TN0709-1: Foothill Furor – Seeking Basis for Public Policy on Ozone Pollution

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15 September 2007
(Version 4oct07)

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Acknowledgements – I want to thank Mr. Joe Fish, Deputy Air Pollution Control Officer of the Northern Sierra AQMD, for the time he spent in reviewing the first version of this report and then kindly inviting me to an extended work session in his Grass Valley facility to go over the methodology of current ozone measurement and county-wide ozone level assessment. Thanks also to Mr. Sam Longmire, Air Pollution Control Specialist III of the NSAQMD, who is the prime information source for the mandated attainment process through which Nevada County must go to satisfy the requirements of The Federal Clean Air Act. I am also grateful to fellow SESF director Russ Steele for bringing certain technical references to my attention and the many useful discussions of this research. The mistakes that survive are mine alone, and I welcome all reader comments and corrections sent to me at gjrebane@msn.com .

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Abstract

This technical note addresses the ozone pollution issue recently heightened in the public awareness. Determining the magnitude of ozone pollution in Nevada County begins with an understanding of what are the actual ozone levels where people live and how these levels are derived. The county-wide ozone levels as displayed in the ozone movies at www.sparetheair.com and reported online are calculated from a proprietary computer model that incorporates sparse and widely separated readings from ozone monitors in the Sierra foothills along with the more closely spaced readings from the Central Valley. These published ozone maps, however, do not comprise the formal evidence recognized by state and federal agencies as proof of excessive ozone pollution in Nevada County. Instead, such evidence is developed from a single ozone monitor located in Grass Valley and operated by the Northern Sierra AQMD. The county's mandated path to attainment with federal and state ozone standards is a complex one that will involve multiple agencies and local governments, dubious definitions by fiat, an atmospheric modeling technology that is not validated and difficult to access, and an overall process that has little or no science to recommend it. In this report we describe how our ozone pollution is perceived and actually measured, the process by which the state and federal agencies will formally determine our compliance to their most recent ozone standards, and the status of computer models focusing on their specific roles in the current debate and in the mandated attainment process to come. Additionally herein we present currently available information that is assessed in terms of the state-of-the-art of atmospheric modeling, and we conclude that to date there is no evidence that the daily calculated and mandated ozone levels ascribed to hold across Nevada County are now or have ever been reliable. We develop the basis for this conclusion from interviews with NSAQMD management and the recently published literature on climatological and atmospheric modeling. Finally, we argue that reliable information about ozone levels needs to be made available to county elected officials and their staffs before adopting new public policy on air pollution, and make recommendations to that end.

1 Background

Ozone (O3) as a ground level pollutant has become a hot-button issue when we think about air quality in Nevada County. The toxicity of various O3 levels has been treated elsewhere (e.g. California Department of Health Services) and is not here a subject of de-

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bate. There is much confusion about the incidence and levels of O3 in the Sierra foothill counties and specifically in Nevada County. This report is an attempt to explain the county's current ozone measurement, its uses to ascribe county-wide ozone levels, misunderstandings about the current use of ozone reporting and modeling, and the process by which the county will be judged to attain federal and state mandated ozone levels.

Confusion about claims that the county is in non-attainment comes from several sources. These sources may be categorized into the following –

1. **Government (EPA and CalEPA) Ozone Standards** - A confusing and changing standard that specifies the maximum allowable number of days during which an average measure of ozone in ppb (parts per billion) is not allowed to exceed over a given number of hours. The location of the ozone measurement[1] is arbitrarily set at one point in the county and by government fiat that measurement is declared to accurately represent the ground-level occurrence of ozone over the remainder of western Nevada County.
2. **Online Ozone Level Maps** - The forging of an indelible public apprehension of county-wide ozone levels and its daily reinforcement from displayed ozone maps on the Sacramento Metro AQMD (Air Quality Management District) Spare The Air (Sac STA) website. These maps color code hourly ozone levels calculated by Sonoma Technologies Inc. from their proprietary computer model which uses ozone measurement inputs supplied by about two dozen monitoring stations located around the valley and foothills as listed on the website. There is no evidence that this model's output is reliable in the technical sense as described below in §2.
3. **The Ozone Standard Attainment Process** – EPA has mandated a complex process that involves ascribing to Nevada County a non-attainment classification (e.g. 'Moderate', 'Severe', 'Extreme') from the historical data output by the county's single ozone monitoring station operated by the Northern Sierra AQMD and located on the roof of the Litton Building in Grass Valley. The county will be required to develop an attainment plan. The EPA will then exercise a suite of computer models using inputs from the attainment plan to predict when the county's ozone levels will attain the mandated standard. Based on these calculated predictions, the EPA will either accept the county's attainment plan or require it to be revised.

We will expand each of these categories and examine their ramification on community attitudes and potential responses. Figure 1 contains the schematical integration of the major activities involved in the overall process and will serve as the basis for most of the explication to follow. The red colored arrows and borders indicate processes, documents, and programs for which evidence of scientific support is lacking or absent as detailed in the sections to follow.

[1] In this report we define the term 'ozone measurement' to mean the reading from a physical ozone monitoring device at a fixed location. The term 'ozone level' is defined as the output of a computer model that purports to calculate ozone readings over a wide region using inputs from ozone monitoring devices and possibly other source and weather related data.

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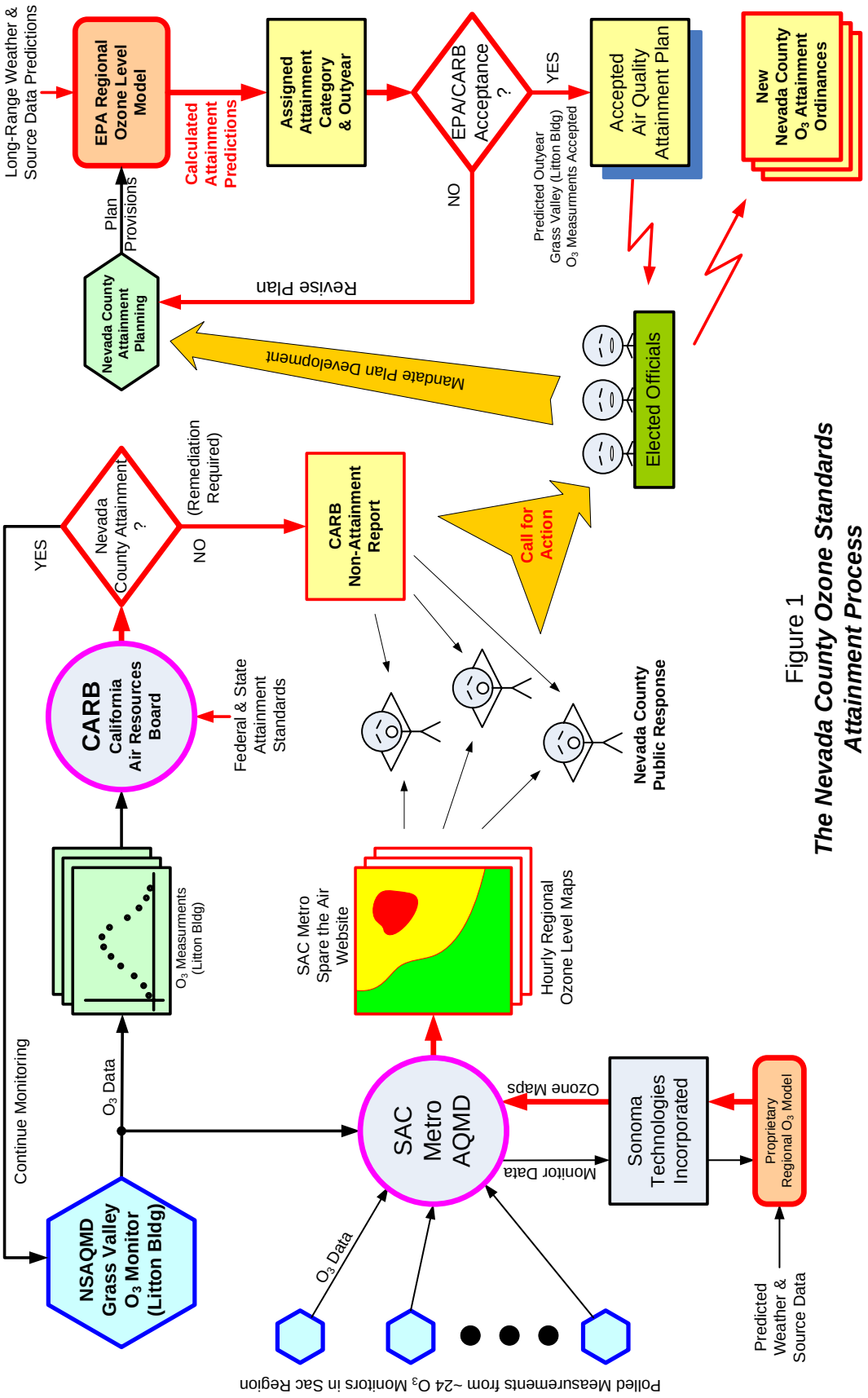

Figure 1
The Nevada County Ozone Standards Attainment Process
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1.1 Government Ozone Standards and their Attainment

According to our own NSAQMD, in recent years the EPA and the California EPA have engaged in a process of taking turns to impose ever more strict ozone standards. Initially the EPA mandated a 120 ppb/1 hour standard. This was subsequently reduced by CARB (California Air Resources Board) to 90 ppb/1 hour which was then again 'bettered' by the federal EPA. In this manner the most recent EPA standard sits in a range from 60 to 75 ppb, and there is no guarantee that this will be the last pronouncement on ozone levels.

How has attainment of standards in Nevada County been determined by the federal and state governments, and how do they plan to do it in the future? The process is very straightforward and completely arbitrary. The EPA simply states that western Nevada County's ozone levels are uniform over the entire region at the averaged value calculated from the output of the single NSAQMD ozone monitor in Grass Valley. This monitor is annually certified by the EPA to be reliable in that it produces an accurate stream of ozone measurements. There is no evidence that this monitor has ever delivered anything except reliable ozone measurements at its installed location, currently on top of the Litton Building some fifty feet above the ridge top where the building is located.

The part that is disturbing to the technical reader is that this single measurement is then ascribed to be the uniform ground-level ozone concentration over a region of about 500 square miles of very complex terrain comprised of hills, ridges, valleys, and canyons.

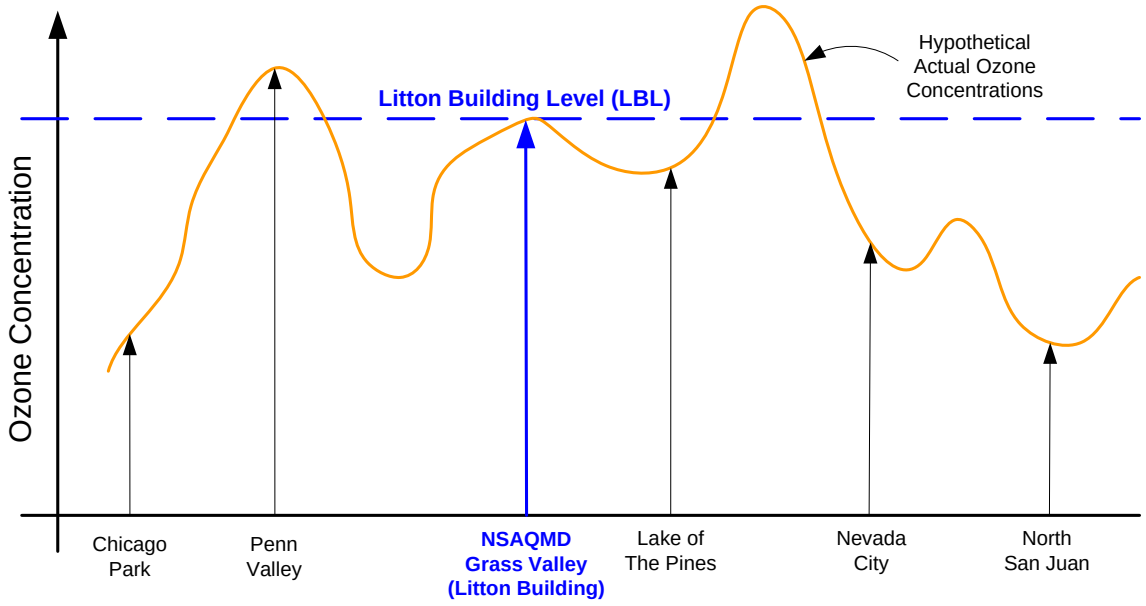

Figure 2. The Litton Building Level (LBL) and Countywide Ozone Variablity

This is also a region of highly complex and poorly understood airflows which is located between the highest mountain range in the continental US and the broad California cen-

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tral valley at essentially sea level. Everyone in western Nevada County is known by the EPA to breathe the same ozone level – hereafter labeled the Litton Building Level (LBL) - that is measured at the height of approximately 50 feet above the crest of one of its ridges. And by the fiat of imposing the LBL to hold over western Nevada County, the EPA pronounces the county to be in attainment or non-attainment.

In order that there is no confusion about the 'one ozone level fits all', we illustrate the situation in Figure 2 above. The curvy line in the figure shows the potential variability of readings over western Nevada County. This curve denotes the hypothetical ground-level readings at a given time that ozone monitors would provide if a sufficient number of them were located across the landscape. Noted on the figure are various county communities along with the NSAQMD Grass Valley monitor from which the illustrated LBL is obtained.

We substantiate the strong criticism, illustrated in Figure 2, of using LBL as the proxy for the county-wide ozone levels by looking at a plot of real data recorded by NSAQMD. In 1993 this agency moved its offices from Nevada City to its current location in Grass Valley. A fortunate aspect of this move was that NSAQMD was able to operate two calibrated ozone monitors – the old one in Nevada City and the new one in Grass Valley - concurrently and record comparable data from these monitors located approximately five miles from each other. A plot of these composite hourly ozone values was provided to SESF by Mr. Joe Fish of NSAQMD and is shown in Figure 3. The data points in these

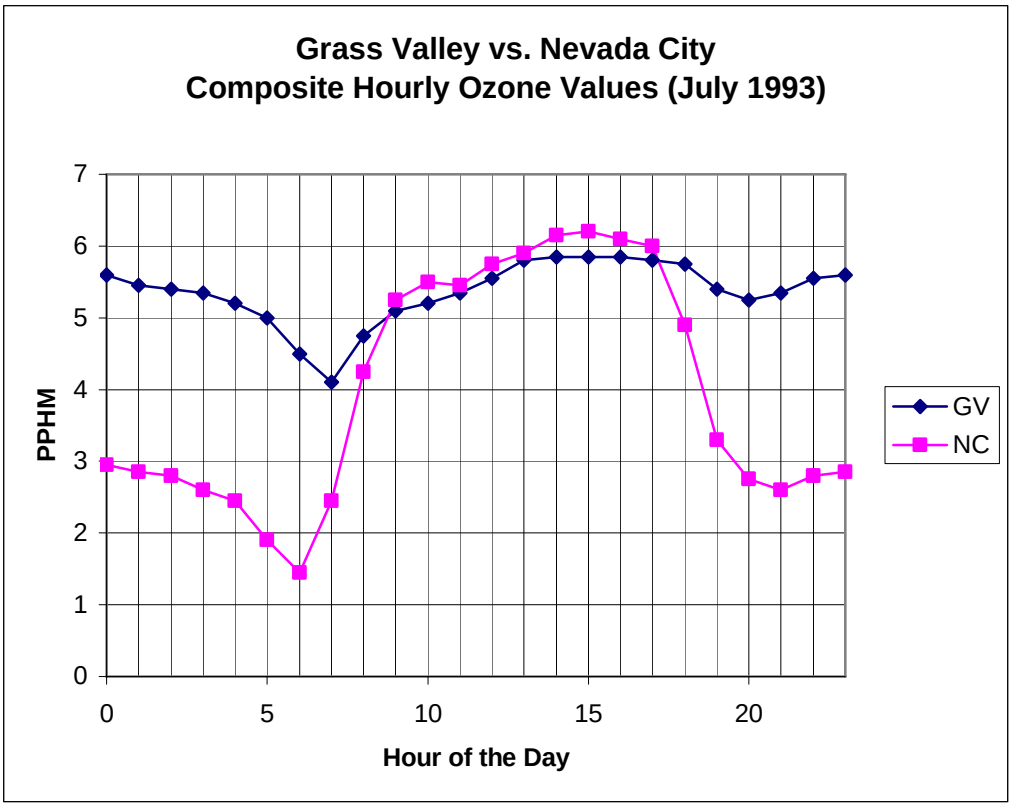

Figure 3 (Data supplied by NSAQMD)

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plots represent the average readings for each hour of the day during July 1993. Since averaging is a smoothing process, it is clear that the plots of individual readings between the sites would show even more variability than illustrated in the figure. With this evidence in hand, the continued use of the LBL over a wide region is not supported by actual real-world ozone measurements.

1.2 Influencing Public Perceptions about Ozone Pollution

In Figure 1 the ozone data from the NSAQMD monitor is also shown being transmitted to CARB and the Sacramento Metropolitan AQMD (SAC Metro AQMD). We now describe the uses of these reliable single-site ozone readings from a periodically calibrated and EPA certified instrument.

As shown in the figure, SAC Metro AQMD polls ozone data from about two dozen monitors in the central valley and the foothills. This data is actually collected by Sonoma Technologies Incorporated, a vendor to SAC Metro. STI inputs the area wide ozone measurements into a computer model that is the company's proprietary intellectual property and not available for public disclosure. The STI model outputs hourly color-coded ozone level maps of the region. It is these model-generated levels for the western county, and specifically for Grass Valley and Nevada City, that are then broadcast on local radio/TV, the web (Spare the Air), newspapers, and also cited at community workshops and briefings. It is these calculated levels, when they are high during summer months, that are the source of current concern.

As will become evident in §2, where we discuss the state of development of general circulation models of the atmosphere, the STI model is a second tier effort for which there is no evidence of peer review or of its having gone through any validation process. The model generates a series of online graphics of unknown reliability suitable for viewing only by an uncritical and impressionable public. Further evidence of the value of this computer model is that CARB apparently places no value in its calculated ozone levels. Its apparent function is to help SAC Metro AQMD remind folks that they have a responsibilty in reducing air pollution in the greater Sacramento area.

The Northern Sierra AQMD also publishes a dedicated webpage for O3 in Nevada County. This page does not contain O3 levels in the county, nor makes any claims about the reliability of such information. It does cite that in 2004 the county was designated to be in non-attainment and references the appropriate EPA standards that have been exceeded. In Figure 1 this process is shown by CARB's receipt of NSAQMD measurements and then deciding through the application of the LBL criterion (described above) that Nevada County is in non-attainment. The report of such non-attainment contributes predictably to public concern.

In the midst of this community dialogue NSAQMD regularly informs us that "Most of Nevada County's ozone is transported by upslope winds from the Sacramento and Bay Areas.", and continues with "Nearly half of California's ozone is the result of on-road motor vehicle exhaust." However in other studies and presentations (for example, here)

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it is clear that "most" translates to 'the overwhelming amount'. The above non-sequitor about motor vehicle exhaust seems to imply that half the county's O3 levels are the result of local vehicular traffic. Contrary to this, there is no evidence that the elimination of all the county's ozone sources would change the calculated O3 levels to bring the county into compliance. During a county Board of Supervisors meeting the author suggested to the California Air Resources Board that such a baseline study be conducted first.

Adding to this confusion are the vocal efforts of local activist groups such as Save the Air in Nevada County. They state that –

> "STA in NC was founded in 2006 by a group of community residents who were alarmed to discover that their small town in the Sierra Nevada Foothills was home to some of the highest levels of ozone pollution in the State of California and in the nation."

It appears that they have already signed up to the notion that we have the "highest levels of ozone pollution" without bothering to corroborate how or if these reported levels could even be determined. In their zeal to at least do something they prematurely (as of 15 September 2007) state that –

> "Save-The-Air in Nevada County has begun monitoring ozone levels around the county, to complement the work being done by the local air management district. We're also comparing the air indoors and out, because, when ozone levels climb, we're warned to avoid exercise and to stay indoors – to shelter in place."

As will become clear below, reliable calculations of ozone levels in complex terrains with complex air currents is still an unverified art seeking the support of science. STA in NC has yet to reveal its methodology or resulting data from its ozone monitoring efforts. In their favor is their public recognition that the major sources of our air pollution lie upwind and to the west of us. (STA in NC celebrated the receipt of its first portable ozone monitors on 11 September 2007. See §3.2.)

Finally, adding to the growing public clamor for action is NSAQMD's reminder that the county must prepare an Attainment Plan for bringing ozone levels to the prescribed standard. The process for attempting to achieve this is described below and involves a most hopeful application of computer modeling within the next five to ten year period. In this regard we abstract the following revealing paragraph regarding ozone modeling -

> ***How Much Air Pollution Will We Have To Reduce?***
>
> In addition to the above requirements, western Nevada County must achieve a 15% reduction in the emission of ozone precursors (VOC and/or NOx) between 2002 and 2008 and then ***meet additional annual reductions based on ozone modeling that is currently under way***. Most of our reductions are expected from cars becoming cleaner, although increasing population works against these reductions. (emphasis added)

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In western Nevada County there are now in place resolutions calling for a TBD regional air quality summit at which we presume that higher level organizations like the California Air Resources Board (CARB) will be taken to task about the use of LBL and the county's ability to contribute to its attainment of the mandated ozone standard.

1.3 The Ozone Standards Attainment Process

The CARB Non-Attainment judgment and public outcry jointly reinforce a call for action by the county's elected officials as indicated in Figure 1. Following the prescriptions described by NSAQMD, our elected officials will have no choice but to direct their staffs to start county-wide attainment planning.

At an appropriate future time the attainment planning process will produce a draft plan with specific provisions for reducing ozone levels. These provisions would presumably be forwarded through CalEPA to EPA which agency will translate the provisions into data suitable for input to a TBD EPA Regional Ozone Level Model as indicated. The model will then output a calculated attainment prediction. It is important to understand what form this attainment prediction will take. EPA claims that it will compute a series of ozone readings that will be realized by the NSAQMD Grass Valley ozone monitor. Based on these calculated readings EPA will assign Nevada County an 'Attainment Category' (e.g. 'Moderate', 'Severe', 'Extreme') and, if possible, the outyear during which attainment will occur. Again we note that the EPA will mandate that the west county area-wide ozone levels will be determined by the same arbitrary LBL method as described above.

Depending on the assigned Attainment Category and the attainment outyear - given that the plan provisions succeed - the county's draft attainment plan will be accepted or remanded for revision. Once accepted, the Attainment Plan will form the basis for the county's elected officials to pass the appropriate attainment ordinances to implement the plan.

Since all of this depends on the development and proper exercise of unknown computer models developed at NOAA and other institutions, we next examine what are the prospects that any of this will be supported by the available science.

2 Modeling Ozone Pollution

2.1 General Problems and Current Shortcomings

Two revealing reports from government agencies have been written recently that allow us to put the O3 modeling issue into perspective. In 'A Major Challenge in Meteorological Model Evaluation for Air Quality' Bao and Michelson [1] have outlined in detail the major problems which remain with designing and building computer models that explain and predict ozone levels over large areas containing complex terrain and even more com-

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plex air flows. These scientists from NOAA and the University of Colorado (CIRES), both located in Boulder, Colorado, have concluded in a carefully worded report that there is yet so much work to be done that the state of the current models represents only the beginning of a much longer journey to understanding how ozone pollution behaves in the real world.

Specifically, they report that all aspects of such air quality models are poorly understood and/or unconfirmed. The fundamental physics of involved airflows that determine how and where the ozone spreads are unknown.

> There are no reliable observations for the verification of the surface turbulence fluxes and soil conditions. However, our process evaluation indicates that surface fluxes and soil conditions are important to the evolution of the local wind conditions in the central California region that are known to have a pronounced impact on ozone concentrations.

The conceptual model – not including the actual equations - that defines what physical factors should be included (and represented by sets of carefully crafted and coupled equations) so as to correctly represent the observed physical processes has yet to be verified.

The major recommendation of their report is that a model validation scheme should be set up to perform some very important and fundamental steps to confirm that what is out there now works. Such a process apparently has never been implemented to validate the calculating tools now in everyday use. Figure 4 below showing the recommended process is abstracted from their report. The technical reader in the system sciences will see

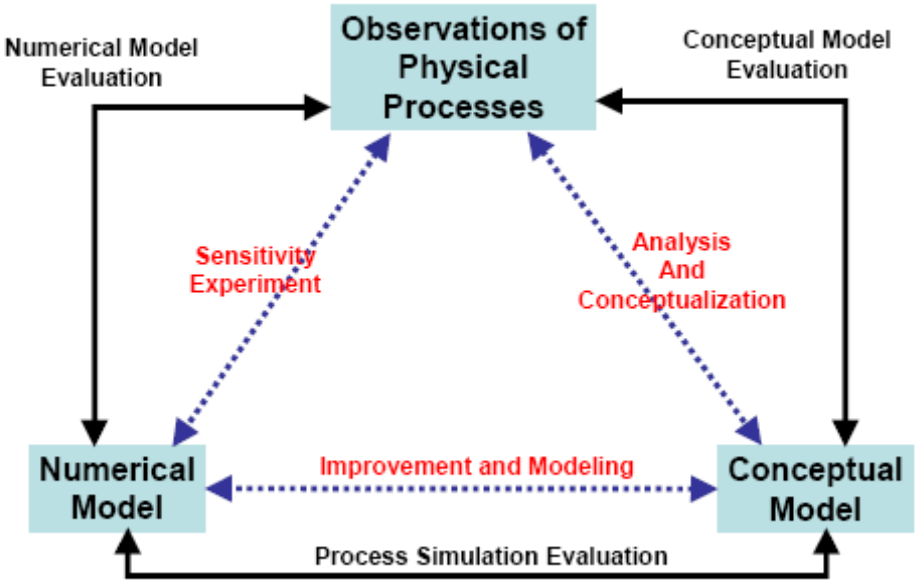

Figure 4. Bao and Michelson Model Validation Process [1]

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that these tasks are the fundamental and necessary precursors before any model is promoted to an operational phase, and that their completion is critical if the model outputs will be used to influence public policies affecting millions of residents.

In the second report [2] - 'Comparison of Simulated Ozone Generated with Growth-and-Control vs. Uniformly-Reduced Emission Inventories in California' by C.L. Archer et.al. - the authors describe the difficulties in comparing measured data to model outputs. The work is based on an extensive data gathering effort and study called 2000 CCOS which covered California's central valley and extended to the coast in the Bay Area as shown below in their map of the "modeling domain". An important and remarkable fact emerges: this seminal study *excluded* all the difficult foothill counties (including Nevada County) with their complex terrains and airflows (Figure 5). This is the study that is cited extensively in the literature as the basis for developing, tuning, and operating the CARB adopted models that calculate our county's daily ozone levels. In this light the concerns and recommendations of Bao and Michelson become even more understandable.

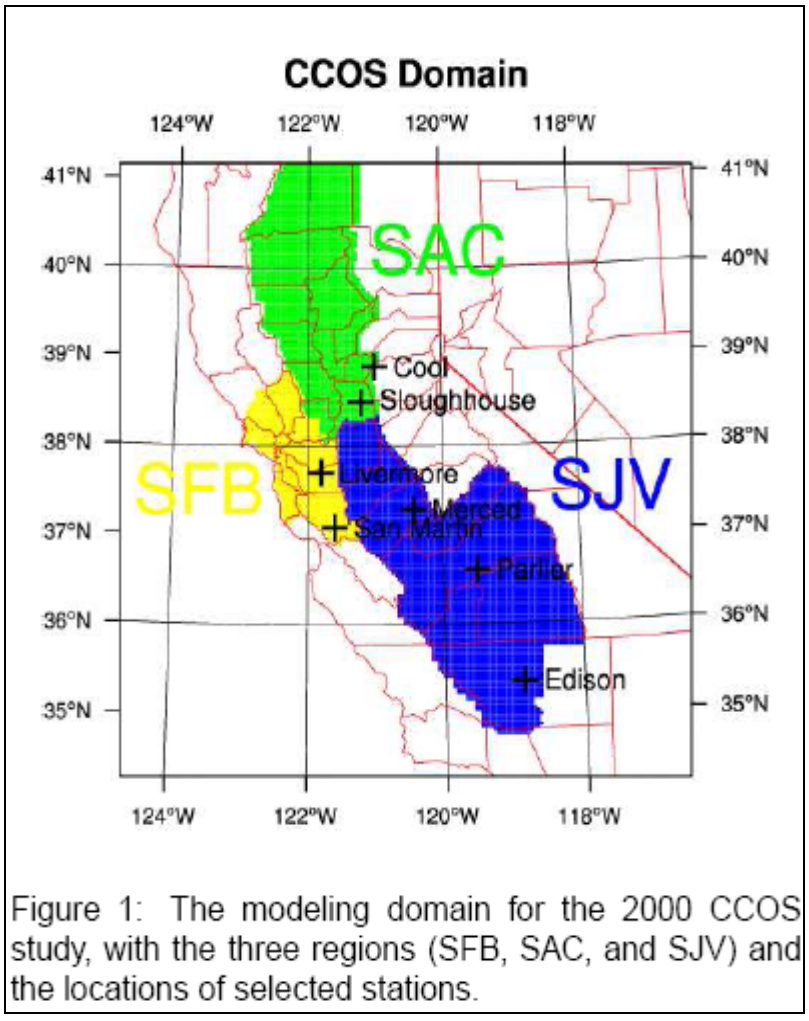

Figure 1: The modeling domain for the 2000 CCOS study, with the three regions (SFB, SAC, and SJV) and the locations of selected stations.

Figure 5. The Modeling Domain for the 2000 CCOS Study [2]

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2.2 The Dynamics of Uncertainty in the Modeling Community – from Model Building to Policy Making

Complex computer models are not yet stamped out by machines on an assembly line. They are products of human agony and joy that emerge after years of work from an equally complex society of technicians and bureaucrats. Models of realworld processes are the products of cooperating 'domain experts' who understand the, say, various physics involved, and systems engineers and/or computer scientists who understand the data handling and algorithmic requirements to implement the model in a real computational environment. In the end no one individual is expert on all facets of knowledge which any large model embodies.

Due to political and economic factors, there is great pressure to move models from the development phase to the operational phase – we always want to start using them sooner than later. Climatological and atmospheric models, such as used for ozone level modeling, are not an exception to such a path from inception to field use. Finally, when we superpose onto this the realization that all models only approximate to a certain level of uncertainty what happens in the realworld, then understanding the social dynamic of this process becomes an important piece of knowledge for policy makers whose decisions depend on the data and information generated by such models.

The importance of models and their use in advanced countries has now come to the attention of sociologists and anthropologists. Specifically, because of the public interest in climate change and air pollution, the veracity of such models from their original development, through modifications, to their use and subsequent assessment of their outputs for policy making is the subject of a recent study and paper by M. Lahsen [3]. The contents and conclusions of this very readable paper should be known to everyone involved in the process of advocating and/or making public policy that is influenced by such models and their reported output.

In this subsection I will summarize some of the more important observations made by Lahsen during her multi-year work in Boulder, Colorado with modelers and scientists at CIRES (Cooperative Institute for Research in the Environmental Sciences, University of Colorado) and NOAA (National Oceanic and Atmospheric Administration).

The heart of such efforts to generate explicative and predictive models of climate and atmosphere is the General Circulation Model (GCM). GCMs are developed to study and predict climate, weather, and the movement of certain components of the atmosphere such as pollutants. The complexity of the models increase with the number of forcing factors (weather, sun intensity, anthropogenic pollutants, …), the complexity of the geography, and the resolution of the three-dimensional cells that all such models use to relate their output to the earth's surface. Air pollution models in mountainous areas that are required to calculate pollutant levels over diurnal cycles over cells that measure of the order of a square mile horizontally and the order of feet vertically are, perhaps, the most complex of all such GCMs. It is the output of one or more such GCMs that is used to calculate the ozone levels for the Sierra foothills.

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Lahsen [2] informs us that "GCMs are simulations used to model climate dynamics. GCMs use computations to simulate complex interactions between the components of the earth system; time-dependent three-dimensional flows of mass, heat, and other fluid properties. The models divide the earth system into three-dimensional grids, mathematically representing the physical movement of gaseous or liquid masses and the transfer, reflection and absorption of energy. They compute these processes at each grid-point at appropriate time intervals and repeat and speed-up these processes to simulate future states of the climate system."

Now we enter the human dynamic studied by Lahsen that can be generalized over all fields making and applying models. She observers that "modelers typically identified the problem of *users*' misuse of their model output, suggesting that the latter interpret the results too uncritically. Model developers profess that they, as one of them put it, take the models 'seriously but not literally'." And goes on to point out that all GCM users modify the models they receive where "no single person deeply knows, or is 'close to', all aspects of a given GCM."

People in a modeling community speak to each other differently than they do to an outsider – who may represent model promoters, model users, or model output consumers. A common paradigm in such dialogues is that modelers and their agencies' PR people speak to outsiders "invoking models as 'truth machines'". This is done almost subconsciously and often leads to significant misconceptions on the part of the people downstream of the modelers.

Lahsen then tells us the important part, that "(t)he complexity of GCMs undermines modelers' ability to gauge the validity of their own models. Computer models have grown so complex and scientists so specialized that modelers spend little time checking their own models against available observations. This weakens their ability to identify where their models fail to accurately represent empirical evidence."

Inevitably there exists a hierarchical insularity among modelers, empiricists, and users, all of whom may at times overlap some of their functions. For example users complain that modelers often have a "fortress mentality" wherein "they have built themselves into a shell into which external ideas do not enter."

This to a great extent explains, for example, why it is difficult for empiricists and user agencies such as the NSAQMD to have access to models that source agencies use to generate the published daily ozone levels across western Nevada county.

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3 What Are the Ozone Levels Where We Live?

3.1 The General Situation

Most informed people already know that Nevada County's O3 is imported from upwind sources in the Central Valley and the Bay Area, and that there is little or nothing that we can do here to affect our O3 levels. The next question on everyone's mind should now be 'what are the actual O3 levels where we live?'. There are no measurement data that corroborate ground level predictions for the Sierra foothills, including west county, from the STI model (Figure 1). No one has yet taken a properly calibrated O3 measurement instrument around the county to compare the actual levels to the model predicted levels (although progress toward that goal is being attempted). This step, which may be irrelevant to the currently mandated attainment process, is critical before we start agitating for new resolutions, filing law suits, and/or writing public policy that may wind up only hurting the county's residents.

To motivate us to confirm what the unknown EPA ozone models will say, we should consider the following factors (in no particular order) about such models in light of the material in §2 above –

- The regional input O3 measurements are sparse with no data on their reliability – accuracy and applicability.
- The public sentiment impacting STI model is maintained as a confidential intellectual property not available for qualified third-party inspection, study, or review. Specifically, the information about which of these are used how to calculate the published daily large area ozone level maps is not available.
- CARB lists a suite of models that presumably will be included in the EPA regional level ozone model (Figure 1) that will be used to assess the acceptability of the TBD Nevada County Attainment Plan.
- The Northern Sierra AQMD has not been able to find and communicate with any domain expert familiar with the workings of the EPA model that will calculate the predicted outyear Litton Building ozone levels upon which the county's ozone standards attainment will be assessed.
- Models, like those developed by NOAA and CIRES for the EPA, give widely varying outputs that depend on numerous assumptions all of which must hold. The assumptions and the model's sensitivity to them are not known [1].
- EPA's overall regional O3 level model must use other sub-models in its working – e.g. horizontal and vertical air transport models, pollutant specific generation and dispersion models, topography models, weather effects model, etc. These models, according to the literature, are also poorly or not known.
- Almost all of the county's O3 is actually 'cooked' by sunlight from a collection of complex precursor pollutants while on their upwind trajectory toward us. This varies with altitude in a complex manner. How much of this does the model include and how?

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- Western NC has a varied and complex terrain. It has not been established that there exist *any* reliable air movement substance dispersion models for mountainous terrain, especially when we specify 'distance above ground level'.
- The EPA model must account for various distributed and time-varying sources of O3 and precursor pollutants. For a baseline determination, what county levels (or even LBL) does the model predict if all NC sources are zeroed out?
- The EPA model's output of O3 levels over the region will be stated as a single number for any given location. Modeling such a complex process with so many inter-dependent assumptions, sub-models, and sources for error will at best yield a distribution of levels for any given location that attests to its reliability. Stating it as a single unqualified number is unprofessional and totally unacceptable for any reasoned consideration as the basis for making public policy.

There are other factors, not discussed here, that cover the arcane techniques of computability, algorithmics, estimation, … which are intimate to any such efforts to model complex systems like O3 generation and dispersion over large mountainous regions. Bottom line – today we know neither the scope nor details of our O3 problem. We have only the mandated LBL that is used to ascribe county-wide ozone in a scientifically baseless manner.

3.2 A New Effort to Measure Local Ozone Levels

On 11 September 2007 STA in NC publicly celebrated and displayed its acquisition of a portable O3 monitor. This transportable device is the Model 202 manufactured by B2 Technologies, Inc. Information about the monitor including its downloadable Operation Manual is readily available on the company's website.

STA in NC has stated that it intends to begin monitoring ozone levels at designated locations such as parks and school grounds where children and other people are active outdoors. They have now acquired a second monitoring device which will be used in a similar manner.

It is not yet clear how the ozone levels recorded by these devices will be made available. Since the 'care and feeding' requirements of the CARB (EPA) ozone level calculation models are not known, it is too early to tell whether these monitors can also provide their outputs as inputs to the models. From the basics of modeling such ozone level fields, we know that providing a denser sensor network over a given area should enhance the models' performance (given all the other findings reported in §2).

Perhaps a more critical requirement for the data from these monitors (to be used in either assessing the current levels of ozone pollution or contributing to the EPA model inputs for deciding the acceptability of the county's TBD attainment plan) is that the monitors must be accredited as is the NSAQMD Grass Valley monitor. Specifically, the STA in NC monitors must first go through a formal EPA acceptance process and receive certifi-

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cation – i.e. get the 'EPA sticker' pasted on it. In any event, we do expect STA in NC to publicize the ozone measurements that its monitors will record.

Finally, a perusal of the Model 202 Operation Manual indicates that setting up, calibrating, and operating the monitor is not a task for the layman. Additionally, more care will need to be taken to select the actual monitoring locations and intervals so as not to contaminate the measurements.[2] In order to shed more light than heat on the ozone pollution issue, STA in NC should make available its monitoring methodology and the resulting recorded data for third party review and analysis.

A strongly recommended first step is that both Model 202 monitors be initially co-located with the NSAQMD ozone monitor on the roof the Litton Building in Grass Valley. Mr. Joe Fish has stated that the NSAQMD is already supporting STA in NC in this effort. Comparing the outputs of all three monitors over appropriate intervals should be very revealing and serve to establish the confidence level in the output of both uncertified monitors when used in a stationary setting. SESF looks forward to supporting the results analysis of such tests which should be repeated at a prescribed frequency or after any of the monitors undergoes a material change (e.g. recalibration, repair, relocation).

4 Conclusions and Recommendations

This short technical note is not intended to be an end-all explication of what is required for Nevada County to resolve its ozone issue nor is it a thorough review of complex modeling efforts; such work is well reported in [1,2,3] and their references. Neither is the intention here to summarily conclude the extent of Nevada County's ozone pollution problem. It is the intent of this report to alert community leaders and the interested public about the basis of the much publicized ozone levels in our county and the upcoming process through which we are expected to achieve attainment of government standards.

Our summary finding is that –

1. **The reliability of the calculated and/or summarily designated ozone levels over the land area of western Nevada County that currently inform federal/state/county government decisions and public debate is unknown.**
2. **There is no evidence that any proposed Nevada County attainment plan will be evaluated with correct ozone propagation models that satisfy the minimum requirements as outlined by Bao and Michelson [1].**
3. **Given the available evidence on the sources of Nevada County's ozone pollution, any mandated county attainment provisions can only be based on arbitrary political factors lacking the support of available science.**

[2] The nationwide array of NOAA's ground temperature monitoring stations is being surveyed by meteorologist Anthony Watts and a team of volunteers that includes Russell Steele, a Director of SESF. Their documented findings to date indicate that a large fraction of these temperature sensors have been recording faulty readings due to their placement near man-made heat sources. These findings (here and here and here) have been nationally publicized and are impacting the global warming debate.

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Further, it is not clear that the most current technical basis for understanding Northern California air pollution (the 2000 CCOS study) even included the factors related to the complex terrain and air movements of the Sierra foothills. If the county is forced to go through the attainment planning process as outlined above, then a perversion of fundamental logic will be the result. The EPA will evaluate our attainment provisions by running their model with inputs of predicted upwind O3 sources and precursors 1) which will overwhelmingly determine our ozone levels, and 2) which the county is powerless to influence.

From this state of affairs it is clear that job one is to obtain demonstrably reliable ground-level ozone readings for western Nevada County. It is possible, though unlikely, that the methodology for calculating such levels from the CARB (EPA) models is already in place. Taking into account the revelations of Lahsen's study [3], this needs to be verified through an open dialogue with the management and technical people of the state and regional agencies involved. And as appropriate, the recommendations of Bao and Michelson should then be carried out.

As a parallel effort, a thorough review of The Federal Clean Air Act, which sets requirements for non-attainment areas, should be on the county's agenda. While out of scope of the present report, researching this law may reveal the legal bases for defining ozone levels and source management processes that could prove useful in deciding what avenues are available to us through the courts.

Without such information and data we will continue to wage an unproductive battle against rumor, anecdote, and pending government mandates armed with conjecture and unsupported histrionics in the county's public forums. With more reliable data and information on hand, we as a community can then determine the extent of our ozone pollution problem, formulate reasonable alternatives, and decide on next steps to pursue.

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