

November 2023

EPA Nearby Source Selection Guidance: History, Application, and Opportunities for Practice Improvement

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Contents

Contents	i
Executive summary	ii
Introduction	1
White Paper objectives and intended audience	2
Policy and practice questions.....	2
History of EPA nearby source section guidance	4
First modeling conference.....	5
Second modeling conference.....	8
Guideline revisions during the 1980’s and 1990’s	9
Guideline revisions during the Early 2000’s	11
2006 and 2010 NAAQS modifications	11
Tenth modeling conference	13
2014 Regional/State/Local modeling conference	14
Eleventh modeling conference	16
Nearby source selection approaches	18
Policy and practice analysis	18
Question 1: Sufficiency of existing EPA guideline language.....	18
Question 2: Content and limit of the significant concentration gradient (SCG) construct.	20
Question 2a: How is significance determined in practice?	22
Question 2b: Can the SCG be applied in the absence of a local ambient air quality monitor?	29
Question 2c: How is “professional judgment” established and applied under the Guideline?	30
Question 3: Nearby source selection based on actual versus permitted emissions.....	33
Question 4: Proposed EPA practice improvement efforts.	38
APPENDIX A	42

Executive summary

This White Paper (Paper) was created in response to an ongoing need to improve nearby source selection practices that are included in a cumulative National Ambient Air Quality Standards (NAAQS) air dispersion modeling demonstration. This work is intended to foster discussion on this topic between air quality dispersion modelers and related air management professionals, relying on the terms of art relevant to the field. Outside of 40 CFR 51, Appendix W (herein, “Guideline”), and several EPA-related clarification documents, there is little information or expectation to guide the ongoing evolution, curation, and improvement of the nearby source (NBS) selection practice. In the forty or more years since the Guideline was developed, the significant concentration gradient (SCG) and nearby source (NBS) definition and practices have remained largely the same. Changing ambient standards and public expectation present new challenges to the SCG and NBS, requiring a more thoughtful pursuit as the field progresses. Through the examination of four Policy and Practice Questions, we offer the following recommendations for further discussion and consideration:

1. Sufficiency of EPA Guideline Language.

Short Answer: The current Guideline provides conceptual language without details or expectations to aid application. This is particularly so with the significant concentration gradient construct. Other terms, such as professional judgment, lack definition or clarification, and further reduce Guideline language potency.

Recommendation: A more predictable and functional nearby source selection outcome can be strengthened through further language clarification and case study examples. This work should be developed outside the Guideline.

2. Content and limit of the Significant Concentration Gradient (SCG) construct

a. How is significance determined in practice?

Short Answer: Over the past four decades, a variety of approaches have been developed and applied to approximate the significant concentration gradient without providing a definition of the term or an explanation of why the approach is consistent with EPA’s Guideline language.

Recommendation: The most efficient and effective support EPA can provide reviewing authorities on this topic is the publication of a “significance” definition, along with selection rubrics and case studies to support this work.

b. Can the SCG be applied in the absence of a local ambient air quality monitor?

Short Answer: The SCG, as presented through traditional EPA methods, can likely be applied within most modeling domains, when an ambient air quality monitor is absent; however, this decision will sacrifice the ability to omit selected nearby sources through local ambient air quality monitoring, as the surrogate monitor does not measure the ambient pollutant concentrations within the domain modeled. While this practice is likely observed in many jurisdictions, case studies or examples were not available for this work.

Recommendation: This situation is common, with many reviewing authorities providing general nearby source direction to the consulting and permitted community on this topic. Ideally, a generalized understanding of this approach could be documented to further dispel ambiguity and support ongoing program development efforts.

c. How is “professional judgment” established and applied under the Guideline?

Short Answer: Development of a model or generic professional judgment scheme that supports air quality modeling professionals nearby source selection.

Recommendation: Develop, with support by reviewing authorities, a generic professional judgment model that supports air quality modeling needs.

3. Nearby source selection based on actual versus permitted emissions.

Short Answer: Permitted allowable emissions should not be used in the initial selection of a nearby source inventory. This conclusion is based on empirical evaluation and the existing Guideline language.

Recommendation: EPA can resolve the actual versus permitted allowable emission inventory issue through a clarification memorandum or similar language in a larger interpretative work.

4. Proposed EPA Practice Improvement Efforts.

Short Answer: Develop a “Best Practices” document through an EPA workgroup.

Recommendation: The most technically feasible and administratively nimble approach is an EPA-managed Significant Concentration Gradient/Nearby Source Selection “Best Practices” document outside of the Guideline. This document and related workgroup would focus on nearby source selection practices and related topics pursued at their discretion and national need.

Introduction

Air quality management programs at the federal, state, regional, tribal, and local level frequently rely on air quality dispersion modeling to inform program and air quality permit decisions. More specifically, modeling may be used to evaluate ambient air quality conditions as part of a federal-state air management expectation, for environmental impact purposes, or to “test” whether existing and proposed air quality permit emission limits are protective of applicable ambient air quality standards as part of a National Ambient Air Quality Standards (NAAQS) or Prevention of Significant Deterioration (PSD) program increment analysis.¹

The United States Environmental Protection Agency (EPA) recognizes and supports air quality dispersion modeling through approved air quality dispersion models, air quality modeling guidance, preferred modeling tools, and data, to guide air management authorities and permittees in the development of defensible regulatory air quality dispersion modeling demonstrations. The EPA document that guides acceptable air modeling practices is known as the *Guideline on Air Quality Models*, often referred to as Appendix W, but for this work, is referred to as “Guideline.” The Guideline, first published in 1978, has been revised numerous times to reflect changes in models, modeling practices, and EPA expectations.

Regulatory air dispersion modeling demonstrations are typically cumulative in nature, involving the permitted allowable emissions from a facility under review, along with any nearby source emissions considered to have a “significant concentration gradient” (SCG) on the facility as described in the Section 8.3.3 of the Guideline. The EPA has not defined the “significant concentration gradient” term, allowing reviewing authorities’ discretion to develop and refine the meaning for their own air quality dispersion modeling program purposes noting, “...we continue to believe that comprehensively defining significant concentration gradients in the Guideline is inappropriate and could be unintentionally and excessively restrictive.”²

Through this regulatory and air management framework, EPA extends deference to the reviewing jurisdiction expertise. This approach has resulted in a diverse collection of nearby source selection practices across the nation, loosely connected by various federal and state processes and practices. Over the past several decades, some states have sought and obtained EPA review and concurrence of nearby source selection methods, seemingly as either operational surrogates, or functional approximations of the SCG construct (e.g., New York, North Carolina, Oregon) to enhance their programmatic nearby source selection practices. These tools are frequently accepted for use by other states; however, it is unclear how the tools are applied.

Nearby source selection (NBS) methods, premised on the SCG, can be categorized into two approaches, either a “gradient” method of selection, where an approximation of a concentration gradient is applied to evaluate potential nearby source impact, or, the “magnitude” approach, which fundamentally involves a nearby source annual emission inventory divided by the distance between the source under review (or its pollutant-specific significant impact radius based on air quality modeling). A performance-based evaluation of the gradient versus magnitude approaches is absent in the air quality modeling literature. Given the nature and application of either approach, application of the SCG for NBS decision-

¹ See Ahlers, Christopher D., *Air Modeling as a Tool in Environmental Law and Policy: A Guide for Communities and Environmental Groups. Part I*. Philadelphia, Pennsylvania: Clean Air Council, 2016.

² See Environmental Protection Agency, 40 C.F.R. Part 51, Appendix W (January 2017): 5198.

making purposes is not apparent, or even possible given the current language and configuration of various selection methods. Double-counting concerns are present in both selection categories.

The EPA nearby source selection Guideline is limited largely to the older NAAQS, a reflection of the time when general modeling practices were developed. The SCG nearby source selection approach limitations become particularly apparent through state experience with the newer one-hour National Ambient Air Quality Standards (NAAQS) for Sulphur dioxide (SO₂) and nitrogen dioxide (NO₂), along with the 24-hour standard for particulate matter less than 2.5 microns (PM_{2.5}). The resulting practice has been largely state-specific, relying on either the direct application of the EPA recognized nearby source selection tools, the development of one-off approaches, or “professional judgment” dogma that is often not well documented. Further complications have emerged, including the role of permitted allowable versus actual emissions during the initial nearby source selection process, and the need for greater nearby source detection and selection resolution in response to public concern, particularly in Environmental Justice areas.

This White Paper (Paper) offers a review of the current nearby source emission inventory selection problem, supported by EPA Guideline including a history of the SCG construct, a review of the existing nearby source selection practices, as well as an indirect proposal to refine existing Guideline language. It is assumed that language refinement would support better delivery of the SCG and nearby source selection practice. An additional finding of this work is a proposal for a Best Practices Nearby Source Inventory Selection Workgroup.

White Paper objectives and intended audience

This White Paper (Paper) was developed to achieve the following objectives:

- Present a history of the nearby source emission inventory selection practice, including the SCG, through EPA Guideline history, supplemented by related EPA publications;
- Offer the community of practice a conversation structure focused on the identification of nearby source selection practice gaps and potential solutions that enhance and improve EPA Guideline application; and,
- Build a foundation for future EPA nearby source selection and characterization “best practices.”

The Paper content is aligned to the experience and expertise of the practicing air quality modeler; however, the underlying conversation is germane to air management professionals tasked with modeling-related decisions. Given the unique composition of the interested audience, this work maintains technical and regulatory language consistent with the field of interest. It is intended and designed to support nearby source selection conversations and decisions at the EPA’s 13th Conference on Air Quality Modeling.

Policy and practice questions

Through conversations with EPA and various public and private sector air quality dispersion modeling professionals, common or shared questions were identified and developed to guide the Paper:

1. Does the current EPA Guideline provide sufficient information and methods to apply the SCG in the reasonable selection and development of a nearby source emission inventory? (*Sufficiency of existing EPA Guideline Language*)

2. Have the boundaries and content of the Significant Concentration Gradient (SCG) and Nearby Source Selection (NBS) constructs been established? (*Content and limit of the Significant Concentration Gradient (SCG) construct*)
 - a. How is “significance” determined in practice?
 - b. Can the SCG be applied in the absence of a local ambient air quality monitor?
 - c. How is “professional judgment” established and applied under the Guideline?
3. What impact does the nearby source emission inventory characterization (actuals versus permitted emissions), have on the initial and final nearby source emission inventory for an air quality dispersion modeling demonstration? (*Nearby Source Selection based on Actual versus Permitted Emissions*)
4. What national administrative approaches can be developed and applied to support nearby source emission inventory selection practice over time? (*Proposed EPA Practice Improvement Efforts*)

Evidence supporting question responses was drawn from existing EPA air quality modeling and monitoring guidance, along with readily available information from EPA conferences and workshops. These documents were reviewed to better understand the SCG and NBS selection practice origin, rationale, and evolution. Additional information was provided through published NBS selection methods that received EPA concurrence. This review is not exhaustive and did not include a hard-copy review of archived EPA documents, rather, relying on information available through online searches.

History of EPA nearby source section guidance

Air quality modeling science predates the Clean Air Act (CAA), conducted largely to address urban airshed pollutant issues and the effectiveness of potential air pollution control strategies over a given area through local air management authority. With the passage of the 1970 CAA, the national ambient air goals that would “protect and enhance” national air quality were subjected to a 1972 court challenge that directed the EPA “not to approve any state programs for air quality management that did not contain mechanisms to ensure the prevention of significant deterioration of air quality (PSD).”³ To meet this challenge, Congress provided EPA with additional authority and direction through the 1977 revisions of the CAA.⁴

At the time of the 1972 lawsuit, EPA extended air quality modeling to the evaluation of individual facilities from specific sectors, ideally, to develop more effective air pollution control strategies, as provided through EPA’s air quality State Implementation Plan (SIP). This practice would become formalized through EPA’s Prevention for Significant Deterioration (PSD) program. Belden explained “The PSD program grew out of regulations EPA promulgated in December 1974 to prevent the deterioration of air quality in attainment areas. In 1977, congress codified the PSD program in CAA Sections 160 to 169.”⁵ Through the PSD program, the NAAQS and Increment⁶ became facility-level expectations, rather than the urban airshed, thereby testing the proposed emission limits of the permit to existing ambient air quality conditions and applicable ambient standards. Melnick commented that “the EPA envisioned its original PSD program as an elaborate accounting system based on dispersion modeling and designed to force the states to make conscious decisions about the amount of growth desired.”⁷ Given the prominence of air quality dispersion modeling in the new PSD permitting program, Congress recognized the need to develop standardized models and practices, clearly articulated in a September 30, 1976 Congressional Conference Report on the Clean Air Act Amendments of 1976, the “Standardized Air Quality Modeling” (Section 318) “set forth a general prescription for a conference on this subject which would presumably lead to a ‘guidance document,’ possibly published in the Federal Register.”⁸ Ultimately, this practice would become formalized in Federal regulation through EPA’s Air Modeling Conference program and Guidance development.⁹

³ See Deland, Michael R., and Sanford E. Gaines. “The New PSD Regulations: EPA Seeks to Resolve the Continuing Controversy.” *Nat. Resources Law*. 13 (1980): 523.

⁴ A review of these actions is provided in Landau, Jack L. “Alabama Power Co. v. Costle: An end to a decade of controversy over the prevention of significant deterioration of air quality?” *Environmental Law* 10, no. 3 (1980): 585-642.

⁵ Belden, Roy S. *The Clean Air Act*. (Chicago, IL, American Bar Association, 2001): 44

⁶ From Martineau, Robert J., and David P. Novello. *The Clean Air Act handbook*. (Chicago, IL, American Bar Association, 2004): 132. “PSD ‘increments’ established the maximum increases in ambient pollution levels for specified criteria pollutants that can result from all sources within the area after certain dates, which, ...is referred to as the baseline. The key requirement is that no increment be completely consumed (or exceeded) by the combination of the emissions from specified existing sources and the emissions associated with the new or modified source covered by the PSD program.”

⁷ Melnick, R. Shep, *Regulation and the courts: The case of the Clean Air Act*. Washington D.C.: Brookings Institution Press, 2010: 107

⁸ The *Specialists’ Conference on the EPA Modeling Guideline* was held February 22-24, 1977, in Chicago, Illinois. See page 23.

⁹ See generally 42 U.S.C. §7620. Standardized air quality modeling. (a) Conferences. Not later than six months after August 7, 1977, and at least every three years thereafter, the Administrator shall conduct a conference on air quality modeling. In conducting such conference, special attention shall be given to appropriate modeling necessary for carrying out part C of subchapter I of this chapter (relating to prevention of significant deterioration of air quality).

First modeling conference

The *Specialists' Conference on the EPA Modeling Guideline* (herein referred to as the First Modeling Conference) focus was a review and critique of the second EPA air quality modeling Guideline draft. Per the First Modeling Conference report, the intended goal and perspective of the technical review was “the degree to which it is appropriate for a Guideline to prescribe calculational methods and/or specific computer codes to be used in the analysis of air quality problems.”¹⁰ Of concern was the tension between standardization, in particular, a rigid observance of the proposed guideline (“regulatory perspective”), and the need for professional judgment (“scientific perspective”) to account for unique circumstances.¹¹ Under this backdrop, the conferees were tasked with supporting a generally applicable guideline after reviewing and considering the validity, reliability, and predictive capacity of nearly two dozen air quality modeling platforms, fundamental considerations of facility-scale modeling under the PSD program, pollutant-specific issues with the applicable Federal ambient air quality standards, and the availability and cost of modeling input data.¹² The nearby source topic was not formally present in the First Modeling Conference proceedings or any of the post-Conference submittals based on readily available information; however, ambient air pollutant background issues were raised by a post-Conference comment specific to the use of measured ambient pollutant data in modeling from situations where grouped urban emission sources have an impact on nearby monitor.¹³ In addition, a version of the Guideline had been reviewed by the public, with EPA describing three policy themes based on public comment:¹⁴

The first is whether a preliminary screening technique should be used to determine if full scale modeling would be necessary for preconstruction review. The second is whether the modeled estimate of source impact should be limited to a certain distance or a minimum numerical impact or both. Finally, the need to create an arbitration board to resolve modeling disputes was raised.

The first two policy themes responded to the need for EPA to clarify expected modeling practice under the new PSD program. While not stated as such, the first policy statement reflected the need for an ambient air quality screening value, while the second reflected the need to consider ambient air quality impact areas for the source under review. The third policy statement, an arbitration board to resolve air modeling disputes, was not established because of administrative delay and burden.

¹⁰ United States Environmental Protection Agency, *Report to the USEPA of the Specialists' Conference on the EPA Modeling Guideline*, by John J. Roberts, Donald M. Rote, Albert E. Smith, and Kenneth L. Brubaker, Under Interagency Agreement No. EPA-1AG-D7-0013 between ERDA and EPA. (Research Triangle Park, NC, 1977): 23.

¹¹ *Ibid.*, 24.

¹² A complete list of the proposed Conference topics was provided to each invited conferee prior in advance. See pages 321-322 of the 1977 Conference Report.

¹³ The 1977 Conference Report contained post-conference correspondence. The ambient air quality background concentration challenge was offered to Dr. John J. Roberts, Argonne National Laboratory, from Maynard E. Smith, Mark L. Kramer, and John R. Martin. The text of this correspondence is found on page 252 of the 1977 Conference Report.

¹⁴ See Environmental Protection Agency, *Federal Register* 43, no. 118, (June 19, 1978): 26398.

EPA modeling priorities integrated ambient air quality monitoring and ambient air quality data within the analytical framework. A few months after the First Modeling Conference, EPA published a guidance document supporting ambient air quality monitor siting for SO₂.¹⁵ This work presented EPA's desire to integrate air quality modeling demonstrations in support of ambient air quality monitor siting. An important finding from this work was the need to recognize the influence of nearby source air pollutant plumes on potential air monitoring sites. Air quality modeling was used to evaluate potential ambient impacts of nearby sources and determine whether they contributed to an "undue influence" on the "typical" ambient air pollutant concentrations in each area, prior to air monitor siting. The "undue influence" pollutant concentration level, described in this early work was an ambient screening value, applied in a similar way that the contemporary Significant Impact Level (SIL) is used to evaluate the potential "undue influence" of a nearby source on a potential ambient air quality monitor. Per the EPA document, if a nearby source imparted an "undue influence" on the proposed monitor location, the "interference distance" (ID) was evaluated to determine how far a monitor must move to eliminate the nearby source undue influence.

General public-sector air management practices relied on air pollutant concentration gradients based on air quality monitoring data, or occasionally, air modeling data, for a variety of air management decisions since at least the 1960's. Concentration gradients were commonly reported as annual averages. The concentration gradient data was used to evaluate changes in urban airsheds because of various emission reduction initiatives, as well as to determine whether a new source (or change in a source emissions) would be greater than the existing gradient value. Given the monitor siting expectation illustrated in the 1977 EPA publication, a relatively stable pollutant concentration gradient was preferred, allowing for the ability to detect "undue influences" through a designated screening value approach. While no specific source relevant to this review has cited to this early work in support of SCG, the formalized understanding of the "undue influence" practice provides a functional consideration that likely informed EPA's nearby source selection practice.

In October of the same year, EPA published the *Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 10 (Revised), Procedures for Evaluating Air Quality Impact of New Stationary Sources*.¹⁶ (AQMPA). The AQMPA was developed for state air management authorities to evaluate new source emissions to determine whether a facility would conform with applicable EPA-approved state control strategies and protect the National Ambient Air Quality Standards (NAAQS). Specifically, the AQMPA introduced a three-phase approach that included ambient screening thresholds to evaluate potential air quality impacts. Both air quality monitoring and air quality modeling were discussed as part of the overall analytical approach. Official comments on the AQMPA through the Federal Register explained that the EPA would retain this document and proposed screening practices moving forward, offering:¹⁷

The purpose of such procedures is to reduce resource burdens where there is little or no threat to the PSD increments or NAAQS. However, as the threat to the increment increases, more sophisticated techniques would be used. If these procedures indicate that the ambient concentration increase would exceed one-half of the remaining

¹⁵ Ball, Robert J., and Gerald E. Anderson. *Optimum Site Exposure Criteria for SO₂ Monitoring*. Vol. 77, no. 13. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards, Monitoring and Data Analysis Division, 1977.

¹⁶ Budney, Laurence J. *Guidelines for Air Quality Maintenance Planning and Analysis*. Vol. 6. EPA, Office of Air and Waste Management, Office of Air Quality Planning and Standards, 1974. This work was initially published by EPA in 1974.

¹⁷ Environmental Protection Agency, *Federal Register* 43, no. 118, (June 19, 1978): 26398.

ambient increment or ceiling allowance, then refined analytical techniques would be used.

The AQMPA screening discussion highlights future EPA approaches; however, of note was the evaluation of multiple sources on a proposed new source. In Section 4.5.2.C (Proposed source in the vicinity of an urban area or other large number of sources, p. 4-37) provides the following:

If data from a comprehensive air monitoring network are available, it may be possible to rely entirely on the measured data. The data should be adequate to permit a reliable assessment of maximum concentrations, particularly in (1) the area of expected maximum impact of the proposed source, (2) the area of maximum impact of the existing sources and (3) the area where all sources will combine to cause maximum impact.

By late 1977 and early 1978, identification of a nearby source emission inventory and proposed source screening fundamentals were in place. When EPA published the Guideline in April of 1978, the following modified AQMPA language was provided to support nearby source selection, explaining:¹⁸

The impact of the nearby sources must be summed for locations where interactions between the effluents of the point source under consideration and those of nearby sources occur. Significant locations include (1) the area of maximum impact on the point source, (2) the area of maximum impact of nearby sources, and (3) the area where all sources combine to cause maximum impact. It may be necessary to identify these locations through a trial-and-error analysis.

It is unclear if this language was provided to the Conference participants as part of their EPA document review packet, as these details were not readily accessible for this work, making it difficult to determine whether EPA and external parties considered the nearby source topic. Given the Guideline language provided, and the informal support for EPA publications on monitoring and modeling, the nearby source selection practices were likely considered reasonable and appropriate, for the time, requiring less conferee attention. The Conference priority focused on model standardization, performance, and acceptance. A distinction between the AQMPA and the Guideline nearby source language was the absence of monitoring network language in the modeling guidance. No supporting comments were available to explain this change in practice; however, EPA and stakeholders appeared to prefer or accept modeled results for this analysis rather than air quality monitoring network data.

In 1978, the EPA revised the PSD program regulations, marking what appears to be the anticipated refinement in new source screening practices aimed at pre and post construction monitoring, emission rates, and ambient impacts, through various “significance” thresholds. EPA published the *Ambient Monitoring Guideline for Prevention of Significant Deterioration* (PSD) in 1980 to clarify the new screening practices for pre and post construction ambient air monitoring.¹⁹ The document detailed procedures for evaluating proposed source emissions and maximum impacts, through air quality dispersion modeling and monitoring. The document also deployed the new federally defined PSD air quality screening terms such as Significant Emission Rates (SER’s), Significant Monitoring Concentrations

¹⁸ EPA published its first air quality dispersion modeling guidance in April of 1978 ((EPA-450/2-78-027) Guideline on Air Quality Models (Section 5.4 Background Air Quality, page 36).

¹⁹ United States Environmental Protection Agency, *Ambient Monitoring Guideline for Prevention of Significant Deterioration* (PSD). EPA Publication No. EPA-450/04-80-012. [NT IS No. PN 81-153231] (Research Triangle Park, NC. 1980).

(SMC)²⁰, and Significant Ambient Air Quality Impacts or Significant Ambient Impact (SAI) values.²¹ The new, refined screening and evaluation practices based on “significant” threshold values would be an important analytical frame for the PSD program and air modeling, especially the nearby source selection process.

Second modeling conference

The EPA commenced the second Guideline revision with the *Second Conference on Air Quality Modeling*, held August 10-12, 1981, at Thomas Jefferson Auditorium, Washington D.C. The Second Conference informed to great extent the draft 1984 Guideline, which is the first appearance of the Significant Concentration Gradient (SCG) language:²²

All sources expected to cause a *significant concentration gradient in the vicinity of the source or sources under consideration should be explicitly modeled*. [Italics added] For evaluation against annual standards these sources under consideration should be modeled at worst case actual emissions. For evaluation of short-term standards these sources should be modeled at maximum allowable emissions. The nearby source inventory should be determined in consultation with the local air pollution control agency. It is envisioned that the nearby sources and the sources under consideration will be evaluated together using an appropriate Appendix A model.

The impact of the nearby sources should be examined at locations where interactions between the plume of the point source under consideration and those of nearby sources (plus natural background) can occur. Significant locations include: (1) the area of maximum impact of the point source; (2) the area of maximum impact of nearby sources; and (3) the areas where all sources combine to cause maximum impact. These locations may be identified through trial and error.

Given that the 1984 draft EPA Guideline was informed by the *Second Triannual Conference on Air Quality Modeling*, it was expected that the SCG would have been introduced and discussed as part of the formal proceedings. A review of the Conference transcript did not reveal any open discussion of the nearby source selection process or the evaluation of nearby sources on the source under review.²³ The draft 1984 Guideline referenced a 1981 (revised in 1982 and 1983) *Regional Workshops on Air Quality Modeling: A Summary* (Workshop), as one of the two documents controlling air modeling policy (The

²⁰ On August 7, 1980, the EPA introduced PSD regulations that included significance levels of projected ambient impacts for the purpose of determining whether a proposed source or modification would be eligible for an exemption from the requirement for ambient monitoring under 40 CFR 51.24(i)(8) and 52.21(i)(8). See *Federal Register* 72, no. 183, (September 21, 2007): 54141 which features EPA’s summary.

²¹ The initial SMI values were published in the *Federal Register* 43, no. 118, (June 19, 1978): 26380. The same values can be found in United States Environmental Protection Agency, *Ambient Monitoring Guideline for Prevention of Significant Deterioration (PSD)*, 1980, see page A-7. The Significant Ambient Impact values appear to be the forerunners of the current Significant Impact Levels or SILs. Table A-3 provides the early screening values applied in Class I and Class II air quality dispersion modeling to establish significant ambient air quality impact areas for monitoring and monitoring purposes. They were initially part of the PSD program regulations; however, they were removed from the regulations in 1980. See *Federal Register* 72, no. 183, (September 21, 2007): 54138-54140 for further SIL history details.

²² United States Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guideline on Air Quality Models (Revised)*. Draft version. (Research Triangle Park, NC, November, 1978): 9-6.

²³ United States Environmental Protection Agency, Second Conference on Air Quality Modeling (Meeting Transcript), August 10 – 12, 1981, Thomas Jefferson Auditorium, South Agriculture Building, 14th Street & Independence Avenue S.W., Washington, D.C., 1981.

second was the 1978 Guideline).²⁴ The 1981 Workshop document provided more detailed modeling demonstration guidance, and contains appendices with a modeling checklist that uses the term “significant impact” to describe the relationship of source impacts within 50 km to urban areas, nonattainment areas, topographic features, other major existing sources, and ambient air monitors.²⁵ An early version of current Tables 8-1 and 8-2 are provided in Appendix B that guided characterization details for sources within the facility “significant impact” area,²⁶ along with maps to identify the modeled “significant impact” area of the source under review.²⁷ The term “significant impact” is not defined in this document. Operationally, this term most likely finds its interpretative footing through the 1980 PSD regulation revisions, discussed previously, along with EPA’s January 16, 1979, interpretive ruling.²⁸

Ultimately, there are no readily available EPA documents from this time that specifically described and explained the Guideline SCG rationale. This documentation may be available through EPA archives which are not currently available online. Given the scope and challenge of the revised PSD program regulations and supporting guidance documents, especially the stated need to evaluate and screen new PSD sources, it seems likely that the “significance” threshold concept migrated to modeling guidance, including the 1981 Workshop effort, with support by ambient air monitor siting practices and the “undue influence” evaluation.

Guideline revisions during the 1980’s and 1990’s

The EPA revised the Guideline two more times during the 1980’s, with the draft 1984 content, including the SCG language, becoming official in 1986.²⁹ Another revision was completed in 1988; however, the SCG language remained intact.³⁰ The 1993 EPA Guideline revision maintained the SCG and reorganized Section 9.2.3 to include references to Tables 9-1 and 9-2.³¹

All sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled. For evaluation for compliance with the short term and annual ambient standards, the nearby sources should be modeled using the emission input data shown in Table 9-1 or 9-2. The number of such sources is expected to be small except in unusual situations. The nearby source inventory should be determined in consultation with the reviewing authority. It is envisioned that the nearby sources and the sources under consideration will be evaluated together using an appropriate Appendix A model.

The impact of the nearby sources should be examined at locations where interactions between the plume of the point source under consideration and those of nearby

²⁴ United States Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guideline on Air Quality Models (Revised). Draft version.* (Research Triangle Park, NC, November, 1984): iii.

²⁵ United States Environmental Protection Agency, Office of Air Quality Planning and Standards, *Regional Workshops on Air Quality Modeling: A Summary Report. (Revised 1982).* [EPA-450/4-82-015]. (Research Triangle Park, NC, 1981): B-1.

²⁶ *Ibid.*, B-2.

²⁷ *Ibid.*, B-4.

²⁸ The EPA determined that a source will generally be considered to contribute a significant contributor to a NAAQS violation if its modeled impacts exceed the significance levels found in the Offset Interpretive Ruling (*Federal Register* 44, no. 11, (January 16, 1979): 3283.)

²⁹ Environmental Protection Agency, *Federal Register* 51, no. 174, (September 9, 1986): 32176

³⁰ Environmental Protection Agency, *Federal Register* 53, no. 163, (August 23, 1988): 32081

³¹ Environmental Protection Agency, *Federal Register* 58, no. 137, (July 20, 1993): 38838

sources (plus natural background) can occur. Significant locations include: (1) The area of maximum impact of the point source; (2) the area of maximum impact of nearby sources; and (3) the area where all sources combine to cause maximum impact. These locations may be identified through trial-and-error analysis.

The reference to Tables 9-1 and 9-2 were provided as a more uniform means of adjusting the nearby source emission inventory based on actual operating conditions and enforceable air quality permit language, likely influenced by the 1981 Workshop content. Given the prominent role EPA modeling conferences have on the Guideline content, it was expected that the Fifth Conference on Air Quality Modeling would have contained some discussion on this revision; however, a copy of the proceeding was not available at this time.³²

The August 1996 Guideline adjusted to the adoption of the Code of Federal Regulations (CFR) system for paragraph labeling.³³ An important nearby source selection and SCG development was the refinement of Section 9.2.3 (Recommendations [Multi-Source Areas]).³⁴

- a. In multi-source areas, two components of background should be determined.
- b. Nearby Sources: All sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled. For evaluation for compliance with the short term and annual ambient standards, the nearby sources should be modeled using the emission input data shown in Table 9–1 or 9–2. The number of such sources is expected to be small except in unusual situations. The nearby source inventory should be determined in consultation with the reviewing authority. It is envisioned that the nearby sources and the sources under consideration will be evaluated together using an appropriate Appendix A model.
- c. The impact of the nearby sources should be examined at locations where interactions between the plume of the point source under consideration and those of nearby sources (plus natural background) can occur. Significant locations include: (1) the area of maximum impact of the point source; (2) the area of maximum impact of nearby sources; and (3) the area where all sources combine to cause maximum impact. These locations may be identified through trial-and-error analyses.
- d. Other Sources: That portion of the background attributable to all other sources (e.g., natural sources, minor sources, and distant major sources) should be determined by the procedures found in Section 9.2.2 or by application of a model using Table 9–1 or 9–2.

The 1996 Guideline, as noted above, is an attempt to define and refine the background concentration concept into two components, nearby sources with a SCG and “other sources.” The SCG and nearby source maximum impact language is offered in two separate sections (Section 9.2.3.b and 9.2.3.c), while “other sources” is defined and directed to other sections of the Guidance for additional supporting content. Details from the Sixth Conference on Air Quality Modeling, held in August 1995, were not available for review. A notable Sixth Conference event was the introduction of AERMOD and CALPUFF as

³² The Fifth Conference on Air Quality Modeling was held on March 7-9, 1991, at the Thomas Jefferson Auditorium, South Agriculture Building, 14th Street & Independence Avenue S.W., Washington, D.C.

³³ Environmental Protection Agency, *Federal Register* 61, no. 156, (October 2, 1996): 41838.

³⁴ *Ibid.*, 41855-41856.

new and acceptable modeling platforms for various analyses, with AERMOD the preferred platform over ISC3 for some analyses.³⁵

Guideline revisions during the Early 2000's

The 2003 Guideline provided further Section 9.2.3 refinement (Recommendations [Multi-Source Areas])³⁶ A copy of the Section 9.2.3 language is found in Appendix A of this work. This version featured more refined language: *Section a* specifically detailing the two relevant contributing components to ambient background concentrations; *Section b* illustrating the SCG and maintaining the need for reviewing authority discretion in this determination and application; *Section c* acknowledging the role of Tables 9-1 and 9-2; *Section d* presenting the relationship between operational realities of nearby sources and the source under review, with the burden to demonstrate these operating characteristics on the source under review; *Section e* provided the nearby source plume overlap and maximum impact instruction; and, *Section f* provided the same “other source” direction as the previous Guidance language. The *Seventh Modeling Conference on Air Quality Modeling*, held on June 28-29, 2000, did not discuss revision of this section in any presentations, transcripts, or review material.³⁷

The *Eighth Conference on Air Quality Modeling*, held on September 22nd through the 23rd, 2005, was devoted to the review of the AERMOD and CALPUFF modeling systems, with the 2005 Guideline focused on the same topic. During this revision, AERMOD replaced ISC3 as the preferred model for near-field dispersion of emissions for distances up to 50 km.³⁸ The nearby source details (renumbered to Section 8.2.3) remained unchanged in the 2005 Guideline.

The *Ninth Conference on Air Quality Modeling* was held at EPA Research Triangle Park in North Carolina from October 9th through October 10th, 2008.³⁹ The focus of the conference was the new AERMOD platform, and issues related to the new EPA 24-hour and Annual PM_{2.5} NAAQS, promulgated in 2006.⁴⁰ Based on publicly available presentations and transcripts, nearby source selection was not discussed at this event.

2006 and 2010 NAAQS modifications

The EPA promulgated the 24-hour and Annual PM_{2.5} NAAQS in 2006, followed by two new ambient standards in 2010: the one-hour SO₂ NAAQS,⁴¹ and, the 2010 one-hour NO₂ NAAQS.⁴² The two new standards impacted how nearby sources were identified and characterized, resulting in an EPA response. The first was a 2011 published guidance memorandum *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂, National Ambient Air Quality*

³⁵ Environmental Protection Agency, *Federal Register* 65, no.78, (April 21, 2000): 21506.

³⁶ Environmental Protection Agency, *Federal Register* 68, no. 72, (April 15, 2003): 18464.

³⁷ Environmental Protection Agency, *Federal Register* 65, no. 98, (May 19, 2000): 31858. An online archive of the event can be found at <https://www.epa.gov/scram/7th-conference-air-quality-modeling> (March 2, 2022).

³⁸ Environmental Protection Agency, *Federal Register* 70, no. 216, (November 9, 2005): 68218.

³⁹ Environmental Protection Agency, *Federal Register* 73, no. 187, (September 25, 2008): 55508.

⁴⁰ Environmental Protection Agency, *Federal Register* 71, no. 200, (October 17, 2006): 61144.

⁴¹ Environmental Protection Agency, *Federal Register* 75, no. 119, (June 22, 2010): 35520.

⁴² Environmental Protection Agency, *Federal Register* 71, no. 200, (October 17, 2006): 61144; Environmental Protection Agency, *Federal Register* 75, no. 26, (February 9, 2010): 6474.

Standard (2011 EPA Memorandum).⁴³ The 2011 EPA Memorandum did not alter SCG or nearby source selection described in the Guideline, rather, the intention focused on “some additional explanation regarding what this guidance means and how it should be applied.”⁴⁴ EPA offered their understanding of “gradient,” by attempting to clarify in the Guidance, that it is a “physical quantity” which is measured as “the ground-level concentration of the pollutant being assessed.”⁴⁵ The Memorandum went on to clarify that the “the gradient of the ground-level concentration has two dimensions, a longitudinal (along-wind) gradient and a lateral (cross-wind) gradient.”⁴⁶ This clarification is important as the gradient dimensionality is not discussed in the 2011 EPA Memorandum. The Memorandum connects the SCG to ambient air monitoring explaining “why a significant concentration gradient is mentioned as the sole criterion.”⁴⁷

Since an ambient monitor is limited to characterizing air quality at a fixed location, the impact from a nearby source that causes a significant concentration gradient in the vicinity of the project source is not likely to be characterized very well by the monitored concentration in terms of its potential for contributing to the cumulative modeled design value due to the high degree of variability of the source’s impact.

The Memorandum also distinguished and highlighted the relevance of distinct lateral and longitudinal gradients, and acknowledged the role of transport wind direction effects on ambient air impacts with minor changes in wind direction providing potentially “significant changes in modeled concentrations.”⁴⁸ The two gradient dimensions were contrasted further, where wind speed and atmospheric stability present less of an impact to the longitudinal gradient than the lateral gradient, concluding “the lateral gradient may be more important to consider for purposes of assessing which background sources should be explicitly modeled.”⁴⁹

Given the lateral gradient dimension a role in nearby source selection, the Memorandum considered the following approach:⁵⁰

Concentration gradients associated with a particular source will generally be largest between the source location and the distance to the maximum ground-level concentrations from the source. Beyond the maximum impact distance, concentration gradients will generally be much smaller and more spatially uniform.

From this work, EPA maintained that the maximum concentration and maximum impact distance are defining aspects of nearby source selection; however, the Memorandum authors did not identify, define, or suggest that these attributes are the “significance” referred to in the Guideline. They do offer perspective on evaluating maximum impact distance using a simple 10 times source release height calculation, as well as the use of EPA’s AERSCREEN “for identifying the worst-case meteorological

⁴³ Tyler Fox, Leader, Air Quality Modeling Group, to Regional Air Division Directors, March 1, 2011, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard*. Office of Air Quality Planning and Standards, United States Environmental Protection Agency, Research Triangle Park, NC.

⁴⁴ *Ibid.*, 15.

⁴⁵ *Ibid.*

⁴⁶ *Ibid.*

⁴⁷ *Ibid.*

⁴⁸ *Ibid.*, 15.

⁴⁹ *Ibid.*

⁵⁰ *Ibid.*

conditions for individual sources, as well as determining locations of maximum impact and areas of significant concentration gradients.”⁵¹

Tenth modeling conference

In 2012 EPA held the *Tenth Conference on Air Quality Modeling* at the EPA Research Triangle Park Campus in North Carolina from March 13th through the 15th.⁵² The nearby source topic was discussed and subject to formal comment and response by EPA; however, the comment focus was the effective operational domain of AERMOD and its ability to perform better than CALPUFF when nearby sources were located greater than a distance of 20km. During the proceedings, rather than through formal written comments, nearby source selection and the significant concentration gradient were addressed several times by Roger Brode, PhD, EPA Office of Air Quality Planning and Standards (OAQPS). The SCG topic was raised initially during Dr. Brode’s opening remarks on the first day of the conference, where limitations of the nearby source selection practices were discussed considering the newly promulgated NAAQS, along with their modeling challenges and Appendix W interpretation issues. Dr. Brode explained:⁵³

So, we discussed the criteria in Appendix W regarding -- now, what nearby sources should be included and what Appendix W says is-- those sources which cause a significant concentration gradient in the vicinity of your source. So, that is the criteria in Appendix W. That doesn't necessarily say draw a circle at your maximum significant impact level, add 50 kilometers to that, and then take all of those sources and dump them into the model. Again, if you want to do that, we are probably going to be okay with it, but if you do that and you come up with a result that is way over the standard, then maybe you need to rethink how you did it, so -- I don't want to overly belabor that point, but -- it is an issue that we are concerned about and, you know, we have tried to clarify well -- why does Appendix W -- Appendix W doesn't say any more than that -- significant concentration gradient, but what does that mean? You know, how can I understand that and try to apply it in my case? So, we have tried to provide some discussion that we hope is helpful. In time, we might be able to go further and go into more detail, provide more examples, and so on.

Dr. Brode acknowledged the SCG Guideline ambiguity and stated that EPA would be taking further action to clarify the nearby source selection practice. This commitment was strengthened on the second day of the Conference, where Dr. Brode discussed EPA’s position on the SCG language and the state of the existing nearby source selection practice, given their age with respect to the newer short-term NAAQS, explaining:⁵⁴

Now, there's aspects of that that can be somewhat complicated, but it's not impossible to define that. It may be that, as we move forward in updating Appendix W, we can work towards having a more concrete understanding and example of how we define that significant concentration gradient, what it means, and how best to put in practice an approach to identifying in a more, I guess, prescriptive way what nearby sources to

⁵¹ Ibid., 16.

⁵² Environmental Protection Agency, *Federal Register*, 78, no. 19, (January 31, 2012): 4808.

⁵³ Roger Brode, PhD, “Comments on nearby source selection and Appendix W.” In United States Environmental Protection Agency 10th Conference of Air Quality Models Day One [Transcript]. March 13, 2012: 53-54.

⁵⁴ Roger Brode, PhD, “Defining Significant Concentration Gradient.” In United States Environmental Protection Agency 10th Conference of Air Quality Models Day Two [Transcript]. March 14, 2012: 108-110.

model. But right now, we need to work with what we've got. So, we did not comprehensively define the term given the uniqueness of each modeling situation, but if we can get an understanding of these situations in the context of these standards, hopefully, we can provide more information and refine the guidance and ultimately perhaps update Appendix W.

In this exchange, Dr. Brode maintained that the SCG construct could be defined and that in fact, the foundation for that definition already existed in Guideline language. He also suggested a collaborative approach to generate a “more concrete understanding” that would be premised on case-by-case situations. At this time, Dr. Brode was committed to refining the Guideline language rather than create another guidance document. Later, on the second day of the conference, the SCG definition and nearby source identification topic was raised by a Conference participant during an open session. Dr. Brode responded:⁵⁵

We took a source, actually a taller stack and a shorter stack and calculated the concentrations and actually calculated gradients. And one of the things that our March [2011] memo points out is that Appendix W just says significant concentration gradient. It doesn't say a gradient in which direction, so there's a longitudinal gradient. Along the path of the plume, there's a lateral gradient and, in my view, maybe the lateral gradient should be given more weight, in fact, especially for an hourly standard. Because one of the issues is if there is a strong lateral gradient, it means that that plume's impacts may not be adequately captured by a monitor. I think that's, I mean, Appendix W doesn't go on to say why that's the one criterion, but if you think about it, I think that makes sense. If there is significant concentration gradient, then an ambient monitor may not adequately capture that source's contribution. But, you know, we actually did some plots and it was kind of interesting. We might try to do some more. We actually talked about maybe modifying AERSCREEN to output the concentration gradient versus distance or something.

This explanation identified three items of note. The first acknowledged the 2011 EPA Memorandum's role and impact on current and future SCG refinement. Brode also brings the SCG back to its air monitoring foundation and the role of an “outlier” nearby source concentration gradient in comparison to existing ambient air conditions. This understanding is frequently not considered in the SCG dialogue. Last, EPA conveyed their support for using AERSCREEN in nearby source evaluations; however, the possibility of retooling the model to provide concentration gradient output was a unique challenge. Given the detailed conversations and interest, new SCG and NBS language (and possible tools) were anticipated as part of the next Guideline revision.

2014 Regional/State/Local modeling conference

Post Conference and working from the 2011 EPA Memorandum, EPA's James Thurman, PhD, presented on an emerging EPA work product referred to as the *Significant Concentration Gradient Memo* at the

⁵⁵ Roger Brode, PhD, “Defining Significant Concentration Gradient.” In United States Environmental Protection Agency 10th Conference of Air Quality Models Day Two [Transcript]. March 14, 2012: 108-110.

⁵⁵ Roger Brode, PhD, “AERSCREEN modification comment.” In United States Environmental Protection Agency 10th Conference of Air Quality Models Day Two [Transcript]. March 14, 2012: 210-211.

2014 EPA Regional/State/Local Modeler's workshop in Salt Lake City Utah (EPA 2014 Presentation).⁵⁶ The presentation subject was the proposed EPA SCG memorandum, which has not been completed to date. From the presentation, two items offered new direction to the SCG conversation and SCG and nearby source selection process revision potential in the Guideline.

Thurman focused on SCG term definitions and their potential ambiguity.⁵⁷ In his discussion, Thurman posed the question: "Is significant relative to all directions or just a subset of receptors between the potential nearby source and the source(s) under consideration for limits?" Underscoring this question were prompts to consider whether this determination would be a qualitative or quantitative determination, whether it would be based on a visual inspection of concentration maps or through a statistical definition (i.e., 98th percentile of gradients, upper 10%, etc.). It is unclear if these questions were to be addressed in Thurman's memorandum. The "concentration" term was also discussed, with the question posed: "Is this the concentration of a potential nearby source or total concentration (all sources)?" Lastly, he discussed the "vicinity" term, posing: "Is vicinity within the area of SIL exceedances of the source under consideration for emission limits?" Thurman's second contribution raised questions pertaining to which pollutant concentrations might be considered in a gradient analysis.⁵⁸

- Maximum impacts, independent of the SIL exceedances of the project source(s)?
- Concentrations paired in time and space with the project source(s) SIL exceedances?
- Nearby source's design values?

No conclusions were drawn from the presentation based on available information; however, the questions posed in this analysis are still relevant to the topic at hand. His third contribution to the ongoing SCG conversation was the mathematical representation of the longitudinal and lateral gradient from the 2011 memorandum (Equation #1):⁵⁹

Eq. 1

$$\nabla X = \frac{\partial X}{\partial x} \mathbf{i} + \frac{\partial X}{\partial y} \mathbf{j}$$

x=direction of flow in Gaussian space

The implications of Thurman's 2014 presentation offered clearer boundaries to the SCG construct, with more direction on how to contribute important content that informs the case-by-case practice. As provided, there was an expectation that the SCG memorandum would contain this much needed content. As the memorandum (to date) was not completed, what remains is a working template for future effort.

⁵⁶ Thurman, James. "Significant concentration gradient memo." Guidance and clarification memoranda presentation. United States Environmental Protection Agency, Office of Air Quality Planning and Standards, 2014 Regional/State/Local Modelers Workshop, Salt Lake City, Utah, May 21, 2014.

⁵⁷ Ibid., Slide 4.

⁵⁸ Ibid., Slide 5.

⁵⁹ Ibid., Slide 7

Eleventh modeling conference

The *Eleventh Conference on Air Quality Modeling* was held August 12th through the 13th, 2015.⁶⁰ The stated purpose of the Eleventh Conference was the revision of the Guideline. Given the general interest in nearby source selection since the previous conference and prior to it, the Eleventh Conference seemed a suitable forum for presenting and proposing updates on the SCG as well as nearby source selection process. Unfortunately, the topic was only mentioned once and was not part of the formal agenda. The SCG comment was offered by George Bridgers, EPA OAQPS, as part of the revised Guideline language.⁶¹

but there is updated language about the concept of using significant concentration gradients to understand where you have situations where you have nearby sources that are just not well classified or characterized by the monitor and need to be explicitly included. But there should be--and this statement is from the proposed guidance that there should be only a few nearby sources in most cases.

Given this statement, further SCG and nearby source selection practice refinement would have been a reasonable anticipation. EPA published the 2017 Guideline⁶² with SCG and nearby source language and expanded content in comparison to previous versions. The 2017 Guideline SCG and nearby source language is found Section 8.3.3, (See extracted language in Appendix A).

Discerning which nearby sources to include in an air quality modeling demonstration is in part, a function of which nearby sources are captured by an ambient air quality monitor (if available), and, if not, which nearby sources impart a significant concentration gradient on the source under review. Section 8.3.3a presented this understanding in a manner not offered in previous Guideline versions, explicitly acknowledging this distinction. Section 8.3.3b. *i-iii (nearby sources)* presents greater detail on the selection and development of a nearby source emission inventory, with the Section making clear that the significant concentration gradient should be applied to sources *not* captured by a local ambient air quality monitor.

Section 8.3.3b also provides EPA's nearby source practice for selection and characterization based on facility operating characteristics. While concentration gradient is considered a foundational element in nearby source selection, the EPA recognized that concentration gradient variability affects selection, explaining "The pattern of concentration gradients can vary significantly based on the averaging period being assessed. In general, concentration gradients will be smaller and more spatially uniform for annual averages than for short-term averages, especially for hourly averages."⁶³ EPA also recognized that "Concentration gradients associated with a particular source will generally be largest between that source's location and the distance to the maximum ground-level concentrations from that source."⁶⁴ The explanation for this position relied on the expected nearby source emission inventory size, where "The number of nearby sources to be explicitly modeled in the air quality analysis is expected to be few except in unusual situations. In most cases, the few nearby sources will be located within the first 10 to 20 km from the source(s) under consideration."⁶⁵ From this section, there is an assumption that a local

⁶⁰ Environmental Protection Agency, *Federal Register* 80, no. 145, (July 29, 2015): 45340

⁶¹ George Bridgers, "Comments on the use of significant concentration gradient and expected number of nearby source." In United States Environmental Protection Agency, 11th Conference on Air Quality Modeling, Wednesday, August 12, Morning Session. [Transcript] 2015: 119.

⁶² Environmental Protection Agency, *Federal Register* 82, no. 10, (January 17, 2017): 5182.

⁶³ Environmental Protection Agency, *Federal Register* 82, no. 10, (January 17, 2017): 5220-5221.

⁶⁴ *Ibid.*, 5221.

⁶⁵ *Ibid.*

ambient air quality monitor exists such that many potential nearby sources could be excluded if their emissions are represented in monitored data.

Lastly, the Section offered a caveat to the SCG, stating “no attempt is made here to comprehensively define a ‘significant concentration gradient.’”⁶⁶ Given the Conference SCG conversations, this new language seemed consistent with past practices, but not consistent with conference attendees understanding, EPA continued to maintain the position that SCG application “calls for the exercise of professional judgment by the appropriate reviewing authority (paragraph 3.0(b)). This guidance is not intended to alter the exercise of that judgment or to comprehensively prescribe which sources should be included as nearby sources.”⁶⁷ EPA maintains that “professional judgment” is the determining factor in both defining and applying the SCG. Unfortunately, no unique catalogue of selection practices currently exists nor does EPA define or present how “professional judgment” should be applied or documented.

Section 8.3.3c (*i-ii*) reiterates the need to employ EPA approved dispersion models but also directs reviewing authorities to apply the emission characterization found in Table 8–1 or 8–2 to nearby sources. This section also provides guidance on modeling a facility “that *does not have a permit and the emissions limits contained in the SIP for a particular source category is greater than the emissions possible given the source’s maximum physical capacity to emit*”⁶⁸ [Italics added] further explaining that “the burden is on the permit applicant to sufficiently document what the maximum physical capacity to emit is for such a nearby source.”⁶⁹ Greater detail and examples were provided to illustrate when and how to include nearby sources that may not operate at times the source under review operates, with EPA stating “*it is not necessary to model impacts of a nearby source that does not, by its nature, operate at the same time as the primary source or could have impact on the averaging period of concern, regardless of an identified significant concentration gradient from the nearby source.*”⁷⁰ [Italics added]. The burden of proof supporting this conclusion is also on the permittee.

Section 8.3.3d (*Other sources*) maintains EPA’s concern and position on potentially double-counting emissions, relying on section 8.3.2 procedures to compare monitoring data to the nearby source emission inventory and the source under review to reduce “the source-oriented impacts from nearby sources to avoid potential double counting of modeled and monitored contributions.”

In summary, the 2017 Guideline offered the importance of ambient air monitoring data to screen out remaining nearby sources; however, it did not offer reviewing authorities’ direction on how to manage situations where no local ambient air monitoring exists. EPA also maintained its position on the use of the SCG to select nearby sources, and that the whole of the inventory (a relatively small group of sources) should largely be located within the 10 to 20 km radius of the source under review; however, the SCG is still left undefined. EPA offered greater clarity on the role and expectation of a concentration gradient, as well as direction on the nearby source inventory in relationship to the source under review. Tables 8-1 and 8-2 featured prominently in this section. While the 2017 Guideline developments presented several improvements, the lack of a defined SCG, and, more importantly, the absence of a “professional judgment” definition, further constrained practice potential.

⁶⁶ Ibid.

⁶⁷ Ibid.

⁶⁸ Ibid.

⁶⁹ Ibid.

⁷⁰ Ibid.

Several states pursued nearby source selection efforts, given the Guideline language over the years, to better achieve their expected cumulative air dispersion modeling demonstration rubrics. This work, mentioned here, is examined in greater detail in the *Policy and Practice Questions* section.⁷¹

Nearby source selection approaches

From the 1980's until the early 1990's, several states pursued quantitative approaches to evaluate and develop nearby sources for cumulative modeling demonstrations. The tools can be distinguished by their mode of performance where gradient-based tools relied on some form of dispersion modeling to evaluate ambient pollutant concentration gradient, versus magnitude-based approaches which rely on annual emission inventory values over distance. The gradient-based methods include the state of Oregon's "Range of Influence" (ROI) approach and the state of New York's Grad/D² approach. The state of North Carolina's emission inventory/distance method, a magnitude-based approach, evaluates nearby source conditions to determine where ratios greater than 20 are included in the nearby source inventory (20D method). All three applications are in use; however, they are typically (though not exclusively) tailored to meet unique reviewing authority needs and resources.

The underlying premise of these state-related actions was their interpretation of "significance" within their own state programmatic boundaries. These actions, on their own, hold a unique perspective on nearby source selection; however, perhaps more important, is the role of EPA concurrence. A more detailed review of each practice is examined in Policy Question 2a(1).

Policy and practice analysis

The policy questions serve multiple purposes. First and foremost, they frame the review boundaries and content. Second, they present a scaffolding for reflective understanding and consideration of the current SCG and NBS practice, and lastly, they mark an opportunity for deliberate and ongoing calibration and improvement of the practice. Given this understanding, each question is developed to identify possible opportunities and gaps in our current understanding of the nearby source selection task.

Question 1: Sufficiency of existing EPA guideline language

The Guideline often serves as the interpretative source material for SCG and NSB decisions. As a guidance document, it is not intended to be prescriptive, allowing for reviewing authority discretion through the application of professional judgment. Under EPA's approach, the scope of the Guideline language, intentionally general and indeterminate, in theory supports a range of practices that may result in a defensible conclusion. This premise shapes the call of our first question:

Does the current EPA Guideline provide sufficient information and methods to apply the SCG in the reasonable selection and development of a nearby source emission inventory?

While EPA's Guideline intention is desirable and necessary to meet the breadth and depth of situations over time and across the country, language ambiguity and uncertainty limit a fuller use of the SCG construct. From a general decision-making perspective, ambiguity is understood to be a "lack of clarity

⁷¹ On August 13, 2019, the U.S. Environmental Protection Agency (EPA) announced the Twelfth Conference on Air Quality Modeling. The modeling conference, mandated by Section 320 of the Clean Air Act, was held on the EPA RTP, NC Campus from October 2nd through 3rd, 2019.

or consistency,” while uncertainty presents a different proposition: a “lack of understanding.”⁷² The two concepts are related but distinguished by how the underlying construct weaknesses are resolved. In this case, collectively, they act to create linguistic challenge and impose interpretative difficulty.

Ambiguous language creates administrative uncertainty that can be resolved in a variety of ways including administrative agency clarification memorandums to a more extreme solution through the judicial system.⁷³ Our goal is not to provide an interpretative solution, rather, to explore the limits of the existing Guideline language. We attempt this effort through a focus on end-user application experience, and their ability to apply the nearby source selection language in the Guideline “as-is” through a hypothetical “means-end” framework, where the “means” encompass the Guideline and supporting documentation, and the “ends” a final nearby source determination.

It is our position that as written, the EPA Guideline does not provide sufficient clarity to interpret the significant concentration gradient method and develop a defensible nearby source emission inventory. This position is not surprising, as under the Guideline, EPA has intentionally withheld further commentary or details that would support effective implementation of SCG methods:⁷⁴

In particular, there were numerous requests to further clarify the analysis of significant concentration gradients from “nearby sources,” as used in the selection of which nearby sources should be explicitly modeled in a cumulative impact assessment under PSD. In the proposed revisions to the Guideline, we expanded the concept of significant concentration gradients from the previous version of the Guideline. Given the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources, we continue to believe that comprehensively defining significant concentration gradients in the Guideline is inappropriate and could be unintentionally and excessively restrictive. Rather, the identification of nearby sources to be explicitly modeled is regarded as an exercise of professional judgment to be accomplished jointly by the applicant and the appropriate reviewing authority.

While EPA claims that they have “expanded the concept of significant concentration gradients” they have fallen short in providing a functional definition of the Guideline term. The absence of Guideline language clarity on this topic is further complicated by the insertion of “professional judgment,” yet another undefined term, adding analytical and administrative uncertainty.

Without a functional definition of SCG, reviewing authorities will continue to struggle, or even fail, in their attempts to operationalize and implement the concept. Ideally, EPA should define the SCG in functional terms, specifically:

- (1) What gradient is being calculated?; and,
- (2) What does EPA mean by the term “significant”?

With respect to the gradient question, one is left to wonder whether this application is to be applied longitudinally from the source, or should the lateral gradients be calculated as well? If so, what is the purpose of these calculations? What are they being compared against? The “significant” term, tethered

⁷² March, J.G. and Chip Heath, *Primer on decision making: How decisions happen*. (New York, Simon and Schuster, 1994): 178.

⁷³ Clearly, administrative agency documentation and guidance can be the subject of a legal challenge, either directly, or as evidence to a final decision. State and Federal courts often extend deference to state and federal agency actions and decision-making; however, the courts will also weigh other factors including whether an agency should have pursued rulemaking or has acted outside of its authority. Due to the fact-intensive nature of administrative decision challenges, no attempt to is made to explore specific examples in this Paper.

⁷⁴ Environmental Protection Agency, *Federal Register* 82, no. 10, (January 17, 2017): 5182.

to the Guideline gradient definition, is also subject to further scrutiny. In any comparison between a calculated gradient and its significance, a threshold must be determined. EPA has not provided any guidance on what value should be used or how to develop a significance value, with the Guideline remaining silent on this issue. One may consider that significance should somehow be correlated to, or associated with, the relevant ambient air quality background monitors employed in the modeling analysis.⁷⁵

Nearby sources: All sources in the vicinity of the source(s) under consideration for emissions limits that are not adequately represented by ambient monitoring data should be explicitly modeled. Since an ambient monitor is limited to characterizing air quality at a fixed location, sources that cause a significant concentration gradient in the vicinity of the source(s) under consideration for emissions limits are not likely to be adequately characterized by the monitored data due to the high degree of variability of the source's impact.

While the Guideline does not clearly explain a functional SCG implementation or practice, additional guidance is contained in other EPA publications. Specifically, EPA's March 1, 2011 memorandum entitled *"Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard"* contains additional information on the SCG method.⁷⁶ It begins to broach the topics omitted from the Guideline, but still fails to provide enough information for a modeling professional to implement a consistent, standardized SCG methodology. Additionally, the most current Guideline version makes no reference to this earlier work, thereby raising the possibility that it could be omitted from consideration during project development.

The EPA is preparing to revise the Guideline as part of the 13th Modeling Conference. While the SCG and NSB language may not be subject to revision, the EPA should consider clarifying their understanding of SCG by providing a set of case studies to help instruct modeling professionals on the desired SCG methods of implementation. Articulating, with clarity, the accepted understanding and practices supporting SCG application would provide a reasonable means to generate a defensible NBS product. In support of this work, Question 2 raises some additional elements in support of EPA's further SCG and NBS guidance efforts.

Question 2: Content and limit of the significant concentration gradient (SCG) construct.

The Significant Concentration Gradient (SCG) first appeared as a nearby source selection factor in the draft 1984 EPA air quality modeling Guideline. Through this work, in particular, our conclusion from Question #1, we have identified that the SCG has never been defined through the Guideline or any other federal guidance but is featured as one of the criteria for selecting relevant nearby emission sources for Class II NAAQS and Increment analysis.⁷⁷ Given the period the SCG term first appeared, designating the concentration gradient as "significant" appears to align with revisions to federal PSD regulations and the introduction of quantitative significance levels.⁷⁸ In a broad sense, plain or common language definitions of "concentration" and "gradient" are generally understood by air quality professionals with little

⁷⁵ See 40 C.F.R. Part 51, Appendix W, Section 8.3.3.b

⁷⁶ See pages 11-13 of this Paper for additional details.

⁷⁷ For the purpose of this Paper, the SCG is inclusive of the potential nearby sources as well as the "vicinity of the source(s)" under review. The "vicinity" is understood as the source Significant Impact Area (SIA) evaluation.

⁷⁸ See pages 11-13 of this Paper for additional details.

uncertainty or ambiguity and are not the primary focus of this examination. Of interest is how EPA envisioned the content and scope of the SCG and NBS concepts. In pursuit of this task, the full expression of Question #2 is posed as follows:

Have the boundaries and content of the Significant Concentration Gradient (SCG) and Nearby Source Selection (NBS) constructs been established?

From the review, above, it is understood that the EPA added additional SCG detail, in clarification of the one-hour NO₂ NAAQS modeling guidance and in the 2017 Guideline. This information is considered supplemental to our analysis. The EPA addressed the SCG issue as part of the updated one-hour NO₂ NAAQS modeling guidance, explaining “given the issues and challenges arising from the implementation of the new 1-hour NO₂ standard, we feel compelled to offer some additional explanation regarding what this guidance means and how it should be applied.”⁷⁹ EPA expounded on the “gradient” term, explaining “that the gradient of the ground-level concentration has two dimensions, a longitudinal (along-wind) gradient and a lateral (cross-wind) gradient.” This contribution is an important SCG content detail and adds to the overall understanding of EPA’s expectation on this topic. The 2017 Guideline added language that described differences in a source theoretical SCG based on the individual NAAQS averaging time (short-term versus annual), along with the source-specific SCG characteristics related to the maximum impact distance and the GEP-related distances, as well as the number of nearby sources expected in a cumulative air quality dispersion modeling demonstration.⁸⁰

The supplemental 2011 and 2017 EPA content added greater nearby source selection details, further supporting the examination of both practical and theoretical SCG topics in this Paper. This section explores the SCG through three inquiries. The first inquiry investigates “significance” established through three general but distinct practices that rely on differing interpretative frames focused on the primary task of nearby source selection. While the EPA does not explicitly provide any direction or detail to aid practitioners’ interpretation and application of a “significant” concentration gradient through the Guideline, based on other EPA-related sources, several practices offer useful perspective:

- EPA recognized nearby source selection procedures;
- Pollutant-specific Significant Impact Level (SIL) approach; or,
- Historic or legacy pollutant-specific NAAQS design value “undue influence/gradient”

This position establishes the foundation of the second inquiry - availability of air quality monitoring data. A complicating factor for many air quality dispersion modeling demonstrations is the availability of local, representative ambient air quality monitoring data. Frequently, air quality modeling demonstrations rely on ambient air quality monitoring data that is not directly representative of the modeled area, adding uncertainty to the analysis that is often assumed to be resolved through the selection of a “conservative” ambient air quality monitor selection from outside the area.

The air quality modeler capability, experience, and professional judgment, along with programmatic and institutional resource and practice, is often a controlling factor in the nearby source selection process. Professional judgment, the connective element of the analysis, maintains a compelling role in this

⁷⁹ Tyler Fox, Leader, Air Quality Modeling Group, C439-01 to Regional Air Division Directors, March 1, 2011, United States Environmental Protection Agency, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard*. [Memorandum] Research Triangle Park, NC, Office of Air Quality Planning and Standards: 15.

⁸⁰ 40 C.F.R. Part 51, Appendix W, Section 8.3.3bi-111

activity, yet despite its prominence in the Guideline, EPA has been silent on its application and documentation. This is the subject of the third inquiry in this section.

The goal of each inquiry is a more complete characterization of the topics and their role in defining the SCG scope and content. The results are not intended to be prescriptive or definitive, as the Paper authors recognize EPA's wisdom in this endeavor, urging "caution against interpreting this guidance too literally or too narrowly, and emphasize that a 'large number of variables' (Appendix W, Section 8.2.3.b) are involved in this assessment."⁸¹ The section objective is an attempt at clarification of some analytical terminology and administrative practices that aid in defining and applying the SCG to the nearby source inventory selection task, as well as identifying opportunities for further development.

Question 2a: How is significance determined in practice?

Air quality modelers have applied various analytical measure to identify a defensible nearby source inventory for many decades. The SCG is one fixture in this practice, becoming the touchstone by which nearby source selection efforts are judged; however, given the undefined quality of the term, a medley of related nearby source selection practices has emerged over time, with notable strengths and weaknesses. Benchmarking individual nearby source selection practices from each reviewing authority throughout the United States would not be possible within the scope and resources available for this work. Instead, generally accepted or recognized nearby source selection practices are reviewed, with attention given to the "significance" approximation applied to the overall SCG decision.

Existing practices based on accepted nearby source selection procedures.

Between 1984 and the 1993, three states developed methods and procedures to evaluate and select nearby source emission inventories that reflect the Class II NAAQS and air quality modeling practices of the time. Two of the three approaches are computationally simple, while the third, the New York State GRAD/D², involves the use of a screening model. All three approaches are still used and offer analytical support to nearby source emission inventory selection; however, it is unclear how effective they may be in managing newer short-term NAAQS or revised numeric values of existing standards. Furthermore, they may encounter challenges when applied in Environmental Justice areas where emission sources may be numerous and clustered, presenting new challenges with diverse pollutants and release characteristics. An interest presented in this Paper is how these approaches internalize "significance" when applied to nearby source emission inventory selection.

Gradient-Based Approaches

Range of Influence (ROI)

The state of Oregon created the Range of Influence (ROI) method, to identify a nearby source's range of significant influence within a modeling domain, aimed at understanding the relationship between the nearby source influences on the modeled source impact area (SIA). This work was completed in the early 1990's; however, the original technical documentation supporting this work was not available for this review.⁸² The ROI approach does not distinguish between the short and long-term NAAQS. While the

⁸¹ Tyler Fox, Leader, Air Quality Modeling Group, C439-01 to Regional Air Division Directors, March 1, 2011, United States Environmental Protection Agency, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard*. [Memorandum] Research Triangle Park, NC, Office of Air Quality Planning and Standards: 16.

⁸² Oregon Department of Environmental Quality, *Competing Source Emission Inventories for Air Quality Analysis*, Brandy Albertson. (Oregon Department of Environmental Quality, Portland, Oregon, 2015).

original ROI documentation was not available, unlike other methods, this approach is memorialized in state rule.⁸³

the calculation of the distance in kilometers from the source impact area of the new or modified source to other emission sources that could impact that area. If there is no source impact area, the distance is calculated from the new or modified source. Any location that is closer to the source than the ROI may be considered to be ‘within the range of influence’ of the source.

The state rule-defined ROI formula for competing sources is presented as:

$$(2) \text{ ROI (km)} = Q \text{ (tons/year)} / K \text{ (tons/year km)}$$

This version of the ROI assumes the use of a source impact area, likely developed through ambient air quality dispersion modeling and a pollutant-specific screening value assumed to be the Significant Impact Level (SIL), recognized as a *de Minimis* ambient pollutant concentration. Where the maximum ROI is 50 km, Q is the emission rate of the potential competing source in tons per year, and K is a regulated pollutant specific constant, presented in state rule, summarized in (Table 1). The K-term origin does not appear in the rule; however, operationally, it appears to function as a simple exponential decay function that approximates pollutant-specific air quality dispersion.

Oregon also provided an alternative ROI version that does not use the source impact area and does not appear in rule. Instead, it provides for a combination of the new source contribution (in tons per year) to the individual nearby source inventory, divided by the distance between the nearby source and the source under review.⁸⁴

$$(3) \text{ ROI (km)} = ((Q_{\text{nsi}} \text{ in tons/year}) + (Q_{\text{nsc}} \text{ in tons per year})) / K \text{ (tons/year km)}$$

Where Q_{nsi} is the pollutant-specific annual emission inventory for the nearby source, and Q_{nsc} is the pollutant-specific contribution.

Table #1 Pollutant-specific K-values (Tons per kilometer)

Pollutant	CO	NOx	PM _{2.5} /PM ₁₀	SO ₂	Lead (Pb)
K	40	5	5	5	0.15

This approach is relevant for two reasons. First, the approach appears to contain the underlying modeling and application of EPA “significance” metrics, at least in a broad plume overlap perspective, and second, the relational approach supports its potential for automation and visualization as a spatial analysis decision-support tool. This approach does not take in to account any physical site-specific features, meteorology, or ambient air quality background concentrations.

GRAD/D²

The New York State Department of Environmental Conservation (NYSDEC) created the Gradient over Distance Squared (GRAD/D²) method to identify nearby sources consistent with EPA’s “significant

⁸³ See generally the State of Oregon’s administrative rule OAR 340-225-0020.

⁸⁴ Oregon Department of Environmental Quality, Competing Source Emission Inventories for Air Quality Analysis, Brandy Albertson. (Oregon Department of Environmental Quality, Portland, Oregon, 2015): 4.

concentration gradient” construct.⁸⁵ The documentation does not distinguish alternative usage between the short and long-term versions of the NAAQS; however, the foundational work on this approach was completed well before the new short-term NAAQS schema. The NYSDEC noted the underlying mathematical relationships of the approach:

The ‘distance-squared’ factor could better represent the concept of vicinity since the combined dispersion parameters in the Gaussian equation are proportional, for the most part, to the distance to the power of two in the range of maximum impacts predicted.

The NYSDEC submitted the GRAD/D² to EPA’s Office of Air Quality Planning and Standards (OAQPS) for review. The EPA concurred with the NYSDEC approach in a March 31, 1994, Memorandum.⁸⁶ The GRAD/D² method applies to an initial set of all major sources in the Significant Impact Area (SIA) out to 50 kilometers. The GRAD/D², as provided in the 1994 EPA Memorandum, employed four development steps:

1. Determine the concentration gradient (GRAD) between the maximum impact location (Xmax) and 1000m downwind from this location (Xmax+1000) using the SCREEN3 (or equivalent) model as: $GRAD = (X_{max} - X_{max+1000}) / 1,000m$
2. Determine the distance D (in Km) from the background source to the proposed source and calculate GRAD/D² for each source.
3. Rank order, from highest to lowest, the sources according to the GRAD/D².
4. All sources equal to and above 1% of the maximum GRAD/D² ratio should be modeled as nearby sources.

The GRAD/D² documentation encourages professional judgment to apply the 1% criteria, especially in situations where outliers may occur. The documentation does not provide for any specific form of outlier analysis. Additionally, the initial documentation described the use of EPA’s SCREEN3, a screening version of the former Industrial Source Complex Short-Term (ISCST3) air quality dispersion model, to support the GRAD/D² evaluation. The EPA has since replaced SCREEN3 with AERSCREEN, a screening version of EPA’s American Meteorological Society and U.S. Environmental Protection Agency Regulatory Model (AERMOD) air quality dispersion model. The AERSCREEN platform offers a predictive improvement over the former SCREEN3 performance and can provide functional output to support the GRAD/D² approach; however, it is computationally more demanding than SCREEN3.

This approach was developed and applied through air quality modeling, with an added benefit of taking into consideration the spatial reality of near source maximum ambient air pollutant concentrations; however, the 1% “significance” determination is not well supported in the original documentation. An added benefit is the analytical adaptability and prowess of the approach to manage new ambient

⁸⁵ New York State Department of Environmental Conservation, *A method for determining nearby sources for cumulative impact analysis. (Draft)*. Albany, NY, 1992. See also Kenneth Eng, Chief, Air Compliance Branch, Region II, to Joseph A. Tikvart, Chief, Source Receptor Analysis Branch (MD-14), March 2, 1994, *Green Island Resource Recovery Facility – Modeling Emission Inventory*, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

⁸⁶ Joseph A. Tikvart, Chief, Source Receptor Analysis Branch (MD-14), to Kenneth Eng, Chief, Air Compliance Branch, Region II, March 31, 1994, *Green Island Resource Recovery Facility – Modeling Emission Inventory*, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

standards as well as distinguishing between the short and long-term versions of the NAAQS, limited only by the choice of screening model inputs. Terrain and meteorology could also be included if AERSCREEN is used to support this approach. AERMOD could be employed if a more refined analysis is needed. This approach is still used by the NYSDEC for nearby source selection purposes.⁸⁷

Magnitude-Based Approach

20D Protocol

The state of North Carolina created one of the earliest and simplest methods to identify a nearby source emission inventory. The North Carolina Protocol (Protocol) (1985) was designed as part of the state's implementation of the federal Prevention of Significant Deterioration (PSD) air quality permitting program.⁸⁸ The 20D method distinguishes between two applications to evaluate the short and long-term versions of the NAAQS (See Figure 1). For the short-term NAAQS, the Protocol excludes nearby sources that have potential maximum allowable emissions (Q) in tons/year that are less than 20 times the distance between the nearby source and the source under review in kilometers (20D). This approach is based on the nearby source "screening threshold" offered in EPA's *Prevention of Significant Deterioration Workshop Manual* (1980).⁸⁹ Sources not eliminated through the 20D approach resulted in a pool of potential nearby sources that could be included in the final refined air quality modeling demonstration.

For long-term NAAQS the Protocol required the user to identify an air quality "impact area" for the source under review. EPA explained that "the impact area is a circular area whose radius is equal to the greatest distance from the source to which approved dispersion modeling shows proposed emissions will have a significant effect."⁹⁰ The EPA provided ambient air quality screening values referred to as "significance levels for air quality impacts" for Sulphur dioxide (SO₂), Total Suspended Particulate (TSP), Nitrogen Dioxide (NO₂), and Carbon Monoxide (CO).⁹¹ At the time the Protocol was developed, impact area assessment relied on simple look-up tables provided in *Turner's Workbook of Atmospheric Dispersion Estimates* (WADE),⁹² early versions of computer-aided air quality models, or hand calculations. The long-term averaged ambient standards identified nearby sources outside the impact

⁸⁷ Julia Stuart, Chief, Impact Assessment and Meteorology Section, New York State Department of Environmental Conservation, to Jim Sullivan, Risk Evaluation and Air Modeling Unit, Minnesota Pollution Control Agency, April 10, 2023, Status of an early NYSDEC air quality modeling nearby source selection process.

⁸⁸ Eldewins Haynes, Meteorologist, Air Permits Unit, State of North Carolina Department of Natural Resources and Community Development, to Lewis Nagler, Air Management Branch, EPA Region IV, Atlanta, Georgia, July 22, 1985, A screening method for PSD.

⁸⁹ United States Environmental Protection Agency, *Prevention of Significant Deterioration Workshop Manual*. 450280081. Office of Air, Noise, and Radiation, Office of Air Quality Planning and Standards (Research Triangle Park, NC, 1980): I-C-18.

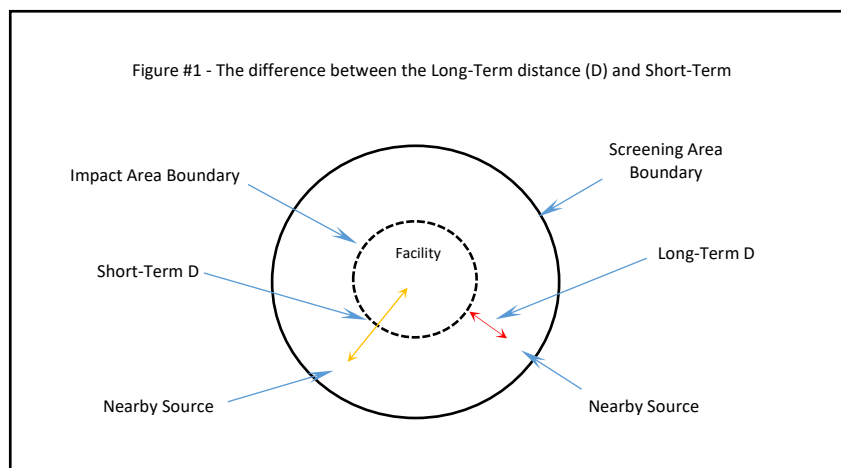
⁹⁰ Ibid., I-C-12.

⁹¹ Ibid., I-C-14.

⁹² United States Environmental Protection Agency, *Workbook of Atmospheric Dispersion Estimates*. D. Bruce Turner. Office of Air Programs Publication No. AP-26. Office of Technical Information and Publications, Office of Air Programs, Research Triangle Park, NC: Environmental Protection Agency, 1970.

area to the edge of the screening area. A nearby source with a Q value equal or greater to 20D, is treated as having a “critical” emission rate for modeling and air management purposes.

The Protocol assumptions included an effective stack height of 10 meters, a Stability Class of D (neutral), a 2.5 meter/second wind speed, and a mixing height of 300 meters. The Protocol development relied on ambient air concentrations developed from either Turner’s WADE or EPA’s Point Distance (PTDIS) dispersion model.



The PTDIS model was included in EPA’s User Network for Applied Models of Air Pollution (UNAMAP) and featured three-point source models: PTMAX – calculates the maximum short-term concentration from a single source; PTDIS – calculates the downwind ground-level concentration; PTMTP – hourly concentrations at up to 30 receptors whose locations are specified from up to 25-point sources.⁹³ Annual pollutant concentration values used 1/7th of the 24-hour impacts. While not explicitly stated, the 20D approach operated under a linear inverse proportional relationship between source emissions and impacts with distance. North Carolina documented the 20D practice in a July 22, 1985, correspondence from the state of North Carolina Department of Environmental Quality to EPA Region IV. The EPA reviewed the Protocol in September of 1985 and reflects the structure and numeric values of the National Ambient Air Quality Standards (NAAQS) of the era, likely a product of the revised PSD regulations and Draft 1984 Guideline.

The 20D approach was the first method to receive EPA concurrence. It was intended for PSD modeling (increment and NAAQS) and designed to meet the North Carolina state air management program needs. Since its origin, many reviewing authorities have relied on 20D, or versions of it, to develop their nearby source inventories. Ultimately, this approach has not been evaluated to determine its effectiveness with the newer short-term NAAQS. Additionally, it does not explicitly rely on the EPA “significance” criteria and has no direct relationship to project-specific meteorology or terrain.

Significant Impact Level (SIL) based determination.

Typically, “significance” is understood as a quantitative metric, especially within the environmental regulatory setting, where it maneuvers through and connects with the boundaries of scientific, statistical, and legal practice. The early PSD regulations adopted various significance thresholds to

⁹³ See Benarie, Michael M. *Urban air pollution modelling*. (London and Basingstoke: Springer, 2015).

address the need for better permit-related screening and prioritization tasks.⁹⁴ Many of these approaches, in particular, air pollutant concentration significance thresholds for air quality monitors and air permitting thresholds, were adapted to the regulatory air quality dispersion modeling practice. The EPA expected that PSD air permit applicants would demonstrate compliance with the applicable NAAQS and Increment through ambient air quality dispersion modeling. From the *1980 EPA PSD Workshop Manual*, the initial air quality modeling task still in use today, identified as the source impact area (SIA), was defined as the area around the proposed facility “where the proposed emissions will have significant ambient concentrations in order to determine compliance with applicable ambient air standards and increment.”⁹⁵ The impact area is described as “a circular area whose radius is equal to the greatest distance from the source to which approved dispersion modeling shows proposed emissions will have a significant impact.”⁹⁶ The radius was based on the “values of significant ambient air impacts,” an early version of the Significant Impact Level.⁹⁷

The pollutant specific SIL has become a utility “unit of significance” measurement in several recognized air management applications. As a *de minimis* pollutant concentration value, it is applied as a measure to evaluate whether a modeled facility has caused or contributed to a modeled NAAQS exceedance. From above, the SIL is a measure of significant impact, applied to evaluate the spatial impacts of a proposed or existing source.⁹⁸ From this utility, it is possible to explore overlapping SIA’s through a SIL-based nearby source selection method, operating as a SCG surrogate.

This approach would be considered an SIA “overlap” comparison between the source under review and the data frame of potential nearby sources within the operational limits of the model, a derivative of the “significant locations” approach described in the 1978 Guideline where “The impact of the nearby sources must be summed for locations where interactions between the effluents of the point sources under consideration and those of nearby sources can occur.” The 1978 Guideline identified “significant areas” of interest as: (1) the area of maximum impact of the point sources, (2) the area of maximum impact of nearby sources, and (3) the area where all sources combine to cause maximum impact.⁹⁹ This early EPA description is in line with more recent details described by EPA in their 2011 gradient concept review. With a clearer understanding of EPA’s gradient, combined with the initial Guideline expectation, a SIL-based approach would effectively replace the 1978 Guideline “maximum” term with SIL-related language and continue to operate in the fashion described.

Such an effort appears to be a revision of the current Oregon ROI approach, offering a reasonable approximation of a SIL-based plume overlap evaluation method, though it is not known if the ROI is a SIL-based analysis. It is unclear if other permitting authorities in the United States follow this construct, or a variant of it. The potential benefits of this approach are premised on the general acceptability of the SIL’s by industry and regulators, given their use as a quantitative significance measure consistent with various recognized air management practices. In addition, reliance on air quality modeling and related modeling demonstration development practices, along with accepted SIL values, seems to provide

⁹⁴ A summary of this suggested development history is found on pages 6-8 of this Paper.

⁹⁵ United States Environmental Protection Agency, *Prevention of Significant Deterioration Workshop Manual*. 450280081. Office of Air, Noise, and Radiation, Office of Air Quality Planning and Standards (Research Triangle Park, NC, 1980): I-C-12.

⁹⁶ Ibid.

⁹⁷ Ibid. A summary of the SIL history is found on pages 6-8 of this Paper.

⁹⁸ United States Environmental Protection Agency, *The Role of Atmospheric Models in Regulatory Decision-Making: Summary Report*. C. S. Burton, Systems Applications, Inc., San Rafael, CA. Prepared under contract No. 68-01-5845. (Docket No. A-80-46, II-M-6). Research Triangle Park, NC., 1981.

⁹⁹ See pages 6-8 of this Paper for additional details.

support for a defensible nearby source selection approach, especially in the absence of ambient air monitoring data.

A potential limitation is embedded in the analytical expectation that all potential nearby sources have an accurate SIA. The SIA overlap is a spatial analysis, meaning that all the respective SIAs for potential nearby sources and the source under review would be plotted to evaluate their respective overlap. Availability of annual or hourly nearby source emission inventory data may be a challenge for some permitting authorities. If the emission data is readily available, building the analytical framework and executing the analysis can be achieved through reasonably available technology and skills. The Oregon ROI approach appears to be a functional analog, with enhanced use achieved through automated GIS applications. Added to this concern is the potential for double-counting if a local monitor is used to develop an ambient air quality background concentration.

Another concern is size of the nearby source inventory generated from this approach, as it applies a higher detection resolution for potential nearby sources outside the source SIA. Nearby sources located within the source SIA are another matter. It is assumed that any nearby facility within the source SIA would be included in the cumulative air quality modeling demonstration as they would potentially contribute greater than a SIL-value under most screening methods. Given the need to better evaluate potential sources of air pollution in urban and environmental justice areas, this approach appears to offer a greater source detection and selection resolution that is directly linked to the applicable ambient standard and public interest.

NAAQS design value-based determination.

The third approach is based on historic air management practices developed at a time when air quality modeling for stationary sources was not readily available. The task faced by many Air Quality Control Region (AQCR) managers was prioritizing the existing emission inventory for air quality control and permitting, as well as evaluating ambient air impacts from new stationary sources. The practice developed at that time involved a comparison between pollutant-specific baseline ambient air quality monitoring data and the actual or potential stationary source ambient concentration. Stationary sources with the potential for ambient concentrations greater than the applicable ambient pollutant baseline concentration would be subject to further control and permitting activities. Practices developed prior to the 1970 NAAQS relied on various statistical metrics applied to ambient air quality pollutant concentration data that established the applicable ambient baseline conditions. This scheme was designed to manage existing ambient air conditions and ultimately improve overall air quality conditions through air quality control strategies from facility to regional scale. Once the NAAQS were promulgated, the AQCR's relied on the numeric threshold and form of the applicable standard, rather than previous non-regulatory goals or standards. Potential ambient air quality impacts for existing or new stationary sources typically relied on a variety of calculation methods to establish the ambient impact and concentration gradient. Practice details from this time are numerous and varied, extending beyond the scope of this work.

Regulations, technology, and the state of air quality science and human health impacts have evolved considerably since this time. Superior analytical and technical capability have replaced the ambient baseline comparison approach; however, this practice may still have some relevance to nearby source selection through a comparison of existing and proposed ambient concentration gradients.

This approach resonates with nearby source selection and the ambient air quality background concentration association, where a direct comparison to monitored ambient air quality data supports the significance determination. The newer one-hour SO₂ and NO₂ NAAQS and the newer PM_{2.5} NAAQS,

all featuring lower pollutant concentration thresholds, may operate as a safeguard for over or under selecting the NBS inventory. Furthermore, a uniform ambient air quality background concentration across the modeling domain is a general assumption of the current AERMOD modeling platform, a helpful assumption for comparing concentration gradients.

There are also disadvantages. At this point, such a practice is speculative as many questions remain unanswered. For example:

- How would a design value comparison operate if the nearby source selection process does not rely on refined ambient air quality dispersion modeling in the form of the applicable NAAQS?
- The comparison window would operate between the ambient air quality ceiling of the applicable NAAQS and the monitored design value for a given area, assuming that the area is in attainment. This raises the question of how much greater than the design value would be considered significant for this analysis? The numeric design value plus one SIL value of the applicable pollutant?
- Given the rationale and role of the source SIA, any potential nearby source within a source SIA would not be subject to this analysis as the ambient air quality impact of combined sources would be neglected by this approach. This would confine the approach to potential nearby sources outside of the source SIA.

Despite these limitations, a reasonable inquiry could be made to evaluate these approaches, especially within and beyond the source SIA. Additionally, automation would be achievable if the relevant data is available, and the defining assumptions can be tested. Potentially, a two-tiered inquiry could be created with the SIL-based analysis assigned to the source SIA radius, while the design value approach could be applied beyond the source SIA.

Question 2b: Can the SCG be applied in the absence of a local ambient air quality monitor?

Many of the Guideline Section 8.3 analytical assumptions are premised on the presence of one or more ambient air quality monitors within the modeling domain. This is the ideal and may in fact occur in some parts of the United States; however, in practice, ambient air quality monitors are not always distributed in this manner. The Guideline does not address nearby source selection when an ambient air quality monitor does not exist within the modeling domain location. Lacking an ambient air quality monitor, it is assumed that any nearby source which has a significant concentration gradient on the source under review should be included in the final modeling demonstration. This section considers nearby source selection when an ambient air quality monitor is absent.

In the absence of an ambient air quality monitor, selection of a representative ambient air quality monitor may be challenging, as the surrogate monitor should match the intended modeling domain as much as possible. One option would be the selection of a monitoring location with concentration values higher than those in the modeled domain (conservative); however, such concentrations would likely be an overrepresentation and most assuredly result in overestimated modeled pollutant concentrations. Ideally, the selected representative ambient air quality monitor data would support a competent perspective of the nearby sources within the modeled domain. This is really the only utility (albeit an important one) that a representative ambient air quality monitor can serve. The surrogate representative ambient monitor data cannot be used to remove nearby sources from a modeling domain, as it does not represent the details of the modeled domain area emission inventory, terrain, and meteorology, in the same way.

Another representative background monitor selection option is an emission landscape comparison around both the facility and potential monitor. The most representative monitor (i.e., similar emissions landscape) would be selected for the ambient model background concentration. To ensure all emission types are accounted for, another option is the use of gridded emission inputs from recent photochemical modeling.

Nearby source selection would be entirely independent from ambient air quality monitoring under these circumstances. Discussed previously in Question #2a, generally accepted, though largely untested, nearby source selection methods exist which can be applied to determine the final emission inventory. Given AERMOD's ability, along with current computing power, and availability of emission inventory data, the selected NBS could be evaluated further through an initial model run, thereby verifying which sources should remain in the inventory. Ideally, this would be initiated without source modification through Guideline Tables 8-1 and 8-2.

To date, a generally accepted practice (or practices), does not exist; however, as described above, this is likely how many reviewing authorities apply the selection process. Given the advent of superior computing capability, modeling to evaluate and determine a final NBS inventory seems possible; however, there are issues with cost, time, and emission inventory development. This topic seems worthy of further discussion, especially considering current national and state interest in improving ambient air quality in Environmental Justice designated areas, where nearby source inventories may be more compact and numerous.

Question 2c: How is “professional judgment” established and applied under the Guideline?

Professional judgment, a prominent presence in nearby source selection, appears five times throughout the 2017 Guideline. Despite EPA's reliance on this skill, it does not provide additional narrative to support users' professional judgment during the nearby source inventory selection task. Given the absence of additional narrative, this paper offers commentary and suggests additional clarity on the topic for EPA consideration. Two options are considered: The “Business as usual” approach; and a generic professional judgment narrative model. The “Business as Usual” (BAU) examination explores the current conditions, benefits, and challenges of the current EPA practice without modification or revision. It is the baseline for comparison to the second option, which focuses on a generic professional judgment documentation model, offering a guided approach to characterize the nearby source selection process and conclusions for the administrative record.

Further distinction is important. Regulatory air quality modeling involves several technical disciplines that may require licensure or certification where professional judgment topics are a condition of the professional licensure status. For example, a Professional Engineer will likely be required and held to a standard of performance in the exercise of their professional judgment. Reviewing authorities and consulting firms alike are often staffed with Professional Engineers that maintain a license through various state accrediting boards, as well as function within the context of an authorized professional or within some form of programmatic professional discretion. While this reality is recognized and understood, on its own it is likely insufficient to manage the decision task in question. Additionally, many air quality modeling professionals are not engineers and work outside the scope of an engineering subject matter sphere. Furthermore, most jurisdictions do not maintain a requirement that an air quality dispersion modeling demonstration be completed under the oversight of a Professional Engineer, at least directly, meaning that whatever professional standards may apply to a Professional Engineer during the development of facility emissions, may not apply to a non-engineer completing the

dispersion modeling demonstration. The model proposed in this Paper is not intended to replace or compel professional judgment practices already in existence, rather, it is offered as a generic proposal for further discussion.

The “Business as usual” option

Under the “Business as usual” (BAU) option, it is assumed that the existing EPA SCG and NBS guidance operate without change or refinement, including professional judgment. This assumption holds true, as the EPA has not provided additional professional judgment direction or narrative since the late 1970’s, likely observing a cooperative federalism role to support and foster reviewing authority discretion. This approach has served reasonably well “as is” for the past four decades, where modeling challenges were typically met with appropriate creativity, innovation, and rigor at the level of the reviewing authority, occasionally requesting assistance or comment by EPA either through agency initiative, per request, or during a case-by-case review of various air quality permits.

The revised short-term NAAQS in the late 2000’s presented a new challenge that EPA admitted affected the ability to develop a nearby source emission inventory under traditional approaches.¹⁰⁰ To date, these concerns still exist, further burdening private and public sector SCG and NBS professional judgment. In the past several years, an emerging national Environmental Justice framework and focus on cumulative ambient air impacts, have added additional analytical complexity to the modeling task. EPA has stated that it may not be able to rely on past nearby source selection practices to meet the demands of their new priorities. The topic status is amplified further under the proposed PM_{2.5} NAAQS revisions and the new EPA Environmental Justice agenda.¹⁰¹ Given the more recent and substantial changes in federal air quality management expectations, professional judgment practice should be clarified to align with EPA and reviewing authority priorities.

Proposed generic professional judgment documentation model

It is our position that a generic “professional judgment” documentation model could be developed in support of new and evolving nearby source determination decisions, without the need for rule or formal guidance revision. The Paper offers a documentation approach to justify a final nearby source emission inventory selection, rather than a prescriptive decision-making process. A review of the professional judgment and decision-making literature on this topic varies between subject matter and profession. A deeper analysis of this body of work would be beyond the scope of analysis for this Paper.¹⁰²

The absence of a “professional judgment” definition is not likely an EPA oversight as professional judgment definitions are often unique to a given field or subject matter if they exist at all. For the purposes of this discussion, a general definition is offered. “Professional Judgment” is understood as a

¹⁰⁰ Roger Brode, PhD, “Comments on the state of nearby source selection practices and new NAAQS challenges.” In United States Environmental Protection Agency 10th Conference of Air Quality Models Day One [Transcript]. March 13, 2012: 53-54.

¹⁰¹ United States Environmental Protection Agency, *Cumulative Impacts: Recommendations for ORD research. External Review Draft*, Wenning, Richard. Washington, DC: Office of Research and Development, January 2022. See also Executive Order 13985: Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (January 20, 2021); Retrieved on April 10, 2023, from [Executive Order On Advancing Racial Equity and Support for Underserved Communities Through the Federal Government | The White House](#)

¹⁰² An excellent example of this topic is covered in work by Royce A. Francis, Marie C. Paretti, and Rachel Riedner, "Theorizing Engineering Judgment at the Intersection of Decision-Making and Identity." *Studies in Engineering Education*, 3(1), (2022): 79-98.

connection of personal knowledge and experience to a given set of conditions and information, including discursive activities, that stated generically, result in the following:¹⁰³

An objectively reasonable and impartial belief, opinion or conclusion held with confidence, and founded on appropriate professional knowledge, skills, abilities, qualifications, and competencies, after careful review, analysis and consideration of the relevant subject matter and all relevant facts and circumstances that were then known by, or reasonably available to, the person or party holding such belief, opinion, or conclusion.

The model definition places professional judgment in the practitioners' knowledge, skills, and abilities, along with the situational parameters, propelled by the underlying need for a decision to move forward under theoretical or practical conditions. Separating the theoretical from the practical can be a vexatious proposition. Writing from a medical professional judgment model, Downie and McNaughton distinguished the theoretical from the practical, provided as a working example in this Paper, explaining "A theoretical judgement is an assertion about what is probably true or correct, and a practical judgment concerns what we ought to do."¹⁰⁴ Application of the SCG and selection of a nearby source emission inventory invokes both theoretical and practical professional judgment concerns, as the subject matter is imbued with various forms of uncertainty and limited options. The challenge of professional judgment is not only the engagement with uncertainty, but in the justification and documentation of the decision. Again, Downie and McNaughton commented on this practice, explaining "there must be some evidence or some reasonable considerations determining our judgement; otherwise, it is not a judgement but a guess."¹⁰⁵ This understanding also raises the issues of options, consequences, and how they affected the final professional judgment decision.

Professional judgment, at a minimum, can be considered as an expression of common sense, intuition, and pragmatic knowledge "which can...prevail even in the face of analytical findings to the contrary."¹⁰⁶ Such decisions can be articulated within an expression of Bayesian reasoning, where a decision logic is grounded through the experience and knowledge of the professional within the defined problem space. Such decisions are not infallible, holding an adaptive or "self-correcting" potential when documented in an administrative decision and subject to revision with new information. Professional judgment is most valuable when it is expressed meaningfully within the subject matter-specific measures of credibility, validity, reliability, and ideally, not overly influenced by personal, professional, or institutional bias.¹⁰⁷ The delimiting aspect of professional judgment is that it is heavily conditioned, with a final decision made by the practitioner under the relevant conditions and personal or professional knowledge of the time. The measure of professional belief and adherence to or departure from the relevant decision factors is revealed through professional judgment documentation that becomes part of the final

¹⁰³ Reasonable Professional Judgment definition, retrieved on August 21, 2022, from

<https://www.lawinsider.com/dictionary/reasonable-professional-judgment>

¹⁰⁴ Downie, Robin, and Jane Macnaughton. "In defence of professional judgement." *Advances in Psychiatric Treatment* 15, no. 5 (2009): 322

¹⁰⁵ *Ibid.*, p. 322

¹⁰⁶ See generally, Vick, Steven G. *Degrees of belief: Subjective probability and engineering judgment*. ASCE Publications, 2002: 87.

¹⁰⁷ Evans, Handley, Over, and Perham, explained "Although intuitions based on personal belief and prior knowledge may be moderated by conscious reasoning about explicit statistics, the evidence of our experiments suggests that intuition will still tend to dominate overall." See Evans, Jonathan St BT, Simon J. Handley, David E. Over, and Nicholas Perham. "Background beliefs in Bayesian inference." *Memory & Cognition* 30, no. 2 (2002): 180.

decision record. Under the proposed documentation model, practitioners could consider, at a minimum, describing and explaining the following elements of their nearby source selection analysis through the broad documentation categories provided:

- Modeling objectives
- Modeling domain extent and facility content, along with any potential nearby source inventory selection challenges
- The quality and quantity of available nearby source facility data and information (May include ambient air quality monitoring data)
- Applicable practices, methods, and tools used to evaluate the nearby source facilities within the modeling domain
- Identification and application of the nearby source emission inventory selection decision criteria (EPA Guideline) in the final decision
- Justification of the final NBS determination (i.e., how and why)

These elements provide a structure to assist the reviewing authority in making their determination, as well as imparting a loose form of uniformity and consistency that enhances programmatic comparison of the nearby source selection task at the project level. An additional advantage is the enhanced administrative record, where opportunities for scrutiny and challenge are greater, given the new EPA Environmental Justice priorities and application of new NAAQS. Lastly, the decision elements provided reduce the potential for “decision by habit” or “personal preference” practices that act to curtail new questions posed at improving project analysis and programmatic performance through further inquiry and testing.

In sum, this proposal offers elements of a generic professional judgment documentation model, including a working definition in support of the Guideline. It is submitted for further discussion by air management professionals rather than as a proposed solution. It cannot and should not be considered as a programmatic directive or professional advice. Of particular interest is a conversation on functional and effective ways EPA can support reviewing authority professional judgment practices in their nearby source emission inventory decisions.

Question 3: Nearby source selection based on actual versus permitted emissions.

The scope and call of this question are a reaction to James Thurman’s work presented to the 2014 Regional/State/Local modeling conference held in Salt Lake City, Utah.¹⁰⁸ Thurman posed the “potential versus actual” emission inventory question relative to the initial nearby source selection activity. For the purpose of the Paper, this question is recast as:

What impact does the nearby source emission inventory characterization (actuals versus permitted emissions), prior to initial selection, have on the final nearby source emission inventory for an air quality dispersion modeling demonstration?

¹⁰⁸ Thurman, James. “Significant concentration gradient memo.” Guidance and clarification memoranda presentation. United States Environmental Protection Agency, Office of Air Quality Planning and Standards, 2014 Regional/State/Local Modelers Workshop, Salt Lake City, UT, May 21, 2014.

It is our position, based on the Guideline nearby source inventory composition and ambient air quality background expectations, that the initial nearby source emission inventory should be selected through the use of actual emissions, consistent with the actual measurement of pollutant concentration in the ambient air.¹⁰⁹ It is unclear if any reviewing authorities rely on facility permitted Potential to Emit (PTE) values¹¹⁰ in their initial nearby source emission inventory selection activities; however, given the 2014 question posed by Thurman, this Paper examines the topic to demonstrate limitations of such an approach.

In an ideal modeling scenario, all nearby source emissions would be measured and accounted for by a monitor located near the subject facility. The monitor would measure ambient air pollutant concentrations from the actual emissions of the sources surrounding the subject facility, as well as the underlying background concentrations that exist in the region. Monitors that are not near the subject facility may exclude influences of facilities' emissions located in close proximity (nearby) the subject facility, and these nearby sources will likely need to be explicitly modeled. It is for this reason that actual emissions, consistent with the Guideline language, should be used to characterize the initial nearby source data frame, as they best represent the ambient air conditions of the air quality modeling domain.¹¹¹ This is, of course, the ideal. When explicitly modeling the nearby sources, the goal is to have the contributions of those sources approximately equivalent to what a monitor located near the subject facility would measure if it existed. In practice, ambient air quality monitors are not always available within a given modeling domain, adding additional analytical challenges to the nearby source selection task.

Establishing an acceptable nearby source selection process forms the basis to test Thurman's "actual versus allowable" emission nearby source selection premise. While nearby source selection practices may vary between reviewing authorities, for the purpose of this Paper, a typical or general nearby source inventory selection and development approach would likely follow along these steps:

1. Plot of the overall nearby source facility emission data relative to the subject facility using actual emissions;
2. Selection approach applied to determine the initial nearby source emission inventory;¹¹²

¹⁰⁹ In Appendix W of 40 C.F.R. Part 51, Section 8.3.1 (2017 Guideline,) the EPA presented their "Background concentrations are essential in constructing the design concentration, or total air quality concentration, as part of a cumulative impact analysis for NAAQS and PSD increments (section 9.2.3)." Per EPA, the ambient background concentration should not include emissions from the source under review; however, it should include emissions from nearby sources that are "located in the vicinity of the source(s) under consideration for emissions limits that are not adequately represented by ambient monitoring data. Typically, sources that cause a significant concentration gradient in the vicinity of the source(s) under consideration for emissions limits are not adequately represented by background ambient monitoring." Nearby sources that align with these factors should be modeled explicitly. Given that these factors are premised in an understanding of ambient air quality impacts based on ambient air quality monitoring, the initial nearby source inventory selection analysis would rely on the actual nearby source emission inventory.

¹¹⁰ Under 40 C.F.R. 70.2 "Potential to emit" means the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is enforceable by the Administrator. This term does not alter or affect the use of this term for any other purposes under the Act, or the term "capacity factor" as used in title IV of the Act or the regulations promulgated thereunder.

¹¹¹ We address this topic in greater detail in Question 2b of this work. In short, it is not always possible to find a representative ambient air quality monitor within the modeling domain.

¹¹² The approach used to evaluate and select the initial nearby source emission inventory may vary between reviewing authorities. No attempt is made to identify a specific approach outside the three common techniques described in this Paper.

3. Review of the selected nearby source inventory to determine which facilities should be included in the final inventory given their spatial relation to the source under review and any available ambient air quality monitor relevant to the analysis;
4. Selection of the final nearby source emission inventory;
5. Characterization of the final nearby source emission inventory through an application of the nearby source permitted PTE's; and,
6. If necessary, application of the Guideline Table 8-1 or Table 8-2, to adjust the nearby source PTE's.¹¹³

For this Paper, the authors evaluated potential nearby source emission inventories in an urban modeling domain using both annual actual emissions and permitted allowable emissions to determine the size and relevance of each selection approach. Each inventory selection approach was conducted using the MNLookup tool, a regression-based approach developed from AERSCREEN to estimate 1-hour concentrations from a representative stack used to characterize the nearby source.¹¹⁴ The AERSCREEN one-hour output was scaled to a 24-hour value using a 0.60 multiplier.¹¹⁵ The entire data frame included 98 sources in an urban setting extending out to 50 km, and evaluated for both the actual annual emission and facility annual potential to emit (PTE) inventories (Both measured in tons per year (TPY)). Typically, the nearby sources selection process is focused on the facility under review as the centroid of the analysis, with the potential nearby source emission inventory surrounding the centroid to 50 kilometers, the functional AERMOD simulation boundaries.¹¹⁶ The nearby source selection results are markedly different between the two emission inventory characterization approaches. Using the reported actual annual emission inventory, 26 facilities were selected for further analysis. The selected nearby source emission inventory total increases to 98 facilities if potential annual emissions are used in the screening process. Please note that the analysis completed for this Paper was conducted for the first two steps in the six presented above. A review and comparison of the findings by emission type and distance is found in Table #2 .

¹¹³ Under 2017 Guideline Section 8.2.2 c: "Table 8–2 allows for the model user to account for actual operations in developing the emissions inputs for dispersion modeling of nearby sources, while other sources are best represented by air quality monitoring data." Similar language is provided for Table 8-1 in the same section. The tables provide greater application details to account for actual operating conditions.

¹¹⁴ The MNLookup tool was created by the Minnesota Pollution Control Agency (MPCA) as a regression-based hybrid of the Oregon ROI and New York Grad/D². This approach was employed as a matter of convenience for this work and is not an endorsement of this approach for other reviewing authorities. The North Carolina 20D approach was also applied using the same data set, with no facilities selected using the actual emission inventory and 20 facilities selected using annual PTE. The selected nearby sources facilities typically had annual PTE values greater than 100 TPY, with some exceeding 1,000 TPY.

¹¹⁵ United States Environmental Protection Agency, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised. EPA 454/R-92-019. (Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, October 1992): 4-16.

¹¹⁶ Per EPA, AERMOD has a functional simulation distance out to 50 km from the centroid of the source under review. "The EPA further revised the Guideline on November 9, 2005 (70 FR 68218), to adopt AERMOD as the preferred model for near-field dispersion of emissions for distances up to 50 km." Environmental Protection Agency *Federal Register* 82, no. 10, (January 17, 2017): 5184.

Table #2 – MNLookup Nearby Source Selection based on Actual versus Potential Emissions (TPY) by Distance (km).

Source under review to 10km (18 Sources)			
	Distance (km)	Actual (TPY)	Facility PTE (TPY)
Maximum	9.6	30.69	450.00
Minimum	1.4	0.00	6.00
Average	5.75	6.35	95.67
1st Quartile	4.125	0.09	18.00
2nd Quartile	5.9	1.98	30.00
3rd Quartile	7.675	10.34	130.00
4th Quartile	9.6	30.69	450.00
Selected Sources		5	18
Greater than 20 km (38 Sources)			
	Distance (km)	Actual (TPY)	Facility PTE (TPY)
Maximum	19.90	35.24	6,626.00
Minimum	10.60	0.00	15.00
Average	15.63	6.15	371.17
1st Quartile	13.03	0.14	42.75
2nd Quartile	16.10	2.17	88.50
3rd Quartile	18.53	9.81	279.00
4th Quartile	19.90	35.24	6,626.00
Selected Sources		9	38
Greater than 30 km (42 Sources)			
	Distance (km)	Actual (TPY)	Facility PTE (TPY)
Maximum	45.70	171.74	6,626.00
Minimum	20.40	0.00	15.00
Average	30.34	19.73	371.17
1st Quartile	23.40	0.03	42.75
2nd Quartile	29.05	1.76	88.50
3rd Quartile	35.08	17.35	279.00
4th Quartile	45.70	171.74	6,626.00
Selected Sources		12	42

The analysis did not consider meteorology or terrain. This abbreviated nearby source selection analysis explored the selection differences when PTE, rather than actual, emissions were used to conduct the evaluation. The implications for a PTE-based nearby source emission inventory selection analysis are important to acknowledge and possibly, discouraged. First and foremost, the initial nearby source emission inventory will be much larger than the actual emission-based analysis, resulting in a much larger final nearby source emission inventory. Second, the modeled results using a nearby source emission inventory selected through PTE's will most certainly be more conservative, at a minimum, and potentially present gross overestimates of modeled concentrations, potentially requiring more restrictive control and operating limits for the source under review. Lastly, given the actual emission relationship to ambient air pollutant concentration described in the Guideline, use of PTE (permitted maximum allowable emissions) for initial nearby source selection are not supported.¹¹⁷

¹¹⁷ From the 2017 Guideline, Section 8.3.1a.i. "nearby sources," EPA assumes that ambient air quality monitoring data selected for an air quality modeling demonstration should be a reasonable representation of ambient air conditions. The air quality monitoring data is relied upon to represent the nonsignificant portion of the nearby source emission inventory, which includes actual emissions from both permitted nearby facilities, along with other unpermitted emission sources. The "nonsignificant" nearby source emission component of an ambient air quality background concentration is not considered (at least initially) to impose a "significant" burden on the proposed (and existing) air quality permit conditions for the source under review. Other factors are involved if a given area is near or in NAAQS nonattainment. This section further states that nearby sources which impart a significant concentration gradient on the source under review and are not captured in an ambient air quality monitor, should be included as an explicit source within the modeling demonstration.

This does not exclude the use of PTE's to characterize the nearby source emissions in the final modeling demonstration. In fact, the Guideline recommends and supports this practice to better evaluate and calibrate the permit limits for the source under review within the cumulative operating conditions of the modeled domain.¹¹⁸ The details of this practice may vary among reviewing authorities; however, the Guideline and relevant tables should be consulted in support of this modeling demonstration step.

Question 4: Proposed EPA practice improvement efforts.

Nearly all the existing nearby source selection practices currently in use (though in various forms and iterations) were developed in the span of a few years over thirty years ago. The 2011 EPA one-hour NO₂ Memorandum offered some additional clarity around SCG application, but beyond being an occasional topic of conversation at various conferences over the past decade or so, there has been little added to the NSB or SCG practice. Given the current Guideline language, the new and proposed NAAQS, and further national interest in improving air quality dispersion modeling practices especially in designated Environmental Justice areas, this Paper poses the question:

What national administrative approaches can be applied to support nearby source emission inventory selection practice over time?

From the 2017 Guideline, the EPA determined that there was no need to add further clarity on this topic; however, it has remained an ongoing modeling conversation for EPA and many states. The current options available are to continue on the current practice without modification, referred to previously as the "Business as Usual" option, with two change options: Formal language revision to the Guideline; or an EPA-sponsored "Best Practices" workgroup and publication.

The "Business as Usual" option

The "Business as Usual" (BAU) option is a relevant point of reference for comparing the two change options identified previously (Guideline language revision, or the "best practices" work group). The BAU for this discussion is characterized as following the current Guideline without modification or intentional support from additional nearby source selection documentation. In essence, the current body of information offered through the existing Guideline and adjunct resources is sufficient to meet all reviewing authority needs on this topic. The BAU accounts for the frequency of various ambient air quality standard modifications since 1977 and program-related permitting details (e.g., regulation changes, etc.) that have the potential to affect air quality dispersion modeling practices, including the selection of a nearby source emission inventory.

The Guideline modification options proposed are a reaction to a change in the underlying status quo conditions that have supported the BAU for over four decades. Given the technical nature of the practice, the potential for newer and more stringent NAAQS, and the ongoing work to improve air quality conditions in designated Environmental Justice areas, the existing SCG and NSB practices will be burdened with even greater expectations, beyond the role and capacity of the current Guideline version.

¹¹⁸ Following the same section cited above (2017 Guideline, Section 8.3.1a.i.) EPA states "The ambient contributions from these nearby sources are thereby accounted for by explicitly modeling their emissions (section 8.2)." This is a reference to more explicit characterization of the source under review and the nearby source inventory selected through a significance determination. From 2017 Guideline, Section 8.2.2.c. EPA clarifies their expectations for a cumulative NAAQS analysis: "The new or modifying stationary point source shall be modeled with 'allowable' emissions in the regulatory dispersion modeling. As part of a cumulative impact analysis, Table 8-2 allows for the model user to account for actual operations in developing the emissions inputs for dispersion modeling of nearby sources, while other sources are best represented by air quality monitoring data."

The increase in public attention and policy direction on cumulative levels and effects or impacts analysis is a factor that is significantly different from the past four decades and places the NSB activity under new scrutiny. Simple clarification and related guidance documents will not sufficiently address the fundamental issues described in this Paper. Given the dynamic nature of the topic and fragmented status of existing SCG and NBS practices, it is in the best interest of EPA and reviewing authorities pursue a more thoughtful approach to manage ongoing progress.

Formal guideline revision option

A possible change option is a formal revision of Guideline Section 8.3.3 language. This activity typically revolves around the EPA-sponsored Modeling Conferences. The Guideline is managed through the Federal Administrative Procedure Act, subject to notice and comment rulemaking. As provided in the Guideline history section in this Paper, EPA has modified nearby source language over the years, with one of the more active sessions occurring during the 2017 Guideline cycle. Despite the intense interest to change NSB-related language, the EPA maintained their position in providing for discretion and flexibility over prescriptive language and practice. Given the current state of the Guideline in the midst of regulatory change and public interest, a language change could be useful; however, it is unclear how this might appear, as the nature of the questions raised would likely be too extensive to absorb in a single guidance document. Aside from cost and controversy, administration of an overly prescriptive federal guidance reduces creativity and potentially constrains the use of new and functional alternatives. In this sense, prescriptive language is less desirable.

National work group and publication

A second option is the creation of a work group tasked with suggesting reasonable nearby source selection practices, consistent with the Guideline through a non-regulatory publication (meaning a document that would operate outside the need for formal APA processes). The EPA and many states have had success in managing complex and emerging technical tasks through the work group format, often resulting in a catalogue of “best practices” that offer credible ways to generate technical evidence in support of a regulatory decision. The SCG and NSB topics appear to be fit subjects for this form of development. The rationale of this effort relies on the following assumptions:

- Most effective when SCG and NSB practices are built on what is already known and accepted;
- Regularly scheduled “best practices” review and updating support ongoing calibration and refinement grounded in actual practice;
- A clearer understanding of how modelers can apply aspects and variations of the SCG and NSB on a case-by-case basis; and,
- Providing a model framework for developing professional judgment narratives that greater assists reviewing authorities.

Ideally, the workgroup would be established and led by the EPA and coordinated around the designated Conferences on Air Modeling. The nearby source selection practices would be a resource for reviewing authorities to consider during unique projects or program development activities, rather than prescriptive actions that require strict observance. This approach also provides a cycle of ongoing calibration through regularly scheduled review, revision, and publication. This approach is the preferred option of this Paper.

Conclusions and recommendations

This Paper was created in response to an ongoing need to improve the nearby source selection practice for cumulative NAAQS air dispersion modeling. Outside of the Guideline, and several EPA-related clarification documents, there is little information or expectation to guide the ongoing evolution, curation, and improvement of the practice. In the forty or more years since the Guideline was developed, the SCG and NBS practices have remained largely the same. Changing ambient standards and public expectation present new challenges to the SCG and NBS, requiring a more thoughtful pursuit of progress in the field. From the examination of the four Policy and Practice Questions, we offer the following recommendations for further discussion and consideration:

1. Sufficiency of EPA Guideline Language.

Short Answer: The current Guideline provides conceptual language without details or expectations to aid application. This is particularly so with the significant concentration gradient construct. Other terms, such as professional judgment, lack definition or clarification, and further reduce Guideline language potency.

Recommendation: A more predictable and functional nearby source selection outcome can be strengthened through further language clarification and case study examples. This work should be developed outside the Guideline.

2. Content and limit of the Significant Concentration Gradient (SCG) construct

a. How is significance determined in practice?

Short Answer: Over the past four decades, a variety of approaches have been developed and applied to approximate the significant concentration gradient without providing a definition of the term or an explanation of why the approach is consistent with EPA's Guideline language. While many of these approaches may indeed be sufficient for their intended purpose, further work is needed to align these practices more realistically with the "significance" term and EPA expectation.

Recommendation: The most efficient and effective support EPA can provide reviewing authorities on this topic is the publication of a "significance" definition, along with selection rubrics and case studies to support this work.

b. Can the SCG be applied in the absence of a local ambient air quality monitor?

Short Answer: The SCG, as presented through traditional EPA methods, can likely be applied within most modeling domains, when an ambient air quality monitor is absent; however, this decision will sacrifice the ability to omit selected nearby sources through local ambient air quality monitoring, as the surrogate monitor does not measure the ambient pollutant concentrations within the domain modeled. While this practice is likely observed in many jurisdictions, case studies or examples were not available for this work.

Recommendation: This situation is common, with many reviewing authorities providing general nearby source direction to the consulting and permitted community on this topic. Ideally, a generalized understanding of this approach could be documented to further dispel ambiguity and support ongoing program development efforts.

c. How is “professional judgment” established and applied under the Guideline?

Short Answer: Two approaches were considered during this review: The “do nothing” or “business as usual” which is the current EPA status quo practice; and, development of a model or generic professional judgment scheme that supports air quality modeling professionals nearby source selection (and perhaps other air quality modeling decisions).

Recommendation: Develop, with support by reviewing authorities, a generic professional judgment model that supports air quality modeling needs.

3. Nearby Source Selection based on Actual versus Permitted Emissions.

Short Answer: Permitted allowable emissions should not be used in the initial selection of a nearby source inventory. This conclusion is based on empirical evaluation and the existing Guideline language.

Recommendation: EPA can resolve the actual versus permitted allowable emission inventory issue through a clarification memorandum or similar language in a larger interpretative work.

4. Proposed EPA Practice Improvement Efforts.

Short Answer: Three approaches were considered in this Paper: Do nothing and allow the current status quo practices; A formal language change in the Guideline; and, a “Best Practices” informal guidance developed through an EPA workgroup. The “Best Practices” approach was considered superior to the other options considered due to the adaptive nature of the process and non-regulatory stature.

Recommendation: The most technically feasible and administratively nimble approach is an EPA-managed Significant Concentration Gradient/Nearby Source Selection “Best Practices” document outside of the Guideline. This document and related workgroup would focus on both nearby source selection practices and nearby source characterization efforts under the Table 8-1 and Table 8-2 Guideline language.

APPENDIX A

Significant Concentration and Nearby Source Selection and Characterization Guideline Language

The 2003 Guidance provided further Section 9.2.3 refinement (Recommendations [Multi-Source Areas]):¹¹⁹

- a. In multi-source areas, two components of background should be determined: Contributions from nearby sources and contributions from other sources.
- b. Nearby Sources: All sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled. The number of such sources is expected to be small except in unusual situations. Owing to both the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources, no attempt is made here to comprehensively define this term. Rather, identification of nearby sources calls for the exercise of professional judgement by the appropriate reviewing authority (paragraph 3.0(b)). This guidance is not intended to alter the exercise of that judgement or to comprehensively define which sources are nearby sources.
- c. For compliance with the short-term and annual ambient standards, the nearby sources as well as the primary source(s) should be evaluated using an appropriate Appendix A model with the emission input data shown in Table 9–1 or 9–2. When modeling a nearby source that does not have a permit and the emission limit contained in the SIP for a particular source category is greater than the emissions possible given the source’s maximum physical capacity to emit, the “maximum allowable emission limit” for such a nearby source may be calculated as the emission rate representative of the nearby source’s maximum physical capacity to emit, considering its design specifications and allowable fuels and process materials. However, the burden is on the permit applicant to sufficiently document what the maximum physical capacity to emit is for such a nearby source.
- d. It is appropriate to model nearby sources only during those times when they, by their nature, operate at the same time as the primary source(s) being modeled. Where a primary source believes that a nearby source does not, by its nature, operate at the same time as the primary source being modeled, the burden is on the primary source to demonstrate to the satisfaction of the appropriate reviewing authority (paragraph 3.0(b)) that this is, in fact, the case. Whether or not the primary source has adequately demonstrated that fact is a matter of professional judgement left to the discretion of the appropriate reviewing authority. The following examples illustrate two cases in which a nearby source may be shown not to operate at the same time as the primary source(s) being modeled. Some sources are only used during certain seasons of the year. Those sources would not be modeled as nearby sources during times in which they do not operate. Similarly, emergency backup generators that never operate simultaneously with the sources that they back up would not be modeled as nearby sources. To reiterate, in these examples and other appropriate cases, the burden is on the primary source being modeled to make the appropriate demonstration to the satisfaction of the appropriate reviewing authority.
- e. The impact of the nearby sources should be examined at locations where interactions between the plume of the point source under consideration and those of

¹¹⁹ Environmental Protection Agency *Federal Register* 68, no. 72 (April 15, 2003): 18464.

nearby sources (plus natural background) can occur. Significant locations include: (1) The area of maximum impact of the point source; (2) the area of maximum impact of nearby sources; and (3) the area where all sources combine to cause maximum impact. These locations may be identified through trial-and-error analyses.

f. Other Sources: That portion of the background attributable to all other sources (e.g., natural sources, minor sources and distant major sources) should be determined by the procedures found in subsection 9.2.2 or by application of a model using Table 9–1 or 9–2.

2017

8.3.3 Recommendations for Multi-Source Areas

a. In multi-source areas, determining the appropriate background concentration involves: (1) Identification and characterization of contributions from nearby sources through explicit modeling, and (2) characterization of contributions from other sources through adequately representative ambient monitoring data. A key point here is the interconnectedness of each component in that the question of which nearby sources to include in the cumulative modeling is inextricably linked to the question of what the ambient monitoring data represents within the project area.

b. Nearby sources: All sources in the vicinity of the source(s) under consideration for emissions limits that are not adequately represented by ambient monitoring data should be explicitly modeled. Since an ambient monitor is limited to characterizing air quality at a fixed location, sources that cause a significant concentration gradient in the vicinity of the source(s) under consideration for emissions limits are not likely to be adequately characterized by the monitored data due to the high degree of variability of the source's impact.

i. The pattern of concentration gradients can vary significantly based on the averaging period being assessed. In general, concentration gradients will be smaller and more spatially uniform for annual averages than for short-term averages, especially for hourly averages. The spatial distribution of annual impacts around a source will often have a single peak downwind of the source based on the prevailing wind direction, except in cases where terrain or other geographic effects are important. By contrast, the spatial distribution of peak short-term impacts will typically show several localized concentration peaks with more significant gradient.

ii. Concentration gradients associated with a particular source will generally be largest between that source's location and the distance to the maximum ground-level concentrations from that source. Beyond the maximum impact distance, concentration gradients will generally be much smaller and more spatially uniform. Thus, the magnitude of a concentration gradient will be greatest in the proximity of the source and will generally not be significant at distances greater than 10 times the height of the stack(s) at that source without consideration of terrain influences.

iii. The number of nearby sources to be explicitly modeled in the air quality analysis is expected to be few except in unusual situations. In most cases, the few nearby sources will be located within the first 10 to 20 km from the source(s) under consideration. Owing to both the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources, no attempt is made here to comprehensively define a "significant concentration

gradient.” Rather, identification of nearby sources calls for the exercise of professional judgment by the appropriate reviewing authority (paragraph 3.0(b)). This guidance is not intended to alter the exercise of that judgment or to comprehensively prescribe which sources should be included as nearby sources.

c. For cumulative impact analyses of short term and annual ambient standards, the nearby sources as well as the project source(s) must be evaluated using an appropriate appendix A model or approved alternative model with the emission input data shown in Table 8–1 or 8–2.

i. When modeling a nearby source that does not have a permit and the emissions limits contained in the SIP for a particular source category is greater than the emissions possible given the source’s maximum physical capacity to emit, the “maximum allowable emissions limit” for such a nearby source may be calculated as the emissions rate representative of the nearby source’s maximum physical capacity to emit, considering its design specifications and allowable fuels and process materials. However, the burden is on the permit applicant to sufficiently document what the maximum physical capacity to emit is for such a nearby source.

ii. It is appropriate to model nearby sources only during those times when they, by their nature, operate at the same time as the primary source(s) or could have impact on the averaging period of concern. Accordingly, it is not necessary to model impacts of a nearby source that does not, by its nature, operate at the same time as the primary source or could have impact on the averaging period of concern, regardless of an identified significant concentration gradient from the nearby source. The burden is on the permit applicant to adequately justify the exclusion of nearby sources to the satisfaction of the appropriate reviewing authority (paragraph 3.0(b)). The following examples illustrate two cases in which a nearby source may be shown not to operate at the same time as the primary source(s) being modeled: (1) Seasonal sources (only used during certain seasons of the year). Such sources would not be modeled as nearby sources during times in which they do not operate; and (2) Emergency backup generators, to the extent that they do not operate simultaneously with the sources that they back up. Such emergency equipment would not be modeled as nearby sources.

d. Other sources. That portion of the background attributable to all other sources (e.g., natural sources, minor and distant major sources) should be accounted for through use of ambient monitoring data and determined by the procedures found in section 8.3.2 in keeping with eliminating or reducing the source-oriented impacts from nearby sources to avoid potential double counting of modeled and monitored contributions.