



February 4, 2011

MEMORANDUM

SUBJECT: Transmittal of *Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen and Sulfur* – Final Document

FROM: Lydia N. Wegman, Director /s/
Health and Environmental Impacts Division
Office of Air Quality Planning and Standards

TO: Holly Stallworth
Designated Federal Officer
Clean Air Scientific Advisory Committee
EPA Science Advisory Board Staff Office

Attached is the final document, *Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen and Sulfur* (Policy Assessment), prepared by the Environmental Protection Agency's (EPA) Office of Air Quality Planning and Standards (OAQPS) staff as part of EPA's ongoing review of the secondary national ambient air quality standards (NAAQS) for oxides of nitrogen and oxides of sulfur. An earlier version of this document – the January 14, 2011 version – was made available to the Clean Air Scientific Advisory Committee (CASAC) Oxides of Nitrogen and Sulfur Secondary NAAQS Review Panel (the Panel) prior to final document production to provide sufficient time for the Panel to consider a final Policy Assessment in advance of the Panel meeting scheduled for February 15-16, 2011. The CASAC requested the upcoming meeting (Russell and Samet, 2010) so as to develop CASAC recommendations on key elements of the NAAQS for oxides of nitrogen and sulfur based on a final, more complete Policy Assessment than the second draft Policy Assessment that the Panel reviewed in October 2010.

Since I conveyed the earlier version of the Policy Assessment to the Panel (Wegman memorandum, January 18, 2011), we have completed document production, including final reference checks and document formatting. This final Policy Assessment, like the January 14, 2011 version, presents staff analyses and conclusions relevant to EPA's review of the secondary (welfare-based) standards for oxides of nitrogen and sulfur. It reflects consideration of, and is responsive to, comments from the Panel (Russell and Samet, 2010), as well as public comments, on the second draft Policy Assessment. Attachment 1 presents a broader discussion of changes made to the second draft Policy Assessment than was included with my earlier memo. The attachment also notes the following minor changes that have been made relative to the January 14, 2011 version: modified Figure 2-32; expanded discussion of the range of effects related to nutrient enrichment in section 6.3.2; added ecoregion-level water quality data to Appendix C; and expanded discussion of future research and data collection (Appendix F, section F.5).

This final Policy Assessment is being made available to the Panel in the form of the attached electronic files, one for the main body of the document and the other for the appendices, which we request that you forward to members of the Panel. This document is also available on the same EPA website as the earlier version: http://www.epa.gov/ttn/naaqs/standards/no2so2sec/cr_pa.html. Printed copies of this document will be sent to members of the Panel via Federal Express.

As I expressed previously, we appreciate the effort that the Panel has made in reviewing draft documents in conjunction with our review of the secondary NAAQS for oxides of nitrogen and sulfur, and welcome further comment and advice from the Panel on the key elements of the NAAQS. We look forward to the Panel's discussion at its upcoming meeting in February. Should you have any questions regarding this document, please contact Dr. Rich Scheffe (919-541-4650; email scheffe.rich@epa.gov).

cc: Vanessa Vu, SAB/OA
Rosalina Rodriguez, OAQPS/OAR
Karen Martin, OAQPS/ OAR
Rich Scheffe, OAQPS/OAR
Ginger Tennant, OAQPS/OAR
Randy Waite, OAQPS/OAR
John Vandenberg, ORD/NCEA-RTP
Debra Walsh, ORD/NCEA-RTP
Doug Johns, ORD/NCEA-RTP
Tara Greaver, ORD/NCEA-RTP

Attachment 1

Staff Responses to CASAC Comments on the second draft *Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen and Sulfur*

Changes made in the final Policy Assessment in response to the CASAC Panel's comments on the second draft Policy Assessment are summarized below by chapter. We also note major organizational changes made in the document to eliminate redundancy and improve the logical flow of information presented. Further, we note a few minor changes made to the January 14, 2011 version of this document beyond formatting, referencing, and editorial changes.

Organizational changes include:

- A new technical chapter (chapter 2) has been added, covering emissions, air quality monitoring networks and modeling, deposition, water chemistry and ecosystem modeling, and trends of each component (emissions, air, water).
- A new integrated policy chapter (chapter 7) has added that addresses all the elements of a new multi-pollutant, multi-media standard for aquatic acidification (indicators, form, averaging time and level), implications of alternative levels and forms, uncertainties associated with individual and combined components of such a standard, and staff conclusions regarding these elements. This chapter integrates and replaces chapters 5 and 9 of the second draft Policy Assessment.
- An expanded uncertainty analysis is now presented in Appendices F and G, building on and replacing the analyses that were presented in chapter 7 of the second draft Policy Assessment.
- Additional Appendices have been added to provide detailed information on spatial aggregation (Appendix C), the implications of alternative standards (Appendix D), and additional analysis of alternative indicators of oxides of nitrogen (Appendix E).

Executive Summary and Chapter 1 – *Introduction*

These sections have been shortened substantially and focused on the key policy-relevant questions and issues, consistent with the framework used to organize the information presented throughout this final document.

Chapter 2 -- *Characterizing Emissions, Air Quality, Deposition, and Water Quality*

This new chapter was developed to consolidate much of the underlying technical information that is relied on to develop the policy discussion in chapter 7. This chapter includes many of the technical discussions, maps and tables that were in chapters 2, 4 and 8 of the second draft Policy Assessment. Figure 2-32 (Figure 3-2.12 in the second draft document) has been modified by adding a panel showing relative changes in concentrations and deposition and revising the figure caption and legends accordingly. New material, some of which was extracted from the Risk and Exposure Assessment and the Integrated Science Assessment, was added to address water chemistry and trends of emissions, air concentrations, deposition and water quality. Much

of the content in chapter 2 is presented in the context of how this information relates to specific aspects of developing the standard in chapter 7.

A generalized trends analysis that combines time series of emissions, air quality, deposition, and water quality is provided in section 2.5 of chapter 2. While this trends analysis is not an explicit reconstruction of historical values of the aquatic acidification index (AAI), it does demonstrate that the directional responses across all of these components are consistent with the structure of the form of the standard presented in this final Policy Assessment. We would expect a retrospective analysis to exhibit a pattern of response similar to the prospective analysis that has been included in chapter 7, as described below. We explored ways of reconstructing historical AAI values, although the lack of both observed and modeled data bases precluded such a study.

Chapter 3 – *Known of Anticipated Ecological Effects*

No major changes were made to this chapter other than to move some of the material on ecosystem modeling to the new chapter 2 and to add material on biological effects that had been in chapter 5 of the second draft document. Both of these changes were made to consolidate biological effects into one chapter and reduce redundancy. Some editing was done to improve the logical presentation of the material, remove redundancy, and add citations as appropriate.

Chapter 4 – *Considerations of Adversity to Public Welfare*

In response to comments on this chapter, we added an explanation of non-linear values in the aquatic acidification section and included more emphasis on nonuse (existence), preservation and bequest values. For terrestrial acidification values, we included actual survey values for existence and bequest values as well as a discussion explaining why the model results for provisioning services were smaller than the values for recreational and other uses. Also, we added more discussion of the beneficial effects of nitrogen, including potential effects on carbon sequestration, as well as more explanation of climate regulating services by ecosystems.

Chapter 5 – *Co-Protection for Other Effects Potentially Afforded by an Aquatic Acidification Standard*

Revisions to this chapter mostly included editorial corrections and clarifications.

Chapter 6 – *Addressing the Adequacy of the Current Standards*

In response to comments on this chapter, section 6.3.2 has been revised to be more inclusive of the range of effects nutrient enrichment can have on ecosystems. We note that changes to this section were inadvertently left out of the January 14, 2011 version of the document, but have been included in this final Policy Assessment.

Chapter 7 -- *Consideration of Alternative Standards for Aquatic Acidification*

Chapter 7 serves as the policy chapter, effectively replacing chapters 5 and 9 of the second draft Policy Assessment. This new policy chapter provides the rationale underlying staff's conclusions on each element of the standard, building from a more simplified conceptual model to a full expression of the standard. Calculations are provided to demonstrate how the standard would be

applied and to provide estimates of areas likely not to meet alternative standards, defined in terms of alternative levels and alternative percentiles that are an integral part of the specification of the form of the standard.

Spatial aggregation methodology is discussed as part of the discussion of the form of the standard (section 7.2.5), with a focus on Omernik ecoregion Level III categorization, which is used for defining several of the water quality and atmospheric variables incorporated in the standard. Extensive background information on the Omernik level III ecoregions is provided in a new Appendix C. We note that water quality data have been added for each such ecoregion beyond the information presented in the January 14, 2011 version of Appendix C.

We have conducted a prospective analysis of the behavior of the standard, as discussed in section 7.5 and more fully presented in Appendix D. This analysis includes calculated AAI values based on both 2005 current conditions and an emissions sensitivity run with significant reductions of oxides of nitrogen and sulfur used as proxies for potential future conditions. We interpret the results of the prospective calculations as demonstrating expected and interpretable behavior of the standard.

To facilitate the flow across the sections within this chapter addressing individual elements of the standard, many of the details regarding model assumptions and derivations are appended, and much of the effects discussion relevant to establishing a range of ANC levels for consideration that had been in the previous chapter 5 was moved to chapter 3.

Overall, this new integrated chapter addresses comments related to clarifying the description of spatial aggregation as well as clarifying how it all elements of the standard work together. Greater clarity describing the linkage of all elements of the standard is enabled by moving much of the underlying technical information to chapters 2 and 3.

Appendix F – *Evaluation of Variability, Sensitivity, and Uncertainty in the Acidification Index*

With regard to comments related to further evaluation of the stability of the *transference ratios*, we have done additional analyses, which are presented in Appendix F and discussed in section 7.6 of chapter 7. Previously, we reported on the spatial and temporal variability of transference ratios based on the spatial variability across 12 km grid cells in the Adirondacks and Shenandoah areas, as well as the sensitivity to major reductions in emissions of nitrogen and sulfur oxides. For this final Policy Assessment, we added three additional analyses of the transference ratios that are included in Appendix F. These include a comparison of CMAQ 12 km and 36 km generated transference ratios, transference ratios generated by the Canadian AURAMS model, and construction of transference ratios based on combining observations of wet deposition, ambient air concentrations from CASTNET, and dry deposition using the CASTNET dry deposition model. We were not able to perform a chemical mechanism sensitivity analysis that held all modeled platform attributes the same other than the chemical mechanism. We currently plan to continue probing the behavior of transference ratios both through modeled sensitivity studies as well as through constructing observation-based ratios.

With regard to comments related to further *CMAQ evaluation and improvement*, we have conducted comparisons of CMAQ-predicted SO₂ with observed SO₂ at rural SEARCH sites; these results were added to Appendix F. The most relevant model improvement steps for CMAQ with regard to deposition also are listed in Appendix F. These include adoption of PRISM-

adjusted precipitation, bi-directional ammonia flux, and addition of lightning-generated nitrogen oxides. Further, a planned dry deposition flux study for nitrogen and sulfur will provide a more rigorous observational basis for evaluating the deposition schemes in CMAQ. Collectively, these tasks, as well as related model improvement efforts in chemical mechanism development and emissions and meteorological processing, are all intended to enhance the underlying scientific foundation of CMAQ and reduce biases of model estimates relative to observations.

With regard to comments on future research areas, we have expanded the discussion in Appendix F (section F.5) to incorporate additional areas suggested by the Panel that should be considered for future research and data collection. We note that this expanded discussion was not included in the January 14, 2011 version of this document.

Appendix G – Cumulative Uncertainty Analysis

A cumulative uncertainty analysis was developed in response to comments recommending a comprehensive quantitative analysis of uncertainties of all components of the standard. This analysis is included in Appendix G. Staff designed and performed a Monte Carlo-style analysis to assess the cumulative effects of uncertainty in the AAI equation. This analysis included bootstrap analyses to generate uncertainty distributions for the main components of the AAI (Neco, NH_x, T_{NO_y}, T_{SO_x}, and CL, which includes BCo and Q). To assess the cumulative effect of the uncertainty, the results of the bootstrap analyses were randomly sampled to generate repeated AAI trade-off curves. The results of these analyses were illustrated graphically, including estimates of 95% confidence intervals.