DRAFT

The Colorado Modeling Guideline for Air Quality Permits is currently undergoing a final round of internal review by Division staff. However, a draft version is available to the public during this review period to assist in the preparation of modeling analyses for permit applications. Please note that some changes might still occur in the near future.

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COLORADO
Department of Public
Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

COLORADO MODELING GUIDELINE FOR AIR QUALITY PERMITS

MAY 2018

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
AIR POLLUTION CONTROL DIVISION, TECHNICAL SERVICES PROGRAM
MODELING AND EMISSIONS INVENTORY UNIT

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Preface

The Colorado Modeling Guideline for Air Quality Permits (Guideline) presents current Air Pollution Control Division (Division) air quality modeling guidance for estimating impacts from stationary sources of air pollution. It addresses modeling issues for source types ranging from small minor sources to major sources such as those subject to Prevention of Significant Deterioration (PSD) review. Recommendations in the Colorado Air Quality Modeling Guideline may not be applicable in all situations.

The Guideline is intended to help permit applicants, air quality specialists, and others understand the Division's expectations for the ambient air impact analysis and to prevent unnecessary delays in the permit process. It provides a starting point for modeling, but allows the use of professional judgement. To avoid misunderstandings, obtain the most recent version of Colorado's guidance documents from http://www.colorado.gov/airquality/permits.aspx. In addition, obtain current regulations and applicable U.S. Environmental Protection Agency (U.S. EPA) guidance.

This guideline is not intended to describe the implications of modeling results. Such implications are generally controlled by the permit rules or other relevant state and federal regulations, laws and guidance. Nevertheless, the Guideline contains incidental discussion of the effects of certain modeling results. Such discussion is for informational purposes only and shall not be construed to be authority defining the regulatory impact of any modeling result. For that, the reader should refer to the applicable rules and regulations.

This is a guide through modeling-related regulations and procedures. It is intended to promote technically sound and consistent modeling techniques, while encouraging the use of improved and more accurate techniques as they become available. The guideline helps permit applicants understand when modeling is warranted. It clarifies what modeling-related information and data should be included with a permit application. Supplemental guidance on specific technical issues and other modeling-related data and information, including checklists and meteorological data, are available at http://www.colorado.gov/airquality/permits.aspx. If modeling procedures other than those recommended in Colorado and U.S. EPA guidance are used, there might be delays while the procedures are reviewed. In some cases, U.S. EPA approval may be necessary.

This is only a guidance document. It has been published in accordance with §25-6.5-102, C.R.S. It is not intended to supersede statutory/regulatory requirements or recommendations of the U.S. EPA.

U.S. EPA models and guidance are available on the Internet at http://www.epa.gov/scram.

What's New in this Document

May 2018:

The following has been revised on May 17, 2018 from the April 2018 version of the Guideline.

- Ozone background criteria to use ARM2
- Figure 5 Title as the map only applies to PM_{10}
- Table 8 footnote (a) corrected to increment

April 2018:

The following has been revised on April 20, 2018 from the March 2018 version of the Guideline.

- Spelling and syntax errors were corrected throughout
- $PM_{2.5}$ SILs are now EPA approved based on recent guidance

March 2018:

The following has been revised on March 16, 2018 from the December 27, 2005, version of the Guideline.

- The overall document has been reformatted.
- The overall document has also been reorganized to improve the flow of information as well as the understanding and retention of information presented.
- Hyperlinks have been updated to obtain the correct sites.
- Duplicate tables and figures have been removed. Only one version of each table and figure is provided.
- Quotes from Regulation No. 3 and Appendix W have been updated to match the most recent versions.
- Section 2 was added to address the applicable regulations that authorize Colorado to perform modeling analyses.
- Section 3 was added to illustrate the full picture of the modeling analysis process.
- Section 4 was added to detail the different types of modeling analyses the applicant may be required to perform.
- Section 5 was added to detail the information the applicant should use when performing a modeling analysis.
- Section 6 was added to detail what information the Division is looking for when the applicant submits a modeling analysis.
- Appendix A was added which includes the description of how the modeling thresholds in Table 1 were developed.
- Section 4 Additions:
    - U.S. EPA's opinion on submitting a modeling protocol and language that a protocol is not intended to be legally binding.

   - Screening-level models were added with updated guidance on when screening models cannot be used.
   - Procedural steps were added to the Significant Impact Analysis
   - Procedural steps were added to the NAAQS & CAAQS Analysis
   - Procedural steps were added to the PSD Increment Analysis
- Section 5 Additions:
   - The Ambient Ratio Method 2 (ARM2) is now the approved Tier 2 approach replacing the Ambient Ratio Method (ARM). The approved ambient ratio for Colorado is discussed more in detail. The Ozone Limiting Method is now a regulatory option.
   - Annual PM_{10} NAAQS compliance demonstration was removed as the NAAQS was revoked.
   - 24-hour and annual $PM_{2.5}$ NAAQS compliance demonstrations were added.
   - 1-hour SO_2 compliance demonstrations as well as a discussion regarding the 24-hour and annual SO_2 NAAQS demonstrations were added.
   - PS Memo 10-01 discussion was added.
   - Nearby source emission calculations have been updated in Appendix W from allowable emissions to a subset of actual emissions. The threshold emission rates for nearby sources to include was removed.
   - Flagpole receptors guidance was added.
   - The use of Digital Elevation Model (DEM) data for sources and receptors was removed and language to use National Elevation Dataset (NED) files was added.
   - Meteorological data will be provided by the Division in an AERMOD-ready format. The applicant no longer needs to process meteorological data.
   - Precursors to ozone was added.
   - Secondary formations of $PM_{2.5}$ was added.
   - Mobile sources guidance was added.
   - Modeling scenarios guidance was added.
- Language was updated throughout discussing when source and modifications are exempt from modeling. The exemption now includes emissions below Table 1 thresholds AND not meeting the scenarios (footnotes) described below Table 1.
- References to the Modeling Submittal Completeness Checklist to verify the necessary information to submit with the modeling analysis was added.
- The sections relating to additional impacts analysis and AQRVs is currently still under review so these sections have been greyed out.

Definitions

The following explanation of terms are included solely for the reader's convenience; they do not take the place of any definition in state or federal laws, rules, or regulations.

Air Quality Models. Computer codes for estimating ambient concentration levels (i.e., "impacts") from new and existing sources of air pollution. They allow one to forecast future air quality levels from sources that have not been constructed. They simulate in a simplified manner the complex behavior of emissions injected into the atmosphere.

Air Quality Related Value (AQRV). A feature or property of a Class I area that may be affected by air pollution. General categories of AQRV's include visibility, odor, flora, fauna, soil, water, geological features, and cultural resources. https://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf

Ambient Air. Defined by 40 CFR 50.1(e) as "that portion of the atmosphere, external to the source, to which the general public has access." NAAQS and PSD increments apply only in ambient air.

Appendix W, 40 CFR Part 51- Guideline on Air Quality Models. The U.S. EPA's *Guideline on Air Quality Models* recommends air quality modeling techniques that should be applied to State Implementation Plan (SIP) revisions for existing sources and to new source reviews, including prevention of significant deterioration (PSD). It is intended for use by the U.S. EPA in judging the adequacy of modeling analyses performed by U.S. EPA, state and local agencies, and industry. The *Guideline* identifies those techniques and databases U.S. EPA considers acceptable. The guide is not intended to be a compendium of modeling techniques. Rather, it serves as a basis by which air quality managers, supported by sound scientific judgment, have a common measure of acceptable technical analysis. Appendix W was updated on January 17, 2017. https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf

Attainment Area. Any area that meets the national primary or secondary ambient air quality standard for an applicable criteria pollutant.

Background. Air contaminant concentrations present in the ambient air that are not attributed to the source or site being evaluated.

Building Downwash. Turbulence created by the wind flowing over buildings or structures that would ordinarily not exist. This effect can alter ground-level concentration levels than would exist in the absence of the building or structure.

Class I Area. An area defined by Congress that is afforded the greatest degree of air quality protection. Class I areas are deemed to have special natural, scenic, or historic value. The Prevention of Significant Deterioration (PSD) regulations provide special protection for Class I areas. Little deterioration of air quality is allowed.

Class II Area. An area defined by Congress where a moderate degree of emissions growth is allowed.

Complex Terrain. Any terrain exceeding the height of the stack being modeled. This includes terrain commonly referred to as intermediate terrain (***receptors*** between stack height and plume height).

Criteria Pollutant. A pollutant for which a National Ambient Air Quality Standard (NAAQS) has been defined.

Cumulative Impact Analysis. A full modeling impact analysis that involves the facility under permit review, nearby sources, and background concentrations to compare the facility's impact to the NAAQS.

Fugitive Emission. Any gaseous or particulate contaminant entering the atmosphere that could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening designed to direct or control its flow.

Good Engineering Practice (GEP) Stack Height. From Regulation No. 3, Part D, §VIII.D.3, "The greater of 65 meters or for stacks in existence on January 12, 1979 and for which the owner or operator had obtained applicable pre-construction permits or approvals required, $H_g = 2.5*H$ (provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation and for all other stacks $H_g = H + 1.5*L$ where,

H_g: good engineering practice stack height measured from the ground level elevation at the base of the stack

H: height of nearby structure(s) measured from the ground level elevation at the base of the stack

L: lesser dimension (height or projected width) of nearby structure(s)."

Hazardous Air Pollutant (HAP). Any pollutant subject to a standard promulgated under the Federal Clean Air Act (FCAA) section 112 (relating to hazardous air pollutants).

Major Stationary Source. The term *major* may refer to the total emissions at a stationary source or to a specific facility.

- A named major stationary source is any source belonging to a list of 28 source categories in 40 CFR 52.21(b)(1) which emits or has the potential to emit 100 tons per year (tpy) or more of any pollutant regulated by the Federal Clean Air Act (FCAA).
- A major stationary source is any source not belonging to the 28 named source categories which emits or has the potential to emit such pollutants in amounts of 250 tpy or more.
- A major source is any source that emits 10 tpy or more of any single HAP or 25 tpy or more of any combination of HAPs under FCAA section 112(b).

Major Modified Stationary Source. Used in the context of a PSD application, the phrase *major modified stationary source or facility* refers to a change in operation that results in a significant net increase of emissions for any pollutant for which a NAAQS has been defined. New sources at an existing major stationary source are treated as modifications to the major stationary source.

Major New Source Review (NSR) Program. The major NSR program contained in parts C and D of title I of the FCCA is a preconstruction review and permitting program applicable to new major sources and major modifications at such sources. In areas meeting the NAAQS (*attainment* areas) or for which there is insufficient information to determine whether they meet the NAAQS (*unclassifiable* areas), the NSR requirements under part C of title I of the FCAA apply. The EPA calls this portion of the major NSR program the *Prevention of Significant Deterioration* or PSD program. In areas not meeting the NAAQS, the major NSR program is implemented under the requirements of part D of title I of the FCCA. The EPA calls this program the "nonattainment" major NSR program. The EPA has promulgated rules in 40 CFR 52.21 to implement PSD in portions of the country that do not have approved state or tribal PSD programs.

Major Source Baseline Date. This is the date after which actual emissions associated with physical changes or changes in the method of operation at a major stationary source affect the available increment. Changes in actual emissions occurring at any stationary source after this date contribute to the baseline concentration until the minor source baseline date is established.

Minor Source. Any stationary source that is not defined as a major stationary source in Regulation No. 3, Part D §II.A.25. The term is sometimes used rather loosely. The definition may vary based on the context in which it is used.

Minor Source Baseline Date. This is the earliest date after the PSD increment *trigger date* on which a PSD application for a new major source or a major modification to an existing source is considered complete. The minor source baseline date is pollutant- and geographically-specific.

Modeling and Emissions Inventory Unit (MEIU). This is the unit within the Technical Services Program (TSP) of the Air Pollution Control Division that is responsible for review of air dispersion modeling.

Modified Stationary Source.

- When used in the context of modeling, the phrase *modified stationary source or facility* refers to a change in the location or stack parameters of an emission point, including emission rate.
- When used in the context of a permit application, the phrase *modified stationary source or facility* refers to a physical change in, or change in method of operation, that results in an increase of emissions

National Ambient Air Quality Standards (NAAQS). Levels of air quality to protect the public health and welfare (40 CFR 50.2). Primary standards are set to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly from the effects of "criteria air pollutants" and certain non-criteria pollutants. Secondary standards are set to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Nearby Sources. Any major source, major stationary source, or minor source that causes a significant concentration gradient in the vicinity of a new or modified source.

Nonattainment Area (NAA). Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for a criteria pollutant.

Other Background Sources. All sources of air pollution other than the source under review and those identified as nearby sources. Examples include area and mobile sources, natural sources, most minor sources, distant major sources, and major stationary sources. They usually are accounted for by using an appropriate ambient background concentration as recommended in section 8 of Appendix W of 40 CFR Part 51 or by application of a model using inventory recommendations in Table 8-2 of Appendix W.

Project. An operational and/or physical change that may affect air emission rates at a site.

PSD Increment. The maximum allowable increase of an air pollutant that is allowed to occur above the applicable baseline concentration for that pollutant.

Qualitative Determination. Relies on descriptive generalized statements and made without regard to quantity.

Quantitative Determination. A numerical “estimate” of the air pollutant concentration in ambient air.

Reasonable Further Progress (RFP). From the Common Provisions Regulation, “The annual incremental reductions in emissions of the applicable air pollutant (including substantial reductions in the early years following approval or promulgation of plan provisions under the Federal Act, section 110(a)(2)(I) and regular reductions thereafter) which are sufficient in the judgment of the commission and U.S. EPA, to provide for attainment of the applicable National Ambient Air Quality Standards by the date required in section 172(a) of the Federal Act.”

Receptor. As used here, a receptor is a geographic location (point) at which the model calculates the impact (i.e., air pollutant concentration) from a source of air pollution. In practice, a large number of receptors (i.e., a grid of receptors) is used to estimate air quality impacts over the probable area of impact from the source. Each receptor has a unique geographic coordinate and elevation.

Refined Model. An analytical technique that provides a detailed treatment of physical and chemical atmospheric processes and requires detailed and precise input data. Specialized estimates are calculated that are useful for evaluating source impact relative to air quality standards and allowable increments. The estimates are more representative than those obtained from conservative screening techniques.

Requested Emission Rate. The emission rate calculated using the maximum rated (design) capacity of the source or the emission rate specified as an enforceable permit condition.

Scenic and/or Important Views. An important or sensitive panorama or long-range view anywhere in Colorado. This includes important views of landmarks or panoramas. The Division maintains a list of scenic and/or important views in Colorado (https://www.colorado.gov/airquality/permits/SCENICVW2005.pdf).

Screening Technique. A relatively simple analysis technique to determine whether a given source is likely to pose a threat to air quality. Concentration estimates from screening techniques are conservative.

Significant Impact Analysis (SIA). Modeling analysis involving only the project sources to determine whether a new and/or modified facility, or a combination of the two, could cause a significant ambient air impact.

Significant Impact. A concentration in ambient air that exceeds a modeling significance level.

Significant Impact Levels (SILs). Values established by EPA to determine whether a proposed new or modified source will cause or contribute to a violation of the NAAQS or PSD increments. When a facility impact is above the applicable SILs, a refined cumulative impact analysis is required.

Simple Terrain. Any terrain with elevations lower than the top of the stack.

Stationary Sources Program (SSP). This is the program within the Air Pollution Control Division that is responsible for air quality permitting and enforcement.

Unclassifiable Area. Any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

Universal Transverse Mercator (UTM). A plane coordinate system that uses distances from a specified reference point as the basis for all locations. It is based on a transverse Mercator projection that divides the Earth's surface into zones that are 6 degrees of longitude wide. Precise locations on the earth are described in terms of north-south (northing) and east-west (easting) distances, measured in meters from the origin of the appropriate UTM Zone.

Most of Colorado is zone 13, while the western seventh is in zone 12.

Section 1 – Introduction

Air quality models are used to estimate impacts (air pollutant concentration levels) in ambient air to determine if a proposed source or activity will comply with applicable ambient air standards and other applicable regulatory requirements. Federal law requires that the Division have legally enforceable procedures in place to prevent construction or modification of any source where the emissions from the projected activity would violate control strategies or interfere with attainment and maintenance of the National Ambient Air Quality Standards (NAAQS).[1]

All estimates of ambient concentrations required under Colorado Air Quality Control Commission (AQCC) Regulation No. 3 must be based on U.S. EPA-approved air quality models, data bases, and other requirements generally approved by the U.S. EPA and specifically approved by the Division. Case-by-case approval from the Division and/or U.S. EPA is required if a non-EPA model is proposed.

Regulation No. 3, Part A, §VIII.A.1 states that *"all estimates of ambient concentrations required under this Regulation No. 3 shall be based on the applicable air quality models, data bases, and other requirements generally approved by U.S. EPA and specifically approved by the division. If a non-U.S. EPA approved model, such as a wind tunnel study, is proposed, the nature and requirements of such a model should be outlined to the division at a pre-application meeting. The application will be deemed incomplete until there has been an opportunity for a public hearing on the proposed model and written approval of the U.S. EPA has been received."*

The primary U.S. EPA modeling guideline is 40 CFR Part 51, Appendix W - Guideline on Air Quality Models (https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf). There are many other U.S. EPA guidance documents, memos, and U.S. EPA model clearinghouse decisions that explain modeling procedures. This *Guideline* is intended to help permit applicants understand federal modeling procedures. It also provides Colorado's interpretation of gray areas in federal guidance. As such, it presents procedures that are "specifically approved" by the Division.

[1] Pursuant to section 110(a)(2)(C) of the federal Clean Air Act, the State Implementation Plan (SIP) needs to regulate the "*modification and construction of any stationary source within the areas covered by the plan as necessary to assure that national ambient air quality standards are achieved*." Similarly, 40 CFR section 51.160 requires the State to have the authority to prohibit any construction or modification that would interfere with the attainment or maintenance of a national standard. This includes PSD increments as well as NAAQS. See also 40 C.F.R 51.166. There is no distinction in these provisions between major and minor sources.

The primary Colorado regulation for air quality permits is Regulation No. 3.[2] Certain new/modified air pollution sources are subject to the regulatory modeling requirements of Regulation No. 3 (authorized by §25-7-114 to 25-7-114.7, Colorado Revised Statutes (C.R.S.)).

To avoid unnecessary delays in permit processing, pre-application meetings and communications (e.g., phone, e-mail, letter) are strongly recommended, particularly for new major sources and major modifications. The Division does not routinely require or perform modeling to determine impacts from hazardous air pollutants (HAPs).

Section 2 – Authority for Air Quality Impact Analyses

The Colorado AQCC developed regulations that require the Division's preliminary analysis for construction permits to indicate the air quality impact from a proposed source or activity. In addition, the Division must determine if the proposed source or activity will comply with applicable ambient air quality standards. The recommended tools for determining *impacts* are air quality models. This section discusses the regulatory requirements for air quality impact analyses.

While modeling is not required to obtain an operating permit, it may be performed or requested if the operating permit is modified (Regulation No. 3, Part C, §X). Operating permits may also be subject to modeling if the application is for a combined construction/operating permit (Regulation No. 3, Part C, §III.C.12.d).

For both major sources and minor sources, Regulation No. 3, Part B, §III.B.5.d states, *"the preliminary analysis shall indicate what impact, if any, the new source will have (as of the projected date of commencement of operation) on all areas (attainment, attainment/maintenance, nonattainment, unclassifiable), within the probable area of influence of the proposed source…When the preliminary analysis includes modeling, the model used shall be an appropriate one given the topography, meteorology, and other characteristics of the region that the source will impact. Use of any non-guideline model required U.S. EPA approval under Section VIII.A. of Part A of this regulation."*

Regulation No. 3, Part B, §III.D.1 states that the Division or the AQCC "*shall grant the permit if it finds that…the proposed source or activity will not cause an exceedance of any National Ambient Air Quality Standards; and the source or activity will meet any applicable ambient air quality standards and all applicable regulations…"*

While Regulation No. 3 requires that the Division indicate the "impact, if any" in its preliminary analysis, it does not explicitly require modeling; however, a demonstration of compliance with all NAAQS and CAAQS is required. Thus, the impact analysis can be done using quantitative (modeling) or qualitative (non-modeling) methods, as appropriate; however, U.S. EPA approved models and/or methods must be used if a numerical estimate (i.e., pollutant concentration in ambient air) of the impact is made.

[2] Colorado air quality regulations are available on the CDPHE website (https://www.colorado.gov/pacific/cdphe/aqcc-regs) or upon request. To obtain official copies, please contact the Secretary of State's office.

The modeling thresholds and scenarios outlined in Table 1 may be used to determine when modeling is warranted. If it is unclear if modeling is warranted, please contact the Division. The thresholds are applicable for sources located in nonattainment as well as attainment areas.

The impact analysis requirement in Regulation No. 3 applies to all areas: attainment, attainment/maintenance, nonattainment, and unclassifiable.

Attainment Areas

New major sources and major modifications subject to PSD attainment area rules are required to submit various types of modeling and/or analyses along with their permit application. The application must include appropriate modeling and/or analyses to be ruled complete. Please refer to Regulation No. 3, Part D, §VI.A.2 and §VI.A.6 for source impact analysis requirements.

With respect to ambient air standards, §VI.A.2 requires that *"the owner or operator of the proposed source or modification shall demonstrate to the Division that allowable emission increases from the proposed source or modification in conjunction with all other applicable emissions increases or reductions (including secondary emissions) will not cause or contribute to concentrations of air pollutants in the ambient air in violation of either:*

> *VI.A.2.a: any state or national ambient air quality standard in any baseline area or air quality control region; or*
>
> *VI.A.2.b: any applicable maximum allowable increase over the baseline concentration in any area"*

Regulation No. 3, Part D, §VI.D.1.b requires that "*the proposed source or modification will achieve an emissions rate that will ensure that the emissions of such pollutant from the source or modification will not significantly affect ambient air quality in the nonattainment area."* That is, the modeling that is required should be used to determine if the source would have a significant impact in any nonattainment area.

Major sources and major modifications are subject to additional requirements. See section 4 for more details. The impact analysis requirement of Regulation No. 3 applies to all areas (attainment, attainment/maintenance, nonattainment, unclassifiable).

Minor sources and minor modifications are not required by regulation to submit a modeling analysis that demonstrates compliance along with their permit application; however, a demonstration of compliance (quantitative or qualitative) with all NAAQS and CAAQS is required. Nevertheless, applicants may elect to include modeling with the applications to prevent unnecessary delays.

If modeling is not submitted with the permit application, the Division will decide if modeling is warranted to complete the impact analysis and compliance demonstration required by Regulation No. 3. If modeling is warranted, the Division will perform a screening-level analysis if it is technically feasible to perform one. If the screening-level analysis shows there could be modeled violations of applicable standards, the Division will contact the applicant to discuss options. Since the Division does not usually perform refined-level modeling as part of the permitting process, the Division will typically require that the applicant perform any refined modeling that might be warranted.

If modeling is warranted, refer to sections 4, 5, and 6.

Nonattainment Areas

The impact analysis requirement of Regulation No. 3, Part B, §III.B.5.d applies in all areas *("attainment, attainment/maintenance, nonattainment, unclassifiable")*. Thus, modeling may sometimes be warranted for sources in nonattainment areas. The goals of the impact analysis vary depending on the applicable regulatory requirements. The regulations refer to the concept of reasonable further progress (RFP) for sources located in nonattainment areas. If emissions from a new source or modification would prevent a nonattainment area (NAA) from coming into compliance by the applicable date in the Federal Act or in the SIP, then the source impairs RFP.

New major sources and major modifications subject to NSR nonattainment area rules are required to submit various types of modeling and/or analyses along with their permit application. In nonattainment areas, Regulation No. 3, Part D, §V contains a number of requirements for obtaining a permit. Refer to the regulation for details. A few of the requirements follow:

- Offsets must represent reasonable further progress towards attainment of the National Ambient Air Quality Standards when considered in connection with other new and existing sources of emissions.
- In addition, offsets for PM_{10}, sulfur oxides, and carbon monoxide must show, through atmospheric modeling, a positive net air quality benefit in the area affected by the emissions.
- Provided, however, that offsets meeting the requirements of this section V.A.3 may also be obtained from existing sources outside the nonattainment area if the applicant demonstrates:
    - A greater air quality benefit may thus be achieved; or sufficient offsets are not available from sources within the nonattainment area; and
    - The other area has an equal or higher nonattainment classification than the area in which the source is located; and
    - Emissions from such other area contribute to a violation of the National Ambient Air Quality Standard in the nonattainment area in which the source is located.
    - With respect to offsets obtained from outside the non-attainment area, the division may increase the ratio of the required offsets to new emissions the greater the distance such offsets are from the new or modified source.
- Precursors to ozone must be analyzed and discussed. Please use EPA guidance regarding how to perform an analysis for precursors to ozone.

If modeling is not submitted with the permit application, the Division will decide if modeling is warranted to complete the impact analysis and compliance demonstration required by Regulation No. 3. If modeling is warranted, the Division may perform a screening-level analysis if it is technically feasible to perform one. If the screening-level analysis shows there could be modeled violations of applicable standards, the Division will contact the applicant to discuss options. Since the Division does not usually perform refined-level modeling as part of the permitting process, the Division will typically request that the applicant perform any refined modeling that might be warranted. If modeling is warranted, refer to sections 4, 5, and 6.

In the event that compliance with standards cannot be demonstrated using typical attainment area modeling procedures, a case-by-case approach should be developed in consultation with Division staff familiar with the affected nonattainment area.

Requirements Unique to Colorado

The following are additional modeling-related regulatory requirements unique to Colorado:

- A major source by itself may not consume more than 75% of any applicable PSD increment
- Class I SO_2 increments apply to some pristine Class II areas
- For major sources subject to PSD review, *water* is included as one of the required elements in the *additional impact analysis;* the requirement is intended to provide information on acid deposition in high altitude lakes
- Sulfur dioxide (SO_2) 3-hour standard of 700 µg/m^3

Section 3 – Air Quality Impact Analysis

An applicant must demonstrate that the proposed source or modification, as represented in the air permit application, would not cause or contribute to a National Ambient Air Quality Standard (NAAQS) or Prevention of Significant Deterioration (PSD) increment violation. An air quality impact analysis is the means for the applicant to make the demonstration. It is an evaluation of the potential impact on the environment associated with a new and/or modified facility. Additional analyses required by federal rule would also be included in the air quality impact analysis.

The air quality impact analysis is a stand-alone report. Results from the report should be sufficient for Division staff to evaluate the impact of the proposed operation without input from other reports. Division staff should not refer to other documents or reports for data required to be in the report. In addition, applicants should not exclude items normally required without coordination with the Division's Technical Services Program (TSP) modeling staff unless the items are clearly not applicable to the project. Refer to the Colorado Modeling Submittal Completeness Checklist (https://www.colorado.gov/airquality/permits/CompletenessChecklist-ModelingSubmittal14Feb.pdf) to determine what information needs to be submitted in the air quality impact analysis.

Air Dispersion Modeling

Air dispersion models are tools to approximate concentrations from one or more facilities or sources of air contaminants. When an air contaminant is emitted into the atmosphere, it is transported and dispersed by various atmospheric processes. Algorithms and equations have been developed to approximate (model) these atmospheric processes and have been incorporated into various computer codes (computer models). Division staff uses the results from these computer models in their review of air permit applications. A modeled prediction is used to demonstrate if the new or modifying source will show compliance with the NAAQS and CAAQS. If the model predicts an exceedance of the NAAQS and/or CAAQS, the applicant is given the opportunity to adjust the facility allowable emissions, operating hours, source parameters, and source configuration in order to demonstrate the predicted impact will be in compliance with all state and federal standards.

Procedures and models other than those recommended by U.S. EPA or in this guideline may be approved on a case-by-case basis if there is sufficient technical justification. U.S. EPA approval may be required in some cases. Refer to U.S. EPA guidance for use of alternative models.

If a non-EPA-approved model, such as a wind tunnel study, is proposed, the nature and requirements of such a model should be outlined to the Division at a pre-application meeting. The permit application will be deemed incomplete until there has been a public hearing on the proposed model and written approval of the U.S. EPA has been received (Regulation No. 3 Part A §VII).

The most recent version of U.S. EPA-approved models should be used. Division approval should be obtained if an older version is used.

For Class I area modeling, the Division generally supports the use of models and modeling techniques recommended by the Interagency Workgroup on Air Quality Modeling (IWAQM)[3]. Written IWAQM guidance does not always reflect their latest recommendations. In addition, recommendations for the Class I analysis may vary from one area to another. Thus, work with Division staff and affected federal land managers (FLMs) on a case-by-case basis to determine the appropriate methods to address impacts at each affected Class I area.

Air Quality Impact Analysis Process

Division staff with the appropriate expertise reviews various aspects of the impact analysis. For example, different specialists may provide comments on dispersion modeling, monitoring data, visibility modeling, and air quality related values. Internal comments by reviewers are typically sent directly to the permit engineer in the Stationary Sources Program who interprets the comments and, if necessary, brings staff together to discuss or resolve issues.

Modeling submittals that accompany permit applications should generally be sent to the Division's Stationary Sources Program where a permit engineer processes the permit application. The permit engineer forwards modeling reports, date, modeling input/output files, the permit application, and other relevant information to appropriate staff. As required by regulations, copies of the permit applications for major stationary sources are sent to federal agencies such as U.S. EPA Region VIII and affected federal land managers.

It is appropriate for applicants or their modelers to send modeling protocols directly to modeling staff in the Division's Technical Services Program. A copy should also be sent to the Stationary Sources Program permit review staff since they are responsible for the overall review of the permit.

The Division encourages phone conversations, e-mail, and other types of communication between staff and the applicant's modeler(s) and other specialists to resolve issues once the actual review process begins. It is assumed the applicant's modeler or other specialists will notify the applicant of important

[3] IWAQM was formed to provide a focus for development of technically sound, regional air quality models for regulatory assessments of pollutant source impacts on federal Class I areas. The guidance included input from the U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, the U.S. EPA, and several states.

modeling-related issues as necessary. It is recommended that significant issues and information transfers be done in writing. Copies of any letters or e-mail messages shall be sent to the permit engineer.

When oversights, errors, or questionable assumptions and/or methods are found during the review process, Division staff will use professional judgment to decide if deficiencies are sufficient to change the outcome of the compliance demonstration. If the ramifications of a modeling-related issue are not significant, the deficiencies are noted in the comments and appropriate language is included to justify that a specific issue is minor. If it is difficult to assess the ramifications without redoing the analysis, the Division may attempt to redo the analysis, while the deficiencies will be noted in the review comments and the applicant will be asked to address the comments.

Any responses to comments may be sent directly to Technical Services Program modeling staff, but it is recommended that a copy also be sent to the permit engineer. In cases where there are no modeling issues, the Division's modeling comments are not usually forwarded to the applicant. Instead, the written comments are added to the permit file.

Figure 1 graphically depicts the permit review process as it relates to air quality modeling. While the flowchart is applicable to all permit applications for major stationary sources where modeling is required, only certain portions of the flowchart are applicable for minor sources. For example, the loop involving U.S. EPA Region VIII and the federal land manager (FLM) is not an integral part of the review process for minor sources.

Figure 2 graphically shows the roles and responsibilities for the modeling review process within the Division for air quality construction permits.

Figure 3 illustrates key aspects of the regulatory decision process for major stationary sources and major modifications seeking construction permits. ***This figure is currently under review within the Division. Please contact Division staff to confirm the review process for an AQRV and Visibility analysis in Class I areas.***

Figure 1. Permit Review Process

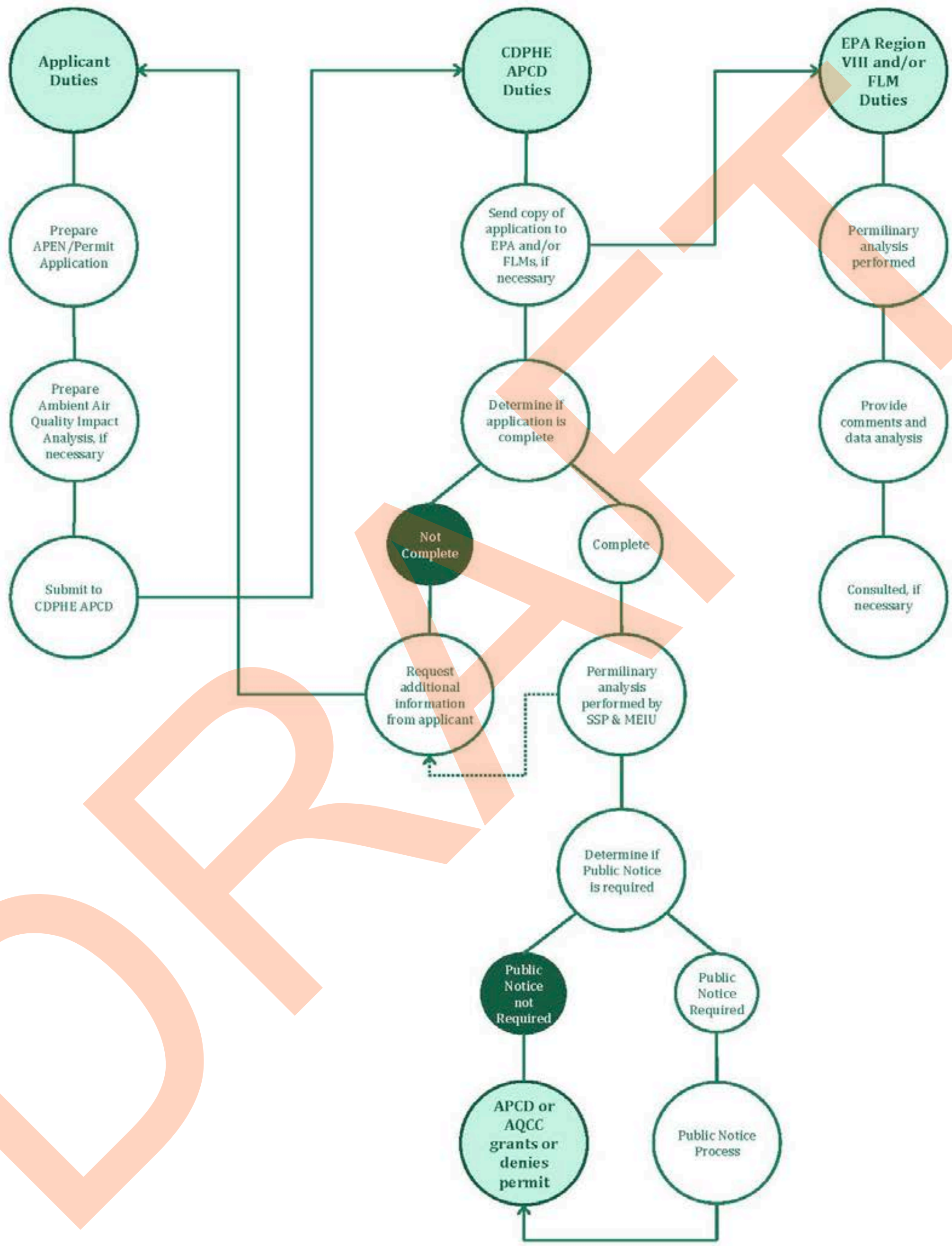


Figure 2. Roles & Responsibilities within CDPHE

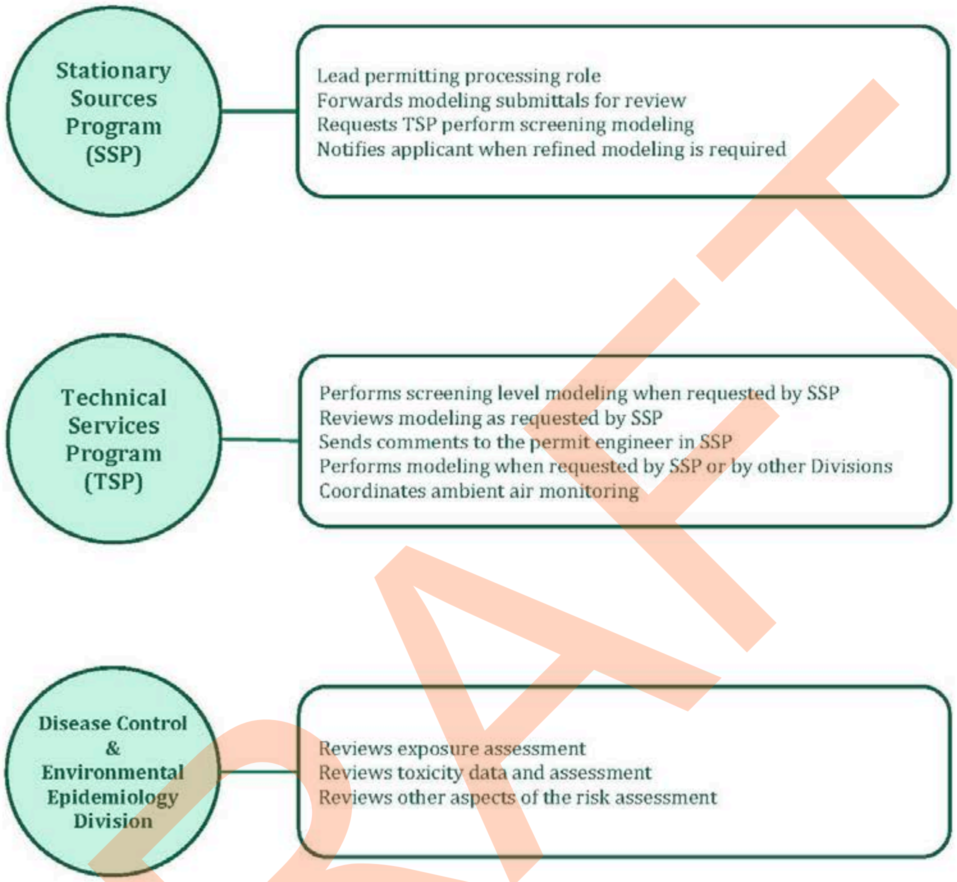
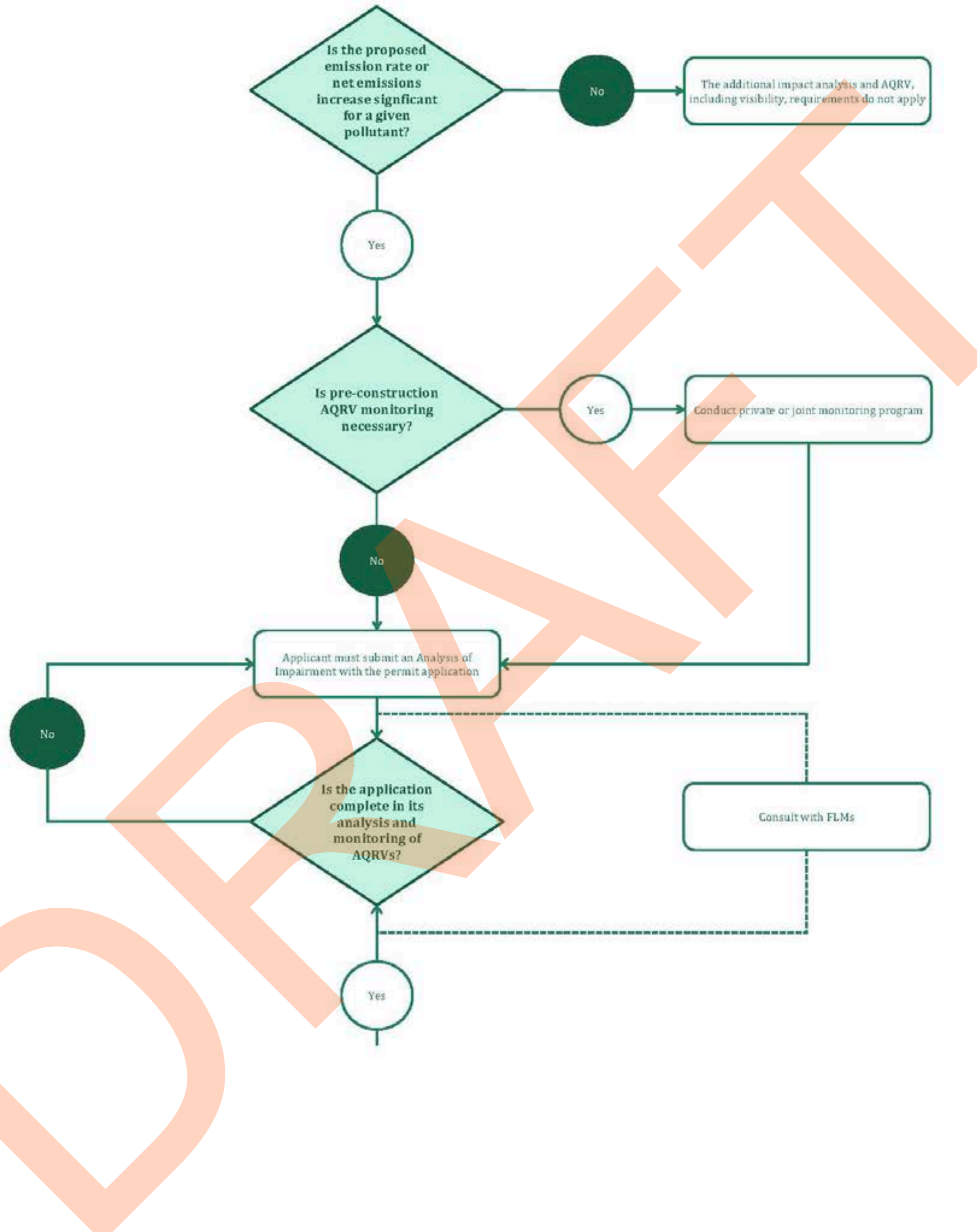
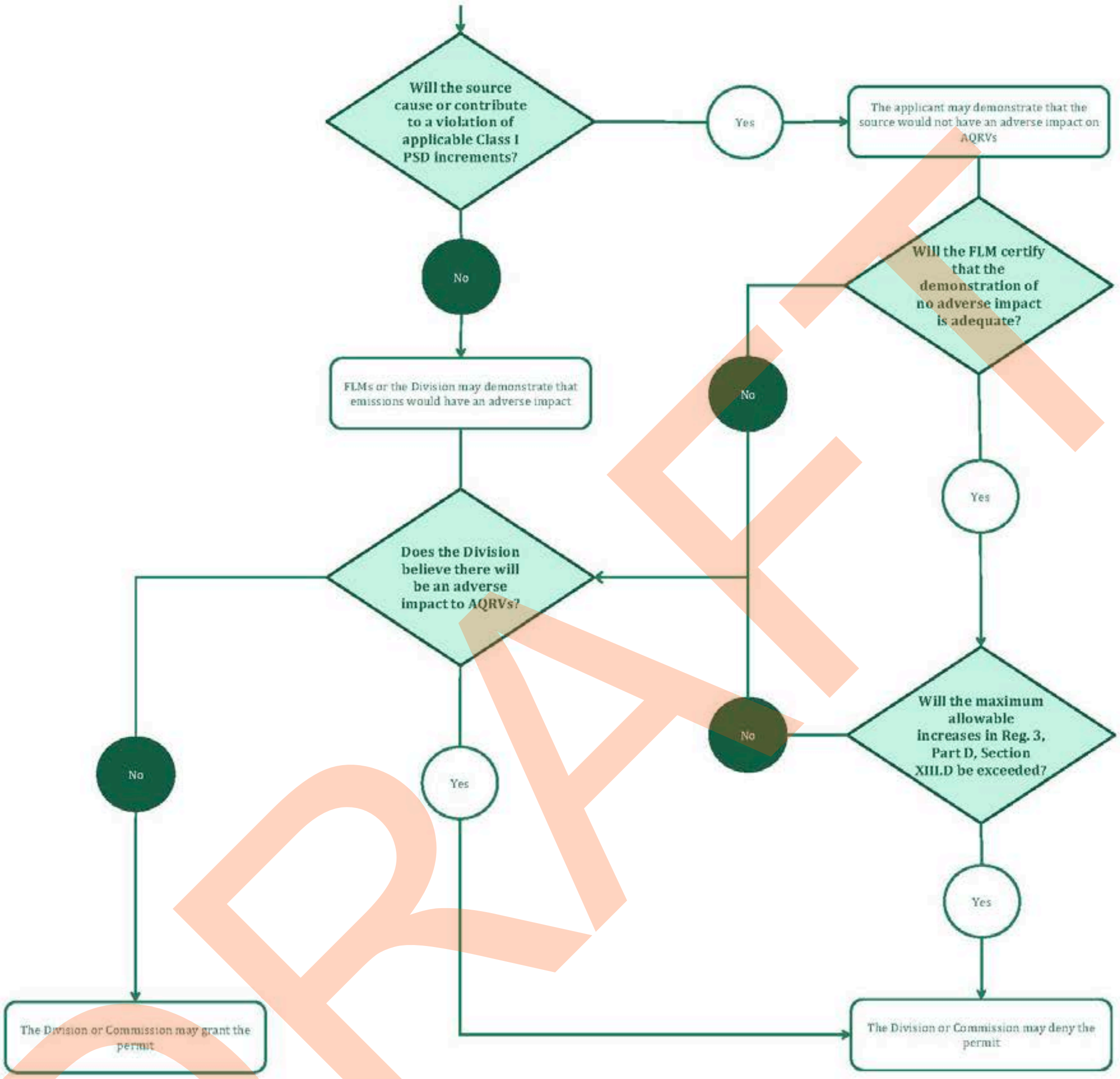


Figure 3. Regulatory Decision Process for AQRVs




Will the source cause or contribute to a violation of applicable Class I PSD increments?
Yes
The applicant may demonstrate that the source would not have an adverse impact on AQRVs
No
FLMs or the Division may demonstrate that emissions would have an adverse impact
Will the FLM certify that the demonstration of no adverse impact is adequate?
No
Yes
Does the Division believe there will be an adverse impact to AQRVs?
Will the maximum allowable increases in Reg. 3, Part D, Section XIII.D be exceeded?
No
No
Yes
Yes
The Division or Commission may grant the permit
The Division or Commission may deny the permit

Section 4 – Performing the Air Quality Impact Analysis

As discussed in Section 2, the Colorado AQCC developed regulations that require the Division's preliminary analysis for construction permits to indicate the air quality impact from a proposed source or activity. In addition, the Division must determine if the proposed source or activity will comply with applicable ambient air quality standards. The recommended tools for determining *impacts* are air quality models.

Figure 4 depicts the air quality impact analysis.

Modeling Thresholds

Modeling thresholds were developed to identify new sources and modifications that would have relatively small impacts and do not warrant further analysis with respect to applicable air quality standards. The development of these thresholds is intended to assist the Division staff, permit applicants, air quality consultants, and others decide when modeling is warranted and to determine the impact from a source. This section introduces *de minimis* emissions, which have low probability of causing or contributing to an exceedance of an air quality standard. By using this approach, permitting costs associated with the impact analysis required by Regulation No. 3 can be minimized.

Air quality modelers developed the modeling thresholds in Table 1 during a technical peer review of the Division's modeling practices. The Division performed dispersion modeling to help demonstrate that the thresholds in Table 1 are appropriate. This analysis can be seen in Appendix A at the end of this document. Permit applicants and the Division should try to avoid situations where the decision to perform modeling takes longer than actually performing a screening-level modeling analysis (screening-level models can often be run quickly with minimal cost).

For a given pollutant, modeling is usually warranted if the long-term (tons per year) or short-term (pounds per hour, etc.) requested emission rate for a new source or the facility-wide net emissions increase for a modification is above the applicable emission threshold in Table 1. If the requested emission rate and/or the facility-wide net emissions increase is below both of the thresholds, modeling is usually not warranted ***unless one of the situations outlined in the footnotes of Table 1 applies***. If there is doubt regarding the need for modeling, the applicant should consult the Division.

The thresholds in Table 1 were not developed to address compliance with minor modifications to major sources located within 10km of a Class I area. Thus, modeling decisions related to Regulation No. 3, Part D, §II.A.44.c are made on a case-by-case basis. According to §II.A.44.c, any net emissions increase of a regulated pollutant at a major stationary source located within 10 kilometers (6.2 miles) of a federal Class I area should perform modeling to determine if the maximum 24-hour average impact in the Class I area exceeds 1.0 μg/m^3 on a 24-hour basis. If it does, the emissions increase is significant and the modification constitutes a major modification subject to PSD review.

The Class I significance level of 1.0 μg/m^3 on a 24-hour basis is only intended to determine if a modification is major. It should not be used to determine if the impact in a Class I area is significant.

Table 1. Modeling Thresholds

If emission rate is less than threshold, a qualitative description of impact may be adequate unless a situation warrants modeling.[1]		
Pollutant	Requested Emission Rate from New Source or Facility-Wide Net Emissions Increase from a Modification	
	Long Term (tons per year)	Short Term (pounds per hour)
Carbon Monoxide (CO)	23 pounds per hour	
Nitrogen Oxides (NO_x)	40	0.46
Sulfur Dioxide (SO_2)	40	0.46
Particulate Matter < 10 µm (PM_{10})	82 pounds per day	
Particulate Matter < 2.5 µm ($PM_{2.5}$)	5	11 pounds per day
Lead (Pb)	25 pounds per 3-months	

[1] Circumstances where source may cause or contribute to a violation of applicable ambient air quality standards despite being below the thresholds:

(a) *Sources of SO_2, NO_2, PM_{10}, $PM_{2.5}$, CO, or Pb where a substantial portion of the new or modified emissions have poor dispersion characteristics (e.g., rain caps, horizontal stacks, fugitive releases, or building downwash) in close proximity to ambient air at the site boundary*

(b) *Sources located in complex terrain (e.g., terrain above stack heights in close proximity to the source)*

(c) *Sources located in areas with poor existing air quality*

(d) *Modification at existing major sources, including grandfathered sources that have never been modeled before*

Modeling Protocol

The protocol is the primary mechanism by which all affected parties such as the applicant, the Division, U.S. EPA, and federal land managers reach agreement on a modeling approach. The protocol development process is intended to minimize the chances of misunderstandings and to avoid delays in the permit process. It explains in detail how a modeling analysis will be performed, how the results will be presented, and how compliance with applicable requirements will be demonstrated. The protocol is not intended to be a binding, legal document as changes or deviations are often necessary as the data collection and analysis progresses.

Submission of a modeling protocol is strongly recommended for all air quality impact analyses.

Screening Modeling

The U.S. EPA developed screening-level modeling techniques to determine quickly whether a facility should perform in-depth refined modeling analyses. Screening-level models produce estimates of worst-case impacts from a single source without the need for hourly metrological data. Most applicants are recommended to perform a screening-level analysis to show the facility is in compliance with the applicable NAAQS and CAAQS. If there is doubt regarding the need for modeling, the applicant is recommended to perform a screening-level analysis. If the screening-level analysis does not show compliance with the NAAQS and CAAQS, then refined modeling is required.

The U.S. EPA has regulatory screening models that should be used for this analysis. These models can be found on the U.S. EPA Support Center for Regulatory Atmospheric Modeling (SCRAM) website.

Screening models are designed to evaluate a single source. Most facilities, however, do not consist of a single source, but screening models can still be used by summing the emissions from all sources at the facility and model them as if they are being emitted from a single source. This method is only acceptable when all sources are stacks and being emitted from the shortest stack, to represent worst-case.

When facilities consist mostly of fugitive emissions, screening models are not acceptable. When summing these types of emissions together and modeling as a single source, the accuracy of the model is reduced substantially and the results not credible. Therefore, the Division does not accept screening models from the following source categories:

- Gravel Pits
- Quarries
- Landfills
- Mining Operations
- Any type of facility not mentioned above that involves multiple sources of fugitive emissions

Refined Modeling

Refined modeling requires detailed and precise input data along with more complex models in order to provide refined impact estimates. If refined modeling is warranted, it should be performed in two distinct phases.

The first phase is the significant impact analysis (SIA), which determines if the applicant can forego further air quality analysis for a particular pollutant with respect to Colorado and National Ambient Air Quality Standards and, for new major sources and major modifications, Prevention of Significant Deterioration increments. The second phase is the cumulative impact analysis for the CAAQS, NAAQS, or applicable PSD increments; it is sometimes referred to as the *full impact analysis*[4].

[4] U.S. EPA sometimes uses the phrase "full impact analysis" to refer to the National Ambient Air Quality Standards (NAAQS) analysis and the Prevention of Significant Deterioration (PSD) increment analysis.

Significant Impact Analysis

Individual facilities may be subject to different requirements depending on the proposed emission rates of each facility. There are two general categories of permits: major NSR and minor NSR. The major NSR permit is often referred to as a federal or PSD permit.

Technically, all Colorado APCD permits are federal in that the state must implement a minor NSR permitting program to ensure the NAAQS and increments are attained. The air quality impact analyses for major NSR and minor NSR permits begin with a significant impact analysis (SIA). The purpose of a SIA is to determine whether a new and/or modified facility, or a combination of the two, could cause a significant ambient air impact. Below are general steps for identifying emissions to include in the SIA.

SIA Step 1: Identify All Sources of Emissions. Include emissions from all new and/or modified sources at the facility associated with the project.

SIA Step 2: Determine Whether There Is a Net Emissions Increase. Determination of the project emissions may vary depending on the type of permit (minor NSR or major NSR). The determination of the level of federal applicability is the first step in the technical review process and is performed by the permit engineer. The federal applicability process determines whether a project is minor or major. While the steps of the modeling process are consistent, requirements vary based on the type of permit and pollutant.

SIA Step 3: Evaluate Modifications to Existing Sources at the Site. Carry out this step even if there is no net increase in emissions. For both minor and major NSR modeling, include these sources in the SIA if there is a change in operating hours or stack parameters, and previous modeling demonstrations were limited to those operating hours or stack parameters. That is, the permit was based on those limits.

SIA Step 4: Develop the Emission Inventory for the Site. In general, the requested allowable emission rate, requested operating rate or maximum design rate should be modeled; however, the applicant should consult with the permit engineer to verify that the appropriate emission rates were developed. If the requested emission or operating rate used in the modeling is less than the maximum design rate, it may become a permit condition. For modifications, the facility-wide net emissions increase for the modification should be modeled in the SIA.

Major stationary sources do not need to include emissions from the commercial, residential, and industrial growth analysis in the SIA. The growth analysis required by the PSD rules is only recommended if a CAAQS and NAAQS analysis, a PSD increment analysis, or a similar air quality impact analysis is triggered.

Carry out the SIA modeling.

For a given pollutant and averaging period, the highest estimated concentration at each receptor in ambient air is compared to the modeling significance levels in Table 2 and Table 3. Impacts from nearby and other background sources, including background concentrations, are not considered in the SIA. If the estimated concentration levels are below the applicable modeling significance level, no further analysis is recommended. The source is considered to have an insignificant impact. For example, if impacts are below the significance levels in Table 3, a compliance demonstration for Colorado and National Ambient

Air Quality Standards (CAAQS and NAAQS analysis) is not triggered. For major stationary sources subject to PSD rules, a Class I or Class II PSD increment analysis is not triggered if the impacts are below the significance levels in Table 2; however, other analysis requirements of the PSD rules must nevertheless be addressed. If the impact exceeds the modeling significance levels, the source or modification has a significant impact in ambient air and the next phase of analysis is triggered, as discussed below.

The SIA also provides a convenient way to define the “probable area of influence” of a source’s emissions (see Regulation No. 3, Part B, §III.B.5.d). In practice, it is sometimes useful to define the significant impact radius or area for the source or activity of interest.

If modeling shows that no violation of a standard (or, for major stationary sources, an applicable PSD increment) will occur within the significant impact area of a proposed source, as determined by a comparison with the applicable modeling significance levels, no cumulative air quality impact analysis is warranted.

Significant Impact Level (SIL)

PSD increment *modeling significance levels* (Table 2) are only used for major stationary sources subject to PSD rules. The Class I PSD increment significance levels are based on U.S. EPA proposals from 1996.[5] For minor sources and minor modifications, the Division does not consider compliance with PSD increments as a criterion in determining if a permit should be issued for a minor source or minor modification.

The modeling significance levels in Table 2 are only intended for the PSD increment analysis. Table 2 does not include values for Class III areas as there are no Class III areas in Colorado. The modeling significance levels were not developed to determine if there would be significant impacts to air quality related values (AQRVs).

[5] Federal Register: July 23, 1996 (Volume 61, Number 142), Proposed Rules, Page 38249-38344.

Table 2. Significant Levels for PSD Increments ($\mu g/m^3$)

Pollutant	Class I	Class II
Carbon Monoxide (CO)		
8 hour	(a)	500
1 hour	(a)	2000
Nitrogen Dioxide (NO_2)		
Annual	0.1	1
1 hour	(a)	7.5
Sulfur Dioxide (SO_2)		
Annual	0.1	1
24 hour	0.2	5
3 hour	1.0	25
1 hour	(a)	4
Particulate Matter < 10 µm (PM_{10})		
Annual	0.2	1
24 hour	0.3	5
Particulate Matter < 2.5 µm ($PM_{2.5}$)		
Annual	0.05	0.2
24 hour	0.27	1.2

(a) Modeling significant level has not been defined

For minor and major stationary sources, the modeling significance levels in Table 3 are used to determine if a CAAQS and NAAQS analysis is triggered (see Figure 4). The significance levels in Table 3 are listed in Regulation No. 3, Part D, §VI.D.2.

Table 3. Significant Levels for NAAQS & CAAQS (µg/m^3)

Pollutant	SIL
Carbon Monoxide (CO)	
8 hour	500
1 hour	2000
Nitrogen Dioxide (NO_2)	
Annual	1
1 hour	7.5
Sulfur Dioxide (SO_2)	
Annual	1
24 hour	5
3 hour	25
1 hour	4[a]
Particulate Matter < 10 µm (PM_{10})	
Annual	1
24 hour	5
Particulate Matter < 2.5 µm ($PM_{2.5}$)	
Annual	0.2
24 hour	1.2

[a]Interim modeling significance level developed by the Division: https://www.colorado.gov/airquality/permits/Interim1-hrSO2SIL.pdf

Cumulative Impact Analysis

The components of the cumulative impact analysis vary depending on the applicable regulatory requirements. For minor sources and minor modifications, a compliance demonstration with Colorado Ambient Air Quality Standards (CAAQS) and National Ambient Air Quality Standards (NAAQS) is usually the only type of impact analysis that is requested. Refer to Table 1 to determine if modeling is warranted.

Table 4 summarizes the typical types of air quality analysis for new minor sources or minor modifications that might be applicable. In attainment areas, all new sources and modifications with a significant impact in ambient air should perform a cumulative CAAQS and NAAQS analysis. For nonattainment area requirements, please refer to the Nonattainment Areas portion of Section 2.

Impact analysis requirements are stated in applicable regulations. Regulation No. 3, Part B, §III.D presents the general requirements for all construction permit applications, including minor sources.

For minor sources and minor modifications, a compliance demonstration with the Prevention of Significant Deterioration (PSD) increments is not required to obtain a construction permit. A preliminary opinion in June 1998 from the Colorado Attorney General's office suggests that rulemaking would be necessary before compliance with PSD increments could be a permit issuance criterion for minor sources and minor modifications. Therefore, increment consumption from minor source growth is assessed only during the modeling process for new sources and modifications subject to PSD rules and during periodic increment studies. Nevertheless, since all sources, including minor sources, can consume PSD increment in areas where the PSD minor source baseline date has been triggered, new minor sources and minor modifications are encouraged to voluntarily demonstrate compliance with applicable increments.

Table 4. Ambient Air Impact Analyses Applicable for New Minor Source & Minor Modifications

Area Classification	Ambient Air Impact Analysis
Attainment, Unclassifiable	NAAQS & CAAQS
Nonattainment	NAAQS & CAAQS
	Reasonable Further Progress (RFP)

The components of the major stationary source or major modification air quality impact analysis vary depending on the applicable regulatory requirements. Permit applicants are encouraged to contact the Division as early as possible to discuss permitting requirements. The Division and U.S. EPA encourages applicants to submit modeling protocols.

All areas of Colorado are classified as Class II with the exception of the twelve federal Class I areas, which are shown in Figures 6 and 7. Class I areas have the greatest protection from air quality deterioration; Class III areas have the least protection; however, there are no Class III areas in Colorado. In addition to demonstrating compliance with ambient air quality standards, major stationary source permit applicants must demonstrate that they will not cause or contribute to violations of PSD increments. Major stationary sources located within nonattainment areas are subject to additional requirements as discussed in the Nonattainment Areas portion of Section 2.

Table 5 summarizes the typical types of air quality analysis for new major sources or major modifications that might be applicable. The significant impact analysis must be performed if there is a possibility the proposed source will impact a nonattainment area.

Table 5. Ambient Air Impact Analyses Applicable for New Major Source & Major Modifications

Area Classification	Ambient Air Impact Analysis
Attainment, Unclassifiable	NAAQS & CAAQS
	PSD Increment
	Additional Impacts Analysis in any area (Visibility, Water, Soils, Vegetation, Growth)
	AQRV Analysis in Class I Areas
	Pre- and Post-Construction Monitoring
Nonattainment	NAAQS & CAAQS
	Reasonable Further Progress (RFP)
	Net Air Quality Benefit
	AQRV Analysis in Class I Areas

Major stationary sources are required by regulation to submit an additional impacts analysis to address potential impairment to soils, vegetation, water, visibility, and growth, if applicable; it applies in all areas, including Class I and Class II areas. In addition, regulations require that applicants submit an analysis of impairment to Air Quality Related Values (AQRVs) in affected Class I areas.

PSD applicants should also consult with the Division to determine if there will be any pre-construction ambient monitoring requirements. Refer to Regulation No. 3, Part D, §VI to understand how the Division decides if pre- or post-construction monitoring is required.

There are other regulatory requirements in addition to those required by PSD rules. For example, Regulation No. 3, Part B, §III.D.1 subparts a through g list general requirements for obtaining a permit. While subpart e applies to major PSD sources, subparts c and d provide requirements that are more general. Thus, the PSD modeling requirements of subpart e are only one of many requirements that may be applicable.

Regulation No. 3, Part D, §VI.B states, *"the [PSD] requirements of section VI.A do not apply to a major stationary source or major modification with respect to a particular pollutant if the owner or operator demonstrates that...the emissions from the source or modification would not be significant."* Thus, the impact analysis and monitoring requirements of the PSD rules are not applicable for a given pollutant if the emission rate is not significant, as defined in Regulation No. 3, Part D, §II.A.44. In situations where the requirements of §VI are waived, modeling for compliance with ambient air standards may nevertheless be warranted under the requirements of Regulation No.,3, Part B, §III.

NAAQS & CAAQS Analysis

The federal Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of sensitive populations such as people with asthma, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. Colorado and National Ambient Air Standards (CAAQS and NAAQS) are listed in Tables 6 and 7, respectively. Units of measure for the standards are parts per million (ppm) by volume, parts per billion by volume (ppb), and micrograms per cubic meter of air (µg/m^3).

The ambient air quality standards in Tables 6 and 7 are based on a reference temperature and pressure of 25 degrees Celsius and 760 millimeters of mercury (1,013.2 millibars or 1 atmosphere), respectively. Correction of modeled concentration estimates to reference conditions (i.e., standard temperature and pressure, STP) before comparison with ambient air quality standards is not required for air quality permit modeling in Colorado. If it is necessary to perform unit conversions, the following formula may be used:

$$X_{ppm} = \frac{X_{\mu g m^{-3}}}{(40.9 \times MW)} \; ; MW = Molecular\ weight\ of\ pollutant\ in \frac{g}{mole}\ and\ X\ is\ concentration$$ [6]

If the impact is significant and a CAAQS and NAAQS modeling analysis is warranted, the modeling should account for the source under review plus existing air pollution levels at the locations (receptors) where the source has a significant impact. The purpose of the NAAQS/CAAQS analysis is to demonstrate that proposed emissions of criteria pollutants from a new facility or from a modification of an existing facility that does not trigger PSD increment review will not cause or contribute to an exceedance of the NAAQS and CAAQS.

This can be done in several ways. In general, the compliance demonstration for standards should include:

NAAQS/CAAQS Step 1: Conduct a SIA. Perform a significant impact analysis to predict whether the proposed source(s) could make a significant impact on existing air quality. That is, the model predicts concentrations at one or more receptors in the modeling grid greater than or equal to a significant impact level (SIL).

- Model all new and/or modified sources. Compare the predicted high concentration at or beyond the property line for each criteria pollutant and each averaging time to the appropriate SIL.
- If the sources do not make a significant impact for a pollutant of concern, the demonstration is complete. If there is a significant impact, then the significant receptors define a significant impact area and a full NAAQS analysis is required. Go to Step 2.

NAAQS/CAAQS Step 2: Determine Significant Impact Area. Each criteria pollutant and averaging period subject to the NAAQS/CAAQS analysis may have a different significant impact area.

- The significant impact area is the set of receptors that have predicted concentrations at or greater than the SIL for each applicable averaging time and criteria pollutant.

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[6] $1\,ppm_v = \frac{1 L_{\text{pollutant}}}{10^6\, L_{air}} = \frac{0.0409\,\text{moles}\cdot L^{-1} \times 1000\, L\cdot \text{m}^{-3} \times MW \times 10^6\ \mu g \cdot g^{-1}}{10^6\, L_{air}} = (40.9 \times MW)\,\mu g \cdot m^{-3}$

where $n/V = P/RT = 0.0409\ \text{moles}\cdot \text{L}^{-1}$, where P =1 atm, T =298 K, R =0.08206 L·atm·K^{-1}·mole^{-1}, L = liters

- The full NAAQS analysis is carried out for each criteria pollutant and averaging time separately and need only include the significant impact area for the associated criteria pollutant and averaging time combination.
- Refinement of the significant impact area may be necessary as is discussed in Section 5, Receptor Network.

NAAQS/CAAQS Step 3: Evaluate Nearby Sources. The applicant needs to request a nearby source inventory from the Division. It is the responsibility of the applicant to obtain the data and ensure the accuracy. Any changed made to the data must be documented and justified.

The nearby source inventory for major source and major modifications (e.g., sources subject to PSD rules) should expand to 50km of the significant impact area of the new source or modification under review. Identify nearby sources to explicitly model. Select additional background sources as appropriate to account for impacts not reflected in the background concentration. Sources beyond 50 kilometers should be considered if long-range transport modeling is being performed for a federal Class I area. Estimated impacts from growth in residential, commercial, and industrial sources associated with, but not part of, the proposed source should be included in the analysis for major sources and major modifications.

NAAQS/CAAQS Step 4: Conduct a CIA. Perform a cumulative impact analysis. Model all facility sources with the nearby sources obtained from the Division. Model allowable emission rates for all sources that emit the criteria pollutant.

NAAQS/CAAQS Step 5: Add Background concentration to CIA modeled result. The applicant needs to request a representative background concentration from the Division. This background concentration should be added to the modeled result from the CIA.

NAAQS/CAAQS Step 6: Compare to NAAQS/CAAQS. Compare the modeled CIA concentration plus representative background concentration for each criteria pollutant and averaging time to the appropriate NAAQS. Use the correct design value that follows the form of the applicable NAAQS or the highest first high depending on the meteorological determination (discussed in Section 5, Criteria Pollutants Recommendations).

If the maximum concentrations are at or below the NAAQS/CAAQS, the demonstration is complete. If the concentration is above the NAAQS/CAAQS, perform a contribution analysis to demonstrate that the proposed source will not exceed the applicable significant impact levels in Table 3 at the point (receptor) and time of the modeled violation. If the proposed source will not exceed the applicable SIL at the point and time of the modeled violation, the demonstration is complete. No further air quality impact analysis is warranted for the new source or modification, even when a new violation would result from its insignificant impact. If the proposed source has a significant impact at the point and time of the modeled violations, review the demonstration and determine if any refinements can be made or demonstrate that the project's impact will not be significant. The following options can be considered to further refine the model to show compliance with the NAAQS/CAAQS:

- Emission Limits;
- Operating schedule restrictions;

- Physical changes at the facility to improve dispersion characteristics;
- The use of fences or physical barriers to preclude public access from contiguous land owned or controlled by the operator (i.e., standards and increments only apply in ambient air);
- Additional pollution control equipment;
- The use of more refined modeling techniques, including nonguideline models (e.g., non-EPA dispersion models, physical models, and monitoring-based methods)

The Common Provisions Regulation, §II.A states that if emissions generated from sources in Colorado cross the state line, such emissions shall not cause the air quality standards of the receiving state to be exceeded, provided reciprocal action is taken by the receiving state. The Division is not aware of any formal written agreements regarding reciprocal action. Nevertheless, if the impact from a new or modified source will have a significant impact in another state as defined in section 5, or if it will likely affect another state, the Division recommends contacting the appropriate agency in the affected state to determine if there are any applicable state standards. If so, consult with the Division to determine what if any analysis is recommended.

The Division may recommend that additional analysis be performed to show compliance with applicable standards of that state. If modeling appears to be warranted, staff from the Division and the affected state should discuss the situation to determine an acceptable modeling approach.

Table 6. Colorado Ambient Air Quality Standards (CAAQS)

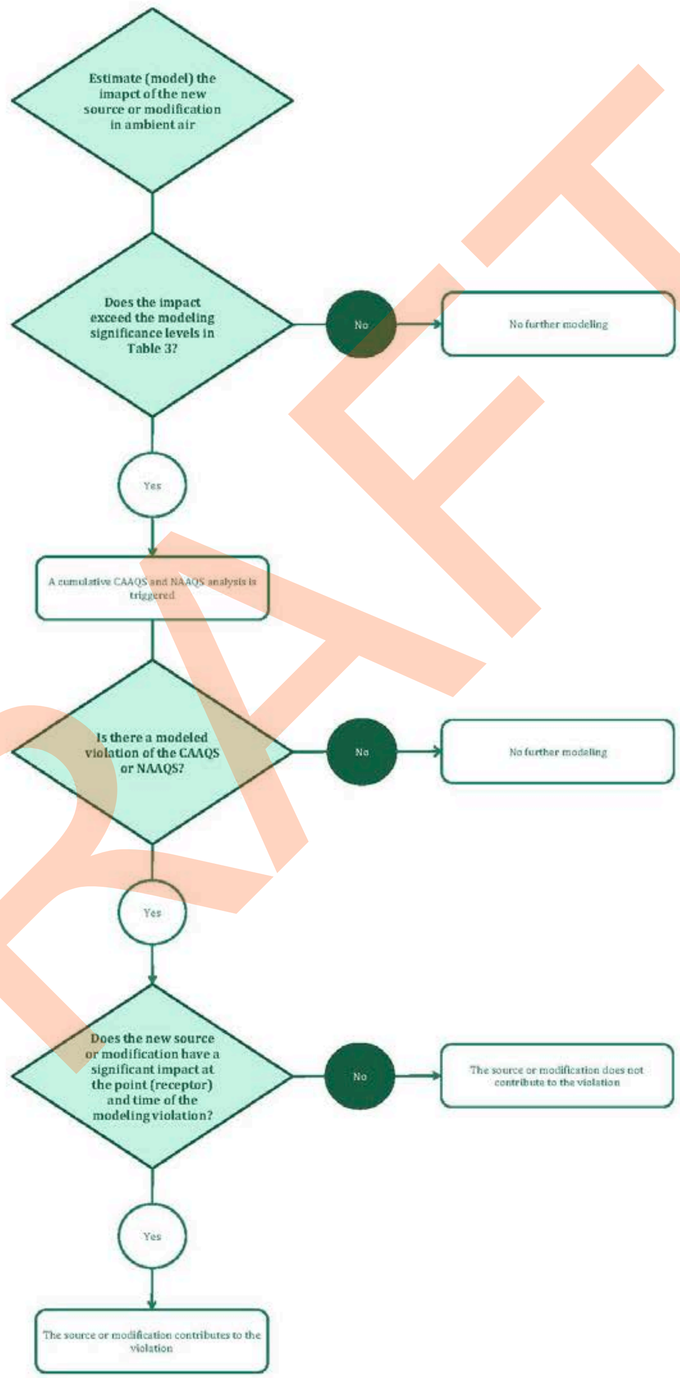
Pollutant & Averaging Period	Level	Form
Carbon Monoxide (CO)		
1 hour	40,000 µg/m^3	Not to be exceeded more than once per year
Nitrogen Dioxide (NO_2)		
Annual	100 µg/m^3	Annual Mean
Ozone (O_3)		
1 hour	235 µg/m^3	Expected number of days per calendar year, with maximum hourly average concentration greater than 0.12 ppm, is equal to or less than 1
Sulfur Dioxide (SO_2)		
3 hour	700 µg/m^3	Not to be exceeded more than once per year

Table 7. National Ambient Air Quality Standards (NAAQS)

Pollutant & Averaging Period	Primary/Secondary	Level	Form
Carbon Monoxide (CO)			
8 hour	Primary	9 ppm	Not to be exceeded more than once per year
1 hour	Primary	35 ppm	Not to be exceeded more than once per year
Lead (Pb)			
Rolling 3 month	Primary & Secondary	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)			
Annual	Primary & Secondary	53 ppb	Annual Mean
1 hour	Primary	100 ppb	98th percentile of 1-hour daily maximum concentrations, average over 3 years
Ozone (O_3)			
8 hour	Primary & Secondary	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Sulfur Dioxide (SO_2)			
Annual[1]	Primary	0.03 ppm	Annual mean
24 hour[1]	Primary	0.14 ppm	Not to be exceeded more than once per year
3 hour	Secondary	0.5 ppm	Not to be exceeded more than once per year
1 hour	Primary	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Particulate Matter < 10 µm (PM_{10})			
Annual	Revoked in 2006		
24 hour	Primary & Secondary	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Particulate Matter < 2.5 µm ($PM_{2.5}$)			
Annual	Primary	12.0 µg/m^3	Annual mean, averaged over 3 years
Annual	Secondary	15.0 µg/m^3	Annual mean, averaged over 3 years
24 hour	Primary & Secondary	35 µg/m^3	98th percentile, averaged over 3 years

[1]The 24-hour and Annual SO_2 standards were revoked in 2010; however, they remain in effect in Colorado until December 21, 2018. Please contact the Division if you have questions regarding SO_2.

Figure 4. Flowchart of the Air Quality Impact Analysis Process for CAAQS and NAAQS



PSD Increment Analysis

The air quality analysis for new/modified sources subject to Prevention of Significant Deterioration (PSD) rules must demonstrate compliance with PSD increments if the impact from the new source or modification is significant. This section is not intended to provide a complete overview of PSD increment consumption; for that, refer to EPA guidance documents.

The purpose of the PSD increment analysis is to demonstrate that emissions of applicable criteria pollutants from a new major source or major modification of an existing source will not cause or contribute to an exceedance of an increment. The PSD increment is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant. The following discussion explains PSD increment analyses followed by the basic procedure for conducting the analyses.

Refer to Section 5, Criteria Pollutants Recommendations, for more information about the design value that should be used to determine compliance with applicable PSD increments. Increment consumption is a receptor-by-receptor concept. That is, the consumption of PSD increment by one particular source does not necessarily preclude similar increment consumption by another nearby source if the consumption occurs on a different day (i.e., under different meteorological conditions) and/or at a different location (e.g., receptor).

All changes in emissions and related parameters[7] after the minor source baseline date may affect PSD increment consumption or expansion. This includes both stationary sources and mobile sources. In addition, modifications at major stationary sources after the major source baseline date also may affect increment consumption. Refer to U.S. EPA guidance and Division guidance[8] for procedures.

Area and mobile sources may be important increment consuming sources. In most situations, the Division can provide at least a county-level inventory of increment consuming area and mobile emissions; however, because of the amount of time required by the Division to develop such inventories, the Division will typically not develop increment inventories for an individual permit application until the permit applicant and the Division agree that an area and mobile source inventory is actually warranted. If the Division does not have the resources necessary to develop the inventory in the time frame needed by the applicant, the burden of doing the area and mobile analysis may fall on the applicant.

All areas of Colorado are Class II areas except for the Class I areas shown in Figures 6 and 7. PSD baseline areas for PM_{10} are based on the Colorado Air Quality Control Regions (AQCRs) shown in Figure 5. It is worth noting that there are both Colorado AQCRs (planning areas) and federal AQCRs. They are comprised of different counties. While the Colorado AQCRs are used as PSD baseline areas for PM_{10}, the federal AQCRs are used in U.S. EPA's Air Quality System (AQS). The entire state serves as the baseline

[7] "The creditable increase of an existing stack height or the application of any other creditable dispersion technique may effect increment consumption or expansion in the same manner as an actual emissions increase or decrease. That is, the effects that a change in the effective stack height would have on ground level pollutant concentrations generally should be factored into the increment analysis." (USEPA, 1990)

[8] Refer to the *Technical Guidance Series: PSD Increment Tracking System* document for a detailed discussion about the PSD increment tracking in Colorado.

area for SO_2 and NO_2. Figure 5 and Table 9 show the minor source baseline areas and trigger dates in Colorado.

Increment Calculation

The baseline concentration does not need to be obtained to determine the amount of PSD increment consumed or the amount of increment available. Instead, the amount of PSD increment that has been consumed in an attainment or unclassified area is determined from the emissions increases and decreases that have occurred from stationary sources in operation since the applicable minor source baseline date. Modeled increment consumption calculations reflect the change in ambient pollutant concentration attributable to increment-affecting emissions. Increment consumption (or expansion) calculations are determined by evaluating the difference between the actual emissions at the applicable minor source baseline date ($Actual_{BD}$) and actual emissions as of the date of the modeling demonstration ($Actual_{MD}$).

- *$Actual_{BD}$.* This is the representative 2-year average for long-term emission rates, or the maximum short-term emission rate in the same 2-year period immediately before the applicable minor source baseline date. For major sources permitted at or after the applicable major source baseline date but not in operation as of the applicable minor source baseline date or for minor sources not in operation as of the applicable minor source baseline date, $Actual_{BD}$ would be the permit allowable emission rate.
- *$Actual_{MD}$.* This is the most recent, representative 2-year average for long-term emissions rates, or the maximum short-term emission rate in the same 2-year period immediately before the modeling demonstration. If little or no operating data are available, as in the case of permitted sources not yet in operation at the time of the increment analysis, $Actual_{MD}$ would be the permit allowable emission rate.

A tiered approach is suggested for this analysis to limit the amount of research needed to determine actual emission rates. The applicant should follow the basic procedure described in the following paragraphs.

PSD Increment Step 1: Determine whether the modeled high concentration (excluding background concentration) obtained in the PSD cumulative NAAQS analysis is equal to or less than the applicable increment. If yes, the demonstration is complete because all sources were modeled at allowable emission rates. This does not apply for criteria pollutants with NAAQS that are statistically-based (i.e., multi-year average).

PSD Increment Step 2: Determine the significant impact area for each criteria pollutant and averaging period subject to the PSD increment analysis. The significant impact area will be the same one used in the PSD NAAQS analysis, except for those criteria pollutants with NAAQS that are statistically-based. For criteria pollutants with NAAQS that are statistically-based, determine the significant impact analysis following the convention of exceedance-based NAAQS (i.e., maximum predicted concentration).

PSD Increment Step 3: Obtain a listing of applicable increment-affecting sources and associated parameters within 50km of the significant impact area from the Division to evaluate in the air quality impact analysis. Sources beyond 50km should be considered if a long-range transport increment analysis is being performed for a federal Class I area. It is the responsibility of the applicant to obtain these data and ensure their accuracy. Any changes made to the data must be documented and justified.

PSD Increment Step 4: Adjust the emission inventory using professional judgment.

- Omit any source from the inventory that has a negative emission rate unless the source existed and was in operation at the applicable minor source baseline date. A source must have existed and been in operation on or before the applicable minor source baseline date to be considered for increment expansion.
- Omit any source permitted after the applicable minor source baseline date that has shut down or any source as part of the current project that will be shut down. A source that did not exist or was not operating on or before the applicable minor source baseline date would not have contributed to the air quality at that time, and there would be no need to model the source with an emission rate of zero.

PSD Increment Step 5: Conduct the modeling demonstration using the same meteorological data set used in the determination of the significant impact area using the following tiered approach, as applicable.

Increment Modeling Tier I. Model all sources using their allowable emission rates. This approach is conservative since the increment consumed is based on the entire allowable emission rate. Compare the modeled high concentration to the appropriate increment. If the increment is not exceeded, the demonstration is complete. Otherwise, go to Tier II.

Increment Modeling Tier II. Model selected sources with $Actual_{MD}$ emission rates and all other sources at allowable emission rates. The selected sources are usually the applicant's sources. This process assumes that the increment consumed for the selected sources is based on the entire actual emission rate and the entire allowable emission rate for all other sources. If the increment is not exceeded, the demonstration is complete. Otherwise, go to Tier III.

Increment Modeling Tier III. Model selected sources that existed and were in operation at the applicable minor source baseline date with the *difference* between $Actual_{MD}$ and $Actual_{BD}$.

- For major sources permitted at or after the applicable major source baseline date but not in operation as of the applicable minor source baseline date or for minor sources not in operation as of the applicable minor source baseline date, use the difference between $Actual_{MD}$ and the allowable emission rate.
- For sources that existed at the applicable minor source baseline date, where a change in actual emission rates involved a change in stack parameters, use the emission rates associated with both the applicable minor source baseline date and the current and/or proposed source configuration. That is, enter the $Actual_{BD}$ as negative numbers along with the applicable minor source baseline source parameters, and enter $Actual_{MD}$ for the same source as positive numbers along with the current and/or proposed source parameters.
- Use emission rates found in Tiers I or II for other sources, as applicable.

If the increment is not exceeded, the demonstration is complete. Otherwise, continue to refine increment emission rates or demonstrate that the project's impact will not be significant.

Unique Colorado PSD Increment Requirement

As required by Regulation No. 3, Part D, §X.A.5.a, new sources and modifications subject to PSD rules should demonstrate that the source by itself will not consume more than 75% of any applicable PSD increment. The 75% rule does not apply to minor sources.

Along with the 75% increment consumption requirement, there are also Class II areas in Colorado that have the same protections as Class I areas for SO_2. Refer to Regulation No. 3, Part D, §VIII.B for more information. Modeling is recommended for SO_2 sources that could impact these areas, based on boundaries that existed on August 7, 1977:

a) Florissant Fossil Beds National Monument;

b) Colorado National Monument;

c) Dinosaur National Monument;

d) Black Canyon of the Gunnison National Park (areas that are not already Class I);

e) Great Sand Dunes National Park and Preserve (areas that are not already Class I);

f) Uncompahgre Mountain Primitive Area;

g) Wilson Mountain Primitive Area;

h) BLM lands in the Gunnison Gorge Recreation Area.

Figure 6 depicts these Class II areas.

Table 8. PSD Increments (µg/m^3)

Pollutant	Class I	Class II
Nitrogen Dioxide (NO_2)		
Annual	2.5	25
1 hour	(a)	(a)
Sulfur Dioxide (SO_2)		
Annual	2	20
24 hour	5	91
3 hour	25	512
1 hour	(a)	(a)
Particulate Matter < 10 µm (PM_{10})		
Annual	4	17
24 hour	8	30
Particulate Matter < 2.5 µm ($PM_{2.5}$)		
Annual	1	4
24 hour	2	9

(a) PSD increment level has not been defined

Class III increment values have been removed as there are no Class III areas in Colorado

Table 9. PSD Baseline Dates in Colorado

As of March 2018[1]

Pollutant	Major Source Baseline Date	Trigger Date	Minor Source Baseline Date	Air Quality Control Region (AQCR)	Triggering Application
Sulfur Dioxide (SO_2)	01/06/1975	08/07/1977	10/12/1977	Entire State	Rio Blanco Oil Shale – Tract C-a
Nitrogen Dioxide (NO_2)	02/08/1988	02/08/1988	03/30/1989	Entire State	Amoco Production – Wattenberg
Particulate Matter < 10 µm (PM_{10})	01/06/1975	08/07/1977	11/01/1988	AQCR 1	Colorado Power Partners – Brush
			01/17/1980	AQCR 2	Platte River Power Authority – Rawhide
			11/14/2000	AQCR 3	North American Power Group – Kiowa Creek
			11/22/1994	AQCR 4	Colorado Springs Utilities – Nixon
			11/09/2000	AQCR 5	Tri-State – Limon
			06/19/1989	AQCR 6	Cimarron Chemical – Vilas
			04/04/1995	AQCR 7	Westplains Energy - Pueblo
			Not Triggered	AQCR 8	NA
			Not Triggered	AQCR 9	NA
			08/20/1984	AQCR 10	Colorado Ute – Nucla
			10/12/1977	AQCR 11	Rio Blanco Oil Shale – Tract C-a
			07/01/1983	AQCR 12	Louisiana Pacific – Kremmling
			Not Triggered	AQCR 13	NA
Particulate Matter < 2.5 µm ($PM_{2.5}$)	10/20/2010	10/20/2011	09/10/2013	--	Black Hills – Pueblo Airport Generating Station Unit 6

[1]Contact the Division for the latest information
$PM_{2.5}$ increment is currently being reviewed within the Division. This table will be updated once the Division makes a final decision regarding the AQCRs for $PM_{2.5}$. Please contact the Division for more information.

Figure 5. Colorado PM_{10} PSD Baseline Areas

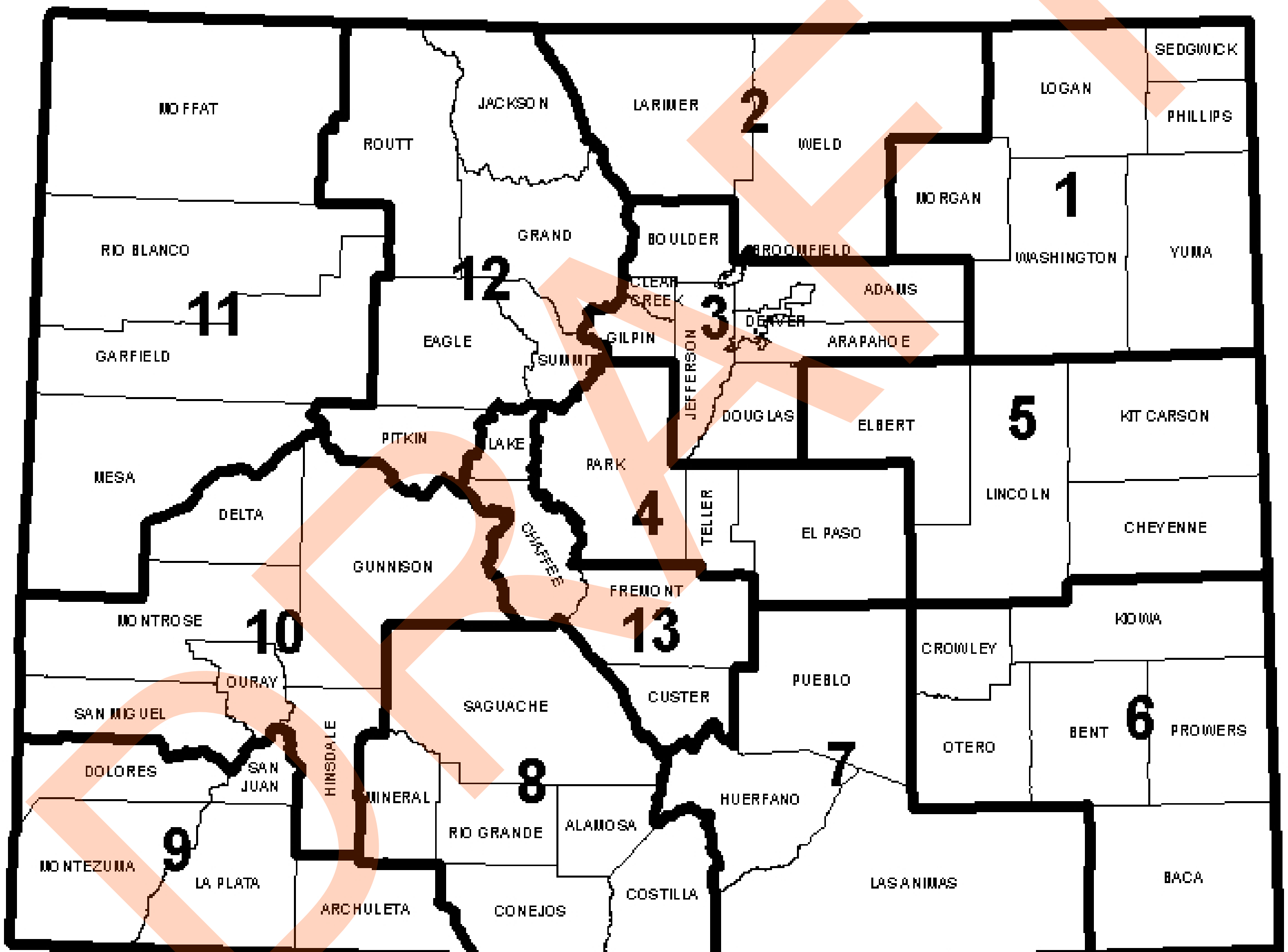


Figure 6. Class II Areas with "Class I Protection" for SO_2 Increment

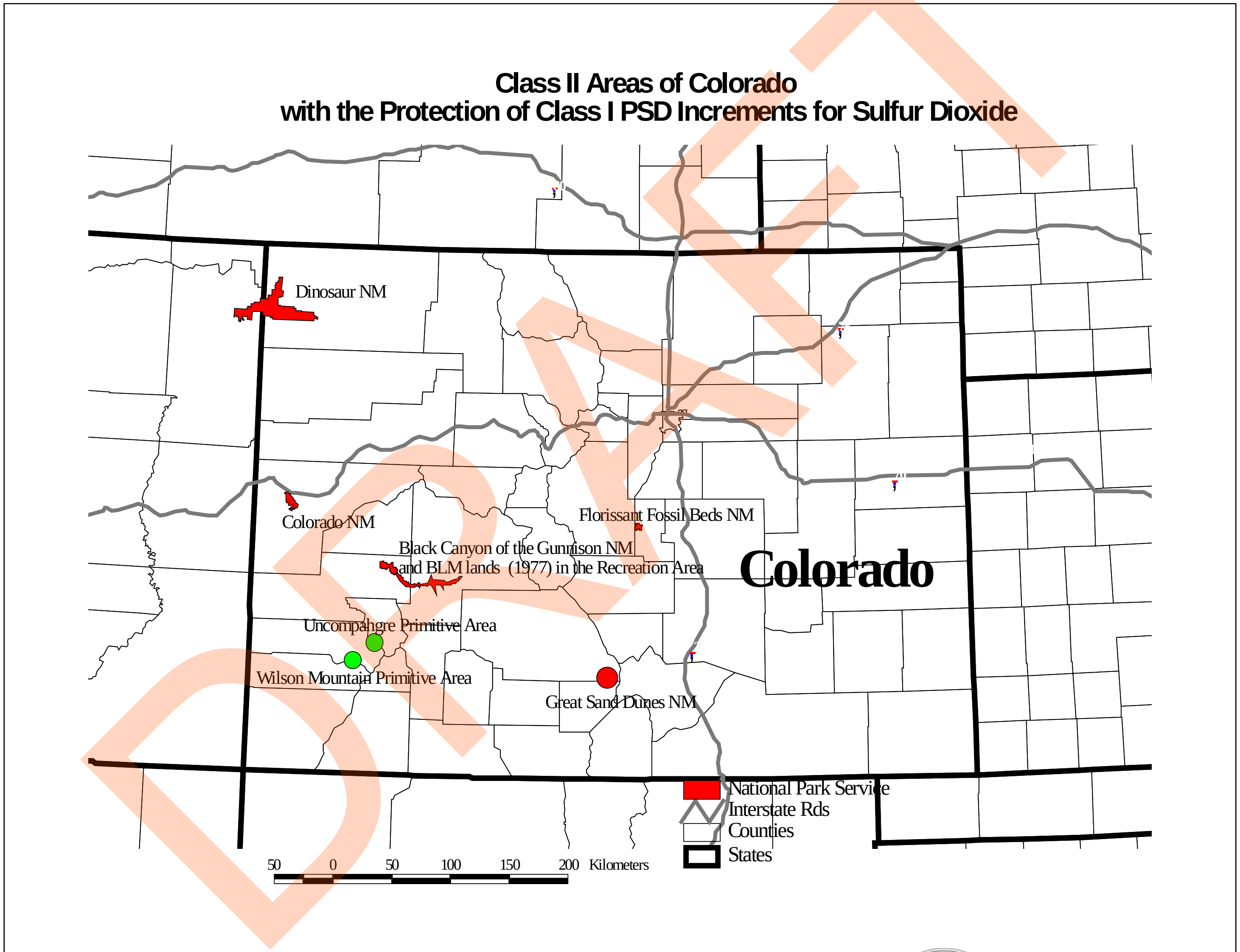
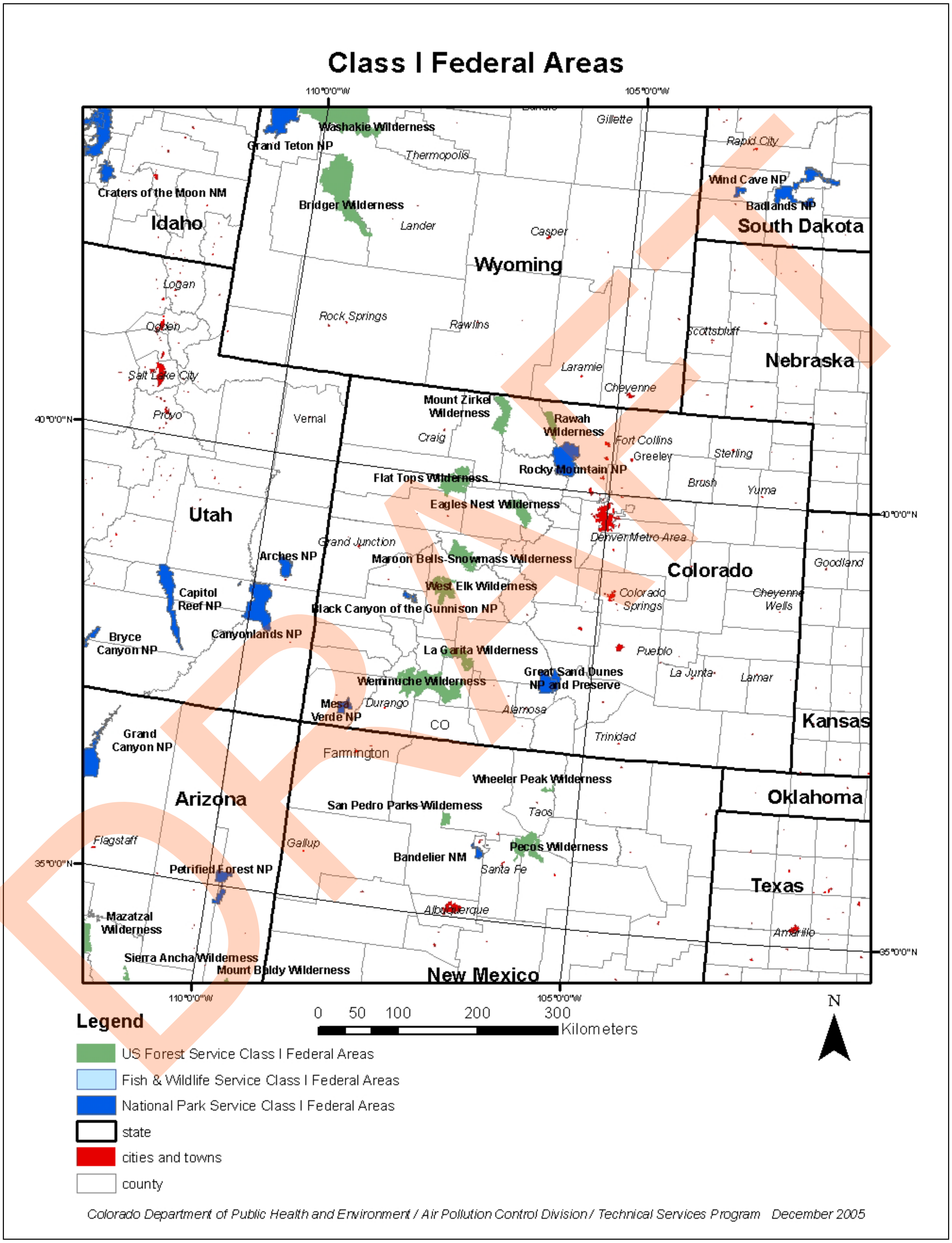


Figure 7. Federal Class I Areas



Additional Impacts Analysis

This section is currently under review within the Division. Please contact Division staff to confirm the procedure for an additional impacts analysis.

Regulation No. 3, Part D, §VI.A.6 requires an *additional impact analysis* for ***major stationary sources*** and major modifications. The additional impact analysis applies in all areas, including Class I and Class II areas. The regulation specifically requires an "analysis of the impairment to visibility, water, soils, and vegetation." In some instances, a growth analysis is also required. The growth analysis is recommended only if the new source or modification will have a ***significant impact***; that is, it is only required if an air quality impact analysis (e.g., CAAQS and NAAQS analysis, PSD increment analysis) is triggered.

The *additional impact analysis* can be done using ***qualitative*** or ***quantitative*** methods. The Division generally views the *analysis of impairment* as a disclosure type of requirement. The level of analysis depends on the situation and the likelihood that there could be some type of impairment.

In general, if the additional impact analysis suggests there might be adverse impacts to soils, vegetation, or visibility, the information may be used in the BACT review process. This does not mean that the BACT determination must fix the problem; it means that all the issues associated with BACT, including economics and environmental impacts should be balanced and considered.

Impact Analysis for Water

The inclusion of water in the additional impact analysis is a Colorado requirement. By regulation, the water analysis in Class II areas does not affect permit approval or denial or control technology selection. The water impact analysis is intended to serve as a data-gathering and analysis mechanism to allow the Division and others to further investigate problems such as acid deposition in high altitude lakes. Refer to the "Additional Impact Analysis" discussion in the "Statement of Basis and Purpose for the Prevention of Significant Deterioration Program Regulations" (adopted March 10, 1983) of the Common Provisions Regulation for more information about the intent of this requirement.

Visibility Analysis

In addition to the Class I visibility analysis discussed in section 7.5, an analysis of impairment to visibility in Class II areas should also be addressed in the permit application (see Regulation No. 3, Part D, §VI.A.6).

According to U.S. EPA guidance (USEPA 1990), "*in the visibility impairment analysis, the applicant is especially concerned with impacts that occur within the impact area of the proposed new source or modification. Note that the visibility analysis required here is distinct from the Class I area visibility analysis requirement. The suggested components of a good visibility impairment analysis are:*

- *a determination of the visual quality of the area,*
- *an initial screening of emission sources to assess the possibility of visibility impairment, and*
- *if warranted, a more in-depth analysis involving computer models*."

Refer to U.S. EPA guidance for more specific recommendations. The focus of Class I visibility analysis is on assessing visibility impacts within a Class I areas. The focus of the Class II visibility analysis is on sensitive views outside of Class I areas. The Division has developed a database of sensitive views to assess impacts in Class II areas. These are called ***scenic and/or important views***. They are not integral vistas.[9] The Class II scenic and/or important views do not have the force and effect of the visibility rules in Class I areas. The information regarding levels of change in visibility is used to track changes in visibility that might be important to the public. A list of these views is available from the Division.

The Division does not appear to have the authority to deny a permit if adverse visibility impacts occur outside a Class I area. Instead, the information may be used to consider the need for additional emission controls. Therefore, it is important to keep the Class I visibility analysis distinct from the Class II visibility analysis in the modeling report.

In practice, when PSD applicants contact the Division, the Division will determine if there are any Class II scenic views within the probable area of influence of the proposed source. If there are, the analysis approach should be determined on a case-by-case basis in consultation with the Division. If modeling is warranted, the modeling procedures for the scenic and/or important views are usually based on techniques similar to those used for Class I visibility assessments.

The Division does not have specific thresholds or criteria for determining when there is *impairment* to a Class II view. Impairment determinations are made on a case-by-case basis considering a number of factors including the geographic extent, intensity, duration, frequency, and time of modeled visibility impairment. Other factors such as interference with a visitor's visual experience, correlations between time of impairment with natural conditions that reduce visibility, and other criteria might be considered. Finally, limitations of the modeling system are considered. For example, results from a screening-level model do not carry as much weight as results from a refined model. The ability of the modeling system to properly account for relevant atmospheric chemistry and meteorology is also considered. If, after considering all appropriate criteria, it is believed that Class II visibility may be impaired, the Division may request that the "environmental impact analysis" portion of the "best available control technology" (BACT) determination be revisited.

A compliance demonstration with Colorado's visibility standard, which is applicable in the AIR Program[10] area, is not required to obtain a permit.

[9] An integral vista adopted into regulation can be afforded the same level of protection from visibility impairment as the Class I area itself or any lesser level or protection, as determined by a state on a case-by-case basis. Because views in the Western U.S. commonly extend for great distances, integral vistas are a controversial aspect of the Visibility SIP package. The Department of the Interior (DOI) preliminarily identified integral vistas associated with Class I areas on January 15, 1981. However, both the DOI (speaking for the National Park Service) and the Department of Agriculture (speaking for the U.S. Forest Service) later declined to officially list any vistas. One reason given by the DOI was that states already had sufficient opportunity through existing authority to protect integral vistas. Thus, the naming of integral vistas and incorporation into SIPs was left to individual states (CDPHE, 1992).

[10] The AIR program area is defined in 42-4-304, C.R.S. It generally includes all or part of the following counties: Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, and Weld.

Soils and Vegetation Analysis

Regulation No. 3 states that the owner or operator should provide an analysis of impairment to soils and vegetation for each regulated pollutant emitted in a significant quantity. Only vegetation with commercial or recreational value should be addressed. U.S. EPA's guidance states that, for most soils and vegetation, ambient concentrations of criteria pollutants below the secondary National Ambient Air Quality Standards (NAAQS) will not result in harmful effects. Nevertheless, the secondary NAAQS may not adequately protect certain sensitive vegetation and soils, particularly for regulated non-criteria pollutants (USEPA 1990), see section 7.3. As recommended in U.S. EPA guidance, new sources or modifications subject to PSD rules should:

a) provide an inventory of soils and vegetation with commercial or recreational value in the vicinity of the facility (e.g., crops);

b) review peer-reviewed scientific literature to determine the concentration level (for appropriate averaging times) of regulated pollutants that would be harmful to vegetation; if no information is available in the literature, assume the secondary NAAQS is protective if one exists for the regulated pollutant under review; if modeling has been done, compare modeled impacts to the secondary NAAQS and to other levels of concern identified through a literature search; if the potential impact is determined to be harmful, discuss the nature of the harm and its spatial extent in the modeling report.

AQRV and Visibility Analysis in Federal Class I Areas

This section is currently under review within the Division. Please contact Division staff to confirm the procedure for an AQRV and Visibility analysis in Class I areas.

The Air Quality Related Values (AQRV), analysis is required as part of a PSD permit to estimate potential changes in visibility, deposition, soils and water in Class I areas. The goal of the Class I impact analysis is to determine if the projected changes to AQRVs, as a result of the installation of a new source or the modification of an existing source under the PSD regulations, are acceptable for a given Class I area (See Regulation No. 3, Part D, §XIII and XIV for regulatory requirements). The decision to issue a permit is the responsibility of the Division. A permit application can be denied if a proposed source would impair visibility or other AQRVs in a Class I area. It is important to note that the determination of impairment is done on a case-by-case basis. In the case of visibility, this determination will be made based on the magnitude, number of occurrences, time of year and if such changes would affect a visitor's experience in the area. For more on the regulatory framework, refer to applicable regulations and section 10.1.

In general, the elements of the federal Class I AQRV, including visibility, analysis are determined on a case-by-case basis.

Regulation No. 3, Part D, §XIII.A states that "Within twenty days of receipt of a permit application for a new major stationary source or major modification that may affect visibility or air quality related values in any Federal Class I area, the division shall transmit a copy of the application to all affected Federal Land Managers and consult with them as to its completeness in its analysis and monitoring (if required) of air quality related values. If the division receives advance notification of a permit application of a source that may affect visibility or air quality related values, it will notify all affected Federal Land Managers within thirty days of such notification. The division will consider any analysis performed by a Federal Land Manager that indicates there will be an adverse impact on visibility or air quality related values if such analysis is received within thirty days after the Federal Land Manager receives a copy of the complete application. If the division disagrees with the Federal Land Manager, any notices for public comment or of a public hearing on the application will explain the disagreement or state where the explanation can be obtained."

If a protocol is submitted to the Division, as recommended in section 8.1, a copy should be provided for each affected federal land manager.

As stated in Regulation No. 3, Part D, §XIII, the Division sends affected FLMs a copy of the permit application for proposed new sources or modifications that may affect *air quality related values* (AQRVs) in any federal Class I area. For relatively small and/or distant major stationary sources, the FLM may not take an active role in the review or modeling process. In other cases where a significant impact may occur or where there may be unacceptable levels of change to AQRVs, including visibility, the FLM usually takes an active role.

While the Division's Stationary Sources Program is responsible for forwarding the permit application to the appropriate FLMs, Technical Services Program staff typically contact affected FLMs to obtain Class I significance levels and other recommendations for the analysis required by Regulation No. 3.

The initial contact with FLMs should occur early in the process. If there is a PSD pre-application meeting, FLMs should be invited. Regulations require that the Division consult with the FLMs as to the completeness of the permit application. If the applicant decides to directly contact affected FLMs for recommendations, the Division should be kept in the loop.

Air Quality Related Values Analysis for Major Stationary Sources

For proposed major stationary sources and major modifications located in attainment areas, visibility requirements for new sources and modifications subject to PSD rules are found in various sections of Regulation No. 3, Part D including: §VI.A.6, §XIII, and §XIV.E

For proposed major stationary sources and major modifications located in nonattainment areas, refer to Regulation No. 3, Part D, §V.

Figure 3 illustrates key aspects of the regulatory decision process for major stationary sources and major modifications seeking construction permits:

- The first step in the process is to determine those pollutants for which there will be a *significant* emission rate increase for a new source or a significant net emissions increase for a major modification.
- If the proposed emission rate is not significant, the additional impact analysis (Regulation No. 3, Part D, §VI.A.6) and the AQRV requirements (§XIII and §XIV.E) do not apply. In practice, new sources are major for some pollutants and minor for others. In some cases, the modification may not be major for all pollutants that would affect AQRVs.

- If the Division concludes that an "analysis of impairment" (§VI.A.6) is necessary, there are several key decisions that must be made. For example, the applicant should discuss the project with the Division to decide if any AQRV monitoring is warranted (§XIII.B). The Division will make this decision after consultation with the FLM. If monitoring is required, a monitoring plan should be prepared and submitted for Division approval. If monitoring is not warranted, which is usually the case, then the applicant can move on to the next step in the flowchart.
- The applicant should consult with the Division to determine the extent of the "analysis of impairment." The regulations do not clearly define what constitutes an "analysis of impairment." Thus, the extent of the analysis is decided on a case-by-case basis. The Division and U.S. EPA strongly recommend that the applicant submit a protocol.
- When the permit application is submitted to the Division, it must include the "analysis of impairment" to be ruled complete.
- Aplicants should be aware of Regulation No. 3, Part D, §XIII.A – Federal Class I Areas; it states, *"Within twenty days of receipt of a permit application for a new major stationary source or major modification that may affect visibility or air quality related values in any Federal Class I area, the Division shall transmit a copy of the application to all affected Federal Land Managers and consult with them as to its completeness in its analysis and monitoring (if required) of air quality related values. If the Division receives advance notification of a permit application of a source that may affect visibility or air quality related values, it will notify all affected Federal Land Managers within thirty days of such notification."*
    - The next step is to determine if the source will cause or contribute to a violation of applicable Class I PSD increments.
    - If the source does not cause or contribute to a Class I increment violation §XIII.A states, *"The Division will consider any analysis performed by a Federal Land Manager that indicates there will be an adverse impact on visibility or air quality related values if such analysis is received within thirty days after the Federal Land Manager receives a copy of the complete application"*

But if the FLM fails to determine if there will be an adverse impact, the Division may perform the analysis, as explained in Regulation No. 3, Part B §XIII.C.

- If it is determined, through modeling provided by the applicant, that the source will cause or contribute to a violation of applicable Class I PSD increments, then the Division may still issue the permit if the requirements of §XIII.D are met. Regulation No. 3, Part B, §XIII.D states, *"The owner or operator of a proposed major stationary source or major modification may demonstrate to the satisfaction of the Federal Land Manager that the emissions from such source or modification would not* *have an adverse impact on the air quality related values (including visibility) of Class I lands under the Federal Land Manager's jurisdiction, notwithstanding that the change in air quality resulting from emissions from such source or modification would cause or contribute to concentrations that would exceed the maximum allowable increases for Class I area. If the Federal Land Manager concurs with such demonstration and so certifies to the Division, the Division or the Commission may, provided that applicable requirements are otherwise met, issue the permit with such emission limitations as may be necessary to assure that emissions of sulfur dioxide, and PM10, PM2.5 and nitrogen oxides would not exceed the following maximum allowable increases over the minor source baseline concentration for such pollutants..."*

- *PM2.5*
  - *Annual arithmetic mean 4 μg/m^3*
  - *Twenty-four hour maximum 9 μg/m^3*
- *PM10*
  - *Annual arithmetic mean 17 μg/m^3*
  - *Twenty-four hour maximum 30 μg/m^3*
- *Sulfur Dioxide*
  - *Annual arithmetic mean 20 μg/m^3*
  - *Twenty-four hour maximum 91 μg/m^3*
  - *Three-hour maximum 325 μg/m^3*
- *Nitrogen Dioxide*
  - *Annual arithmetic mean 25 μg/m^3*

- Although the FLMs have an affirmative responsibility to protect AQRVs they have no permitting authority under the federal Clean Air Act (CAA). They also have no authority under the CAA to establish air quality-related rules or standards. The FLM role consists of considering whether emissions from a new source may have an adverse impact on AQRVs and providing comments to permitting authorities. Thus, the final decision to grant or deny a permit is made by the Division or AQCC. Regulation No. 3, Par B, §XIII.A states, *"If the Division disagrees with the Federal Land Manager, any notices for public comment or of a public hearing on the application will explain the disagreement or state where the explanation can be obtained."*
- If the FLMs disagree with the Division's decision to grant a permit, they may request a hearing, see Regulation No. 3, Part D, §IV.A.6.

Pre- and Post-Construction Monitoring Analysis

Division modeling and monitoring staff should be contacted as early as possible to discuss the need to conduct pre-construction monitoring. If monitoring is proposed or required, a monitoring plan consistent with applicable U.S. EPA and Division monitoring guidance (e.g., "Ambient Air Pollution and Meteorological Monitoring Guidance") should be submitted for approval.

If the proposed emission rate from a new source or the net emissions increase from a modification is significant for a given pollutant, as defined by Regulation No. 3, the estimated impact from the new source or modification should be compared to the significant monitoring concentration (see Table 10 or Regulation No. 3, Part D, §VI.D.2). In addition, if possible, existing air quality levels should be compared to the significant monitoring concentration.

Pre-Construction Monitoring Analysis

Refer to Regulation No. 3, Part D, §VI.A.3 for details about how pre-construction monitoring requirements are determined.

If existing air quality levels or the estimated impacts from the proposed source or modification are below the applicable monitoring de minimis level, Regulation No. 3 states that the monitoring requirements may not apply. If the levels are above the de minimis levels, pre-construction monitoring may be required if the Division believes it is necessary.

Permit applicants should be aware that the time-line for submitting a PSD application could be affected by the requirement to collect ambient data. For example, if the collection of site-specific meteorological data is required, at least a full year of data must be collected. For air quality data, at least a full year of data is typically required, although as little as four months of data may be allowed in some circumstances. The Division must approve ambient data for use before the permit application can be ruled *complete*.

Post-Construction Monitoring Analysis

The modeling report submitted with the permit application should address the need for post-construction monitoring (see Regulation No. 3, Part D, §VI.A.4).[11] As part of the permit review process, the Division will, based on the language in the regulation, determine if post-construction monitoring is necessary.

[11] 40 CFR Part 51.166(v)(2) states that the source "shall...conduct ambient air monitoring as the reviewing authority determines is necessary...."

Table 10. PSD Significant Monitoring Concentration[1]

Pollutant & Averaging Period	Level
Carbon Monoxide (CO)	
8 hour	575 µg/m^3
Nitrogen Dioxide (NO_2)	
Annual	14 µg/m^3
Ozone (O_3)	
8 hour	100 tpy VOCs
1 hour	100 tpy VOCs
Sulfur Dioxide (SO_2)	
24 hour	13 µg/m^3
Particulate Matter < 10 µm (PM_{10})	
24 hour	10 µg/m^3
Particulate Matter < 2.5 µm ($PM_{2.5}$)	
24 hour	4 µg/m^3
Fluorides	
24 hour	0.25 µg/m^3
Total Reduced Sulfur	
1 hour	10 µg/m^3
Hydrogen Sulfide	
1 hour	0.2 µg/m^3
Reduced Sulfur Compounds	
1 hour	10 µg/m^3

[1]The significant monitoring concentrations (de minimis levels) apply only to new sources and modifications subject to PSD review (see Regulation No. 3, Part D, §VI).

Regulated, Non-Criteria Pollutant Analysis

For regulated, non-criteria pollutants (i.e., fluorides, total reduced sulfur, hydrogen sulfide, and reduced sulfur compounds), a separate air quality analysis should be submitted if the applicant proposes to emit the pollutant in a significant amount from a new source or proposes to cause a significant net emissions increase from a modification. The PSD significant emission rates for these pollutants are as follows:

- Fluorides, 3 tons per year;
- Sulfuric Acid Mist, 7 tons per year;
- Hydrogen Sulfide, 10 tons per year;
- Total Reduced Sulfur (including hydrogen sulfide: 10 tons per year);
- Reduced Sulfur Compounds (including hydrogen sulfide: 10 tons per year);

Estimated impacts from regulated non-criteria pollutants should be presented and compared to the significant monitoring concentrations (see Table 10 or Regulation No. 3, Part D, §VI.B.3). Existing background concentration estimates should be determined in consultation with the Division. If ambient measurements are available, they should be presented and compared to the significant monitoring concentrations.

Section 5 – Preferred Air Dispersion Models & Associated Inputs

Source Data

Begin by clearly identifying and documenting all sources of emissions associated with the modeling analysis. For each identified source, evaluate and discuss how emissions are generated and emitted. This discussion will be the supporting basis for the source characterization used in the modeling analysis. Then determine and document the appropriate source parameters associated with the source characterization.

Criteria Pollutant Recommendations

While this section is intended for sources located in attainment or unclassified areas of Colorado, it may, in some cases, be used by sources located in nonattainment areas; however, sources in nonattainment areas should read Section 2, Nonattainment Areas, first.

In a compliance demonstration, the applicable design concentration must be calculated. This is usually done within the model or by using a post-processor. The design concentrations vary depending on the available meteorological data. If there is not a meteorological dataset that is adequately representative of the facility, then the design concentration needs to be the highest concentration for all pollutants and averaging periods. This allows the worst-case impacts to be captured in the modeling analysis.

The design concentrations also vary depending on the impact analysis being performed. For a NAAQS/CAAQS analysis Appendix W states, *"the design concentration is the combination of the appropriate background concentration with the estimated modeled impact of the proposed source…The specific form of the NAAQS for the pollutant(s) of concern will also influence how the background and modeled data should be combined for appropriate comparison with respective NAAQS in such a modeling demonstration. Given the potential for revision of the form of the NAAQS and the complexities of* *combining background and modeled data, specific details on this process can be found in the applicable modeling guidance available on the EPA's SCRAM Web site."* For a PSD increment analysis Appendix W states, *"the design concentration includes impacts occurring after the appropriate baseline data from all increment-consuming and increment-expanding sources."* For short-term increments, the maximum allowable increases may be exceeded once per year at each site. For annual increments, the maximum allowable increases may not be exceeded.

The facility should contact the Division's Stationary Sources Program (SSP) to determine what pollutants need to be included in the air quality impact analysis.

Carbon Monoxide

Compliance demonstrations should address both the 1-hour and 8-hour NAAQS. The maximum highest first high (H1H) modeled concentration from all receptors should be the design value from the SIA to compare to the SILs. When using representative meteorological data, the maximum high second high (H2H) modeled concentration from all receptors should be the design value for both 1-hour and 8-hour averaging periods.

Lead

Compliance demonstrations should address the 3-month NAAQS. The NAAQS is significantly more stringent than the CAAQS monthly value; therefore, the monthly CAAQS was revoked from Colorado Regulation 8 Part C II.B in March 2010.

Nitrogen Dioxide

Compliance demonstrations should address both the 1-hour and annual NAAQS; however, the Division's Stationary Sources Program (SSP) published a memo (PS Memo 10-01) that exempts facilities from showing compliance with the 1-hour NO_2 NAAQS if the long-term modeling threshold is not exceeded. Please be aware that the Division's TSP modeling staff will model the 1-hour averaging period if the facility emissions are above the short-term threshold regardless of their long-term emissions rate. The Division's TSP modeling staff will perform this analysis in support of Regulation No. 3 to demonstrate the facility's impact will not cause or contribute to a violation of the NAAQS. The outcome of the analysis will be included in the public final modeling report.

Both averaging periods are best performed with a tiered approach:

Tier I: 100 percent conversion of nitrogen oxides (NO_x) to nitrogen dioxide (NO_2).

Tier II: Ambient Ratio Method 2 (ARM2) uses an ambient ratio between 0.5 and 0.9 that must be derived from U.S. EPA's Air Quality System. Colorado no longer accepts the EPA-recommended ARM ratio of 0.8 as monitoring data has shown NO_2/NO_X ambient ratios exceeding 0.8 conversions. Justification for ambient ratio used is required. This method should also be used if the following are true:

- Tier I results are within or below a range of 150 – 200 ppb
- NO_2 background concentrations are below EPA's recommended range of 20 – 30 ppb
- O_3 background concentrations are below EPA's recommended range of 80 – 90 ppb
- In-stack NO_2/NO_x ratios at or below 0.2

Tier III: Ozone Limiting Method (OLM) uses in-stack NO_2/NO_x ratios and background concentrations. The EPA established a general acceptance of 0.5 as a default in-stack ratio of NO_2/NO_x for input to OLM. If the applicant proposes to use an in-stack NO_2/NO_x ratio other than the EPA default, sufficient justification and documentation will need to be provided to support the source-specific data. The source-specific in-stack NO_2/NO_x ratio needs approval from the permit engineer. Hourly by season profiles of both NO_2 and O_3 should be requested from the Division for input to OLM.

The maximum highest first high (H1H) modeled concentration from all receptors should be the design value from the SIA to compare to the SILs. When using representative meteorological data, the 1-hour design value should be the maximum 5-year average of the 98th percentile of the annual distribution of the maximum daily 1-hour modeled concentrations or the highest eighth high (H8) for each receptor. When using representative meteorological data, the annual design value should be the maximum modeled concentration for all receptors across all years of meteorological data.

Ozone

In general, accurate and cost effective methods for modeling ozone impacts from stationary point sources are not available. Therefore, ozone modeling is not routinely requested for construction permits, although it could be in unusual cases such as situations where the Division believes ozone standards could realistically be violated by the proposed source or modification. If modeling is considered, the cost of conducting such an analysis will be factored into the decision process.

Precursors to ozone need to be discussed with the Division's TSP modeling staff. The applicant should review applicable EPA guidance regarding precursors to ozone.

Particulate Matter < 10µm (PM_{10})

Compliance demonstrations should address the 24-hour NAAQS. The annual PM_{10} NAAQS was revoked in 2006 so compliance is no longer required for this averaging period. The maximum highest first high (H1H) modeled concentration from all receptors should be the design value from the SIA to compare to the SILs. When using representative meteorological data, the design value should be maximum highest sixth high (H6H) modeled concentration for all years of meteorological data.

Particulate Matter < 2.5µm ($PM_{2.5}$)

Compliance demonstrations should address both the 24-hour and annual NAAQS. The maximum highest first high (H1H) modeled concentration from all receptors should be the design value from the SIA to compare to the SILs. When using representative meteorological data, the 24-hour design value should be the maximum 5-year average of the 98th percentile of the annual distribution of the maximum 24-hour modeled concentration or the highest eighth high (H8H) for each receptor. When using representative meteorological data, the annual design value should be the maximum 5-year average modeled concentration from all receptors.

Secondary formation of $PM_{2.5}$ needs to be discussed with the Division's TSP modeling staff. The applicant should review applicable EPA guidance regarding when modeling secondary formation of $PM_{2.5}$ is necessary.

Sulfur Dioxide

Compliance should be demonstrated with the 1-hour, 3-hour, 24-hour, and annual NAAQS as well as with the Colorado 3-hour standard of 700 µg/m^3. The 24-hour and annual NAAQS remain in effect for "*any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards and any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards."* The state of Colorado was designated as attainment/unclassifiable on December 21, 2017; therefore, compliance demonstrations for the 24-hour and annual NAAQS are required until December 21, 2018.

Also, the Division's Stationary Sources Program (SSP) published a memo (PS Memo 10-01) that exempts facilities from showing compliance with the 1-hour SO_2 NAAQS if the long-term modeling threshold is not exceeded. This memo does not exempt a facility from showing compliance with the 3-hour and 24-hour NAAQS and CAAQS. Please be aware that the Division's TSP modeling staff will model the 1-hour averaging period if the facility emissions are above the short-term threshold regardless of their long-term emissions rate. The Division's TSP modeling staff will perform this analysis in support of Regulation No. 3 to demonstrate the facility's impact will not cause or contribute to a violation of the NAAQS. The outcome of the analysis will be included in the public final modeling report.

The maximum highest first high (H1H) modeled concentration from all receptors should be the design value from the SIA to compare to the SILs. When using representative meteorological data, the 1-hour design value should be the maximum 5-year average of the 99th percentile of the annual distribution of the maximum daily 1-hour modeled concentration or the highest fourth high (H4H) for each receptor. When using representative meteorological data, the 3-hour and 24-hour design values should be the maximum highest second high (H2H) modeled concentration from all receptors. When using representative meteorological data, the annual design value should be the maximum modeled concentration from all receptors across all years of meteorological data.

Mobile Sources Data

Facilities that involve haul trucks need to include fugitive dust emissions in both the permit application and the air quality impact analysis. Large mining equipment tailpipe emissions should also be included. The Division is currently developing more guidelines to establish when to include tailpipe emissions from haul road traffic and mining equipment. The Division has the current procedure if tailpipe emissions are to be included in the air quality impact analysis. If the applicant is unsure whether tailpipe emissions should be included, please contact the Division.

A facility is likely to have a fleet of trucks that is made up of a variety of different trucks. If the air quality impact analysis involves NO_2 modeling using the Tier III approach, an in-stack NO_2/NO_x ratio is necessary. Different trucks will have different in-stack NO_2/NO_x ratios. The Division recommends using a similar tiered approach.

Tier A: Use the highest in-stack NO_2/NO_x ratio of all the mobile engines in the fleet. This ratio should be applied to all sources used to represent the truck traffic or non-road engines.

Tier B: Calculate a weighted average in-stack NO_2/NO_x ratio based on the total vehicle fleet and the number of units with different in-stack NO_2/NO_x ratios and use that value for the entire vehicle fleet. This accounts for the influence of the different types of engines according to the number of units with higher or lower in-stack NO_2/NO_x ratios while at the same time keeping the modeling analysis simple.

Tier C: Represent vehicles with similar in-stack NO_2/NO_x ratios with separate sets of sources assigning the corresponding in-stack NO_2/NO_x ratio to each set of sources. Each road segment could have multiple sets of sources overlaid on top of each other. This is the most accurate representation of the vehicle traffic.

All proposed in-stack NO_2/NO_x ratios require sufficient justification and documentation to support the source-specific data. The source-specific in-stack NO_2/NO_x ratios need approval from the permit engineer.

Nearby Sources Data

U.S. EPA recommends that, at a minimum, all nearby sources should be explicitly modeled as part of the NAAQS analysis. Other background sources usually are accounted for by using an appropriate ambient background concentration (i.e., see §9.2.2 of the USEPA Guideline on Air Quality Models) or, if a suitable ambient background concentration is not available, by application of a model. Nearby sources and other background sources are terms used to reference all stationary sources except the new source or modification under permit review.

The emissions estimates used in modeling nearby and other background sources should be consistent with U.S. EPA recommendations in Table 8.2 of the USEPA Guideline on Air Quality Models and other applicable U.S. EPA guidance. Table 8.2 recommends that actual operating levels averaged over 2 years and federally enforceable permit limits should be used for all nearby sources. That is, emission rates based on a combination of both allowable and actual data, if the actual data is available. A nearby source is any major source, major stationary source, or minor source that causes a significant concentration gradient in the vicinity of a new or modified source. All sources should be included if they are within 5 kilometers of the significant impact area of the source (significant impact area + 5km). Nevertheless, this is not a bright line; in some cases, the 5-kilometer distance from the significant impact area should be expanded. Professional judgment should be used when selecting sources to model.

The Division does not recommend a specific objective procedure for determining which sources should be classified as nearby sources and which should be classified as other background sources. The procedure used to select nearby sources should be based on professional judgment. In addition, it should consider local conditions such as topography, meteorology, dispersion characteristics, availability of ambient monitoring data, existing air quality, and other relevant factors. The procedure should include an examination of the modeling results to ensure that all sources that should have been included were included.

The nearby sources inventory provided by the Division may be missing key stack parameters as this information is taken from submitted APENs. When the APENs are missing the stack parameters, this information is left blank in the inventory. The Division has developed an initial approximation procedure for applicants to use when the stack parameters are missing. Further refinement may be necessary in order to demonstrate compliance.

- Determine the type of emission source: stack (point) or fugitive.

- Point source: Find stack parameters for similar equipment in the inventory. Provide justification for the stack parameters used.
- Fugitive source: Group all the fugitive (non-stack) emissions from a facility into one area source with dimensions of 100m x 100m, release height of 2 m, and initial sigma-z of 3 m. The x and y coordinates of the facility in the nearby source inventory can be used as the southwest corner of the area source.

A nearby sources inventory will be provided to the applicant upon request from the Division's Inventory and Support staff. The applicant must specify the following when requesting a nearby source inventory:

- Coordinates of the project site
- Pollutants to be modeled
- Extent of the area included in the inventory

Background Concentrations

In general, the background concentration is intended to account for sources not explicitly included in the modeling.

For annual standards, the recommended background is typically based on the annual average value. For shorter-term standards, selection of a background concentration can be more challenging. In general, the background concentration should be one that can reasonably be assumed to occur with the modeled concentration.

Determination of a background that can "reasonably be assumed to occur" is sometimes difficult. In general, the niche being filled by the background concentration should be defined before a value is selected. Since the background concentration field is usually assumed to be spatially uniform, the background should account for elevated concentration levels that are expected to occur in the receptor grid from non-modeled sources. Alternatively, a variable background field could be used if there is sufficient data to generate one.

For purposes of addressing short-term standards, the total predicted concentration distribution should represent combinations of impact and background that can reasonably be expected to occur simultaneously in the particular application. The Division recognizes that the chance of two independently caused short-term concentration maxima occurring simultaneously at any particular location may be low.

The Division can usually provide a background concentration upon request to account for other background sources, including mobile sources and transport from distant sources. Determination of the nearby sources accounted for by the background concentration can be rather subjective. Consequently, the applicant should review the location and the collection date of the background data with respect to nearby sources to determine how it should be incorporated into the overall modeling procedure.

The Division does not typically recommend the use of a background concentration to account for increment consumption. Nevertheless, there may be situations where a statistical analysis or review of trends in ambient air quality data would be useful to quantify local or regional changes in air quality since the minor source baseline date.

To streamline the background concentration requests, a form is available on the Division's website (https://www.colorado.gov/airquality/permits.aspx). If the applicant would like seasonal background data, please contact the Division's TSP modeling staff.

Elevation Data

Terrain elevations for sources and receptors should be used when appropriate. Discuss the source of terrain data in the modeling report.

Terrain elevations for receptors as well as nearby and other background sources should be based on U.S. Geological Survey (USGS) National Elevation Dataset (NED). A minimum resolution of 1/3 arc second (10-meter) files covering a minimum radius of 40 kilometers from the facility under review. NED files can be downloaded using the CDPHE Elevation Data Quad Download Tool (https://www.colorado.gov/airquality/quad_selector_map.aspx).

Some facility sites are graded (e.g., flat) so that actual site topography is or will be significantly different from the topography that is found in a USGS NED or in other elevation data. Thus, it is appropriate to use the site-specific graded elevations for the facility sources and buildings. A plot plan should be provided that depicts the site-specific elevations. If NED files are used for facility sources and buildings, sufficient justification and documentation will need to be provided to support the use of non-site-specific data.

Downwash Applicability

Downwash is a term used to represent the potential effects of a building on the dispersion of emissions from a source. Downwash is considered for sources characterized as point sources. The stack height and proximity of a point source to a structure can be used to determine the applicability of downwash. Downwash does not apply to sources characterized as areas. Downwash is indirectly considered for volume sources by adjusting the initial dispersion factors.

Point sources with stack heights less than good engineering practice (GEP) stack height should consider dispersion impacts associated with building wake effects (downwash). GEP stack height is the greater of (40 CFR § 51.100(ii)):

(1) 65 meters, measured from the ground-level elevation at the base of the stack:

(2)(i) For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52.

$Hg = 2.5H$,

provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation:

(ii) For all other stacks,

$Hg = H + 1.5L$

where

Hg is the GEP stack height;

H is the structure height; and

L is the lesser of the structure height or maximum projected width (the width as seen from the source looking towards either the wind direction or the direction of interest) of the structure.

These formulas define the stack height above which building wake effects on the stack gas exhaust may be considered insignificant.

A structure is considered sufficiently close to a stack to cause downwash when the minimum distance between the stack and the building is less than or equal to five times the lesser of the structure height or maximum projected width of the structure (5L). This distance is commonly referred to as the structure's region of influence. If the source is located near more than one structure, assess each structure and stack configuration separately.

Once downwash applicability is determined, provide documentation to support that determination.

Receptor Network

The approach to creating a receptor network varies with the goals of the modeling study. Case-by-case professional judgement should be used. Factors such as topography, density of nearby sources, meteorology, and requirements of the selected model should be considered when selecting receptors. In general, the network should be consistent with U.S. EPA's recommendations. It should extend far enough to define the significant impact area for the source or modification under review. For elevated point sources, it is sometimes useful to initially use a simple screening-level model to help determine how far out to extend the receptor network.

If the concentration gradient is increasing at the edge of the network, the network should be extended. 1-hour modeling analyses tend to result in large significant impact areas; therefore, professional judgement should be used when extending and refining the receptor network. Refer to U.S. EPA Memos (https://www.epa.gov/scram/air-quality-models-clarification-memos-dispersion-models) for guidance. The Division generally considers a fine receptor grid to have receptor spacing of 100 meters or less. A coarse receptor grid usually refers to receptor spacing greater than 100 meters.

While source-specific issues such as expected plume rise and topography should be considered when deciding if the following recommendations are appropriate, the following recommendations often provide a good starting point:

a. Up to 1 kilometer – grid with 100-meter receptor spacing (fine)
b. From 1 to 3 kilometers – grid with 250-meter spacing (coarse)
c. From 3 to 10 kilometers – grid with 500-meter spacing (coarse)
d. Beyond 10 kilometers – grid with 1-kilometer spacing (coarse)
e. Along fence line or ambient air boundary – 50 to 100 meter receptor spacing
f. If no fence or boundary – 50-meter receptor spacing within source facility
g. Discrete receptors for sensitive nearby sites (e.g., residences, schools) unless the grid is sufficient

h. Flagpole receptors on balconies and rooftops of buildings not owned or operated by the facility under review (e.g., balconies on apartment buildings, rooftop restaurants, rooftop pools)

i. If the modeled maximum values from the facility under review (or maximum values in an air quality impact analysis such as a CAAQS and NAAQS analysis) occur in a coarse receptor grid, additional modeling should be performed with a fine grid to find the maximum concentrations

j. Additional fine receptor grids or discrete receptors may be necessary in complex terrain or sensitive areas to clearly define the area of maximum impact

Receptors may be omitted from the property of the facility under review, provided that public access is precluded by a fence or other physical barrier. Refer to the definition of ambient air in the definitions section at the beginning of this document. If there is not a physical barrier (e.g., fence, wall), receptors should be located on the property of the applicant. Division and/or U.S. EPA approval is necessary if the applicant wants to use a physical barrier such as a canyon, river, tailings pile, intense terrain or other physical features as the ambient air boundary. Intense terrain will be approved on a case-by-case basis to preclude public access as a physical barrier. Intense terrain that acts as a physical barrier needs to have a minimum slope of 5 to 1, per EPA guidance. If a physical barrier is approved by the Division to preclude public access, frequent posting is usually necessary along with routine security patrols; in addition, points of public access into the posted area (e.g., roads, trails) should be fenced or gated. Refer to U.S. EPA memos on this subject.

Meteorological Data

Meteorological data should be collected, processed, and applied in ways that are consistent with the most current federal regulations (https://www3.epa.gov/ttn/scram/guidance/guide/appw_17.pdf), guidance and model user's guides. If representative meteorological data are not available, it may be necessary to collect at least one (1) year of site-specific data. Any source intending to collect site-specific data should contact the Division prior to setting up a monitoring program. The Division has monitoring guidance available.

Meteorological data will be provided by the Division. The Technical Services Program modeling staff will determine the most representative meteorological data appropriate to use for the facility under review. The applicant should provide the following information to the Division to obtain AERMOD-ready meteorological data:

- Coordinate (latitude/longitude or UTM) of source location, including datum
- Source location identified on 1:24,000-scale topographic map(s)
- Brief description of the sources of emissions (i.e., stack vs fugitive, stack heights, source types)

The Division staff takes the above information and assesses the expected conditions at the source location and for each source type. A dataset will be identified that best matches the conditions expected at the source location from the available meteorological datasets known and that meet the completeness requirement.

Per regulatory requirements, for PSD applications where the Division has required pre-construction meteorological monitoring, the permit application will not be ruled complete until the data has been submitted to the Division and approved.

As stated in §8.4.2 of the USEPA Guideline on Air Quality Models, 5 years of adequately representative NWS data, at least 1 year of site-specific data, or at least 3 years of prognostic meteorological data should be used. If more than 1 year of site-specific data exist, multiple years (up to 5 years) should be used. For long-range transport modeling and complex wind situations see §8.4.4.2 of the USEPA Guideline on Air Quality Models.

The use of prognostic meteorological data is currently not accepted in Colorado due to complex terrain. The Division is currently reviewing how prognostic meteorological data can be used to capture the effects of complex terrain.

When deciding whether or not to recommend or require collection of site-specific meteorological data, Division modeling staff considers:

a. Dispersion characteristics of the source under review

b. Meteorological and dispersion issues associated with complex terrain

c. Distance to the nearest Class I area (for new sources and modifications subject to PSD rules)

d. The likelihood that the source will have an adverse impact on ambient air quality

e. Whether or not the source is subject to PSD rules (monitoring is more likely to be requested for new major stationary sources or major modifications subject to PSD rules than for minor sources)

f. Other relevant factors

To streamline the permit process and reduce the economic burden for minor sources and minor modifications, collection of site-specific meteorological data is seldom requested for minor sources and modifications. Nevertheless, it may be recommended if there is reason to believe the new source or modification will cause or contribute to a violation of CAAQS or NAAQS.

If allowed under federal regulations and approved by the Division, conservative screening meteorological data may be used in refined models instead of site-specific data for compliance demonstrations.

Modeling Scenarios

It is common for facilities to have sources that do not operate simultaneously with other sources at the facility. This situation results in modeling different scenarios. For example, if a facility wants a permit that allows operation of either flares or engines, but not both at one time, both the flare scenario and engine scenario should be modeled.

If there are several sources that cannot operate simultaneously which would result in a significant amount of scenarios, the applicant can simply include the worst-case source. Please be aware that using this approach requires demonstration of the worst-case source. Comparing emission rates of these sources does not equate to a worst-case analysis.

Permit conditions will be proposed based on the information used in the modeling. Restricted operating schedules used to demonstrate compliance will be become permit conditions.

Section 6 – Reporting Requirements

Include in the air quality impact analysis a written discussion covering the project, the modeling performed, and the results.

The air quality impact analysis is a stand-alone report. Results from the report should be sufficient to make a decision without input from other reports. Do not refer to other documents or reports for data required to be in the report. In addition, do not exclude items without coordination with the Division's TSP modeling staff unless the items are clearly not applicable to the project. Follow the reporting requirements to expedite the technical review of the air quality impact analysis and to eliminate unnecessary modeling.

Specific data are needed to review and perform modeling. The recommended list of data elements presented here are often necessary to perform and/or review dispersion modeling. The applicant should be prepared to provide these data with the application or upon request by the Division. If the data are not provided with the application and cannot be provided upon request in a timely manner, the permit process may be delayed. In addition, if data cannot be provided in a suitable format, additional staff time may be necessary for data-processing tasks. Staff time is usually charged back to the applicant at the permit processing hourly rate. While some of the data elements discussed here are already part of the permit application and APEN forms, they are mentioned here for emphasis.

Send the air quality impact analysis to the permit engineer that requested the analysis. In addition, for PSD applications send a copy of the air quality impact analysis to EPA Region 8.

Consistency in Geographic Coordinates

Geographic coordinates are used in modeling. Whenever possible, the datum upon which geographic coordinates are based should be provided. For example, potentially significant discontinuities in source and receptors coordinates may occur if some Universal Transverse Mercator (UTM) coordinates are based on the North American Datum of 1927 (NAD27) while others are based on NAD83. Often, site surveys are performed using GPS systems that are based upon WGS84 while UTMs might be based upon a NAD27 topographic map. Therefore, a coordinate conversion should be performed when appropriate so that receptors, source locations, and other coordinates reference a consistent system.

Exemptions from Submitting Modeling-Related Data

New sources and modifications with emissions less than the thresholds in Table 1 that do not meet any of the situations described in the footnotes of Table 1 and sources not emitting any of the pollutants listed in Table 1 do not need to provide any modeling-related data beyond what is requested in the permit application and/or APEN forms.

Since ozone modeling and HAPs modeling are not routinely performed as part of the permit review process, VOC sources do not need to provide any modeling-related data beyond what is requested in the permit application and/or APEN forms.

New Sources and Modifications Not Subject to PSD Rules

At a minimum, new sources and modifications not subject to PSD rules with emissions greater than the thresholds in Table 1 should submit the data outlined in the Modeling Submittal Completeness Checklist with the permit application or be prepared to provide the data upon request. The Modeling Submittal Completeness Checklist can be found on the Division's Air Quality website (https://www.colorado.gov/airquality/permits.aspx).

New Sources and Modifications Subject to PSD Rules

New sources and modifications subject to PSD rules with emissions greater than the thresholds in Table 1 should submit the data outlined in the Modeling Submittal Completeness Checklist with the permit application or be prepared to provide the data upon request. The Modeling Submittal Completeness Checklist can be found on the Division's Air Quality website (https://www.colorado.gov/airquality/permits.aspx).

The following additional items should be submitted as well:

- For each pollutant for which the new source or modification is subject to modeling under PSD rules, provide a source history that clearly shows the start-up and shutdown dates of each unit (e.g., emissions source) at the facility. Include current and historic stack parameters and source/building configurations. Compare start-up and shutdown dates to applicable PSD baseline dates to determine PSD increment consuming and expanding emissions (see the Division's "PSD Increment Tracking System" for baseline dates and related information). Provide metadata (i.e., describe the methods used to generate the data). The applicant may choose to ignore this data element if an air quality impact analysis is not requested or if PSD increment modeling is not requested; however, the Division encourages applicants to provide these data so that PSD increment consumption and expansion can be tracked.
- A table showing nearby increment consuming/expanding sources (only recommended if a PSD increment analysis has been performed). Refer to the Division's "PSD Increment Tracking System" guidance for details, in particular section 2.1.2.
- A table comparing maximum modeled impacts with appropriate thresholds such as modeling significance levels, standards, PSD increments, significant monitoring concentrations, and levels of acceptable change to AQRVs.
- UTM coordinates for maximum modeled concentration estimate(s) from the PSD increment compliance demonstration modeling (if applicable). These data are used to help the Division track increment consumption across the state.

Recommended Additional Guidance

Air Quality Models – Clarification Memos for Dispersion Models: https://www.epa.gov/scram/air-quality-models-clarification-memos-dispersion-models

Federal Land Managers' Air Quality Related Values Work Group (FLAG): https://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf

Model Clearinghouse Information Storage and Retrieval System: https://cfpub.epa.gov/oarweb/MCHISRS/

Clean Air Act Permit Modeling Guidance: https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance

Air Quality Dispersion Modeling – Preferred and Recommended Models User Guides and Implementation Guides: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models

CDPHE APCD Air Quality Modeling Guidance for Permits: https://www.colorado.gov/airquality/permits.aspx

Air Dispersion Modeling Analysis
to
Support the Modeling Thresholds
and Associated Language in Section 2
of the
Colorado Modeling Guideline for Air Quality Permits
(January 2002, April 2010)

Colorado Department of Public Health & Environment
Air Pollution Control Division
Technical Services Program
Modeling, Meteorology, and Emission Inventory Unit
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Table of Contents

1. Preface

The Air Pollution Control Division (Division) participated in a review of the “Colorado Modeling Guideline for Air Quality Permits” (Colorado Modeling Guideline). The review process resulted in revisions to the modeling guideline based on comments from a technical peer review conducted in 2000 and 2001, public comments, and comments from several stakeholder meetings. A public hearing on the guideline was held on December 20, 2001.

As part of the review process, the Division performed air quality modeling to help in the development of appropriate language and emission modeling thresholds for Table 1 of the Colorado Modeling Guideline. This report provides the results of the Division’s modeling study. While the body of this report is focused on point source modeling, a series of graphical images are provided in the appendix to illustrate the magnitude and spatial extent of strong concentration gradients near fugitive sources. All of the fugitive source modeling is based on a continuous emission rate of 15 tons per year, which is the PM-10 modeling threshold in Table 1 of the Colorado Modeling Guideline.

Table 1 from the January 1, 2002 version of the Colorado Modeling Guideline and associated language in Section 2.5 – Modeling Thresholds - is presented on the next two pages. The Colorado Modeling Guideline was updated on December 27, 2005 to reflect revisions to Colorado AQCC Regulation No. 3 and EPA’s Appendix W to 40 CFR Part 51 - Guideline on Air Quality Models and did not result in any material change to Table 1 or its associated language in Section 2.5.

[Excerpts from the January 1, 2002 version of the Colorado Modeling Guideline.]

Section 2.5 Modeling Thresholds

The modeling thresholds in this section are applicable for sources located in nonattainment and attainment areas (see sections2.1, 2.2, and 2.3). The thresholds were not developed to address situations such as those described in section 2.4.

The modeling thresholds were developed to identify new sources and modifications that would have relatively small impacts and do not warrant further analysis with respect to applicable air quality standards. The development of these thresholds is intended to assist the Division Staff, permit applicants, air quality consultants, and others decide when modeling is warranted to determine the impact from a source. This section introduces de minimis emissions, which have a low probability of causing or contributing to an exceedance of an air quality standard. By using this approach, permitting costs associated with the impact analysis required by Regulation No. 3 can be minimized.

Air quality modelers developed the modeling thresholds in Table 1 during a technical peer review of the Division's modeling practices. The Division performed dispersion modeling to help demonstrate that the thresholds in Table 1 are appropriate.[1] Permit applicants and the Division should try to avoid situations where the decision to perform modeling takes longer than actually performing a screening-level modeling analysis (screening-level models can often be run quickly with minimal cost).

For a given pollutant, modeling is usually warranted if the long-term (tons per year) or short-term (pounds per hour, etc.) ***requested emission rate*** for a new source or the facility-wide net emissions increase for a modification is above the applicable emission threshold in Table 1. If the requested emission rate and/or the facility-wide net emissions increase is below both of the thresholds, modeling is usually not warranted unless one of the situations at the bottom of Table 1 applies. If there is doubt regarding the need for modeling, the applicant should consult with the Division.

[1] The Division's modeling study shows that the thresholds are appropriate in situations where a source has reasonably good dispersion characteristics. In situations where a source has poor dispersion characteristics or in areas with poor existing air quality, the thresholds might not be appropriate. In these situations, the Division will work with the source to determine an appropriate threshold.

Table 1 [January 1, 2002]. Modeling Thresholds. Modeling is usually warranted to quantify the impact if the emission rate is equal to or greater than these long-term (tons per year) and/or short-term (pound per hour, etc.) emission thresholds. If the emission rate is less, a qualitative description of the impact is adequate unless there is a situation that warrants modeling. (1)

Pollutant	Requested Emission Rate from a New Source or Facility-Wide Net Emissions Increase from a Modification
Carbon Monoxide (CO)	100 tons per year or 23 pounds per hour
Nitrogen Oxides (NO_x)	40 tons per year[2]
Sulfur Dioxide (SO_2)	40 tons per year or 27 pounds per 3-hours
Particulate Matter (PM-10)	15 tons per year or 82 pounds per day
Lead (Pb)	0.6 tons per year or 100 pounds per month

(1) Modeling is usually warranted, even though the source or modification does not exceed the modeling thresholds in Table 1, if it is reasonable to believe the source will cause or contribute to a violation of applicable ambient air quality standards in circumstances such as:
- (a) Sources of SO_2, PM-10, CO, or Pb where a substantial portion of the new or modified emissions have poor dispersion characteristics (e.g., rain caps, horizontal stacks, fugitive releases,[3] or ***building downwash***[4]) in close proximity to ***ambient air*** at the site boundary;
- (b) Sources of SO_2, PM-10, CO, or Pb located in ***complex terrain*** (e.g., terrain above stack height in close proximity to the source);
- (c) Sources located in areas with poor existing air quality;
- (d) Modifications at existing major stationary sources, including grandfathered sources that have never been modeled before.

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[2] For new sources or modifications, including those with poor dispersion characteristics, that emit less than 40 tons per year (tpy) of NO_x, modeling is usually warranted only in the situations described in caveats (1)(c) and (1)(d), provided that most (e.g., >85%) of the NO_x is emitted as nitric oxide (NO). That is, because of near-field chemical transformation assumptions, NO_2 impacts from a 40 tpy NO_x source are usually expected to be below the NO_2 ambient air quality standard. Thus, modeling is only warranted in situations where existing NO_2 levels are high enough that the ***significant impact*** from the new source or modification might "contribute" to a modeled violation of the NO_2 air quality standard.

[3] For sources without stacks (e.g., fugitive releases from area or volume sources), modeling may be warranted at levels less than those in Table 1 if most of the emissions are from sources located less than 250-meters from the limit to public access. The 250-meter recommendation is based on a modeling study performed by the Division.

[4] For sources with emission rates below those in Table 1 where the stack height is less than the U.S. EPA's ***good engineering practice (GEP) stack height,*** modeling may be warranted; however, the presence of a non-GEP stack height does not mean that modeling is automatically warranted. The degree (e.g., severity) of the downwash effects, existing air quality levels, the distance to the boundary of ambient air, and any other relevant factors should be considered.

Table 1 was updated in April 2010 to address NAAQS changes for lead, particulate matter less than 2.5 microns, and nitrogen dioxide (the associated language in section 2.5 – Modeling Thresholds remains unchanged since January 1, 2002).

[Excerpts from the April 2010 update of Table 1 in the Colorado Modeling Guideline.]

Table 1 [April 2010]. Modeling Thresholds. Modeling is usually warranted to quantify the impact if the emission rate is equal to or greater than these emission thresholds. If the emission rate is less, a qualitative description of the impact is adequate unless there is a situation that warrants modeling.(1) [Note: The long-term (tons per year) thresholds apply to modeling decisions regarding annual average ambient air quality standards. The short term (pound per hour) thresholds apply to modeling decisions for short-term standards (i.e., ≤ 24-hr average).]

Pollutant	**Requested Emission Rate from a New Source or Facility-Wide Net Emissions Increase from a Modification**
Carbon Monoxide (CO)	100 tons per year or 23 pounds per hour
Nitrogen Oxides (NO_X)	40 tons per year[5] or 0.46 pound per hour
Sulfur Dioxide (SO_2)	40 tons per year or 27 pounds per 3-hours
Particulate Matter < 10 µm (PM_{10})	15 tons per year or 82 pounds per day
Particulate Matter < 2.5 µm ($PM_{2.5}$)	5 tons per year of primary $PM_{2.5}$ or 11 pounds per day of primary $PM_{2.5}$
Lead (Pb)	25 pounds per 3-months

(1) Modeling is usually warranted, even though the source or modification does not exceed the modeling thresholds in Table 1, if it is reasonable to believe the source will cause or contribute to a violation of applicable ambient air quality standards in circumstances such as:
(a) Sources where a substantial portion of the new or modified emissions have poor dispersion characteristics (e.g., rain caps, horizontal stacks, fugitive releases[6], or ***building downwash***[7]) in close proximity to ***ambient air*** at the site boundary;
(b) Sources located in ***complex terrain*** (e.g., terrain above stack height in close proximity to the source);
(c) Sources located in areas with poor existing air quality;
(d) Modifications at existing major stationary sources, including grandfathered sources that have never been modeled before.

[5]For new sources or modifications, including those with poor dispersion characteristics, that emit less than 40 tons per year (tpy) of NO_X, modeling for the annual NO_2 NAAQS is usually warranted only in the situations described in caveats (1)(c) and (1)(d), provided that most (e.g., >85%) of the NO_X is emitted as nitric oxide (NO). That is, because of near-field chemical transformation assumptions, NO_2 impacts from a 40 tpy NO_X source are usually expected to be below the annual NO_2 ambient air quality standard. Thus, modeling is only warranted in situations where existing annual NO_2 levels are high enough that the significant impact from the new source or modification might "contribute" to a modeled violation of the annual NO_2 air quality standard.

[6]For sources without stacks (e.g., fugitive releases from area or volume sources), modeling may be warranted at levels less than those in Table 1 if most of the emissions are from sources located less than 250-meters from the limit to public access. The 250-meter recommendation is based on a modeling study performed by the Division.

[7]For sources with emission rates below those in Table 1 where the stack height is less than the U.S. EPA's ***good engineering practice (GEP) stack height,*** modeling may be warranted; however, the presence of a non-GEP stack height does not mean that modeling is automatically warranted. The degree (e.g., severity) of the downwash effects, existing air quality levels, the distance to the boundary of ambient air, and any other relevant factors should be considered.

2. Introduction

In determining compliance with Ambient Air Quality Standards (AAQS), impacts from new/modified emission unit(s) are estimated with an air dispersion model. If estimated impacts from the new/modified emission unit(s) are above modeling significance levels, they are added to impacts from other emission units located at the facility, impacts from emission units located nearby, if appropriate, and a background concentration to determine total ambient air concentrations for compliance with the National Ambient Air Quality Standards (NAAQS) and Colorado Ambient Air Quality Standards (CAAQS). If the estimated impacts from the new/modified emission unit(s) are below modeling significance levels, the new/modified emission unit(s) is not considered to have a significant impact in ambient air[8] and no further analysis is necessary. Table 2 lists the modeling significance levels and AAQS for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and fine particulate matter (PM_{10}).

Table 2 [January 2002]. Modeling Significance Levels and AAQS for NO_2, SO_2, and PM_{10}

	Modeling Significance Level (µg/m³)			NAAQS (µg/m³)			CAAQS (µg/m³)		
Pollutant	**3-hr**	**24-hr**	**Annual**	**3-hr**	**24-hr**	**Annual**	**3-hr**	**24-hr**	**Annual**
NO_2			1			100			100
SO_2	25	5	1	1300*	365	80	700		
PM_{10}		5	1		150	50		150	50

*Secondary NAAQS

Table 2 lists the modeling significance levels and AAQS for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$) effective in April 2010.

Table 2 [April 2010]. Modeling Significance Levels and AAQS for NO_2, SO_2, PM_{10}, $PM_{2.5}$

	Modeling Significance Level (µg/m³)				NAAQS (µg/m³)				CAAQS (µg/m³)
Pollutant	**1-hr**	**3-hr**	**24-hr**	**Annual**	**1-hr**	**3-hr**	**24-hr**	**Annual**	**3-hr**
NO_2	4[a]			1	~189			100	
SO_2		25	5	1		1300[b]	365	80	700
PM_{10}			5	1			150		
$PM_{2.5}$			1.2[c]	0.3[c]			35	15	

[a]Interim modeling significance level developed by the Division
[b]Secondary NAAQS
[c]Interim modeling significance level developed by the Division based on level proposed by EPA for NAAQS only

[8] "Ambient air" is defined as "that portion of the atmosphere, external to the source, to which the general public has access."

The "Colorado Modeling Guideline for Air Quality Permits" (Colorado Modeling Guideline) does not require a quantitative impact analysis for every new source/modification. The Colorado Modeling Guideline provides threshold emission levels that would trigger a quantitative impact analysis. Some of the public comments argue that only new/modified emission units emitting pollutants greater than Prevention of Significant Deterioration (PSD) Significant Emission Rates (shown below in Table 3) should trigger a quantitative impact analysis. Others also support raising the PM_{10} emission threshold level from 15 tons per year (tpy) to 40 tpy. This implies that new/modified emission units with emission rates equivalent to or greater than the PSD Significant Emission Rates would not cause or contribute to an exceedence of the AAQS.Table 3. Current (1998) and proposed (2001) modeling emission rate thresholds in tons per year, tpy. The proposed levels are the same as the PSD Significant Emission Rates of Criteria Pollutants in Regulation No. 3 **[Note: One exception is that the fugitive PM_{10} threshold would remain at 5 tpy].**

Pollutant	Current Emission Rate (tpy) Thresholds (Table 1; 12/23/98 Guideline)	Proposed Emission Rate (tpy) Thresholds (Table 1; 2/14/01 Guideline)
CO	50 attainment, 25 nonattainment	100
NO_X	20	40
SO_2	20	40
PM_{10} (Stack)	5	15
PM_{10} (Fugitive)	5	5
Pb	0.1	0.6

The January 2002 modeling analysis was performed to determine if a point source emitting 40 tpy of NO_X[9], SO_2, or PM_{10} or 15 tpy of PM_{10} would have a significant impact in ambient air (refer to Sections 4, 5, and 6).

The April 2010 modeling analysis (refer to Section 7) was performed to determine if the emission rate thresholds in Table 3 (above) are adequate to indicate when a quantitative impact analysis is necessary to demonstrate if the proposed modification or source will or will not cause or contribute to a violation of a recently promulgated NAAQS [24-hr and annual $PM_{2.5}$ (December 18, 2006, includes retaining the 24-hr revoking of the annual PM_{10} standard), 3-month rolling Pb (January 12, 2009), and 1-hr NO_2 (April 12, 2010)].

3. Effects on Ambient Air Impact Estimations

Ambient air impacts are a function of atmospheric dispersion. Various factors affect atmospheric dispersion, including plume rise, building wake effects, and meteorological

[9] The ambient air standards are for nitrogen dioxide (NO_2), not oxides of nitrogen (NO_x). NO_x includes both nitric oxide (NO) and NO_2. While some NO_2 is directly emitted from the stacks of stationary sources, a significant portion of the emissions usually occur as nitric oxide (NO). The NO is converted to NO_2 by chemical mechanisms in the atmosphere. To account for possible chemical conversion in the atmosphere, the total NO_x emission rate is used in Table 2 instead of only the primary NO_2 emission rate.

conditions. Plume rise is due to the momentum or buoyancy of the exhaust gases. Factors that hinder plume rise are stack-tip downwash and building wake effects.

3.1. Buoyancy

Stack gases exhausted into the atmosphere having a density less than that of ambient air will experience plume rise due to buoyancy. Lower molecular weight or high stack gas exit temperature will result in a stack gas density lower than that of ambient air. In most regulatory air models, buoyancy is a function of the difference between stack gas exit temperature and ambient temperature. Model inputs used to determine the magnitude of buoyant forces are stack gas exit temperature, ambient temperature, stack diameter, and stack gas exit velocity. The larger of buoyancy force and momentum force is used to determine the effective plume height.

3.2. Momentum

The force imparted on the stack gases provides the momentum necessary for successful exhaustion into the atmosphere. Momentum is important if the temperature of the stack gases is within a few degrees of ambient temperature or subject to building wake effects. Obstructions at the top of a vertical stack, such as a rain cap, can reduce or eliminate vertical momentum and affect plume rise. Horizontal discharges also have essentially no momentum plume rise. Model inputs that affect momentum are stack gas exit velocity and stack diameter. Depending on meteorological conditions, stack gas exit temperature and ambient temperature also affect momentum calculations.

3.3. Stack-Tip Downwash

Stack-tip downwash occurs when the stack gas plume is drawn down to the low pressure or slight vacuum region downwind of the stack. The area of low pressure/slight vacuum is cause by wind flowing past the stack. Stack-tip downwash can be eliminated if exit velocities are greater than or equal to 150% of the wind speed at the stack top. Model inputs that affect stack-tip downwash are stack gas exit velocity and wind speed. Stack diameter is also used to determine the effective plume height.

3.4. Building Downwash

Wind flow around a building creates turbulent eddies downwind of the building. Plumes released near buildings can be caught in the turbulent wake of the building. For elevated releases, plumes subject to building downwash usually result in increased ground-level concentrations. To avoid the effect of building downwash, the general rule is to design a stack that is 2.5 times the lesser of the height or projected width of nearby buildings.[10] This is known as the Good Engineering Practice (GEP) height. Building dimensions are input into modeling systems to determine if the stack gas plume will be affected by downwash.

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[10] A building is considered to be nearby if it is within 5L (five times L, where L is the lesser of the building height or the projected width of the building) of a building or structure [see 40 CFR 51.100 (jj)(1)].

4. Methodology (January 2002 Analysis)

Multiple model runs were performed using a range of values in stack parameters. The Industrial Source Complex Model (ISCST3 version 00101) was used with 1989 Denver Stapleton Meteorological Data. The emission rate used for all runs is 1.15 g/s (40 tpy) to determine NO_X, SO_2, and PM_{10} concentration levels. Since modeling was performed for only one emission unit and concentration is directly proportional to emission rate, concentration levels determined with a 40 tpy emission rate are scaled to obtain PM_{10} concentrations at 15 tpy.

Table 5 summarizes the values of each parameter for each model run. Stack characteristics were selected to illustrate the effects of each/combination of parameter(s) on impact estimates. The range of values in Table 5 is not intended to represent all possible stack characteristics and combinations. In practice, many emission units have stack parameters that are lower or higher than the range of values used in this study.

4.1. Receptor Spacing

The receptor network is described in Table 4 below.

Table 4. Receptor spacing and location

Distance from Source Location	Receptor Spacing
Fenceline	8 receptors spaced 50 m, 30 m, or 15 m (see Table 5) apart forming a square perimeter with source location in the center; spacing varies per run
50 m	8 receptors spaced 50 m apart forming a square perimeter with source location in the center
0 to 5000m	100 m Cartesian grid
5000 m to 10,000 m	250 m Cartesian grid

4.2. Model Runs

4.2.1. Sensitivity Analysis (Runs 1 through 10)

A base case (Run 1) was selected to compare with Runs 2 through 10. The sensitivity analysis consists of 9 runs where each run differed from the base case by only one modeling parameter. The parameters are stack height, urban dispersion, stack diameter, stack gas exit velocity, and stack gas exit temperature. These runs assume that the plume is not subject to building downwash.

4.2.2. Building Downwash (Runs 11 through 18)

Runs 11 through 18 were performed to examine the effects of building downwash effects on the impacts and their location from the source. The footprint of the building is 9.14 m x 9.14 m (30 ft x 30 ft). Building height of 50% and 75% of the stack height were used. Runs 13 and 14 use urban instead of rural dispersion coefficients. Runs 15 through 18 with urban dispersion include fenceline receptors closer to the source.

4.2.3. Multiple changes in Stack Characteristics with Building Downwash (Runs 19 through 22)

Runs 19 through 22 represent vertical unobstructed stacks with stack and building configurations that hinder plume rise.

4.2.4. Horizontal Stack (Runs 23 through 25)

The stack inputs were modified to follow EPA guidance for modeling horizontal stacks (July 9, 1993 memo from Joseph A Tikvart to Ken Eng). Stack diameter is set to 0.001 m. Actual stack height is used.

4.2.5. Capped Stack (Runs 26 through 28)

The stack inputs were modified to follow EPA guidance for modeling capped stacks (July 9, 1993 memo from Joseph A. Tikvart to Ken Eng). Stack diameter is set to 0.001 m. Stack height is reduced by 3 times the actual stack diameter.

4.2.6. Minimum and Maximum Range of Values (Runs 29 and 30)

Run 29 represents a vertical stack with no obstruction that is subject to building downwash with the lowest stack parameters in Table 4. Run 30 represents a vertical stack with no obstruction and no downwash effects with the highest stack parameters in Table 4.

4.3. Comparison with Modeling Significance Levels and AAQS

According to U.S. EPA guidance, the highest impact concentration of any averaging period should be used to determine whether the emission unit will have a significant impact in ambient air. That is, the modeling significance level is used to determine if a source "contributes" to a modeled violation of AAQS. When impacts are significant for an averaging period at a specific receptor, the impacts from the emission unit are added to the impacts from nearby sources, if appropriate, and a reasonable background concentration to determine the total ambient air concentration for the compliance demonstration with the AAQS. The maximum annual and highest-2nd-highest (H2H) short-term SO_2 and PM_{10} (the allowance of one exceedence of the 24-hr PM_{10} when using one year of meteorological data) total ambient air concentrations are compared to the AAQS. For simplicity in this modeling analysis, H2H short-term SO_2 and PM_{10}, and maximum annual concentrations are compared to the modeling significance level for significance determination and used to determine whether the impact itself would exceed the AAQS.

5. Results (January 2002 Analysis)

The results are presented in tabular format for all runs by emission rate and averaging period in Table 6. The 24-hr results of model Runs 1 through 10 are also presented in Figure 1 through Figure 5 to examine the magnitude and location of impacts. Since no chemical transformations or conversion factors were used, the impacts listed below apply to any pollutant.

Table 5. Summary of stack, building and fenceline parameters for each model run

Model Run[1]	Dispersion[2]	Stack Height (m)	Stack Diameter (m)	Stack Gas Exit Temperature (K)	Stack Gas Exit Velocity (m/s)	Stack Orientation[4]	Building Height (m)[3]	Fenceline Distance (m)
1 - Base Case	R	6.10	0.31	644	25.4	V	0	50
2 - Height Decrease	R	3.05	0.31	644	25.4	V	0	50
3 - Height Increase	R	9.14	0.31	644	25.4	V	0	50
4 - Urban	U	6.10	0.31	644	25.4	V	0	50
5 - Diameter Decrease	R	6.10	0.15	644	25.4	V	0	50
6 - Diameter Increase	R	6.10	0.46	644	25.4	V	0	50
7 - Velocity Decrease	R	6.10	0.31	644	9.14	V	0	50
8 - Velocity Increase	R	6.10	0.31	644	76.2	V	0	50
9 - Temperature Decrease	R	6.10	0.31	477	25.4	V	0	50
10 - Temperature Increase	R	6.10	0.31	811	25.4	V	0	50
11- BH 50% SH	R	6.10	0.31	644	25.4	V	3.05	50
12 - BH 75% SH	R	6.10	0.31	644	25.4	V	4.58	50
13 - BH 50% SH, urban	U	6.10	0.31	644	25.4	V	3.05	50
14 - BH 75% SH, urban	U	6.10	0.31	644	25.4	V	4.58	50
15 - BH 50% SH, urban, 30 m FL	U	6.10	0.31	644	25.4	V	3.05	30
16 - BH 75% SH, urban, 30 m FL	U	6.10	0.31	644	25.4	V	4.58	30
17 - BH 50% SH, urban, 15 m FL	U	6.10	0.31	644	25.4	V	3.05	15
18 - BH 75% SH, urban, 15 m FL	U	6.10	0.31	644	25.4	V	4.58	15
19 - T/D/V Decrease, BH 75% SH, 30 m FL	R	6.10	0.15	477	10	V	4.58	30
20 - H/T/D/V Decrease, BH 67% SH, 30 m FL	R	4.58	0.15	477	10	V	3.05	30
21 - T/D/V Decrease, BH 75% SH, urban, 30 m FL	U	6.10	0.15	477	15	V	4.58	30
22 - H Decrease, BH 100% SH, urban, 30 m FL	U	3.05	0.31	644	25.4	V	3.05	30
23 - Horizontal[5]	R	6.10	0.001	644	0.001	H	0	50
24 - Horizontal, BH 50% SH[5]	R	6.10	0.001	644	0.001	H	3.05	50
25 - Horizontal, BH 50% SH, 30 m FL [5]	R	6.10	0.001	644	0.001	H	3.05	30
26 - Capped[6]	R	5.17	0.001	644	0.001	C	0	50
27 - Capped, BH 50% SH[6]	R	5.17	0.001	644	0.001	C	3.05	50
28 - Capped, BH 50% SH, 30 m FL [6]	R	5.17	0.001	644	0.001	C	3.05	30
29 - Low range of values, Building 100% SH	R	3.05	0.15	477	9.14	V	3.05	30
30 - High range of values	R	9.14	0.46	811	76.2	V	0	30

[1]Model Run Codes: BH = Building Height, SH = Stack Height, D = Diameter, V = Exit Velocity, T = Exit Temperature, FL = Fenceline.
[2]Dispersion Codes: R = Rural, U = Urban.
[3]Building Footprint Dimensions: 9.14 m x 9.14 m (30 ft x 30 ft).
[4]Stack Orientation Codes: V = Vertical, H = Horizontal, C = Capped, Vertical Obstructed.
[5]Stack parameters adjusted according to EPA Guidance (July 9, 1993 memo from Joseph A Tikvart to Ken Eng)
[6]Stack parameters adjusted according to EPA Guidance (July 9, 1993 memo from Joseph A Tikvart to Ken Eng), assumes D = 0.31 m
Shaded Values – Values different than base case

Table 6. Summary of impacts for 40 tpy and 15 tpy emission rates. [Note: In a compliance demonstration with ambient air quality standards (AAQS),[11] impacts from nearby sources, if appropriate, and background sources would be added to these results.]

Model Run	Impact Concentration ($\mu g/m^3$)				
	40 tpy H2H 3-hr	**40 tpy H2H 24-hr**	**40 tpy Max Annual**	**15 tpy H2H 24-hr**	**15 tpy Max Annual**
1 - Base Case	88.26	28.15	3.74	10.56	1.40
2 - Height Decrease	148.08	37.90	5.57	14.21	2.09
3 - Height Increase	61.71	17.88	2.68	6.71	1.01
4 - Urban	161.08	71.03	9.77	26.64	3.66
5 - Diameter Decrease	283.71	76.96	12.21	28.86	4.58
6 - Diameter Increase	46.37	12.35	1.55	4.63	0.58
7 - Velocity Decrease	203.94	59.79	8.75	22.42	3.28
8 - Velocity Increase	36.12	9.05	1.07	3.39	0.40
9 - Temperature Decrease	118.95	35.72	5.16	13.40	1.94
10 - Temperature Increase	74.16	24.62	3.14	9.23	1.18
11- BH 50% SH	128.26	28.35	3.77	10.63	1.41
12 - BH 75% SH	308.61	83.93	6.47	31.47	2.43
13 - BH 50% SH, urban	196.43	71.42	9.80	26.78	3.68
14 - BH 75% SH, urban	544.72	237.69	35.92	89.13	13.47
15 - BH 50% SH, urban, 30 m FL	208.77	71.42	9.80	26.78	3.68
16 - BH 75% SH, urban, 30 m FL	949.60	317.85	54.00	119.19	20.25
17 - BH 50% SH, urban, 15 m FL	196.43	71.42	9.80	26.78	3.68
18 - BH 75% SH, urban, 15 m FL	1045.30	237.69	35.92	89.13	13.47
19 - T/D/V Decrease, BH 75% SH, 30 m FL	1487.95	463.76	99.96	173.91	37.49
20 - H/T/D/V Decrease, BH 67% SH, 30 m FL	1444.40	582.41	109.67	218.40	41.13
21 - T/D/V Decrease, BH 75% SH, urban, 30 m FL	1683.62	626.98	114.99	235.12	43.12
22 - H Decrease, BH 100% SH, urban, 30 m FL	1606.12	654.28	101.58	245.36	38.09
23 – Horizontal[5]	1341.46	377.22	54.20	141.46	20.33
24 - Horizontal, BH 50% SH[5]	4308.35	1138.81	188.96	427.05	70.86
25 - Horizontal, BH 50% SH, 30 m FL [5]	5676.34	1546.20	239.56	579.83	89.84
26 - Capped[6]	1824.50	480.88	80.05	180.33	30.02
27 - Capped, BH 50% SH[6]	5990.40	1577.67	252.12	591.63	94.55
28 - Capped, BH 50% SH, 30 m FL [6]	8643.41	2357.32	364.89	884.00	136.83
29 - Low range of values, Building 100% SH	8693.97	2037.43	487.96	764.04	182.99
30 - High range of values	9.38	2.30	0.31	0.86	0.12

[11] Modeling Significance Levels and AAQS for NO_2, SO_2, and PM_{10}

	Modeling Significance Level ($\mu g/m^3$)			NAAQS ($\mu g/m^3$)			CAAQS ($\mu g/m^3$)		
Pollutant	**3-hr**	**24-hr**	**Annual**	**3-hr**	**24-hr**	**Annual**	**3-hr**	**24-hr**	**Annual**
NO_2			1			100			100
SO_2	25	5	1	1300	365	80	700		
PM_{10}		5	1		150	50		150	50

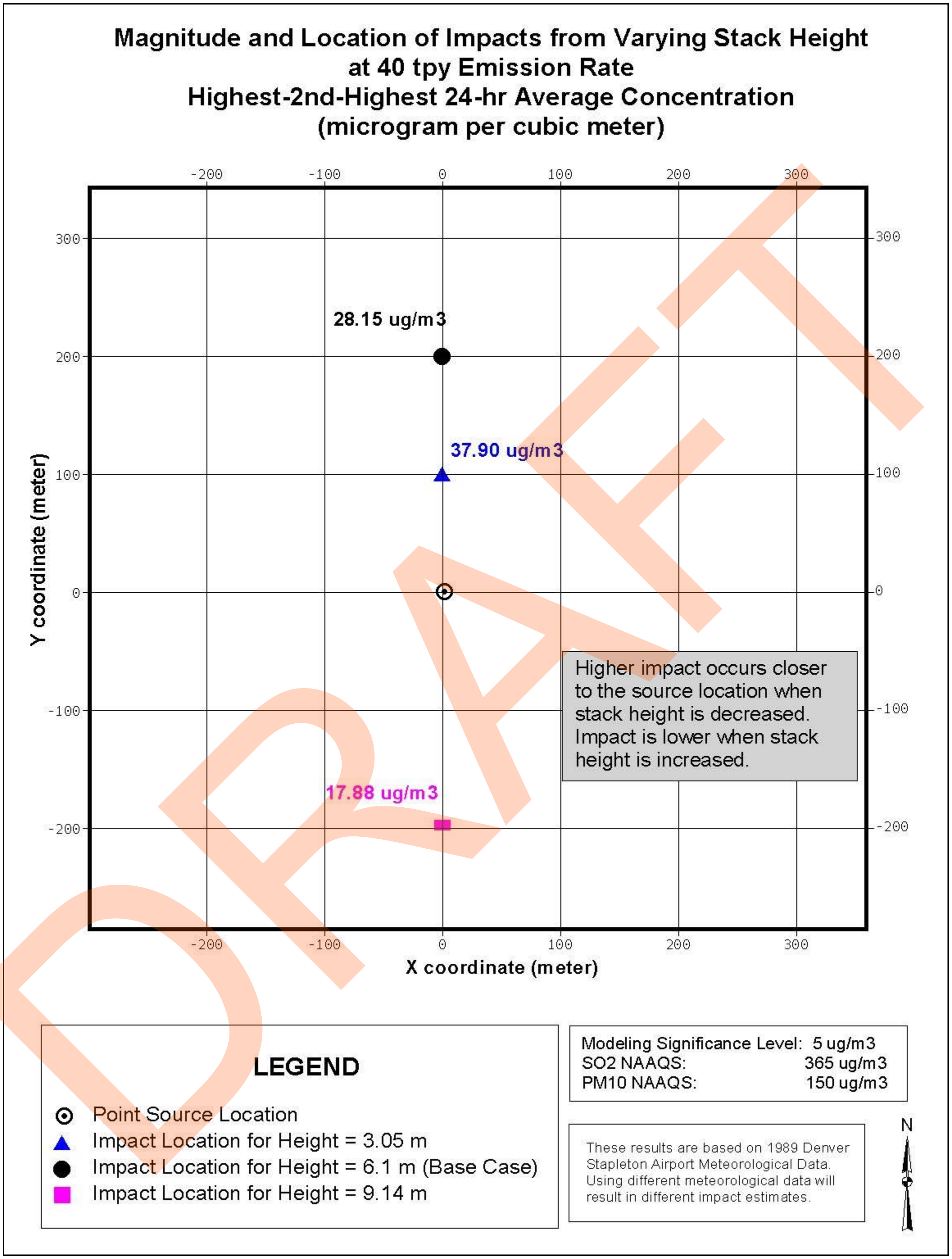


Figure 1. Magnitude and Location of Impacts from Varying Stack Height

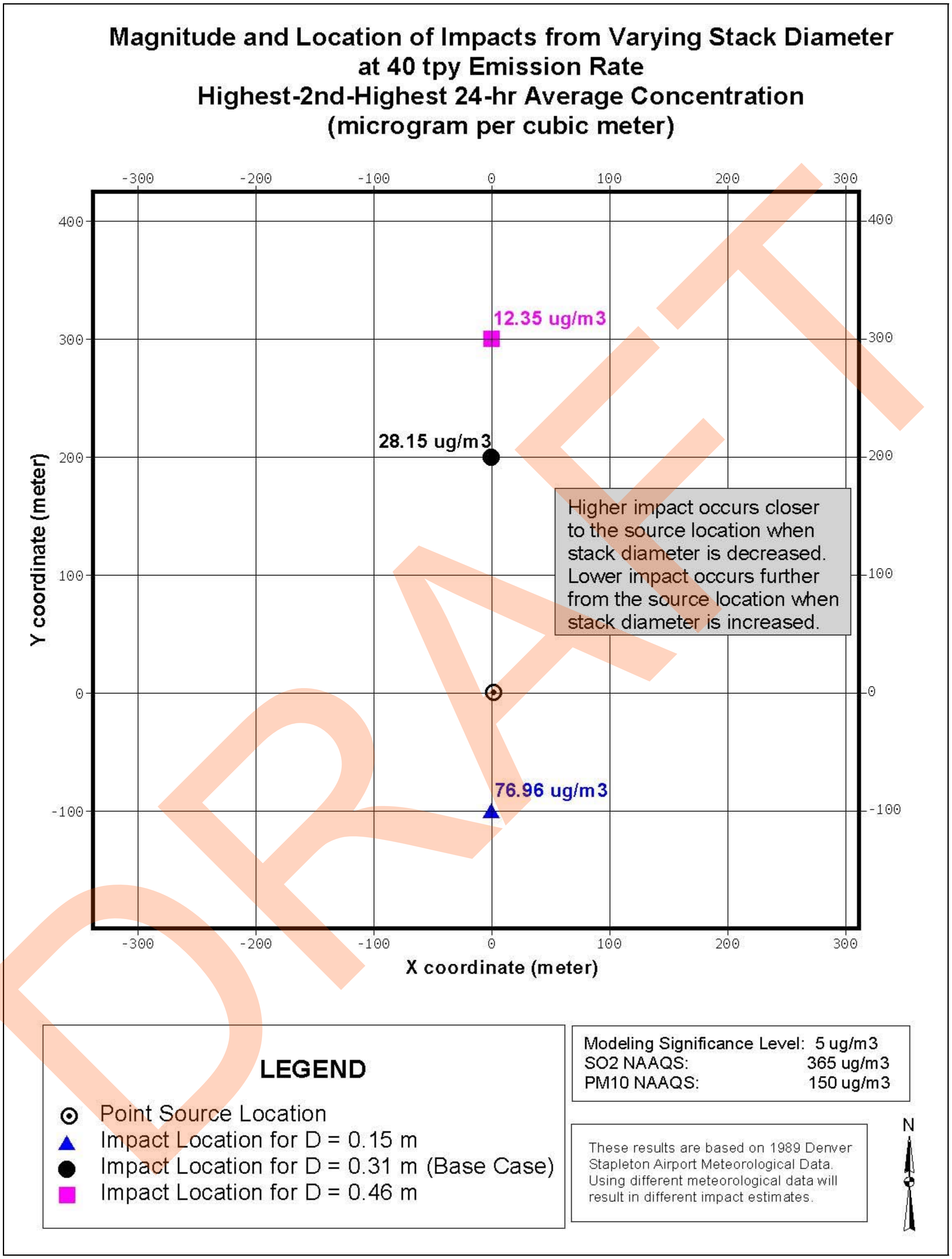


Figure 2. Magnitude and Location of Impacts from Varying Stack Diameter

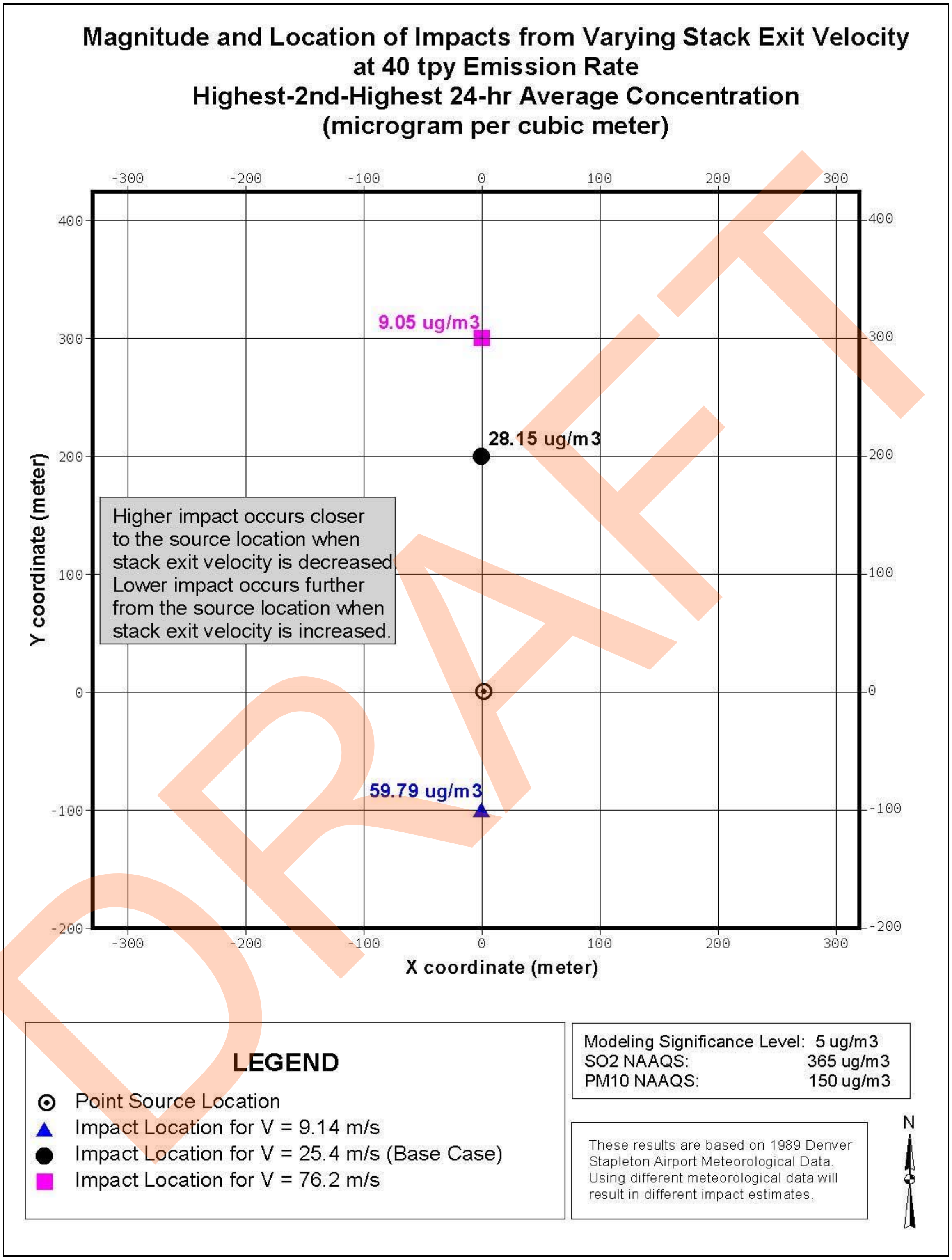


Figure 3. Magnitude and Location of Impacts from Varying Stack Exit Velocity

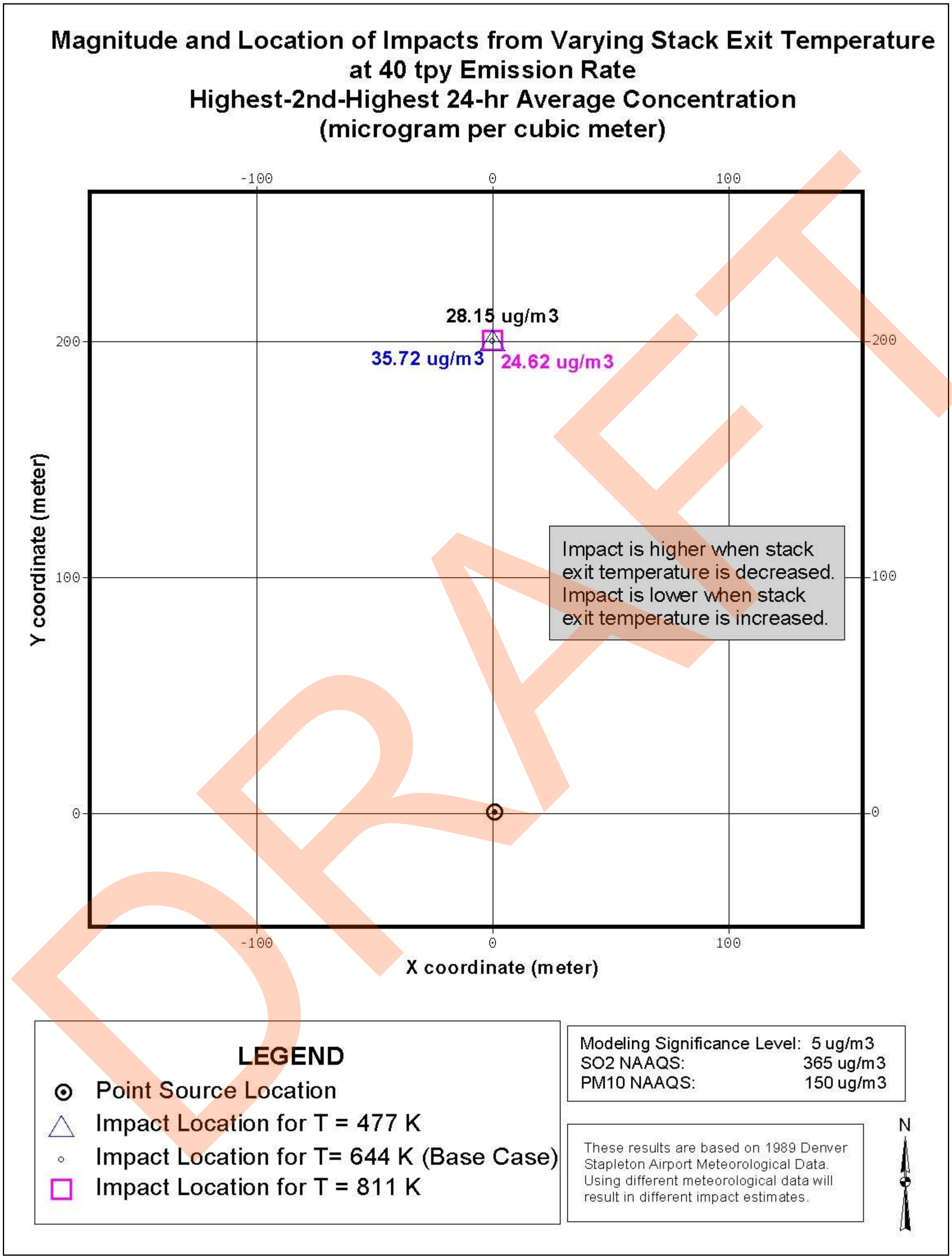


Figure 4. Magnitude and Location of Impacts from Varying Stack Gas Exit Temperature

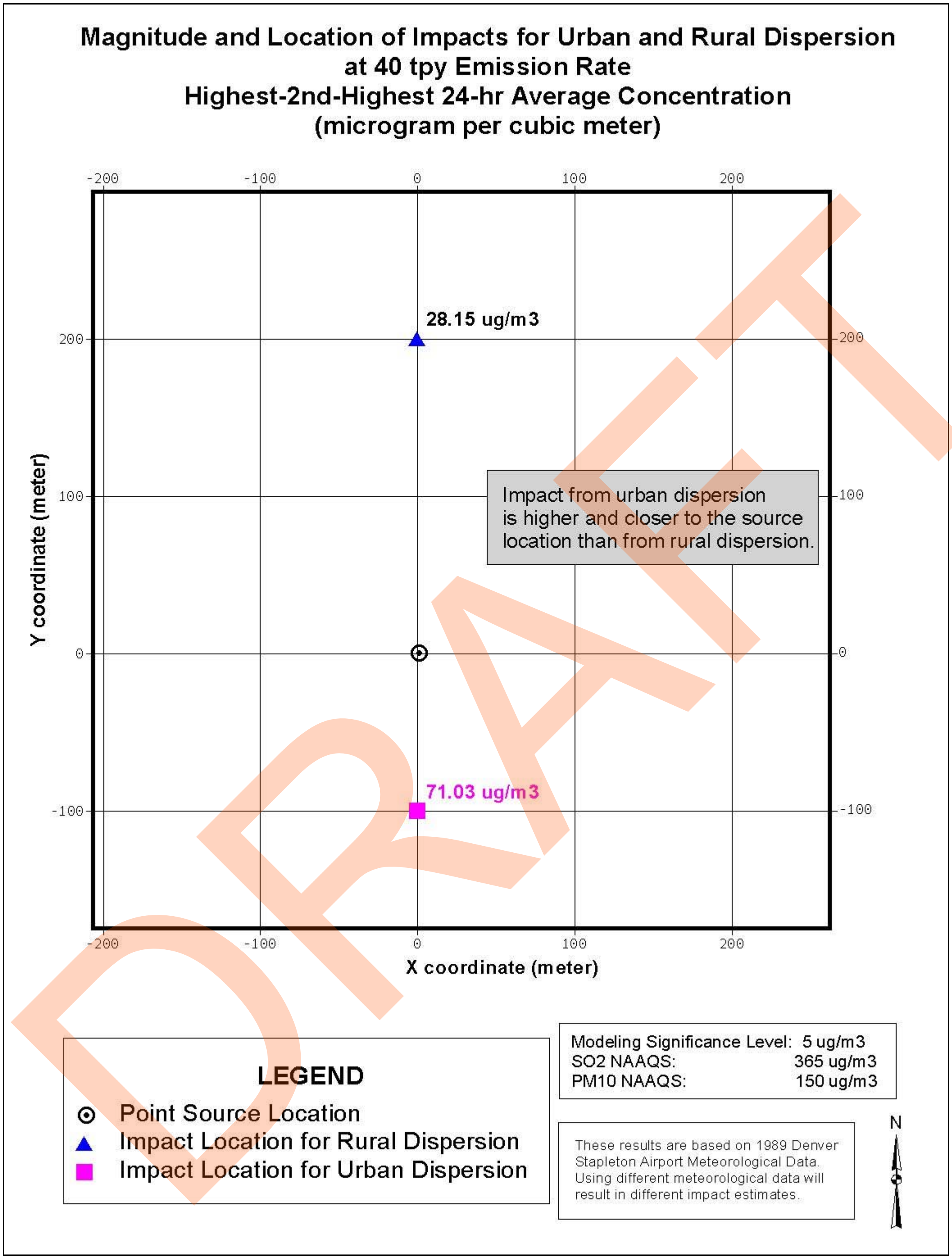


Figure 5. Magnitude and Location of Impacts for Urban and Rural Dispersion

6. Discussion (January 2002 Analysis)

6.1. Sensitivity Analysis (Runs 2 through 10)

The results show that increases in stack height, stack diameter, stack gas exit velocity, and stack gas exit temperature decrease ambient pollutant concentration levels and increase the distance of impact from the source. Decreases in stack height, stack diameter, stack gas exit velocity, and stack gas exit temperature increase ambient pollutant concentration levels and decrease the distance of impact from the source. Tall and wide stacks with high velocity and temperature promote plume rise. Short and narrow stacks with low velocity and temperature impede plume rise. The modeling parameters used for these runs with an emission rate of 40 tpy resulted in exceedances of the modeling significance levels for all averaging periods for SO_2, NO_2, and PM_{10}. All impact concentrations for 15 tpy PM_{10}, except for diameter and velocity increases, are above the modeling significance levels for both averaging periods for PM_{10}.

6.2. Building Downwash (Runs 11 through 18)

Increase in building height increases the magnitude of impact and decreases the distance of impact from the source. Examining the concentrations for runs 13 through 18 in Table 7 reveals the relationship between maximum impacts and fenceline receptors. The maximum impacts obtained for a given emission unit can vary with the location of the fenceline. Thus, the fenceline location is important because it usually determines the ambient air boundary.[12] For example, the maximum annual concentration for an emission unit subject to downwash from a building height equal to 75% of the stack height with a fenceline at 50 m is 35.92 μg/m^3. If the same emission unit has a fenceline at 30 m, the maximum annual concentration is 54.00 μg/m^3, a 50% increase. For the emission unit subject to downwash from a building height equal to 50% of the stack height, the H2H 24-hr and maximum annual concentrations are the same for all fenceline distances used. The modeling parameters used for these runs with an emission rate of 40 tpy resulted in exceedences of the modeling significance levels for all averaging periods for SO_2, NO_2, and PM_{10}. All impact concentrations for 15 tpy PM_{10} are above the modeling significance levels for both averaging periods for PM_{10}. The 3-hr SO_2 CAAQS is exceeded by the source impacts.

Table 7. Impacts from 40 tpy by fenceline distance from source

Fenceline Distance from Source	Impact Concentration from 40 tpy (μg/m^3)					
	Building Height = 50% Stack Height			Building Height = 75% Stack Height		
	H2H 3-hr	H2H 24-hr	Max Annual	H2H 3-hr	H2H 24-hr	Max Annual
50 m	196.43	71.42	9.8	544.72	237.69	35.92
30 m	208.77	71.42	9.8	949.60	317.85	54.00
15 m	196.43	71.42	9.8	1045.30	237.69	35.92

6.3. Multiple Changes in Stack Characteristics with Building Downwash (Runs 19 through 22)

These runs were performed to determine impact concentrations resulting from vertical, unobstructed stacks subject to building downwash with poor dispersion characteristics (low temperature, velocity and stack diameter). Short stacks with fairly good dispersion can have high impacts due to an overwhelming effect from building downwash. The modeling parameters used for these runs with an emission rate of 40 tpy resulted in exceedances of the modeling significance levels for all averaging periods for SO_2, NO_2, and PM_{10}. All impact concentrations for 15 tpy PM_{10} are above the modeling significance levels for both averaging periods for PM_{10}. The SO_2 AAQS and 24-hr PM_{10} NAAQS (at 40 tpy and 15 tpy) have been exceeded by the

[12] Ambient air quality standards apply only in "ambient air." That is, it is not necessary to place receptors (e.g., to estimate impacts) within property owned or controlled by the facility if public access is precluded by a fence or physical barrier.

source impacts. The NO_2 impacts, using a 75% annual conversion to NO_2 from NO_X, range from 75 μg/m^3 to 86 μg/m^3, greater than 75% of the NO_2 NAAQS.

6.4. Horizontal Stack (Runs 23 Through 25) and Capped Stack (Runs 26 through 28)

Horizontal and capped stacks do not promote plume rise. This is illustrated by the exceedances of the modeling significance levels for all averaging periods as well as most of the AAQS for SO_2, NO_2, and PM_{10} with a few exceptions (annual NAAQS for runs with no building downwash).

6.5. Minimum and Maximum Range of Values (Runs 29 and 30)

These runs were performed to determine the range of impact concentrations for the range of stack and building characteristics used in this modeling analysis. Run 29 is the poor dispersion example with all impact concentrations exceeding the modeling significance levels and AAQS. Run 30 is a good dispersion example with all impact concentrations below the modeling significance levels.

6.6. Other Modeling Variables Not Examined in this Modeling Analysis

There are other parameters used in modeling that are not examined here, such as different meteorological data sets, elevated terrain, and background concentrations. Typical yearly variations of meteorological data at one location can result in modeled design concentration differences of up to 25% or even higher in some locations.[13] Higher impacts may result when plume rise is insufficient to clear nearby terrain.

Contributors to ambient air concentration for determining compliance with AAQS are impacts from the source of interest and nearby sources, and the background concentration. Even though impacts are just above modeling significance levels or only a small fraction of the AAQS, a complete compliance demonstrate must also take existing air pollutant concentration levels into account. This may mean that, in addition to adding a background concentration, nearby sources with strong concentration gradients should be included in the modeling. Since it's not reasonable to model all sources, it is necessary to add a background concentration to account for the emissions from all sources that have not been explicitly included in the modeling. Background concentrations vary by geographic area. For areas with high background concentrations (and/or strong concentration gradients from nearby sources) near the AAQS, a source impact that is greater than the modeling significance levels, but still a relatively small percentage of the AAQS, can result in a modeled violation of the AAQS.

[13] In a recent study conducted in Alaska, it was found that the modeled maximum annual average concentration varied by as much as 200% over a five (5) year period at one particular site, depending on which year of meteorological data was used in the model. At two other sites, the maxima varied by 139% and 122%, respectively. For short-term (24-hour) concentrations, the maximum modeled concentration varied by 161%, 148%, and 121% at three different sites, depending on which one of the five years of meteorological data were used. In addition to the variation in the maximum modeled impact, the location (geographic location) of the modeled maxima varied significantly from one year to the next. [Reference: Presentation by Alan Schuler, Alaska Department of Environmental Conservation, 2001 EPA/State/Local Modeler's Workshop, Chicago]

7. Methodology, Results, and Discussion of the April 2010 Analysis

7.1. Methodology

Annual, 24-hr, and 1-hr impacts for 22 individual point source scenarios using 48 one-year periods of hourly meteorology were estimated with AERMOD (09292) and SCREEN3 for a range of emission rates. Since no chemical transformations or conversion factors were used, the impacts in Figures #-# below are applicable for any pollutant. Urban effects were not modeled.

7.1.1. Meteorology

The following meteorological data (station/years) were used in this analysis.

DEN (Denver Stapleton) 1990-1994
Greely (Greeley) 2002-2006
Akron (Akron) 1990-1994
Pueblo (Pueblo Memorial Airport) 2002-2006
COSprings (Colorado Springs) 1987-1991
Sydney (Sydney) 2003-2007
Kodak 1993-1997
PRPA06 (Platte River Power-Rawhide)
Thermo/Ft Lupton
FtStVrain (Fort St Vrain Power)
PuebloDepot (Peublo Chemical Depot) 1998-2000
Portland
Asarco1993, 1994, 1998-2000
Naturita

7.1.2. Receptor Network

Receptors were placed every 10 degrees at the following distances (meters) from the point source: 30, 50, 75, 100, 125, 150, 175, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 2600, 2700, 2800, 2900, 3000, 3100, 3200, 3300, 3400, 3500, 3600, 3700, 3800, 3900, 4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700, 4800, 4900, 5000, 5500, 6000, 6500, 7000, 7500, 8000, 8500, 9000, 9500, 10000. Flat terrain was assumed.

7.1.3. Point Sources

Table 8 summarizes the point source parameters (building dimensions, where applicable) for each scenario/model run. The range of source types in this analysis (points, with and without building downwash) is not intended to represent all possible stack characteristics and combinations but is intended to illustrate the effects of each/combination of parameter(s) on impact estimates.

Table 8. Summary of Point Source Inputs

Source ID	Emissions Rate (g/s)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Stack Diameter (m)	Bldg Height (m)	Bldg Width (m)	Bldg Length (m)	Location of Bldg
B1	100	10	293	1	2.4				
B2	100	35	293	11.7	2.4				
B3	100	35	432	11.7	2.4				
B4	100	100	416	18.8	4.6				
B5	100	150	425	26.5	5.6				
B6	100	200	425	26.5	5.6				
BC08	100	8	377	10	0.7				
BC10	100	10	300	15	0.2				
BCMD	100	40	325	10	1.5				
BCLG	100	91.4	467.6	17.1	4.57				
CO1	100	6	400	15	0.5				
ASOS1	100	55	432	11.7	2.4				
D1	100	10	293	1	2.4	34	60	120	NE bldg corner = stack location
D2	100	10	293	1	2.4	34	60	120	NE bldg corner SW of stack (-96 m, -96 m)
D3	100	35	432	11.7	2.4	34	60	120	NE bldg corner = stack location
D4	100	35	432	11.7	2.4	34	60	120	NE bldg corner SW of stack (-96 m, -96 m)
D5	100	100	416	18.8	4.6	50	60	120	NE bldg corner = stack location
D6	100	100	416	18.8	4.6	50	60	120	NE bldg corner SW of stack (-140 m, -140 m)
BC08D	100	8	377	10	0.7	6	10	6	North side of building centered on stack
BC10D	100	10	300	15	0.2	8	10	6	NE bldg corner located 4 m south of stack
CO1D	100	6	400	15	0.5	4	4.5	9	North side of building centered on stack
ASOS1D	100	55	432	11.7	2.4	34	60	120	NE bldg corner = stack location

7.2. Results and Discussion

Predicted concentrations from AERMOD and SCREEN3 for various emission rates are compared to the NAAQS for Pb (3-month), $PM_{2.5}$ (24-hr and annual), and NO_2 (1-hr) in the subsequent subsections. The SCREEN3 concentrations do not include estimates in the cavity region, consistent with past and present Division practice.

7.2.1. 1-hr Concentrations

Figure 6 through Figure 9 present the 1-hr concentrations for emission rates of 9.13 pounds per hr (annual NO_X emission rate threshold equivalent - 40 tpy), 2.28 pounds per hr, 1.14 pounds per hour, and 0.46 pound per hr. Based on these results, the 1-hr NO_2 NAAQS could be threatened by an individual emission unit with an emission rate around or greater than 2.28 pounds per hour. At a point source emission rate of 1.14 pounds per hour (with or without building downwash), it is reasonable to believe the source will cause or contribute to a violation of the 1-hr NO_2 NAAQS. For a point source with an emission rate of 0.46 pound per hour with poor dispersion, there will be situations (Table 1 footnotes and Section 7.2.5) when the modeling significance level is exceeded and it is reasonable to believe the source will cause or contribute to a violation of the 1-hr NO_2 NAAQS.

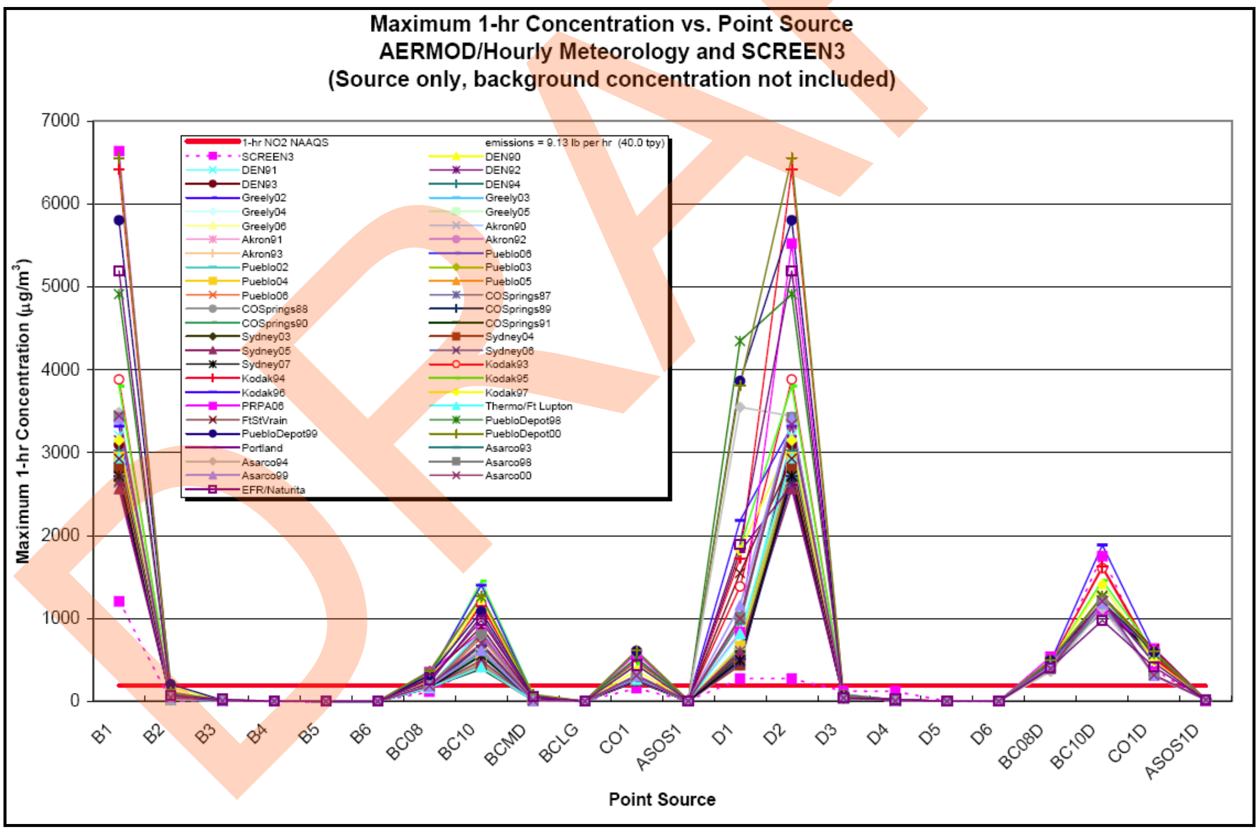


Figure 6. Maximum 1-hr Concentrations - 9.13 pounds per hr (40 tpy equivalent)

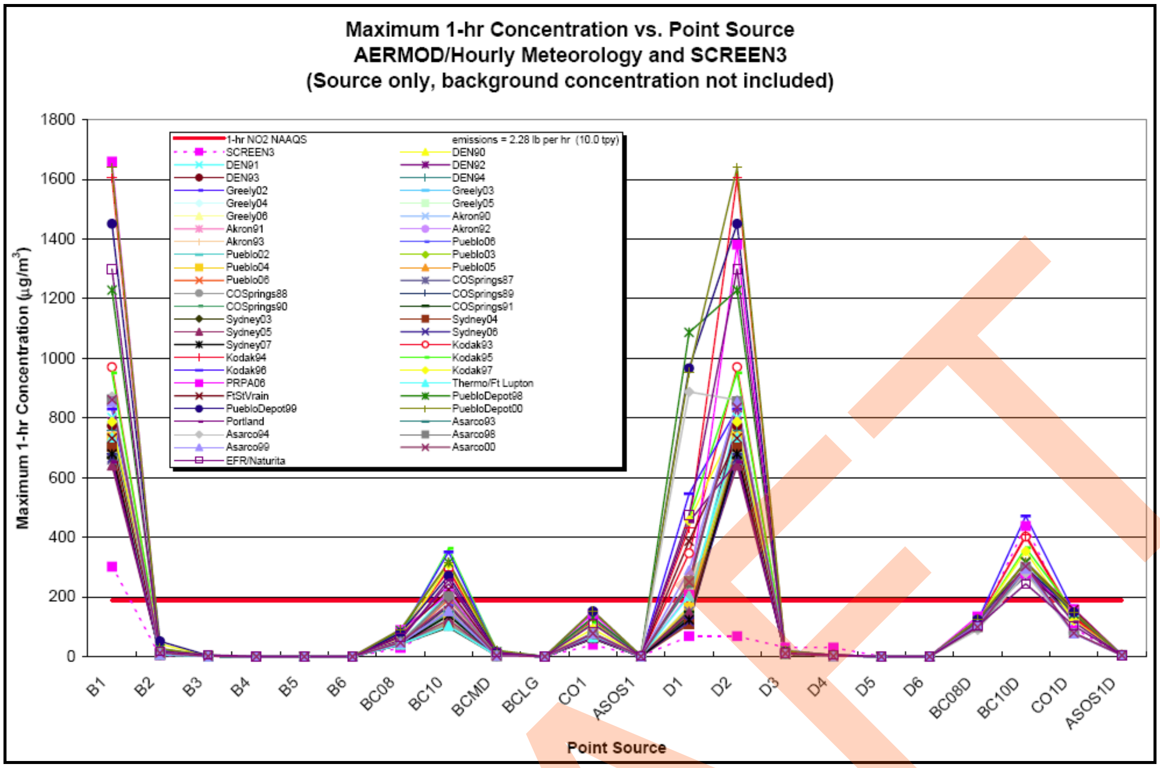


Figure 7. Maximum 1-hr Concentrations -2.28 pounds per hr (10 tpy equivalent)

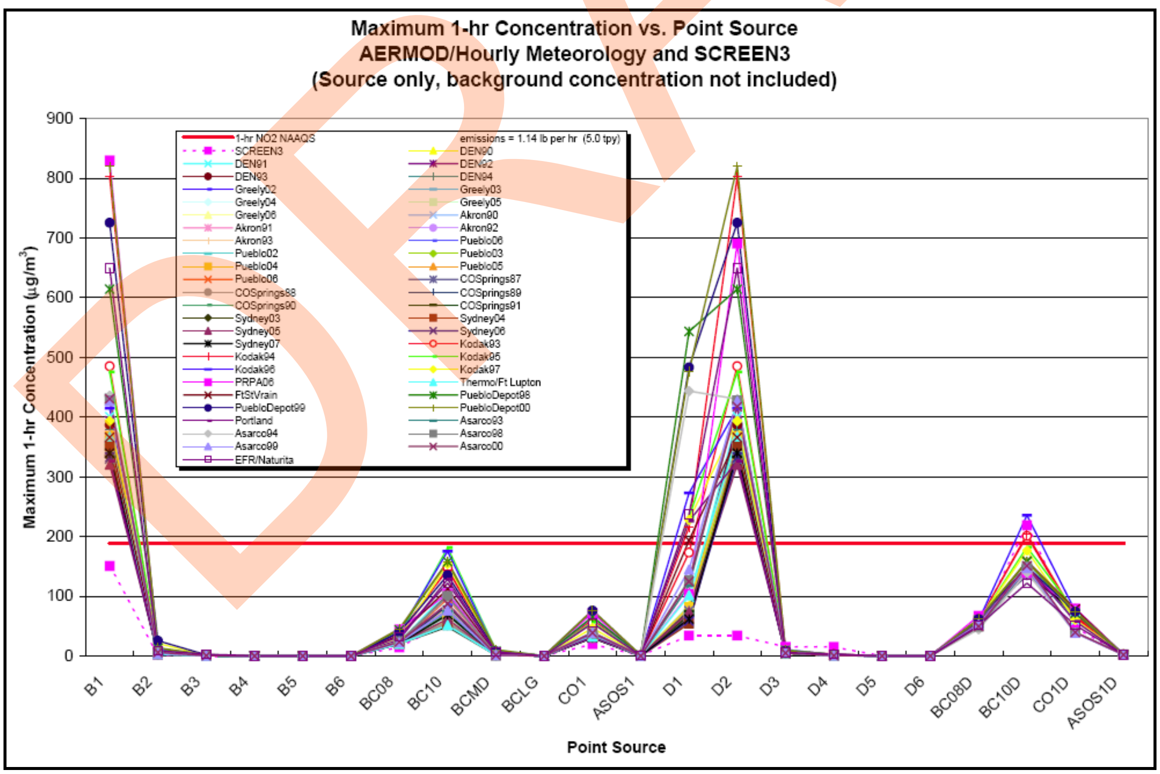


Figure 8. Maximum 1-hr Concentrations - 1.14 pounds per hr (5 tpy equivalent)

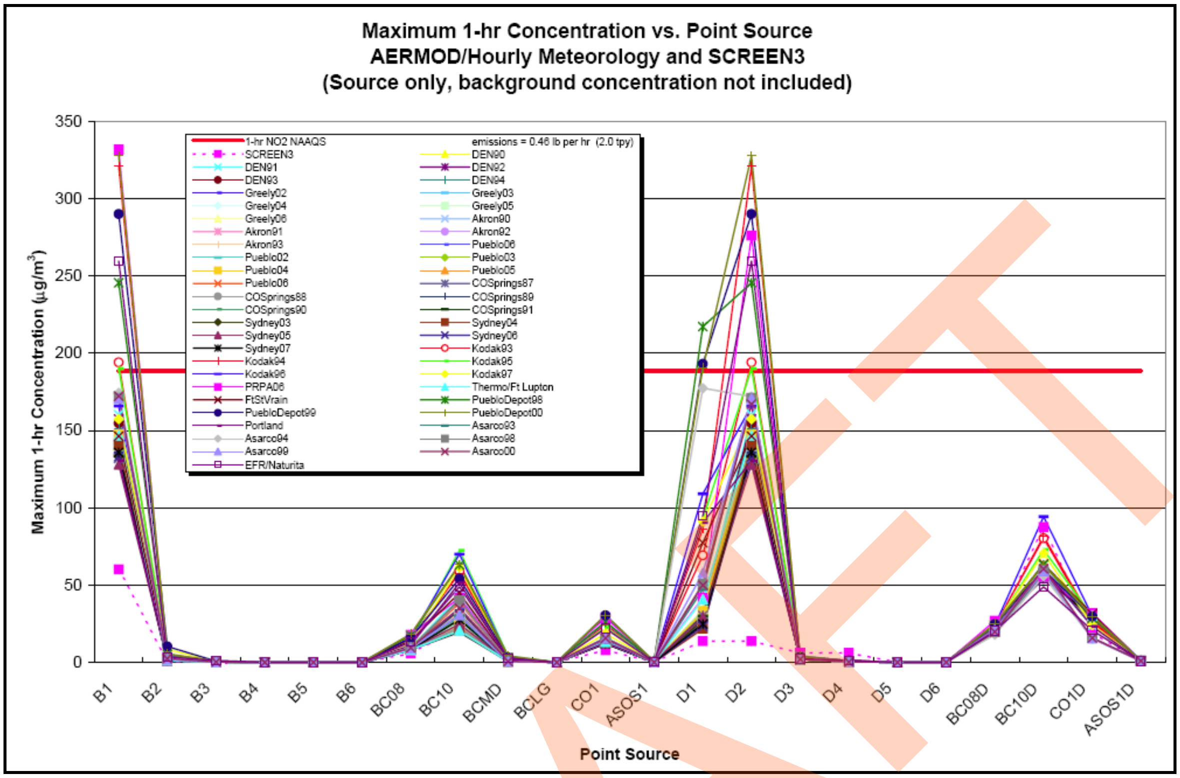


Figure 9. Maximum 1-hr Concentrations - 0.46 pound per hr (2 tpy equivalent)

7.2.2. 24-hr Concentrations

Figure 10 through Figure 12 present the 24-hr concentrations for emission rates of 82 pounds per day (24-hr PM_{10} emission rate threshold), 27 pounds per day, and 11 pounds per day. Based on these results, the 24-hr $PM_{2.5}$ NAAQS could be threatened by an individual emission unit with poor dispersion and an emission rate around or greater than 27 pounds per day. For a point source with an emission rate of 11 pounds per day with poor dispersion, there will be situations (Table 1 footnotes and Section 7.2.5) when the modeling significance level is exceeded and it is reasonable to believe the source will cause or contribute to a violation of the 24-hr $PM_{2.5}$ NAAQS.

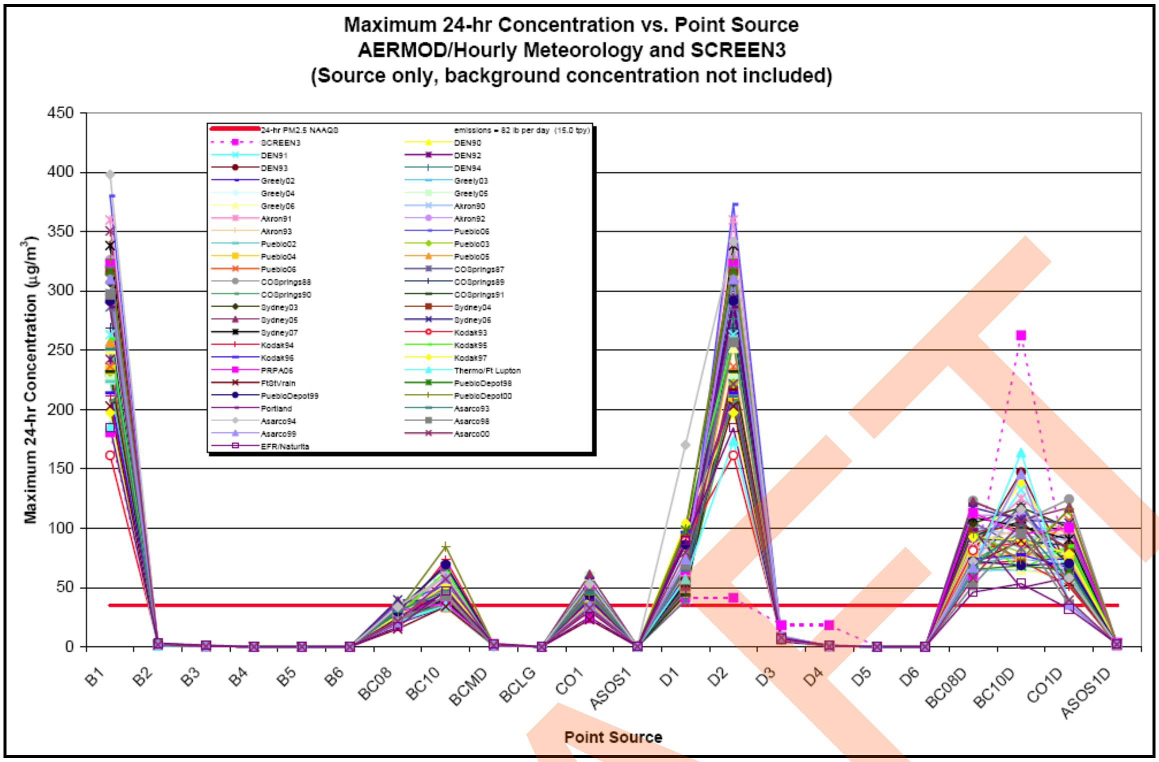


Figure 10. Maximum 24-hr Concentration - 82 lb per day (15 tpy equivalent)

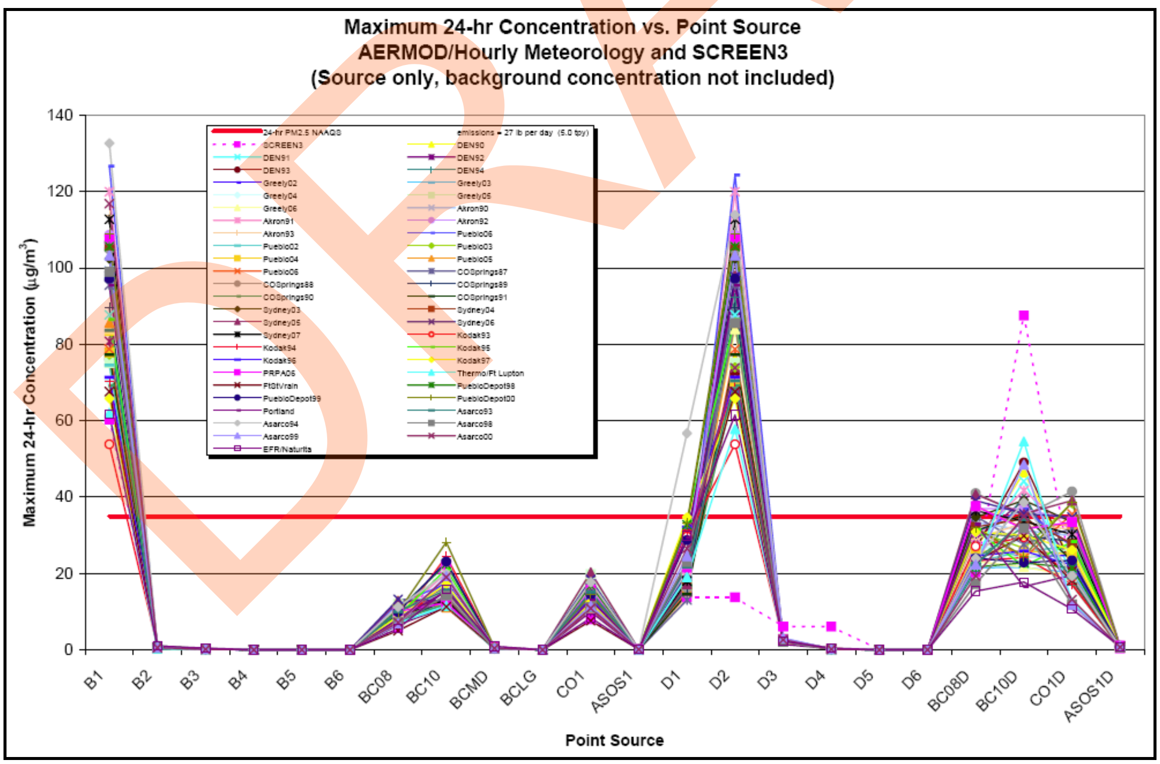


Figure 11. Maximum 24-hr Concentration - 27 lb per day (5 tpy equivalent)

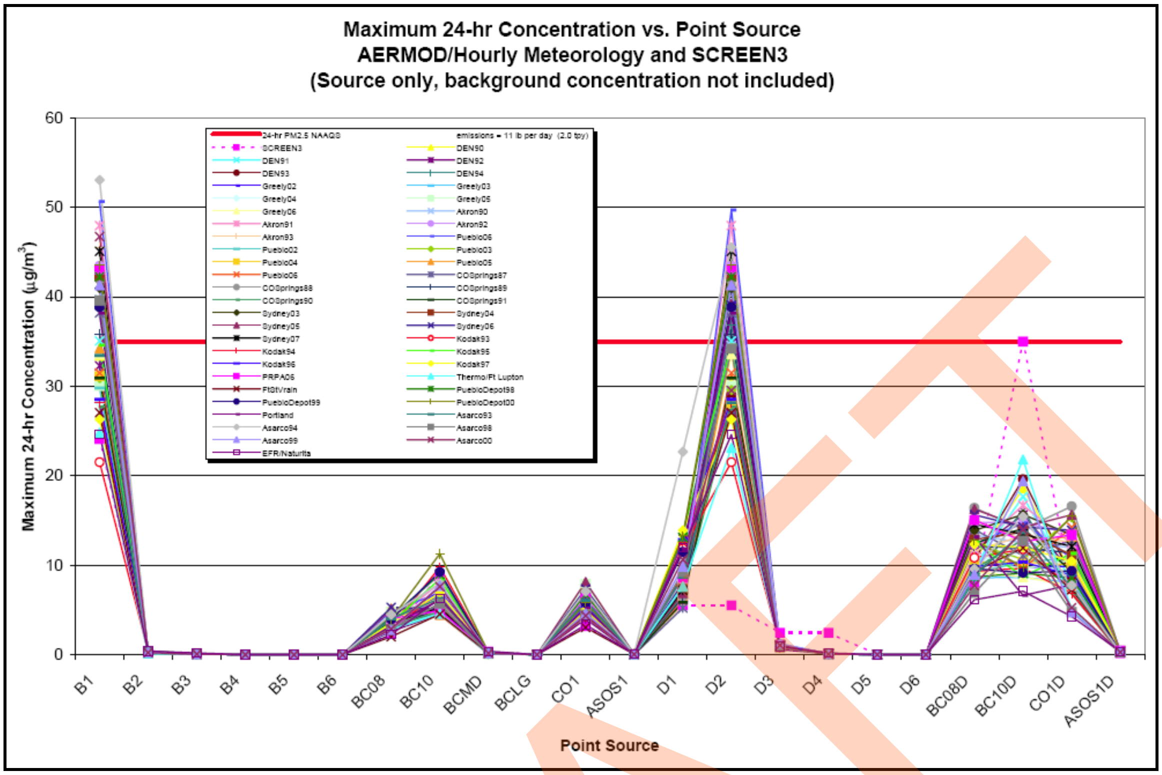


Figure 12. Maximum 24-hr Concentration - 11 lb per day (2 tpy equivalent)

7.2.3. Annual Concentrations

Figure 13 through Figure 15 present the annual concentrations for emission rates of 15 tpy, 10 tpy, and 5 tpy. Based on these results, the annual $PM_{2.5}$ NAAQS could be threatened by an individual emission unit with poor dispersion and an emission rate around or greater than 10 tpy. For a point source with an emission rate of 5 tpy with poor dispersion, there will be situations (Table 1 footnotes and Section 7.2.5) when the modeling significance level is exceeded and it is reasonable to believe the source will cause or contribute to a violation of the 24-hr $PM_{2.5}$ NAAQS.

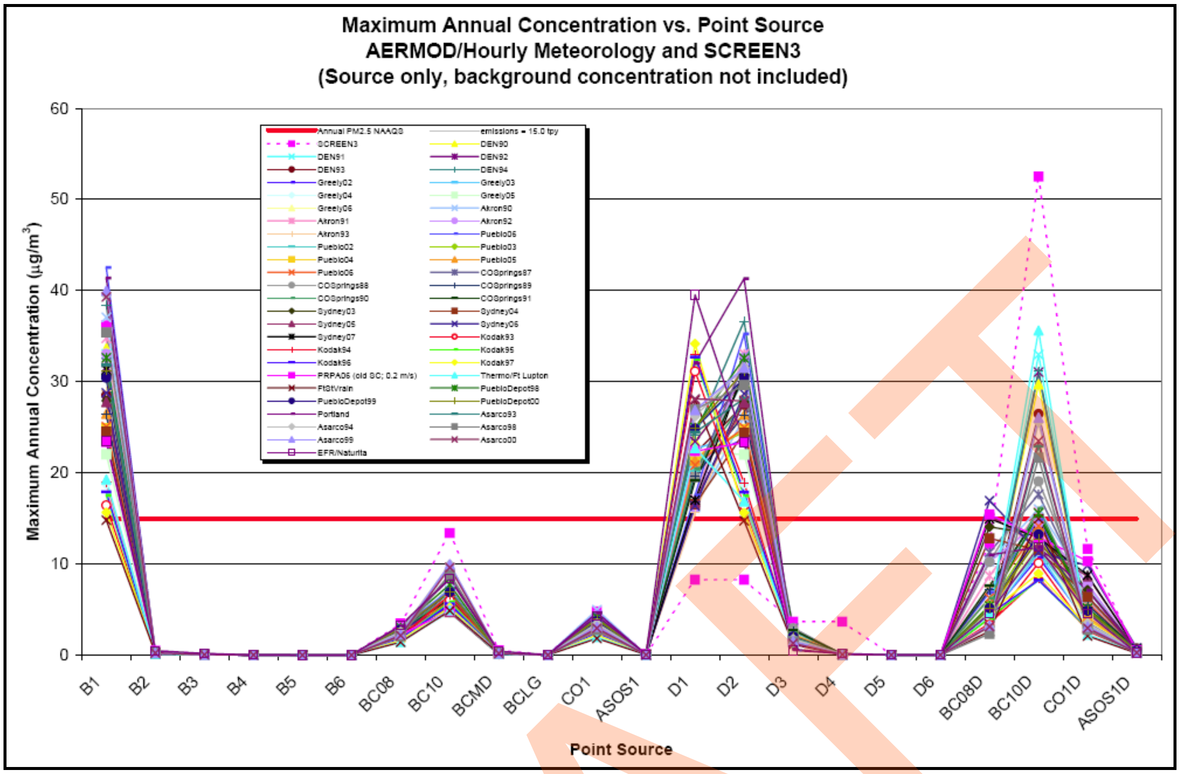


Figure 13. Maximum Annual Concentrations - 15 tpy

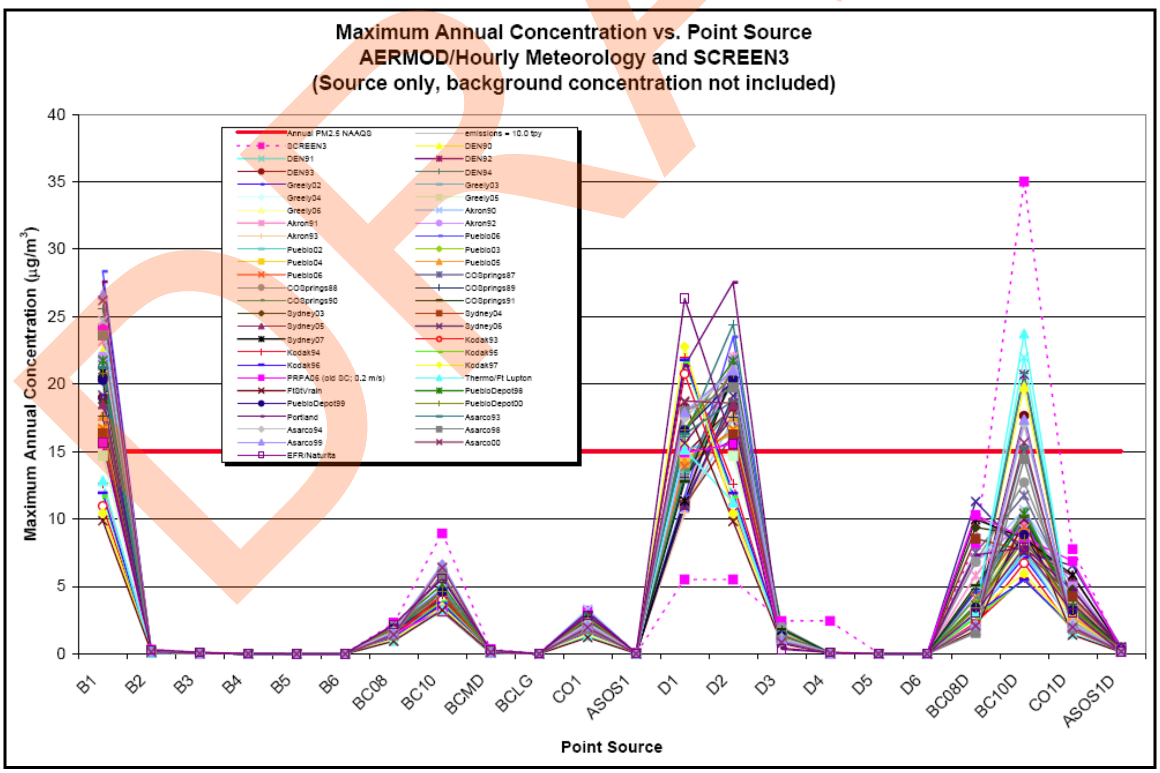


Figure 14. Maximum Annual Concentrations - 10 tpy

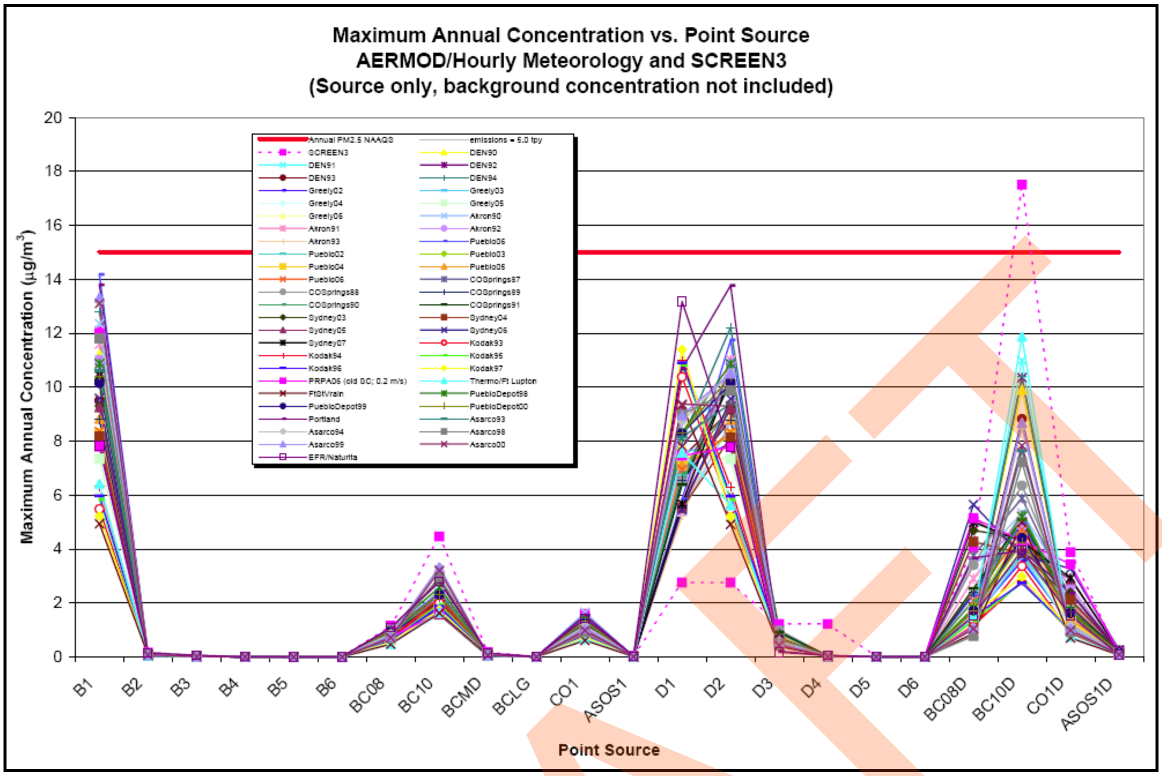


Figure 15. Maximum Annual Concentrations - 5 tpy

7.2.4. 3-month Concentrations

For the rolling 3-month Pb NAAQS, the annual and 24-hr concentrations (monthly average concentrations were not obtained from the model) were reviewed for emission rates of 0.6 tpy/300 pounds per 3-months (Figure 16 and Figure 17), 0.1 tpy/50 pounds per 3-months (Figure 18 and Figure 19), and 0.05 tpy/25 pounds per 3-months (Figure 20 and Figure 21). Concentrations for a 3-month average are greater than the annual average but less than the 24-hr average. Based on these results, the 3-month Pb NAAQS could be threatened by an individual emission unit with poor dispersion and an emission rate around or greater than 0.1 tpy/50 pounds per 3-months. For a point source with an emission rate of 0.05 tpy/25 pounds per 3-months with poor dispersion, there will be situations (Table 1 footnotes and Section 7.2.5) when it is reasonable to believe the source will cause or contribute to a violation of the rolling 3-month Pb NAAQS.

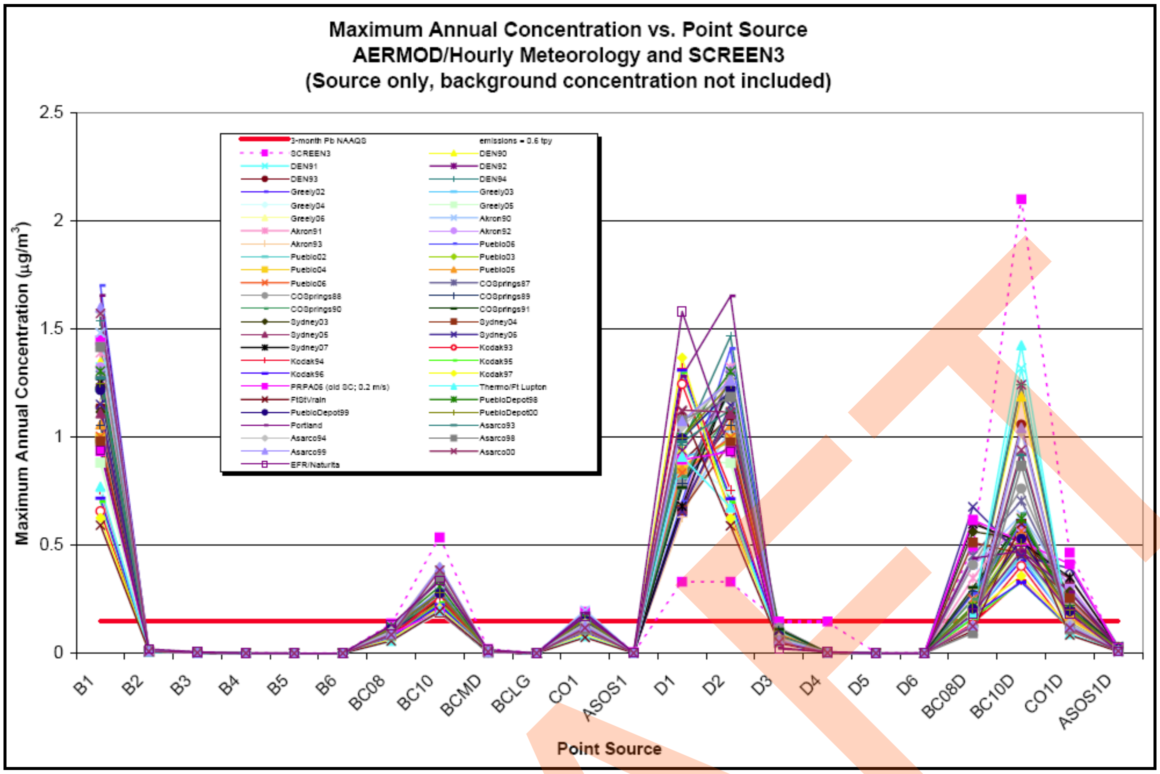


Figure 16. Maximum Annual Concentrations - 0.6 tpy

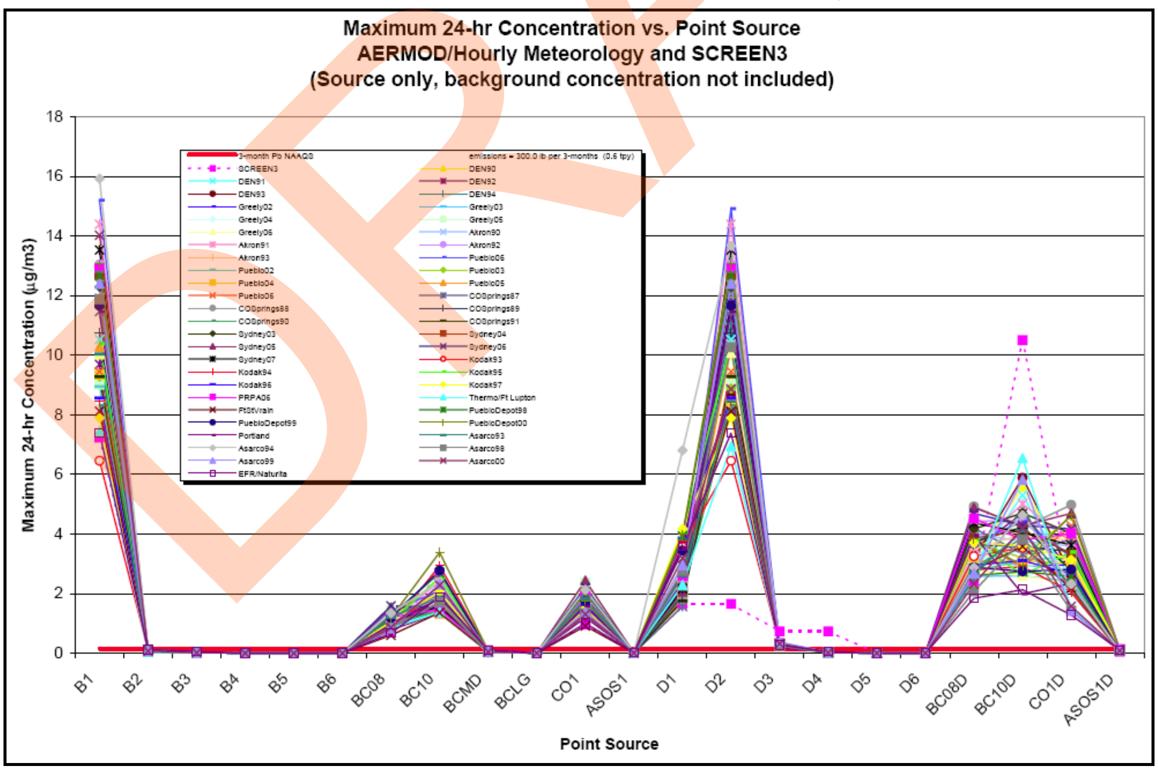


Figure 17. Maximum 24-hr Concentrations - 300 pounds per 3-months

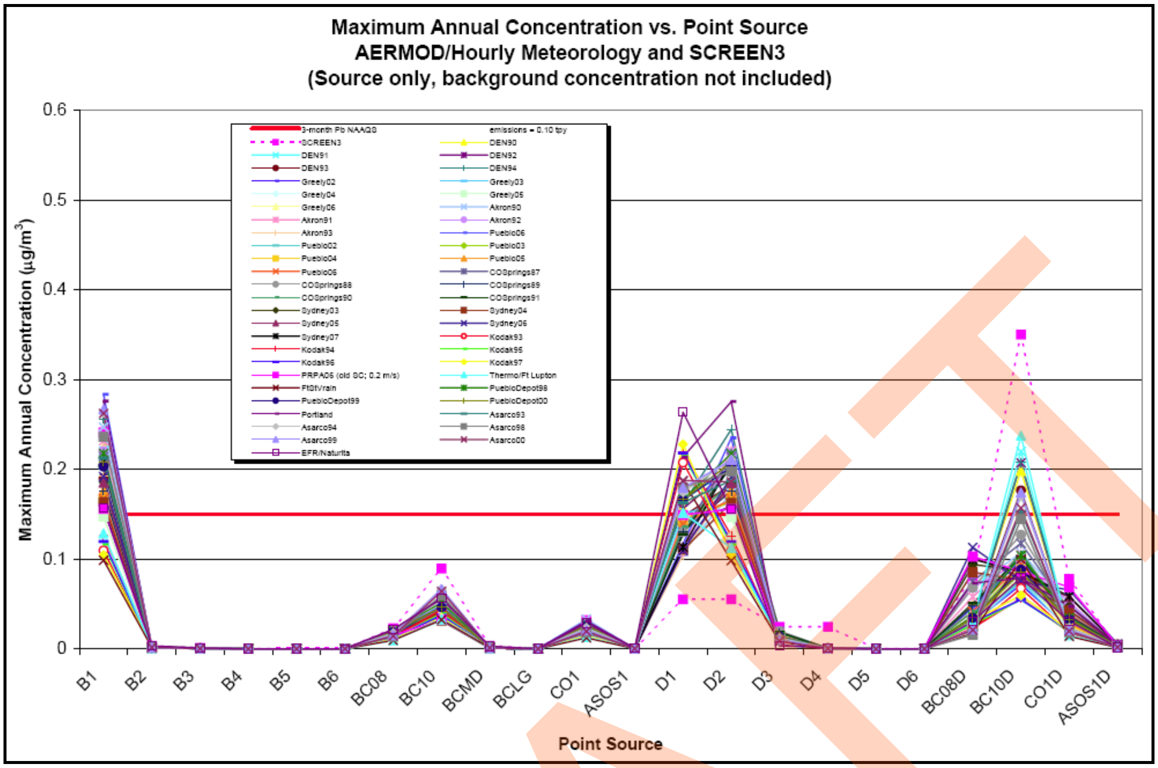


Figure 18. Maximum Annual Concentrations - 0.1 tpy

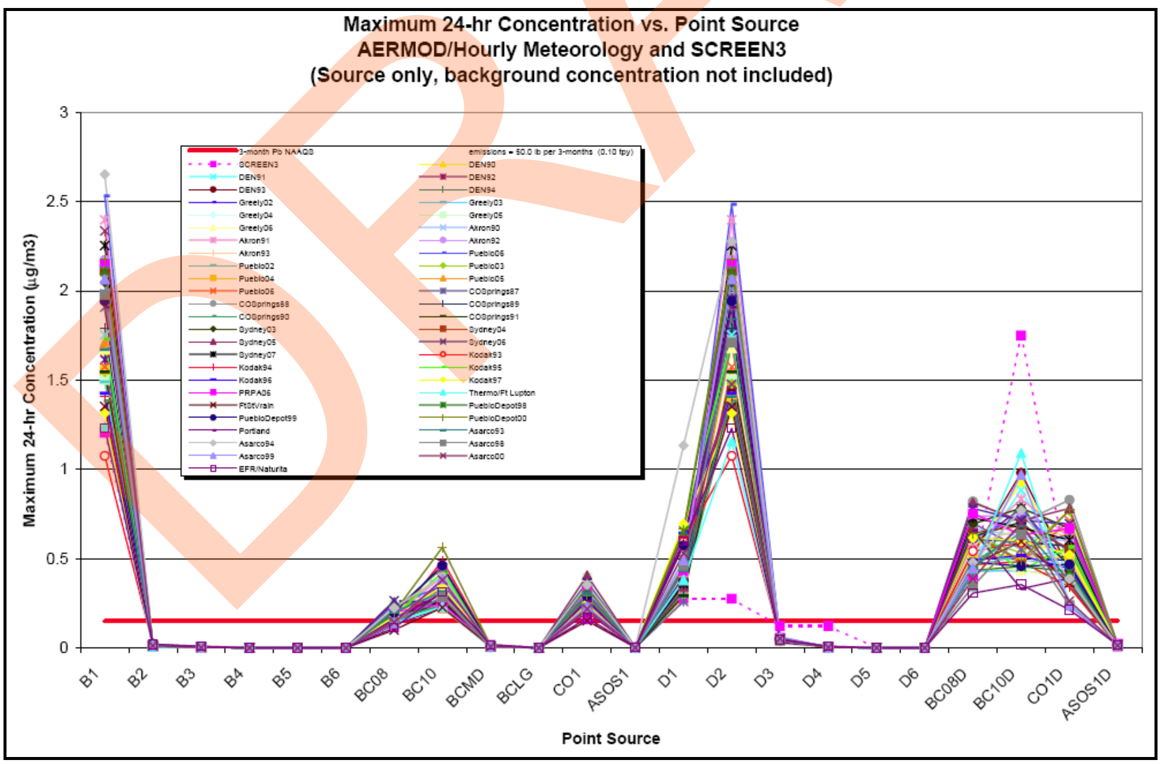


Figure 19. Maximum 24-hr Concentrations - 50 pounds per 3-months

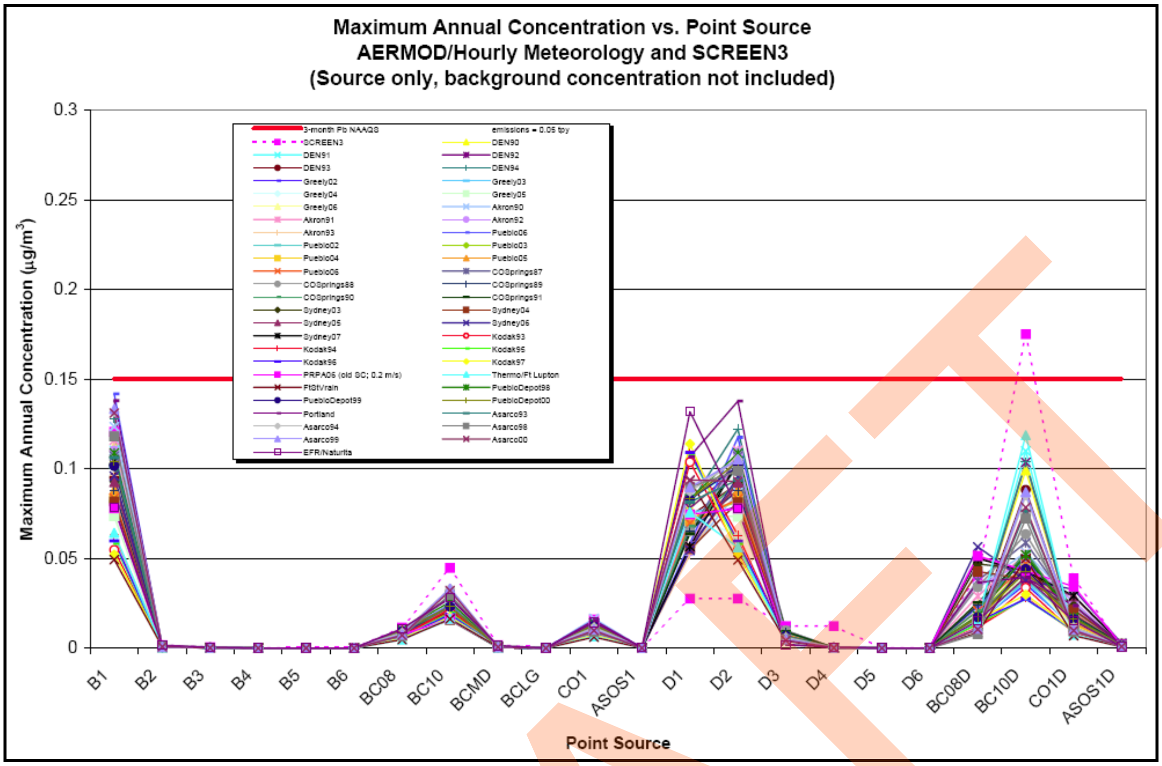


Figure 20. Maximum Annual Concentrations - 0.05 tpy

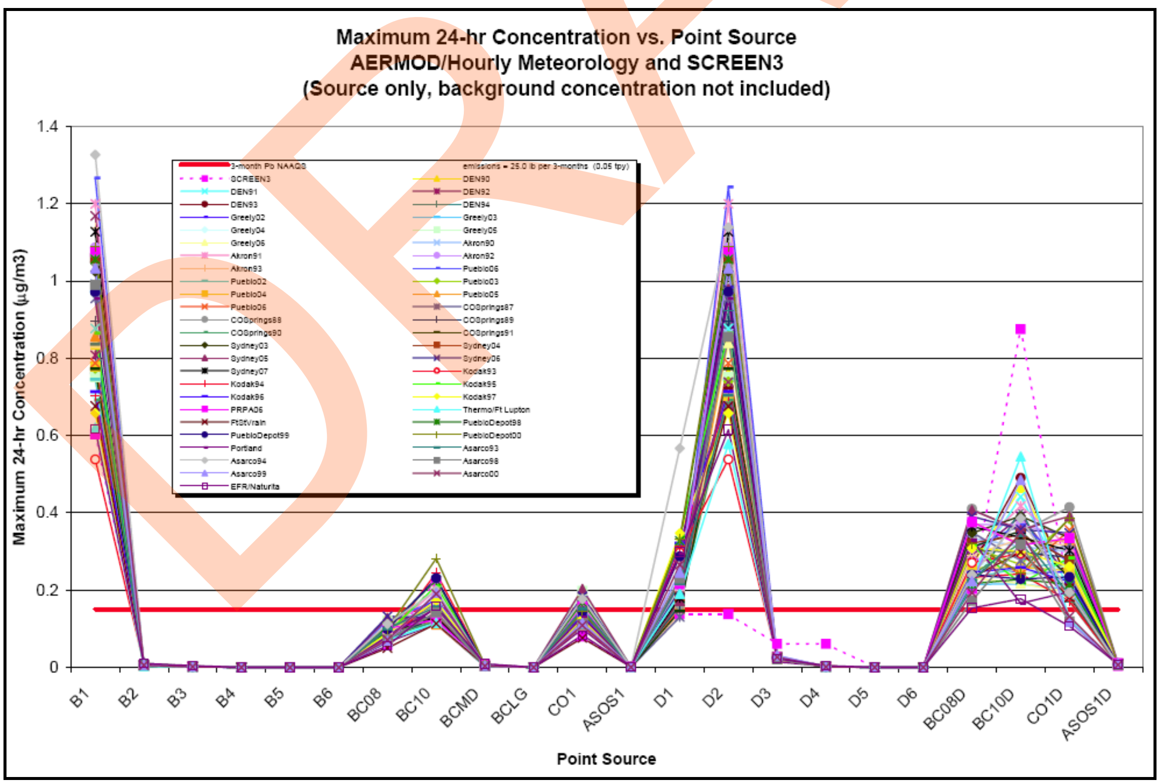


Figure 21. Maximum 24-hr Concentrations - 25 pounds per 3-months

7.2.5. Other Modeling Variables Not Examined in this Modeling Analysis

There are other parameters used in modeling that are not examined here, such as elevated terrain, urban effects, and background concentrations. Higher impacts may result when plume rise is insufficient to clear nearby terrain. As discussed in EPA's AERMOD Implementation Guide (March 19, 2009), plumes emitted or entrained into an urban air mass would be affected by the dispersive nature of the "convective-like" boundary layer that forms during nighttime conditions due to the urban heat island effect. Contributors to ambient air concentration for determining compliance with AAQS are impacts from the source of interest and nearby sources, and the background concentration. Even though impacts are just above modeling significance levels or only a small fraction of the AAQS, a complete compliance demonstrate must also take existing air pollutant concentration levels into account. This may mean that, in addition to adding a background concentration, nearby sources with strong concentration gradients should be included in the modeling. Since it's not reasonable to model all sources, it is necessary to add a background concentration to account for the emissions from all sources that have not been explicitly included in the modeling. Background concentrations vary by geographic area. For areas with high background concentrations (and/or strong concentration gradients from nearby sources) near the AAQS, a source impact that is greater than the modeling significance levels, but still a relatively small percentage of the AAQS, can result in a modeled violation of the AAQS.

8. Conclusion

The results in the January 2002 study demonstrate that a point source emitting 40 tons per year of nitrogen oxides (NO_X), sulfur dioxide (SO_2), or fine particulate matter (PM_{10}) or 15 tons per year of PM_{10} could have a significant impact in ambient air, and in certain stack and building configurations, exceed ambient air quality standards by itself. Lead (Pb) modeling was not investigated as part of this study. When compounding factors such as the presence of nearby sources and existing air pollution levels are considered, it is reasonable to conclude that even sources with relatively small emission rates (much lower than those in Table 1 of the Modeling Guideline) could cause or contribute to modeled violations of ambient air quality standards.

The results in the April 2010 study demonstrate that a point source emitting 0.46 pounds per hour of NO_X, 5 tons per year of $PM_{2.5}$, 11 pounds per day of $PM_{2.5}$, or 25 pounds per 3-months of Pb could have a significant impact in ambient air, and in certain stack and building configurations, exceed ambient air quality standards by itself.

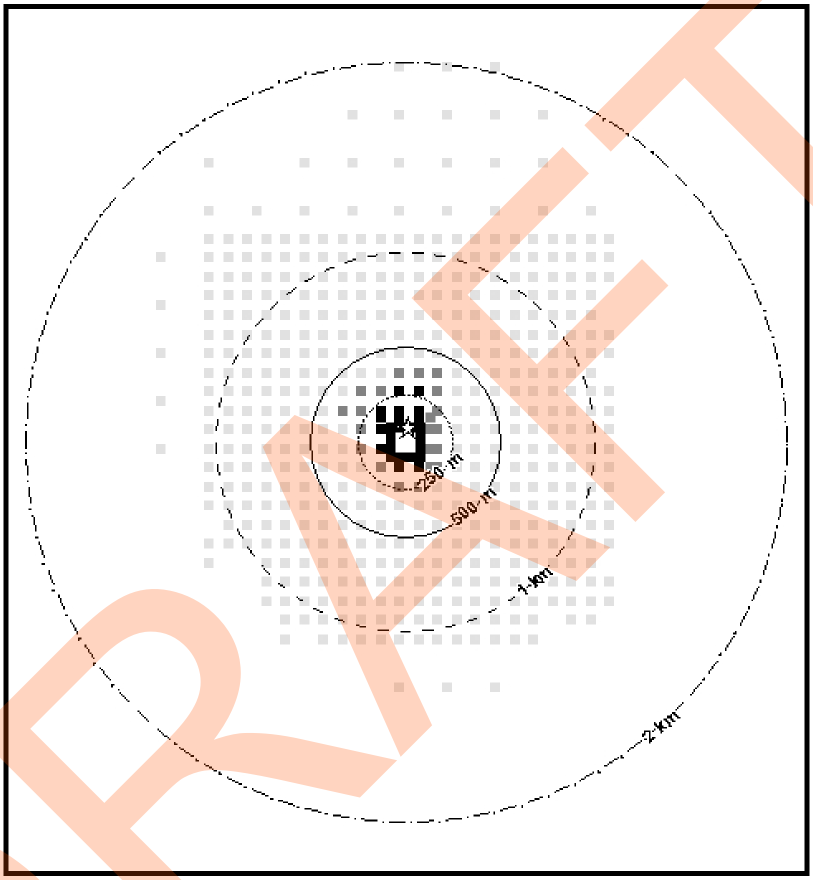
Clearly, these studies show that it is problematic to use only emission rates to determine when modeling is warranted. Many factors (including dispersion characteristics of the proposed source) should be considered in the decision to perform modeling. Consequently, the Division opposes the adoption of bright line exemptions from modeling that are based solely on emission rates. Furthermore, due to the complexity of pollution dispersion in the atmosphere, it is not realistic to develop a simple look-up table that adequately accounts for all of the important factors that affect air pollution dispersion.

The study shows that, in cases where a source has good dispersion characteristics and the existing air quality is well below ambient air quality standards, there is a low probability that the source will cause or contribute to a modeled violation of ambient air quality standards. Thus, it is reasonable to conclude that modeling is not warranted for minor sources and minor modifications with good dispersion at emission rates below the thresholds in Table 1 of the Colorado Modeling Guideline.

Appendix

Air Dispersion Modeling Analysis of Fugitive Sources

Magnitude and Location of Impacts from an Area Source 1 Square Acre and Release Height of 0 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

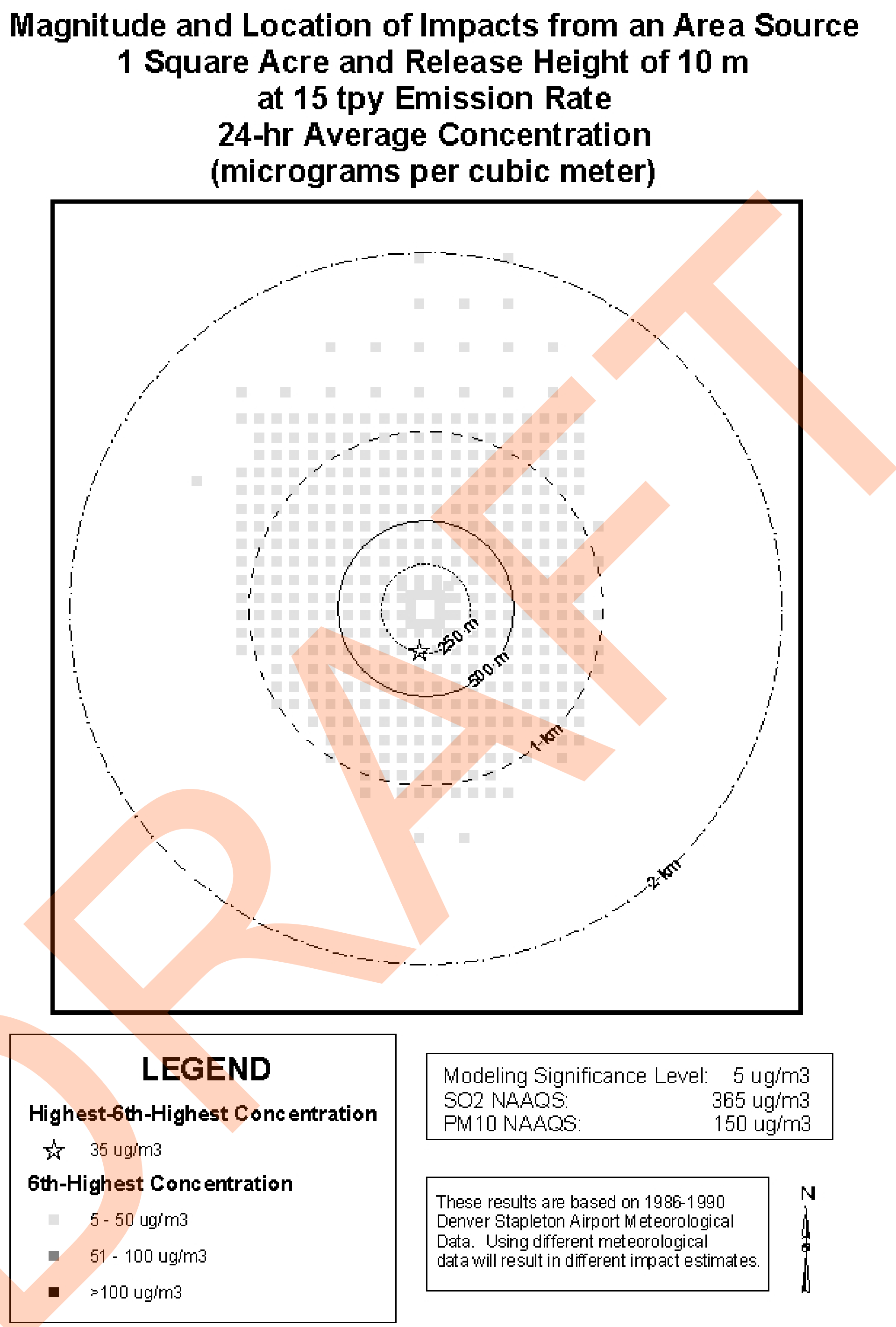
☆ 613 ug/m3

6th-Highest Concentration

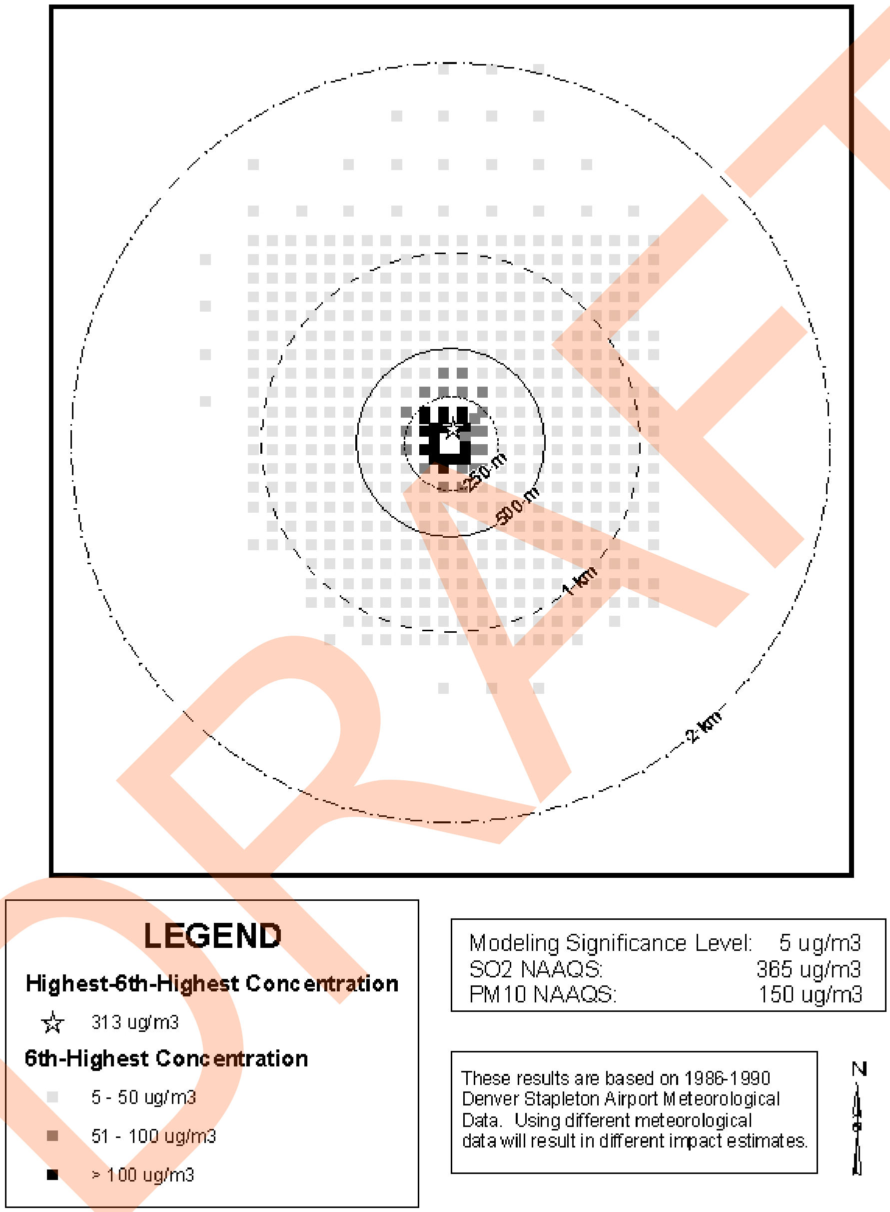
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

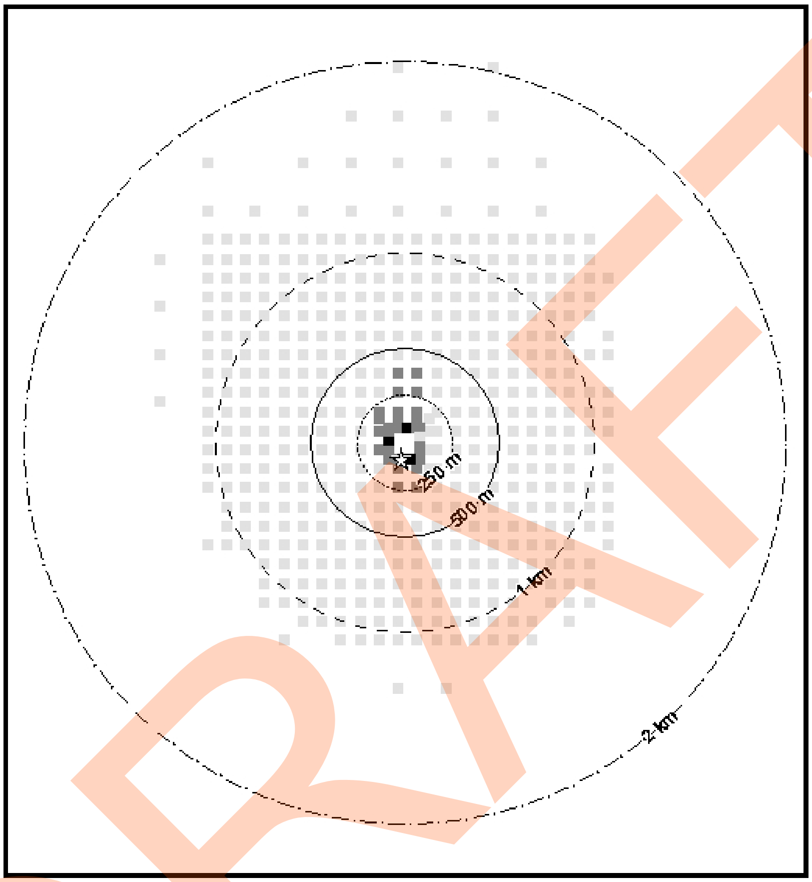
These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.


Magnitude and Location of Impacts from an Area Source
1 Square Acre and Release Height of 10 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)
250 m
500 m
1 km
2 km
LEGEND
Highest-6th-Highest Concentration
35 ug/m3
6th-Highest Concentration
5 - 50 ug/m3
51 - 100 ug/m3
>100 ug/m3
Modeling Significance Level: 5 ug/m3
SO2 NAAQS: 365 ug/m3
PM10 NAAQS: 150 ug/m3
These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.
N
DRAFT

Magnitude and Location of Impacts from an Area Source 1 Square Acre and Release Height of 2.5 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



Magnitude and Location of Impacts from an Area Source 1 Square Acre and Release Height of 5 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 124 ug/m3

6th-Highest Concentration

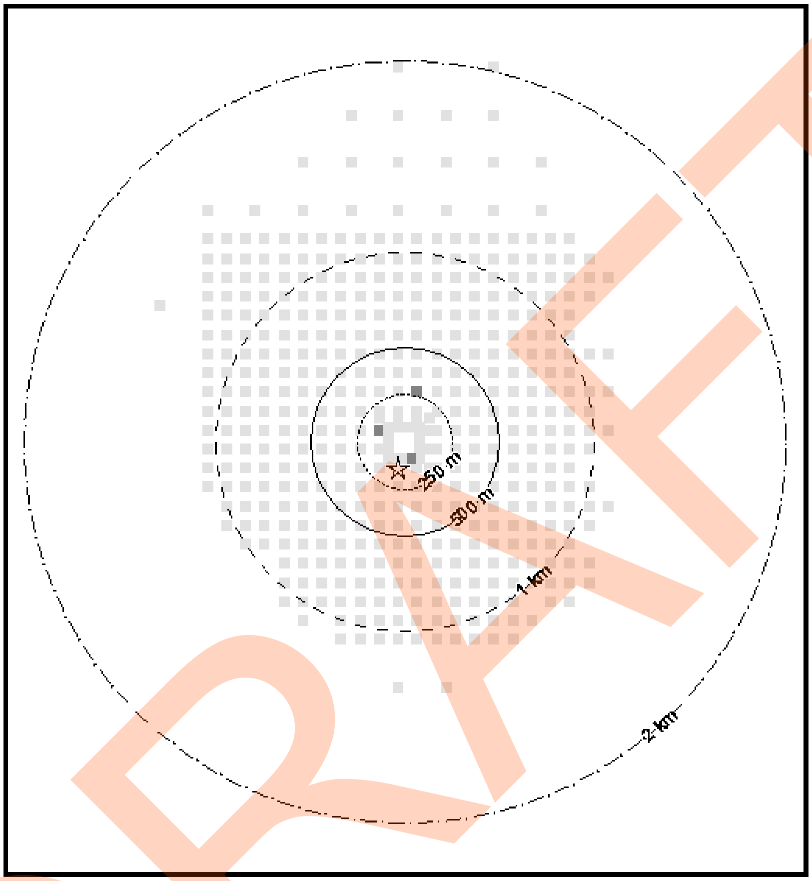
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source 1 Square Acre and Release Height of 7.5 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 59 ug/m3

6th-Highest Concentration

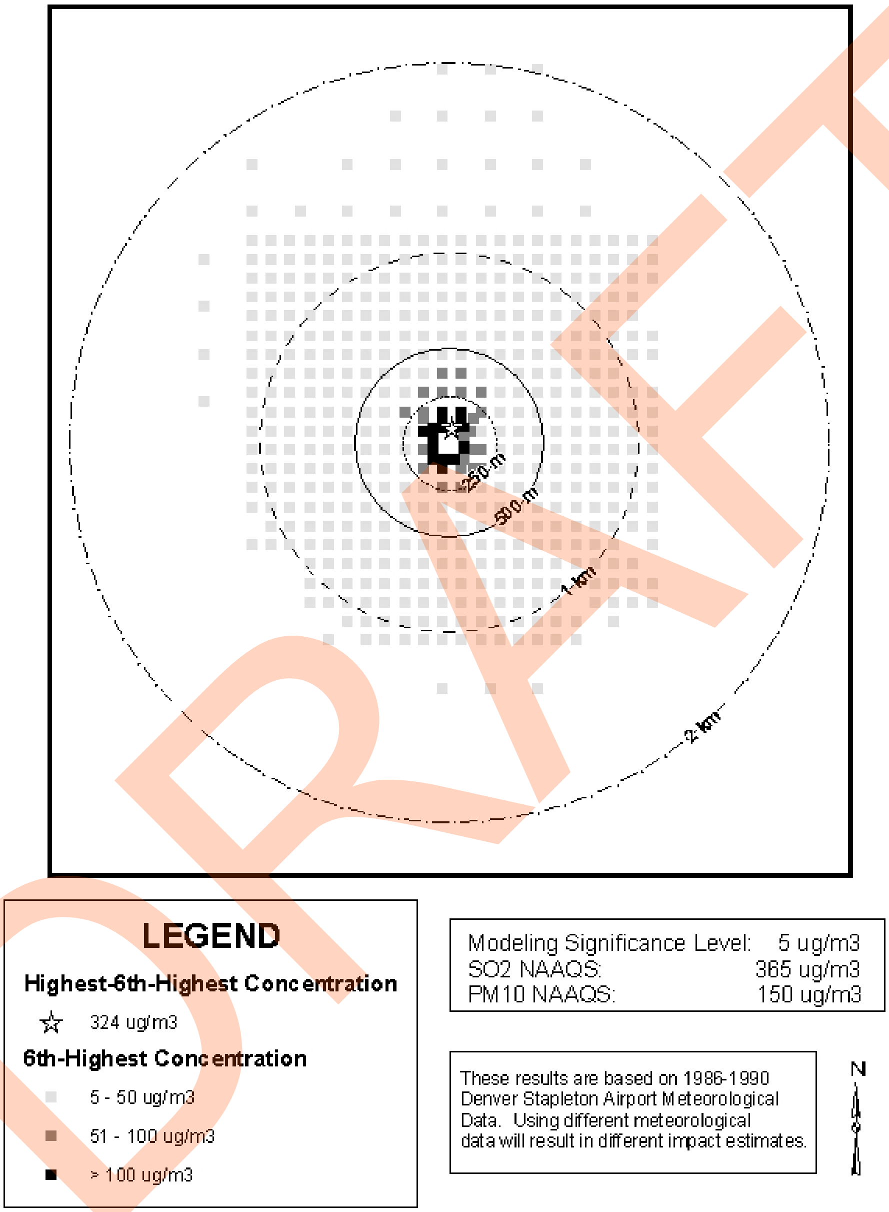
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

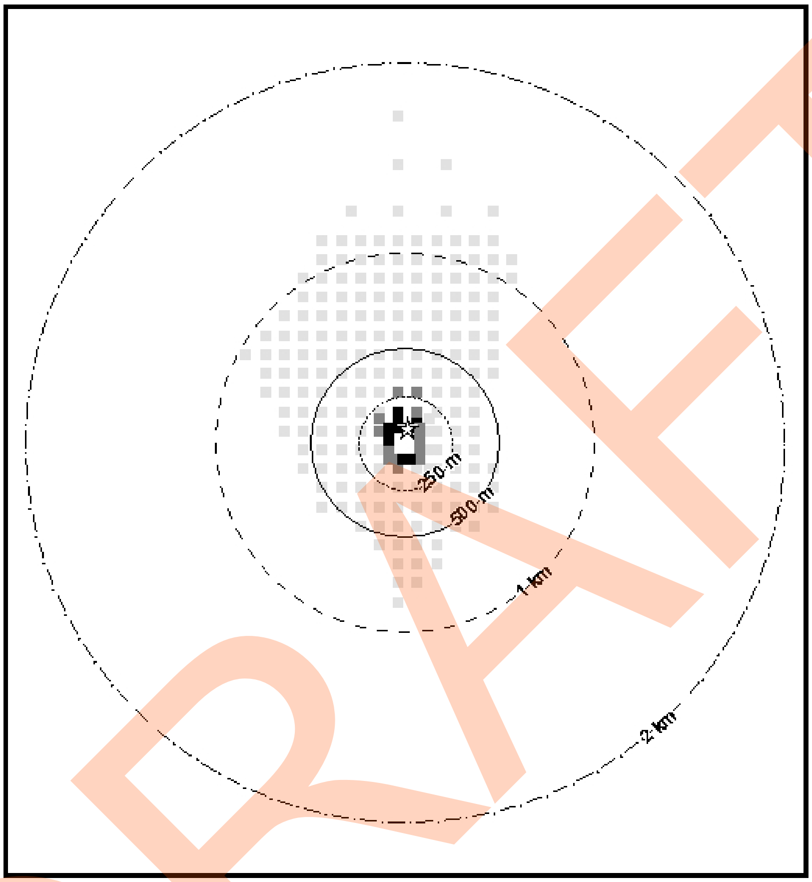
These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source 1 Square Acre, Release Height of 2 m, and Initial Vertical Dispersion of 3 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



Magnitude and Location of Impacts from an Area Source 1 Square Acre, Release Height of 2 m, and Initial Vertical Dispersion of 3 m at 15 tpy Emission Rate Annual Average Concentration (micrograms per cubic meter)



LEGEND

Maximum Annual Concentration

☆ 98 ug/m3

Annual Concentration

1 - 15 ug/m3

16 - 30 ug/m3

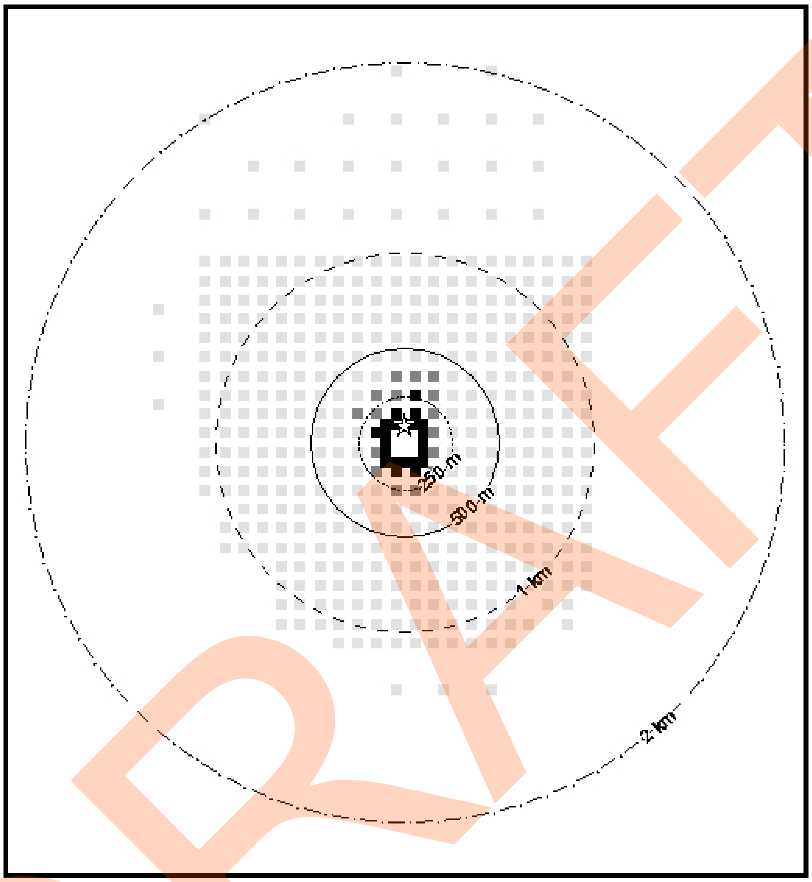
> 30 ug/m3

Modeling Significance Level:	1 ug/m3
NO2 NAAQS:	100 ug/m3
SO2 NAAQS:	80 ug/m3
PM10 NAAQS:	50 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source
2 Square Acres and Release Height of 0 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 468 ug/m3

6th-Highest Concentration

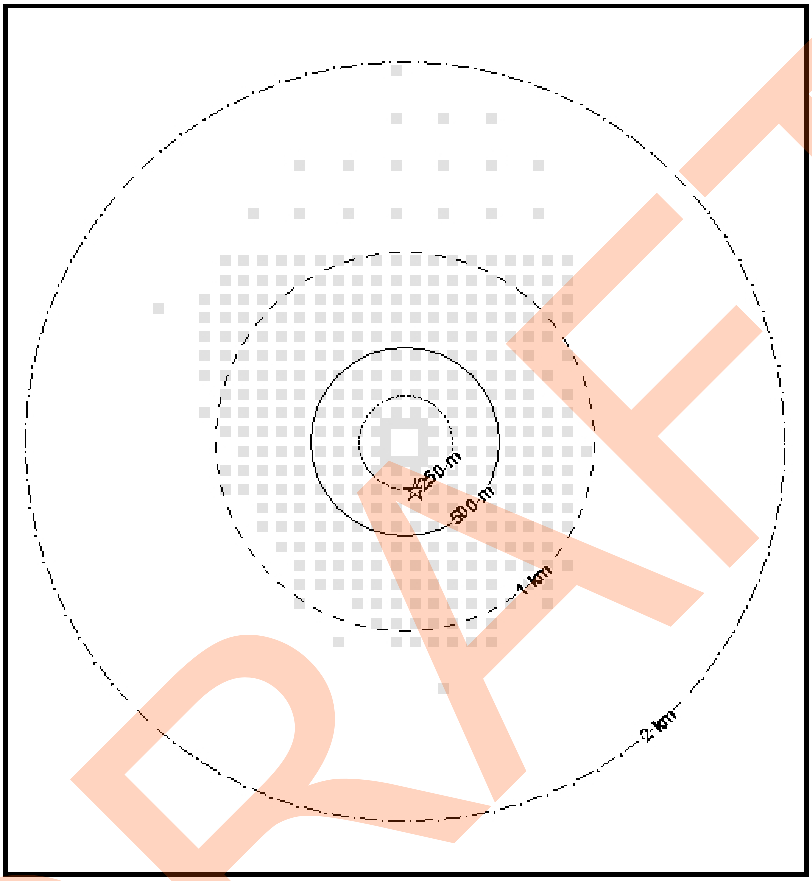
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source
2 Square Acres and Release Height of 10 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 31 ug/m3

6th-Highest Concentration

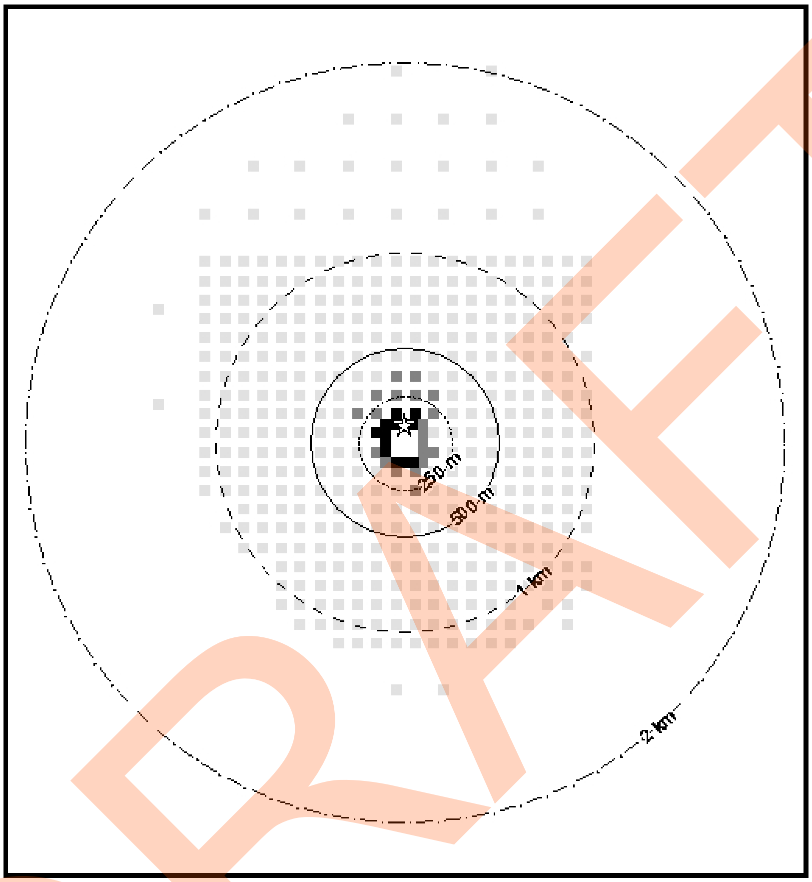
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source
2 Square Acres and Release Height of 2.5 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 245 ug/m3

6th-Highest Concentration

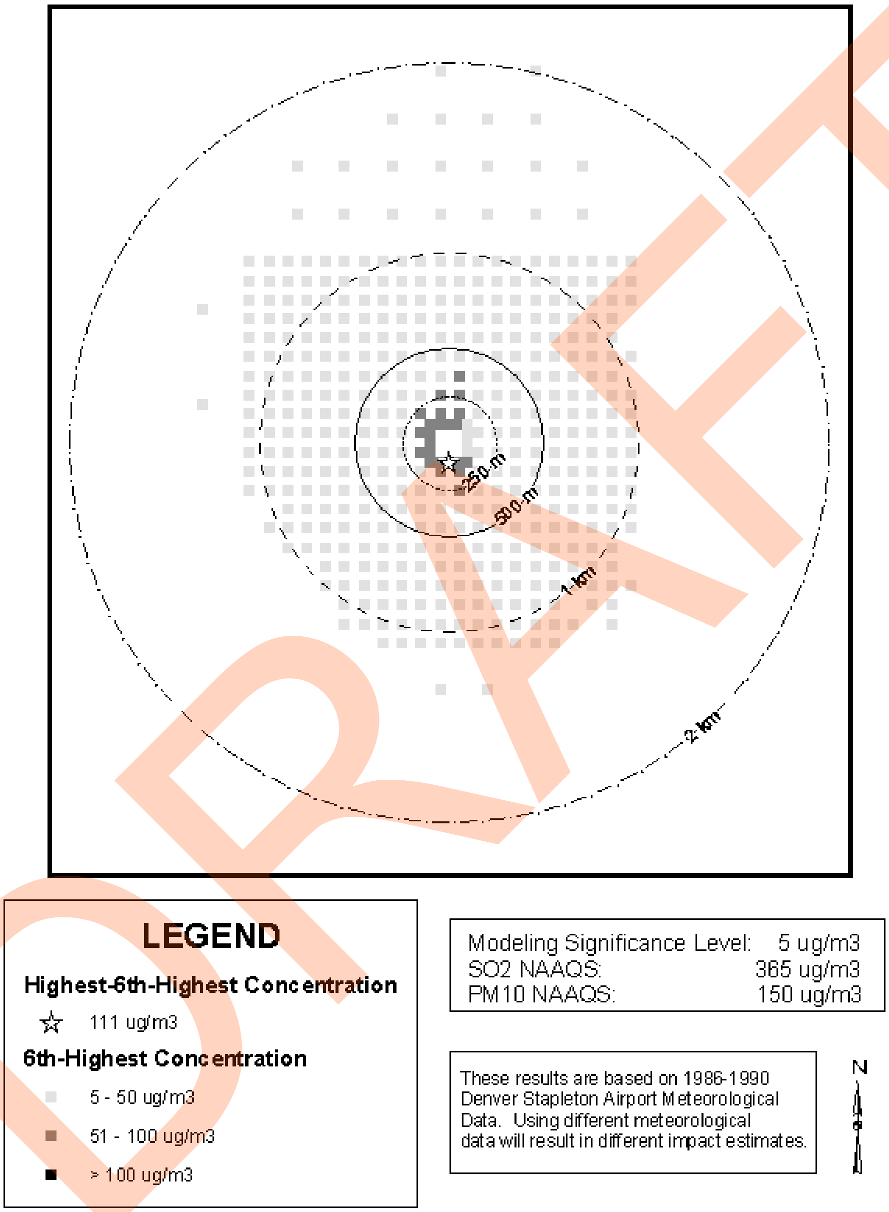
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

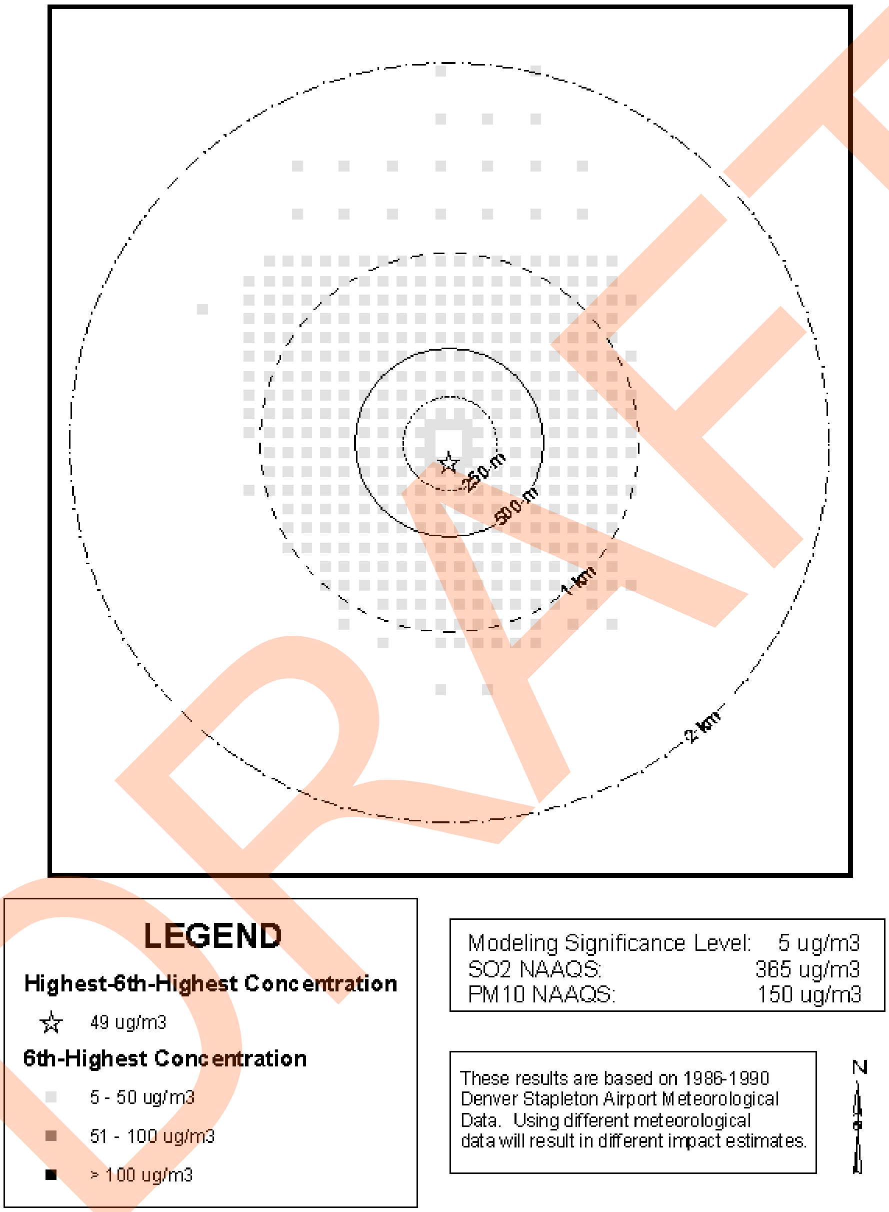
These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

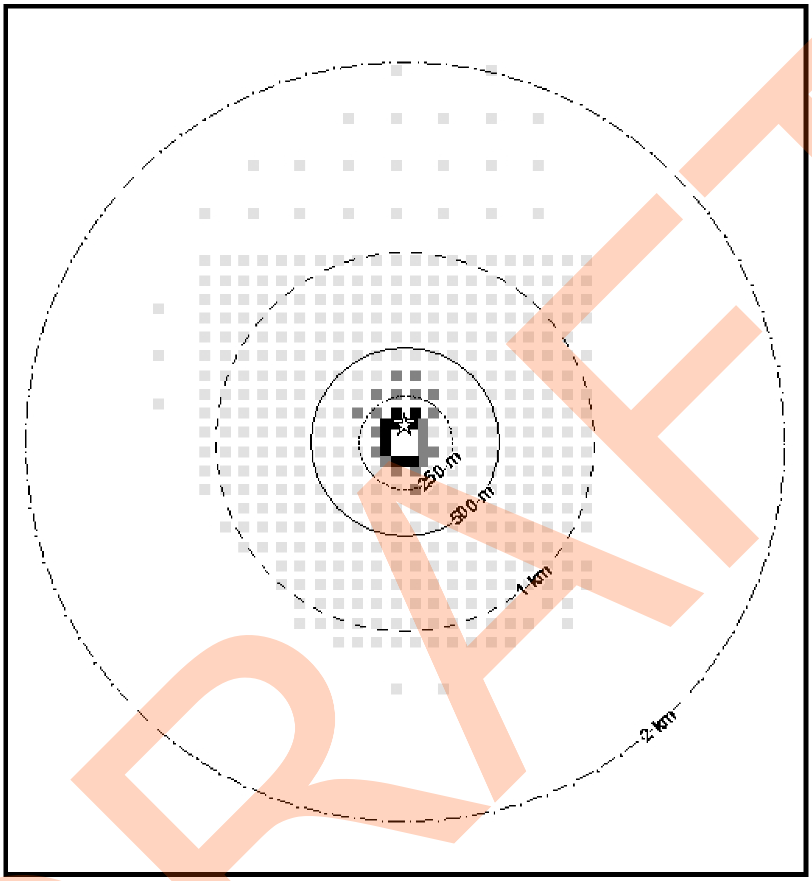
Magnitude and Location of Impacts from an Area Source 2 Square Acres and Release Height of 5 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



Magnitude and Location of Impacts from an Area Source 2 Square Acres and Release Height of 7.5 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



Magnitude and Location of Impacts from an Area Source 2 Square Acres, Release Height of 2 m, and Initial Vertical Dispersion of 3 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 248 ug/m3

6th-Highest Concentration

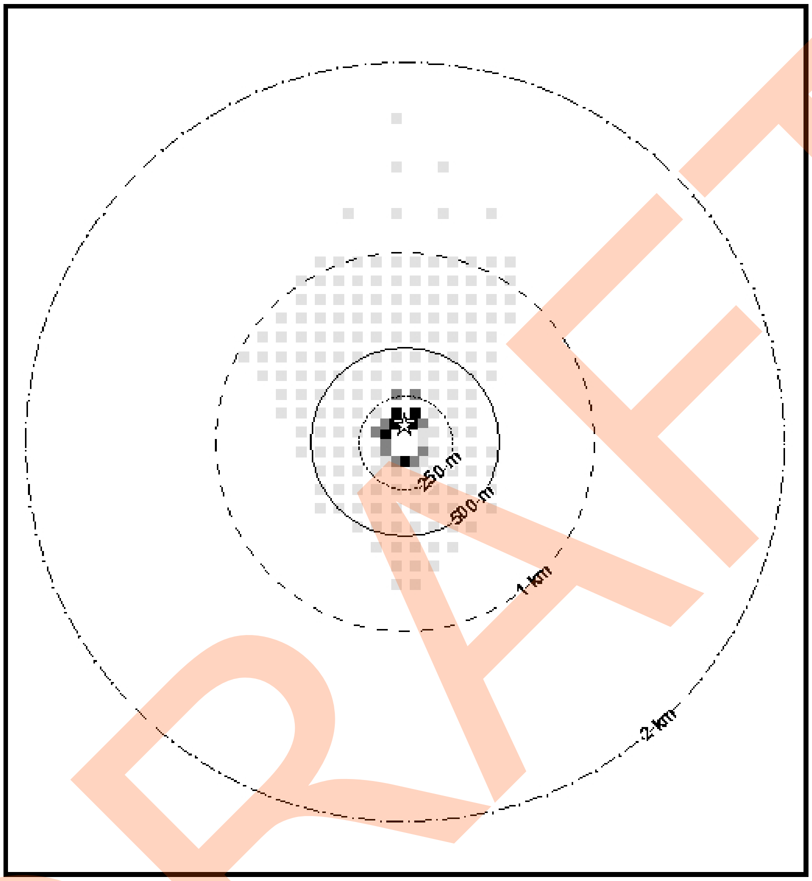
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source
2 Square Acres, Release Height of 2 m, and
Initial Vertical Dispersion of 3 m at 15 tpy Emission Rate
Annual Average Concentration
(micrograms per cubic meter)



LEGEND

Maximum Annual Concentration

☆ 78 ug/m3

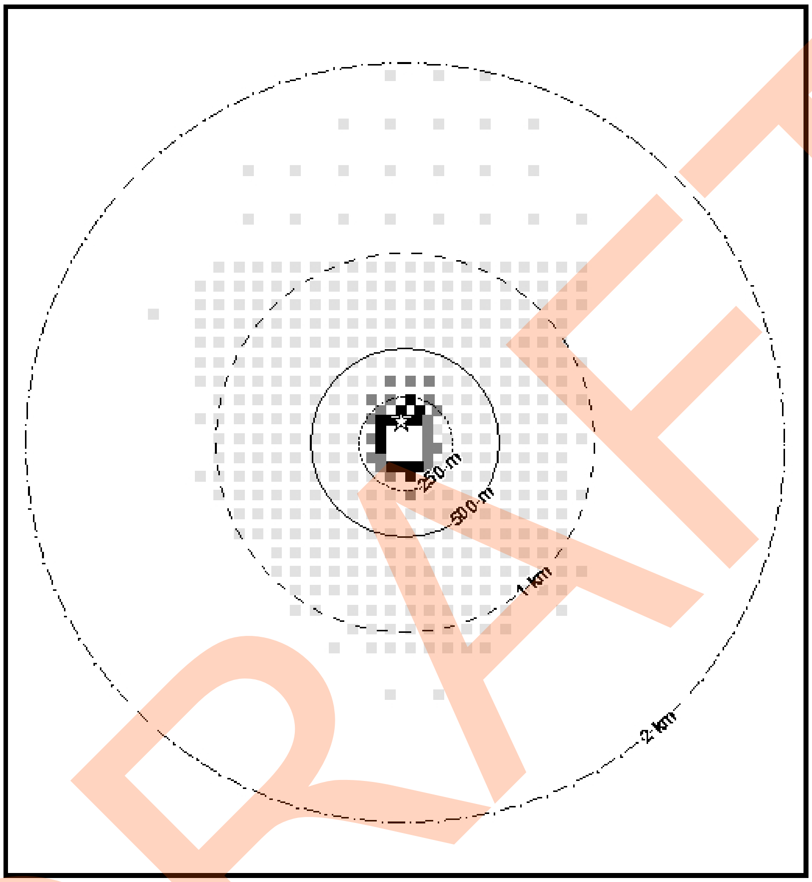
Annual Concentration

- 1 - 15 ug/m3
- 16 - 30 ug/m3
- > 30 ug/m3

Modeling Significance Level:	1 ug/m3
NO2 NAAAQS:	100 ug/m3
SO2 NAAQS:	80 ug/m3
PM10 NAAQS:	50 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

Magnitude and Location of Impacts from an Area Source
5 Square Acres and Release Height of 0 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 263 ug/m3

6th-Highest Concentration

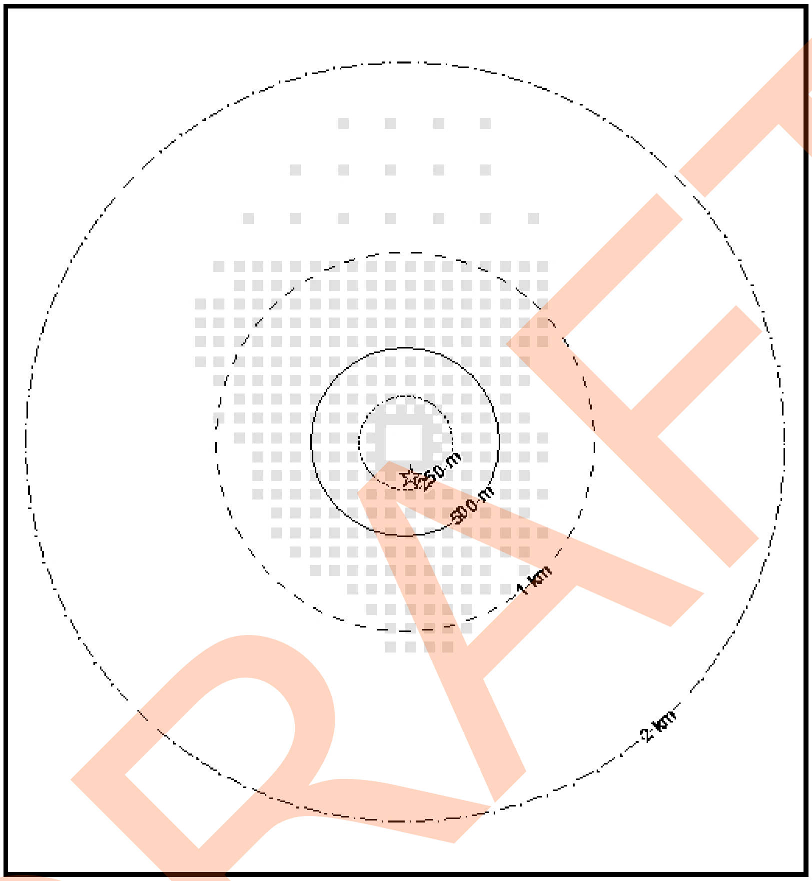
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- >100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

Magnitude and Location of Impacts from an Area Source 5 Square Acres and Release Height of 10 m at 15 tpy Emission Rate 24-hr Average Concentration (micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

☆ 32 ug/m3

6th-Highest Concentration

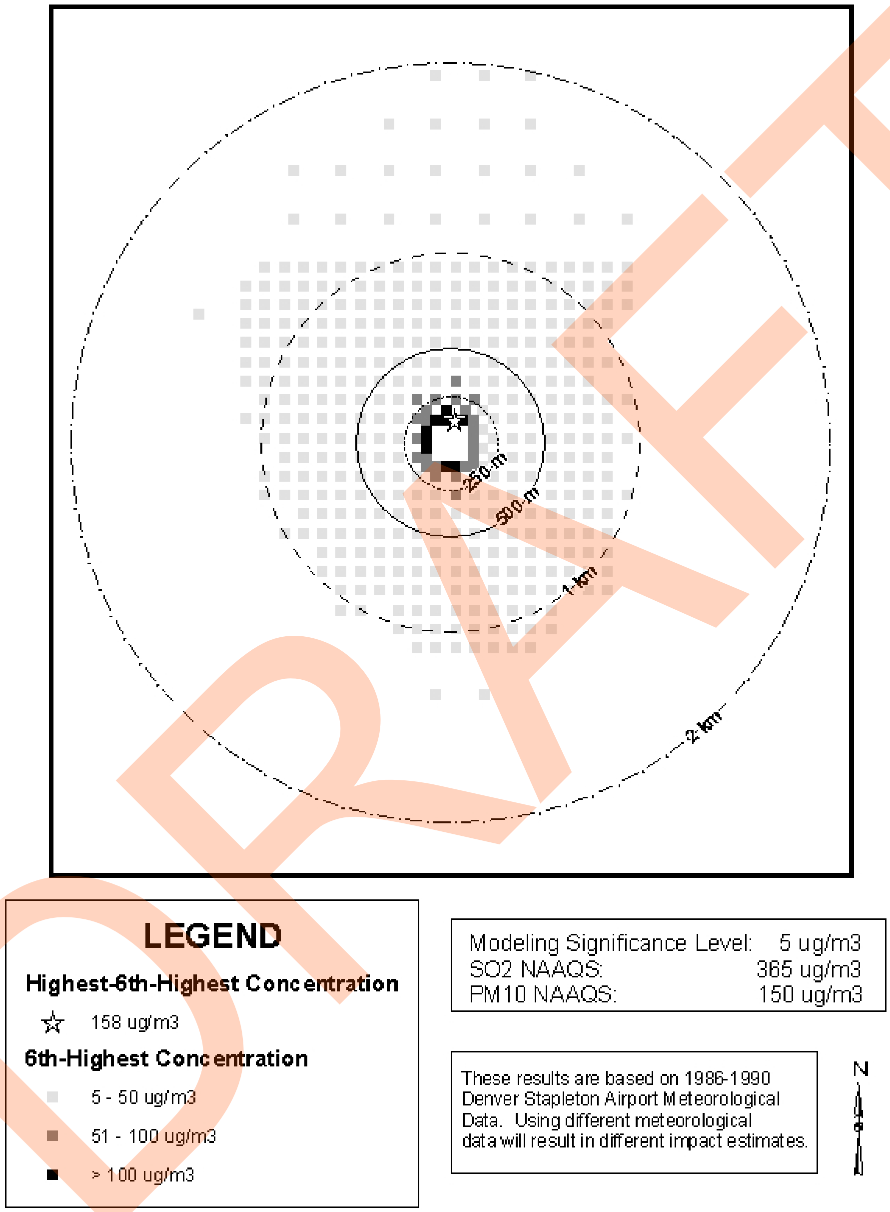
- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

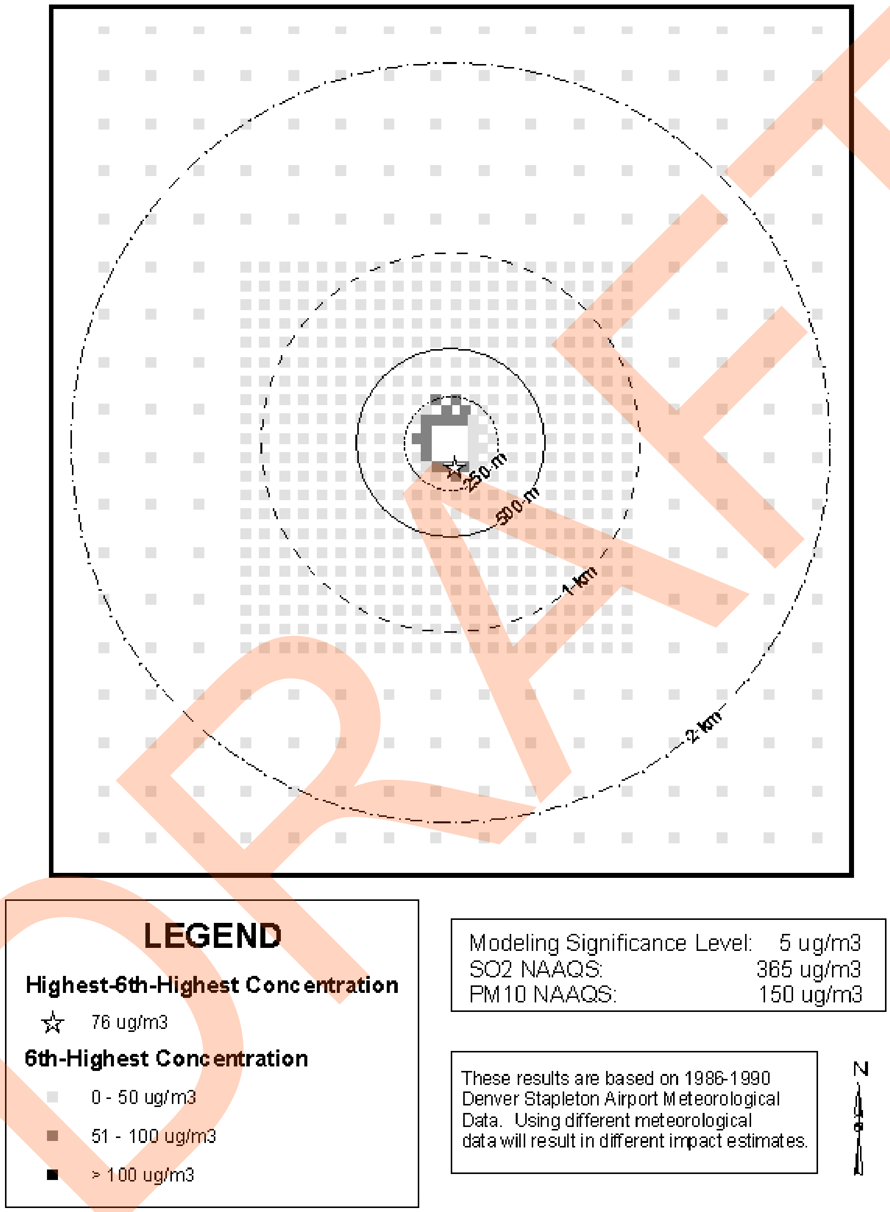
These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.

N

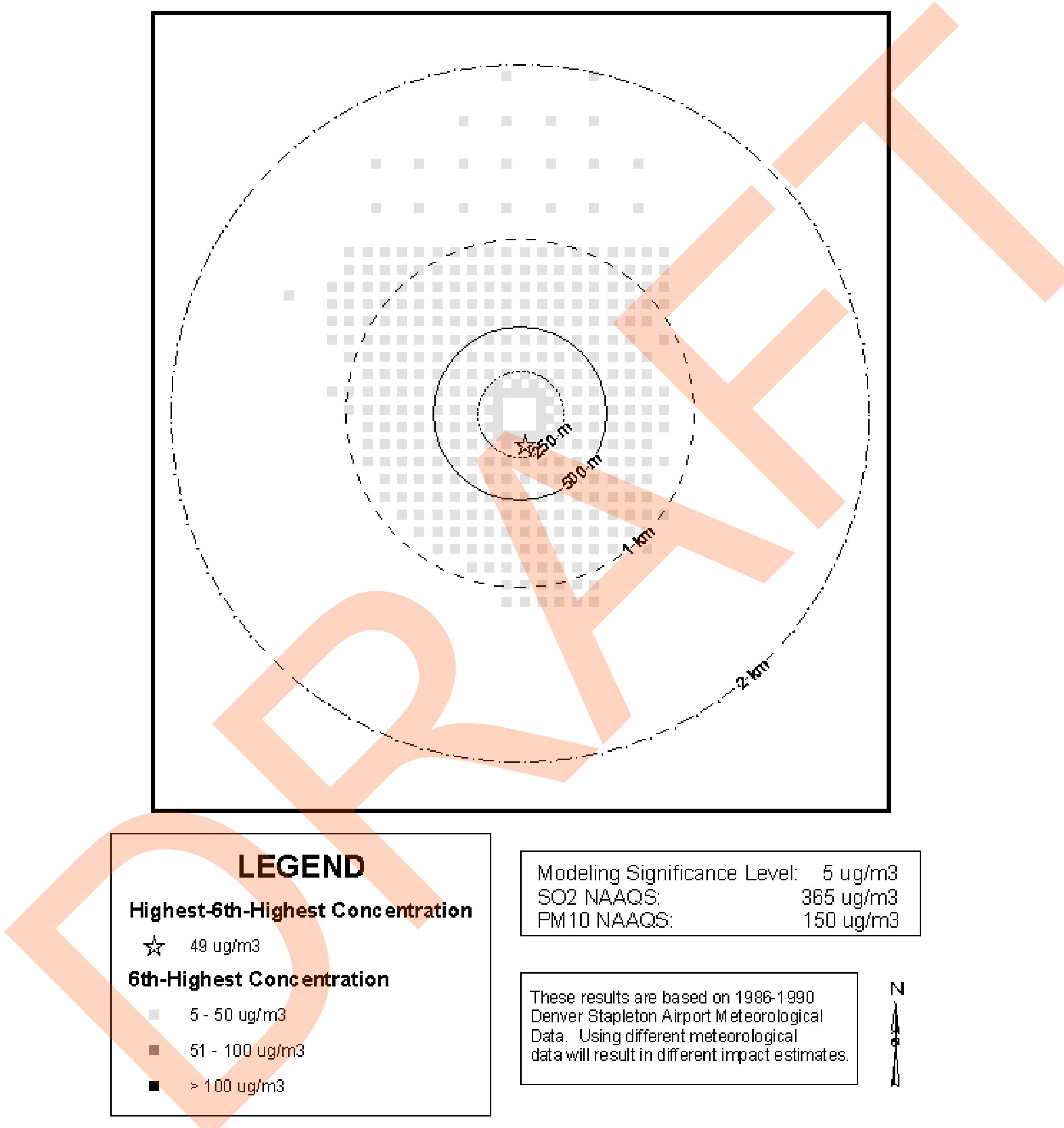
Magnitude and Location of Impacts from an Area Source
5 Square Acres and Release Height of 2.5 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)



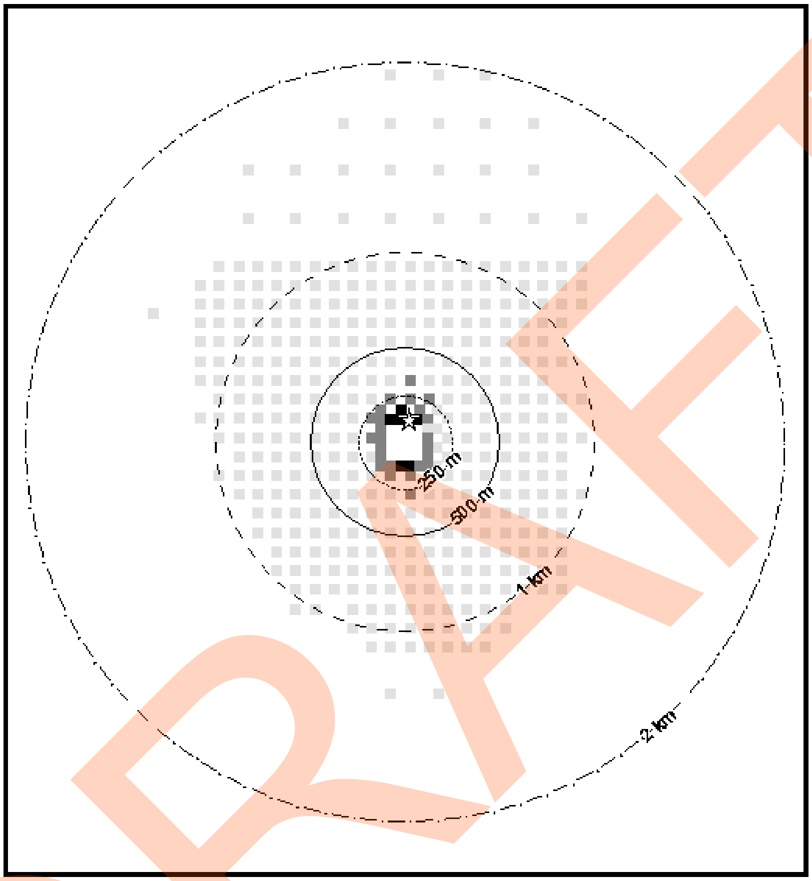
**Magnitude and Location of Impacts from an Area Source
5 Square Acres and Release Height of 5 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)**



Magnitude and Location of Impacts from an Area Source
5 Square Acres and Release Height of 7.5 m
at 15 tpy Emission Rate
24-hr Average Concentration
(micrograms per cubic meter)



Magnitude and Location of Impacts from an Area Source 5 Square Acres, Release Height of 2 m, and Initial Vertical Dispersion of 3 m at 15 tpy Emission Rate Annual Average Concentration (micrograms per cubic meter)



LEGEND

Highest-6th-Highest Concentration

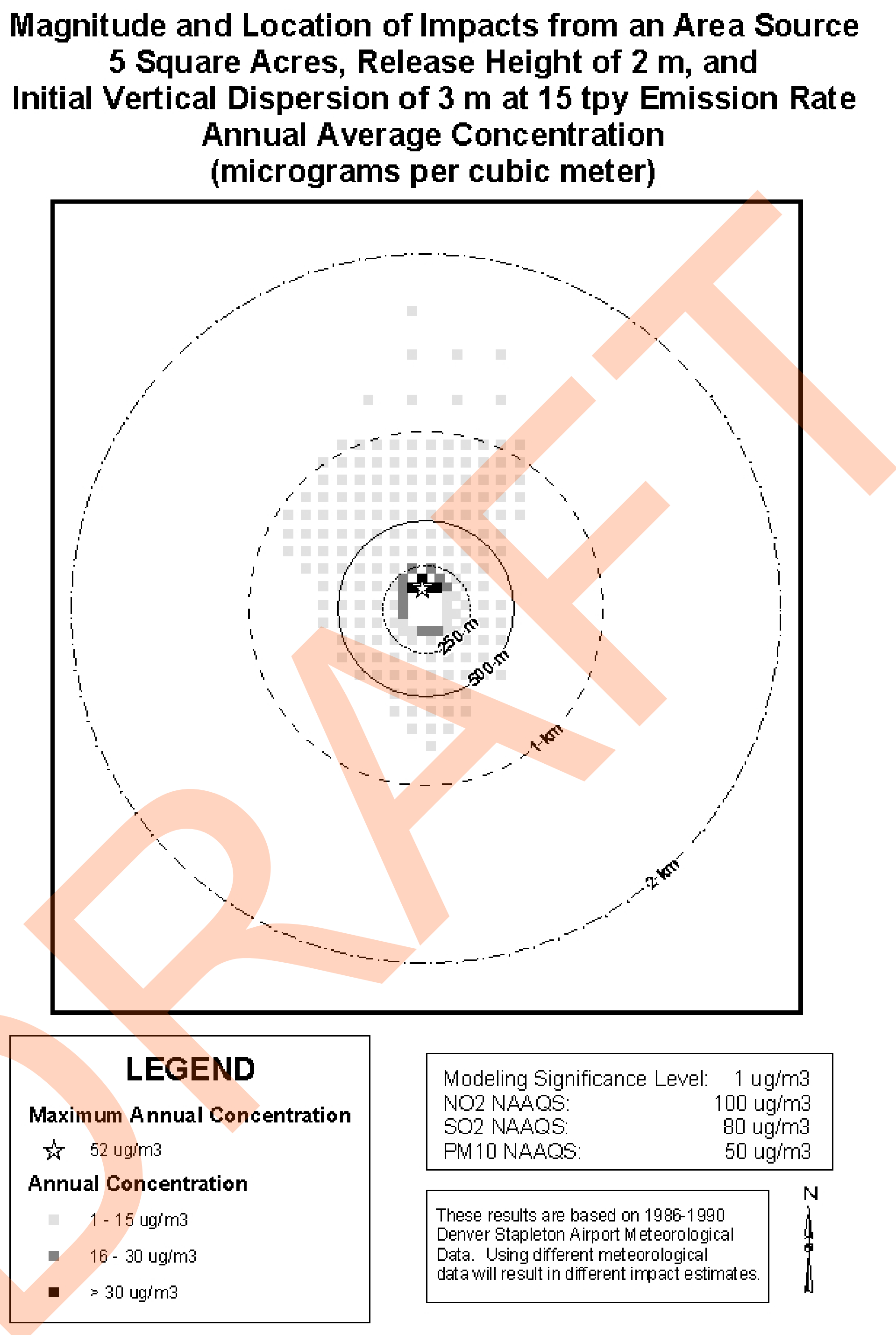
☆ 153 ug/m3

6th-Highest Concentration

- 5 - 50 ug/m3
- 51 - 100 ug/m3
- > 100 ug/m3

Modeling Significance Level:	5 ug/m3
SO2 NAAQS:	365 ug/m3
PM10 NAAQS:	150 ug/m3

These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.


Magnitude and Location of Impacts from an Area Source
5 Square Acres, Release Height of 2 m, and
Initial Vertical Dispersion of 3 m at 15 tpy Emission Rate
Annual Average Concentration
(micrograms per cubic meter)
250 m
500 m
1 km
2 km
LEGEND
Maximum Annual Concentration
52 ug/m3
Annual Concentration
1 - 15 ug/m3
16 - 30 ug/m3
> 30 ug/m3
Modeling Significance Level: 1 ug/m3
NO2 NAAQS: 100 ug/m3
SO2 NAAQS: 80 ug/m3
PM10 NAAQS: 50 ug/m3
These results are based on 1986-1990 Denver Stapleton Airport Meteorological Data. Using different meteorological data will result in different impact estimates.
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DRAFT