Draft White Paper

REVISED 8-HR OZONE NAAQS & IMPLICATIONS FOR THE WESTERN STATES

Prepared for

Western Regional Air Partnership

Western Governors' Association
1515 Cleveland Place, Suite 200
Denver, CO 80202

Prepared by

Gerard Mansell
ENVIRON International Corporation
773 San Marin Drive, Suite 2115
Novato, CA 94998

15 July 2008

Introduction

On March 12, 2008 the EPA finalized revisions to the National Ambient Air Quality Standards (NAAQS) for 8-hour ozone. The latest revisions to the ozone NAAQS resulted from the terms of a consent decree reached as part of a US Supreme Court challenge to EPA's 1997 proposed revisions to the ozone standards. The final form of the 2008 ozone NAAQS were set following a required public comment period on the EPA's proposed rules issued on June 20, 2007. From relatively limited selection of possibilities, and based on extensive reviews of numerous studies, the EPA chose to set both the primary (health-based) and the secondary (welfare-based) standards for 8-hr ozone concentrations at a level of 0.075 ppm. These revisions to the ozone NAAQS will have number of implications for the West going forward with respect to implementation of the regional haze control programs to align with the new standards, as well as efficient regional air quality analysis, planning, and control strategy development efforts.

This paper presents an overview of the revised standards for 8-hr ozone, including historical background and implementation timelines, a summary of current ozone monitoring and its relation to attainment/nonattainment status and designations throughout the region, an assessment of regional air quality modeling efforts, and the associated emission inventories, conducted to date by the Western Regional Air Partnership (WRAP), and a discussion of the implications of the revised standards for the West and the collaborative air quality modeling and planning efforts of the WRAP.

Background

The Clean Air Act (CAA) directs the US Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. National standards exist for six pollutants: ozone, particulate matter, carbon monoxide, lead, nitrogen dioxide, and sulfur dioxide. For each of these pollutants, the Clean Air Act requires EPA to set the health-based or "primary" standards at a level judged to be "requisite to protect the public health with an adequate margin of safety" and establish secondary standards that are "requisite" to protect public welfare from "any known or anticipated effects associated with the pollutant in the ambient air" including effects on crops, vegetation, wildlife, buildings and national monuments, and visibility. The law requires EPA to review the standards once every five years to determine whether revisions to the standards are appropriate.

EPA last updated the ozone standards in 1997. The decision to revise the standards was challenged in court by a number of parties, ultimately reaching the U.S. Supreme Court. In 2001, the Court unanimously upheld the constitutionality of the 1970 Clean Air Act provision that authorizes EPA to set NAAQS to protect public health and welfare. The Court also affirmed that the Clean Air Act requires EPA to set ambient air quality standards, at levels sufficient but not more than necessary, to protect the public health with an adequate margin of safety, and to protect the public welfare, without considering the economic costs of implementing the standards. Under terms of a consent decree, EPA agreed to issue a proposal on the ozone standards by June 20, 2007 and a final rule by March 12, 2008.

The ozone review process began with an assessment of scientific studies on ozone by EPA's National Center for Environmental Assessment. This assessment was published as an Air Quality Criteria Document for Ozone, which explored the scientific data pertaining to the health and environmental effects associated with ozone. EPA's Office of Air Quality Planning & Standards then prepared a "Staff Paper" document which presented key policy-relevant scientific information, the results of quantitative exposure and risk assessments with associated uncertainties, and a policy

assessment that identified policy options, including ranges of standards, for consideration by the Administrator.

The Criteria Document and Staff Paper underwent extensive scientific and public review, including review by the Clean Air Scientific Advisory Committee (CASAC), EPA's independent scientific advisory body established by the Clean Air Act. As part of its mandate, CASAC makes recommendations to EPA on the adequacy of the existing standards and revisions it believes would be appropriate. Based on the scientific assessments, and taking into account the recommendations of CASAC and public comments, the EPA Administrator must judge whether it is appropriate to revise the standards. Before making a final decision on whether to revise the ozone NAAQS, EPA undertook an extensive public review and comment process on its proposed decision of June 20, 2007. The Agency carefully considered and analyzed issues raised in public comments during the public comment period on the proposed rule, which ended October 9, 2007.

Additionally, the CAA requires the EPA to designate areas as attainment (meeting the standards), nonattainment (not meeting the standards), or unclassifiable (insufficient data to classify) after the Agency sets a new standard, or revises an existing standard. A designation to attainment/unclassifiable means that the area has sufficient data to determine that the area is meeting the 8-hour ozone NAAQS or that due to no data or insufficient data, EPA cannot make a determination.

There are two relevant statutory provisions governing designations for the 8-hour ozone NAAQS. Section 107(d)(1) of the Act establishes the requirements for making designations for areas when a NAAQS is promulgated or revised. These are designations of nonattainment or attainment/unclassifiable. The provision provides an opportunity for each State to make a recommendation to EPA concerning the designation of areas in the State within 1 year after promulgation of a new or revised NAAQS. The EPA is required to designate areas across the country no later than 2 years following the promulgation of the NAAQS. The Transportation Equity Act for the 21 Century (TEA-21) §6103 essentially extends by 1 year the 2-year designation process. Therefore, States are allowed 2 years to make their recommendations and EPA is required to designate areas 1 year after the State designation recommendations are due.

With respect to a specific NAAQS, such as the 8-hour ozone NAAQS, these provisions require all areas to be designated nonattainment if they do not meet the standard or contribute to ambient air quality in a nearby area that does not meet the standard. The EPA believes that any county with an ozone monitor showing a violation of the NAAQS and any nearby contributing area needs to be designated as nonattainment. In reducing ozone concentrations above the NAAQS, EPA believes it is best to consider controls on sources over a larger area due to the pervasive nature of ground level ozone and transport of ozone and its precursors. Thus, EPA recommends that the Metropolitan Statistical Area or the Consolidated Metropolitan Statistical Area (C/MSA) serve as the presumptive boundary for 8-hour NAAQS nonattainment areas. In the past, areas within C/MSAs have generally experienced higher levels of ozone concentrations and ozone precursor emissions than areas not in C/MSAs. In addition, the 1990 Amendments to the CAA established the C/MSA as the presumptive boundary for ozone nonattainment areas classified as serious, severe and extreme.

March 12, 2008 Revisions to the 8-hr Ozone NAAQS

As noted above, the Clean Air Act requires EPA to set both a primary and secondary standard for pollutants considered harmful to public health and the environment. The primary, or health-based, standards are to be set at a level judged to be "requisite to protect the public health with an adequate

margin of safety", while the secondary, or welfare-based, standards are set at a level "requisite" to protect public welfare from "any known or anticipated effects associated with the pollutant in the ambient air" including effects on crops, vegetation, wildlife, buildings and national monuments, and visibility. In addition, the CAA explicitly prohibits the EPA from considering costs in setting or revising NAAQS.

In setting the level of the revised 8-hr ozone standard, the EPA proposed for consideration, in June 2007, the following options for the primary standard:

- Revise the primary standard to a level within the 0.070 – 0.075 ppm range;
- Take comments on alternative levels from 0.060 ppm up to, and including, the current level of the standard (0.084 ppm);
- Specification of the standard to the nearest thousandth ppm, while allowing comment of the retention of the current degree of precision of the standard (i.e., top the nearest hundredth ppm)

Options proposed for consideration by the EPA regarding the secondary standard included:

- Replacement of the secondary standard with a cumulative, seasonal standard expressed as an index of the annual sum of weighted hourly concentrations, accumulated during daylight hours (8 am – 8 pm), during the consecutive three-month period during the ozone season with the maximum index value, set at a level within the 7-21 ppm-hr range;
- Revising the secondary standard to be identical with the primary 8-hr standard;
- Consideration of a cumulative, seasonal standard based on a three-year average of annual sums of weighted hourly concentrations, instead of a sum for a single year

Following a required comment period, the EPA chose to do the following:

- Strengthen the primary, health-based 8-hr ozone NAAQS to a level of 0.075 ppm.
- Specify the primary standard to the nearest thousandth decimal place, effectively eliminating the rounding associated with the previous 8-hr ozone standard; and
- Set the secondary, welfare-based 8-hour ozone standard to the level of 0.075 ppm making it identical to the revised primary standard.

According to the EPA, the revised 8-hr ozone standards will yield health benefits valued between $2 billion and $17 billion, which include preventing cases of bronchitis, aggravated asthma, hospital and emergency room visits, nonfatal heart attacks and premature death, among others.

Assessing the Benefits of the Revised Standards

In assessing the benefits of the NAAQS for ozone, it is instructive to understand the effects, both health-based and welfare-based, associated with exposure to ground-level ozone. These health effects, and subsequent implications, include:

- Reduced lung function;

- Irritated airways;
- Increased frequency of asthma attacks;
- Inflammation of and damage to the lining of the lung;
- Increased susceptibility to respiratory infection;
- Aggravation of chronic lung diseases (asthma, emphysema and bronchitis)
- Increased medication use among asthmatics;
- More frequent doctors visits;
- School absences; and
- Increased emergency room visits and hospital admissions.

With respect to the secondary ozone standard, the welfare-based effects due to exposure of plants and ecosystems to ground-level ozone include:

- Interference with the ability of sensitive plants to produce and store food, making them more susceptible to certain diseases, insects, other pollutants, competition and harsh weather;

- Visible damage to the leaves of trees and other plants, harming the appearance of urban vegetation, national parks, and recreation areas; and

- Reduced forest growth and crop yields.

To estimate the benefits of the revised 8-hr NAAQS for ozone, the EPA used a peer-reviewed approach to model the relationship between air quality and health and welfare effects, the air quality impacts of implementing future pollution control technologies, and the dollar values of resulting public health improvements. Based on the EPA's latest Regulatory Impact Analysis, the following range of benefits for meeting the revised ozone standards were noted:

- Based on the largest multi-city study used in EPA's risk analysis, an estimated 260 to 2,000 premature deaths would be avoided annually in 2020, which in combination with other projected benefits from reduced ozone, will result in an estimated total ozone-related benefit of $3 to $17 billion per year.

- A synthesis of data across a large number of individual studies indicates an estimated 420 to 2,300 premature deaths would be avoided annually in 2020, leading to total monetized ozone-related benefits of between $4 and $17 billion per year.

- These benefits estimates also include the value of an estimated reduction in numerous adverse health effects in 2020.

While the EPA is prohibited from considering costs in setting the NAAQS, as noted above, in order to inform the public, cost estimates associated with meeting a standard are calculated. EPA uses several peer-reviewed approaches for modeling the cost of using both existing controls and controls that may be developed in the future for reducing NOx and VOCs . EPA estimates that costs of implementing a standard of 0.075 ppm would range from a low of $7.6 billion to a high of $8.8 billion annually in 2020.

Implementation Timeline and Schedule

The Clean Air Act requires EPA to designate areas as attainment (meeting the standards), nonattainment (not meeting the standards), or unclassifiable (insufficient data to classify) after the Agency sets a new standard, or revises an existing standard. With respect to the revised ozone standard, the following schedule will apply:

- States must make recommendations to EPA no later than March 2009 for areas to be designated attainment, nonattainment and unclassifiable.

- EPA will issue final designations of attainment, nonattainment and unclassifiable areas no later than March 2010 unless there is insufficient information to make these designation decisions. In that case, EPA will issue designations no later than March 2011. EPA's final designations are to be based on ozone monitoring data from 2007-09.

- States must submit State Implementation Plans outlining how they will reduce pollution to meet the standards by a date that EPA will establish in a separate rule. That date will be no later than three years after EPA's final designations. If EPA issues designations in 2010, then these plans would be due no later than 2013.

- States are required to meet the standards by deadlines that vary based on the severity of the problem in the area. These deadlines vary from 2016 for Moderate to 2030 for Extreme nonattainment areas.

A separate rule to address monitoring requirements necessary to implement the new standards will be issued by the EPA, with a proposed monitoring rule issued in June 2008 and a final rule issued by March 2009. Given the relatively sparse ozone monitoring network throughout the Western US, EPA's proposed rules regarding monitoring will be a critical element in implementing the revised standards.

Relation to Attainment/Nonattainment Status and Designations

As noted previously, the EPA believes that any county with an ozone monitor showing a violation of the NAAQS and any nearby contributing area needs to be designated as nonattainment. In addition, due to regional transport of ozone and its precursors consideration should be given to controls on sources over larger areas. However, ozone monitoring networks and ambient measurements are key elements in the determination of attainment designations. Figure 1 displays the current status of nonattainment areas throughout the US with respect to the 1997 8-hr ozone standard based on monitored air quality data from 2004-06. The corresponding ozone monitoring network during the same period is presented in Figure 2. Except for California and several urban areas, the lack of ambient monitors throughout the West is notable.

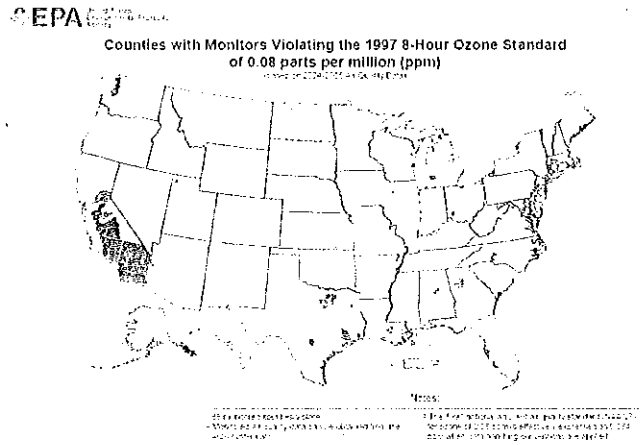

Figure 1. Counties with monitored violations of the 1997 8-hr ozone standard. (Source: EPA)

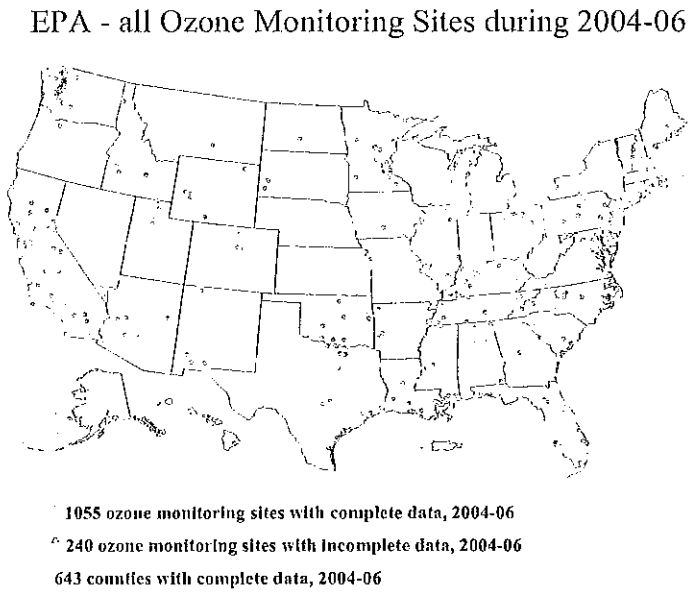

Figure 2. Ozone monitoring network during 2004-06. (Source: EPA)

The status of nonattainment areas, based on the revised 2008 8-hr ozone standard, is presented in Figure 3. As in Figure 1, these designations are based on currently available monitoring data from 2004-06. A comparison of Figures 1 and 3 highlights a number of additional regions throughout the country predicted to violate the 2008 ozone standard. The additional regions predicted to violate the revised standard include mainly urban areas including Las Vegas, Phoenix, Salt Lake City, Denver, Colorado Springs and Boise, as well as, most of Southern California and the Central Valley. The attainment status designations illustrated in Figure 3 are based only on those counties with existing ozone monitors, which in the Western US are concentrated primarily in urban areas, and therefore is not indicative of the regional nature of ozone air quality. Note, however that the situation presented in Figure 3 is based on ambient monitoring data for the three year period of 2004-06, while actual attainment designations will likely be based on the most recent years with complete data records, i.e., 2006-08 or later, which is expected to show some improvement in ambient air quality.

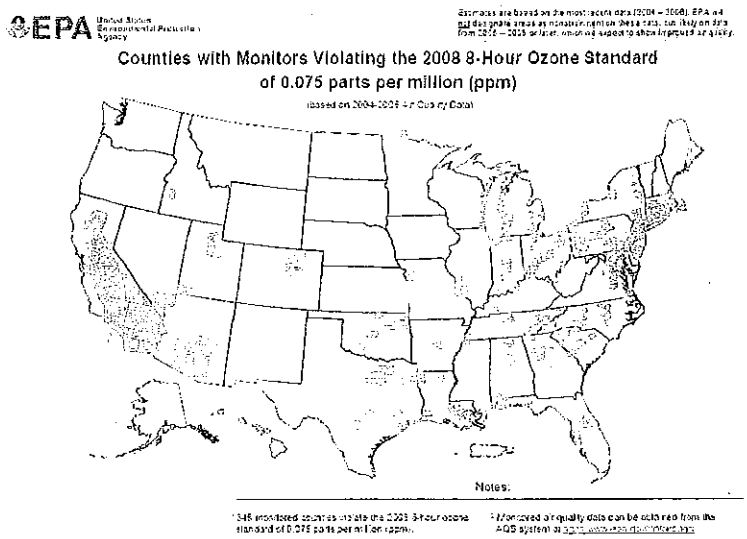

Figure 3. Counties with monitored violations of the 2008 8-hr ozone standard. (Source: EPA)

Figure 4 illustrates the present situation with respect to ozone monitoring across the WRAP region. Displayed are the 4th highest 8-hr average ozone concentrations at non-urban monitors based on data for calendar year 2006. Non-urban monitors include those operated by the National Park Service, the National Forest Service as well as other rural monitoring networks. Exceedances of the revised ozone standard (> 75 ppb) are indicated, as are monitors with measured ozone concentrations in the 70-75 ppb range. It is apparent, given the broad regions throughout the area without ozone monitors, the need for increased monitoring throughout the WRAP region, particularly in the more rural and non-urban areas will be critical in the revised ozone NAAQS implementation process. While the data displayed in Figure 4 represent the air quality based on only a single year of complete monitoring data (calendar year 2006), Figure 5 displays the situation based on the most recent three-year data record for non-urban sites (i.e., 2004-06). These data highlight those areas expected to violate the new ozone standard. Note that a violation is defined as occurring when the 3-year average of the 4th highest daily maximum 8-hour average concentrations exceeds 75 ppb.

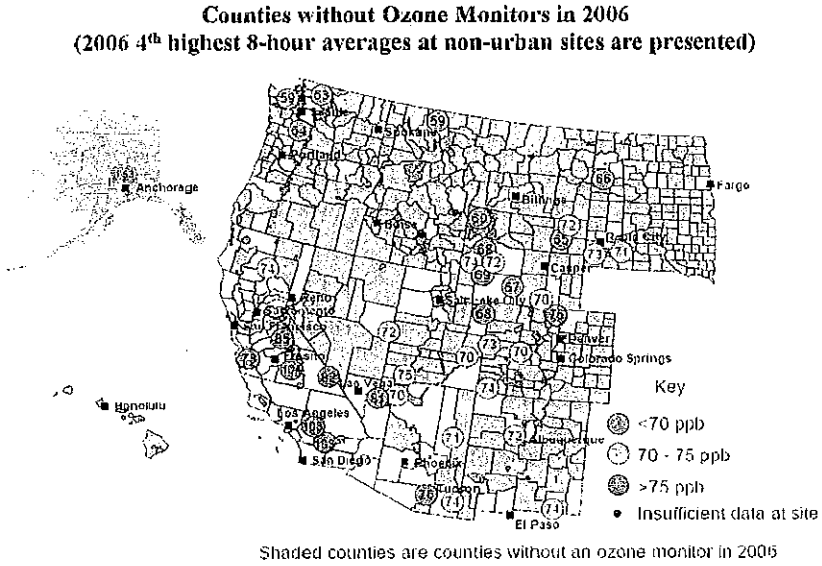

Figure 4. Ozone monitoring data in 2006 (Graphics courtesy of Air Resource Specialists, Inc.)

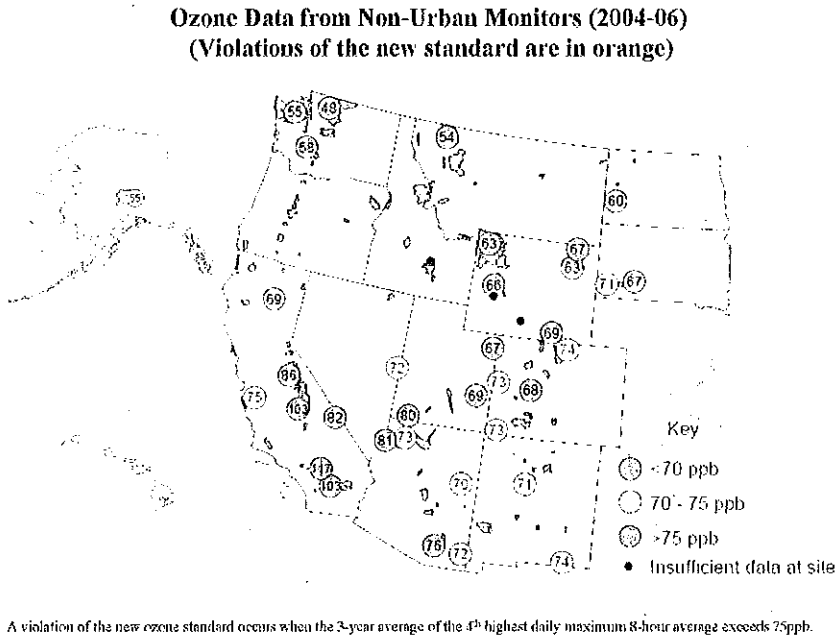

Figure 5. Monitored ozone data for 2004-06 in non-urban areas. (Graphics courtesy of ARS)

A summary of ozone monitoring data in the WRAP region from 2000-06 is presented in Figures 6 and 7. Figure 6 displays the number of exceedances of the 2008 ozone standard over the six year period, while Figure 7 displays the number of violations of the standard over the same time period. As in the previous figures, these displays present data from non-urban monitors only. It is important to note the distinction between an exceedance of the standard and a violation. An exceedance of the standard occurs when any monitored 8-hr average ozone concentration exceeds 75 ppb; a violation occurs when the 3-year average of the 4th highest daily maximum 8-hour average ozone concentration exceeds the standard. Although numerous exceedances are seen to occur during this time period, not all sites recording exceedances are showing violations of the standard during the same time period. With respect to the revised ozone NAAQS and subsequent attainment designations, determinations of attainment status will be based on the most recent three-year time period with complete data at each monitoring site.

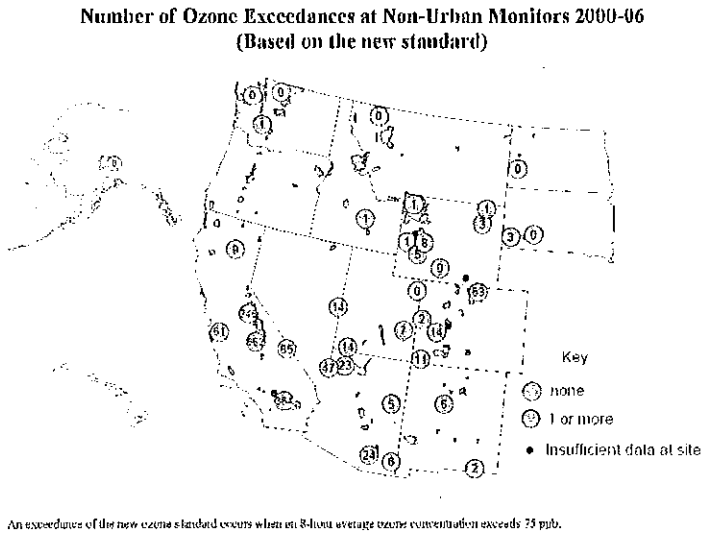

Figure 6. Exceedances of the 2008 8-hr ozone NAAQS in the WRAP region.(Graphics courtesy of ARS)

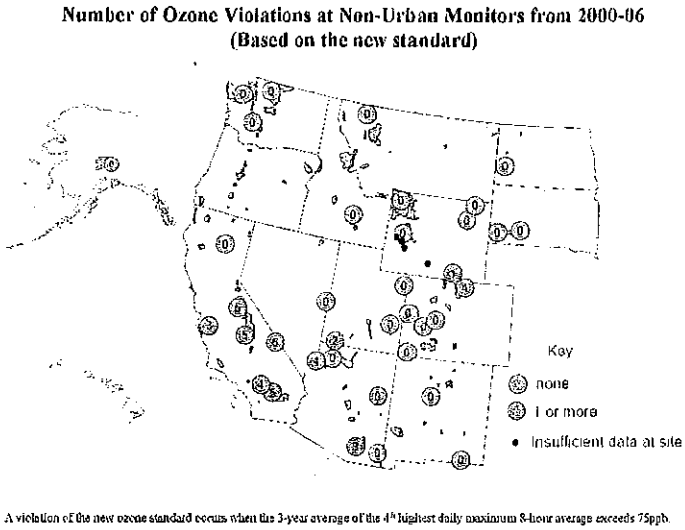

Figure 7. Violations of the 2008 8-hr ozone NAAQS in the WRAP region during 2000-06. (Graphics courtesy of ARS)

Table 1 summarizes the current attainment status for the new ozone standard based on available monitoring data from 2004-06 in the WRAP region as reported by EPA. It is likely that more counties will show violations of the new standard if, and when, additional ozone monitoring data become available throughout the Western US.

Table 1. Summary of counties violating the new ozone standard based on EPA reported data for 2004-06.

State	Counties with Monitors	Counties Violating New Ozone Standard
AK	1 of 27	0
AZ	7 of 15	4
CA	48 of 58	31
CO	11 of 64	4
HI	1 of 5	0
ID	2 of 44	1
MT	1 of 56	0
NV	4 of 17	1
NM	6 of 33	0
ND	7 of 53	0
OR	6 of 36	0
SD	2 of 66	0
UT	6 of 29	5
WA	7 of 39	0
WY	2 of 23	0
State Totals	110 of 565	46
Tribes	No data reported	No data reported

Modeling Analyses for Ozone across the WRAP Region

To evaluate the potential impacts of the revised ozone standards with respect to predicted violations, the EPA conducted national air quality modeling throughout the US for calendar year 2020. The EPA's modeling efforts considered the effects of various emission controls and reduction programs including:

- the Clean Air Interstate Rule;
- the Clean Air Mercury Rule;
- the NOx SIP Call;
- the Clean Air Visibility Rule;
- the Clean Air Nonroad Diesel;
- the Light Duty Vehicle Tier 2 Rule;
- the Heavy Duty Diesel Rule;
- proposed rules for Locomotive and Marine Vessels;
- proposed rules for Small Spark-Ignition Engines; and
- various state and local level mobile and stationary source controls.

Since the modeling was completed, federal court decisions have invalidated the Clean Air Interstate Rule and the Clean Air Mercury Rule, and remanded those programs back to EPA for revision. Figure 8 presents the results of EPA's modeling efforts in terms of counties projected to violate the revised 8-hr ozone standard. It should be noted however, that the EPA's projected ozone modeling results were only considered for those counties with existing ozone monitors, thus masking the inherent regional nature of the ozone air quality problem in the West. Additionally, EPA's regional modeling inventories did not include significant sources within the WRAP region, specifically natural and anthropogenic fire sources, considerable emissions from oil and gas development and off-shore marine sources in the Eastern Pacific.

EPA modeling of counties predicted to violate new Ozone standard by 2020
(does not reflect accurate/representative emissions projections in the West)

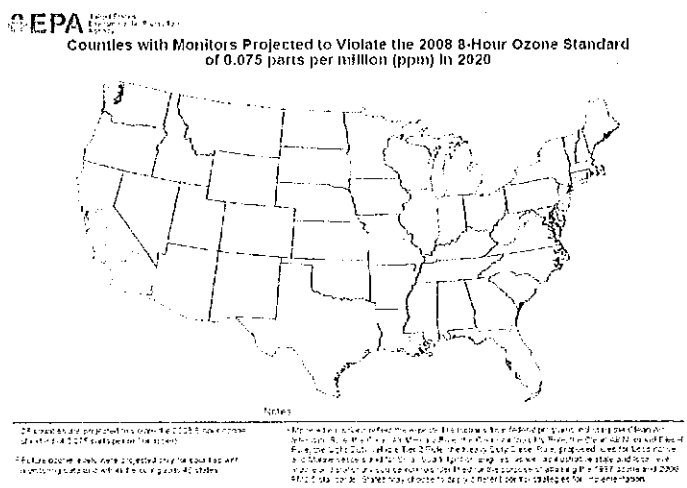

Figure 8. EPA national modeling predictions of counties expected to violate the new ozone NAAQS in 2020 (Source: EPA)

As noted in the title of Figure 8 above, the national air quality modeling conducted by the EPA utilized emission inventories which did not include numerous significant sources of ozone precursors in the Western US. As part of their modeling efforts to address the requirement of the Regional Haze Rule (RHR), the WRAP has been developing and refining regional modeling databases, including emission inventories, throughout the West for the past several years. While

that effort has focused on source sectors and pollutants affecting regional haze and visibility, many of those same sources are also precursors to ozone formation. Additionally, while the geographic extent and spatial resolution of the CMAQ modeling conducted by the WRAP is appropriate for investigation of regional visibility issues, ozone air quality has historically been viewed as a local, mostly urban problem, particularly in the West. The EPA does, however, accept the regional nature of the ozone air quality problem in the Eastern US, although in the West, evidence of long range transport of both ozone and its precursors, are fueling acceptance of ozone as a regional, non-urban issue as well.

Although the WRAP's modeling efforts have focused on regional haze issues, the CMAQ modeling results for ozone are generally acceptable with respect to model performance, and therefore these results are illustrative in regards to predicted ozone air quality throughout the region (Tonnesen, et. al., 2008). Figure 9 presents the results of WRAP's annual CMAQ modeling for calendar year 2018. Displayed are the predicted 4th highest daily maximum 8-hr average ozone concentrations, in ppb, across the WRAP region, as well as the date of occurrence of the 8-hr maximum ozone concentration. The model-predicted 4th highest daily 8-hr value is comparable to the 0.075 ppm 8-hr ozone concentration value adopted in March 2008 as the revised ozone NAAQS. In contrast to EPA's national ozone modeling predictions, broad regions throughout the west are predicted to exceed and/or violate the new ozone NAAQS, with the most exceedances predicted to occur throughout the spring and summer months. Figures 10, 11 and 12 present the regional ozone modeling results for the highest, 2nd highest and 3rd highest model-predicted daily maximum 8-hr average ozone concentrations, respectively. The spatial distributions of these results are similar to the 4th highest 8-hr ozone concentrations, albeit somewhat higher in magnitude. In addition, these maximum concentrations are seen to occur later during the spring and summer months.

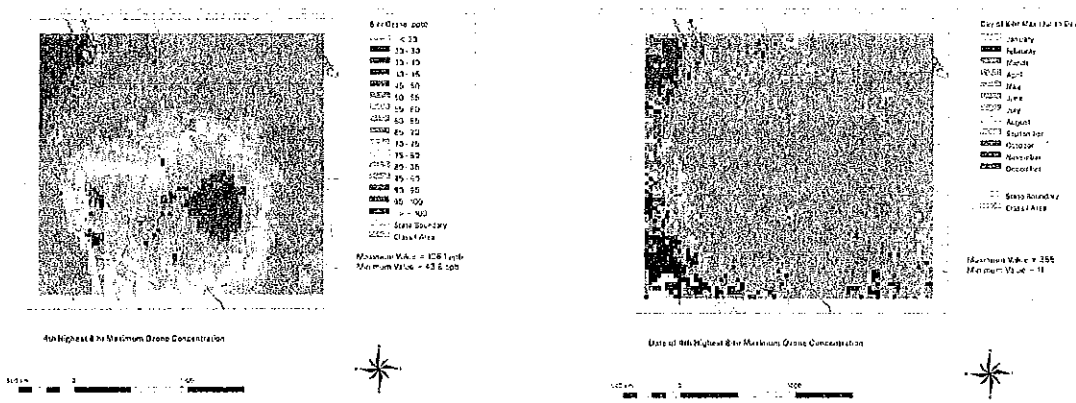

Figure 9. WRAP CMAQ 2018 predicted 8-hr ozone concentrations. 4th highest daily maximum 8-hr average ozone concentrations (left); Occurrence date for maximum daily 8-hr average ozone concentrations (right).

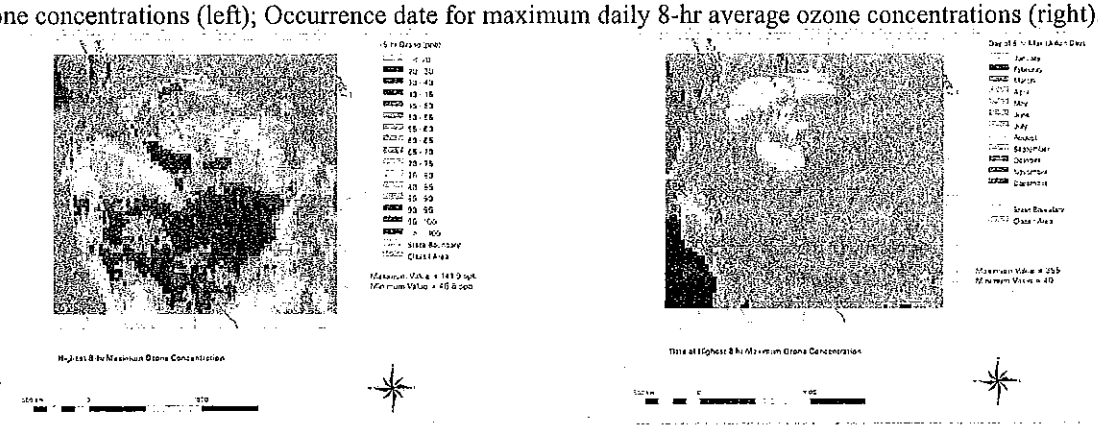

Figure 10. WRAP CMAQ 2018 predicted 8-hr ozone concentrations. Highest daily maximum 8-hr average

ozone concentrations (left); Occurrence date for maximum daily 8-hr average ozone concentrations (right).

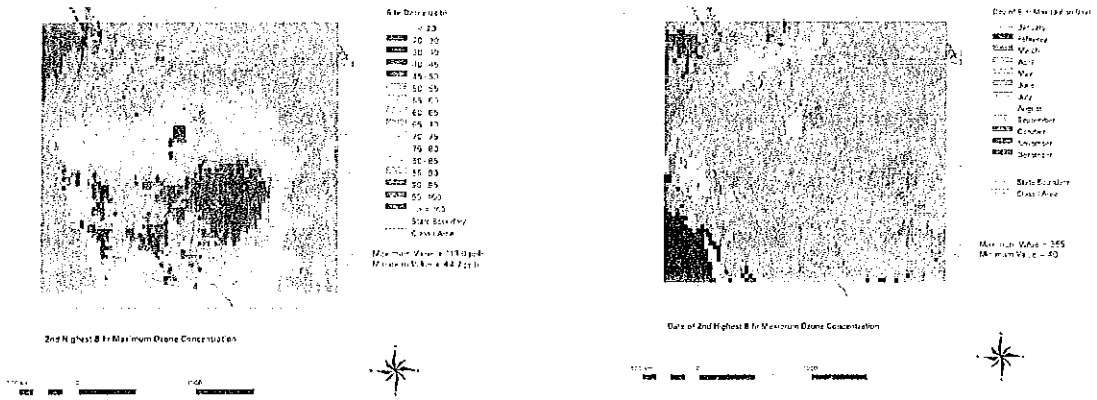

Figure 11. WRAP CMAQ 2018 predicted 8-hr ozone concentrations. 2nd highest daily maximum 8-hr average ozone concentrations (left); Occurrence date for maximum daily 8-hr average ozone concentrations (right).

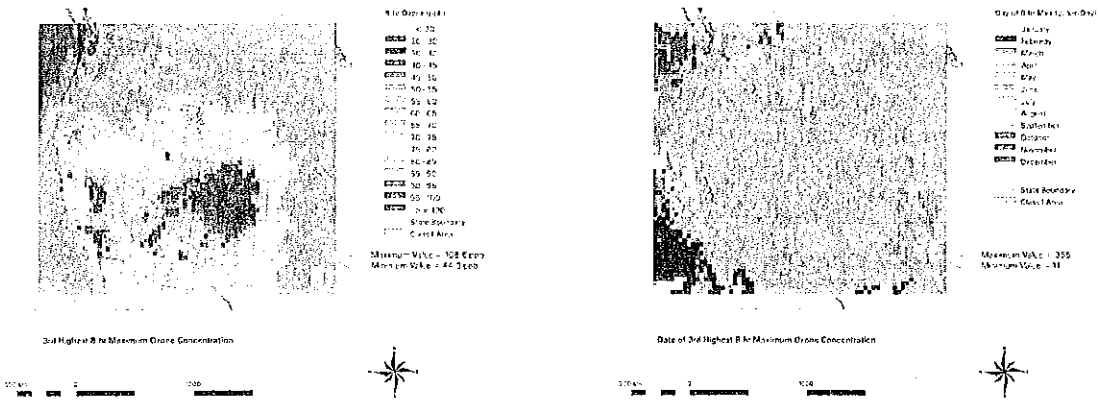

Figure 12. WRAP CMAQ 2018 predicted 8-hr ozone concentrations. 3rd highest daily maximum 8-hr average ozone concentrations (left); Occurrence date for maximum daily 8-hr average ozone concentrations (right).

When evaluating these results of the WRAP regional ozone modeling predictions, and in comparison with EPA's national model predictions, it is important to consider some key differences in the modeling databases used, specifically, the projected future year emission inventories, particularly in the Western US. As noted above, EPA's national modeling inventories included a number of federal regulations and proposed emission reduction programs, as well as various state and local emission control programs. The WRAP has expended considerable time and resources in their inventory development efforts, specifically in order to characterize a number of natural and anthropogenic emission sources including wild and prescribed fires, oil and gas development and off-shore marine vessels. In addition, the issue of international transport was addressed to the extent possible. EPA's modeling efforts associated with assessing the impacts of the revised ozone standards either did not include many of these sources, or were not as well characterized in modeling databases as in the WRAP's modeling efforts to date. Thus, contrary to assessments of the impacts of the new ozone standards based on EPA's model predictions, WRAP's modeling efforts highlight the regional nature of the ozone air quality problem throughout the Western US.

Traditionally, control strategy development for ozone air quality planning has focused on urban areas and the associated sources of precursor (NOx and VOC) emissions, such as large stationary sources (i.e., industrial facilities and electric utilities), mobile sources, including motor vehicle exhaust and evaporative losses, and industrial and commercial solvent utilization. In cases where transport of ozone and/or precursor emissions are known or expected, control strategy development efforts have also considered emission sources in regions upwind of urban areas. Within the WRAP

region, the ozone air quality problem is clearly a regional issue, as evidenced by regional CMAQ modeling results, and therefore a critical element to address in ozone planning for the West will be the determination and quantification of long-range transport of ozone and ozone precursors versus locally formed ozone and associated emission sources. Such a determination will be needed to assess the effectiveness of local versus regional emission control strategies.

The most recent versions of the WRAP emission inventories for regional haze planning include:

- Plan 2002d – The 2002 Planning (Plan02d) emission inventory represents a typical 2002 annual inventory of emissions from all source sectors derived from a number of sources, including state/county emission inventory submittals, permits, MOBILE6 modeling, or other modeled estimates based on activity levels. The planning inventories are used to provide representative baseline visibility conditions for comparisons and assessments of progress towards achieving natural visibility conditions in the future years.

- PRP 2018a – The Preliminary Reasonable Progress emission inventory for 2018 (PRP18a), which incorporates growth and all known existing and/or planned emission controls and a preliminary estimate of SO_2 reductions from BART controls across the WRAP region.

WRAP emission inventories for NOx and VOC are displayed in Figures 13 and 14, respectively. Presented are annual, county-level emission estimates for all emission source sectors, including biogenic emissions, in units of tons per year. Although emissions of NOx and VOC are projected to decrease from 2002 to 2018, significant sources of these ozone precursors are still present and distributed across the West in 2018, illustrating the regional nature of the air quality problem.

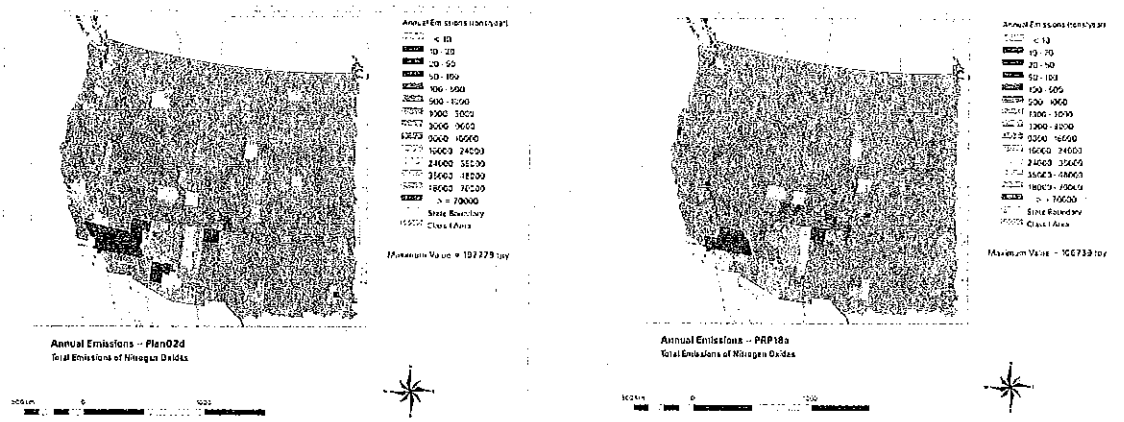

Figure 13. WRAP annual county-level NOx emissions. Plan02d (left); PRP18a (right)

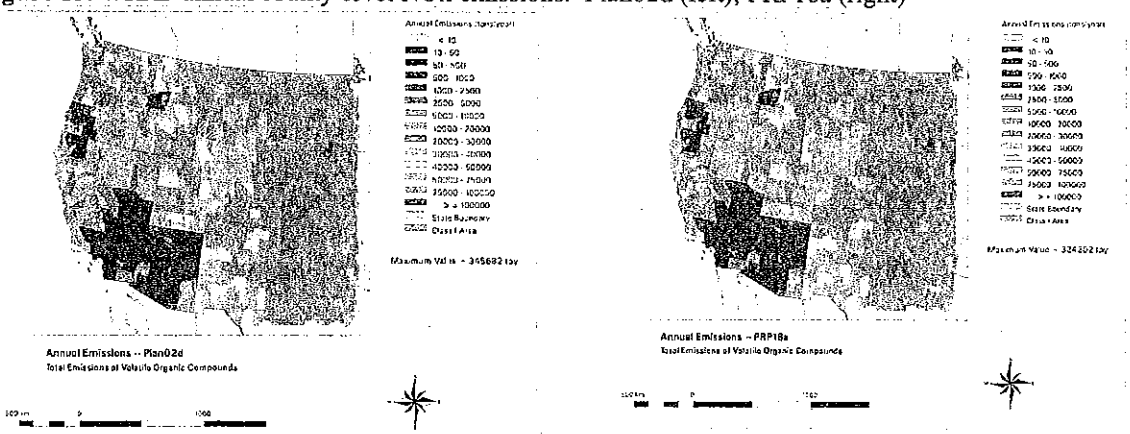

Figure 14. WRAP annual county-level VOC emissions. Plan02d (left); PRP18a (right)

Both the 2002 and 2018 inventories incorporate emission estimates from previously uncharacterized sources including natural fires, offshore marine shipping in the Eastern Pacific, and oil and gas development and production. Note that both the offshore shipping and natural fire emission inventories were held constant from 2002 to 2018 for regional air quality modeling purposes. Figure 15 presents the estimated annual, county-level NOx and VOC emissions from natural fire sources. By definition, natural fires (e.g., wild fires caused by lightning strikes) are clearly unpredictable, unlike other fire sources (e.g., agricultural burning, prescribed fires, etc.) and uncontrollable with respect to air quality planning. Annual NOx and VOC emission estimates from oil and gas development in the WRAP region are displayed in Figures 16 and 17, respectively. Emissions from this source sector are seen to be increasing from 2002 to 2018, particularly in the Inter-Mountain and Southwestern States, and are predicted to increase over time. These emission sources have not been characterized, or quantified, in previous inventories to the degree to which they currently have been by the WRAP and, as noted above, were not considered in EPA's modeling efforts associated with assessments of the revised ozone standard. As these sources are generally far removed from urban centers, and due to their wide-spread geographic distribution, they are likely to become a key component in regional control strategies for ozone air quality.

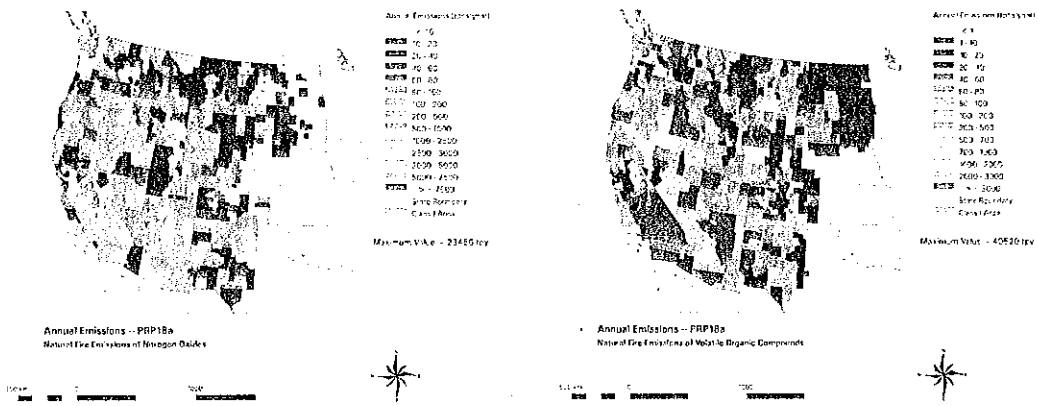

Figure 15. WRAP annual county-level natural fire emissions. NOx (left); VOC (right)

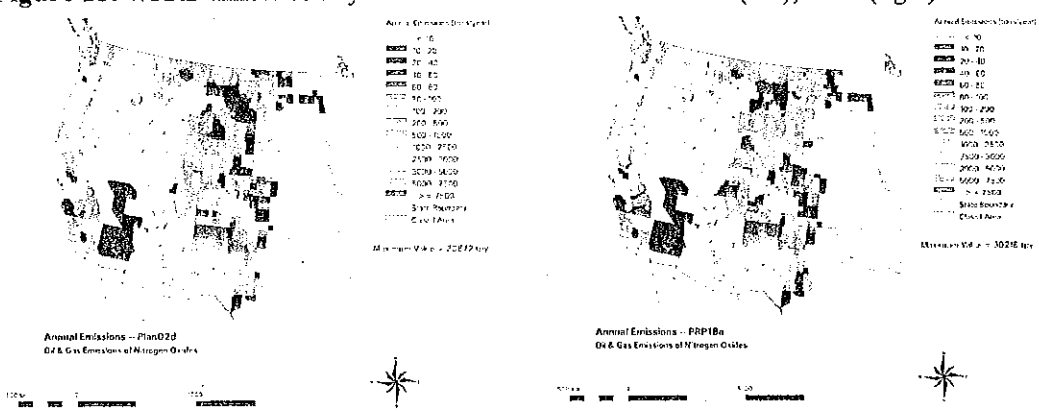

Figure 16. WRAP annual county-level oil & gas NOx emissions. Plan02d (left); PRP18a (right)

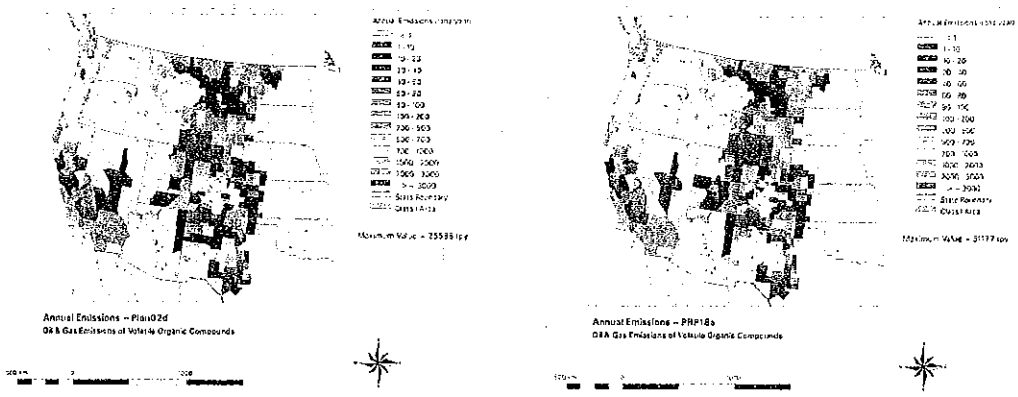

Figure 17. WRAP annual county-level oil & gas VOC emissions. Plan02d (left); PRP18a (right)

Implications for the West

The 2008 revisions NAAQS for 8-hr ozone will have numerous implications for the West. Based on an analysis of the current state of ozone monitoring in the West, there is clearly a critical need for additional monitors throughout the region. This will be necessary to adequately and fully characterize the ozone air quality in the Western US, particularly in more rural, and non-urban areas, as well as to aid in the implementation and progress tracking process with respect to attainment/nonattainment status designations. The collaborative planning efforts of the WRAP members and stakeholders to date with respect to addressing the requirements of the Regional Haze Rule will need to be carried forward as the region embarks on planning and implementation of, not only ozone, but also other regional air quality issues such as particulate matter, mercury and nitrogen deposition, climate change and green house gases and global climate change.

With respect to ozone air quality planning, the WRAP will need to consider a variety of other issues to successfully address the requirements of the revised NAAQS for 8-hr ozone. In particular, as part of their planning and control strategy development efforts, the WRAP states will, among others:

- Need to characterize and quantify the ozone fraction transported to metropolitan areas;
- Need to characterize and quantify the fractions of ozone precursors transported and their effects; and,
- Need to consider emissions density changes in both urban and regional upwind areas from:
  - Population growth and spatial patterns of associated area sources;
  - Changes in energy supply based on lower carbon inputs;
  - Federal mobile source rules and controls;
  - Contributions of fire emissions sources; and
  - Oil and gas development throughout the region, as well as indirect sources related to oil and gas development activities.