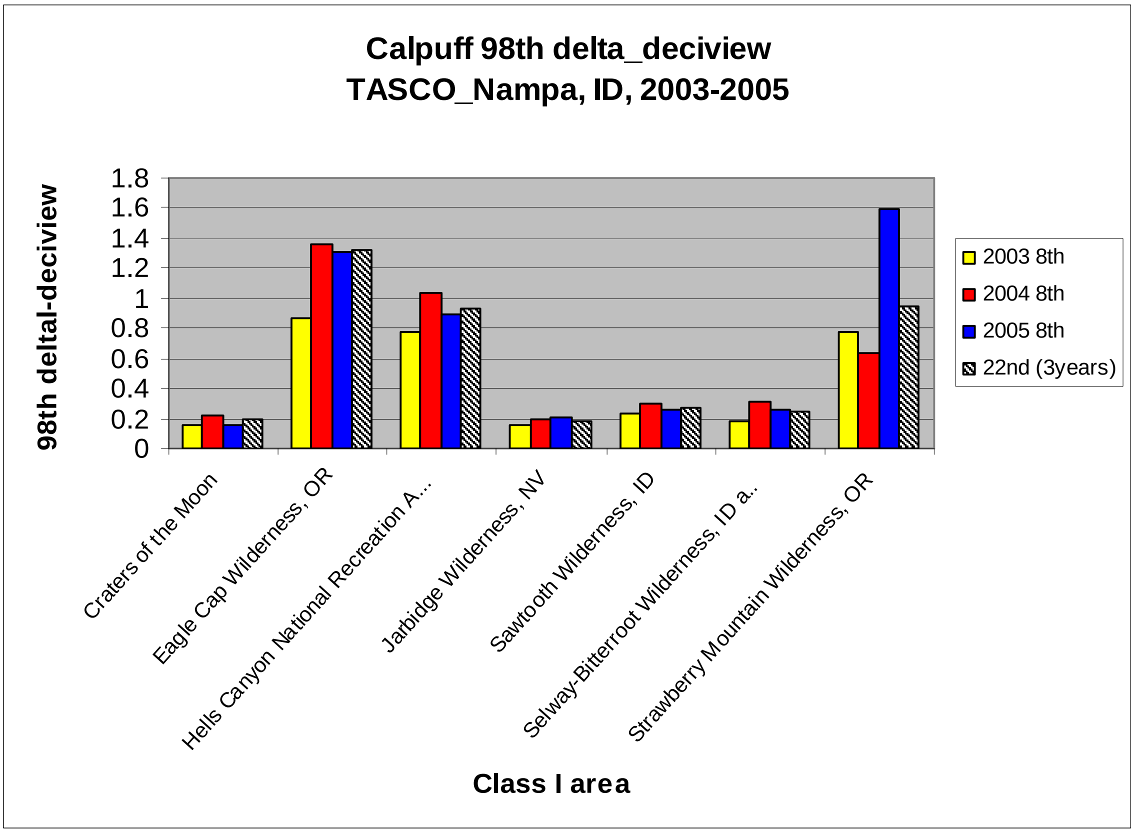

Figure 17. 98th percentile values of delta-deciview in Class I areas for TASCO Riley Boiler, Nampa, Idaho.

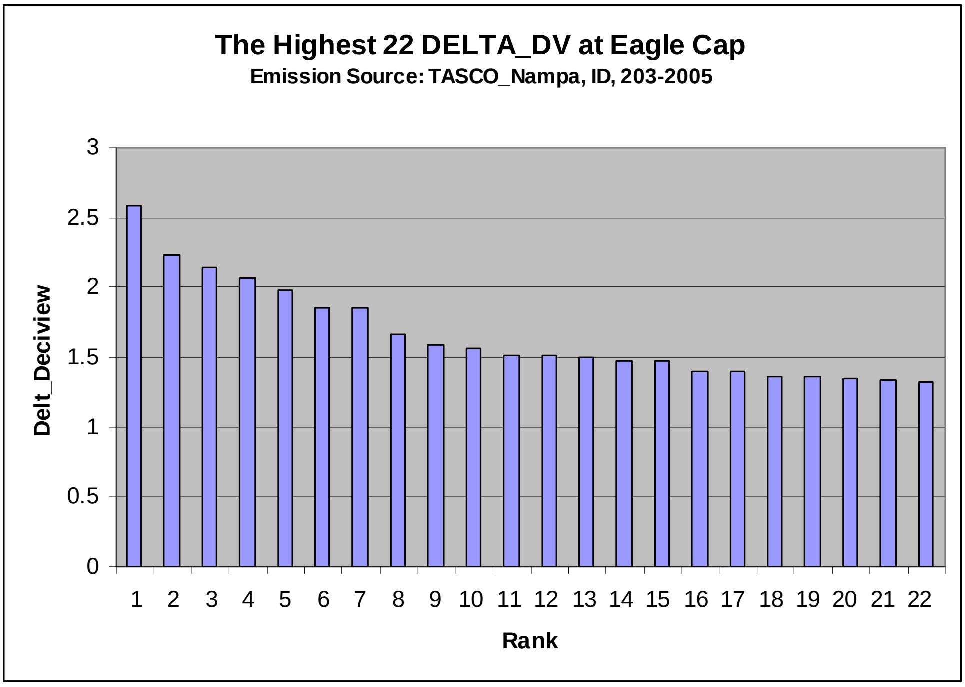

Figure 18. Top 22 highest Delta-deciview values at Eagle Cap Wilderness area for the TASCO Riley Boiler, Nampa, Idaho.

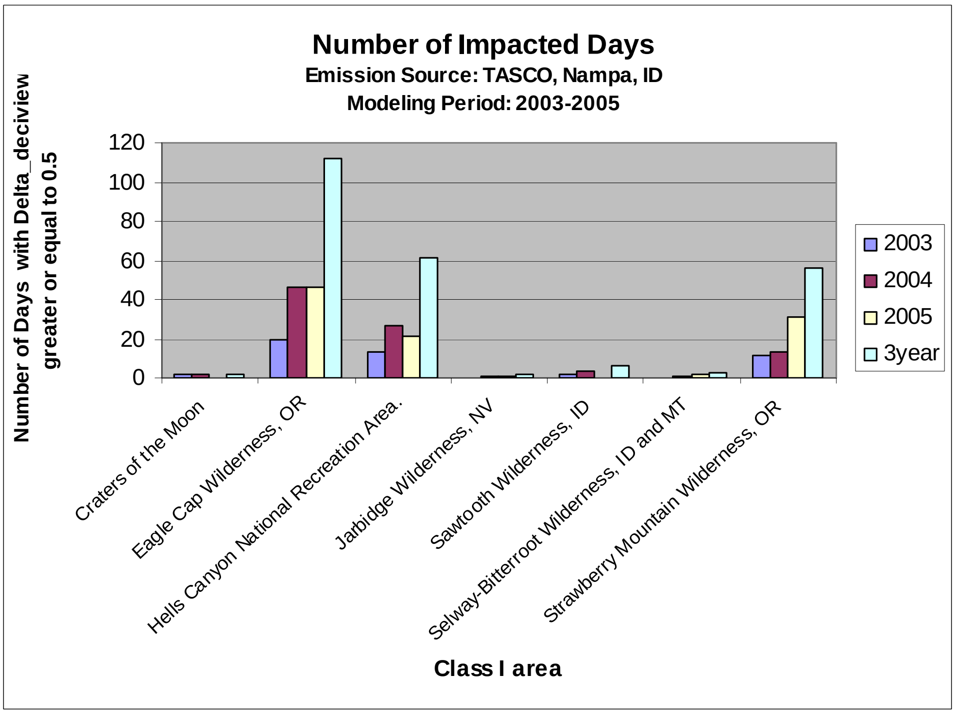

Figure 19. Number of days when the delta-deciview is greater than or equal to 0.50 in the Class I areas during the modeling period, 2003 to 2005.

Dominating Pollutants for Visibility Impact

Figure 20 shows the percentage contribution of the pollutants for the average of the highest 22 days in Eagle Cap in the modeling period from 2003 to 2005. Sulfate and nitrate are the dominating pollutants responsible for the visibility deterioration.

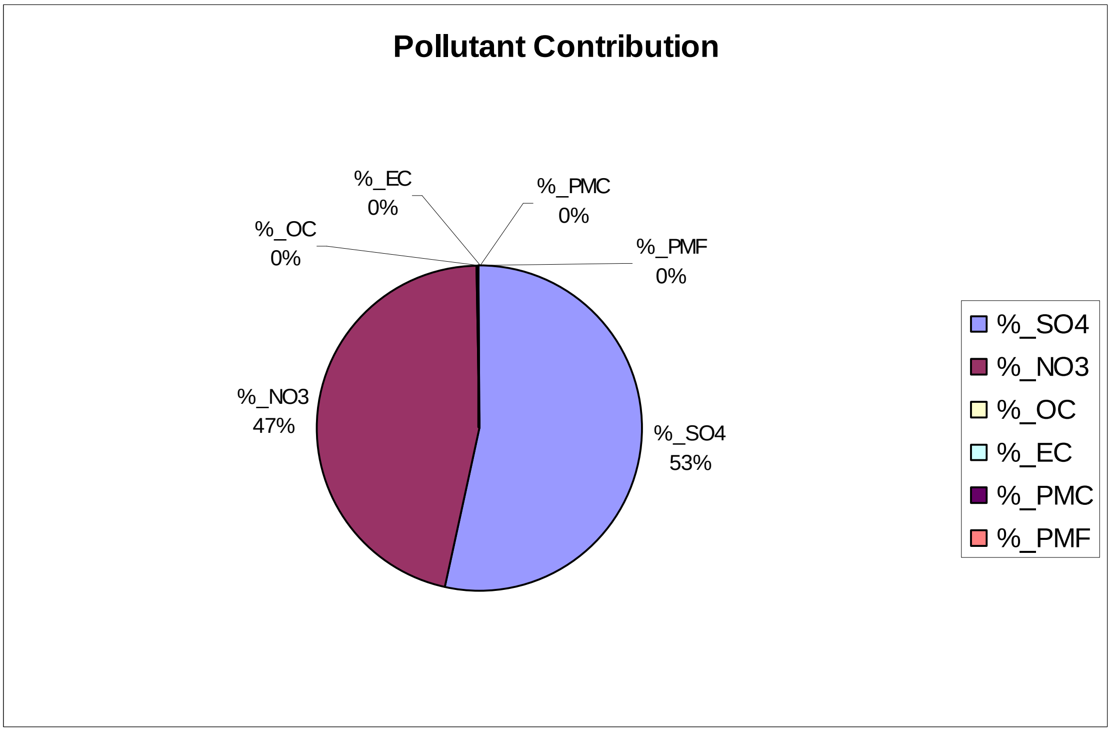

Figure 20. The pollutant contribution from the TASCO Riley Boiler, Nampa, Idaho, to visibility change at Eagle Cap Wilderness area, Oregon. The total contribution from Sulfate and Nitrate is almost 100%.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for the Eagle Cap Wilderness occurs between November and February.

The higher impact appears to have been the result of winter meteorological conditions favorable for hygroscopic aerosol formation, as discussed in the following section. The effect is minimal in the dry, hot summertime.

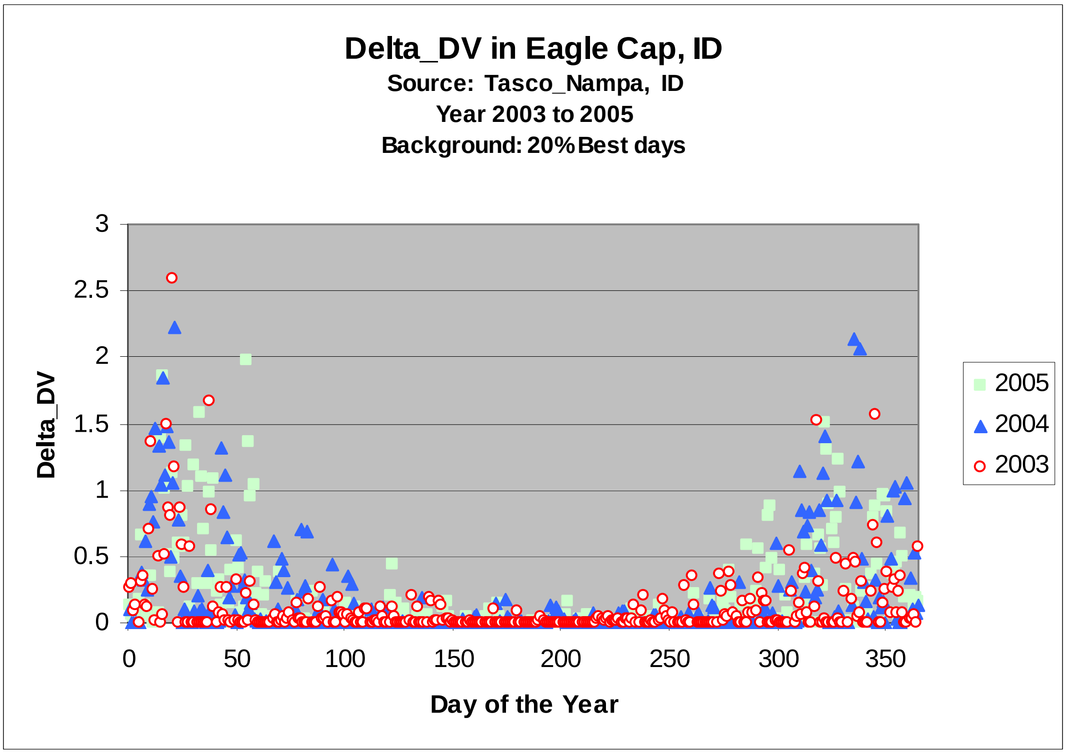

Figure 21. Seasonal impact from the TASCO Riley Boiler, Nampa, Idaho to Eagle Cap Wilderness area, Oregon, which is located about 120 km north-west from the source.

Meteorological and Geological Conditions

The impact to visibility in Class I areas is strongly dependent on meteorological and geological conditions. Figure 22 shows the strong stagnation conditions that occurred during the episode of January 2004. During such an episode, pollutants pool up in the valleys and slowly transport to the Class I areas with little dispersion.

Terrain (geological condition) also strongly influences impact of emission sources in Idaho's Treasure Valley area on the Class I areas. Figure 23 shows a contour map of number of impact days equal to or higher than 0.5 delta-deciview. The channeling effect of the terrain is clearly shown, indicating that Treasure Valley sources are likely to affect Class I areas to the northwest under winter conditions.

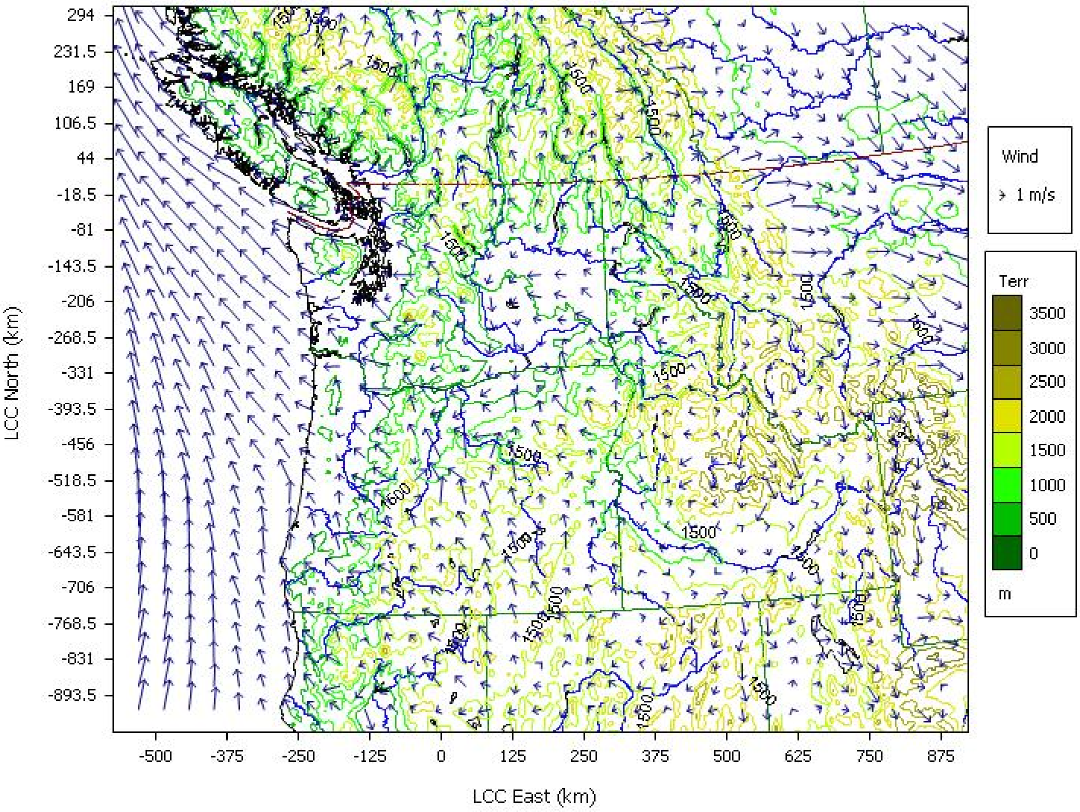

Figure 22. Wind field in the modeling domain. In January 2004, a strong stagnation system persisted in the Snake River Valley, Idaho, where the TASCO Riley Boiler is located, for more than 2 weeks. Pollutants were elevated near their sources, then were slowly dispersed and transported to the Class I areas.

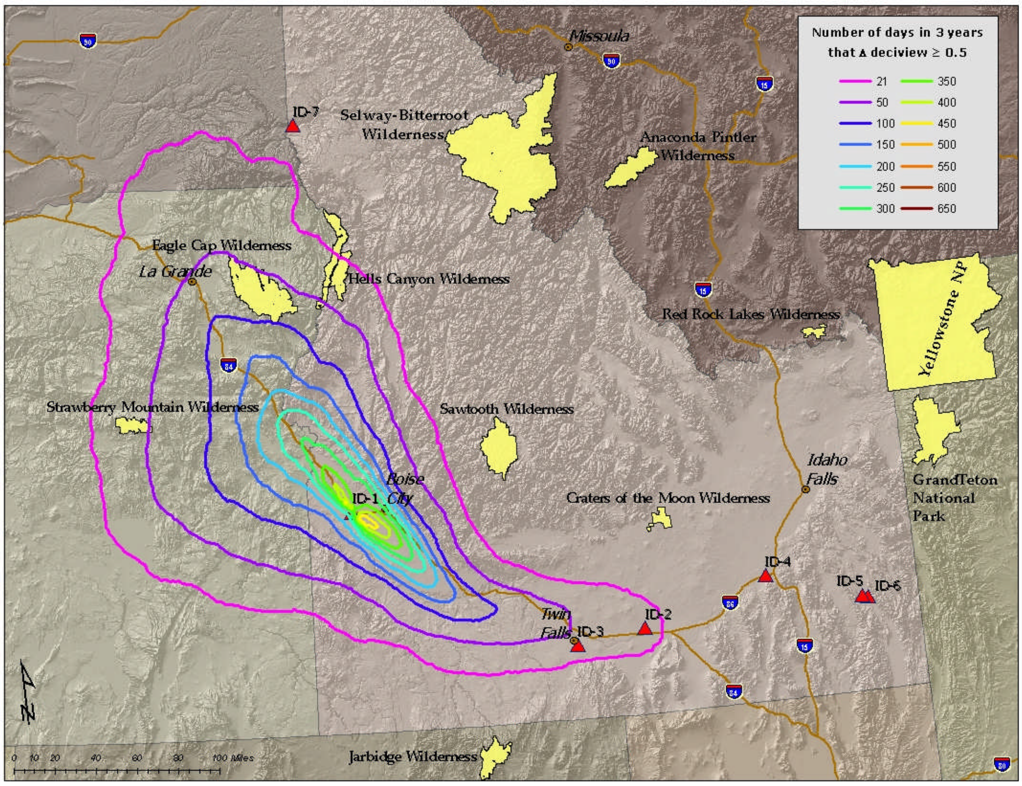

Figure 23. Wind field in the modeling domain. In January 2004, a strong stagnation system persisted in the Snake River Valley, Idaho, where the TASCO Riley Boiler is located, for more than 2 weeks. Pollutants were elevated near their sources, then were slowly dispersed and transported to the Class I areas

Sensitivity Analysis

DEQ performed a sensitivity analysis on the CALPUFF modeling analysis for the Riley Boiler at TASCO, Nampa. The purpose of the sensitivity analysis was to represent the least conservative parameters to show that further refinements (e.g. hourly ozone) are not likely to alter the conclusion, resulting from the *BART Modeling Protocol* analysis, that the Riley Boiler at TASCO's Nampa facility subject-to-BART. **It should be noted that this sensitivity analysis does not imply approval of these "bounding" parameters by DEQ, the EPA and Federal Land Managers.**

The parameters included in the sensitivity analysis include puff splitting, building downwash, low ozone background (10 ppb, the low end of observed vales), and the use of annual average for natural background.

The results of the sensitivity analysis are summarized in Figure 24 and Figure 25, and Table 17. The predicted impact levels based on this less conservative sensitivity analysis in the all Class I areas are lower; however, the predicted visibility deterioration in Eagle Cap Wilderness Area, Strawberry Mountain Wilderness Area, and Hells Canyon National Recreation Area is still significantly higher than the 0.5 dv threshold.

Details of the model setup used for the sensitivity analysis are provided in Appendix 2.

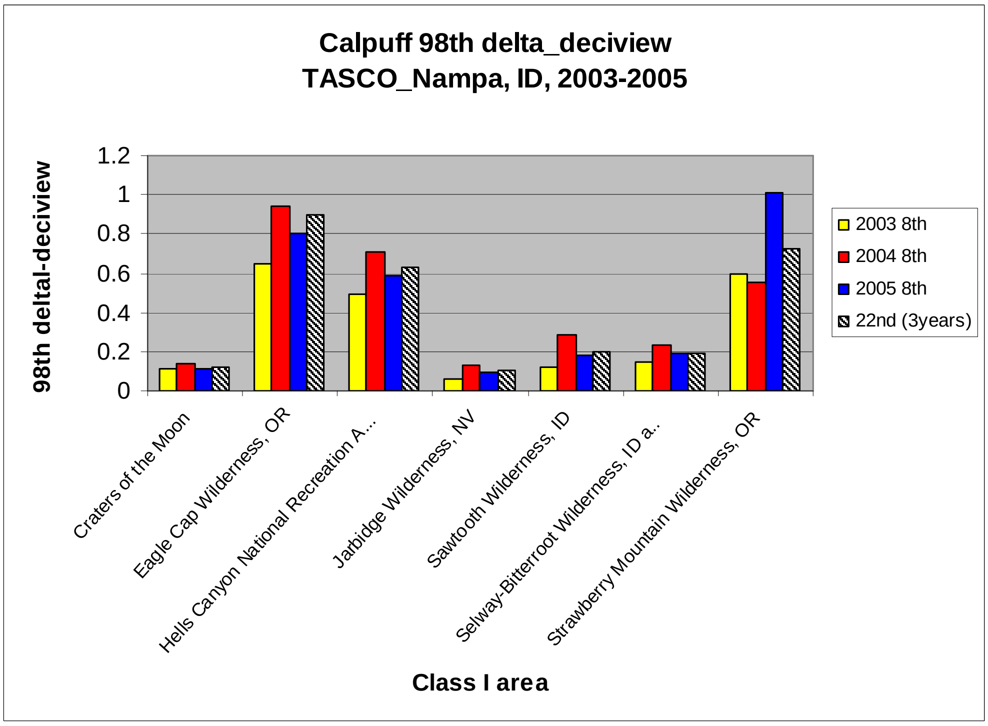

Figure 24. Analysis: 98th percentile values of delta-deciview in the Class I areas

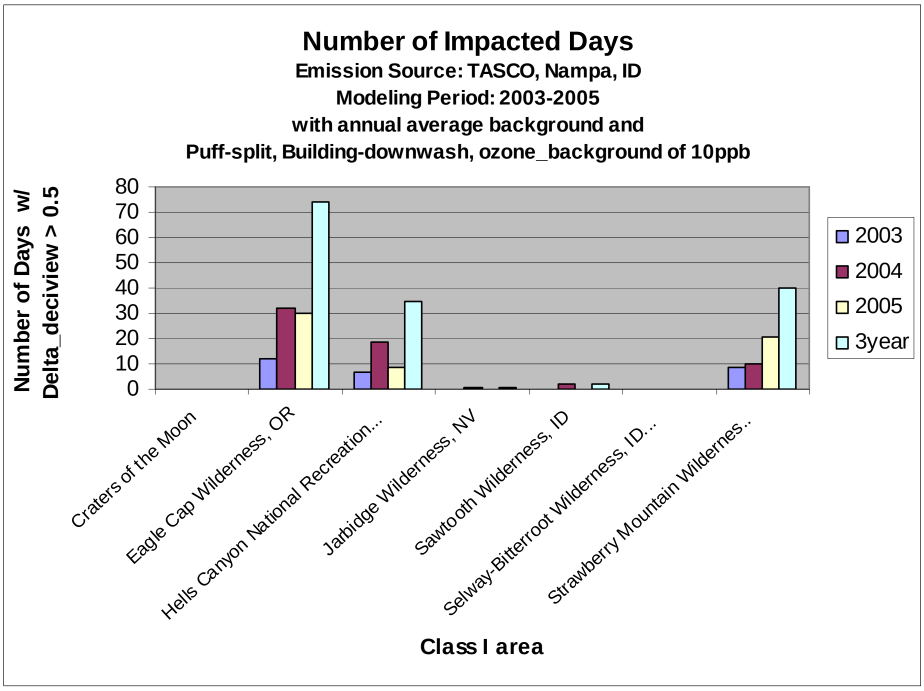

Figure 25. Sensitivity Analysis: Number of days in the Class I areas where the delta-deciview was greater than or equal to 0.5dv

Table 17. Sensitivity Analysis: Change in visibility for Class I areas within 300 km from the TASCO Riley Boiler, Nampa.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Craters of the Moon	0.111	0	0.142	0	0.115	0	0.117	0
Eagle Cap Wilderness, OR	0.646	12	0.944	32	0.806	30	0.895	74
Hells Canyon National Recreation Area, ID	0.494	7	0.708	19	0.591	9	0.632	35
Jarbidge Wilderness, NV	0.064	0	0.128	1	0.097	0	0.101	1
Sawtooth Wilderness, ID	0.124	0	0.283	2	0.179	0	0.201	2
Selway-Bitterroot Wilderness, ID and MT	0.149	0	0.236	0	0.194	0	0.187	0
Strawberry Mountain Wilderness, OR	0.593	9	0.553	10	1.006	21	0.729	40

a. The 8th highest delta-deciview for the calendar year.
b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
c. The 22nd highest delta-deciview value for the 3-year period.
d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Summary and Conclusions

The CALPUFF model predicted that emissions from the **Riley Boiler** at the TASCO Sugar Plant, Nampa, Idaho, impacted visibility with the 98th percentile highest delta-deciview of more than 0.5 deciview on the Class I areas of Eagle Cap Wilderness, OR, Strawberry Mountain Wilderness, OR, and Hells Canyon Wilderness, ID, during the period of year 2003 to 2005.

Eagle Cap Wilderness area had the highest number of days (112 days in 3 years) with delta-deciview value greater than 0.5. The highest 1-year 8th high delta-deciview (1.596, year 2005) was found in Strawberry Mountain Wilderness.

The major contributors to visibility deterioration from the **Riley Boiler** of the TASCO, Nampa facility are SO_2 and NO_2, precursors of sulfate and nitrate aerosols formed in winter under conditions of low temperature and high relative humidity. The impact is greatest when a high-pressure system persists in the area for 3 to 4 days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported remain relatively undiluted.

The subject-to-BART analysis, which followed the *BART Modeling Protocol,* and additional extensive sensitivity analysis have demonstrated that the **Riley Boiler** of the TASCO, Nampa facility is subject to BART.

Appendix 1: CALPUFF Modeling Setup for TASCO Riley Boiler, Nampa, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI10444
Title:	ID-1 4km Existing Control version 3; 2004 through 2005 corrected

Scenario Description: ID-1; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory:	Y:\airmodel\calpuff\runs\bart\wzI10444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1
Source_Elevation_Option:	Model

Source 1

Source Category

Category:	Point

Facility Information

Facility ID:	ID-1
Facility Name:	Amalgamated Sugar - Nampa

Unit Information

Unit ID:	30
Unit Description:	Riley Boiler

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	534.391
Northing (km):	4828.031
Base Elevation (m):	753

Source Location under Domain Projection and Datum

XEasting (km):	344.051
YNorthing (km):	-569.801

Model Source Base Elevation In Calmet Domain

bar_4km (m):	759.705
bar_12km (m):	764.555

Stack Parameters

Height (m):	65
Diameter (m):	2.1
Exit Temperature (K):	427
Exit Velocity (m/s):	16

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	632.50000
SO4 (lb/hr):	6.41455
NOX (lb/hr):	390.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.79000
PMF (lb/hr):	0.76000
EC (lb/hr):	0.03000
SOA (lb/hr):	2.21000

Emission Rate (Unit: g/s)

SO2 (g/s):	79.69366
SO4 (g/s):	0.80822
NOX (g/s):	49.13917
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.09954
PMF (g/s):	0.09576
EC (g/s):	0.00378
SOA (g/s):	0.27846

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	7
ID:	crmowild

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Name:	Craters of the Moon NM - Wilderness
State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	1 - 271

ID:	eaca2
Name:	Eagle Cap Wilderness
State:	OR
# Total Receptors:	596
# Receptors In Calmet Domain:	596
Position In Receptor List:	272 - 867

ID:	heca2
Name:	Hells Canyon Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	868 - 1220

ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	1221 - 1394

ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	1395 - 1747

ID:	selw4
Name:	Selway-Bitterroot Wilderness
State:	ID
# Total Receptors:	575
# Receptors In Calmet Domain:	575
Position In Receptor List:	1748 - 2322

ID:	stmo2
Name:	Strawberry Mountain Wilderness
State:	OR
# Total Receptors:	114
# Receptors In Calmet Domain:	114
Position In Receptor List:	2323 - 2436

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	171
Ending Column:	304
Beginning Row:	33
Ending Row	195

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Appendix 2: Sensitivity Analysis: CALPUFF Modeling Setup for TASCO Riley Boiler, Nampa, Idaho

Scenario Summary

Scenario Information

Scenario Name: wzI10445
Title: ID-1 4km Existing Control version 3; 2004 through 2005 corrected
Scenario Description: ID-1; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected; O3 = 10ppb; Puff splitting on with nsplit=2; building downwash (assume stack name is SPB3 in bpip input file)

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory: Y:\airmodel\calpuff\runs\bart\wzI10445

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1
Source_Elevation_Option:	Model

Source 1

Source Category

Category: Point

Facility Information
Facility ID: ID-1
Facility Name: Amalgamated Sugar - Nampa

Unit Information
Unit ID: 30
Unit Description: Riley Boiler

Control Strategy Applied
Control ID: 41
Control Description: Existing Control - Ver. 3

Source Location and Base Elevation
Datum: NAD27
Projection: UTM
UTM Zone: 11
Easting (km): 534.391
Northing (km): 4828.031
Base Elevation (m): 753

Source Location under Domain Projection and Datum
XEasting (km): 344.051
YNorthing (km): -569.801

Model Source Base Elevation In Calmet Domain
bar_4km (m): 759.705
bar_12km (m): 764.555

Stack Parameters
Height (m): 65
Diameter (m): 2.1
Exit Temperature (K): 427
Exit Velocity (m/s): 16

Emission Rate (Unit: lb/hr)
SO2 (lb/hr): 632.50000
SO4 (lb/hr): 6.41455
NOX (lb/hr): 390.00000
HNO3 (lb/hr): 0.00000
NO3 (lb/hr): 0.00000
PMC (lb/hr): 0.79000
PMF (lb/hr): 0.76000
EC (lb/hr): 0.03000
SOA (lb/hr): 2.21000

Emission Rate (Unit: g/s)
SO2 (g/s): 79.69366
SO4 (g/s): 0.80822
NOX (g/s): 49.13917
HNO3 (g/s): 0.00000
NO3 (g/s): 0.00000
PMC (g/s): 0.09954
PMF (g/s): 0.09576
EC (g/s): 0.00378
SOA (g/s): 0.27846

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Class I Areas

```
Searching Radius (km):         300km
Number of Class I Areas:       7

ID:                            crmowild
Name:                          Craters of the Moon NM - Wilderness
State:                         ID
# Total Receptors:             271
# Receptors In Calmet Domain:  271
Position In Receptor List:     1 - 271

ID:                            eaca2
Name:                          Eagle Cap Wilderness
State:                         OR
# Total Receptors:             596
# Receptors In Calmet Domain:  596
Position In Receptor List:     272 - 867

ID:                            heca2
Name:                          Hells Canyon Wilderness
State:                         ID
# Total Receptors:             353
# Receptors In Calmet Domain:  353
Position In Receptor List:     868 - 1220

ID:                            jarb2
Name:                          Jarbidge Wilderness
State:                         NV
# Total Receptors:             174
# Receptors In Calmet Domain:  174
Position In Receptor List:     1221 - 1394

ID:                            sawt2
Name:                          Sawtooth Wilderness
State:                         ID
# Total Receptors:             353
# Receptors In Calmet Domain:  353
Position In Receptor List:     1395 - 1747

ID:                            selw4
Name:                          Selway-Bitterroot Wilderness
State:                         ID
# Total Receptors:             575
# Receptors In Calmet Domain:  575
Position In Receptor List:     1748 - 2322

ID:                            stmo2
Name:                          Strawberry Mountain Wilderness
State:                         OR
# Total Receptors:             114
# Receptors In Calmet Domain:  114
Position In Receptor List:           2323 - 2436
```

Computational Domain

```
Minimum Buffer (km):           50
Beginning Column:              171
Ending Column:                 304
```

```
Beginning Row:                33
Ending Row                    195
```

Calpuff Run Period Definition

```
Base Time Zone:               8 (Pacific Standard)
Calpuff Beginning Time:       01/01/2003 00:00:00
Calpuff Ending Time:          01/01/2006 00:00:00
Calpuff Time Step(Second):    3600
```

Subject-to-BART Analysis

For the TASCO Erie City Boiler, Paul, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Table of Contents

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[9]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[10], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

[9] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[10] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: TASCO Erie City Boiler, Paul

The **Erie City Boiler** of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Paul, Idaho has been determined to be BART-eligible. Rated at 280 million BTUs per hour, the **Erie City Boiler** is classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input, was installed in 1964, and was put into service between August 7, 1962 and August 7, 1977.

The **Erie City Boiler's** *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 1,051 tn/yr), nitrogen oxide (NO_x, 1,314 tn/yr), and particulate matter (PM, 272 tn/yr), so this unit is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Table 18. Emissions rates used for BART modeling.

Facility/Unit	Maximum 24-hour emission rate (lb/hr)		
TASCO-Paul	SO_2	NO_x	PM_{10} *
Erie City Boiler, Unit 10	26.55	261.67	62.1
*see note of Table 2.			

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* (PM2.5), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF) (see Table 2).

Particulate speciation for the coal-fired **Erie City Boiler** was calculated using the workbook prepared by the National Park Service for dry bottom pulverized coal-fired boilers with wet scrubbers:

http://www2.nature.nps.gov/air/Permits/ect/ectCoalFiredBoiler.cfm

PM size fractions used are as follows: Fine : mean diameter = 0.5 µm, standard deviation = 1.5 µm. Coarse: mean diameter = 5µm, standard deviation = 1.5µm.

Detailed speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 19. Facility information, stack parameters, and speciation of emissions.

Facility Information	**Facility_ID**	**ID-2**
	Facility_Name	**Amalgamated Sugar - Paul**
Unit Information	Unit_ID	10
	Unit_Description	Erie City Boiler
Control Information	Control_ID	41
	Control_Description	Existing Control - Ver. 5
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	12
	Longitude_Easting (km)	273.819
	Latitude_Northing (km)	4721.176
	Base_Elevation (m)	1264
Stack Parameter	Stack_Height (m)	34.1
	Stack_Diameter (m)	3.1
	Stack_Exit_Temperature (K)	313.7
	Stack_Exit_Velocity (m/s)	7.74
Emission Rate (lb/hr)	Sulfur dioxide (SO_2)	26.55
	Sulfate (SO_4)	9.03
	Nitrogen oxides (NO_X)	261.67
	Nitric acid (HNO_3)	0
	Nitrates (NO_3)	0
	Coarse Particulate Matter, 2.5 to 10 micrometers in size, (PMC)	13.29
	Fine Particulate Matter, < 2.5 micrometers in size, (PMF)	32.04
	Elemental Carbon, (EC)	1.24
	Secondary Organic Aerosol (SOA)	3.11
Note: All of sulfate particulates are assumed to be ammonium sulfate, (NH4)2SO4 = 1.375*SO4 (Mass) All of nitrate particulates are assumed to be ammonium nitrate (NH3)NO3 = 1.29*NO3 (Mass)		

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 1.

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

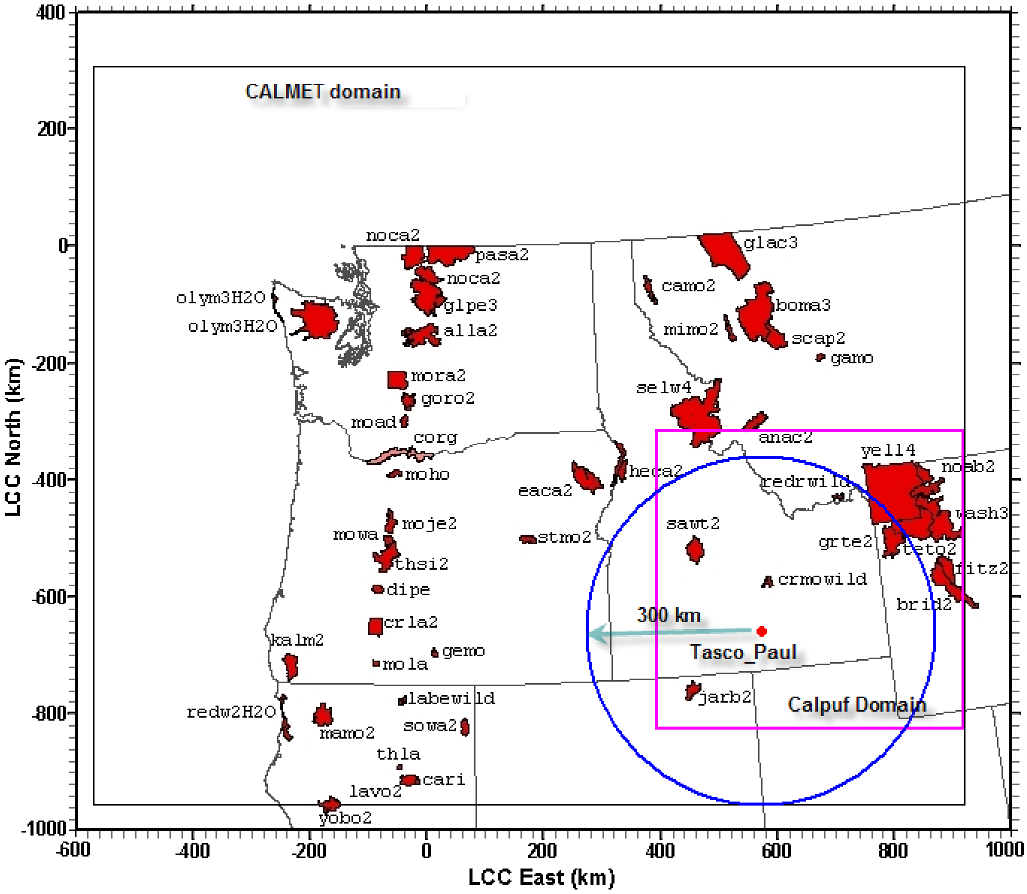

Figure 26. Modeling domain for TASCO Erie City Boiler, Paul, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs (CALMET outputs) needed by CALPUFF for the analysis were prepared by Geomatrix, Inc under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. Figure 1 shows the region that CALMET output covers for the years 2003-2005 at a 4 km resolution.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the TASCO **Erie City Boiler**, Paul are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 20. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the TASCO Erie City Boiler, Paul, Idaho.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003,2004,2005)
Yellowstone NP, WY	0.079	1	0.087	0	0.1	0	0.086	1
Red Rock Lakes, MT	0.073	0	0.088	0	0.08	0	0.081	0
Sawtooth, ID	0.046	0	0.045	0	0.063	0	0.053	0
Teton Wilderness, WY	0.051	0	0.053	0	0.067	0	0.056	0
Jarbidge Wilderness, NV	0.05	0	0.061	0	0.071	0	0.061	0
Yellowstone NP, WY	0.079	1	0.087	0	0.117	0	0.086	1
Craters of the Moon, ID	0.398	4	0.412	3	0.324	4	0.380	11

Class I Area of Greatest Impact

The Erie City Boiler had the greatest impact on the Craters of the Moon Wilderness. Details of the 22 highest calculated changes in deciview for Craters of the Moon for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Sulfate and nitrate are the main contributors.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2, which shows that the 8th highest value varies significantly from year to year.

The top 22 delta-deciview values predicted in the Craters of the Moon Wilderness are plotted in Figure 3.

Table 21. The top 22 highest Delta-deciview values and related modeling output data at Craters of the Moon Wilderness.

Rank	YEAR	DAY	RECEPTOR ID	DV (Total)	DV (BKG)	DELTA DV	F(RH)	% SO_4	% NO_3	% OC	% EC	% PMC	% PMF
1	2003	90	7	2.983	2.035	0.948	2.28	16.54	71.89	2.26	2.26	1.22	3.56
2	2004	32	14	2.989	2.129	0.861	2.74	14.81	77.22	1.55	1.55	0.88	2.67
3	2004	27	243	3.066	2.208	0.858	3.13	17.63	74.13	1.62	1.62	0.81	3.19
4	2005	18	7	3.054	2.208	0.846	3.13	13.46	82.26	0.87	0.87	0.28	2.83
5	2004	341	271	3.025	2.19	0.835	3.04	12.53	81.7	1.13	1.13	0.58	4.37
6	2003	365	3	2.875	2.19	0.685	3.04	13.27	80.77	1.2	1.2	0.46	5.93
7	2003	3	7	2.817	2.208	0.609	3.13	13.61	80.02	1.26	1.26	0.61	3.69
8	2005	315	179	2.74	2.135	0.605	2.77	15.06	76.78	1.6	1.6	0.83	2.76
9	2005	364	271	2.769	2.19	0.58	3.04	15.21	77.9	1.34	1.34	0.74	4.14
10	2005	10	21	2.756	2.208	0.548	3.13	12.67	83.4	0.79	0.79	0.32	3.54
11	2003	337	271	2.732	2.19	0.542	3.04	12.75	81.86	1.06	1.06	0.54	2.75
12	2004	24	271	2.7	2.208	0.492	3.13	11.89	83.07	0.99	0.99	0.52	2.36
13	2003	20	271	2.689	2.208	0.481	3.13	13.36	82.76	0.77	0.77	0.33	3.7
14	2004	335	233	2.605	2.135	0.47	2.77	12.35	81.83	1.17	1.17	0.44	2.62
15	2004	3	7	2.661	2.208	0.453	3.13	14.53	78.36	1.42	1.42	0.62	4.49
16	2003	279	7	2.404	1.971	0.434	1.97	14.68	75.81	1.89	1.89	0.87	3.25
17	2004	360	192	2.609	2.19	0.419	3.04	11.79	84.03	0.85	0.85	0.29	3.11
18	2004	346	271	2.602	2.19	0.412	3.04	14.67	78.92	1.27	1.27	0.61	5.91
19	2004	276	7	2.38	1.971	0.409	1.97	12.81	78.33	1.73	1.73	0.93	2.19
20	2003	81	271	2.439	2.035	0.404	2.28	17.19	70.72	2.36	2.36	1.26	4.42
21	2003	335	271	2.588	2.19	0.398	3.04	10.74	84.67	0.93	0.93	0.33	2.62
22	2004	46	7	2.509	2.129	0.38	2.74	14.11	81.11	0.98	0.98	0.31	2.95

Day: Ordinal day of year
RECEPTOR ID: Identifier for modeled air receptor
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

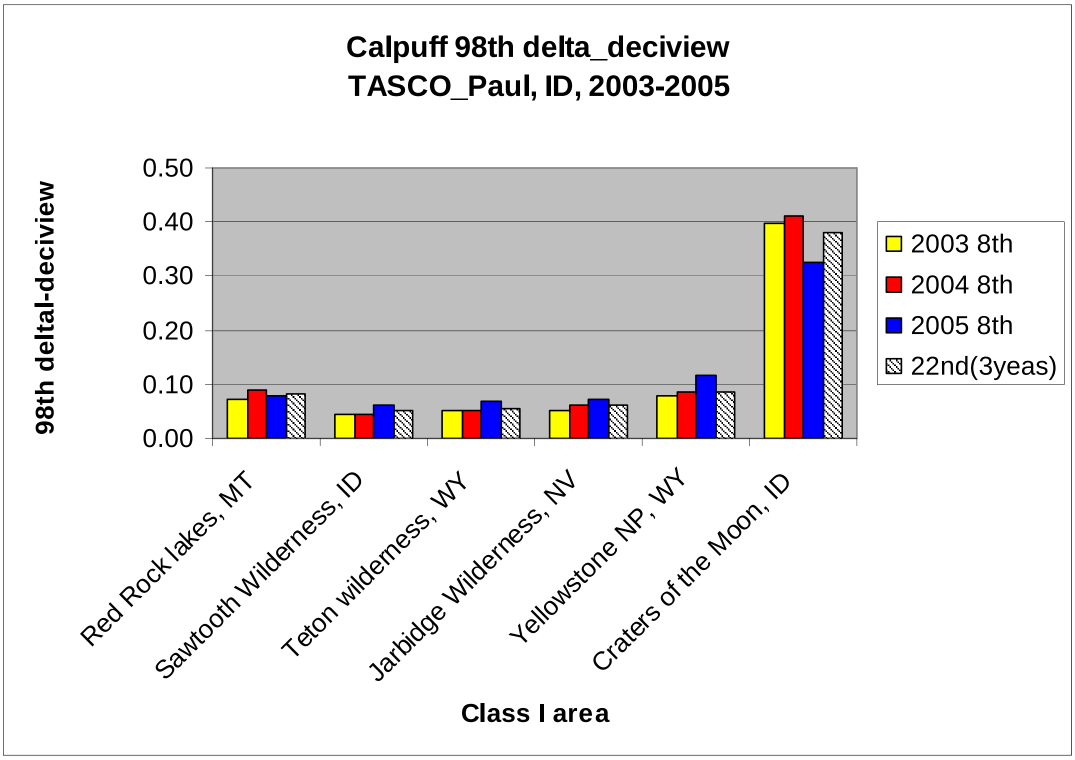

Figure 27. 98th percentile values of delta-deciview in Class I areas for TASCO Erie City Boiler, Paul, Idaho.

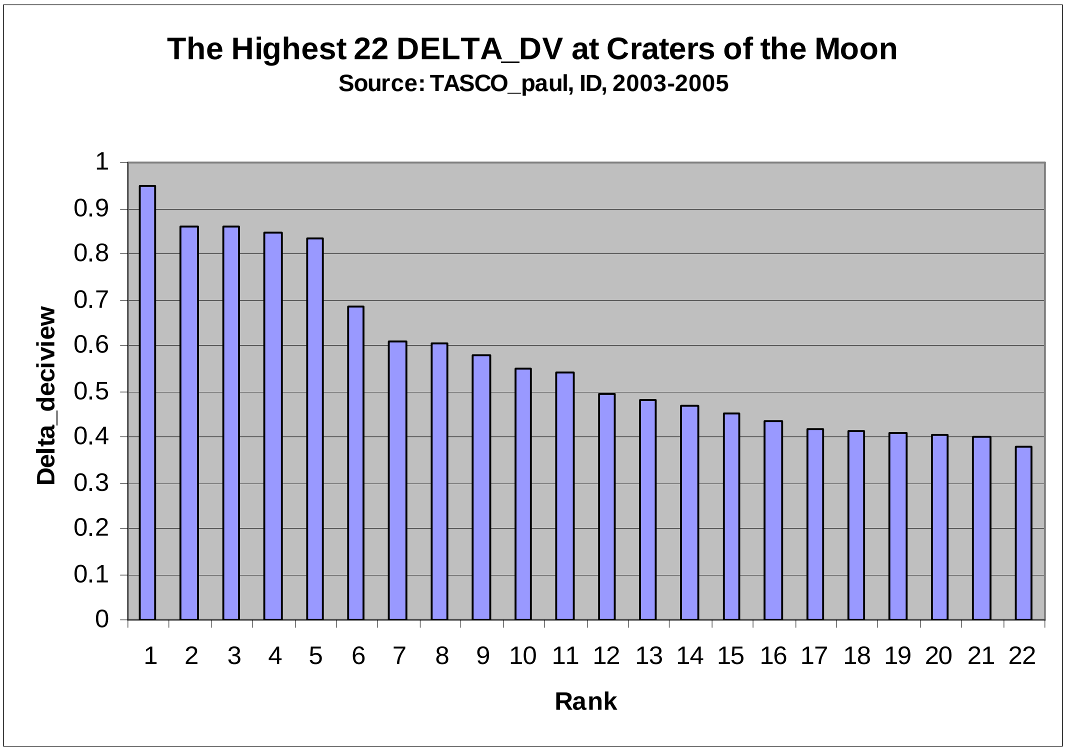

Figure 28. Top 22 highest Delta-deciview values at Craters of the Moon for TASCO Erie City Boiler, Paul, Idaho.

Dominating Pollutants for Visibility Impact

Figure 29 shows the average percentage contributions of the pollutants for the highest 22 days in Craters of the Moon in the modeling period from 2003 to 2005. This is the three-year average of the worst days; impacts may vary considerably for different meteorological conditions and for different areas.

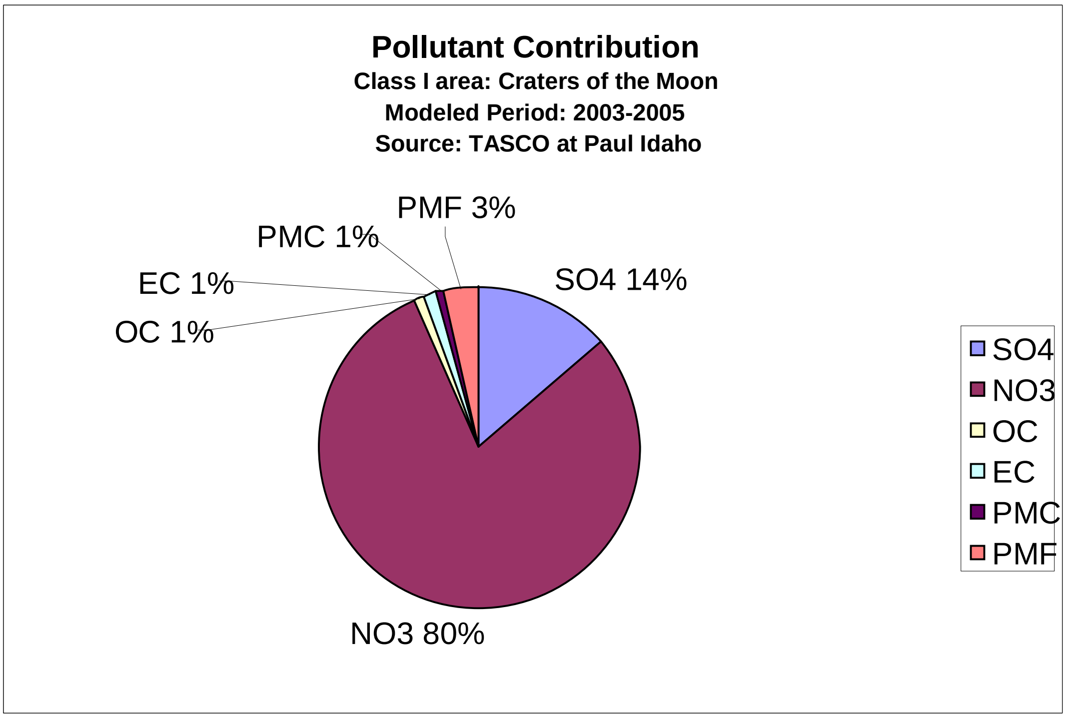

Figure 29. The pollutant contribution from TASCO Erie City Boiler, Paul, Idaho, to visibility change at Craters of the Moon Wilderness.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for the Craters of the Moon Wilderness occurs between November and March.

Although some variations are observed in the modeling period from 2003 to 2005, the variation is not as significant as predicted for the other sources in the area.

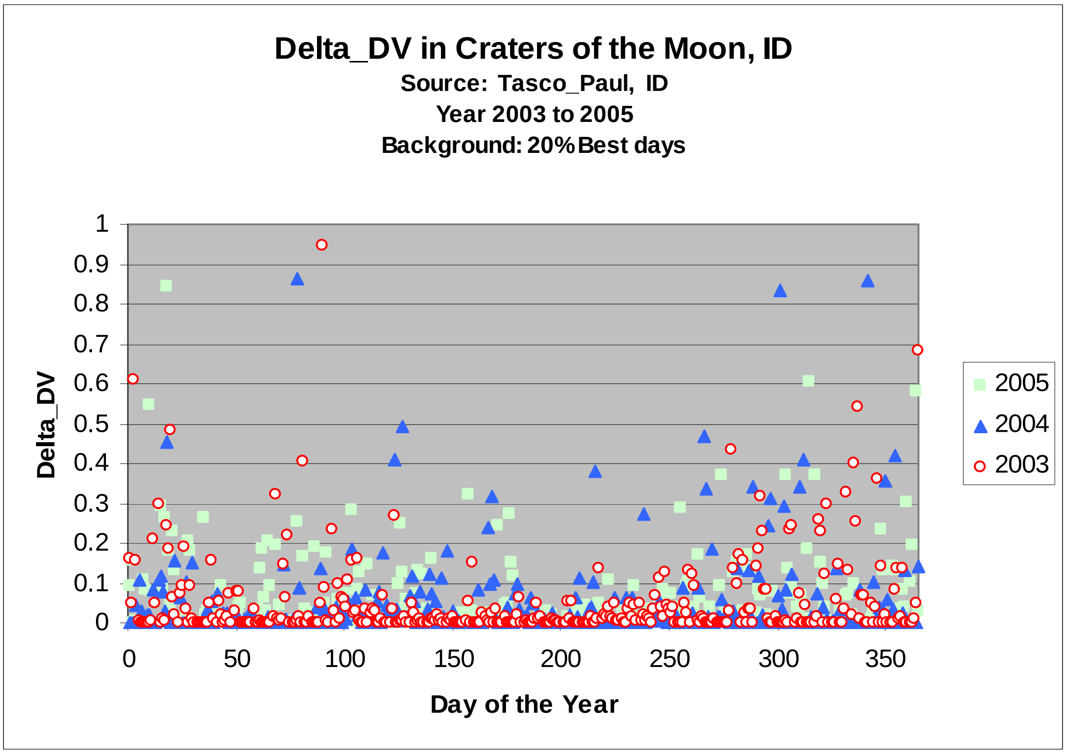

Figure 30. Seasonal impact from TASCO Erie City Boiler, Paul, Idaho to Craters of the Moon Wilderness.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 31 shows the strong stagnation conditions during the episode in January 2004. Pollutants pool up in the valleys and slowly transport to the Class I areas with little dispersion.

Terrain also strongly influences the impact of emission sources. Figure 7 shows a contour map of the number of days, during the modeled period of 2003 to 2005, having an impact higher than or equal to 0.5 deciviews. The channeling effect of the terrain is clearly shown. Because there is no Class I area on the main path of the pollutants, the impact to the visibility in the Class I areas in concern is not significant.

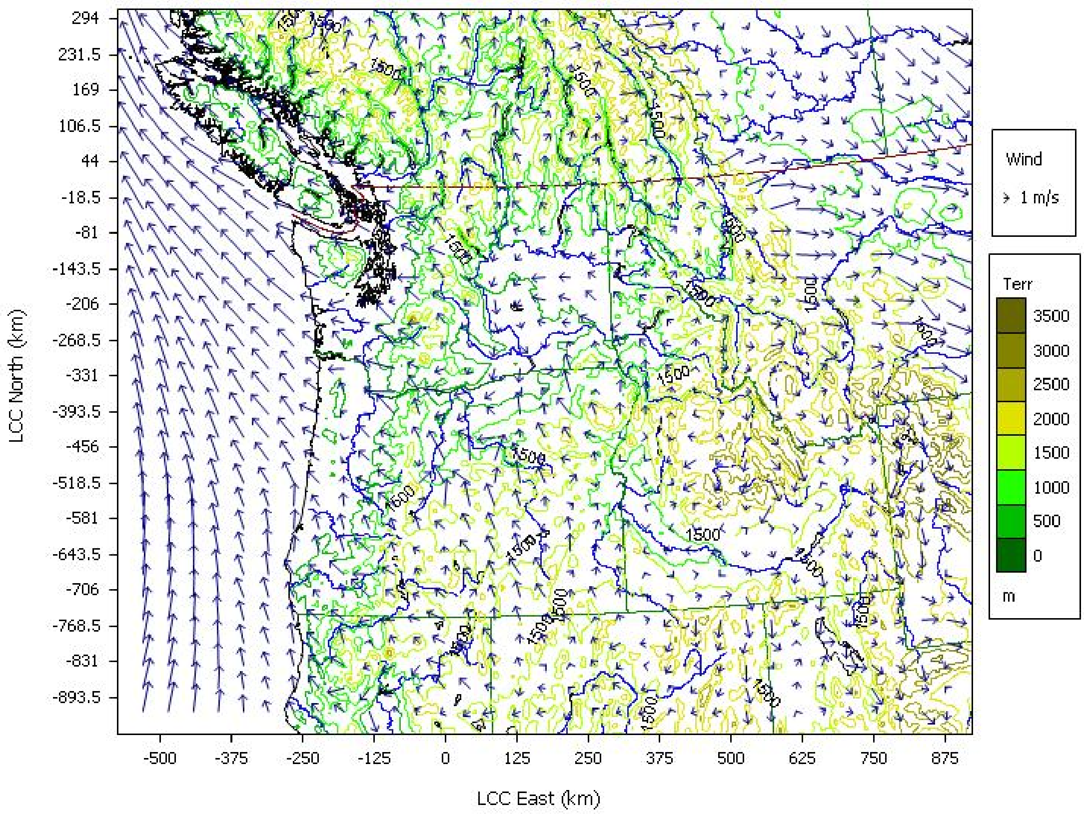

Figure 31. Wind field in the modeling domain for January 15, 2004, one of the high delta-deciview days at Craters of the Moon. A strong stagnation system persisted in the Snake River Valley for more than two weeks. The pollutants were elevated near the sources, slowly dispersed, and transported to the Class I areas.

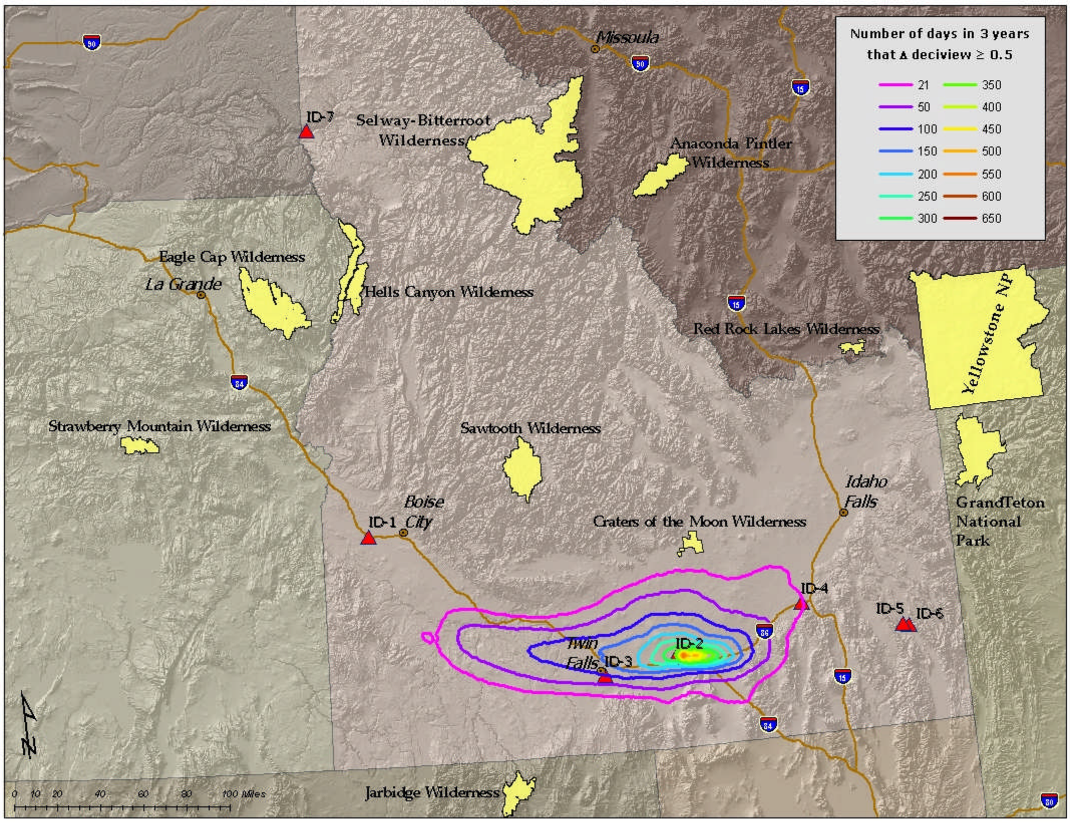

Figure 32. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: TASCO's Erie City boiler at Paul, Idaho. The pattern of dispersion strongly indicates the channeling effects of the terrain. The Craters of the Moon Wilderness is the most significantly impacted Class 1 area because of its location.

Summary and Conclusions

Craters of the Moon had the highest delta-deciview value (0.948) and the highest number of days of visibility degradation (11 days with the delta deciview greater than 0.5, 2003-2005). The eighth highest delta-deciview value in any year was 0.412 (Craters of the Moon, 2004), and the 22nd highest value in the three years was 0.38.

The major contributors to visibility degradation from the TASCO Erie City Boiler are SO_2 and NO_x, precursors of sulfate and nitrate aerosols formed in winter under the conditions of low temperatures and high relative humidity. The impact is greatest when a high pressure system persists in the area for 3-4 days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported to the Class I area relatively undiluted.

The analysis has demonstrated that the TASCO Erie City Boiler is not subject to BART.

Appendix: CALPUFF Modeling Setup for TASCO Erie City Boiler, Paul, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI20444
Title:	ID-2 4km; Existing Control version 5; 2004 through 2005 corrected

Scenario Description: ID-2; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 5 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory:	Y:\airmodel\calpuff\runs\bart\wzI20444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1
Source_Elevation_Option:	Model

Source 1

Source Category

Category:	Point

Facility Information

Facility ID:	ID-2
Facility Name:	Amalgamated Sugar - Paul

Unit Information

Unit ID:	10

Unit Description:	Erie City Boiler

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 5

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	273.819
Northing (km):	4721.176
Base Elevation (m):	1264

Source Location under Domain Projection and Datum

XEasting (km):	572.203
YNorthing (km):	-660.305

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1268.958
bar_12km (m):	1272.286

Stack Parameters

Height (m):	34.1
Diameter (m):	3.1
Exit Temperature (K):	313.7
Exit Velocity (m/s):	7.74

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	26.55000
SO4 (lb/hr):	9.03273
NOX (lb/hr):	261.67000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	13.28940
PMF (lb/hr):	32.04360
EC (lb/hr):	1.24200
SOA (lb/hr):	3.10500

Emission Rate (Unit: g/s)

SO2 (g/s):	3.34524
SO4 (g/s):	1.13810
NOX (g/s):	32.96987
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	1.67444
PMF (g/s):	4.03743
EC (g/s):	0.15649
SOA (g/s):	0.39122

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	7

ID:	crmowild
Name:	Craters of the Moon NM - Wilderness

State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	1 - 271

ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	272 - 777

ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	778 - 951

ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	952 - 1173

ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	1174 - 1526

ID:	teto2
Name:	Teton Wilderness
State:	WY
# Total Receptors:	940
# Receptors In Calmet Domain:	940
Position In Receptor List:	1527 - 2466

ID:	yell4
Name:	Yellowstone NP
State:	WY
# Total Receptors:	915
# Receptors In Calmet Domain:	915
Position In Receptor List:	2467 - 3381

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	373
Beginning Row:	33
Ending Row	160

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)

Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For the TASCO Foster Wheeler Boiler, Twin Falls, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Table of Contents

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[11]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[12], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

[11] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[12] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

BART Eligible Source: TASCO Foster Wheeler Boiler, Twin Falls

The Foster Wheeler Boiler of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Twin Falls, Idaho has been determined to be BART-eligible. Rated at 308 million BTUs per hour, the Foster Wheeler Boiler is classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input, was installed in 1973, so it was put into service between August 7, 1962 and August 7, 1977.

The Foster Wheeler Boiler's *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 1,648 tn/yr) and nitrogen oxide (NO_x, 962 tn/yr).

Particulate matter (PM, 138 tn/yr) emissions do not trigger eligibility but must be included in the visibility modeling analysis for determining whether the unit is subject-to-BART, according to the EPA Guidance..

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles less than 10 micrometers in size.

Table 22. Emissions rates used for BART modeling.

Facility/Unit	**Maximum 24-hour emission rate (lb/hr)**		
TASCO-Twin Falls	SO_2	NO_x	PM_{10}*
Foster Wheeler Boiler, Unit 10	291	174	28.7
* See note of Table 2			

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* (PM2.5), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF). (see Table 2). Particulate speciation for the coal-fired Foster Wheeler Boiler was calculated using the Excel workbook prepared by the National Park Services for coal-fired Boilers-Spreader Stoker using fabric filter for control:

http://www2.nature.nps.gov/air/Permits/ect/ectCoalFiredBoiler.cfm

Detailed speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 23. Facility information, stack parameters, and speciation of emissions.

Facility Information	Facility_ID	ID-3
	Facility_Name	Amalgamated Sugar - Twin Falls
Unit Information	Unit_ID	10
	Unit_Description	Foster Wheeler Boiler
Control Information	Control_ID	41
	Control_Description	Existing Control - Ver. 6
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	11
	Longitude_Easting (km)	711.018
	Latitude_Northing (km)	4711.77
	Base_Elevation (m)	1161
Stack Parameter	Stack_Height (m)	48
	Stack_Diameter (m)	2
	Stack_Exit_Temperature (K)	416.5
	Stack_Exit_Velocity (m/s)	15
Emission Rate (lb/hr)	Sulfur dioxide (SO2)	291
	Sulfate (SO4)	15.33
	Nitrogen oxides (NOX)	174.00
	Nitric acid (HNO3)	0
	Nitrates (NO3)	0
	Coarse Particulate Matter, 2.5 to 10 micrometers in size, (PMC)	1.32
	Fine Particulate Matter, < 2.5 micrometers in size, (PMF)	1.00
	Elemental Carbon, (EC)	0.03
	Secondary Organic Aerosol (SOA)	5.26

Note: All of sulfate particulates are assumed to be ammonium sulfate, (NH4)2SO4 = 1.375*SO4 (Mass)
All of nitrate particulates are assumed to be ammonium nitrate (NH3)NO3 = 1.29*NO3 (Mass)

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 33

- The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.
- The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

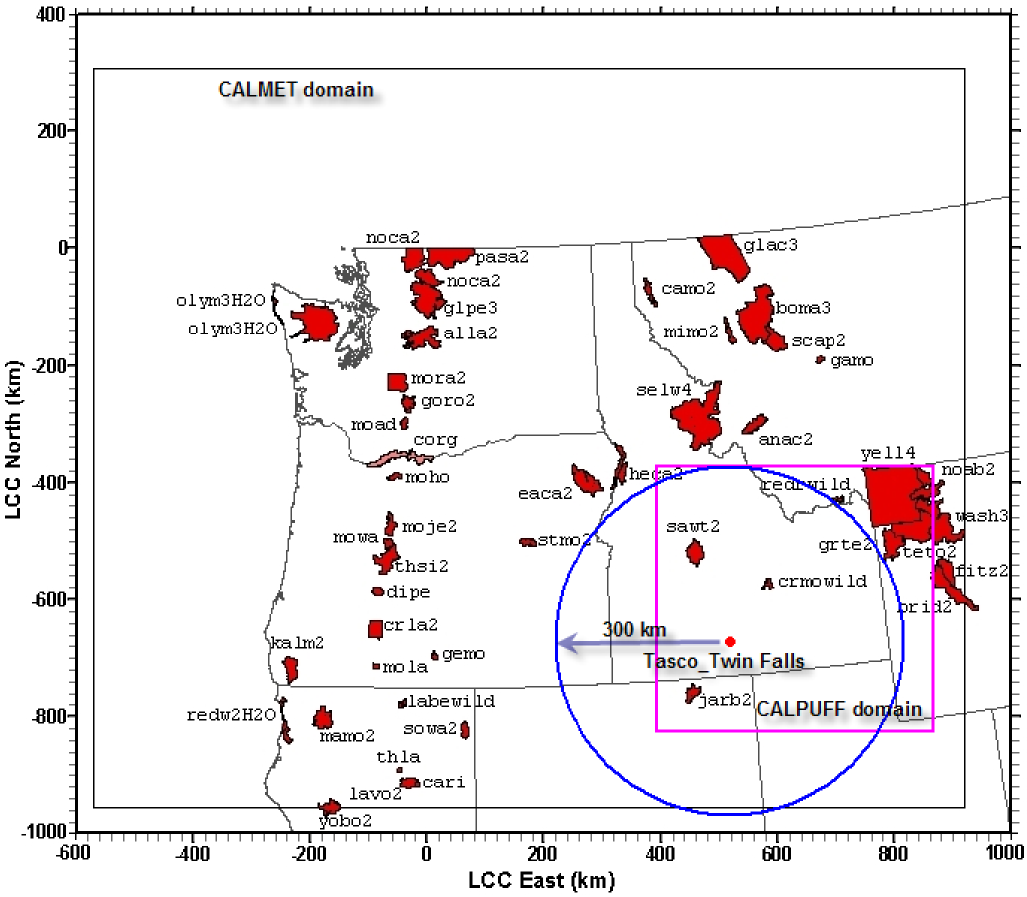

Figure 33. Modeling domain for TASCO Foster Wheeler Boiler, Twin Falls, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the TASCO Foster Wheeler Boiler, Twin Falls are shown in Table 3. Two threshold values for BART were listed:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 24. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
Class I Area	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003,2004,2005)
Great Teton NP, WY	0.076	0	0.073	0	0.085	0	0.073	0
Red Rock Lakes, MT	0.072	0	0.072	0	0.066	0	0.072	0
Sawtooth, ID	0.033	0	0.061	0	0.05	0	0.047	0
Jarbidge Wilderness, NV	0.107	0	0.152	2	0.101	0	0.124	2
Craters of the Moon, ID	0.211	0	0.381	3	0.256	1	0.270	4

Class I Areas Affected

Based on the model results, none of the Class I areas was affected significantly (with the value of 98th percentile over 0.5 deciview) by the Foster Wheeler Boiler, Twin Falls, Idaho.

Area of Greatest Impact

The Foster Wheeler Boiler had the greatest impact on the Craters of the Moon National Monument in February 1, 2004. Details of the 22 highest calculated changes in deciview for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Sulfate and nitrate are the main contributors.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2, which shows that the 8th highest value varies significantly from year to year.

The top 22 delta-deciview values predicted in the Craters of the Moon National Monument area are plotted in Figure 3.

Table 25. The top 22 highest Delta-deciview values and related modeling output data at Craters of the Moon Wilderness Area.

22 highest at Craters of the Moon, Source: TASCO Foster Wheeler Boiler, Twin Falls												
Rank	YEAR	DAY	DV (Total)	DV (BKG)	DELTA DV	F(RH)	% SO4	% NO3	% OC	% EC	% PMC	% PMF
1	2004	19	2.945	2.208	0.737	3.13	59.97	39.12	0.84	0.01	0.02	0.04
2	2004	27	2.887	2.208	0.679	3.13	64.28	34.66	0.98	0.01	0.02	0.05
3	2005	17	2.787	2.208	0.579	3.13	66.11	33.07	0.76	0.01	0.01	0.04
4	2004	341	2.738	2.19	0.548	3.04	44.6	53.54	1.71	0.02	0.05	0.08
5	2004	346	2.669	2.19	0.479	3.04	47.68	50.51	1.66	0.02	0.05	0.08
6	2004	21	2.687	2.208	0.479	3.13	73.06	26.25	0.64	0.01	0.01	0.03
7	2005	361	2.668	2.19	0.478	3.04	49.18	49.35	1.36	0.02	0.04	0.06
8	2003	346	2.64	2.19	0.451	3.04	53.07	45.33	1.47	0.02	0.04	0.07
9	2004	41	2.563	2.129	0.435	2.74	55.98	42.86	1.06	0.01	0.02	0.05
10	2004	340	2.607	2.19	0.417	3.04	47.11	51.32	1.44	0.02	0.04	0.07
11	2005	305	2.551	2.135	0.416	2.77	40.81	55.72	3.18	0.04	0.1	0.15
12	2004	32	2.51	2.129	0.381	2.74	45.87	51.69	2.24	0.03	0.07	0.11
13	2003	323	2.506	2.135	0.371	2.77	40.74	56.93	2.13	0.03	0.07	0.1
14	2005	311	2.491	2.135	0.356	2.77	45.69	51.71	2.38	0.03	0.07	0.11
15	2004	359	2.528	2.19	0.338	3.04	50.25	48.25	1.39	0.02	0.02	0.07
16	2004	336	2.522	2.19	0.332	3.04	53.47	45.31	1.14	0.02	0.01	0.05
17	2004	46	2.436	2.129	0.307	2.74	61.78	37.03	1.11	0.02	0.02	0.05
18	2005	360	2.48	2.19	0.29	3.04	45.64	53.13	1.14	0.02	0.03	0.05
19	2005	274	2.252	1.971	0.281	1.97	38.91	56.27	4.4	0.06	0.15	0.21
20	2004	335	2.415	2.135	0.28	2.77	44.78	53.52	1.58	0.02	0.03	0.08
21	2003	81	2.309	2.035	0.275	2.28	39.69	56.98	3.05	0.04	0.09	0.15
22	2004	20	2.478	2.208	0.27	3.13	69.24	30	0.71	0.01	0.01	0.03

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

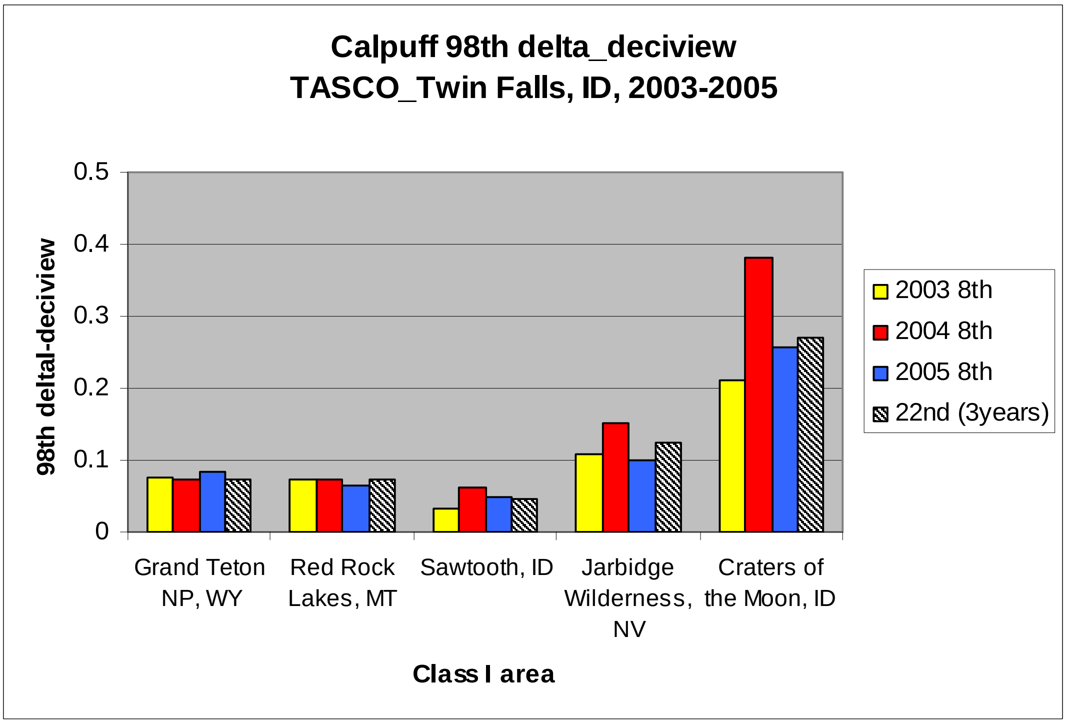

Figure 34. 98th percentile values of delta-deciview in Class I areas for the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

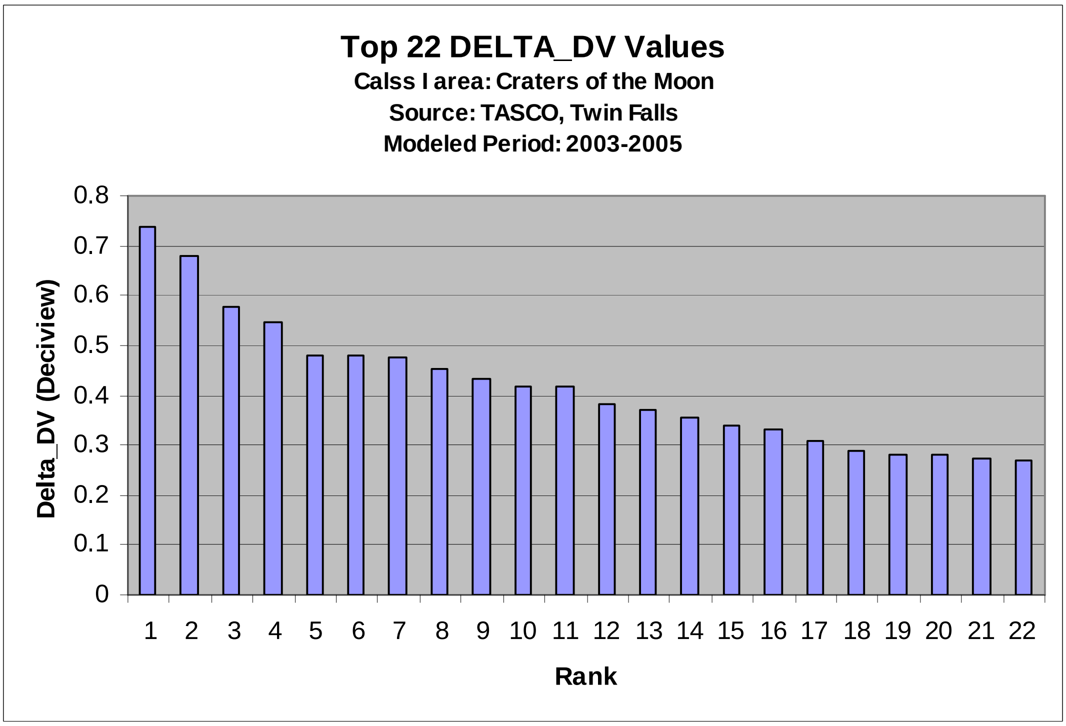

Figure 35. Top 22 highest Delta-deciview values at Craters of the Moon Wilderness area for the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

Dominating Pollutants for Visibility Impact

The results showed secondary aerosols of sulfate and nitrate formed from SO_2 and NO_2 emissions from the TASCO Foster Wheeler Boiler, Twin Falls are the dominating pollutants impacting the visibility in Class I areas. Figure 36 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days.

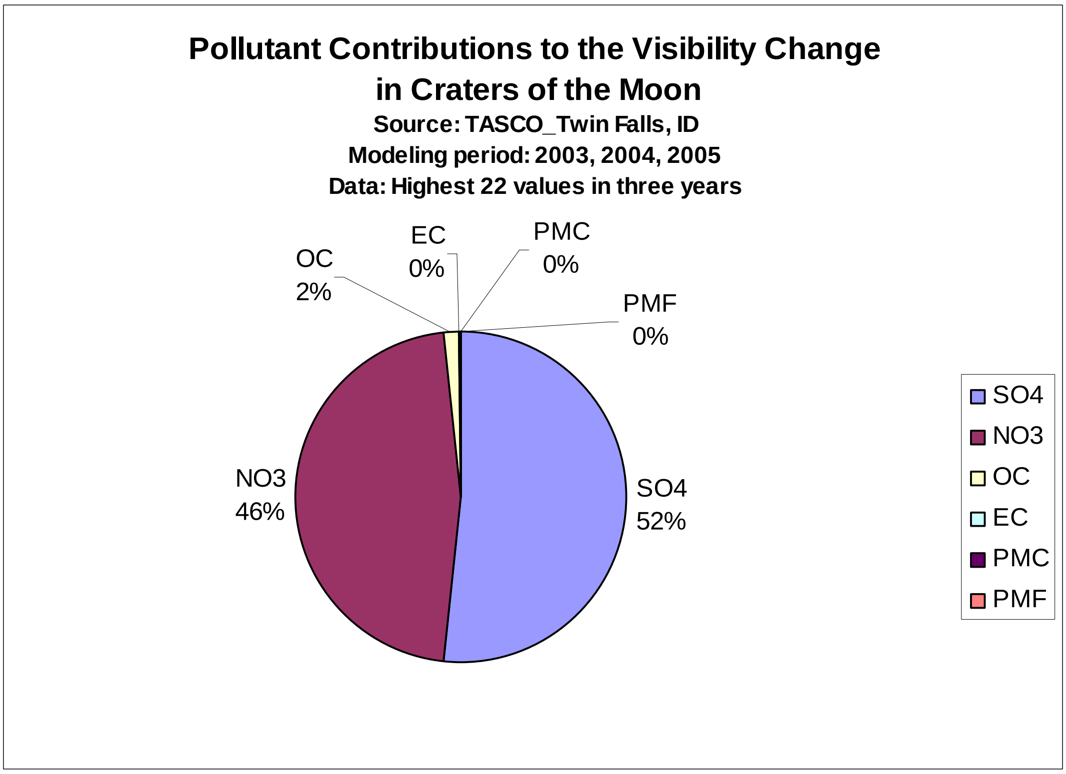

Figure 36. The pollutant contribution from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho, to visibility change at Craters of the Moon WIldeness, Idaho. The total contribution from Sulfate and Nitrate is about 98%.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for the Craters of the Moon Wilderness occurs between November and February.

In the modeling period from 2003 to 2005, significant seasonal variations are observed, and it is especially noticeable for 2004. When the winter meteorological conditions are favorable for hygroscopic aerosols formation, the delta-deciview dramatically increases; the effect is minimal in the dry and hot summertime.

It should be noted that the highest values for the Craters of the Moon, which occurred during January 2004, are much higher than the most highest values in January of 2003 and 2005. An investigation indicated that this winter peak was due to the unusual meteorological conditions during the period and the relative location of the facility and the

Class I Area (see Figure 38 and Figure 39 in the next section) in the broad Snake River valley.

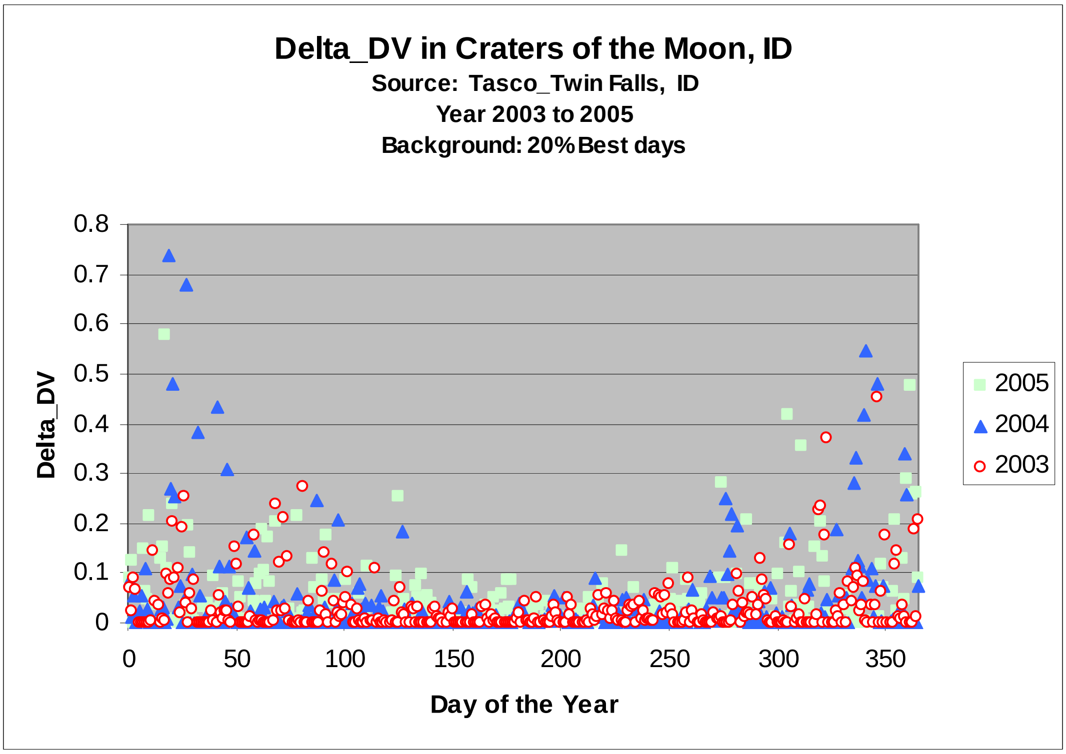

Figure 37. Seasonal impact from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho to Craters of the Moon National Monument area, Oregon, which is located about 120 km north-west from the source.

Meteorological and Geological Conditions

The impact to visibility in Class I areas is strongly dependent on meteorological and geological conditions. Figure 7 shows the strong stagnation conditions that occurred during the episode of January 2004. During such an episode, pollutants pool up in the valleys and slowly transport to the Class I areas with little dispersion.

Terrain also strongly influences impact of emission sources in the area. Figure 39 shows a contour map of the number of days of deciview change higher than or equal to 0.5. The channeling effect of the terrain is clearly shown, indicating that sources are unlikely to significantly affect Class I areas in the region under the investigation.

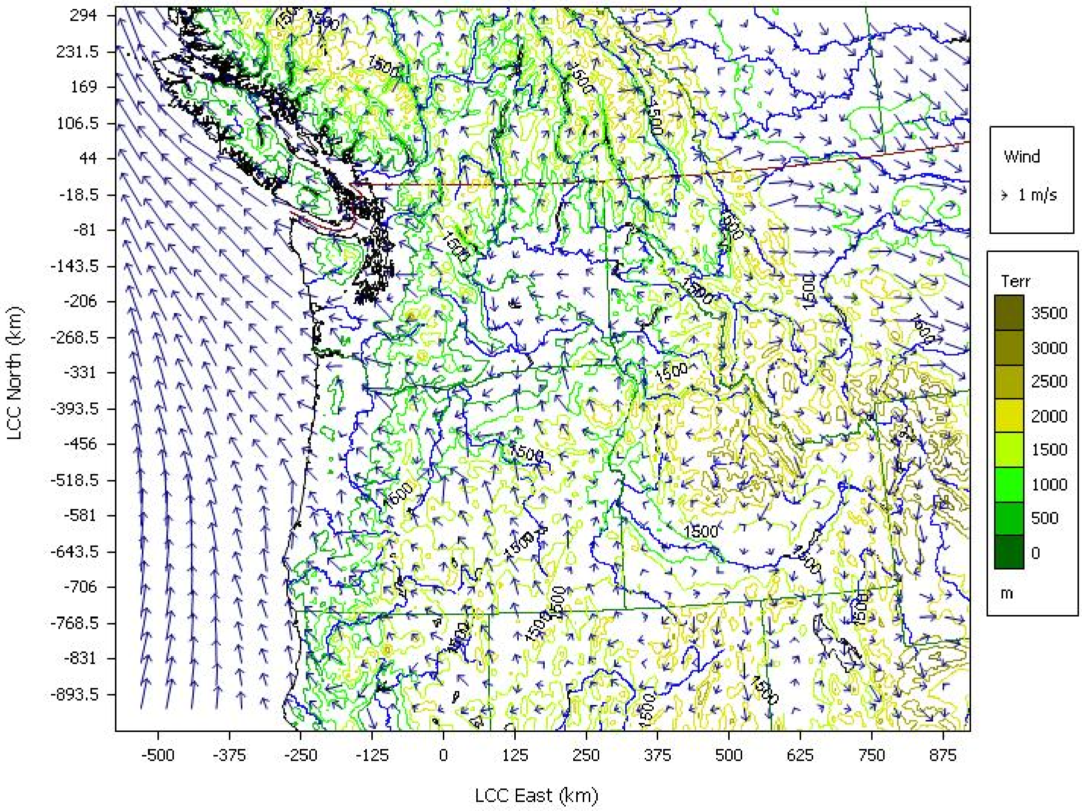

Figure 38. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Craters of the Moon. A strong stagnation system persisted in the Snake River Valley for more than two weeks. The pollutants were elevated near the sources, slowly dispersed, and transported to the Class I areas.

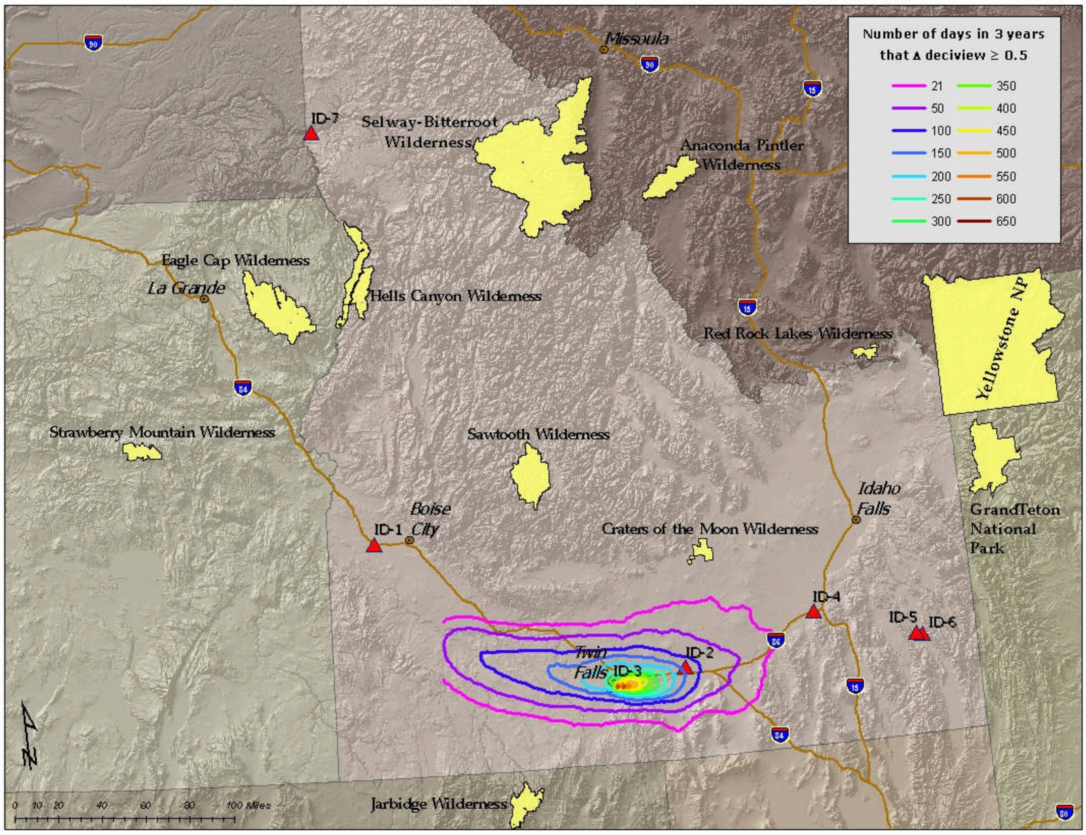

Figure 39. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: TASCO Foster WheelerBoiler at Twin Falls, Idaho (ID-3). The pattern of dispersion strongly indicates the channeling effects of the terrain. The Craters of the Moon Wilderness area is the most significantly impacted area by the source because of its location.

Summary and Conclusions

Craters of the Moon had the highest delta-deciview value (0.737) and the highest number of days of visibility degradation (4 days with the delta deciview greater than 0.5, 2003-2005). The eighth-highest delta-deciview value for Craters of the Moon was 0.381 and the 22nd highest of 0.27.

The major contributors to visibility degradation from the Foster Wheeler Boiler are SO_2 and NO_2, precursors of sulfate and nitrate aerosols formed in winter under conditions of low temperature and high relative humidity. The impact is greatest when a high-pressure system persists in the area for 3 to 4 days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported remain relatively undiluted.

The analysis has demonstrated that the TASCO Foster Wheeler Boiler in Twin Falls is not subject to BART.

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Appendix: CALPUFF Modeling Setup for TASCO Foster Wheeler Boiler, Twin Falls, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI30444
Title:	ID-3 4km Existing Control version 6; 2004 through 2005 corrected

Scenario Description: ID-3; 4km; particle size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 6 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory:	Y:\airmodel\calpuff\runs\bart\wzI30444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1
Source_Elevation_Option:	Model

Source 1

Source Category

Category:	Point

Facility Information

Facility ID:	ID-3
Facility Name:	Amalgamated Sugar - Twin Falls

Unit Information

Unit ID:	10

Unit Description:	Foster Wheeler Boiler

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 6

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	711.018
Northing (km):	4711.77
Base Elevation (m):	1161

Source Location under Domain Projection and Datum

XEasting (km):	519.842
YNorthing (km):	-673.500

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1168.283
bar_12km (m):	1190.666

Stack Parameters

Height (m):	48
Diameter (m):	2
Exit Temperature (K):	416.5
Exit Velocity (m/s):	15

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	291.00000
SO4 (lb/hr):	15.33592
NOX (lb/hr):	174.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	1.32152
PMF (lb/hr):	1.00551
EC (lb/hr):	0.02873
SOA (lb/hr):	5.25736

Emission Rate (Unit: g/s)

SO2 (g/s):	36.66538
SO4 (g/s):	1.93229
NOX (g/s):	21.92363
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.16651
PMF (g/s):	0.12669
EC (g/s):	0.00362
SOA (g/s):	0.66242

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	5

ID:	crmowild
Name:	Craters of the Moon NM - Wilderness

State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	1 - 271
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	272 - 777
ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	778 - 951
ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	952 - 1173
ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	1174 - 1526

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	360
Beginning Row:	33
Ending Row	146

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Amalgamated Sugar Company (TASCO)

Best Available Retrofit Technology Determination

Department of Environmental Quality

Amalgamated Sugar Company (TASCO) Best Available Retrofit Technology Determination

July 17, 2009

Amalgamated Sugar Company (TASCO)
Best Available Retrofit Technology Determination

History of BART

The 1977 Clean Air Act (CAA) Amendments created Part C of the Act entitled Prevention of Significant Deterioration of Air Quality and includes Sections 160-169. The intent of the Prevention of Significant Deterioration (PSD) provisions is to maintain good air quality in areas that attain the national air quality standards and provide special protections for National Parks Wilderness Areas. Part C is divided into two subparts. Subpart 1 established the initial classification of Class I and Class II areas. Class I areas include: Section 162(a)

> *"(1)International Parks,*
>
> *(2) national wilderness areas which exceed 5,000 acres in size,*
>
> *(3) national memorial parks which exceed 5,000 acres in size, and*
>
> *(4) national parks which exceed six thousand acres in size and which are in existence on the date of the enactment of the Clean Air Act Amendments of 1977 shall be Class I areas and may not be redesignated. . . .*
>
> *(b) All areas in such State designated . . . as attainment or unclassifiable which are not established as class I under subsection (a) shall be class II areas . . . ."*

The Class I areas that met this criteria and were in existence on or before 1977 became known as "mandatory class I federal areas." Although states could designate other areas as Class I areas after 1977, PSD and other portions of the Regional Haze Rule focus on those Class I areas in existence on or before 1977.

Based on the classification of an area, the amount of allowable degradation which is from new or modified air pollution sources is determined. In National Parks and other Class I areas smaller amounts of degradation known as "increment" are allowed. The PSD program under Part C, Subpart 1 primarily focuses on emission from 1977 forward and will be further discussed in the chapters on Reasonable Progress and Long Term Strategies.

Visibility is called out much stronger in Part C, Subpart 2 and set the national goal of "the prevention of any future and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution" (CAA Section 169(A). In an effort to remediate the existing impairments to visibility, the Section 169(A)(2)(A) includes "a requirement that each major stationary source which is in existence on the date of enactment of this section, but which has not been in operation for more than fifteen years as of such date, . . .emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any such area, shall procure, install and operate, as expeditiously as practicable (and maintain thereafter) the best available retrofit technology, as determined by the state."

To carry out Congress' intent to install BART on certain emission sources, EPA promulgated the "Regional Haze Rule" [64 FR 35714 (July 1, 1999)]. These rules were challenged, and on May 24, 2002, the U. S. Court of Appeals for the District of Columbia vacated the Regional Haze Rule and remanded the BART provisions in the Rule.

Revisions to the rule were published on July 6, 2005 [70 FR 39104 (July 6, 2005)]. The BART rule can also be found under 40 CFR 51.308(e). As part of the July 6, 2005 rule revisions, EPA published Appendix Y guidance for the implementation of BART. The guidance can be found beginning at 70 FR 39156 (July 6, 2005).

In the spring of 2006, the Department of Environmental Quality (DEQ) went through a negotiated rulemaking process to develop rules for Regional Haze. During this process rules were negotiated for the implementation of BART and Reasonable Progress Goals. These rules pertaining to BART can be found at IDAPA 58.01.01.668. During the negotiated rule making process, it was recommended by industry representatives to follow EPA Appendix Y Guidance on the BART determination process but not incorporate the guidance into rule under IDAPA. A threshold of visibility impact of 0.5 deciviews in any Class I Federal Area was established through negotiated rule making as "contributing" to visibility impairment.

BART Process

The BART provision applies to "major stationary sources" from 26 identified source categories which have the potential to emit 250 tons per year or more of any air pollutant. The CAA requires that only sources which were built or in operation during a specific 15-year time interval be subject to BART. The BART provision applies to sources that existed as of the date of the 1977 CAA amendments (that is, August 7, 1977) but which had not been in operation for more than 15 years (that is, not in operation as of August 7, 1962). The first phase of the BART process is developing a list of BART "eligible" facilities which include those major facilities from the 26 identified source categories that have a potential to emit 250 tons per year of any light impairing pollutant.

The CAA requires BART review when any source meeting the above description "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility" in any Class I area. In most cases, the determination of whether a facility is causing or contributing to visibility impairment is done through modeling. Any BART-eligible facility with an impact of one deciview is considered "causing" visibility impairment, and in Idaho the threshold for "contributing" to impairment is 0.5 deciview[13]. Any BART-eligible facility causing or contributing to visibility impairment is BART "subject." BART subject facilities are required to go through a process to determine what if any controls will be required.

BART Eligibility

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. The Riley Boiler of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Nampa, Idaho has been determined to be BART-eligible. The Boiler is rated at 350 million BTUs per hour which meets the BART criteria as a fossil-fuel boiler of more

[13] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

than 250 million BTUs per hour heat input, was installed in 1969, and was put into service between August 7, 1962 and August 7, 1977.

The Riley Boiler's *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 2,770 tn/yr), nitrogen oxide (NO_x, 1,708 tn/yr), and particulate matter (PM, 55 tn/yr), so this emission unit is eligible for inclusion in the subject-to-BART analysis of visibility impairment in Class I areas. Following this criteria the Riley Boiler at the Nampa TASCO plant is BART-eligible.

BART Subject

The source is *subject to BART* if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews* (delta-deciview)—a measure of visibility impairment—is equal to or greater than a contribution threshold of 0.5 deciviews. Although Appendix Y does provide for thresholds less than 0.5 deciviews and cumulative impacts, it was determined through negotiated rulemaking with industry, federal land management agencies, DEQ and the public that the "contribute" threshold for a single source would be established at 0.5 deciviews. (See IDAPA 58.01.01.668.02.b.) As suggested in Appendix Y guidance, the determination was made by modeling.

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[14], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision. Refer to the *BART Modeling Protocol* for details on the modeling methodology used in this subject-to-BART analysis (See Appendix A).

The Idaho DEQ, in cooperation with Washington State of Ecology and Oregon Department of Environmental Quality contracted with Geomatrix Consultants to develop CALMET datasets to use for the CALPUFF BART modeling. The CALMET datasets were based on Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) runs performed at Washington University. There were two CALMET datasets produced--one using 12km mesh size and another using 4 km mesh size[15]. (See Appendix B.)

As part of the contract, Geomatrix Consultants ran MESTAT to quantify the quality of the MM5 files used as the meteorological dataset in CALMET—used in the CALPUFF modeling. MESOSTATE pairs the MM5 forecasted data with meteorological observations

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[14] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

[15] *Modeling Protocol for BART CALMET datasets, Idaho Oregon and Washington,*Geomatrix Consultants Inc., July 12, 2006

and then performs various statistical manipulations and aggregates the results for output.[16] (See Attachment C.).

Subject-to-BART analysis results for the TASCO Riley Boiler, Nampa are shown in Table 1, which highlights the following two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for delta-deciview in the each year.

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for delta-deciview over three years.

The determining criterion for both values is a delta-deciview of at least 0.5 deciview. Table 26. Change in Visibility Compared Against 20% Best Days Natural Background

Class I Area	**Change in Visibility Compared Against 20% Best Days Natural Background Conditions**							
	Delta-Deciview Value larger than 0.5 from one year period						**Delta-Deciview Value larger than 0.5 from 3 year period**	
	2003		**2004**		**2005**		**2003-2005**	
	8th highest[a]	**Total days[b]**	**8th highest**	**Total days**	**8th highest**	**Total days**	**22nd Highest[c]**	**Number of Days[d] (2003,2004,2005)**
Craters of the Moon	0.161	2	0.224	2	0.153	0	0.196	2
Eagle Cap Wilderness, OR	0.87	20	1.355	46	1.302	46	1.325	112
Hells Canyon National Recreation Area, ID	0.772	13	1.031	27	0.9	21	0.936	61
Jarbidge Wilderness, NV	0.151	0	0.198	1	0.201	1	0.179	2
Sawtooth Wilderness, ID	0.239	2	0.294	4	0.265	0	0.271	6
Selway-Bitterroot Wilderness, ID and MT	0.186	0	0.305	1	0.264	2	0.243	3
Strawberry Mountain Wilderness, OR	0.782	12	0.639	13	1.596	31	0.943	56

e. The 8th highest delta-deciview for the calendar year.
f. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
g. The 22nd highest delta-deciview value for the 3-year period.
h. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

These findings were based on the emission rates and other facility parameters provided by TASCO at the time of the analysis[17]. Based on the analysis, the TASCO Riley Boiler impacted the following Class I areas with the 98th percentile highest delta-deciview greater than 0.5 during the modeling period 2003-2005:

16 *INTITIAL METSTAT REPORT CALMET Fields for BART Idaho, Oregon and Washington,* Geomatrix Consultants

17 The delta deciview impact for each of the Class I areas identified in the Subject-to-BART analysis changed slightly in the final determination process due to refinements in facility parameters such as stack velocities as provided by TASCO.

Eagle Cap Wilderness, Oregon

Hells Canyon National Recreation Area, Idaho

Strawberry Mountain Wilderness, Oregon

In conclusion, the CALPUFF model predicted that emissions from the Riley Boiler at the TASCO Sugar Plant, Nampa, Idaho, impacted visibility with the 98^{th} percentile highest delta-deciview of more than 0.5 deciview on the Class I areas of Eagle Cap Wilderness, OR; Strawberry Mountain Wilderness, OR; and Hells Canyon Wilderness, ID, during the period of year 2003 to 2005.

Eagle Cap Wilderness area had the highest number of days (112 days in three years) with delta-deciview value greater than 0.5. The highest one-year 8th high delta-deciview (1.596, year 2005) was found in Strawberry Mountain Wilderness.

The major contributors to visibility deterioration from the Riley Boiler of the TASCO, Nampa facility are SO_2 and NO_2, precursors of sulfate and nitrate aerosols formed in winter under conditions of low temperature and high relative humidity. The impact is greatest when a high-pressure system persists in the area for three to four days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported remain relatively undiluted.

The subject-to-BART analysis, which followed the *BART Modeling Protocol*, and additional extensive sensitivity analysis have demonstrated that the Riley Boiler of the TASCO, Nampa facility is subject to BART. TASCO was notified of the subject-to-BART findings by letter on July 19, 2007. (See attachment A.)

1.2.3. BART Determination

The third phase of the BART process is the determination of technically feasible control technologies. The Clean Air Act defines five factors in making a determination. They include:

- The cost of compliance,
- The energy and non-air quality environmental impacts of compliance,
- Any existing pollution control technology in use at the source,
- The remaining useful life of the source, and
- The degree of visibility improvement which may reasonably be anticipated from the use of BART.

In making the BART determination TASCO was requested to follow Appendix Y guidance for the implementation of BART as found at 70 FR 39156 (July 6, 2005). Although this guidance was required for Electrical Generation Units (EGUs), EPA has determined there is no reason the guidance cannot be used for other BART categories. The five steps as described in Appendix Y determination process can be summarized as follows:

STEP 1 – Identify all available retrofit emissions control techniques (three categories)

- Pollution prevention (use of inherently lower-emitting processes/practices)

- Use of (and where already in place, improvement in the performance of) add-on controls
- Combination of pollution prevention and add-on controls

STEP 2 – Determine technically feasible options
- Available (commercial availability)
- Applicable (Has it been used on the same or a similar source type?)

STEP 3 – Evaluate technically feasible options
- Make sure you express the degree of control using a metric that ensures an “apples to apples” comparison of emissions performance levels among options (e.g., lb SO2/MMBtu).
- Give appropriate treatment and consideration of control techniques that can operate over a wide range of emission performance levels (evaluate most stringent control level that the technology is capable of achieving plus other scenarios).

STEP 4 – Impact analysis
- Cost of compliance (Identify emission units, design parameters, develop cost estimates.)
    - Baseline emissions rate should represent a realistic depiction of anticipated annual emissions from the source. In general, for the existing sources subject to BART, you will estimate the anticipated annual emissions based upon actual emissions from a baseline period.
- Energy impacts
    - Direct energy consumption for the control device, not indirect energy impacts
- Non-air quality environmental impacts
    - Solid or hazardous waste generation or discharges of polluted water from a control device
- Remaining useful life
    - Can be included in the cost analysis

STEP 5 – Determine visibility impacts (improvements)
- Run the model at pre-control and post-control emission rates
    - Pre-control emission rates = max 24-hour used in BART subject modeling
    - Post-control emission rates = % of pre-control rates (e.g., 95% control efficiency)
    - Calculate results for each receptor as the change in Deciviews compared against natural visibility
- Determine net visibility improvement
    - Consider frequency, magnitude, and duration components of impairment
    - Can compare 98th percent days

TASCO BART Determination

After several consultations with TASCO concerning emission rates, facility parameters and the BART process, TASCO submitted a "Best Available Retrofit Technology Determination – Riley Boiler" on November 20, 2007. After reviewing the document, DEQ requested that TASCO revise the document to include some additional control technologies that were technically feasible, evaluate them using the five steps listed above and provide additional cost and financial detail. TASCO revised the document and resubmitted the information on February 6, 2009. As part of the revisions, DEQ performed the CALPUFF modeling to identify changes in visibility based on the emission estimates and facility parameters provided by TASCO for each of the technically feasible control technologies for each BART identified pollutant. The remainder of this document will review the February 6, 2009 BART determination as submitted by TASCO, comments on issues raised in the document, and provide DEQ's determination on the selection of the Best BART technologies based on the categories listed above.

Particulate BART Control Technology Selection

In determining the "best" BART control technology for particulate controls on the Riley Boiler, DEQ worked in conjunction with TASCO using the five steps as described in EPA Appendix Y.

STEP 1 – Identify all available retrofit emissions control techniques

In consultation with DEQ, the following particulate control technologies were identified:

- Existing baghouse
- Enhanced baghouse
- Wet Electrostatic Precipitator (Wet ESP)
- Dry Electrostatic Precipitator (Dry ESP)

STEP 2 – Determine technically feasible options

In this step, DEQ relied heavily on TASCO engineers to provide the technical feasibility because of plant specific requirements and their familiarity with plant operations. DEQ did review the information as provided below:

Existing Baghouse - The existing baghouse efficiently reduces PM to very low levels. Measured PM emissions are 0.036 lbs/MMBTU, well below the previously proposed industrial boiler MAACT standard of 0.07 lbs/MMBTU. Control efficiencies for baghouses are reported at 99.0 to 99.9%. For this analysis the control efficiency was assumed to be 99% efficient.

Enhanced Baghouse – The addition of a baghouse module may marginally improve the removal efficiency of the existing baghouse. This option would expand the number of modules from four to five resulting in reduced baghouse velocities and pressure drop. Adding another baghouse module to the Riley Boiler baghouse will be difficult and expensive because of physical space limitations near the existing baghouse. PM control efficiency for the additional baghouse is assumed to be 99.0%.

Wet Electrostatic Precipitator – A Wet ESP consists of a series of collection surfaces in the device that removes particulate using an electrical field. The plates are continuously or intermittently cleaned using a circulating water system. Control efficiencies for Wet ESP systems are reported to be 99.0 to 99.9%. For the purposes of this evaluation, the control efficiency is assumed to be 99%.

Because of physical space limitations, the installation of the Wet ESP will require demolition and the removal of the existing baghouse and installation of the WET ESP in its place. In addition the system will produce saturated vapor conditions in the stack during some operation scenarios. A liner will be needed to be installed in the existing stack to protect the stack from corrosive conditions.

Dry Electrostatic Precipitator – A Dry ESP is very similar in operation to the Wet ESP option considered above. The particulate to be removed is charged in an electric field and attracted to a collection plate. Control efficiencies for Dry ESP system are reported at 99.0 to 99.9% efficient. For this evaluation the control efficiency is assumed to be 99.0%.

This information is summarized in Table 2, below.

Table 27. Technically Feasible Options

Pollutant	Technology	Feasibility	Reason Not Feasible
PM	Existing Baghouse	Yes	None
	Enhanced Baghouse	Yes	None
	Wet ESP	Yes	None
	Dry ESP	Yes	None

In conclusion, all particulate technologies identified are technically feasible options for the Riley Boiler .

STEP 3 – Evaluate technically feasible options

In this step, all of the technically feasible options were ranked in order of effectiveness of each control technology identified as technically feasible. Control effectiveness was based on manufacture's performance data, engineering estimates, and demonstrated effectiveness of the technology on the Riley Boiler. This data is summarized in Table 3.

Table 28. Control Technology Efficiency Evaluation

Pollutant	Control Option	BART Baseline	BART Baseline	Removal Efficiency	Expected Maximum	Expected Annual

		Maximum Emission rate (lbs/hour)	Annual Average Emissions (tons/year)		Emission Rate (lbs/hour)	Emissions (tons/year)
Particulate	Existing Baghouse	12.4	34.5	99.0%	12.4	34.5
	Enhanced Baghouse	12.4	34.5	99.0%	12.4	34.5
	Dry ESP	12.4	34.5	99.0%	12.4	34.5
	Wet ESP	12.4	34.5	99.0%	12.4	34.5

Since all control technologies have the same removal efficiency no single control technology is ranked higher than the other for emissions removal.

STEP 4 – Impact analysis

The use of the existing baghouse stands out as the best BART control technology since it will not require additional costs. The existing baghouse has the added environmental benefits of not requiring additional water or electricity. The benefit of adding an additional bag house is so small the benefits are outweighed by the costs. In conclusion, the best BART alternative for particulate is the existing baghouse.

STEP 5 – Determine visibility impacts (improvements)

Since all control technologies have the same removal efficiency there is no merit in modeling specifically for the particulate control scenarios.

Sulfur Dioxide (SO_2) BART Control Technology Selection

In determining the "best" BART control technology for SO_2 controls on the Riley Boiler, DEQ worked in conjunction with TASCO using the five steps as described in EPA Appendix Y.

STEP 1 – Identify all available retrofit emissions control techniques

- Low sulfur coal (LSC)
- Wet flue gas desulfurization (FGD)
- Spray dry FGD
- Dry lime FGD
- Dry Trona injection FGD

STEP 2 – Determine technically feasible options

In this step, DEQ relied heavily on TASCO engineers to provide the technical feasibility because of plant specific requirements and their familiarity with plant operations. DEQ did review the information as provided below:

Low Sulfur Coal (LSC) – Currently the Nampa plant uses coal that is limited to 1% sulfur by weight to comply with the Rules for Control of Air Pollution in Idaho. The average actual percent sulfur for the baseline period is approximately 0.75%. This option will look at using 0.6% sulfur with an actual reduction of 15%.

Wet Flue Gas Desulfurization (WET FGD) – A WET FGD system typically consists of saturated absorber towers located downstream of a particulate control device. The absorbers are usually configured as a flooded tray system or spray tower. Flue gas entering the absorber reacts with slurred limestone or slaked lime to remove SO_2 at the liquid/gas surface boundary. The reaction forms insoluble products or solids that are further treated with forced oxidation to convert to gypsum which is a marketable by product. The treated flue gas passes through a mist eliminator system to remove water droplets from the flue gas stream. The flue gas leaving the absorber is saturated with water vapor and can present a visible steam plume from the stack.

Wet FGD systems offer one of the highest SO_2 removal efficiencies of the available control technologies with a removal efficiency of 95% or greater. This is also a technology which EPA is heavily invested and supports. The Installation of Wet FGD will require significant modification of the facility. Key site-specific considerations are as follows:

Wet FGD results in saturated stack conditions during periods of Riley only operation (Shared stack operation during beet campaign with the B&W Boiler is not anticipated to result in saturated stack conditions). The resulting condensation formed in the stack is anticipated to have very low pH values that will require installation of a stack liner to protect the integrity of the stack. Condensed vapors will need to be neutralized. Installation of a stack liner is estimated at $2,000,000.

Since Wet FGD is a wet process, it will generate a wastewater stream. The actual wet process is expected to be contained within the Wet FGD system with a slip stream discharged for wastewater treatment.

Spray Dryer Flue Gas Desulfurization (Spray Dry FGD) **–** Spray Dry FGD consists of a spray dryer reactor to be located between the exhaust outlet of the boiler and upstream of a particulate removal device (usually an electrostatic precipitator or baghouse). The reactor consists of a spray dryer absorber tower and support equipment. Flue gas is introduced into a vessel and contacts an atomized spray pattern of lime slurry generated by either a set of dual fluid nozzles or a rotary atomizer. The reaction to remove SO_x occurs on lime slurry droplets as they are evaporated from the heat of the flue gas to form a dry particle.

Because the exit temperature of the reactor must be maintained at a set temperature above the adiabatic saturation temperature of the flue gas (controlled by slurry feed rate), the product removed from the system is in dry form. The emission control efficiency of the reactor increases as the exit flue gas temperature approaches the adiabatic saturation temperature of the flue gas. The approach temperature is typically set at 30-40° F above adiabatic saturation temperature (corresponding to removal efficiencies of 90-80% respectively). Recycling fly ash into the lime slurry feed mixture may increase emission control efficiency depending on the chemical characteristics of the ash.

For the purposes of this evaluation a control efficiency of 80% will be assumed (a higher temperature 40° F was assumed to protect the baghouse).

A spray Dry FGD retrofit project will require modifications of the TASCO Nampa facility. The particulate loading to the baghouse will increase as a result of installing a spray dryer.

In addition to the ash entering the reactor with flue gas, the spent lime contributes to overall particulate loading. Approximately 60% of the formed solids are predicted to drop out in the reactor while 40% will be carried to the baghouse for removal. The increase in particulate loading will likely require an additional baghouse.

Dry Lime Injection Flue Gas Desulfurization (Dry Lime FGD) – Dry Lime FGD consists of injecting pulverized lime (milled to less than 10 microns) into the flue gas upstream of the baghouse. The emission control efficiency of a Dry Lime FGD is critically dependent upon:

Particle Size – The smaller the particle size, the greater the surface area for reaction. Lime is milled to less than 10 microns using a ball mill. The smaller size of the particles is also important to avoid downstream depositing of dust in the equipment and ductwork.

Temperatures – Reaction rates increase with increased temperatures of the flue gas.

Flue Gas Mixing – Good lime particle mixing with the flue gas is important to provide uniform distribution of lime reactant in the baghouse.

The control efficiency for DLIFGD is reported to vary between 45 to 55%. For the purposes of this evaluation, the control efficiency is assumed at 55%.

Dry Trona Injection Flue Gas Desulfurization (Dry Trona FGD) – Trona is a naturally occurring source of sodium carbonate that is available from mines in Wyoming. Similar to Dry Lime FGD, Dry Trona FGD consists of injecting pulverized Trona (milled to less than 10 microns) into the flue gas downstream of the existing baghouse and upstream of a new baghouse. The injection system requirements and technical characteristics are very similar to the Dry Lime FGD system discussed above.

The control efficiency for Dry Trona FGD is reported to range between 55 to 65%. For the purposes of this evaluation, the control efficiency is assumed at 65%.

This information is summarized in Table 4, below.

Table 29. Technically SO_2 Feasible Options

Pollutant	Technology	Feasibility	Reason Not Feasible
SO_2	Low Sulfur Coal	Yes	None
	Wet FGD	Yes	None
	Spray Dry FGD	Yes	None
	Dry Lime FGD	Yes	None
	Dry Trona FGD	Yes	None

STEP 3 – Evaluate technically feasible options

Based on the control efficiency rates listed above, TASCO determined the baseline maximum hourly emission rates, baseline average annual emission rate, anticipated control efficiency of emission controls, expected maximum hourly emission rate and expected annual emission rates. This data is summarized in Table 5, below.

Table 30. Technically Feasible SO_2 Options

Pollutant	Control Option	BART Baseline Maximum Emission Rate (lbs/hour)	BART Baseline Annual Average Emissions (tons/year)	Removal Efficiency	Expected Maximum Emission Rate (lbs/hour)	Expected Annual Emissions (tons/year)
SO_2	Low Sulfur Coal	522	1457	15%	444	1238
	Dry Lime FGD	522	1457	55%	235	655
	Dry Trona FGD	522	1457	65%	183	510
	Spray Dry FGD	522	1457	80%	104	291
	Wet FGD	522	1457	95%	26	73

STEP 4 – Impact analysis

TASCO did a cost evaluation for each of the control technologies reviewed. A complete cost evaluation can be found in Appendix D & E of "*Best Available Retrofit Technology (BART) Determination Analysis, 2009.* These findings were based on EPA fact sheets, engineering and performance test data, and information and discussions with equipment vendors. Table 6 summarizes those results.

Table 31. Impact Analysis for NO_x

Control Scenario	Baseline Emissions (tons/yr	Removal Efficiency (percent)	Annual Emissions Reductions (tons/yr	Total Reductions	Total Capital Costs (x 1,000)	Total Annual Costs (x 1,000)	Cost Effectiveness	Incremental Cost Effectiveness
Low Sulfur Coal	1,457	15%	219	219	0	$1,024	$4,685	
Dry Lime FGD	1457	55%	801	801	$11,281	$2,687	$3,353	$2,857
Dry Trona FGD	1,457	65%	947	947	$11,281	$2442	$2,557	-$1678
Spray Dry FGD	1,457	80%	1,166	1,166	$12,970	$2,521	$2,163	$360
Wet FGD	1,457	95%	1,384	1,384	$22,006	$4,034	$3,353	$6,940

After reviewing TASCO's evaluation, DEQ has concerns with the installation of Wet FGD. In reviewing TASCO's BART Determination Analysis for the Riley Boiler, and specifically looking into wastewater treatment processes associated with Wet Flue Gas Desulfurization (Wet FGD), TASCO's submittal does not present technical specifications or much detail regarding the wastewater treatment process. It's not immediately clear that the costs of the wastewater treatment process are included in the estimates presented in their submittal; however, there appear to be many vendors who provide wastewater treatment processes as part of a Wet FGS project, so it is assumed that the cost of wastewater management is contained within the cost estimates provided for the Wet FGD process itself.

There are several variables that make it very difficult to speculate about the volume of wastewater that might be produced, or any constituent concentrations in wastewater from the process. The source and composition of (1) the coal fired in the boiler, and (2) the limestone used in the Wet FGS process will largely dictate the constituents and constituent concentrations in the wastewater, but there are likely to be significant concentrations of chlorides, fluorides, sulfate, arsenic, mercury, selenium, boron, cadmium, zinc, iron, aluminum, and inert fines that will require some sort of treatment prior to any discharge. Because the wastewater stream is saturated with calcium sulfate (i.e., gypsum), scaling is a major issue with operation and maintenance of process units and piping. The wastewater will also be hot, somewhat acidic, and will have high levels of total dissolved solids. There's also information available that indicates the presence of nitrates in the wastewater. Many of these constituents have primary or secondary quality standards in the *Ground Water Quality Rule*, and any proposal involving land application would almost certainly require impact assessments and/or permitting before DEQ would allow them to go forward.

It is entirely possible to design treatment units to manage and remove the majority of these constituents from the wastewater. The gypsum is a marketable product that would likely be precipitated out of solution and recovered as a commodity. The metals can also be precipitated, although many of these are regulated as hazardous wastes at relatively low concentrations (i.e., the hazardous waste program would probably want to be involved with management of these solids). There are also other processes that can be used to reduce residual levels of dissolved solids and nitrates in the final effluent, although it's important to note that more treatment generally means more cost and more oversight required. The potential volume and quality of the final, treated effluent is very difficult to speculate about without knowing more about the wastewater that will be produced by the Wet FGD process and the treatment processes that will be used to manage that wastewater.

With respect to TASCO's existing wastewater treatment system, the facility is presently treating most of its wastewater on site in an aerated lagoon and sending it to the municipal treatment plant operated by the City of Nampa during off-peak hours. To continue with this operation, a very high degree of wastewater treatment will be required, and substantial improvements to the existing treatment process will almost certainly be required. It would be expected that the city might have concerns about any potential increase in the volume of wastewater discharged to its system. This could mean that the City would need to expand its treatment system or that TASCO might look to land application to manage the new wastewater stream.

TASCO does still have a wastewater land application permit with DEQ, but the facility has only utilized land application for a very small fraction of its total wastewater load in recent years. The company land applied ~12MG in the 2005 season (6% of total WW generated), ~5MG in the 2006 season (3% of total WW generated), ~1MG in the 2007 season (1% of total WW generated), and no wastewater was land applied in the 2008 season. As a result of this reduction in land applied wastewaters, we have seen improving trends in its ground water monitoring wells. Historically, there were issues with nitrates, chlorides, and total dissolved solids concentrations in ground water around the site. While some exceedances of the associated ground water quality standards still exists, most monitoring wells have shown improving trends in ground water quality in recent years, and the DEQ Boise Regional Office is encouraging TASCO to continue to minimize wastewater land application at this time.

Although wastewater treatment processes are available to produce a high-quality effluent that could be successfully land applied under a permit from DEQ, these processes will be fairly complex and expensive, and will likely require dedicated staff to operate and maintain. **Additionally, the reduction in wastewater land application in recent years has improved historic issues with ground water quality that have generally been associated with TASCO's operation**, so any proposal to increase loading rates from a new source of wastewater would require a complete permit application that includes a ground water impact assessment showing no adverse impacts to existing ground water quality. We would issue a permit with enforceable limits and comprehensive monitoring/reporting requirements to ensure protection of ground water quality, assuming that the application and impact assessments can be technically verified and approved.

STEP 5 – Determine visibility impacts (improvements)

Since TASCO believed running the CALPUFF modeling for the various control technology scenarios would be costly, DEQ performed the CALPUFF modeling in-house and invited TASCO to have a contractor review the modeling if deemed necessary. Because each scenario can change the stack velocities and temperatures, it was important that DEQ work closely with TASCO. DEQ worked very closely with TASCO facility engineers to determine the modeling inputs for each of the scenarios.

Table 7, below, summarizes the modeling results for SO2 controls

Table 32. SO_x Control Visibility Improvement

Eagle Cap Wilderness, OR	Change in Visibility Compared Against 20% Best Days Natural Background Conditions								
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period		Annual Cost
	2003		2004		2005		2003-2005		($x 1,000)
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)	
Base Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzi10469)	0.956	23	1.454	49	1.388	55	1.399	127	
Base Riley Boiler Scenario (wzi10471)	0.721	15	1.086	41	1.109	41	1.086	97	$0
SO2 Control Scenario 1 - Lower Sulfur Coal (wzi10475)	0.682	15	1.016	39	1.028	36	1.014	90	$1,024
SO2 Control Scenario 2 - Dry Lime Injection (wzi10476)	0.586	9	0.814	28	0.806	29	0.806	66	$2,687
SO2 Control Scenario 3 - Dry Trona Injection (wzi10477)	0.565	9	0.764	24	0.739	25	0.761	58	$2,422
SO2 Control Scenario 4 - Spray Dryer FGD (wzi10478)	0.527	9	0.703	22	0.707	20	0.686	51	$2,521
SO2 Control Scenario 5 - Wet FGD (wzi10479)	0.499	7	0.647	19	0.645	17	0.638	43	$4,053

Conclusion - As part of the impact analysis, non-air quality environmental concerns are to be taken into consideration. Although Wet FGD has a 15% greater removal efficiency over the next closest control of Spray Dry FGD, the potential for reversing the current trend of improvements to ground water due to TASCO land applying outweigh the environmental benefits. TASCO is currently sending pretreated wastewater to the City of Nampa. There is a high likelihood that an increase in TASCO's waste stream would be greater than the city can currently handle. This would more than likely lead to TASCO requesting to increase land application of waste water. For these reasons, DEQ will not be including Wet FGD in the control options even though the technology is technically feasible for improvements in air quality and visibility.

Nitrogen Oxides (NO_x) BART control technology selection

In determining the "best" BART control technology for NO_x controls on the Riley Boiler, DEQ worked in conjunction with TASCO using the five steps as described in EPA Appendix Y.

STEP 1 – Identify all available retrofit emissions control techniques

DEQ in consultation with TASCO identified the following control technologies appropriate for boilers:

- Low NO_x Burners (LNB)
- Low NO_x Burners with Over-fired Air (LNB/OFA)
- Ultra Low NO_x Burners (ULNB)
- Selective Catalytic Reduction (SCR)
- Selective Non-catalytic Reduction (SNCR)

STEP 2 - Determine technically feasible options

In this step, DEQ relied heavily on TASCO engineers to provide the technical feasibility because of plant specific requirements and their familiarity with plant operations. DEQ did review the information as provided below:

Low NOx Burners - LNBs incorporate staged fuel or staged combustion air to control the flame temperature of the boiler. Several low NO_x burner systems are available with different levels of cost and performance capabilities. The estimates for NO_x removal range in removal efficiency from 30-60%.

According to TASCO, low NO_x burner retrofit projects are technically challenging and require significant engineering evaluations to properly size and adapt a supplied low NO_x burner system to a given boiler and burner configuration.

Low NO_x Burners with Over-Fired Air – These systems inject a portion of the combustion air downstream of the fuel burner system to lower flame temperatures and the formation of NO_x. Over-fired air as a stand alone retrofit technology can be difficult to control causing combustion issues with pulverized coal boiler, including water wall corrosion and reduced boiler efficiencies. When combined with a low NO_x burner and reasonable combustion air control, NO_x removal efficiencies can approach 65%.

Ultra Low NO_x Burners – These systems are upgraded LNB designs which involve further control and staging of combustion air and fuel. ULNB was determined not technically feasible on the Riley Boiler. The boiler's existing firebox is not large enough to accept the full burner/flame management system required by the ULNB.

Selective Catalytic Reduction – SCR systems reduce NO_x by injecting ammonia and urea into the flue gas before it passes through a catalytic grid to reduce the NO_x to N_2. This technology requires the flue gas exhaust from the Riley baghouse to be heated to 500° C before injecting ammonia or urea and passing the hot gases through the selective catalytic grid. After treatment, heat is recovered in a heat exchanger to minimize operating costs to reheat the flue gas. This technology is capable of reducing NO_x emissions by 70% to 90%. For the purposes of this evaluation a control efficiency of 90% is assumed.

Selective Non-Catalytic Reduction (SNCR) **–** SNCR consists of injecting ammonia or urea into boiler flue gases in a narrow temperature zone of 1550 to 1950° F. To achieve these temperatures, the injection point must be located between the Riley Boiler economizer and the air pre-heater. The process relies on good gas mixing in the narrow high temperature zone to reduce NO_x to N_2 as the flue gas moves through the ductwork. Boiler load swings can lead to temperature changes at the injection that can significantly reduce removal efficiencies. In addition, injection points can lead to "ammonia slip" or the condition where unreacted ammonia passes through downstream equipment, including the baghouse and discharges from the stack. The gas path for the Riley Boiler lacks the necessary residence time to reliably remove the NO_x. The results of upsets could lead to "ammonia slip." DEQ is concerned about the issues with ammonia emissions due to the Riley Boiler's close proximity to the City of Nampa.

This information is summarized in Table 8, below.

Table 33. Technically Feasible Options for NO_x

Pollutant	Technology	Feasibility	Reason Not Feasible
NO_x	Low NO_x Burners	Yes	None
	Low NO_x Over-Fired Air	Yes	None
	Ultra NO_x Low Burners	No	Boiler Firebox is not large enough to support the flame management system.
	Selective Catalytic Reduction	Yes	None
	Selective Non-Catalytic Reduction	No	Boiler gas path does not have adequate residence time for reliable control

STEP 3 – Evaluate technically feasible options

Based on the control efficiency rates listed above, TASCO determined the baseline maximum hourly emission rates, baseline average annual emission rate, anticipated control efficiency of emission controls, expected maximum hourly emission rate and expected annual emission rates. This data is summarized in Table 9, below.

Table 34. Impact Analysis for NO_x

Pollutant	Control Option	BART Baseline Maximum Emission Rate (lbs/hour)	BART Baseline Annual Average Emissions (tons/year)	Removal Efficiency	Expected Maximum Emission Rate (lbs/hour)	Expected Annual Emissions (tons/year)
NO_x	Low NO_x Burners	374	1042	50.0%	187	521
	LNB/OFA	374	1042	65.0%	131	364
	SCR	374	1042	90.0%	37	104

STEP 4 – Impact Analysis

TASCO did a cost evaluation for each of the control technologies reviewed. A complete cost evaluation can be found in Appendix D & E of "*Best Available Retrofit Technology (BART) Determination Analysis, 2009.* These findings were based on EPA fact sheets, engineering and performance test data, and information and discussions with equipment vendors. Table 10, below, summarizes those results.

Table 35. Impact Analysis for NO_x

Control Scenario	Baseline Emissions (tons/yr	Removal Efficiency (percent)	Annual Emissions Reductions (tons/yr	Total Reductions	Total Capital Costs (x 1,000)	Total Annual Costs (x 1,000)	Cost Effectiveness	Incremental Cost Effectiveness
Low NO_x Burners	1,042	50%	521	521	$2,720	$480	$921	
Low NO_x Burners OFA	1,042	65%	677	677	$4,875	$860	$1,270	$2,431
SCR	1,042	90%	938	938	$16,702	$3,534	$3,768	$10,245

In addition to the control technologies reviewed above, TASCO has provided information relating to operational changes at the facility after the regional haze base years of 2000-2004. In 2006, TASCO installed a new pulp steam dryer system which better utilized current steam production and allowed several old pulp dryers to shut down. The pulp drying typically occurs during the fall and winter months when TASCO's emissions show the greatest impact on the 20% worst days. The following Table 11 is a summary of the emission reductions attributed to the shutdown of the old pulp dryers.

Table 36. Pollution Reductions from Shutdown of Pulp Dryers

Pollutant	Maximum Hourly (lbs/hr)	Average Annual (tons/year)
Particulate	98.1	113
SO_2	17.8	20.6
NO_x	191	221

There are no incremental costs associated with the shutdown of the pulp dryers since they were installed in 2006. As part of the impact and visibility improvements TASCO requested that DEQ look at the visibility improvements associated with the pulp dryer shut down and determine that the reductions from the new steam dryers could be used as an alternative to BART.

STEP 5 – Determine visibility impacts (improvements)

Since TASCO believed running the CALPUFF modeling for the various control technology scenarios would be costly, DEQ performed the CALPUFF modeling in-house and invited TASCO to have a contractor review the modeling if deemed necessary. Because each scenario can change the stack velocities and temperatures it was important that DEQ work with TASCO. DEQ worked very closely with TASCO facility engineers to determine the modeling inputs for each of the scenarios. The modeling scenarios include the Riley Boiler with and without the shutdown of the pulp dryers to identify the visibility improvement attributed to the shutdown of the old dryers. The baseline used for the remaining control scenarios included the reductions from the pulp dryers to simulate current operating conditions. The following is a breakdown of the costs and changes to visibility at Eagle Cap Wilderness (This wilderness area showing the greatest impact form the Riley Boiler.) based on the NO_x controls identified as technically feasible. Similar changes occurred at the other Class I areas impacted by the Riley Boiler. (See Appendix.) Table 12, below, also includes the incremental costs associated with the various NO_x control technologies. Since some of the pulp dryers were shut down to meet PM_{10} NAAQS requirements incremental costs were not included for this scenario. TASCO has found it financially advantageous to shut down additional pulp dryers for cost savings in coal usage.

Table 37. NO_x Visibility Improvements

Eagle Cap Wilderness, OR	Change in Visibility Compared Against 20% Best Days Natural Background Conditions									
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period		Change in Visibility	Incremental Cost
	2003		2004		2005		2003-2005		2003-2005	($/ton)
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days[d] (2003-2005)		
Base Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzI10469)	0.956	23	1.454	49	1.388	55	1.399	127	0.000	
Base Riley Boiler Scenario (wzI10471)	0.721	15	1.086	41	1.109	41	1.086	97	0.313	$0
NOx Control Scenario 1 – LNB (wzI10472)	0.511	11	0.822	29	0.871	29	0.816	69	0.270	$0
NOx Control Scenario 2 – LNB w/ OFA (wzI10473)	0.454	7	0.743	24	0.803	25	0.736	56	0.350	$2,431
NOx Control Scenario 3 – SCR (wzI10474)	0.383	6	0.625	16	0.653	18	0.613	40	0.473	$10,245

Looking at changes in visibility improvements the shutdown of the pulp dryers provided more visibility improvement than LNB and is nearing the improvement of LNB with Over-Fire-Air. The largest improvement in visibility attributed to NO_x controls would come for Selective Catalytic Reduction (SCR). However, the incremental cost of $10,000 per ton for the additional 15% removal efficiency is relatively high. An option for TASCO would be taking permanent permit limits to account for the shutdown of all the pulp dryers and installing LNB with Over-Fire-Air.

Conclusion – BART Control Determination

In conclusion, TASCO has two options for NO_x controls. It can install SCR on the Riley Boiler or install LNB with Over-Fire-Air and take permit limits for shutting down all the pulp dryers. Although Wet FGD has the promise of providing greater emission reductions than Spray Dry FGD, the benefits of Wet FGD are outweighed by the possibility of requiring land application of wastewater. After reviewing the particulate controls, the current baghouse has the same reductions as other options at no additional expense. DEQ is, therefore, recommending a combination of the baghouse, Low NOx Burners with Over-Fire-Air (plus permit limits reflecting shut down of all pulp dryers), and Spray Dry FGD as the "best" of BART technologies. Below is a summary table showing the visibility improvements based upon the "best" of BART control technologies identified in this determination. It should be noted the Base Riley Boiler scenario includes the current baghouse and pulp dryer shutdown.

Table 38. Visibility Improvement - Best BART Alternatives

Eagle Cap Wilderness, Or	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-deciview value larger than 0.5 from one year period						Delta-deciview value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8^{th} highest[a]	Total days[b]	8^{th} highest	Total days	8^{th} highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Base Riley Boiler Scenario (wzi10471)	0.721	15	1.086	41	1.109	41	1.086	97
Base Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzi10469)	0.956	23	1.454	49	1.388	55	1.399	127
NO_x Scenario 2 + SO2 Scenario 4 (wzi10484)	0.228	1	0.319	1	0.330	1	0.319	3

EPA Executive Summary TASCO Financial Hardship

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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AIR, WASTE AND TOXICS

Martin Bauer, Administrator
Air Quality Division
Idaho Department of
Environmental Quality 1410 N.
Hilton
Boise, Idaho 83706

Dear Mr. Bauer:

At your request, EPA Region 10 has completed and enclosed a copy of our analysis of TASCO's claim that it cannot afford BART and Idaho's initial BART determination identified in the "Best Available Retrofit Technology (BART) Determination Analysis: Riley Boiler", dated February 6, 2009, for the TASCO Nampa Facility. This analysis contains data and information provided by TASCO that TASCO claims as 'Confidential Business Information (CBI). Thus we treat this report as containing CBI.

We have determined that TASCO can afford BART as identified in the initial BART determination made by IDEQ. If you have additional questions or would like to discuss this analysis, please contact either myself at 206-553-6985 or Mr. Steve Body at 206-553-0782.

Sincerely

Mahbubul Islam

Mahbubul Islam, Manager
State & Tribal Air Programs Unit

Enclosure

Executive Summary excerpt

from: An Affordability Analysis of The Amalgamated Sugar Company LLC's Affordability Claim with respect to the Best Available Retrofit Technology (BART) for the Riley Boiler at the Nampa, Idaho facility

February 12, 2010

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EXECUTIVE SUMMARY

NOTE: **THIS SUMMARY IS WRITTEN FOR PUBLIC VIEWING AND DOES NOT INCLUDE CONFIDENTIAL BUSINESS INFORMATION (CBI). THE FULL REPORT DOES CONTAIN CBI AND IS SUBJECT TO DISCLOSURE REQUIREMENTS AT 40 CFR PART 2.**

As a result of the Riley Boiler at The Amalgamated Sugar Company LLC (TASCO) Nampa, Idaho facility being identified as a Best Available Retrofit Technology (BART) source by the Idaho Department of Environmental Quality (DEQ), and DEQ's visibility impact modeling which indicated the Riley Boiler exceeded the BART exemption of 0.5 deciview (dv) at any one Federal Class I area, TASCO conducted a site specific BART Determination Analysis for the Riley Boiler (TASCO 2009b), according to EPA Guidelines (EPA Appendix Y).

The BART determination derived from this Determination Analysis has an estimated capital cost of $17.8 million, and estimated annual operation and maintenance (O&M) costs of $3.4 million. TASCO and the State of Idaho have agreed on the BART control technology and specified emission limitations, and they concur on the BART related costs. This BART determination consists of a bag house for particulate matter (which is already in place and operating), a low NOx burner with overfire, and dry gas desulfurization for SO_2. In accordance with Federal BART requirements, the BART controls must be installed and operating by approximately April 30, 2016.

In TASCO's cover letter to its BART Determination Analysis, the company mentions that the above cited BART related costs would affect the "ongoing economic viability of the Nampa facility and TASCO as a whole", and that "affordability is a critical element of the BART determination" (TASCO 2009a). In support of its claims of 'ongoing economic viability' and 'affordability', the company provided reasons and information in the BART Determination Analysis. Subsequently, TASCO provided additional reasons and substantial additional information supporting its claim directly to DEQ and EPA.

In determining BART, the EPA Guidelines indicate the State may take into consideration the economic effects of requiring the use of a particular technology. In the selection process the State may also consider any of the economic effects that are determined to have a severe impact on the plant's or the company's operations. DEQ decided to consider TASCO's affordability claim, but does not have the technical capability to conduct a thorough 'affordability analysis.' The EPA does have this analytical capability, and conducted this affordability analysis. A copy was provided to DEQ.

The purpose of the affordability analysis was to determine the validity of TASCO's affordability claim, i.e., that the company cannot fund the control technology identified in the BART determination. The analysis took into consideration:

- The estimated capital and O&M costs of the BART determination;
- compliance with BART emission limits required no later than approximately April 30, 2016;
- TASCO's continuing viability, i.e., the company's ability to continue as a going concern;
- The reasons provided by TASCO to support its affordability claim;
- The information provided by TASCO and obtained from other sources; - BART related costs are considered to be a cost of doing business, and are not an investment with an expected financial return;
- The TASCO/Snake River Sugar Company (SRSC) owner/operator, management and financial relationships;
- TASCO's financial related commitments; and that
- BART related regulatory events [i.e., DEQ issuing a permit, followed by EPA approval of Idaho's Regional Haze State Implementation Plan (SIP), or in lieu of a SIP the issuance of a Federal Implementation Plan (HP) by EPA] will occur subsequent to the completion of the BART Determination Analysis.

Throughout this BART determination process, it appears that without the issuance of a permit and/or an approved SIP, TASCO's approach to the BART costs has been that the company has no financial or legal obligation to actually address these costs, and that all available funds are already committed for contractual reasons or as part of internal business decisions. A consequence of this approach has been that since about mid-2007, when TASCO was first made aware of the forthcoming BART obligation, the company has made no attempt to actively fund the prospective BART costs. It appears that TASCO does not intend to address the prospect of actually funding the BART costs until a permit is issued, and even then BART funding could depend on certain subsequent events. At the time of issuing a permit there will then exist a legal (regulatory) requirement that has to be met by TASCO and would require the company to make a financial related response. TASCO had to be aware that a decision not to proactively address BART costs prior to the issuance of a permit could make funding the BART related costs difficult.

A review of the company's past and current financial condition through September 30, 2009, which was supported by additional relevant information, indicates that overall the company is in relatively sound financial health. Its annual revenues have remained relatively consistent, the company has been able to meet all of its financial obligations including significant contractually obligated annual cash distributions to its owners, and has maintained regular repayments of its loans.

Taking into consideration TASCO's recent and current operating and financial condition, including annual cash distributions; its known current and future financial obligations and restrictions; how the company has decided to address funding the BART costs until now; the company's most recent audit related issues; the TASCO-SRSC relationship issues; the stipulated time period - defined by when the company becomes obligated to comply with the forthcoming issuance of a permit by DEQ, estimated to be no later than approximately June 2010, and ends with the BART emissions limit compliance date of approximately April 30, 2016 - it appears TASCO can afford to fund BART capital and annual O&M costs at a level of approximately $3.8 million dollars per year — an amount sufficient to cover the estimated BART capital costs by April 30, 2016, and subsequent annual O&M costs. The conclusion is that TASCO can afford to fund the BART.

Best Available Retrofit Technology (BART) Analysis

For P4 Production, L.L.C.

Best Available Retrofit Technology (BART) Analysis

for

P4 Production, L.L.C.
Soda Springs, Idaho

Facility ID No. 029-00001

Photo Credit: Peter Clegg (posted on Google Earth)

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Idaho Department of Environmental Quality
Air Quality Division

August 4, 2009

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Acronyms, Units, and Chemical Nomenclatures

acfm	actual cubic feet per minute
BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
Btu	British thermal unit
CFR	Code of Federal Regulations
CO	carbon monoxide
DEQ	Department of Environmental Quality
DSD	duct spray drying
ENE	east-northeast
EPA	U.S. Environmental Protection Agency
ESP	electrostatic precipitator
FGD	flue gas desulfurization
FSI	furnace sorbent injection
HE	high energy
IDAPA	a numbering designation for all administrative rules in Idaho promulgated in accordance with the Idaho Administrative Procedures Act
km	kilometer
LAER	Lowest Achievable Control Technology
lb/hr	pound per hour
LCDA	Lime Concentrated Dual Alkali
LSD	Lime Spray Drying
LSFO	Limestone Forced Oxidation
m	meter(s)
mi	mile(s)
MACT	Maximum Achievable Control Technology
MEL	magnesium-enhanced lime
MMBtu	million British thermal units
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_4OH	ammonium hydroxide
NNE	north-northeast
NNW	north-northwest
NOx	nitrogen oxides
NSPS	New Source Performance Standards
P4	P4 Production, L.L.C.
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PSD	Prevention of Significant Deterioration
PTE	potential to emit
RACT	Reasonably Available Control Technology
RBLC	(EPA's) RACT/BACT/LAER Clearinghouse
Rules	Rules for the Control of Air Pollution in Idaho
scf	standard cubic feet
SCR	selective catalytic reduction
SIP	State Implementation Plan
SNCR	Selective non-catalytic reduction
SO_2	sulfur dioxide
THFC	tap hole fume collector
T.O.	thermal oxidizer
T/yr	tons per year
VOC	volatile organic compound

1. Executive Summary

The P4 Production, L.L.C. (P4) facility located in Soda Springs, Idaho, produces elemental phosphorus. Coke, quartzite, phosphate ore, and clinker are delivered to the site by truck or railcar. The coke and quartzite are dried, if needed, and screened. Phosphate ore is fed to a rotary kiln (calciner) to form heat-hardened nodules. The exhaust from the kilns is controlled by a dust knockout chamber, nodulizing kiln spray tower, four parallel cyclonic separators, and four parallel hydrosonic scrubbing systems. The hydrosonic scrubbing system includes an SO_2 scrubbing system.

Nodules are then combined with coke and quartzite and heated in a reducing environment in one of three electric furnaces. The furnace vent gases, which contain the phosphorus product in a vapor state, pass through two electrostatic precipitators to remove entrained particles. The vent gas is then sent to water spray condensers where the gases are cooled, and the product phosphorus is condensed. The vent gas is then sent to the nodulizing kiln or a furnace flare to oxidize carbon monoxide (CO) to carbon dioxide. After this project has been completed, a thermal oxidizer will be used for any CO furnace gas that cannot be accommodated by the kiln, and the flares will only be used during startup, shutdown, schedules maintenance, safety measures, upset and breakdown in accordance with IDAPA 58.01.01.130-136. The condensed phosphorus is pumped to settling/storage tanks and then loaded into water-sealed railroad cars for shipment. Slag and ferrophosphorus are regularly removed from the furnaces (a procedure referred to as "tapping") and stockpiled on site. Emissions associated with tapping the furnaces are collected and controlled by the Tap Hole Fume Collector Scrubber (THFC).

Two sources at P4 were identified as potential BART-Eligible Sources (as defined at IDAPA 58.01.01.006.14), the phosphate ore nodulizing kiln (#5 Kiln) and the #9 Furnace (#9 THFC and #9 CO Flare). The Idaho Department of Environmental Quality (DEQ) has completed a determination to identify all BART-Eligible Sources at the P4 facility. The results of the BART determinations (pursuant to IDAPA 58.01.01.668) for these two emission units are summarized in Table 1.1.

P4 is under a consent order to meet BACT for CO emissions from the #7 furnace and to install the same controls on the #8 and #9 furnaces. P4 has proposed using a thermal oxidizer and high energy (HE) venturi scrubber along with controlling operations to balance the CO produced in the furnaces to match the fuel needs for the kiln, the CO BACT Measures. P4 has applied for a Tier II operating permit that will include federally-enforceable requirements for the SO_2 scrubber system and for the CO BACT measures.

Table 1.1. BART FOR P4 PRODUCTION, L.L.C. BART-ELIGIBLE UNITS

<table>
<tr><th>Emission Unit</th><th>Regional Haze Pollutant</th><th>BART Determination</th><th>BART Emission Limit</th><th>Nearest Mandatory Class I Area(s)</th></tr>
<tr><td rowspan="3">Nodulizing Kiln
(#5 Kiln)</td><td>SO_2</td><td>Existing Federally Enforceable Controls:
Limit coal sulfur content to a maximum of 1% by weight.

BART: Lime Concentrated Dual Alkali (LCDA) SO_2 scrubbing system</td><td>143 lb/hr</td><td rowspan="6">Grand Teton National Park
~113 km (~70.2 mi)
to the north-northeast (NNE)

Bridger Wilderness
~ 143 km (~88.8 mi)
to the east-northeast (ENE)

Teton Wilderness
~164 km (~102 mi)
to the NNE

Fitzpatrick Wilderness
~ 164 km (~102 mi)
to the ENE

Yellowstone National Park
~166 km (~103 mi)
to the NNE

Washakie Wilderness
184 km (~115 mi)
to the NNE

Craters of the Moon National Monument
~165 km (~103 mi)
to the north-northwest (NNW)</td></tr>
<tr><td>NO_x</td><td>Existing Federally Enforceable Controls: None

BART: No additional controls.</td><td>n/a</td></tr>
<tr><td>PM</td><td>Existing Federally Enforceable Controls:
Knockout chamber, spray tower,
four parallel high energy (HE) venturi scrubbers, and
four parallel cyclonic separators
BART: No additional controls.</td><td>n/a</td></tr>
<tr><td rowspan="3">#9 Furnace
(#9 THFC & #9 CO Flare)</td><td>SO_2</td><td>Existing Federally Enforceable Controls:
#9 THFC: None
#9 CO Flare: None

BART:
#9 THFC: No additional controls
#9 CO Flare: No additional controls</td><td>n/a</td></tr>
<tr><td>NO_x</td><td>Existing Federally Enforceable Controls: None

BART:
#9 THFC: No additional controls
#9 CO Flare: No additional controls</td><td>n/a</td></tr>
<tr><td>PM</td><td>Existing Federally Enforceable Controls:
#9 THFC: wet venturi scrubber
#9 CO Flare: None

BART:
#9 THFC: No additional controls
#9 CO Flare: No additional controls</td><td><u>Furnace THFC:</u>
≤ 352,000 lb/hr: 0.2 lb per ton of material fed to furnace
> 352,000 lb/hr: Process Weight

<u>Flare</u>:
0.2 lb per 100 lb burned</td></tr>
</table>

2. Introduction

2.1 Source Description and Background

The P4 facility located in Soda Springs, Idaho, produces elemental phosphorus. Coke, quartzite, phosphate ore, and clinker are delivered to the site by truck or railcar. The coke and quartzite are dried, if needed, and screened. Phosphate ore is fed to a rotary kiln (calciner) to form heat-hardened nodules. The exhaust from the kilns is controlled by a dust knockout chamber, nodulizing kiln spray tower, and four parallel hydrosonic scrubbing systems.

Nodules are then combined with coke and quartzite and heated in a reducing environment in one of three electric furnaces. The furnace vent gases, which contain the phosphorus product in a vapor state, pass through two electrostatic precipitators to remove entrained particles. The vent gas is then sent to water spray condensers where the gases are cooled, and the product phosphorus is condensed. The vent gas is then sent to the nodulizing kiln or a furnace flare to oxidize carbon monoxide (CO) to carbon dioxide. After this project has been completed, a thermal oxidizer will be used for any CO furnace gas that cannot be accommodated by the kiln, and the flares will only be used during startup, shutdown, schedules maintenance, safety measures, upset and breakdown in accordance with IDAPA 58.01.01.130-136. The condensed phosphorus is pumped to settling/storage tanks and then loaded into water-sealed railroad cars for shipment. Slag and ferrophosphorus are regularly removed from the furnaces (a procedure referred to as “tapping”) and stockpiled on site. Emissions associated with tapping the furnaces are collected and controlled by the Tap Hole Fume Collector Scrubber (THFC).

Criteria for determining whether an emission unit is subject to Best Available Retrofit Technology (BART) are described in the next section.

2.2 BART-Eligible Sources

A BART-Eligible Source is “any [of 26 listed categories of] stationary sources of air pollutants, including any reconstructed source, which was not “in operation” prior to August 7, 1962, and was in existence on August 7, 1977, and has a potential to emit two hundred fifty (250) tons per year or more of any air pollutant [including fugitive emissions, to the extent quantifiable].” IDAPA 58.01.01.006.14. Among the identified categories of stationary sources are “phosphate rock processing plants.” IDAPA 58.01.01.006.14.m.

When the P4 elemental phosphorus plant began operation in 1952, the emission units consisted of the #4 Kiln, #7 Furnace, #8 Furnace, #7/8 CO Flare, and ancillary equipment/processes and buildings, including nodule screening and crushing operations. The #5 Kiln replaced the #4 Kiln in 1965 and the #9 Furnace (including the #9 CO Flare) was added in 1966. Two pollution control devices, a nodule cooler spray tower and nodule crushing and screening scrubber, were added in 1970. In 1989, the #7 furnace transformer was replaced to increase the power output and therefore increase the production capacity of that furnace by about 12 percent. The #7 furnace hearth was replaced in 1994 by rebuilding the furnace hearth at a lower elevation and modifying the riser duct, which increased the #7 furnace production by about 16 percent. To control kiln emissions, four (4) high-energy tandem nozzle venturi scrubbers were brought on-line in September of 1987, and an SO_2 scrubbing system was installed in 2005. P4 has submitted an application for a Tier II operating permit, which was revised and re-submitted as a permit to construct application.

Potential to Emit (PTE) is defined as “the maximum capacity of a facility or stationary source to emit an air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the facility or source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed,

shall be treated as part of its design if the limitation or the effect it would have on emissions is state or federally enforceable." IDAPA 58.01.01.006.81 (emphasis added).

The PTE for P4 emission units is summarized in Table 2.1 for the BART-eligible emission units based on limitations contained in the federally-enforceable Tier I operating permit and expected federally-enforceable limitations to be incorporated in a Tier II operating permit or a permit to construct.

Table 2.1 P4 EMISSION UNIT PTE

Emission Unit	Year Installed	Idaho SIP Regional Haze Pollutant	"Current" PTE (T/yr)	2004 CEER Actual Emissions (T/yr) [a]	Notes
Nodulizing Kiln (#5 Kiln)	1965	SO_2	626.4 [b]	12,252	Actual emissions are from combustion and phosphate ore-related emissions.
		NO_x	3,750.7 [b]	1,625	
		PM	89.4 [b]	38	
#9 Furnace (including the #9 CO Flare)	1966	SO_2	#9 Furnace: 117.8[a] #9 CO Flare: 6.0 [b]	0.12	CEER Actuals are #9 CO Flare emissions only.
		NO_x	#9 Furnace: 65.7[a] #9 CO Flare: 6.7 [b]	0.13	
		PM	#9 Furnace: 163.6[a] #9 CO Flare: 31.7 [b]	0.65	
Total PTE from BART-eligible units		SO_2	1,124		Total PTE exceeds 250 T/yr
		NO_x	3,823		Total PTE exceeds 250 T/yr
		PM	285		Total PTE exceeds 250 T/yr

[a] Letter, P4 to Michael Edwards, September 6, 2006.
[b] Based on expected federally-enforceable limits to be included in a requested permit to construct

DEQ has concluded that:

1. The P4 facility is a "phosphate rock processing plant;"
2. The #5 Nodulizing Kiln and the #9 Furnace are the only emission units at P4 that began operation after August 7, 1962 and were in existence on August 7, 1977; and
3. PTE for both the #5 Nodulizing Kiln and the #9 Furnace exceed 250 tons per year of any air pollutant.

Based on the conclusions above, DEQ has determined that the #5 Kiln and the #9 Furnace (including the #9 CO Flare) emission units at P4 are BART-eligible sources.

2.3 BART Analysis Methodology

Best Available Retrofit Technology (BART) is defined as "an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by [a BART-eligible source]. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, **any pollution control equipment in use or in existence at the source**, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology." IDAPA 58.01.01.006.16.

P4 submitted a BACT analysis for SO_2 emissions from the #5 Kiln,[18] and a CO BACT analysis for the #7 Furnace and #7/#8 CO Flare. P4 proposed that CO BACT is installation of a thermal oxidizer and scrubber along with operational controls to balance CO production from the furnaces to match the fuel consumption requirements in the kiln. Pursuant to the requirements of a consent order, P4 will apply the same technology to the #9 furnace and #9 CO flare. This information was used by DEQ as the starting point for evaluating BART for BART-eligible sources.

This analysis addresses the following five basic steps for a case-by-case BART analysis:

Step 1. Identify all available retrofit control technologies. This must include identification of the most stringent option and a reasonable set of options for analysis that reflects a comprehensive list of available technologies. This list is considered complete if it includes the maximum level of control each technology is capable of achieving.

To begin Step 1 of the BART analysis, the U.S. Environmental Protection Agency's (EPA) Reasonably Available Control Technology (RACT)/BACT/Lowest Achievable Control Technology (LAER) Clearinghouse (RBLC) database was queried for recent BACT determinations for large industrial sources. The search parameters were for all permits (draft or final) issued since 2001 that included SO_2, NO_x, or PM as a controlled pollutant.

Step 2. Eliminate technically infeasible options.

The decision regarding whether a particular technology was "technically feasible" was based on discussions found in Section IV.D.2 (STEP 2 of EPA's Guidelines for BART Determinations Under the Regional Haze Rule, 40 C.F.R. Part 51, Appendix Y. Control technologies are technically feasible if either:

(1) They have been installed and operated successfully for the type of source under review under similar conditions, or

(2) The technology could be applied to the source under review.

Judgment was used to narrow the list of options if some options were clearly inferior (e.g., controls that are more costly but don't achieve the reductions of other controls).

Step 3. Evaluate control effectiveness of the remaining control technologies.

Step 4. Evaluate impacts of each remaining control technology, including:

- An estimate of the cost of compliance,
- An evaluation of the energy impacts of each BART option,
- An evaluation of the non-air quality impacts of each BART option, and

[18] Tier II operating permit application, Revision 1, received August 1, 2006. Appendix H, SO_2 BACT for Kiln.

- The remaining useful life of the source.

Step 5. ***Evaluate visibility*** *impacts.* Visibility impacts were not evaluated for each technology. See Section 4 for a discussion of the visibility impacts. Step 5 for this BART analysis is to ***Select BART***.

3. BART-Eligible Emission Units Subject to a MACT Standard

None of the potentially BART-subject emission units at P4 are subject to a MACT standard.

4. Baseline Conditions and Visibility Impacts for BART-Eligible Emission Units

Facility-specific visibility impacts for the potentially BART-eligible emission units at P4 have not been modeled. In addition, DEQ determined that CALPUFF modeling for the these emission units was not necessary based on the conclusion that P4 is currently implementing control technologies that meet BART for the #5 Kiln and the #9 Furnace and #9 CO Flare. Federally-enforceable permit conditions will be put in place that require P4 to use these BART technologies. DEQ will conduct visibility impact analyses based on emissions within an airshed.

5. BART Analysis for the Nodulizing Kiln (#5 Kiln)

The Nodulizing Kiln (#5 Kiln) is used to produce phosphate nodules for processing in the facility's furnaces. Phosphate ore, dried underflow solids from the current scrubber tower clarifier, and ore dust from the kiln's drop out chamber are heated to high temperatures (1,500^{o}C) to remove organic material and to thermally agglomerate the mixture to a nodular form. The 325-foot long rotary kiln is primarily fueled by carbon monoxide (CO), a by-product of the plant's three electric arc furnaces. Coal and natural gas are used as supplemental fuel sources. The overall gas flow rate exiting the kiln is approximately 263,800 actual cubic feet per minute (acfm).

Existing federally-enforceable process and air pollution controls for the kiln that are addressed in the facility's current Tier I (Title V) operating permit No. T1-029-0001, issued December 30, 2002 (which has been administratively extended beyond the December 30, 2006 expiration date), consist of:

- A limit on the sulfur content of the coal to no more than 1% by weight.
- A dust knockout chamber, spray tower, four parallel Hydro-Sonic© scrubbers, and four parallel cyclonic separators. The hydrosonic scrubbers were brought on-line in September 1987 in response to a January 1986 Consent Order. These tandem nozzle fixed-throat free-jet scrubbers are required for control of PM/PM_{10} and polonium-210 emissions (a radionuclide) found in the phosphate ore.

The initial control device is a settling chamber where large particles are removed. The exhaust flow is then routed to a concrete tower where it passes through water sprays to remove soluble gases and particulate matter. The exhaust flow is then routed to the four parallel Hydro-Sonic© scrubbers for removal of submicron particles and entrained particle-laden water. The exhaust gases exit the scrubbers and pass though cyclonic separators and fans prior to exiting to the atmosphere though four stacks.

A lime concentrated dual alkali (LCDA) scrubber to control SO_2 emissions from the kiln was installed by P4 in 2005 in accordance with the requirements of a December 30, 2002 consent order issued by DEQ. The LCDA scrubbing process uses the existing hydrosonic scrubbers to absorb SO_2 with a solution of sodium salts comprised of sodium sulfite and bisulfite, the active absorbent species. Some sodium sulfate will also be produced. The spent solution of sodium sulfite/bisulfite/sulfate is continuously withdrawn to a dual-reactor system, where it is treated with hydrated lime. The lime regenerates the scrubbing solution and precipitates calcium sulfite/sulfate solids. The solids are removed from the system through thickening and filtration, and the regenerated solution is returned to the scrubber as feed material. In addition to the hydrosonic scrubbers, the LCDA scrubbing system includes raw material storage tanks, two reactor tanks, thickener/clarifier, filtration (feed tank with vacuum filtering process), and a double-lined landfill with leachate collection.

5.1 Kiln SO_2 BART Analysis

SO_2 is formed in the kiln almost exclusively by the oxidation of sulfur present in the process material feed. Small amounts of SO_2 are formed during the limited use of coal and natural gas as kiln fuel.

5.1.1 Identify Control Technologies

In support of a BACT analysis submitted in 2006, P4 searched the RBLC for all permits (draft or final) issued since 2001 that included SO_2 as a controlled pollutant. This search yielded 376 facilities. Processes that were inherently different than the nodulizing kiln at the P4 facility were eliminated from this initial list. For example, all cement kilns were eliminated because the calcium-containing materials processed in these kilns provide for inherent SO_2 removal not found in the feed to the P4 kiln.

The remaining facilities found in the search of the RBLC database included the following process codes:

- 11.110 – External combustion-Solid fuels and solid fuels mixtures –Coal (includes bituminous, subbituminous, anthracite, and lignite),
- 11.130 – External combustion-Solid fuels and solid fuels mixtures-Other solid fuels and solid fuel mixtures,
- 11.900 – External combustion-Other fuels and combinations (e.g. solid/liquid, liquid/gas) wood, gas & oil fired,
- 62.010 – Inorganic chemicals manufacturing,
- 81.002 – Metallurgical Industry, and
- 90.000 – Mineral products.

None of the facilities found employing SO_2 control technologies were under RBLC plant process code 90.013 for elemental phosphorus plants. The BACT emission limits, therefore, are not directly applicable to the P4 nodulizing kiln due the uniqueness of this process. The control technologies, though, are applicable and have been included in this evaluation.

As part of developing this BART analysis, DEQ reviewed RBLC technologies listed as of July 2008 for these process codes, and confirmed that the 2006 search results are still representative of BACT for these sources. Control technologies that are available to control SO_2 from the #5 Kiln, in top-down order, include:

Wet Flue Gas Desulfurization (FGD)

- Lime or limestone based wet flue gas desulfurization (FGD): ~75 to 98 percent control[19]

Dry FGD

- Lime Spray Drying (LSD) or lime spray dryer absorber: ~82 to 95 percent control[3]
- Humidified In-Duct Injection:
  - ~50 to 70 percent control (when followed by a baghouse)[20]
  - ~ 35 to 50 percent control (when followed by an ESP)[4]
- Convective Pass Injection: ~50 to 70 percent control[4]
- Furnace Sorbent Injection (FSI):
  - Hydrated lime: ~ 50 to 65 percent control[4]
  - Limestone ~ 40 to 50 percent control [4]
- In-Duct Spray Drying (DSD): ~ 50 to 60 percent control (when followed by an ESP)[4]

Regenerative FGD Processes

- Wet: sodium sulfite, magnesium oxide, sodium carbonate, and amine: up to 97% control[3]
- Dry: activated carbon.

Process Controls

- Reducing the fuel sulfur content,
- Reducing the sulfur content of other feed material.

The following discussion of available SO_2 controls was compiled by P4 from the RBLC search; searches of the major California Air Pollution Control Agencies web sites (California Air Resources Board, South Coast Air Pollution Control Agency, San Diego County Air Pollution Control Agency, and the Bay Area Air Quality Management District); EPA Regions 4 and 5 websites; EPA Headquarters website; and a review of SO_2 control literature.

Process Controls
Process controls can reduce emissions in a variety of ways, depending on the source. If the emission unit is primarily a combustion source, reducing the sulfur content of the fuel can reduce SO_2 formation. Examples of this type of process control include use of low sulfur distillate oil, natural gas, or coal, if available. If the source is a process unit that includes the addition of feed material, reducing the sulfur content of the feed can control SO_2.

Add-On Controls
There are two major types of add-on controls for SO_2 removal: once-through and regenerable. In once-through technologies, the SO_2 is permanently bound to the sorbent that must be disposed of a waste or utilized as a by-product (i.e., gypsum). In regenerable technologies, SO_2 can be released from the sorbent during its regeneration and the SO_2 may be further processed to yield H_2SO_4, elemental sulfur, or liquid

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[19] EPA, *Controlling SO_2 Emissions: A Review of Technologies*. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-00/093. November 2000.

[20] Barbara Toole-O'Neil, editor, chair, *Dry Scrubbing Technologies for Flue Gas Desulfurization*, Consortium Review Committee, Ohio Coal Research Consortium, Publisher: Springer, 1998.

SO_2.[21] The initial capital costs and annual operation and maintenance (O&M) costs for regenerable technologies are generally higher than for once-through technologies. Regenerable technologies are usually only economically feasible if a reliable buyer can be found for the by-product.[3]

The most common type of once-through controls, wet scrubbing and dry scrubbing, are collectively known as flue gas desulfurization [FGD] processes. The terms "wet" and "dry" refer to the relative moisture state of the by-product from the process and not necessarily the state of the sorbent in the process.

Wet FGD Processes

In wet scrubbing systems, the flue gas is passed though a slurry consisting of a sorbent in an aqueous medium where the flue gas is cooled to the adiabatic saturation temperature. Particulate and gaseous oxides of sulfur are removed by absorption or chemical reaction. The by-product slurry from this process is dewatered for disposal or sold commercially.

Wet scrubbing systems generally use lime, limestone, or magnesium oxide as sorbents. Limestone is the most common sorbent used in wet scrubbers. In this system, SO_2 reacts with calcium carbonate to form calcium sulfite and carbon dioxide. In the most common version of limestone wet scrubbing, air is injected into the scrubber reactor to oxidize the calcium sulfite to gypsum (hydrous calcium sulfate). Depending on local market conditions, the gypsum can be sold as a product or disposed of as a stable material. This process known as Limestone Forced Oxidation (LSFO) has become the preferred wet FGD process for coal-fired electrical power plants. One reason for the popularity of LSFO is that it minimizes gypsum scaling problems in the absorber.

Additives can reduce the liquid-to-gas ratio and improve sorbent utilization to enhance the efficiency of SO_2 removal in LFSO systems. Organic acids, such as dibasic acid, are commonly added to LFSO systems to improve their SO_2 removal efficiency.

Another variant of limestone scrubbing is Limestone Inhibited Oxidation (LISO). In this process, emulsified sodium thiosulfate is added to the limestone slurry feed to prevent the oxidation of $CaSO_3$ to gypsum in the absorber by lowering the slurry oxidation level. Other widely used wet FGD technologies are lime, magnesium-enhanced lime (MEL), and dual alkali processes. In the lime process, $Ca(OH)_2$ slurry is sprayed counter-current to the flue gas flow. The lime slurry is more reactive than the limestone slurry resulting in a smaller absorber compared to a limestone based system. The lime sorbent, however, is generally more expensive than the limestone sorbent.

The MEL process is a variation of the lime process. The lime sorbent in this process contains magnesium. This addition makes the slurry more alkaline removing more SO_2 compared to a similar conventional lime process. The dual (or double) alkali process uses a sodium solution for scrubbing followed by lime treatment of the scrubbing solution. A sodium sulfite solution is sprayed into an open spray tower or another scrubbing arrangement to remove SO_2 from the flue gas. Lime is added to the product solution in an external tank to recover the sodium solution and form a calcium sulfite-rich sludge. This sludge can be oxidized with air to convert it to gypsum, if desired. This process uses lower-liquid/gas ratios than most other wet FGD processes. The process calcium sulfite/sulfate sludge (if not oxidized) is disposed in a lined landfill.

[21] Srivastava, R.K and W. Jozewicz, *Flue Gas Desulfurization: State of the Art*. Journal of the Air and Waste Management Association, Volume 51, p. 1676-1688. December 2001.

Another variant of wet scrubbing process is the use of ammonia to combine with SO_2 to form various ammonia salts (ammonia sulfate and ammonium bisulfate). These salts can be sold as a marketable byproduct for use in fertilizers.

In summary, available wet scrubbing technologies for SO_2 removal are:

- Lime-Concentrated Dual Alkali,
- Limestone Forced Oxidation,
- Limestone Inhibited Oxidation,
- Lime,
- Magnesium-enhanced Lime, and
- Ammonia.

Dry FGD Processes

The simplest form of dry scrubbing does not include any added sorbent. In coal-fired combustion devices, naturally occurring alkaline materials found in the coal ash absorb the SO_2 in the flue gas. This process occurs on a filter fabric, the main purpose of which is to capture particulate matter. The alkaline portion of the captured particles will absorb SO_2 until this portion is neutralized or until the particles are removed from the filter bad during a cleaning cycle. The removal efficiency of this type of SO_2 removal is varies widely but is relatively low compared to wet FGD processes and is estimated to be approximately 25 to 40 percent.

In dry scrubbers with added sorbent, a chemical slurry is atomized and injected into the flue gas stream (close to saturation) where droplets react with the SO_2 as they evaporate. The resulting dry by-product is collected in the bottom of the dryer or in the particulate removal equipment (such as an electrostatic precipitator [ESP] or a baghouse). The most widely used type of dry FGD process is Lime Spray Drying (LSD). In this process, lime slurry is mixed with the hot flue gas in a spray tower. Simultaneous heat and mass transfer between the alkali in the finely dispersed lime slurry and the SO_2 in the gaseous phase result in a series of reactions a drying of the reacted products. The resulting by-products include calcium sulfate, calcium sulfite, fly ash, and unreacted lime. A portion of this by-product maybe recycled into the spray tower to enhance SO_2 removal. The by-product can usually be disposed of in a non-hazardous waste landfill.[3]

Other forms of dry FGD processes inject the sorbent as a dry powder into the flue gas at a variety of locations in the processes. The resulting by-product is captured down stream in particulate removal equipment. These types of dry FGD processes include Furnace Sorbent Injection (FSI) and Duct Spray Drying (DSD). Both of these processes have been used in coal-fired boilers.

In FSI, dry sorbent is injected directly into the section of the combustion device where temperatures are between 950 and 1,000^{o}C (1742 ^{o}F – 1832 ^{o}F). Sorbent particles (most often lime and sometime limestone) decompose and become porous solids with high surface areas. The end product consisting of calcium sulfate and unreacted sorbent leave the combustion device ands are captured as a solid in a particulate collection device. In a variant of FSI, after the reaction has occurred in the combustion device, water is sprayed on the flue gas to improve SO_2 removal efficiency and improve sorbent utilization.

In the DSD process, slaked lime slurry is sprayed directly into the ductwork upstream of an ESP. The SO_2 in the flue gas reacts with the alkaline slurry droplets as they dry to form calcium sulfate and calcium sulfite. A residence time of at 1-second and preferably 2-second is required for maximum SO_2 removal.

The water entering with the lime sorbent humidifies the flue gas for better SO_2 removal. The particles are then captured in the ESP. The by-products normally can be disposed of in a lined landfill.[3]

In summary, available top-down dry scrubbing technologies for SO_2 removal are:

- Lime Spray Drying (LSD, added sorbent),
- Furnace Sorbent Injection (FSI) or dry sorbent injection, and
- Duct Spray Drying.

Regenerative Processes

Amine processes are the most mature regenerative sulfur removal technology, especially in petroleum refining. This process involves absorption of SO_2 within an aqueous amine absorbent. The amine is regenerated thermally to release the SO_2 stream. SO_2 may then be treated by conventional technologies to produce sulfuric acid as a by-product.

5.1.2 Eliminate Technically Infeasible Options

Process Controls

The 2002 Tier I operating permit limits the maximum sulfur content of the coal. Western coals may run as high as 5 to 6% sulfur by weight. Limiting the maximum sulfur content of the coal to 1% by weight is technically feasible.

Pipeline quality natural gas is inherently a very low sulfur fuel. Further reductions in the natural gas sulfur content were not considered.

The phosphate ore contains sulfur, but removal of sulfur from the ore prior to placing it in the kiln is technically infeasible.

Wet FGD Processes

In determining which SO_2 control technology to install in response to a 2002 Consent Order, P4 conducted extensive research and development on the technical feasibility of a variety of SO_2 control technologies in order to meet the unique requirements of the kiln. P4 initially screened hundreds of control technologies, eliminating most as infeasible for the requirements of the kiln. A wide array of requirements and considerations were used to screen these technologies and select a handful that would prove feasible and successful for the P4 kiln. These requirements included: SO_2 emissions, particulate emissions, solid waste properties, process availability/reliability, reuse of existing equipment, raw material supply/quality/cost, integration with existing operations, demonstrated use of technology in similar applications, and flexibility over a wide range of operating conditions. Recycle processes were examined carefully versus once-through processes due to the potential for the buildup of naturally-occurring radioactive materials. Some of the wet scrubbing options were determined infeasible due to potential sodium or calcium salt buildup (scaling) on the current emission control system and for interfering with the cadmium capture (sulfiding) system.

This screening process resulted in the following options:

- Three options involving alkali scrubbing - LSFO and a variant of Dual Alkali scrubbing (Lime Concentrated Dual Alkali scrubbing [LCDA]).

- A system that would scrub the venturi off-gas with ammonium hydroxide (NH_4OH) solution to form a potentially salable by-product (ammonium bisulfite/sulfite solution).
- Two similar systems involving regenerative scrubbing of venturi off-gas with a proprietary amine, yielding a sulfuric acid by-product.

Dry FGD Processes
Approximately 64 percent of the SO_2 emissions in the United States are produced by the electric power generating units that burn fossil fuels, predominantly coal.[3] Consequently, the majority of the FGD processes in use today have been designed to address SO_2 emission reductions from these electric generating units. The nodulizing kiln at the P4 facility is unlike an electric power generating unit and some of the FGD processes developed for coal combustion units are not technically feasible. Specifically, technically infeasible processes include those that involve injection of sorbent into the combustion chamber. The feed to the kiln is closely regulated to produce nodules that are usable in the furnaces. The addition of lime or limestone into the combustion chamber of the nodulizing kiln is not compatible with the process of nodule preparation and, is therefore, deemed to be technically infeasible. Any SO_2 removal process that utilizes injection of sorbent into the combustion chamber such as FSI and its variations were eliminated from further consideration.

5.1.3 Evaluate Control Effectiveness for Remaining Technologies

All remaining control technologies are capable of removal efficiencies of 97%. The remaining SO_2 control technologies are:

Once-Through Wet FGD Processes:

- LSFO,
- LCDA, and
- Ammonia Scrubbing.

Regenerative Processes:

- Amine scrubbing.

5.1.4 Evaluate Control Technology Impacts

5.1.4.1 Cost of Compliance

BART analyses require a baseline case for the emission unit be selected as a reference point for comparison of alternatives. This baseline case represents a realistic scenario of the upper boundary of uncontrolled emissions from the source.[3] The 2001- 2002 actual emission were chosen for this scenario. This emission rate of 11,914 tons per year was based on P4's Enoch Mine phosphate ore composition, kiln on-stream time, and total daily feed to the kiln for 2001-2002. Cost effectiveness calculations were based on this baseline emissions value.

A summary of the cost effectiveness of each remaining technology is presented below:

Table 5.1.1 COST COMPARISON FOR SO_2 CONTROLS FOR THE #5 KILN

Scrubbing Technology	Initial Capital Costs ($\$x10^6$/yr)	Annual O&M[a] costs ($\$x10^6$/yr)	Total Annualized cost[b] ($\$x10^6$/yr)	Annualized cost per ton of SO_2 removed ($/ton SO_2)
LSFO	21.2	4.4	7.42	$642
LCDA	12.2	3.7	5.44	$466
Ammonia Scrubbing	28.7	6.1	10.20	$881
Regenerative Amine Scrubbing	30.3	5.5	9.81	$849

a. O&M – operations and maintenance
b. 7% discount rate over 10 years

Cost effectiveness calculations are detailed in Appendix H to P4's Tier II operating permit application received on June 26, 2003. Operation and maintenance costs include operating labor, maintenance labor and materials, reagents, disposal of residuals, and energy.

The cost comparisons shown in Table 5.1.1 reflect the annualized cost compared to having no SO_2 controls installed. As shown in the table, LCDA was estimated to have the lowest annualized cost per ton of SO_2 removed. However, P4 is currently required to operate its existing LCDA scrubbing system whenever the kiln is operating. Because each of the SO_2 control technologies shown in the table have similar maximum control efficiencies of about 97%, the incremental cost of replacing the existing LCDA scrubbing system with a different system—even if higher control efficiencies could be reached—would be excessive.

5.1.4.2 Energy Impacts

Energy impacts from a control technology generally occur in one of two ways. First, if the flue gas temperature needs to be elevated in order for the control technology to work most efficiently, the cost of heating may be so large that it negatively impacts the cost effective of this control option. Second, if the energy cost (i.e., electric power) for operating a control technology is a disproportionately large part of the overall operation costs, compared to another technology given the same removal efficiency, the latter technology would be chosen as BART. Conversely, a control technology that uses less energy that the baseline condition would be looked upon more favorably than one that does not, given identical removal efficiencies. Both of these types of impacts are discussed in the cost effectiveness section.

None of the technically feasible technologies requires reheat of the flue gas or has disproportionate energy costs during operations. All will use more energy than the existing operation.

5.1.4.3 Non-Air Quality Environmental Impacts

Environmental considerations in a BART analysis concentrate on impacts other than on air quality from the pollutant under consideration. The focus is on impacts to solid or hazardous waste generation, discharges of pollutants to water, or emissions of pollutants not directly considered in the analysis. The LSFO process produces a solid gypsum by-product (after dewatering). This by-product can usually be disposed of in a non-hazardous waste landfill or, if market conditions are favorable, sold as a raw material. This process then has the potential positive environmental benefit of reusing the by-product as a raw material. One possible negative impact is the generation of fugitive dust from limestone stockpiles if these are not properly managed.

In the LCDA process, SO_2 is absorbed by a solution of sodium sulfite and sodium bisulfate. The spent sodium sulfite/bisulfite/sulfate solution is continuously withdrawn to a dual-reactor system where it is reacted with lime. The lime regenerates the scrubbing solution and precipitates calcium sulfite/sulfate solids. The filter cake resulting from dewatering the solids may be disposed of in a permitted, lined landfill. The use of ammonia scrubbing has the potential positive environmental benefit of reusing the by-product (ammonium bisulfite/sulfite solution) as a raw material. Regenerative amine scrubbing produces liquid sulfuric acid as a by-product. This presents potential heath and safety concern regarding the handing and storage of this material. With proper health and safety procedures, and a stable market for sulfuric acid sales, these environmental impacts will be significantly reduced.

5.1.4.4 Remaining Useful Life

The #5 Kiln is expected to remain in service for the life of the P4 facility. This criterion is not a factor in determining BART.

5.1.5 SO_2 BART for the Nodulizing Kiln (#5 Kiln)

Since all four remaining technologies are capable of 97% removal from baseline condition, the balancing factors of environmental, energy, and economic impacts would dictate the chosen technology. Based on the evaluation above, LCDA was selected by P4 as the preferred alternative for SO_2 control for the kiln emissions. It had the lowest cost per ton of SO_2 removed, a low probability of causing significant environmental impacts, and was a proven, mature technology. It was also compatible with the existing Hydro-Sonic© scrubbers that would continue to be used to control particulate/radionuclide emissions. The evaluation in this subsection was based on a comparison of control technologies versus no controls, and demonstrates that an LCDA scrubbing system would be selected as BART if the facility had no SO_2 controls on the kiln emissions.

P4 is currently required to limit coal sulfur content to a maximum of 1% by weight, and to operate its existing LCDA scrubbing system whenever the kiln is operating. The LCDA scrubbing system is expected to have a control efficiency of 97% for SO_2, which is reflected in the emissions estimates for this pollutant. The requirement to control SO_2 emissions contained in the 2002 DEQ consent order will be made federally-enforceable by incorporation into a permit to construct.

5.2 Kiln PM/PM_{10} BART Analysis

5.2.1 Identify Control Technologies

In response to a request from DEQ, P4 identified all technically available kiln particulate pollution control technologies in September 2006. The control technologies were evaluated and determined to be either technically feasible or infeasible.

The current particulate pollution control equipment on the kiln consists of a dust knockout chamber, spray tower, four parallel high-energy tandem nozzle venturi scrubbers, and four parallel cyclonic separators. The venturi scrubbers were brought on-line in September 1987 in response to a January 1986 Consent Order. A BACT analysis was not performed during the pollution control selection process, however pilot plant tests were performed on three (3) different technologies: venturi scrubber, catenary grid scrubber, and wet electrostatic precipitator (ESP). These technologies are included in the list below.

The following is a list of the available control technologies (in approximately top-down order, i.e., technologies with better control efficiencies are listed first) from the pilot plant testing and RBLC search that was performed in September 2006.

- Baghouse/Fabric Filter,
- Electrostatic Precipitator (ESP),
- Venturi Scrubber,
- Wet ESP,
- Rotoclone Scrubber,
- Catenary Grid Scrubber,
- Packed Scrubber, and
- Good Combustion Control.

5.2.2 Eliminate Technically Infeasible Options

Baghouse/Fabric Filter: This technology is best used in a dry environment. In a moist environment, the fabric can become blinded and the hopper can be bridged. The kiln exhaust gas is a moisture-laden stream because it is first sent through a spray tower to cool the gas stream from approximately 800 ^{o}C to 71 ^{o}C (1472^{o}F to 160 ^{o}F).

ESP: This technology is technically infeasible for the same reasons as a baghouse/fabric filter.

Rotoclone Scrubber: This type of centrifugal or dynamic scrubber is considered a medium energy (medium pressure drop) scrubber and does not have the particulate removal efficiency of a high-energy scrubber. This technology does not have the control efficiency for sub-micron particulate matter that is needed in this application.

Packed Scrubber: The normal use for this technology is for the removal of gases and vapors from a gas stream; however, some types have been used for particulate removal. Coarsely packed beds are very effective at removing coarse dusts and mists. Finely packed beds may be used to remove smaller particulates, but because of pressure drop considerations, the velocity must be kept relatively low. Therefore, finely packed beds have a greater tendency to plug and are generally limited to gas streams with relatively low grain loading.

Catenary Grid Scrubber: P4 conducted a pilot plant test on a slipstream of kiln exhaust gas. The technology was susceptible to plugging of the straightening vanes, and fan vibrations due to buildup. The pilot plant test showed that the scrubber was effective at removing larger particles, but not sub–micron material. Therefore, this technology was not recommended for use in this application.

Good Combustion Control: Combustion in the kiln is carefully controlled to ensure that the kiln temperature stays in the range at which sintering of the phosphate ore occurs, which is 1400^{o}C – 1459^{o}C (2552 ^{o}F – 2658^{o}F). Good combustion controls generally focus on ensuring adequate mixing and providing excess air to promote complete combustion. Excess air tends to cool the combustion chamber and therefore requires more fuel to maintain the high temperatures necessary for sintering the ore. Good combustion control is not feasible in this application.

P4 determined that the following two options were technically feasible:

Wet ESP: A pilot plant test was performed on a slipstream of kiln exhaust gas. The pilot plant test showed that the wet ESP is capable of reducing particulate emissions to an acceptable level. However, the technology is susceptible to fouling, scaling, and plugging from raw water quality. During the testing, the ESP had to be shutdown every two weeks in order to clean the plates and troughs of buildup and sedimentation.

Venturi Scrubber: A pilot plant test was performed on a slipstream of kiln exhaust gas. The pilot plant test showed that the tandem nozzle venturi scrubber was capable of reducing particulate emissions to an acceptable level with some nozzle plugging occurring. However, the problem was eliminated by adding water upstream of the first nozzle to wet the throat area of the nozzle. Venturi scrubber outlet emissions were insensitive to changes in inlet particulate loading, and water solids concentrations had no significant impact on particulate emissions.

5.2.3 Evaluate Control Effectiveness for Remaining Technologies

Wet ESP: On the pilot plant test, the wet ESP was found to have a particulate removal efficiency of approximately 93%. However, with the maintenance problems associated with this technology, it was not recommended for use in this application.

Venturi Scrubber: On the pilot plant test, the tandem nozzle venturi scrubber was found to have a particulate removal efficiency of approximately 95%. Therefore, high-energy tandem nozzle venturi scrubbers were recommended and installed on the kiln to control particulate emissions.

5.2.4 Evaluate Control Technology Impacts

As shown in Table 2.1, PTE emissions of SO_2 and NO_x from the #5 Kiln are substantially greater than estimated PM_{10} emissions. SO_2 emissions are about seven times higher, and NO_x emissions are almost 42 times larger. Because P4 selected the most stringent technically-feasible option available in 1987 (the HE venturi scrubbers), the following impacts were not evaluated:

1) Cost of Compliance,
2) Energy Impacts,
3) Non-air Quality Environmental Impacts, and
4) Remaining Useful Life.

5.2.5 PM/PM_{10} BART for the Nodulizing Kiln (#5 Kiln)

The evaluation in this subsection was based on a comparison of RBLC control technologies identified in 2006 versus no controls. Since 2006, there have been no additional technically-feasible controls identified with greater control efficiency than the HE venturi scrubbers already installed to control particulate emissions from the kiln.

P4 is currently required to use a dust knockout chamber, spray tower, high-energy tandem nozzle venturis, and cyclonic separators to control PM/PM_{10} emissions from the kiln.

If a new technically feasible PM/PM_{10} control technology were identified that has control efficiency greater than 95%, the relatively low level of PM/PM_{10} emissions would cause the incremental cost of replacing the existing group of control devices to be excessive. No additional PM/PM_{10} controls are needed to meet BART criteria.

5.3 Kiln NO_x BART Analysis

5.3.1 Identify Control Technologies

NO_x is formed in the kiln almost exclusively as thermal NO_x due to the high temperatures required to sinter the phosphate ore into nodules. NO_x is also formed when either coal or natural gas is used to supplement or replace the CO normally used to fire the kiln.

P4 conducted a search of EPA's RBLC Clearinghouse database for potential BART options for the control of NO_x emissions from large rotary kilns. The following is a list of the available control technologies that were identified:

- Good combustion control,
- Low NO_x burner, and
- Selective non-catalytic reduction (SNCR).

5.3.2 Eliminate Technically Infeasible Options

Good Combustion Practices: The temperature at which thermal NO_x is formed is approximately 1300^oC (2372^oF). The temperature at which sintering of the phosphate ore occurs is 1400^oC to 1459^oC (2552 ^oF to 2658^oF). Therefore, it is not feasible to lower the temperature in the kiln to minimize or prevent the formation of thermal NO_x.

Low NOx Burner, Limit Excess Air: The temperature required for a low NO_x burner is too low to sinter the phosphate ore and form the required nodules. Sintering of the ore takes place at 1400^oC to 1459^oC, and low NO_x burners must be controlled to operate at temperatures well below 1300 ^oC (2372 ^oF), the temperature at which thermal NO_x is formed.

Selective catalytic reduction: Not included in the RBLC. If a SCR system were installed at the back end of the kiln prior to the particulate control system, the heavy particulate loading in the gas stream would foul the catalyst. Also, the temperature of the kiln offgas would be much too high for SCR to be effective. SCR is only effective in a temperature range of 300^oC to 400^oC (572 ^oF to 752 ^oF). If the SCR system were installed after the particulate control system to prevent catalysts fouling, the temperature of the gas stream would be too low for SCR to function properly. Also, the high moisture content in the gas stream after the particulate control system would cause the SCR system to be inoperable due to water molecules coating the surface of the catalyst and preventing mass transfer for the catalytic reaction to occur.

Selective Non-catalytic Reduction, Low NO_x Burners, top Air Duct: SNCR technology utilizes a reducing agent, the most popular being ammonia, in the gas stream at temperatures between 900 ^oC and 1000^oC (1652 ^oF to 1832 ^oF) for optimum NO_x control. The kiln off gas temperature at the exit of the kiln is between 730 ^oC and 900 ^oC (1346 ^oF to 1652 ^oF), with the normal temperature being 750 ^oC (1382 ^oF). This is well below the minimum required temperature for SNCR to work effectively. Also, the existing ductwork, refractory, and waste heat boiler are not capable of handling gas streams at these temperatures for sustained periods of time. The heavy particulate loading in the kiln off gas stream would make it difficult to inject the liquid ammonia without plugging the spray injectors, and also may hinder the ammonia and NO_x chemical reaction by adsorption on the dust particles. P4's existing process layout would likely not allow enough room for the needed auxiliary burners and SNCR control equipment. If SNCR were installed after the particulate control system, the temperature of the gas stream as it exits the particulate control system (approximately 80°C or 176°F) would be too low for the control system to function properly.

5.3.3 NO_x BART for the Nodulizing Kiln (#5 Kiln)

As demonstrated in the evaluation in this subsection, the required operating temperature range in the #5 Kiln precludes using typical NO_x control technologies. There are no technically feasible retrofit control technologies to control NO_x from the #5 kiln.

6. BART Analysis for the #9 Furnace and #9 CO Flare

Nodules from the #5 Kiln are combined with coke and quartzite and heated (in a reducing environment) in one of three electric furnaces. This reaction results in the production of phosphorus gas, along with CO and entrained particulate matter. The furnace off gas, composed primarily of CO, water, and trace quantities of fluoride, phosphorus, phosphorous compounds, and particulate matter, is sent to the #5 Kiln where the CO is used as fuel for the kiln.

At times, there may be more CO produced than can be burned in the kiln. During such times, the CO gas will be treated in the thermal oxidizer. During periods of startup, shutdown, scheduled maintenance, safety measures, upset and breakdown, the CO from the #7 and #8 furnaces is flared using the #7/8 CO Flare. CO from the #9 furnace is flared using the #9 CO Flare. The 7/8 and #9 CO Flares are typical unassisted flares. The gas first passes through a liquid knockout system to remove water and condensibles before reaching the flare At the top of the flare stack is a flare tip comprised of the burners, a system to mix the fuel and air, and a pilot light to ignite the mixture.

Pursuant to a December 30, 2002 Consent Order issued by DEQ, P4 is required to implement BACT for the #7 furnace CO emissions or install a thermal oxidizer, whichever is more effective in reducing CO emissions. P4 is also required to apply such CO control technology on the #8 and #9 furnaces. P4 submitted a CO BACT analysis for the #7 Furnace and #7/8 CO Flare as part of the Tier II operating permit application received June 26, 2003. P4 proposed as BACT a combination of a thermal oxidizer (98% efficient), using flaring (80 to 98% efficient, to be used on a limited basis during certain operating conditions or process upsets), and controlling plant operations to balance the rate of CO production in the furnaces to match the fuel needs for the kiln.

Emissions from furnace slag tapping and the process stream ESP dust oxidation chamber from each furnace are controlled by a cyclonic separator and venturi scrubber known as the #7, #8, and #9 Furnace Tap Hole Fume Collectors (THFC).

Furnace pressure relief vessel vent gases are currently vented directly to the atmosphere through each furnace vent stack when the furnace is shut down. In the Tier II operating permit application received on November 30, 2007 (Revision 2 to the 2003 application), P4 proposed routing these emissions through the THFCs.

Because the #7 furnace process is representative of all three furnaces, the BACT analysis completed by P4 for the #7 furnace as part of the Tier II application was used as the starting point for the BART analysis for the #9 Furnace and #9 CO Flare. The #9 Furnace is the largest of the three furnaces, but the operations are essentially the same as the #7 furnace and #7/8 CO Flare.

6.1 #9 Furnace and #9 Flare SO_2 BART Analysis

SO_2 emissions points associated with the #9 Furnace and #9 CO Flare include:

- #9 Furnace Vent Riser (P4 has proposed routing these emissions to the THFC stack): 2.35 T/yr
- #9 Furnace THFC Stack (ferrophosphorus and calcium silicate slag tapping): 48.48 T/yr
- #9 Furnace Treater Heat Vent (natural gas burner): 0.03 T/yr
- #9 Furnace Explosion Seal Vent (upsets only): 1.05 T/yr

Total SO_2 emissions associated with the #9 Furnace have been estimated (3/25/09 P4 emissions inventory). The total emissions from the three furnaces with T.O. control is 138 tons per year.

This BART analysis will focus on the two major sources of SO_2 for the furnace (the THFC stack and the #9 CO Flare).

6.1.1 Identify Control Technologies

#9 THFC
Available technologies for removing SO_2 from a gas stream are described in Section 5.1.1 for the #5 Kiln.

#9 CO Flare:
The RBLC database was searched for recent BACT determinations for SO_2 control on flares. Four facilities and 27 processes were found. The industries found were: Petroleum/Natural Gas Production and Refining, Municipal Waste, and Chemical Manufacturing. In each entry, the control listed was "pollution prevention." These pollution prevention measures involved process controls that limit the sulfur content of the flare feed.

6.1.2 Eliminate Technically Infeasible Options

#9 THFC
A detailed review of technical feasibility for all of the available technologies listed in Section 5.1.1 was not conducted. The SO_2 emissions from the THFC stack are relatively small (~50 T/yr, if the furnace vent gases are rerouted to this stack). Installing new SO_2 controls for this waste stream will not be economically feasible.

#9 CO Flare:
Process Controls: The process controls described in the RBLC database for flares included the use of low-sulfur fuel burned at the flare or a reduction in sulfur content of a feedstock for a process upstream of the flare. The production of elemental phosphorus in the #9 Furnace is a highly controlled process. The furnace is operated to optimize the production of elemental phosphorus. This production process does not directly depend on a fossil fuel source or other controllable sulfur-containing feed material. Therefore, process controls to reduce the sulfur in the waste gas to the flare for SO_2 control are technically infeasible for the #9 CO flare.

6.1.3 Evaluate Effectiveness for Remaining Control Technologies

There are no technically feasible options for controlling SO_2 emissions from the #9 furnace (including the #9 CO flare).

6.1.4 Evaluate Control Technology Impacts

There are no technically feasible options for controlling SO_2 emissions from the #9 furnace (including the #9 CO flare).

6.1.5 SO_2 BART for #9 Furnace and #9 CO Flare

There are no technically feasible options for controlling SO_2 emissions from the #9 furnace (including the #9 CO flare).

None of the control technologies identified for SO_2 control are technically feasible on the #9 CO flare. BART for the #9 CO Flare is “no additional controls.”

6.2 #9 Furnace and #9 Flare PM BART Analysis

Particulate emissions points associated with the #9 Furnace and #9 CO Flare include:

- #9 Furnace Vent Riser (P4 has proposed routing these emissions to the THFC stack): 6.58 T/yr
- #9 Furnace THFC Stack (ferrophosphorus and calcium silicate slag tapping): 26.28 T/yr
- #9 Furnace Treater Heat Vent (natural gas burner): 0.58 T/yr
- #9 Furnace Explosion Seal Vent (upsets only): 0.003 T/yr

Total PM emissions associated with the #9 Furnace have been estimated (3/25/09 P4 emissions inventory). The total emissions from the three furnaces with T.O. control is 155 tons per year.

This BART analysis will focus on the two major sources of PM_{10} for the furnace (the THFC stack and the #9 CO Flare).

6.2.1 Identify Control Technologies

#9 THFC

Particulate emissions from #9 Furnace slag tapping and the ESP dust oxidation chamber are currently controlled by a cyclonic separator and venturi scrubber known as the #9 Furnace THFC.

#9 Furnace pressure relief vessel vent gases are currently vented directly to the atmosphere through the #9 Furnace vent stack when the furnace is shut down. In Tier II operating permit application materials received on November 30, 2007 (Revision 2 to the 2003 application), P4 proposed routing these emissions through the THFC.

Available technologies for removing PM from a gas stream, in top-down order, include:

	Total PM	PM <0.3µm
• Baghouse/Fabric Filter:	98 to 99.9%	99 to 99.98%
• ESP:	99 to 99.7%	80 to 95%
• Particle Scrubber	95 to 99%	30 to 85%
- High energy (e.g., venturi)		
- Medium energy		
- Low energy (e.g., spray tower)		
• Mechanical Collector (e.g., cyclone)	70 to 90%	0 to 15%

#9 CO Flare:

P4 queried the RBLC for a process type that included the word "flare" and "PM" as the pollutant. The search yielded 23 facilities with 32 processes. Of these 23 facilities, seven were chemical or plastics manufacturing facilities, four were crude oil refineries, four were landfills, three were oil exploration operations, three were natural gas treating facilities, one was a steel foundry and one was a grain processing plant. Databases from several California regulatory bodies and the Texas Commission on

Environmental Quality (formerly the Texas Natural Resource Conservation Commission) were also queried for updated flare BACT information compared to the extensive discussion in the SENES BACT (2002a). No new information was found.

The most common control technologies for PM for flares in the RBLC were good combustion practices (smokeless flare) or proper operation. One included steam-assisted combustion (from a vacuum tank degasser in a steel foundry). This enhancement reportedly increases the efficiency of flares by providing better mixing with combustion air. The gas streams burned at all of these facilities have a higher heating value and higher VOC content than the gas stream from the P4 furnaces (which is about 300 Btu/scf). None of these facilities burned CO in their flare; therefore, none of these BACT determinations are directly applicable to the P4 furnaces.

6.2.2 Eliminate Technically Infeasible Options

#9 THFC
A detailed review of technical feasibility for the available PM control technologies was not conducted. The PM/PM_{10} emissions from the THFC stack are relatively small (~33 T/yr, if the furnace vent gases are rerouted to this stack). Installing new or retrofit PM controls for this waste stream will not be economically feasible.

#9 CO Flare:
No retrofit options for controlling PM emissions from flares have been identified.

6.2.3 Evaluate Control Effectiveness for Remaining Technologies

There are no technically feasible options for controlling PM emissions from #9 furnace (including the #9 CO flare).

6.2.4 Evaluate Control Technology Impacts

There are no technically feasible options for controlling PM emissions from #9 furnace (including the #9 CO flare).

6.2.5 PM BART for #9 Furnace and #9 CO Flare

#9 THFC
PM BART for the #9 Furnace Vent is to reroute the #9 Furnace vent emissions through the THFC. Because the emissions from the THFC stack already pass through a cyclonic separator and venturi scrubber, and because the PM/PM10 emissions are quite low (~33 T/yr), PM BART for the THFC is “no additional controls.”

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#9 CO Flare:
No retrofit control technologies were identified for PM control on the #9 CO flare. PM BART for the #9 CO Flare is “no additional controls.”

6.3 #9 Furnace and #9 CO Flare NO_x BART Analysis

6.3.1 Identify Control Technologies

NO_x emissions points associated with the #9 Furnace include:

- #9 Furnace Vent Riser (P4 has proposed routing these emissions to the THFC stack): 0.75 T/yr
- #9 Furnace THFC Stack (ferrophosphorus and calcium silicate slag tapping): not estimated
- #9 Furnace Treater Heat Vent (natural gas burner): 4.83 T/yr
- #9 Furnace Explosion Seal Vent (upsets only): 0.0056 T/yr

Total NO_x emissions associated with the #9 Furnace have been estimated (3/25/09 P4 emissions inventory). The total emissions from the three furnaces with T.O. control is 119 tons per year.

This BART analysis will focus on the two major sources of NO_x for the furnace (the THFC stack and the #9 CO Flare).

#9 THFC

NO_x from #9 THFC are currently uncontrolled.

#9 Furnace pressure relief vessel vent gases are currently vented directly to the atmosphere through the #9 Furnace vent stack when the furnace is shut down. In Tier II operating permit application materials received on November 30, 2007 (Revision 2 to the 2003 application), P4 proposed routing these emissions through the THFC.

Available technologies for removing NO_x from a gas stream include:

- Low NO_x burner,
- Overfire Air,
- Reburning,
- Flue Gas Recirculation,
- SCR,
- Selective non-catalytic reduction (SNCR),
- Good combustion control.

#9 CO Flare:

P4 searched the RBLC database for recent BACT determinations for NO_x control from flares. Twenty-one entries for NO_x were found. The industries found were Petroleum/Natural Gas Production and Refining, Municipal Waste, Utility and Large/Industrial-Size Boilers, Commercial/Institutional-Size Boilers, Miscellaneous Combustion, and Chemical Manufacturing. The NOx controls found were listed as: “no controls feasible,” “general control device requirements,”(refers to 40 CFR §60.18 and §63.11) and “good design and proper operating practices.”

As discussed in the SENES BACT analyses, steam injection is a technology that is used on flares to help prevent smoking and to improve the overall efficiency of the flare. Injection of steam is widely used as a standard operating procedure on VOC flares to create turbulent mixing of air and the fuel for more complete combustion and to provide some cooling of the flare tip and stack.

6.3.2 Eliminate Technically Infeasible Options

#9 THFC

A detailed review of technical feasibility for the available NO_x control technologies was not conducted. The NO_x emissions from the THFC stack are relatively small (~23 T/yr, if the furnace vent gases are rerouted to this stack). Installing new or retrofit NO_x controls for this waste stream will not be economically feasible.

#9 CO Flare:

None of the NO_x controls found in the RBLC or elsewhere apply to flares that use CO as their primary fuel. These flares burned volatile organic compounds (VOC), landfill gas, refinery fuel gas, natural gas, or other hydrocarbon-derived fuel. Therefore, none of the process controls or BACT emissions limits identified in the RBLC are directly applicable to the No.7/8 CO Flare. In addition, the fuels that are combusted in most of the flares found in the RBLC or elsewhere have a higher heat input than CO giving these flares a hotter peak temperature and, therefore, a higher NO_x emission rate per unit of fuel gas than the No.7/8 CO flare.

Good design as a control technology applies to new flares and is not an economically feasible retrofit option. Installing new or retrofit NO_x controls for this waste stream will not be economically feasible.

6.3.3 Evaluate Control Effectiveness for Remaining Technologies

There are no technically feasible options for controlling NOx emissions from #9 furnace (including the #9 CO flare).

6.3.4 Evaluate Control Technology Impacts

There are no technically feasible options for controlling NOx emissions from #9 furnace (including the #9 CO flare).

6.3.5 NO_x BART for #9 Furnace and #9 CO Flare

#9 THFC

Because the NO_x emissions are quite low (~23 T/yr), NO_x BART for the #9 THFC is "no additional controls."

#9 CO Flare:

No retrofit control technologies were identified for NO_x control on the #9 CO Flare. NO_x BART for the #9 CO Flare is "no additional controls."

Appendix A – RBLC Summaries

RBLC (RACT-BACT-LAER Clearinghouse) Report for NOx Control on Kilns

Report Date: 8/28/2006

#	Date	Company	Facility	Location	Process Unit	NOx Control	Other Limits
1	8/24/2006	Western Greenbirer Co-Generation, LLC	Western Greenbirer Co-Generation, LLC	WV	Cementitious Material Kiln		
2	8/3/2006	Georgia Pacific Corp	Monticello Mill	MS	Lime Kiln	Good Combustion Practices	
3	10/25/2004	Graymont PA Inc	Graymont Bellefonte Plant	PA	#7 Lime Kiln		
4	6/29/2006	Western Lime Corporation	Western Lime Corporation	MI	Lime Kiln	Low NOx Burner, Limit Excess Air	
5	6/21/2005	Pope & Talbot	Halsey Pulp Mill	OR	Lime Kiln	Good Combustion Control	
6	1/17/2006	Hoeganaes Corp	Hoeganaes Corp	TN	Rotary Kiln	Proper Combustion Control	Operating hours are limited to 8,000 hours/12 consecutive months
7	11/16/2005	Georgia Pacific Corp	Monticello Mill	MS	Lime Kiln	Good Combustion Practices, Kiln Design	
8	1/12/2004	Roanoke Cement	Roanoke Cement	VA	Lime Kiln	Good Combustion Practices	CEMS
9	10/10/2003	Weyerhaeuser	Flint River Operations	GA	Rotary Lime Kiln		
10	9/17/2003	Vulcan Materials	Vulcan Materials	IL	Lime Kiln	Best Combustion Practices	
11	9/17/2003	Continental Cement Company	Continental Cement Company	MO	Rotary Kiln & Pyroprocessing System	Selective Non-catalytic Reduction, Low NOx Burners, Top Air Duct	
12	1/3/2003	LaFarge Corp	LaFarge Corp	IA	Kiln	Good Combustion Practices	
13	3/12/2004	Carolina Stalite Company	Gold Hill	NC	Rotary Expanding Kiln	Good Combustion Techniques	
14	3/17/2005	International Paper	Mansfield Mill	LA	Lime Kiln	Good Process Controls	Water content of lime
15	1/4/2005	Donahue Industries	Donahue Industries Paper Mill	TX	Lime Kiln		
16	9/18/2001	Lehigh Portland Cement Company	Lehigh Portland Cement Company	MD	Preheater/Precalciner Kiln	5-stage preheater/precalciner pyroprocessing plant	Any add-on Nnx emissions control has been determined to be either technically or environmentally infeasible
17	9/22/1998	Holnam, Laporte Co.	Holnam, Laporte Co.	CO	Calciner/Kiln	Special Process: Design of burner/kiln to control alkali from limestone	
18	12/4/2001	Signal Mountain Cement Co, LP	Signal Mountain Cement Co, LP	TN	Dry Feed Kiln	Good Combustion Practices	
19	1/4/2005	Chemical Lime, LTD	Lime Plant	TX	Kiln		
20	6/6/2002	Ash Grove Cement Co.	Ash Grove Cement Co.	UT	Kiln	Low NOx Burner	400 lb/hr at 90% of max production capacity
21	10/7/2002	Weyerhaeuser Co.	Weyerhaeuser Co.	MS	Lime Kiln	Effective operation of kiln	
22	12/4/2002	Westvaco Corp., Chemical Division	Westvaco Corp., Chemical Division	KY	Woodbase Carbon Acid/Mixing, Activation Kiln	Low NOx Burner	
23	3/3/2004	Holnam, Devil's Slide Plant	Holnam, Devil's Slide Plant	UT	Kiln	Low NOx Burner	
24	9/17/2002	Willamette Industries	Marlboro Mill	SC	Kiln	Good Combustion Control	

NOTE: NOx Control column = blank: original RBLC report had (N)

RBLC (RACT-BACT-LAER Clearinghouse) Report for NOx Control on Flares

Report Date: 5/10/2006

#	Date	Company	Facility	Location	Process Unit	NOx Control	Other Limits
1	12/21/2005	New England Waste Services, Inc.	New England Waste Services of Vermont, Inc.	VT	Landfill Gas Flare	NO2 emissions: Low emissions design	
2	10/25/2004	Steelcorr, Inc.	Bluewater Project	AR	Degasser Hotwell Flare		
3	7/5/2005	Charter Manufacturing Co., Inc.	Charter Steel	OH	Vacuum Oxygen Degasser Vessel w/Flare		Emissions from NG combustion from flare; only during oxygen lancing degassing process for low carbon and stainless steel production.
4	12/30/2004	Degussa Engineered Carbons LP	Baytown Carbon Black Plant	TX	Dryers, Boilers, Flare	Good combustion practice and design	
5	12/30/2004	Degussa Engineered Carbons Inc	Borger Carbon Black Plant	TX	Dryers, Boilers, Flare	Good combustion practice and design	
6	10/28/2002	Conoco, Inc.	Ponca City Refinery	OK	Flare	Limit fuel to pipeline grade natural gas	
7	4/6/2004	Valero Refining Company	Corpus Christi Refinery	TX	Main Flare		
					Ground Flare		
8	1/3/2005	Atofina Petrochemicals, Inc.	La Porte Polypropylene Plant	TX	Monument No. 2 Flare	None indicated	
					Train No. 8 Flare	None indicated	
9	1/3/2005	Reliant Energy, Inc.	Limestone Electric Generating Station	TX	FCCU Flare	None indicated	
					HCU Flare	None indicated	
10	1/5/2005	Exxon Mobil Chemical Company	Baytown Olefins Plant	TX	Primary Flare	None indicated	
					Secondary Flare	None indicated	
					Flare, Flarex	None indicated	
11	10/27/2005	City of LA, Bureau of Sanitation	City of LA, Bureau of Sanitation	CA	Landfill, Gas Gathering System Flare		
12	1/3/2005	Vetrotex America	Saint-Gobain Vetrotex America	TX	Propane Flare	None indicated	
13	1/4/2005	Trifinery Petroleum Service	Trigeant Corpus Christi	TX	Flare, Flare	None indicated	
					Plant Flare	No NOx control listed	
14	1/4/2005	Vetrotex America	Vetrotex America	TX	Propane Flare	None indicated	
15	1/16/2004	Cabot Corporation	Ville Platte	LA	Units 1&2 Flare	Design and proper operation	
16	7/24/2003	Formosa Plastics Corp.	Formosa - High Density Polyethylene II	TX	Elevated Flare	None indicated	
17	8/30/2004	Exxon Chemical Company	Exxon Baytown Olefins Plant	TX	Secondary Flare		
18	7/3/2003	MCUA Landfill Gas Utilization Project	MCUA	NJ	Open Flare	None	
19	11/17/2004	Fina Oil & Chemical Company	Port Arthur Refinery	TX	Flare		
20	7/25/2003	Praxair Incorporated	Praxair Synthesis Gas Plant	TX	Flare	None indicated	
21	1/5/2005	Equistar Chemicals, LP	Equistar Chemicals, LP	TX	Cold Flare	None indicated	
22	10/25/2004	Fina Oil and Chemical Company	Port Arthur Refinery	TX	Flare		
23	8/30/2004	Fina Oil and Chemical Company	Atofina's Port Arthur Complex	TX	Flare		
24	10/29/2002	Grain Processing Corp.	Grain Processing Corp.	IN	Watewater Treatment Plant Flare	Flare limited to 520 hr/yr	
25	9/29/2003	Union Carbide Chem & Plastics Co. Inc.	Low Pressure Polyethylene Plant No. 2	TX	Large Flare		
					Small Flare	None indicated, BACT is applied.	
26	12/18/2001	City of Stockton Municipal Utilities Dept	City of Stockton Municipal Utilities Dept	CA	Digester Gas-Fired Flare	No control that is not integral to the flare	
27	9/16/2002	Chevron USA	Chevron USA	MS	SOCMI Distillation Process with Flare	NO2: Flare is used to reduce NOx emissions from the process	
28	1/4/2005	Formosa Plastics Corporation	Marine Loading Facility	TX	Dock Flare	None indicated	
29	12/18/2001	Texaco Exploration and Production	Texaco Exploration and Production	CA	Gas Flare	Kaldair, Coanda Effect, electronic ignition	
30	4/11/2006	Westlake Petrochemicals Corp	Ethylene Manufacturing Complex Petro II Unit	LA	Flare		Emission limits reflect those established by PSD-LA-595(M1). Limits unchanged by PSD-LA-595(M2).

NOTE: NOx Control column = blank; original RBLC report had (N) or ()

Report for NO_x Control on Flares, continued

RBLC (RACT-BACT-LAER Clearinghouse) Report for PM Control on Kilns – Report Date: 9/25/2006

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
1	8/16/2006	Cutler-Magner Company	CLM - Superior	WI	Lime Kiln	High temperature membrane (PTFE) fabric filter baghouse; preheater lime kiln	
2	6/28/2006	Big River Industries, Inc.	Gravelite Division	LA	Nos 1-4 Rotary Kilns	Venturi Scrubber	
3	6/19/2006	US Gypsum Company	US Gypsum Company	VA	Drying Kiln		
4	5/24/2006	Weyerhaeuser, Inc.	Red River Mill	LA	Lime Kiln No. 2	Electrostatic Precipitator (ESP)	
5	4/26/2006	Western Greenbrier Co-Generation, L.L.C.	Western Greenbrier Co-Generation, L.L.C.	WV	Cementitious Material Kiln	Baghouse	Kiln exhaust combined with CFB exhaust and emitted from a commor stack
6	3/30/2006	Suwanne American Cement	Branford Cement Plant	FL	Kiln w/In-Line Raw Mill	Baghouse	
7	1/25/2006	Sierra Pacific Industries	Skagit County Lumber Mill	WA	7 Dry Kilns		
8	10/21/2005	Dalitalia, L.L.C.	Muskogee Porcelain Floor Tile Plant	OK	Kilns	Use of natural gas fuel	
9	10/14/2005	Dalitalia, L.L.C.	Muskogee Porcelain Floor Tile Plant	OK	Kilns	Wet Scrubber	
10	8/30/2005	Arkansas Lime Company	Arkansas Lime Company	AR	Lime Kiln, SN-30Q	Baghouse	
11	3/4/2005	Georgia Pacific Corporation	Monticello Mill	MS	Lime Kiln	Venturi Scrubber	
12	12/20/2004	Florida Crushed Stone Company	Brooksville Cement Plant (FCS)	FL	Clinker Kiln	Baghouse	
13	11/5/2004	Florida Rock Industries, Inc.	Thompson S. Baker - Cement Plant (FRI)	FL	In Line Kiln/ Raw Mill	ESP	
14	10/25/2004	Graymont PA Inc	Graymont Bellefonte Plant	PA	#6 Lime Kiln, #7 Lime Kiln	Fabric Filters	
15	6/29/2006	Western Lime Corporation	Western Lime Corporation	MI	Lime Kiln	Fabric Filters	Use of propane or No. 2 Oil with no stone feed c startup
16	9/29/2005	Lehigh Cement Company	Lehigh Cement Company	IA	Kiln /Calciner/Preheater	ESP	

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
17	7/18/2005	Carmeuse Liome, Inc.	Maple Grove Gacility	OH	Rotary Kiln (2)	Baghouse	
18	8/30/2006	Georgia Pacific Corporation	Monticello Mill	MS	Lime Kiln	Scrubber	
19	8/31/2006	Roanoke Cement	Roanoke Cement	VA	Lime Kiln	Electrostatic Precipitators & Good Combustion Practices	
20	10/10/2003	Weyerhaeuser - Flint River Operations	Weyerhaeuser - Flint River Operations	GA	Rotary Lime Kiln	ESP	
21	9/5/2003	GCC Dacotah	GCC Dacotah	SD	Rotary Kiln #6	Fabric Filters	
22	4/6/2005	Georgia-Pacific Corp.	El Dorado Sawmill	AR	Lumber Drying Kiln	Proper Maintenance and Operation	
23	9/17/2003	Vulcan Materials	Vulcan Materials	IL	Lime Kiln	Baghouse	
24	9/17/2003	Continental Cement Company	Continental Cement Company, L.L.C.	MO	Rotray Kiln	Fabric Filters	
25	1/3/2003	LaFarge Corporation	LaFarge Corporation	IA	Preheater/Precalciner Kiln	Baghouse	
26	5/13/2004	Meadwestvaco Kentucky, Inc.	Meadwestvaco Kentucky, Inc/Wickliffe	KY	Lime Kiln	Scrubber	
27	3/2/2004	Georgia Pacific Corporation	Port Hudson Operations	LA	Lime Kiln No. 1	Wet Scrubbers	
28					Lime Kiln No. 2	ESP	
29	3/12/2004	Carolina Stalite Company	Gold Hill	NC	Rotary Expanding Kiln	Wet Lime Slurry Injection	
30	8/10/2005	Longview Fibre Company	Longview Fibre Company	WA	Lime Kilns 1, 2, 3, 4, and 5		
31	12/22/2003	Bowater	Bowater Coated Paper Division	SC	Lime Kiln, No. 2	ESP	
32	11/24/2003	Ash Grove Cement Company	Portland Cement Clinkering Plant	WA	Kiln Exhaust Stack	Baghouse	
33	9/25/2006	The Dow Chemical Company	The Dow Chemical Company	MI	Incinerator, Rotary Kiln, Hazardous Waste	Venturi Scrubber	
34	3/17/2005	International Paper	Mansfield Mill	LA	Lime Kiln	Venturi Scrubber using Caustic Solution	
35	1/5/2005	Alamo Cement Company II, LTD	Portland Cement Manufacturing Plant	TX	Grinding/Preheating Kiln, K-19	ESP	
36	5/17/2004	International Paper Company	Riegelwood Mill	NC	Lime Kiln	ESP and Fixed Throat Spray Venturi-Type Wet Scrubber	
37	8/22/2006	Crown Paper Company	St. Francisville Mill	LA	Lime Kiln, Emission Pt. RC-01	None Indicated	Stack tests will be conducted

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
38	4/6/2005	Weyerhaeuser Company	Weyerhaeuser Company	MS	Kilns, Dry Lumber, 5; AA-007	Good Combustion Control	AA-007: No controls feasible
39	8/14/2006	Donahue Industries, Inc.	Paper Mill	TX	Lime Kiln	Scrubber	
40	12/27/2001	Gulf Lumber Company	Mobile	AL	Dry Kilns; Lumber Dry Kilns	Good Engineering Practices	
41	3/2/2004	Rio Grande Portland Cement Corp.	Rio Grande Portland Cement Corp.	CO	Kiln, Clinker Cooler	High temerature fabric filter baghouse for clinker cooler	
42					Preheater/Precalciner , Kiln	High temperature filter baghouse	
43	1/4/2005	Temple-Inland Forest Products Corporation	Temple-Inland Pineland Manufacturing Complex	TX	(2) Kiln Drying, Studmills 1&2, EPN91&92	No Controls Required	
44					(4) Kilns 1-4, Drying, Sawmill, EPN101-104	No Controls Required	
45	9/18/2001	Lehigh Portland Cement Company	Lehigh Portland Cement Company	MD	Preheater/Precalciner Kiln	Enclosure, Wet Suppresion Systems and Paved Roads	Control Effciencies Ra from 60-90%
46	12/9/2003	Suwanee American Cement Company, Inc.	Suwanee American Cement Company, Inc.	FL	In Line Kiln & Raw Mill	Baghouse	
47	2/10/2003	Arkansas Lime Company	Arkansas Lime Company	AR	Rotary Lime Kiln, No. 2	Baghouse	
48	12/18/2001	Watsontown Brick Company	Watsontown Brick Company	PA	Kiln, Brick Tunnel	Dustex, PDE-3630-14-40 Fabric Filter	Polymide Bags @ 206 AC
49	3/11/2002	Holnam, Inc.	Holnam, Inc.	MI	Cement Kilns, Wet Process (2)	Fabrick Filter, Slurry Scrubber	
50	1/20/2005	Meadwestvaco Kentucky, Inc.	Wickliffe Carbon Plant	KY	Activation Kiln	Wet Fan, Reverse Jet Scrubber, and Brink Mist Eliminator	
51					Drying Kiln	Baghouse	
52					Activation Kiln	Rotoclone Scrubber	
53	1/4/2005	Texas Lime Co	Texas Lime	TX	Lime Kiln No 4 & No 6	None Indicated	
54	3/2/2004	Holnam, Florence	Holnam, Florence	CO	Kiln/Preheater/Bypass & Clinker Cooler Exhaust	Baghouse	
55	4/18/2002	General Shale Products Corp., L.L.C.	General Shale Products Corp., L.L.C.	AR	Kiln, Aggregate	Natural Gas Usage, Wet Scrubber, and Good Combustion	
56	3/10/2004	Lone Star Industries, Inc.	Lone Star Industries, Inc.	IN	Kiln Operation	ESP	

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
57	1/4/2005	North Texas Cement Company	North Texas Cement Company	TX	Main Kiln/Scrubber Stack	Scrubber and Baghouse	
58	1/4/2005	Champion International Corporation	Camden Complex	TX	(3) Kilns No 1-3, K-01 thru -03	None Indicated	
59	12/3/2003	Holnam, Laporte Co.	Holnam, Laporte Co.	CO	Calciner/Kiln	Baghouse	
60	5/20/2004	Lone Star Industries, Inc.	Lone Star Industries, Inc.	IN	Cement Kiln, Wet Process, Coal	ESP	
61	1/4/2005	Capitol Aggregates, LTD.	Capitol Cement Division	TX	Dry/Wet Kiln	Baghouse	
62	2/26/2003	IMC-Agrico Company	IMC-Agrico Company	FL	Kilns A, B	Packed Scrubber using Pond Water	
63					Kiln C	Caustic Solution Sprayed into Back of Wet Scrubber	
64	1/27/2003	Holnam, Inc.	Holnam, Inc.	MI	Cement Kilns, Wet Process (2)	Baghouse	
65	4/6/2005	Weyerhaeuser Company	Wright City Mill	OK	No. 3 Pine Lumber Kiln		
66	10/9/2002	Illinois Cement Company	Illinois Cement Company	IL	Kiln	Fabric Filter	
67	12/4/2001	Signal Mountain Cement Company, LP		TN	Dry Feed Kiln	Baghouse	
68	9/26/2002	Macmillan Bloedel Packaging	Macmillan Bloedel Packaging	AL	High Temp Lumber Kiln		
69	3/3/2004	Ash Grove Cement Compant	Durkee Facility	OR	Kiln	Baghouse	
70	4/25/2002	Palmetto Lime, L.L.C.	Palmetto Lime, L.L.C.	SC	Vertical Shaft Kilns	Baghouse	
71	12/18/2001	Continental Lime, Inc.	Continental Lime, Inc.	MT	Kiln-Lime, Two	Baghouse	
72	3/8/2002	Weyerhaeuser, Company		AL	Lumber Dry Kilns		
73	4/2/2004	Weyerhaeuser, Company	Greenville Sawmill	NC	Drying Kilns, 7		
74	1/4/2005	Chemical Lime LTD	Lime Plant	TX	Kiln	Baghouse	
75	2/24/2003	Southdown, Inc.	Southdown, Inc.	FL	Kiln 1, 2	Fabric Filters, Good Combustion	
76	8/28/2006	Casie Ecology Oil Salvage	Casie Ecology Oil Salvage	NJ	Kiln	Fabric Filter, Cyclone, Afterburner, Quench	
77	12/17/200	Florida Rock Industries,	Florida Rock Industries, Inc.	FL	Kiln	ESP	

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
	3	Inc.					
78	4/6/2005	Weyerhaeuser Company	Wright City	OK	No 4 Pine Lumber Mill		
79	6/6/2002	Ash Grove Cement Company	Ash Grove Cement Company	UT	Kiln	Baghouse	
80	4/6/2005	Hankins Lumber Company	Hankins Lumber Company	MS	Lumber Dry Kilns (5)		
81	10/7/2002	Weyerhaeuser Company	Weyerhaeuser Company	MS	Lime Kiln	ESP	
82	12/4/2002	Westvaco Corporation, Chemical Division	Westvaco Corporation, Chemical Division	KY	Activation Kiln	Venturi Scrubber	
83					Activation Kiln	Rotoclone Scrubber	
84	10/7/2002	Buckeye Florida, LP	Buckeye Florida, LP	FL	Lime Kiln	ESP	
85	12/4/2001	Western Lime Corporation	Western Lime Corporation	WI	Lime Kiln #2	Pulse-Jet Baghouse	
86	9/6/2002	Riverwood International Corporation	Riverwood International Corporation	GA	Kilns 1 & 2	Venturi Scrubber for each Kiln	
87	8/31/2006	Apple Grove Pulp and Paper Company, Inc.	Apple Grove Pulp and Paper Company, Inc.	WV	Lime Kilns (2)	Fabric Filter	
88	3/3/2004	Holnam, Inc.	Devils Slide Plant	UT	Kiln	Baghouse	
89	9/26/2002	Chemical Lime Company of Alabama, Inc.	O'Neal Quarry	AL	Kiln Dust Bin	Baghouse	
90	9/17/2002	Willamette Industries	Marlboro Plant	SC	Lime Kiln	ESP	
91	12/18/2001	Continental Lime Inc.	Cricket Mtn. Lime Plant	UT	Kiln #4	Baghouse	

NOTE: PM Control column = blank; original RBLC report had (N)

P4 BART Determination Modeling

DATE: August 24, 2010

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SUBJECT: **BART Determination Modeling-Final Report**

We have conducted CALPUFF modeling to determine the improvements to Regional Haze conditions resulting from 2002 upgrades on BART-eligible sources at Monsanto's P4 Plant in Soda Springs, Idaho.

Methods

Emission Rates

Emission rates and stack parameters for the BART-eligible sources were obtained from the emission rates and parameters submitted by P4 as part of their 2009 revisions to their Permit to Construct application materials ("Combined PTC" worksheet revised 3/25/2009).

The BART-eligible sources were determined to be the nodulizing calciner or kiln, which has 4 identical venturi scrubber stacks and Furnace # 9, including fugitive emissions and ancillary equipment related directly to those operations as shown in Table 1. Fugitive emissions include the FeP Slag Tapping Hood Fugitives and FeP Slag Pot Receiving Fugitives associated with Furnace #9. Subsequent modifications to use a thermal oxidizer instead of a flare to dispose of excess carbon monoxide are also included in the PTC for future operations. To reduce simulation times and in view of the relatively small quantity of associated emissions in comparison to the larger included point sources, the fugitive emissions and the #9 Furnace Diesel Burner emissions (in the Base Scenario only) are all combined together with the #9 THFC Stack emissions and assumed to be released with the same stack parameters as shown for the #9 THFC Stack emissions. The total fugitive plus Diesel Burner emissions of all pollutants (SO_2, NOx, and PM_{10}) included with the #9 THFC stack emissions are 0.2% of the total emissions in the base year and 0.5% of the total emissions in the future year scenario. This approximation is justified because the emissions are small and combining them together is expected to have an insignificant, yet conservative effect on the final results for receptors located many kilometers away. The effect is slightly conservative because these fugitive and minor source emissions are all treated as if released from one point, minimizing initial dispersion. In addition, the kiln emissions were modeled as if released from one of the scrubber stacks, however the plume rise is simulated correctly using this approach and the effect of combining emissions at one point on predicted concentrations at the distant receptors should be insignificant.

Stack parameters and combined short-term maximum emissions rates used in the modeling are shown in Tables 2 and 3, respectively. Actual maximum emissions are used to represent the pre-BART Base Year operations, while the Potential to Emit (PTE) emission rates are used for the future scenario, in accordance with BART rules. The apparent increase in NOx emissions from the kiln is due primarily to the difference between actual and PTE estimates, rather than any real process change.

A very small portion of the total haze-causing emissions are composed of PM_{10} (particulate emissions smaller than ten micrometers in diameter). While total PM_{10} emissions are based on source tests, speciation of primary particulate matter emissions into haze-contributing components was accomplished by applying speciation profiles from the Speciate Database documentation (http://www.epa.gov/ttnchie1/software/speciate/ index.html) for elemental phosphorous manufacturing and FeP Slag handling. In these profiles, Fine Particulate Matter (< 2.5 µm) and Coarse Particulate Matter (2.5 µm – 10 µm) are not differentiated, however it was conservatively assumed that after accounting for the haze contributing particulate species SO_4, NO_3, EC and OC, the remainder of the primary PM_{10} mass consists of Fine Particulate Matter (PMF). Again, the effect of this assumption will be very small and will be conservative. Source test total PM_{10} emissions were used along with the Speciate profiles to estimate individual species emissions, resulting in ammonium sulfate and ammonium nitrate emissions as part of the total PM_{10} emission rates. Finally, ammonium sulfate and ammonium nitrate emission rates were stoichiometrically adjusted to reflect only the sulfate (SO4) and nitrate (NO3) components, the forms expected as inputs for CALPUFF.

Modeling Methodology

The CALPUFF air dispersion modeling system (version 6.112) was used to determine the delta deciview (ΔDV) impacts and the number of days per year and per 3 years above the 0.5 ΔDV threshold that is considered significant in the BART modeling. The modeling was performed in accordance with the *BART Modeling Protocol*[22], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision. The meteorological inputs needed by CALPUFF for the analysis were the same data set used for all agency-conducted BART analyses in the Pacific Northwest. It was prepared by Geomatrix, Inc. under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution that was statistically evaluated against National Weather Service data sets throughout the Northwest and was approved by EPA and key federal land managers to be acceptable for this purpose. The meteorological and computational domains are shown in Figure 1 along with all 11 Class I areas within 300 km of the source. The computational domain includes a 50 km buffer distance from any Class I receptors except on the eastern edge where the available MM5 data set does not allow for it. This may result in a minor error in the results for Bridger, Fitzpatrick, Washakie and North Absaroka Wilderness areas but does not affect any of the 3 most impacted Class I areas (Grand Teton, Yellowstone and Craters of the Moon). The meteorological domain was expanded to correct this problem when the switch from MM5 to the Weather Research Forecast (WRF) model occurred at the University of Washington, however it is not feasible to revisit the modeling with the newer domain.)

Pre-BART Base-Year Modeling Results

Regional haze impacts were computed at all 11 Class I areas within 300 km of the source, as shown in Figure 1. Time series modeled impacts for the Base Year and Future (Post BART) simulations are shown in Figures 2 and 3 for Grand Teton National Park and Craters of the Moon National Monument, respectively. The time series graphs show the inter-annual variation and seasonal variation in modeled impacts over the 3 year modeling period. Highest impacts occur in the cooler months, from November through February when the atmosphere is more stable and nitrate volatilization is minimized by the cooler temperatures.

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[22] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

Haze impacts are summarized in Table 4 for the pre-2002, Existing Control, Base-Year scenario before BART controls were installed and in Table 5 for the Future, Permitted Control Scenario under Normal Operations (the highest future emission operating scenario for haze contributing pollutants). The tables show the results obtained from modeling only the BART-eligible sources, both before and after controls. These tables highlight the following two threshold values used in BART modeling analyses:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) benchmark for delta-deciview (ΔDV) in the each year. In addition the numbers of days in each year above the 0.5 ΔDV threshold for BART-subject analysis are shown.

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) benchmark for ΔDV over three years. In addition the number of days in all three years above the 0.5 ΔDV threshold for BART-subject analysis is shown.

The highest 98th percentile haze impacts under the existing, pre-BART control scenario were projected to occur at Grand Teton National Park (1.61 ΔDV), with the second highest occurring at Yellowstone National Park (1.41 ΔDV) as shown in Table 4. This occurs due to the frequent wintertime winds carrying the plume toward the NNE. Class I areas to the west of P4 receive relatively less frequent and less severe haze impacts, as seen in the results for Jarbidge, Sawtooths, and to some extent, Craters of the Moon National Monument. Of the 11 Class I areas within 300 km of P4, only three of them were not impacted above 0.5 ΔDV under the Base Year emissions (Fitzpatrick, Jarbidge and Sawtooth Wilderness areas.)

Post-BART Modeling Results

Future year (Post-BART) modeling results are shown in Table 5. When the BART controls were simulated, the highest 98th percentile impacts over the three year period were reduced from 1.61 to 1.068 ΔDV at Grand Teton National Park and from 1.41 to 0.841 ΔDV at Yellowstone, a more than 0.5 ΔDV reduction at both sites. Craters of the Moon haze impacts were lowered 47%, from 1.266 to 0.671 ΔDV.

Eleven Class I areas within 300 km of the P4 facility were included in this analysis. Overall, of 3 of 11 Class I areas originally over 1.0 ΔDV, two dropped below 1.0 (Craters of the Moon and Yellowstone) while one (Grand Teton NP) remained just above 1.0 ΔDV. Of 5 areas originally between 0.5 and 1.0 ΔDV, 4 of them dropped below the 0.5 ΔDV benchmark (Bridger, North Absaroka, Red Rock Lakes, and Washakie Wilderness areas). Of the 8 areas originally over 0.5 ΔDV, 4 are now below and 4 remain above. Only Grand Teton National Park remains above the 1.0 ΔDV benchmark, while only Craters of the Moon, Teton Wilderness and Yellowstone remain above 0.5 ΔDV.

The net improvement for each Class I area is summarized in Table 6 where the difference in 98th percentile ΔDV values and in days over 0.5 ΔDV are shown for each Class I area. A net reduction of 317 days over 0.5 ΔDV was realized for all 11 Class I areas together, a 52% reduction in days overall. Of this overall reduction in days, 44% of the reduced days were concentrated in the Grand Teton NP, Teton Wilderness and Yellowstone NP where some of the most visited and most scenic views are located.

Table 1 BART-Eligible Source Emission Estimates, lb/hr

Type	Process	Source	Emission Point	Pollutant	Actual Base-Year Emissions[a], lb/hr	Potential Future Emissions[b], lb/hr
Pt	Kiln	Kiln CO, Coal, & Gas Combustion	Kiln Stacks (4)	SO2	3003.31	143.01
Pt	Furnace #9	CO to Flare	#9 CO Flare Stack	SO2	4.33	On Standby
Pt	Thermal Oxidizer	CO to Thermal Oxidizer	T.O. Scrubber Stack 1	SO2	Not Installed	144.37
Pt/Fug	***Sum of Small Sources (below) modeled together***		***#9 THFC Stack***	***SO2***	***5.79***	***40.52***
Pt	*Furnace #9*	*FeP Slag Tapping*	*#9 THFC Stack*	*SO2*	*2.05*	*33.42*
Pt	*Furnace #9*	*Diesel Burner*	*Treater Heat Vent*	*SO2*	*0.22*	
Fug	*Furnace #9*	*FeP Slag Tapping Hood Fug.*	*#9 Furnace Bldg*	*SO2*	*1.52*	*1.64*
Fug	*Furnace #9*	*FeP Slag Pot Receiving Fugitives*	*Outside*	*SO2*	*2.00*	*5.46*
	Note: All Emissions can not occur simultaneously.		**Total:**	**SO2**	**3013.42**	**327.90**
Pt	Kiln	Kiln CO, Coal, & Gas Combustion	Kiln Stacks (4)	NOx	389.39	856.33
Pt	Furnace #9	CO to Flare	#9 CO Flare Stack	NOx	4.77	On Standby
Pt	Thermal Oxidizer	CO to Thermal Oxidizer	T.O. Scrubber Stack 1	NOx	0.00	73.97
Pt	***Sum of Small Sources (below) modeled together***		***#9 THFC Stack***	***NOx***	***1.57***	***5.67***
Pt	*Furnace #9*	*FeP Slag Tapping*	*#9 THFC Stack*	*NOx*	*no data*[c]	*5.67*
Pt	*Furnace #9*	*Diesel Burner*	*Treater Heat Vent*	*NOx*	*1.57*	*Discontinued*
			Total:	**NOx**	**395.73**	**935.96**
Pt	Kiln	Kiln CO, Coal, & Gas Combustion	Kiln Stacks (4)	PM10	15.05[d]	30.00[d]
Pt	Furnace #9	CO to Flare	#9 CO Flare Stack	PM10	20.75	On Standby
Pt	Thermal Oxidizer	CO to Thermal Oxidizer	T.O. Scrubber Stack 1	PM10	0.00	20.90
Pt	***Sum of Small Sources (below) modeled together***		***#9 THFC Stack***	***PM10***	***1.58***	***6.00***
Pt	*Furnace #9*	*FeP Slag Tapping*	*#9 THFC Stack*	*PM10*	*1.43*	*6.00*
Pt	*Furnace #9*	*Diesel Burner*	*Treater Heat Vent*	*PM10*	*0.16*	*Discontinued*
			Total:	**PM10**	**37.38**	**56.90**

Notes: a)FCE Estimate 2001-2002 base year, Prior to Scrubber Installation b)Permitted PTE Future Scenario 1: Normal Operations includes Kiln running, with furnaces at peak power (only #9 Furnace is BART Eligible), flares on pilot only; c)No data for FeP Slag Tapping NOx emissions. Estimated to be < 1 lb/hr; d)P4 reported minor H_2SO4 emissions based on an assumed ratio of SO3/SO2 (not based on measurements). However the SPECIATE profiles applied to the PM10 shown here also include SO4. To assure consistency with the PM10 speciation, and to avoid double-counting of the primary SO4 the reported H_2SO4 (14 lb/hr Base Year and 2.6 lb/hr Future Scenario) is assumed to be included in the PM10 emissions shown in this table and in speciated form as SO4 in Table 3.

Table 2 Stack Parameters for Modeled Sources

Unit Description	Easting, km	Northing, km	Base Elevation, m	Stack Height, m	Stack Diameter, m	Stack Gas Temp, K	Stack Exit Velocity, m/s
Existing Control 2000-2003 Base Year							
Nodulizing Kiln – 4 identical stacks [a]	451.804	4726.349	1826	65	1.4	343	24.63
#9 CO flare	451.836	4725.979	1826	65	1.55	353	25.12
#9 furnace - FeP slag tap stack	451.908	4725.859	1826	22.3	0.945	318	16.83
PTC Future Control with Normal Operations							
Nodulizing Kiln - All 4 together	451.804	4726.349	1826	65	1.4	343	24.63
Thermal Oxidizer scrubber stack	451.836	4725.979	1826	65	1.55	353	25.12
#9 furnace - FeP slag tap stack	451.908	4725.859	1826	22.3	0.945	318	16.83

Note: (a) There is one kiln with 4 identical scrubber stacks (Multiple stacks allow turn-down while maintaining velocity through the venturi throats). Stacks are in a square pattern, each within 3 m of their centroid location. Total maximum Kiln emissions were modeled as if coming from one stack so plume rise is unaffected. A minor conservatism is built in due to concentrating emissions at one point, however the effect is negligible at the distance of all Class I areas.

Table 3 Hourly Emission Rates for Modeled Sources

Unit Description	Gas and Primary Aerosol Species Emission Rate, lb/hr[a]								
	SO2	SO4	NOX	HNO3	NO3	PMC	PMF	EC	OC
Existing Control 2000-2003 Base Year									
Nodulizing Kiln–total emissions from 4 identical stacks	3003.3	3.49	389.4	0.0	0.013	0.0	9.4	0.08	0.75
#9 CO flare	4.3	4.80	4.8	0.0	0.017	0.0	13.0	0.11	1.04
#9 furnace - FeP slag tap, THFC stack [b]	5.8	0.01	1.6	0.0	0.002	0.0	1.1	0.27	0.16
PTC Future Control with Normal Operations[c]									
Nodulizing Kilns - All 4 together	143.0	6.95	856.3	0.0	0.025	0.0	18.8	0.16	1.50
Thermal Oxidizer scrubber stack	144.4	4.84	74.0	0.0	0.018	0.0	13.1	0.11	1.04
#9 furnace - FeP slag tap, THFC stack [b]	40.5	0.05	5.7	0.0	0.006	0.0	4.8	0.46	0.68

Notes: (a) Species definitions: SO2 is sulfur dioxide gas, SO4 is sulfate aerosol, NOx is the sum of nitric oxide and nitrogen dioxide gases, HNO3 is nitric acid gas, NO3 is nitrate aerosol, PMC is coarse particulate matter (2.5 – 10 µm), PMF is fine particulate matter (< 2.5µm), EC is elemental carbon aerosol and OC is organic carbon aerosol. (b) The #9 Tap Hole Fume Collector (THFC) stack emissions include other minor point and fugitive emissions combined together, including FeP Slag Tapping, Diesel Burner (Base Year only), FeP Slag tapping hood fugitives and FEP Slag Pot Receiving fugitives; (c) Future year emissions of NOx and PM species reflect Potential to Emit (PTE) rather than "actual emissions" as reflected in Base Year emissions. Apparent increases of NOx and PM result primarily from this treatment, required under BART rules. One exception is the Thermal oxidizer which does cause a minor NOx increase in comparison to the CO flare that it replaces.

Table 4 Haze Modeling Results for P4 Existing Control 2000-2003 Base Year

Impacted Class I Areas within 300km range from P4 Facility	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value > 0.5 over one year period						Delta-Deciview Value >0.5 over 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Bridger Wilderness, WY	0.724	22	0.706	15	0.724	23	0.720	60
Craters of the Moon NM - Wilderness, ID	0.669	12	1.188	23	1.742	36	1.266	71
Fitzpatrick Wilderness, WY	0.495	7	0.424	4	0.510	9	0.495	20
Grand Teton NP, WY	1.482	42	1.664	49	1.662	57	1.610	148
Jarbidge Wilderness, NV	0.111	1	0.147	1	0.416	5	0.253	7
North Absaroka Wilderness, WY	0.338	4	0.568	8	0.613	11	0.538	23
Red Rock Lakes Wilderness, MT	0.756	10	1.045	16	1.120	24	0.882	50
Sawtooth Wilderness, ID	0.21	2	0.425	5	0.501	9	0.403	16
Teton Wilderness, WY	0.895	20	1.026	33	1.015	34	0.993	87
Washakie Wilderness, WY	0.396	4	0.572	11	0.583	11	0.563	26
Yellowstone NP, WY	0.886	23	1.557	39	1.413	43	1.413	105

Notes: a)The 8th highest delta-deciview for the calendar year; b) Total number of days in 1 year that exceeded 0.5 delta-deciviews; c)The 22nd highest delta-deciview value for the 3-year period; d) Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Table 5 Haze Modeling Results for P4 BART PTC Future Control under the Normal Operations Scenario

Impacted Class I Areas within 300km range from P4 Facility	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value > 0.5 over one year period						Delta-Deciview Value >0.5 over 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Bridger Wilderness, WY	0.517	8	0.487	7	0.439	4	0.483	19
Craters of the Moon NM - Wilderness, ID	0.522	8	0.671	13	0.779	17	0.671	38
Fitzpatrick Wilderness, WY	0.310	2	0.269	0	0.299	1	0.296	3
Grand Teton NP, WY	0.998	32	1.086	33	1.077	41	1.068	106
Jarbidge Wilderness, NV	0.047	0	0.074	0	0.143	2	0.094	2
North Absaroka Wilderness, WY	0.243	0	0.298	1	0.348	4	0.297	5
Red Rock Lakes Wilderness, MT	0.366	4	0.492	7	0.518	9	0.478	20
Sawtooth Wilderness, ID	0.111	1	0.178	0	0.204	0	0.179	1
Teton Wilderness, WY	0.584	9	0.626	14	0.642	14	0.610	37
Washakie Wilderness, WY	0.252	1	0.303	2	0.321	3	0.309	6
Yellowstone NP, WY	0.520	10	1.059	28	0.844	21	0.841	59

Notes: a)The 8th highest delta-deciview for the calendar year; b) Total number of days in 1 year that exceeded 0.5 delta-deciviews; c)The 22nd highest delta-deciview value for the 3-year period; d) Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Table 6 Improvement in Regional Haze Resulting from P4 BART Controls (Base Year Impacts – Future PTE Impacts)

Impacted Class I Areas within 300km range from P4 Facility	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Improvement in Highest Delta-Deciview Values and Reduction in Days > 0.5ΔDV for Indiv dual Years						Improvement over 3 year Period	
	2003		2004		2005		2003-2005	
	Decrease in 8th Highest	Days >0.5ΔDV Reduced	Decrease in 8th highest	Days >0.5ΔDV Reduced	Decrease in 8th highest	Days >0.5ΔDV Reduced	Decrease in 22nd Highest	Total days > 0.5ΔDV Reduced
Bridger Wilderness, WY	0.207	14	0.219	8	0.285	19	0.237	41
Craters of the Moon NM, ID	0.147	4	0.517	10	0.963	19	0.595	33
Fitzpatrick Wilderness, WY	0.185	5	0.155	4	0.211	8	0.199	17
Grand Teton NP, WY	0.484	10	0.5 8	16	0.585	16	0.542	42
Jarbidge Wilderness, NV	0.064	1	0.073	1	0.273	3	0.159	5
North Absaroka Wilderness, WY	0.095	4	0.27	7	0.265	7	0.241	18
Red Rock Lakes Wilderness, MT	0.39	6	0.553	9	0.602	15	0.404	30
Sawtooth Wilderness, ID	0.099	1	0.247	5	0.297	9	0.224	15
Teton Wilderness, WY	0.311	11	0.4	19	0.373	20	0.383	50
Washakie Wilderness, WY	0.144	3	0.269	9	0.262	8	0.254	20
Yellowstone NP, WY	0.366	13	0.498	11	0.569	22	0.572	46
Total Reduction in Days > 0.5 ΔDV		**72**		**99**		**146**		**317**

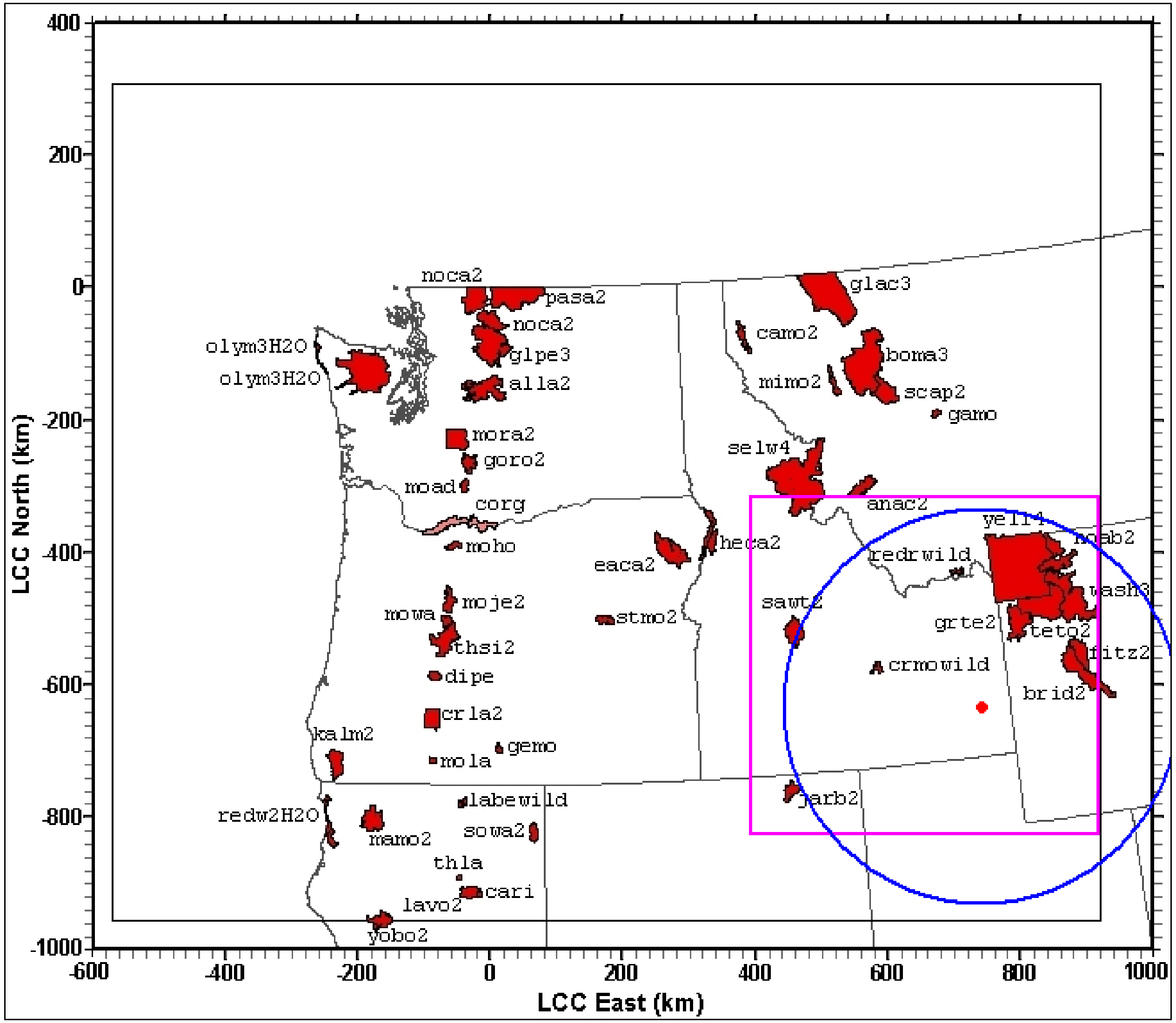

Figure 40 MM5 Meteorological modeling domain (black line) and CALMET/CALPUFF computational domain (pink line), showing Class I Areas within 300km considered in this analysis (blue circle). The red dot locates the P4 facility.

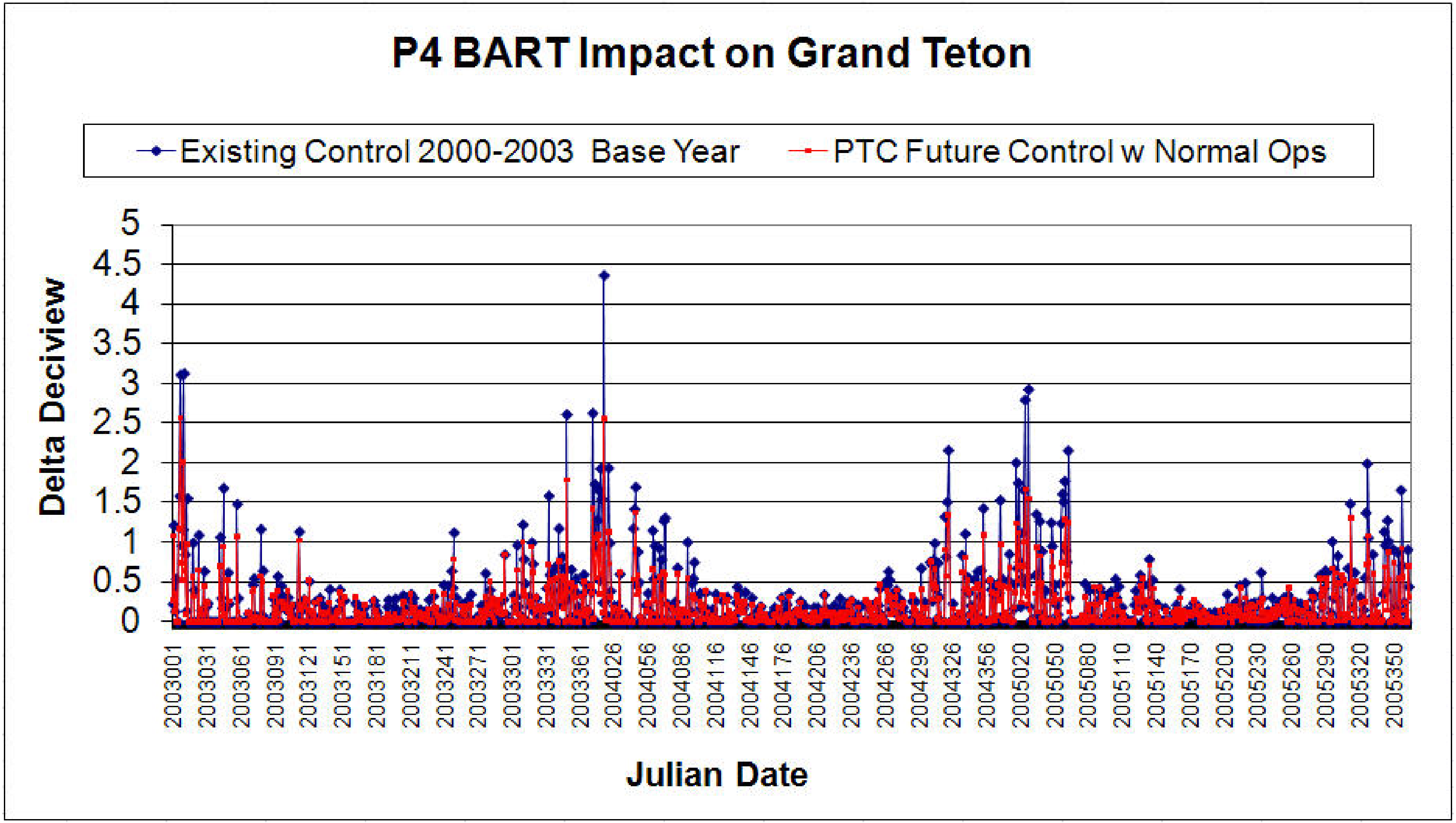

Figure 41 Time series of simulated haze impacts (ΔDV) at Grand Teton National Park for each day of the 3 year modeling period. X-axis labels show Year followed by Julian Day. This figure depicts inter-annual and seasonal variation in base year and future/controlled impacts.

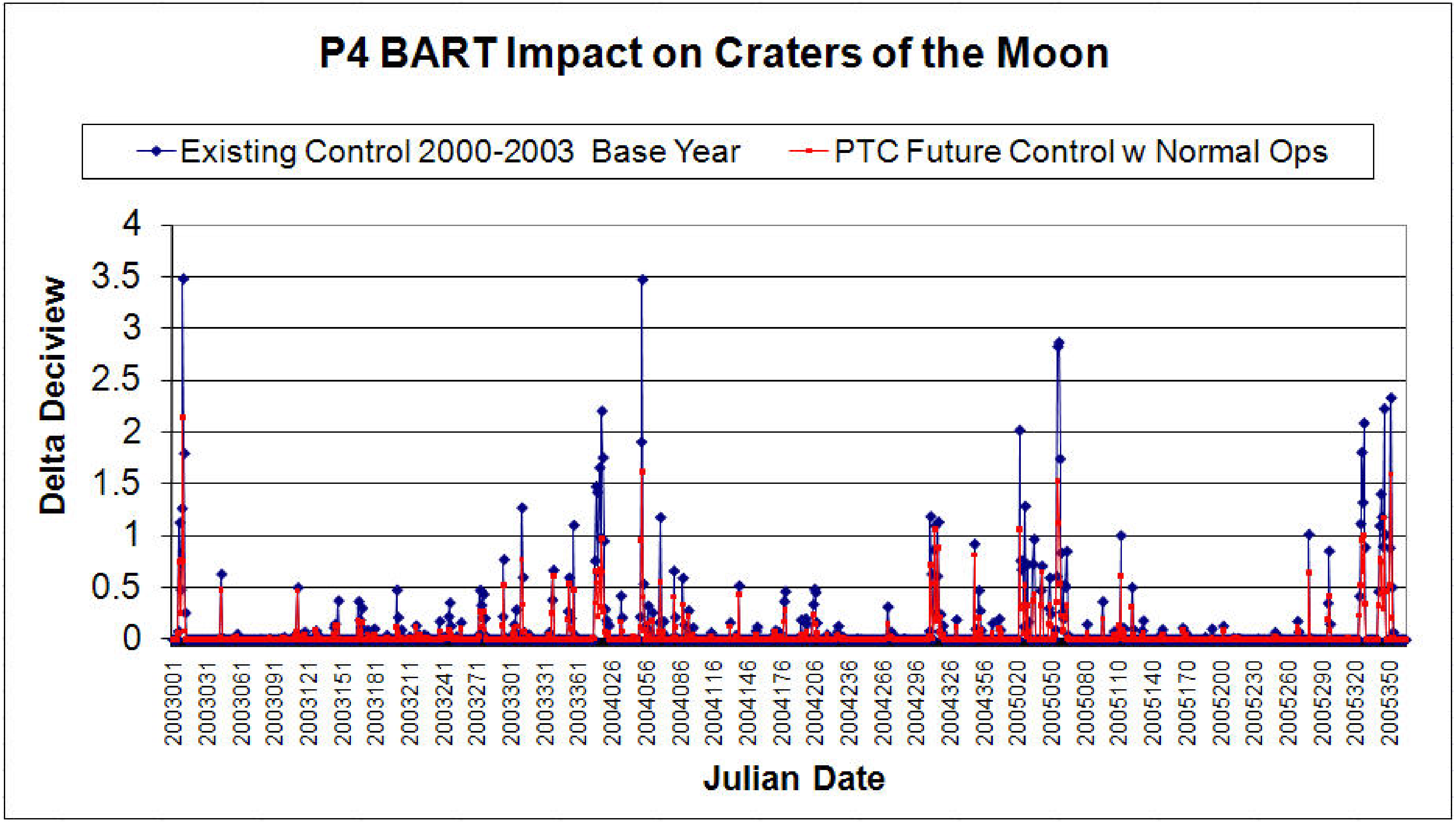

Figure 42 Time series of simulated haze impacts (ΔDV) at Craters of the Moon National Monument for each day of the 3 year modeling period. X-axis labels show Year followed by Julian Day. This figure depicts inter-annual and seasonal variation in base year and future/controlled impacts.