The Long and Short of It:
A National Ozone Standard for Farm and Forest

by Paul Miller

Paul J. Miller is deputy director of the Northeast States for Coordinated Air Use Management (NESCAUM), Boston, MA. E-mail: pmiller@nescaum.org.

Ozone is the most important air pollutant affecting economically valuable agricultural crops and other vegetation in North America and elsewhere.[1,2] Long-term exposure to ground-level ozone above natural background concentrations results in diminished crop yields[3] and decreased forest productivity.[4-6] In the United States, studies have estimated crop losses due to ozone damage in the billions of dollars annually.[7,8]

Ozone-induced vegetation damage results from cumulative long-term exposure occurring over weeks to months during the growing season. In contrast, the public health-based "primary" ozone National Ambient Air Quality Standard (NAAQS) in the United States focuses on reducing people's exposure to sub-daily peak concentrations.

The U.S. Clean Air Act provides for establishing separate and distinct "secondary" air quality standards to address non-health impacts, such as crop damage by ozone, but the historical approach of the U.S. Environmental Protection Agency (EPA) has been to set identical primary and secondary standards. Therefore, while vegetation damage occurs through cumulative long-term exposure to elevated ozone concentrations over many hours across several months, the U.S. ozone standard has been tied to a short-term sub-daily peak concentration.

In recognition of the differences in exposure duration, there have been calls over the years to establish a secondary ozone standard in the United States that is different in form from the health-based primary standard. Such a proposition is not new to the pages of *EM* magazine. In a January 1997 article, Heck and Cowling presented a scientific workshop consensus on the need for a long-term secondary ozone standard better suited to ecosystem protection than the short-term health standard.[9]

During past deliberations over potentially revising the national ozone air quality standards, EPA

considered but ultimately chose not to adopt a different form for the secondary standard. Now, as of the time of this writing, EPA is as close as it has ever been to adopting a new and distinct form for the secondary ozone standard specifically tailored to protect vegetation from long-term exposure to ozone.[10]

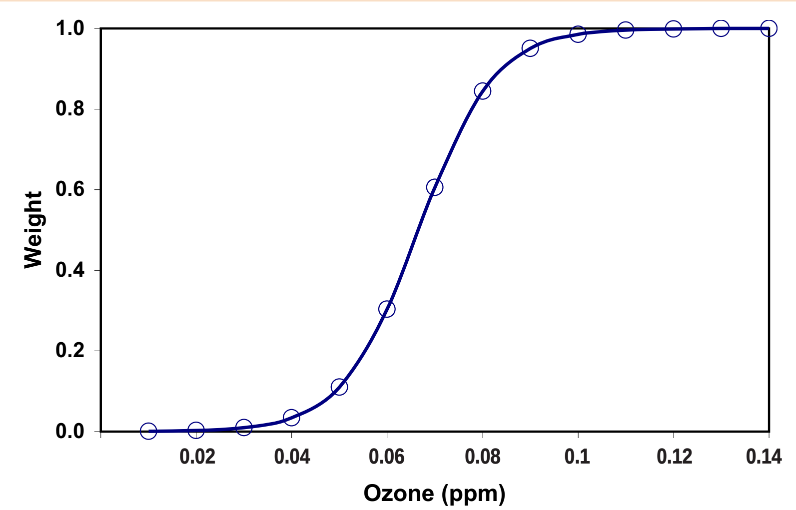
Previous Revisions to the National Ozone Standards

When the 1990 Clean Air Act Amendments were adopted by Congress, the national primary and secondary ozone standards currently in place were identical at a 1-hr averaged concentration of 0.12 parts per million (ppm) not to be exceeded more than four times over a continuous three-year period. In 1997 and 2008, EPA revised the health-based primary ozone standard to reflect scientific understanding of a risk to public health at ozone levels below the then existing ozone standard. Each time, EPA also considered, and ultimately rejected, establishing a secondary ozone standard of a different form to protect non-health values, such as agricultural crops and forests.

For the 1997 ozone standard revision, EPA proposed two alternatives for a new secondary ozone standard: (1) keeping it identical to a revised primary health-based standard, or (2) establishing a longer term standard based on summing hourly ozone concentrations greater than or equal to 0.06 ppm over 12 daylight hours during a three-month period (called the "SUM06" form). In its final decision, EPA opted to make the secondary ozone standard identical to the revised primary standard (0.08-ppm 8-hr average). EPA's rationale was that a secondary standard at the proposed SUM06 level may only have an additional incremental effect beyond what would occur from attaining the revised primary standard.[11]

In its next revision of the national ozone standards in 2008, EPA again proposed two alternatives, and these were similar to the 1997 ozone revision: (1) a secondary standard equivalent to the primary, and (2) a secondary standard based on a longer term exposure. This time, EPA proposed a long-term secondary standard based on a concentration-weighted "W126" form (see sidebar on page 8) rather than the SUM06 summation index previously proposed.

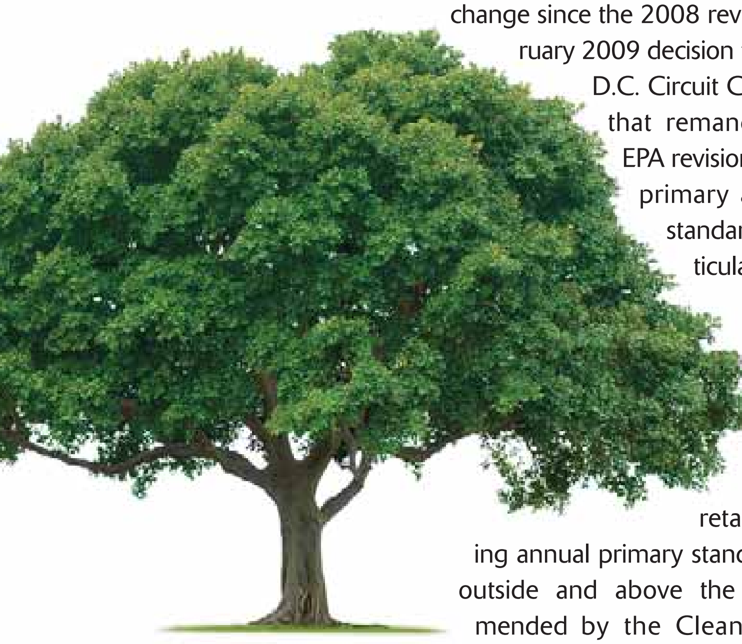
Once again, however, EPA's final rule in 2008 did not change the form of the secondary standard, keeping it equivalent to the revised health-based primary standard (0.075 ppm 8-hr average). During this round, however, EPA apparently had decided to adopt the W126 form for a secondary standard,[12,13] but the White House Office of Management and Budget, citing a conclusion by the President, overruled EPA in the days immediately before the final rule was announced.[14]



The "W126" form is an "S" curve across weighting factors from 0 to 1 that are applied to corresponding hourly ozone concentrations (see plot above). Lower hourly ozone concentrations (e.g., below 0.04 ppm) are weighted toward 0 at the bottom of the S curve, and higher concentrations (e.g., 0.10 ppm) are weighted toward 1 at the top of the S curve. Each hourly ozone concentration during 12 "daytime" hours is multiplied by its corresponding weighting factor on the curve, then all hourly weighted concentrations are summed together, and the highest sum obtained over three consecutive months within a growing season would be used to determine compliance with the proposed W126 secondary standard.

Reconsideration of 2008 Revised Ozone Standards

In March 2009, EPA announced it would reconsider its revision of the 2008 primary and secondary ozone standards. In addition to a new administration after the 2008 national election, another major change since the 2008 revision was a February 2009 decision from the federal D.C. Circuit Court of Appeals that remanded an earlier EPA revision of the national primary and secondary standards for fine particulate matter.



When it revised the fine particulate matter standards in 2006, EPA retained the existing annual primary standard, which was outside and above the range recommended by the Clean Air Scientific Advisory Committee (CASAC), an expert panel created under the 1977 Clean Air Act to give EPA independent advice on the technical bases of national air quality standards. EPA also adopted a secondary standard identical to the 24-hr averaged primary standard, in contradiction to CASAC's (and EPA's staff) recommendation that the secondary standard be a sub-daily form to better protect urban visibility.[15,16] The D.C. Circuit sent these standards back to EPA for reconsideration, holding that EPA failed to adequately explain why it did not follow the recommendations of CASAC.[17]

Parallels exist between EPA's earlier 2006 revision of the fine particulate standards that the D.C. Circuit remanded, and its later 2008 revision of the ozone standards. In specific regard to the ozone secondary standard, CASAC wrote to EPA:

[T]he CASAC unanimously agrees that it is not appropriate to try to protect vegetation from the substantial, known or anticipated, direct and/or indirect, adverse effects of ambient ozone by continuing to promulgate identical primary and secondary standards for ozone. [Italics in original.][18]

The EPA rulemaking docket also contained a memorandum indicating that EPA had apparently decided to adopt the W126 form, explicitly stating, "EPA believes that a secondary standard that is distinctly different in form and averaging time from the 8-hr primary standard is necessary."[12]

EPA placed another document in the rulemaking docket on March 11, 2008, the day before it announced its final decision on the ozone revisions. While the document was marked "Deliberative and Confidential" and does not identify an author, it is written as a concise legal and scientific outline of the basis for adopting a seasonal secondary ozone standard. The document stated:

The Administrator must decide how best to set the secondary standard and a seasonal form is the most legally defensible. By definition, the primary and secondary standards are separate legal actions based on separate criteria. There is no presumption that the secondary standard should be the same as the primary standard. EPA has extensive record support for a seasonal form and lacks scientific support for an 8-hr form. [Bold type in original.][13]

While the document is dated the day before EPA announced its final decision, the announced final decision did not reflect the document's rationale, as EPA once again set the revised secondary ozone standard equal to the revised primary standard based on an 8-hr average. A letter to EPA from the White House Office of Management and Budget dated the day after EPA announced its final decision stated that "the President has concluded" the secondary ozone standard should be identical to the primary.[14]

In light of the D.C. Circuit decision on the earlier revision of the fine particulate matter standard, the 2008 ozone secondary standard likely is susceptible to the same legal flaws identified by the court in remanding the secondary fine particulate standard. It contradicted the expert advice provided by CASAC, as well as EPA's own staff recommendation. There also was little scientific support for setting the secondary ozone standard identical to the primary, a point EPA itself made in its internal documents.

With the arrival of a new administration, EPA reconsidered its previous ozone standards revisions, and proposed in January 2010 to adopt, once again, an ozone secondary standard in the W126 form that differs from the 8-hr primary standard.[10] By the time this article appears in print, EPA may have announced its final decision, and history will either have been made, or repeated.

Summary

A new national ozone secondary standard based on a multi-month growing season would be a departure from previous short-term ozone standards in the United States. Such a standard would be better connected to protection of agricultural crops and forests suffering damage from long-term cumulative exposures, which is not directly addressed by health-based sub-daily peak standards. While the science basis is strong, internal dynamics within the administrative branch has been a historically high barrier to establishing a welfare-based ozone standard of a different form from the health-based standard. Now, with an alignment of robust scientific support, an expert advisory panel recommendation, and a federal court decision, the promulgation of a new and distinctly different national ozone secondary standard appears likely, but not a certainty in light of past events. **em**

By the time this article appears in print, EPA may have announced its final decision, and history will either have been made, or repeated.

References

1. Mauzerall, D.L.; Wang, X. Protecting Agricultural Crops from the Effects of Tropospheric Ozone Exposure: Reconciling Science and Standard Setting in the United States, Europe, and Asia; *Annu. Rev. Energy Environ.* **2001**, *26*, 237-268.
2. Ashmore, M.R.; Marshall, F.M. Ozone Impacts on Agriculture: An Issue of Global Concern; *Adv. Botanical Res.* **1998**, *29*, 31-52.
3. Chameides, W.L.; Kasibhatla, P.S.; Yienger, J.; Levy, H. The Growth of Continental-Scale Metro-Agroplexes, Regional Ozone Pollution, and World Food Production; *Science* **1994**, *264*, 74-77.
4. Broadmeadow, M. Ozone and Forest Trees; *New Phytologist* **1998**, *139*, 123-125.
5. Chappelka, A.H.; Samuelson, L. Ambient Ozone Effects on Forest Trees of the Eastern United States: A Review; *New Phytologist* **1998**, *139*, 91-108.
6. Karnosky, D.F.; Skelly, J.M.; Percy, K.E.; Chappelka, A.H. Perspectives Regarding 50 Years of Research on Effects of Tropospheric Ozone Air Pollution on U.S. Forests; *Envtl. Poll.* **2007**, *147*, 489-506.
7. Adams, R.M.; Crocker, T.D. The Agricultural Economics of Environmental Change: Some Lessons from Air Pollution; *J. Envtl. Mgmt.* **1989**, *28*, 295-307.
8. Murphy, J.J.; Delucchi, M.A.; McCubbin, D.R.; Kim, H.J. The Cost of Crop Damage Caused by Ozone Air Pollution from Motor Vehicles; *J. Envtl. Mgmt.* **1999**, *55*, 273-289.
9. Heck, W.W.; Cowling, E.B. The Need for a Long-Term Cumulative Secondary Ozone Standard—An Ecological Perspective; *EM* January 1997, 23-33.
10. *Fed. Regist.* 2010, 75, 2,938 (January 19, 2010).
11. *Fed. Regist.* 1997, 62, 38,878 (July 18, 1997).
12. Memo from Deputy Administrator Marcus Peacock, U.S. EPA to Susan Dudley, Office of Management and Budget, Re: Ozone Secondary Standard, Docket No. EPA-HQ-OAR-2005-0172-7130 (March 7, 2008).
13. U.S. EPA, Ozone Secondary NAAQS, Docket No. EPA-HQ-OAR-2005-0172-7155 (March 11, 2008).
14. Letter from Administrator Susan Dudley, Office of Management and Budget to Administrator Stephen L. Johnson, U.S. EPA (March 13, 2008).
15. Letter from Dr. Rogene Henderson, Chair, CASAC to Administrator Stephen L. Johnson, U.S. EPA, Subject: Clean Air Scientific Advisory Committee Recommendations Concerning the Proposed National Ambient Air Quality Standards for Particulate Matter, EPA-CASAC-LTR-06-002 (March 21, 2006).
16. U.S. Environmental Protection Agency. Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, EPA-452/R-05-005a (December 2005) (see Chapter 7).
17. *American Farm Bureau Federation vs. EPA*, 559 F.3d 512 (D.C. Cir. 2009).
18. Letter from Dr. Rogene Henderson, Chair, CASAC to Administrator Stephen L. Johnson, U.S. EPA, Subject: Clean Air Scientific Advisory Committee's (CASAC) Peer Review of the Agency's 2nd Draft Ozone Staff Paper, EPA-CASAC-07-001 (October 24, 2006) (see p. 7).