Comments on the U. S. EPA August 2011 Draft Near-Road NO_2 Technical Assistance Document (TAD)

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In February 2010, EPA established a new primary (health-based) 1-hour nitrogen dioxide (NO_2) standard and retained the current primary annual standard.[1] EPA also promulgated new minimum monitoring requirements for the NO_2 monitoring network in support of the new 1-hour NO_2 standard. State and local agencies are required to install near-road NO_2 monitors at locations within 50 meters of heavily travelled roadways in the largest urban areas. A Technical Assistance Document (TAD) is being developed to provide guidance for state and local agencies in implementing the required near-road NO_2 stations. It includes guidance with regard to both NO_2 and multi-pollutant monitoring near roadways. The EPA released the August 2011 draft TAD[2] for review by the Clean Air Scientific Advisory Committee (CASAC) Ambient Monitoring and Methods Subcommittee (AMMS), along with the ambient air monitoring and transportation agency communities. The AMMS has drafted a response letter[3] that will be discussed with the full CASAC in a January 27, 2012 teleconference.

Air Improvement Resource, Inc. (AIR) reviewed the draft TAD and draft CASAC response and believes that Alliance input into the process is important. First, the near-road NO_2 monitoring program will set the precedent for how EPA and the states will approach near-road monitoring for CO (which was mandated in the August 31, 2011 NAAQS final rule[4]) and other pollutants in the future. EPA requires the NO_2 and CO monitors to be co-located unless an alternate location for the CO monitor is approved by the EPA Regional Administrator.

Second, many state and local agencies raised similar points to those the Alliance raised with regard to the EPA's NO_2 proposal. These include the need to measure in locations where there is population exposure, the difficulty of defining an appropriate nonattainment area if the standard is exceeded at a microscale site, and the problems of developing a State Implementation Plan when the federal motor vehicle control program is likely controlling.

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[1] 75 Federal Register 6501, February 9, 2010.
[2] U. S. Environmental Protection Agency, Near-road NO_2 Monitoring Technical Assistance Document, August 11, 2011 draft.
[3] October 27, 2011 draft CASAC letter from Drs. Russell and Samet to Administrator Jackson.
[4] 76 Federal Register 54294, August 31, 2011.

Third, CASAC in September 2009 was split with regard to the need for the two-tier monitoring program that was subsequently promulgated for NO_2. A substantial number of CASAC panelists supported the development of a special-purpose monitoring network oriented towards roadside monitoring that is not used for attainment purposes at this point but for research.

Finally, the draft CASAC-AMMS letter that includes the comments of individual members raises many concerns similar to those raised by the Alliance in its September 2009 comments on the NO_2 proposal.[5] With these concerns in mind, AIR offers the following comments on the draft TAD and on EPA's planned use of near-road monitoring data.

Population Exposure Should be a Prime Consideration in Siting Near-Road Monitors

Any near-roadway monitoring should be carried out in locations where there is population exposure. Sites in the right-of-way of restricted access freeways should not be allowed since EPA regulations[6] define ambient air as "that portion of the atmosphere, external to buildings, to which the general public has access." Within that general definition, ambient air quality has become known to mean air quality as measured at a location that is representative of exposures to the general public. While the TAD refers to population exposure as a secondary consideration, it makes no sense to trigger non-attainment using measurements from a location where there is no exposure to the general public. Several CASAC Panelists and State Agencies raise the same issue and concern. For example, comments by the New York Department of Health indicated that the focus of the monitoring network should not necessarily be to measure maximum ambient levels of NO_2, but to measure levels that are relevant to human exposure (i.e., in areas where people are likely to be exposed).[7]

While the TAD refers to Baldauf et al. (2009)[8] to support its guidance to place monitor probes within 20 meters of the roadway, this is a misreading and misinterpretation of what Baldauf et al. recommend. The TAD indicates:[9]

> Baldauf et al. (2009) note that a distance of 10 to 20 meters should be considered for near-roadway monitoring, and as such, the EPA strongly encourages state and

[5] Comments of The Alliance of Automobile Manufacturers, Primary National Ambient Air Quality Standard for Nitrogen Dioxide; Proposed Rule, Docket No. EPA-HQ-OAR-2006-0922-0347, September 14, 2009.
[6] 40 CFR Chapter 1, Part 50.1 (e).
[7] September 11, 2009 New York Department of Health comments to Docket No. EPA-HQ-OAR-2006-0922, at 5.
[8] R. Baldauf, N. Watkins, D. Heist, C. Bailey, P. Rowley, and R. Shores, "Near-road air quality monitoring: Factors affecting network design and interpretation of data," *Air Qual. Atmos. Health*, 2, 1–9 (2009).
[9] TAD, supra note 2, at 7-1.

> local agencies to try to place near-road NO_2 monitor probes within 20 meters from target road segments when possible.

In actuality, Baldauf et al. recommend multiple monitoring sites with the highest density within the first 100 meters. They then go on to indicate that "If resource limitations prevent the establishment of multiple monitoring sites" which is the case under consideration in the TAD, "a distance most representative of population exposures may be more appropriate." Thus, Baldauf et al. actually recommend population exposure as the most appropriate factor in choosing the distance from the road.

Baldauf et al. go on to indicate:

> A minimum distance of 10–20 m from the road should be considered in order to minimize the influence of vehicle-induced turbulence on the concentration variability of pollutant measurements.

EPA misinterprets the intent of this statement. Since vehicles produce mechanical turbulence that impacts dispersion, all Baldauf et al. are indicating is that if you want to minimize that influence, you need to be at least 10 to 20 meters away from the road. EPA turns that around to suggest that Baldauf et al. recommend that States monitor within 20 meters of the road. If anything, based on Baldauf et al., the EPA recommendation should be to measure at least 20 meters away from the road. In reality, there is no reason to minimize or even consider the influence of mechanical turbulence in choosing monitoring locations to protect public health. The human exposures are whatever they are and the appropriate distance should be chosen based on that most representative of population exposure in the given situation.

The Focus on Placing the Monitor as Close as Possible to the Edge of the Roadway in the TAD is Misguided.

As note above, the draft EPA guidance to locate the monitor as close as possible to the roadway is based on a misreading of the Baldauf et al. (2009) recommendations. With regard to whether the population exposed in the near-road environment experiences the maximum NO_2 exposures, there is substantial evidence to the contrary.

In addition to direct emissions of NO_2 and its dispersion downwind, there are other chemical processes that lead to NO_2 formation and removal. One is titration of ambient ozone with NO in the near-road environment. However, NO_2 also quickly photolyzes to reform NO and ultimately ozone. A CASAC-AMMS panelist described the influence of this process in the near-road environment in November 2010 Comments,[10] noting that the gradient of NO_2 away from a roadway is different from that of a primary pollutant.

There is also a longer-term photochemical formation of NO_2 that takes on the order of

[10] November 24, 2010 CASAC letter from Drs. Russell and Samet to Administrator Jackson, EPA-CASAC-11-001, at 83-88.

hours without consuming ozone. Thus, the maximum NO_2 need not occur near the source. The Alliance provided an analysis of NO_2 monitoring data as a function of the distance from the nearest roadway in its September 2009 comments on the NO_2 proposal that showed this to be the case.[11] In addition, the State of California comments[12] on the proposed rule indicated that, based on the experience with over 100 statewide NO_2 monitors and extensive near roadway studies, determining the location of maximum NO_2 is not straightforward. Therefore, California suggested a phase-in approach of deploying a more limited set of monitors and then evaluating the results to aid in network design.

A CASAC Panelist from California also noted in the November 2010 CASAC letter[13] that California has had a one-hour standard for NO_2 for several decades and studied peak levels and trends throughout the State concluding that current peak locations in California are in intermediate downwind areas (e.g., eastern border of Los Angeles County) where photochemical conversion (and not just immediate ozone titration) has taken place, not in the source areas. Finally, the October 2011 CASAC draft also notes that "near-road NO_2 is not necessarily highest under the most stagnant conditions, nor is it necessarily highest close to the roadway."[14]

Before the TAD is Finalized, the Results of the EPA Pilot Study Should be Made Available to CASAC and the Public

Although EPA is carrying out a Pilot Study to inform monitor placement and network design, no results from the Pilot Study are available yet or discussed in the TAD. CASAC provided comments to the Agency on the planned Pilot Study in November 2010.[15] The result from the Pilot study must be folded into the final TAD. Because of the numerous complex issues involved in establishing a new network of near-road sites, the results of the Pilot Study should be reviewed by both CASAC and interested parties (state and local air pollution agencies, transportation agencies, and the public). It makes no sense to conduct a Pilot Study and not use the results to inform the site selection and setup process.

In its November 2010 letter to Administrator Jackson, CASAC indicated:[16]

> As a general matter, CASAC is deeply concerned about the timing proposed for the current network deployment, as well as for the Pilot Study. The revised NO_2 NAAQS, issued on February 9, 2010, mandates that state and local air monitoring agencies deploy the near-road network by January 1, 2013. This ambitious schedule may make it difficult to absorb lessons learned from EPA's Pilot Study to evaluate and improve the siting and monitoring process. If possible, given this

[11] Alliance comments, supra note 5, at pp. 3-11.
[12] September 14, 2009 letter from the California Environmental Protection Agency to Administrator Jackson, Docket No. EPA-HQ-OAR-2006-0922.
[13] November 2010 CASAC letter, supra note 9, at 29.
[14] Draft CASAC letter, supra note 3, at 6.
[15] November 2010 CASAC letter, supra note 9.
[16] Ibid, at iii.

> mandated date of deployment, EPA might consider deploying the network in stages over time, e.g., 10-20 sites the first year, 20-40 the next and the rest in the final year.

CASAC also indicated:

> We are concerned that the current time frame for the NO_2 near-road network may not allow adequate time to appropriately plan and execute the Pilot Study and then to interpret and use the resulting findings in designing the near-road network. The decisions that will be made have broad implications related not only to NO_2, but to other criteria pollutants and the characterization of multiple-pollutant exposures from roadway sources.

Given these concerns and the fact that the results of the Pilot Study are still not available, we urge CASAC to reiterate these concerns in the current letter.

The Ramifications of the New 1-Hour Standard and Near-Road Monitoring Go Well Beyond Roadway Emissions

By setting a new 1-hour standard, EPA initiated a number of required actions under the Clean Air Act. By establishing a new monitoring network at the same time, EPA has set up a situation that may have important unintended consequences. For example, the NO_2 final rule indicates that EPA will make classification decisions regarding the 1-hour standard within two years as required by the Act. Since the new roadway monitors will not be in place and will not have accumulated sufficient data, EPA plans on making the initial attainment designations based on the existing monitors. Thus, the final rule indicates that EPA intends to promulgate initial NO_2 designations by January 2012 (2 years after promulgation of the revised NAAQS). The rule indicates EPA will designate as ''nonattainment'' any areas with NO_2 monitors recording violations of the revised NO_2 NAAQS. Based on the available data, there will probably be no areas designated non-attainment of the new 1-hour or current annual average standard. However, the final rule indicates:[17]

> We intend to designate all other areas of the country as ''unclassifiable'' to indicate that there is insufficient data to determine whether or not they are attaining the revised NAAQS.

Thus, it is likely the entire country will be designated as unclassifiable for the revised NO_2 NAAQS. There is an important ramification of this classification for stationary source air permitting throughout the entire country, through the New Source Review (NSR)/Prevention of Significant Deterioration (PSD) requirements.

For example, the final rule indicates:[18]

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[17] Final Rule, supra note 1, at 6521.
[18] Ibid. at 6525.

> The EPA acknowledges that a decision to promulgate a new short-term NO_2 NAAQS will clearly have implications for the air permitting process. The full extent of how a new short-term NO_2 NAAQS will affect the NSR process will need to be carefully evaluated.

And also that:[19]

> The PSD program applies when a major source, that is located in an area that is designated as attainment or unclassifiable for any criteria pollutant, is constructed, or undergoes a major modification.

The final rule indicates that major new or modified sources applying for NSR/PSD permits will initially be required to demonstrate that their proposed emissions increases of NOx will not cause or contribute to a violation of either the annual or 1-hour NO_2 NAAQS and the annual PSD increment. In addition, EPA indicates that it has the authority to promulgate a new 1-hour NO_2 PSD increment.[20] Finally, EPA indicates that new screening tools may be required to carry out the needed analyses.

Since the final rule, EPA has issued guidance for how to use the American Meteorological Society/EPA Regulatory Model (AERMOD) in the NSR/PSD permitting process in June 29, 2010 and March 1, 2011 EPA memos from Tyler Fox to Regional Air Division Directors. However, the Agency has not addressed the threshold question as to how well AERMOD or any alternative model performs when predicting 98th percentile 1-hour NO_2 concentrations. Comments to the Agency from Heinold and Paine[21] pointed out the Agency's current recommended screening methods for NO_2 dispersion modeling for industrial applications are inadequately tested in terms of model accuracy for predicting short-term NO_2 concentrations. Heinold and Paine stressed that appropriate modeling techniques for short-term NO_2 need to be developed. In addition, the South Dakota Department of Environment and Natural Resources pointed out the Agency's own modeling guidance indicated that models are more reliable for average concentrations than for short-term concentrations.[22] The lack of model validation with respect to the 1-hour NO_2 standard is a serious shortcoming.

As a result of these new permitting requirements, which have not been fully evaluated and validated, there may be substantial additional costs and/or delays for companies throughout the country that want to build a new facility or modify an existing facility.

EPA has also not adequately considered the decision as to the extent of the nonattainment area if noncompliance with the NO_2 NAAQS is identified at a near-road site. The final

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[19] Ibid.
[20] Ibid.
[21] D. Heinold and R. Paine, *Comments on the Proposed Short-term Nitrogen Dioxide NAAQS: Dispersion Modeling Challenges*, AECOM Environment, September 14, 2009 submission to Docket No. EPA-HQ-OAR-2006-0922.
[22] September 11, 2009 letter from the South Dakota Department of Environment and Natural Resources to Docket No. EPA-HQ-OAR-2006-0922.

rule only indicates:[23]

> EPA intends to issue nonattainment area boundary guidance after additional information is gathered on the probable contributors to violating near-roadway NO_2 monitors.

It is not clear how such additional information would be developed. Depending on the spatial extent of the designated nonattainment area, there may be serious repercussions with regard to more restrictive permitting requirements for stationary sources, the requirement for emission offsets, the potential loss of federal highway or transit funding and greater EPA involvement in and oversight of permitting decisions. If there is a mismatch between the spatial scale of the exceedance area and the spatial scale of the designated nonattainment area, there may be major costs to states and the economy without commensurate benefits.

The Draft Guidance for Modeling Near-Road NO_2 is Deficient

Section 9 of the TAD discusses several ways in which modeling can be used in the site selection process. The TAD discusses only EPA regulatory models (e.g., MOVES for vehicle emissions and AERMOD for dispersion). AIR agrees with CASAC that "it is not clear that AERMOD is the best tool for near-road plume modeling applications and it would be good for the TAD to offer other options " and that "there are line source models available that could be better adapted."[24]

With respect to using AERMOD in a near roadway application, a recent EPA review of air-quality modeling tools for near roadway applications[25] discusses AERMOD and other roadway dispersion models and indicates that AERMOD has not been compared rigorously for line source applications and that it contains a very simplistic algorithm for line sources.

AERMOD is a steady-state Gaussian plume model that has been developed and tested primarily for stationary source applications. EPA did apply it in the NO_2 Risk and Exposure Assessment (RES) to simulate both mobile and stationary sources impacts in Atlanta. The highways in Atlanta were simulated as various line source segments. Although the TAD indicates that AERMOD generally performed well in this application, the actual comparisons provided in the REA indicated otherwise. For example, AERMOD mischaracterized the diurnal distribution of NO_2 and substantially over-predicted (by 50 to 70 %) the average hourly NO_2 during the morning and evening rush hours.[26] No comparisons with peak hourly observations were presented in the REA.

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[23] Final Rule, supra note 1, at p. 6521.
[24] Draft CASAC letter, supra note 3, at 5.
[25] U. S. Environmental Protection Agency, *Emissions and Air Quality Modeling Tools for Near Road Applications,* EPA/600/R-09/001, December 2008.
[26] U. S. Environmental Protection Agency, *Risk and Exposure Assessment to Support the Review of the NO_2 Primary National Ambient Air Quality Standard*, EPA-452/R-08-008a, November 2008, Figure 8-7.

The September 2009 Alliance comments detailed several important limitations in AERMOD that the render its use inappropriate. First, the treatment of NOx/NO_2/ozone chemistry is overly simplistic for use in the near-road environment. The draft CASAC letter agrees "AERMOD and other regulatory models generally lack the detailed chemistry and/or space-time resolution to deal with problems of this nature."[27]

Second, AERMOD does not account for the turbulence and heat generated by traffic that will dominate dispersion in the near-road environment under conditions of minimum dispersion due to the ambient wind. For example, using data from an array of chemical and meteorological measurements around a roadway, Chock demonstrated that the turbulence and heat generated by the traffic had a significant effect on the on-road and near-road wind and concentration fields.[28] In the first 50 meters downwind of the road, mechanical mixing dominates the mixing due to stability considerations so that the vertical dispersion parameters in the first 50 meters approach neutral stability, regardless of the ambient stability. Moreover, at very low wind speeds, the heat from the traffic lifts the exhaust above the Gaussian plume axis. These effects limit the concentrations that can build up on and near roadways under adverse ambient meteorology and are not included in AERMOD. Therefore, AERMOD should not be used to predict peak hourly NO_2 in the near-road environment until it has been validated for the application.

The MOVES (Motor Vehicle Emission Simulator) emission model, on the other hand, is a distinct improvement over its predecessor for the roadway application. MOVES has flexibility to provide emission inputs in several possible ways. Modeling a specific highway could be carried out in a "project level" mode. A great deal of information must be specified, including county, year, month, day, hour, temperature, and humidity plus all of the roadway parameters (type, length, speed, volume, etc.), vehicle types, and operating modes. It should also be possible to run MOVES in "inventory mode". The output could then be processed to obtain the emission factors for each vehicle class, age, hour, month, etc. and use those values as input to the site selection process. One important way MOVES can assist the states is in evaluating the emission impacts of fleet mix and congestion. As noted in Section 4 of the TAD, fleet mix and congestion are important considerations in site selection.

The TAD Does Not Clearly Define the Objectives of the New Monitoring Network

AIR agrees with CASAC that the draft TAD does not clearly define the objectives of the near-road NO_2 network. The draft CASAC letter notes:[29]

> In the November 2010 report, CASAC noted that "the objectives of the network are not well defined in the current outline. High priority should be given to developing clear objectives and providing a rationale for each." This advice was

[27] Draft CASAC letter, supra note 3, at 4.
[28] D. Chock, "General Motors Sulfate Dispersion Experiment: Assessment of the EPA HIWAY Model," *J. Air Pollut. Control Assoc*., **27**, 39-45 (1977).
[29] Draft CASAC letter, supra note 3, at 2.

not carried through into the TAD. A revised draft TAD should clearly state the objectives of the Near-Road NO_2 network, along with the rationale for each objective. The lack of clearly stated network objectives led to the committee having difficulty assessing how well the information provided in the TAD would lead to siting decisions that would best meet the network objectives.

One obvious objective is to determine compliance with the new 1-hour NO_2 standard. However, as CASAC notes, specific population exposures that are to be characterized by the monitors should be defined. CASAC also questions whether the goal is to measure the maximum annual average concentration, the concentrations at locations that are likely to experience the highest value for the 98th percentile 1-hour concentration, or the concentrations most likely to be associated with human exposures in the near-roadway environment. AIR strongly urges the Agency to focus the network on locations where there is human exposure relevant to the time scales of the NAAQS.

There are a number of other possible worthy objectives, but the current network design and deployment timing does little to satisfy these objectives. Given the known artifact issues with the current NO_2 monitoring technique, it is particularly important to characterize the "true" NO_2 concentrations. Several CASAC panelists have also brought this up and there is ongoing research to test possible alternatives, but the timing of the deployment of the network probably will mean that states will only use the current federal reference method. Another potential issue needs to be evaluated. Since the federal reference method is a difference method (NO_x-NO), there may be a mismatch between the high temporal variability in ambient concentrations near the source and the timing of the instrument's switching between the NOx and NO modes that may affect and decrease the precision of the calculated NO_2. An AMMS panelist alluded to this potential issue in November 2010 comments.[30] In addition, a recent Health Effects Institute Study[31] of on-roadway concentrations of various pollutants in heavy traffic in the Los Angeles Basin reported data on one-minute on-roadway concentrations of NO and NOx but did not report NO_2, suggesting a mismatch.

Another worthy objective is to characterize near-road pollutant concentrations. To do this properly would require additional measurements to determine the gradient away from the road under different conditions. If the objective is to identify the impact of the roadway, then measurements both upwind and downwind are required. If the objective is to identify the sources that contribute to measured concentrations of NO_2, then supplemental measurements of other constituents and traffic parameters are needed. If the objective is to identify the atmospheric processes that contribute to the observed NO_2, again supplemental measurements are required. If the objective is to gather data that can be used for health studies, the siting decisions must take human exposure into account.

[30] November 2010 CASAC letter, supra note 10, at 89.
[31] Health Effects Institute Research Report 156, *Concentrations of Air Toxics in Motor Vehicle–Dominated Environments,* February 2011.

Conclusion

Based on all these considerations, it is even more important that the experience with the Pilot Study be thoroughly evaluated before EPA moves ahead with the planned near-road NO_2 monitoring. AIR strongly urges the Agency to focus the network on locations where there is human exposure relevant to the time scales of the NAAQS.

In the CO final rule, EPA established a phased approach to its near-road monitoring requirements, noting:[32]

> Furthermore, EPA has concluded that public comments suggesting a phased-in implementation, allowing for later stages to benefit from experience in an initial round of monitor installations, have merit.

and further indicating:

> EPA intends to review the experience of states with the first round of near-road CO monitors and the data produced by such monitors and consider whether adjustments to the network requirements are warranted.

AIR urges CASAC to recommend a similar phase-in and review approach to EPA for the NO_2 network.

[32] CO Final Rule, supra note 4, at 54319.