Response to Questions from the AQCC

1. The model has been said to be underpredicting the current and future ambient ozone concentrations at the monitoring locations. Why is the model underpredicting and by how much? Please explain

ANSWER: Good model performance is a prerequisite for use of a model in an attainment demonstration. EPA has published draft 8-hour ozone modeling guidelines (EPA, 1999) that are used as a basis for judging the adequacy of the Denver base case (2002) simulation. For the June 25-July 1, 2002 episode, the model performance meets the EPA modeling guidelines. During this episode, the model is deemed adequate to use in a relative sense to demonstrate attainment of the 8-hour ozone standard. The photochemical model performance for the 2002 base year is presented in Appendix I of the TSD. Using the photochemical model in a relative sense reduces problems posed by disagreements on an individual day.

The EPA draft guidance for 8-hour ozone modeling has specific procedures for using the current and future modeling results in a relative fashion rather than using an absolute modeled concentration to scale the observed 8-hour ozone Design Values to project future-year 8-hour ozone Design Values (EPA, 1999). EPA's approach toward scaling ozone Design Values using Relative Reduction Factors (RRFs) has some safeguards against using too low modeled ozone concentration in the Design Value scaling by screening out any days in which the maximum 8-hour ozone value near the monitor is less than 70 ppb. These procedures were used for the Denver EAC to estimate 2007 8-hour ozone Design Values under the various 2007 emission scenarios.

Table 1-1 presents an indication of model accuracy over the June 25-July 1, 2002 episode at the Rocky Flats monitor. For two modeled days, June 26 and June 27, there were no ozone monitor data to pair the data and are indicated as "Na" in the table. However, June 27 is considered in the modeling analysis since the base year 2002 model results were greater than 70 ppb. June 25, 26, and 28 were not used in the attainment demonstration per EPA Modeling guidance because the 2002-modeled concentrations were less 70 ppb. The shaded areas (yellow) indicate the dates that were used for the attainment demonstration.

For all paired data, the overall model to monitored accuracy is 15.4%. For all paired data that was used in the attainment demonstration (i.e. 6/29,6/30,7/1), the model accuracy was 13.7%. For July 1, where both the model prediction and the monitored concentration is near the 8-hour ozone standard, the accuracy is 4.0%.

In all instances, the modeled value was less than the monitored concentration. Keep in mind that the absolute modeled concentration estimates were not used to determine attainment but rather modeled data was used in a relative manner to determine attainment. Also, the modeled values are the highest estimated concentrations "nearby" the Rocky Flats monitor.

Table 1-1: Accuracy of Modeled vs. Monitored Data at Rocky Flats during the June 25-July 1, 2002 Episode

Date	Modeled	Monitored	% Difference
6/25/2002	62.8	80.0	21.5%
6/26/2002	62.7	Na	Na
6/27/2002	70.9	Na	Na
6/28/2002	62.1	73.0	14.9%
6/29/2002	70.5	89.0	20.8%
6/30/2002	73.8	88.0	16.1%
7/1/2002	84.5	88.0	4.0%
Mean	70.7	83.6	15.4%
Mean of 6/29,6/30,7/1	76.3	88.3	13.7%

As discussed in the Denver 8-hour ozone EAC Modeling Protocol (Tesche et al., 2003-TSD Appendix A), model performance evaluation consists of a series of tests that become more stringent as one moves through the model performance process. Recommendation in the EPA draft 8-hour modeling guidelines are used as an initial test of model performance. Some reasons why the absolute concentrations, although not used for the attainment demonstration, may have been underpredicted include (Morris and Mansell, 2003):

- The model exhibits a spatial displacement of the elevated ozone concentrations further away from the Denver Metropolitan Area (DMA) than observed.
- Overstatement of the afternoon ozone suppression in the Denver Metropolitan Area (DMA) on most days.
- Underestimation of ozone transport into the Denver Metropolitan Area (DMA).
- Underestimation of the amount of local photochemical production due to local emissions.
- Overstatement or misallocation of local convective activity during some days of the episode.
- Understated mixing in the Denver area.
- Overstated maximum afternoon mixing heights.
- Understated VOC emissions inventory or understated VOC reactivity (local and/or regional).
- Overstated local NOx emissions.
- Understated ozone and/or VOC boundary conditions (BCs).
- Wind direction and wind speed errors.

2. There have been several problems asserted to exist with the development of the emissions inventory. What problems with the inventory have been raised and why is it valid to proceed when such problems exist? On the contrary, why are the issues raised not problems?

ANSWER: All of the inventories were developed using EPA-approved emissions modeling methods, including EPA's Mobile6 model and local VMT data for on-road mobile source emissions, EPA's non-road model and local demographic information for area and off-road sources, and reported actual emissions for point sources. Estimates for future emissions are based on the above-mentioned tools and the EPA EGAS model for estimating future point sources activity, VMT growth for on-road mobile sources, and 2007 demographic data for off-road and area sources. The ozone maintenance plan technical support document (Appendix C) contains detailed information on model assumptions and parameters for each source category. Using EPA-approved emissions modeling methods assures that the SIP inventories will be approvable.

3. Does the Division/RAQC believe that the Denver area is "Hydrocarbon Limited" as an ozone nonattainment area? There has been an assertion that there is not enough data to determine if HC limited or NOx limited? Please explain why we can assume HC limited and proceed to reduce VOC emissions across the nonattainment area as our path forward to reduce ambient concentrations of ozone.

ANSWER: Along with the limited amount of ambient data that show the Denver area is VOC limited, the photochemical modeling done to date indicate that VOC controls are the most beneficial and there is a NOx disbenefit is most cases. Table 3-1 presents various sensitivity test that were performed and the relative difference in ozone concentrations based on the various scenarios. As seen in the table, there is a general disbenefit of NOx controls at RFN. VOC control in the DMA is more effective than NOx control for reducing 8-hour ozone concentrations near the Rocky Flats monitor, as well as all the other monitors except Rocky Mountain National Park.

Table 3-1. Projected 2007 8-hour ozone Design Values at the Rocky Flats monitor for the emission reduction sensitivity simulations.

Scenario	Base	DV	ΔO_3
2001-2003 Observed		87	
2007 Base		86.6	
8.1RVP/40%EtOH, Flash/RICE (cntl4)*	07Base	86.2	-0.4
10% VOC (cntl8)	07Base	86.1	-0.5
10% NOx (cntl9)	07Base	87.0	+0.4
Cntl4 plus 10% VOC+NOx (cntl10)	07Base	86.3	-0.3
Cntl4 plus 10% VOC (cntl11)	Cntl4	85.9	-0.3
Cntl4 plus 10% NOx (cntl12)	Cntl4	86.6	+0.4
10% VOC+NOx (cntl13)	Cntl4	86.0	-0.2
10% On-Road VOC (cntl14)	07Base	86.5	-0.1
20% On-Road VOC (cntl15)	07Base	86.3	-0.3

Scenario	Base	DV	ΔO_3
10% Off-Road VOC (cntl16)	07Base	86.5	-0.1
20% Off-Road VOC (cntl17)	07Base	86.5	-0.1

4. What is the Division's prediction for ozone concentrations in the Denver metro area for the next 1, 2, 3 years?

ANSWER: Although we have not done analysis for 1-year increments, our emissions inventories (TSD-Appendix B) and the trend analysis presented in the WOE appendix indicate along with the current modeling that ozone trends should stay about the same or decrease over the next three years.

5. **Does Elbert County really need to be included in the nonattainment area boundary and why? Please explain.**

ANSWER: On December 3, 2003, EPA recommended that 11 counties along the Front Range be included in the 8-hour ozone nonattainment area: all of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Elbert, Jefferson, Larimer, Morgan, and Weld Counties. This includes the 8 counties in the Denver-Boulder-Greeley Consolidated Metropolitan Statistical Area (CMSA) plus three adjacent counties containing sources that may be contributing to violations. Factors considered were source locations, commuter patterns, population density, meteorology and topography. The 8-hour standard has been violated in Jefferson and Douglas Counties (Rocky Flats North, NREL, and Chatfield), and other monitoring sites in Weld, Larimer, and Arapahoe Counties are close to violating (Weld Tower, Rocky Mountain National Park, and Highlands).

On February 5, 2004, CDPHE responded that the size of the recommended boundary should be reduced due to the lack of sources in rural areas and the great distance of emission sources from the high ozone areas. The recommended boundary should be adjusted to eliminate the northern portions Larimer and Weld Counties, the far eastern portions of Adams, Arapahoe, and Weld Counties, and all of Elbert and Morgan Counties from the nonattainment area. If some portion of Morgan County must be included in the boundary, then the eastern half of Morgan County should be excluded from the boundary. EPA will make a final decision on the boundary by April 15, 2004.

Elbert County contains very few sources and is, for the most part, outside of the airshed due to elevated terrain.

6. Does the APCD/RAQC suggest that the Commission adopt a proposal to apply all of the Regulation Number 7 requirements to the entire area or intend to leave the applicability of the rule as it exists today? Please explain why the APCD/RAQC would not propose to extend the requirement to the entire NA area?

ANSWER: The RAQC/APCD have not proposed that the requirements of Regulation No. 7 be expanded to the ozone nonattainment area at this time. First, the boundary for

the area has not been finalized, and will not be finalized before the March 11th AQCC hearing on the ozone plan. Second, stationary sources in the 7-county metro Denver counties are already subject to Reg. 7's VOC control requirements. The additional VOC reduction potential for an expanded Reg. 7 was not determined due to time constraints and the boundary uncertainty.

It is estimated that for the year 2007, stationary source emissions not presently subject to Reg. 7., or the proposed rules, are less than 5 tons per day. RACT will achieve emission reductions from numerous sources, but these emissions reductions could be quite expensive. Some sources may be voluntarily implementing controls as this may be a standard practice, or for economic or pollution prevention purposes, but this is unknown at this time. Given additional time, a cost/benefit analysis could be performed to determine the implications on expanding the applicability of the Reg. 7 requirements.

7. From base case modeling to future case modeling we see a 53 tpd voc emissions reduction yet this only produces a 0.9% ambient concentration reduction for 8-hour ozone. Please explain why the model is so insensitive to the control program modeled?

ANSWER: As discussed by Morris and co-workers (TSD Appendix J), the modeling results appear to be very stiff, that is the estimated 8-hour ozone Design Values are not very sensitive to local emission controls. The reasons for this are:

- The projected 8-hour ozone Design Values are based, in part, on 2003 ozone observations that occurred during more adverse ozone conducive formation meteorological conditions than 2002 producing ozone concentrations that are much higher than previous years including the July 2002 episode. Thus the contributions of local emissions to the July 2002 episode ozone is not as great as for the observed 2001-2003 Design Values that are being scaled.

- Although the model achieved most of EPA's performance goals, it exhibited a general underprediction tendency so that less ozone was likely attributable to the local emissions in the model than occurred in reality.

Both of these factors lead to the modeled ozone being less responsive to local emissions controls than it should be. EPA's approach toward scaling ozone Design Values using Relative Reduction Factors (RRFs) has some safeguards against using too low modeled ozone concentration in the Design Value scaling by screening out any days in which the maximum 8-hour ozone value near the monitor is less than 70 ppb. In the case of the 8-hour ozone Design Value projections for Denver, the RRFs are based in part on maximum modeled 8-hour ozone concentrations near the monitor that are just over 70 ppb, which explains in part why the modeling results are so stiff.

In addition, the sensitivity analysis shows that reduction in both VOC and NOx emission at the same time is less beneficial than VOC controls alone (see Question #3). In the base cases, while VOCs are being reduced by 53 TPD in the base case, NOx emissions are

also being reduced by 38 TPD. Federal tailpipe standards and regulation, .including those for small engines and non-road mobile sources for Tier II and low sulfur gasoline standards change from 2002 and 2007 and effect both NOx and VOC emissions.

8. Why is the Relative Reduction Factor at the Rocky Flats north monitor so much higher than the RRF's at the other monitors? Please spatially plot the RRF's over the modeling domain and present with the prehearing statement of the Division.

ANSWER: Table 8-1 presents Relative Reduction Factors (RRF) that was developed for the 2007 base and the 2007-attainment scenario. As seen in Table 8-1, the RRFs from Rocky Flats are in-line, and in some cases, lower than the rest of the monitors for both the base 2007 case and the 2007 attainment scenario.

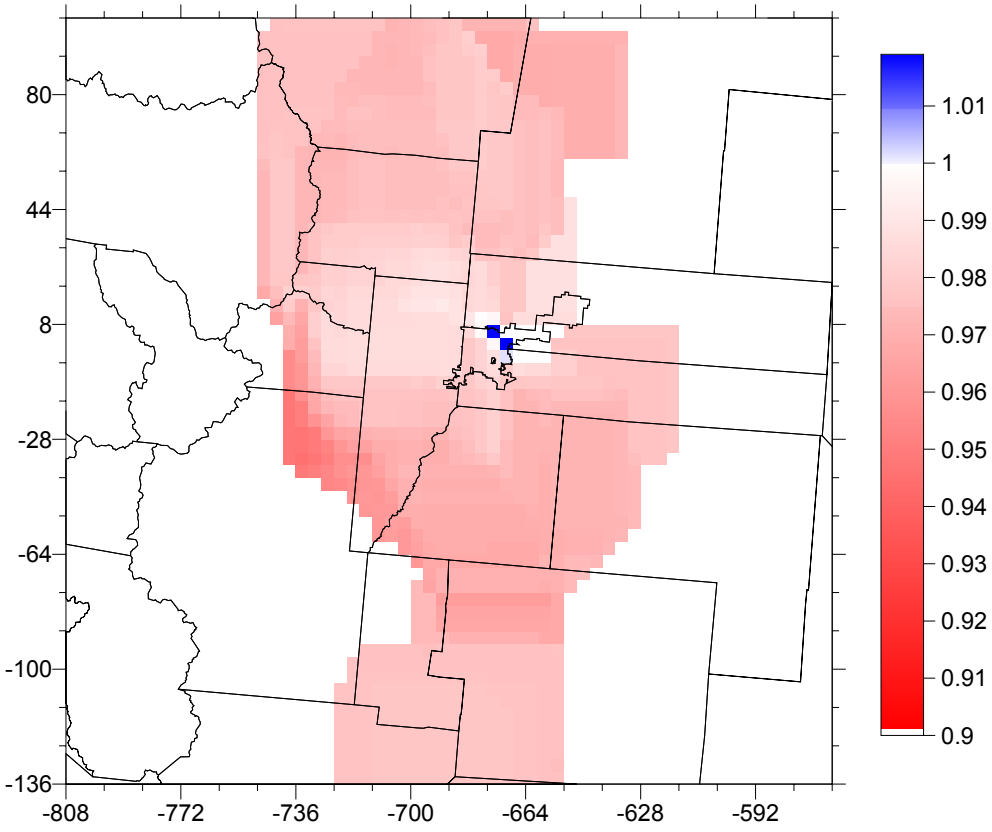
Table 8-1: Relative Reduction Factors for the 2007 Base and 2007 Attainment Scenario 1

Site	RRF (2007 Base)	RRF (2007 Attainment 1 scenario)
Weld County Tow	0.9875	0.9780
Rocky Mtn. NP	0.9846	0.9711
Fort Collins	0.9969	0.9854
USAF Academy	0.9781	0.9612
Welch	0.9879	0.9798
Rocky Flats Nor	0.9961	0.9888
NREL	0.9966	0.9891
Arvada	0.9992	0.9923
Welby	1.0063	0.9993
S. Boulder Cree	0.9961	0.9879
Carriage	0.9907	0.9830
Highland	0.9891	0.9795
Chatfield Res.	0.9849	0.9761

Figure 8-1 presents a spatial plot of the RRFs over the modeling domain. This graphic was produced for the 2007 base case+flash+rice+8.1rvp/40%Etoh scenario in December 2003. Although the relative reduction factors have been updated since then, the general spatial pattern of RRFs can be seen. As shown in Figure 8-1, the RRFs in the northern Denver metro area are generally closer to 1.00 (stiffer) than in other areas.

Spatial Distribution of 2007 Cntl4 RRF (ENVIRON, Dec ’03)

- Clear/white area RRFs not calculated because ozone always < 70 ppb
- RRFs > 1.0 in downtown Denver due to NOx reductions
- RRFs “stiffer” west of DMA (e.g., Rocky Flats)



9. Please provide a discussion of the growth factors that were employed as a part of the emissions inventory development. Please indicate the different increases and decreases by sector.

ANSWER: A detailed discussion of the growth factors that were employed as a part of the emission inventory development is presented in detail in the TSD-Appendix C. Table 9-1 presents a general summary of the methodologies that were used to grow the individual source categories. As shown in Table 9-1, the EPA EGAS model for estimating future point sources activity, VMT growth for on-road mobile sources, and 2007 demographic data for off-road and area sources.

Table 9-1: Summary of Methodologies used to Grow Source Category Emissions

Category	2002 inventory Calculation Method	Projection to 2007 and 2012
Point Sources	Colorado Air Inventory System	EPA EGAS Model
Distillate Oil	Grown From 1999 NEI	Population
Natural Gas	"	"
Adhesives and Sealants	"	"
Architectural Coatings	"	"
Automotive Aftermarket Products	"	"
Cutback Asphalt	"	"
Household Products	"	"
Industrial Maintenance Coatings	"	"
Personal Care Products	"	"
Pesticide Application: All Processes	"	"
Traffic Markings	"	"
Structure Fires	"	"
Air Taxi	Based on 1999 NEI Emission Factors and FAA Terminal Area Forecast	FAA Terminal Area Forecast
Commercial Aircraft	"	"
General Aviation	"	"
Yard Locomotives	Grown From 1999 NEI	EPA Non-road Model
Railroad	"	"
Agricultural Equipment	EPA Non-road Model	EPA Non-road Model
Airport Equipment	"	"
Commercial Equipment	"	"
Construction and Mining Equipment	"	"
Industrial Equipment	"	"
Lawn and Garden Equipment	"	"
Pleasure Craft	"	"
Railroad Equipment	"	"
Recreational Equipment	"	"

10. Please identify the amount of emissions reductions by VOC species and plot those emission reductions by each VOC species spatially.

11. Please provide a spatially oriented trend analysis of the VOC emissions in the area.

ANSWER (Questions 10 and 11): Preliminary 2002 and 2007 emissions data for the VOC species as they are segregated for the Carbon Bond –IV chemical mechanism have been made available at the RAQC's web site (URL: http://www.raqc.org/ozone/EAC/ozone-eac-mrp.htm). Because of the time constraints of the EAC and the time and resources requirements required to look at VOC species individually, a spatial analysis of the emissions reductions for individual VOC species and VOC compounds have not been conducted. The photochemical model remains the best tool for understanding the role of VOCs in the atmospheric photochemical process, the transport of ozone and ozone precursors, and the resulting ozone concentration.

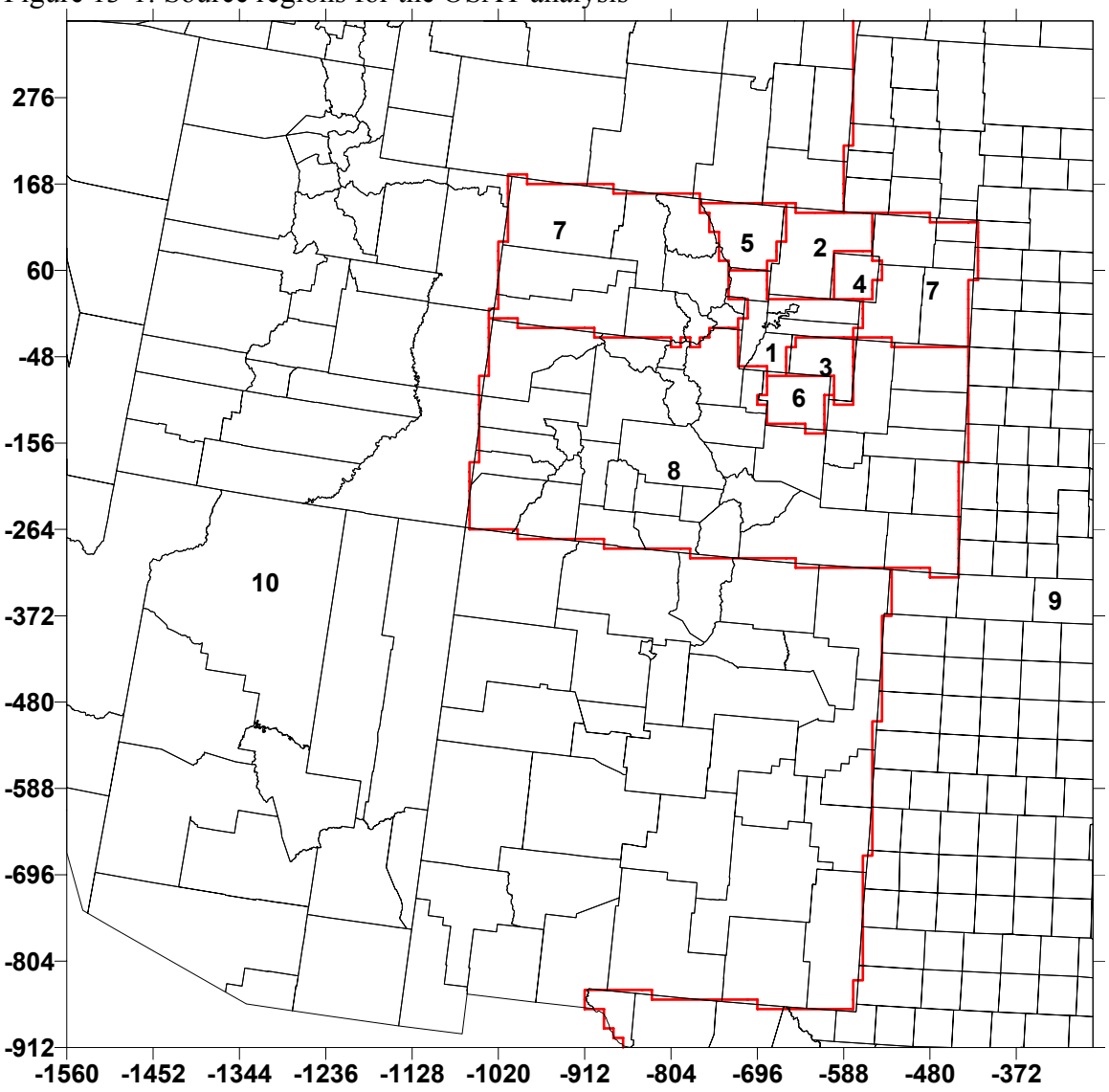
12. Please provide a source culpability analysis for all emissions sectors in the inventory.

ANSWER: An Ozone Source Apportionment (OSA) by ENVIRON is underway.

13. Discuss the amount of ozone transported into the Denver area and transported into the state. Please identify how the modeling accounts for this amount of ozone transported into the area, how that value is arrived at and why it is valid?

ANSWER: An Ozone Source Apportionment (OSA) by ENVIRON is underway. It is anticipated that the (OSA) will be able to determine the amount of ozone transported into the Denver area from other areas of the state and from outside of the state. Figure 13-1 presents the ten source regions that have been set up as part of the OSA analysis.

Figure 13-1: Source regions for the OSAT analysis



14. Please provide a comparison of wind fields at the Rocky Flats North monitoring site that are generated by the model and those that are generated by the meteorological model MM5. Please explain why these are comparable.

ANSWER: This question is confusing in that it asks for a comparison of wind fields "generated by the model" and those "generated by the meteorological model MM5". The MM5 model is the only model used that generates wind fields. The photochemical model does not. To fully answer this question to the satisfaction of the questioner, we need to get some clarification.

15. What is the effect of eliminating ethanol from summertime fuel at the Rocky Flats North monitor?

ANSWER: A model sensitivity analysis that entirely eliminates ethanol from summertime fuel has not been conducted. Therefore, we do not know the effects on Rocky Flats in a non-ethanol scenario.

16. **Is the proposed emission control program for the oil & gas sector practically enforceable? Please explain how the Division plans to conduct such enforcement activities?**

ANSWER: Basically, the Division will look to see if required control devices are installed, operating properly, and maintained properly. Source testing may be required in some instances. Also, reporting of required activities will be reviewed for adequacy.

17. **The Division/RAQC need to present an alternative regulatory analysis for the different options to regulate the oil & gas sector. Please present the threshold emissions for individual wells.**

ANSWER: The current proposal allows the operators of condensate tanks to determine which emission point to control, as long as a 50% emission reduction is achieved from the system under each operator's control. The Division will monitor compliance through inspections and reviewing annual reports. The present cost/benefit analysis assumes 55 tons per day of VOC reductions from condensate tanks. At $13,973 per day, the cost is $254 per ton of VOCs reduced. Actual costs may be less if the industry can control 50% of emissions more efficiently. Installation costs were not determined, but if accounted for, the controls could be more costly. Alternatively, costs may be reduced if the cost of control equipment is reduced through market forces and innovations.

18. **The proposed emissions reduction for the RICE engines will reduce NOx. How will NOx emission reductions from RICE impact ambient ozone concentrations at RFN?**

ANSWER: In the modeling results, controlling all engines does not have an impact on ozone concentrations at Rocky Flats North, NREL, or at Carriage. Controlling all RICE is beneficial at all other monitoring sites, especially at the Ft. Collins and the Rocky Mountain National Park sites (0.19 and 0.16 ppb improvement, respectively).

When looking solely at NOx reductions (approximately 19 tons per day) due to the control of rich-burn RICE, it is estimated that ozone concentrations at Rocky Flats North could increase by about 0.2 ppb. However, the VOC benefit from the control of all engines counters this increase, so the net affect is 0.0 ppb impact from controlling all RICE.

19. Please explain why the emission control options proposed in the draft plan do not seem to have any impact on ozone concentrations at RFN.

ANSWER: See explanation of model " stiffness" given in response to Question 7.

20. Please explain why the model does not seem to respond to the control measures selected?

ANSWER: See explanation of model " stiffness" given in response to Question 7.

21. It has been mentioned that there are other tools available besides the model to use in the process of trying to predict long-term compliance with the 8-hour ozone standard. Please explain what other tools are available and why/how they would supercede the use of the model?

ANSWER: EPA's draft guidance for regulatory modeling in support of 8-hr ozone attainment demonstrations (EPA, 1999) suggests that a complementary analysis of air quality, meteorological and emissions data be undertaken. The additional analyses are needed to design and focus modeling which underlies the attainment test.

Provided model results of the attainment and screening tests are not failed by a wide margin, an area may use evidence produced by corroborative analyses together with results of the tests in a weight of evidence (WOE) determination. The modeling guidance suggest that, if the results of the modeled attainment demonstration is between 84 ppb and 89 ppb at more than one site, a WOE determination should be performed. This is the case for the Denver Early Action Compact (EAC)

A weight of evidence determination includes the modeled attainment and screening test results, plus results of additional model outputs plus other analyses of air quality, meteorological and emissions data. A weight of evidence analysis may be used either to increase or decrease emission reductions identified as sufficient. In a National Academy of Sciences (NAS) report entitled Air Quality Management in the United States (2004) the NAS supports using a weight-of-evidence approach for air quality decision making.

The key concept behind WOE is that the determination of attainment (based on monitored ozone concentrations) allows for some exceedances of the 8-hour standard. Thus, even though the model may show some areas with peak concentrations above 84 ppb, such modeled exceedances do not necessarily imply violations.

22. Please explain how many more people are impacted from the implementation of the 8-hour ozone standard than were impacted by the 1-hour ozone standard.

ANSWER: According to the Colorado Department of Local Affairs, Demography Section, by July 1, 2005, the population in the 7-county 1-hour ozone attainment/maintenance area will be approximately 2,598,322 million. The population in the 11 county potential 8-hour nonattainment area will be 3,139,324, or 541,002 additional people.

23. Please explain all of the emission controls that are included in the model for the future case scenario. This would include where MACT controls are and are not applied, where NSR controls are counted and where they are not, whether or not the voluntary emission reduction agreements were factored into the modeling, etc. and how much credit they receive in the analysis.

ANSWER: The control measures and assumptions that impact emissions in 2007 are as follows:

- The current enhanced I/M program for the Denver metro area with a 50% clean screen component – 4.9 tons per day VOC reduction, 111.9 tons per day carbon monoxide reduction and 1.7 tons per day NOx reduction;
- Federal fuels and tailpipe standards and regulations for on- and off-road motor vehicles and small engines - emission reduction credit undetermined;
- The existing Regulation No. 7 VOC RACT requirements for the 7-county Denver metro area - emission reduction credit undetermined;
- Flash emission controls in Weld County – 55 tons per day VOC reduction
    - The rule will be applicable for the final nonattainment area boundary when promulgated;
- Control of uncontrolled engines, dehydrators, and gas plants in Weld County – 6 tons per day VOC reduction and 19 tons per day NOx reduction
    - The rule will be applicable for the final nonattainment area boundary when promulgated;
- 8.1 psi RVP gasoline applied to the 7-county metro Denver area – 10 tons per day VOC reduction;
- 25% market share for ethanol;
- All existing rules that impact reported actual emissions from stationary sources – Regulation Nos. 1, 3, 6, Common Provisions - emission reduction credit undetermined;
- No voluntary emission reduction measures were assumed;

- The impacts of MACT were not determined
    - If MACT controls were already in place in 2003, then sources' APENs may have accounted for the MACT - emissions on the APEN system in early 2003 were used in the modeling; and
- The impacts of NSR reform on ozone were not determined.

24. Please provide the historical use of ethanol in the Denver metropolitan area and why an average of the market penetration is a valid way to model the overall ethanol usage for 2007.

ANSWER: During the past five summers, the APCD has surveyed the market share of ethanol as follows:

1999 15%
2000 60%
2001 35%
2002 20%
2003 65%

The APCD originally used the 5-year average of ethanol market share, 40%, as the assumed market share for the 2007 emission inventories and modeling. However, based on information provided from the ethanol industry regarding the future demand for ethanol throughout the United States, the APCD has revised this assumption to be 25% ethanol market share in 2007.

25. A. What would the Commission rely upon in the consideration of a Weight of Evidence argument in this situation?

Please explain in the prehearing documents and discuss at the March 11th hearing the following:

B. How different were the 2003 summertime ozone season meteorological conditions from meteorological conditions of the past 20 years.

C. What are the key assumptions that have gone into the model, and explain why the values have been chosen are why they are valid. The Commission is interested in assumptions like:

1. **What is the value of ozone transported into the Denver area?**
2. **What is the value of ozone transported into the state?**
3. **What kind of meteorology was input into the model, some have claimed that the model generated the wind patterns and that the Division and RAQC ignored real world data when it was offered.**
4. **What is the NOx/VOC ratio assumed for the modeling area? How/why is it different from that of the emission inventory?**

ANSWER 25 A: See response to Question 21.

ANSWER 25 B: In the WOE document (TSD-Appendix O), a comparison of meteorological conditions was made for the past several years. A 20-year analysis of meteorological conditions was not performed, however, climatic data from the National Weather Service indicates that July 2003 was the warmest month on record for much of Colorado. August 2003 had 19 days with maximum temperatures of 90 degrees F or higher. August was warmer than average but did not make the top ten for average temperature. According to the NWS: "in the temperature department ...August 2003 tried desperately to get into the top 10 warmest. It was either the hottest August or tied for the second hottest for nearly the entire month. Then came the last 3 days of the month with highs and lows well below normal and August 2003 fell out of the top ten warmest."

While the summers of 2000 through 2002 were also warmer than normal, the summer of 2003 was set apart from these years by anomalously low mixing heights during the highest ozone days. Lower mixing heights can lead to higher concentrations of ozone and its precursors near the surface. The average late afternoon thickness of the mixing layer on those days responsible for the four highest 8-hour ozone concentrations each year at NREL, Chatfield, and Rocky Flats North is shown in the Table 25-1 below. The average mixing layer depth was significantly lower on the highest ozone days in 2003.

Table 25-1: Average mixing depth in feet on those days responsible for the 4 highest concentrations each summer at
NREL, Chatfield, and Rocky Flats North.

Year	Average Worst Ozone Day Mixing Depth in Feet
2003	6,500
2002	12,600
2001	9,300
2000	11,800

ANSWER 25 C: There are literally hundreds of assumptions and model options, some very technical in nature, that go into the emission inventories, emissions processor, meteorological model MM5, and the photochemical model CAMx. Please refer to Appendix A (modeling protocol and overall assumptions), Appendix B (MOBILE6 and Non-Road models), Appendix D, (MM5), Appendix E (emissions processor-EPS2x), and Appendix (A and H-CAMx model) for specific details on the various model assumptions and the model options used.

ANSWER 25 C1: See response to question 13

ANSWER 25 C2: See response to question 13

ANSWER 25 C3: The MM5 model was used to generate the gridded 3-diminsional meteorological fields for use in the photochemical model CAMx. A full description of such items as to how the model was used, what parameters were used, and performance metrics are presented in Appendix D of the Technical Support Document.

Local discrepancies between MM5 predictions and point measurements (observations) highlight a classic problem in comparing modeled and monitored results. Models like MM5 are scientifically designed to produce 'gridvolume averaged' temperature, wind and moisture predictions, relevant to the nominal grid mesh being employed. That means, in this instance that the MM5 predictions correspond to a spatial average of the winds over a 4 km by 4 km (or 12 km by 12 km) region and a vertical extent on the order of 30 to 50 meters thick. In contrast, surface measurements against which the spatially averaged model predictions are compared are point measurements and hence are not strictly compatible with the modeled values. For this reason, the emphasis in meteorological model evaluation shifts from site specific comparisons to regional and subregional comparisons where one seeks to judge the overall fidelity and consistency of the modeled and observed fields, both aloft and at the ground.

The MM5 model is not scientifically formulated to reproduce the exact wind speed and direction at each measurement point, but rather to generate three-dimensional sub-regional and regional wind, temperature and moisture fields that are internally consistent and strictly satisfy the laws of mass, momentum, and energy conservation. In order to address ozone, which is generally considered a regional pollutant, using a meteorological model to focus on consistency in three-dimensional regional and subregional flows and thermodynamic fields is more productive than focusing on a few surface base observations. Focusing on a few specific meteorological monitoring sites will not address the regional nature and transport of ozone and its precursors into the area.

A limited amount of nudging occurred within the MM5 modeling for the Denver area using meteorological stations that are based on regional flows as opposed to local flows. Local 'nudging' or some other form of post-processing of the MM5 fields to ameliorate perceived deficiencies in the modeled fields is not supported by current meteorological modeling practice and is inconsistent with the modeling procedures set forth in the Denver EAC protocol.

ANSWER 25 C4: From ambient data collected during the 2003 ambient air quality, NMOC/NOx ratios at Welby average 8.43:1 in the morning to an average of 79.07:1 in the afternoon. The overall range from the 2003 data at Welby was 5.25:1 to 125.08:1.

The CAMP NMOC/NOx ratio during the morning hours averaged 14.11:1 and during the afternoon the ratio averaged 20.58:1. The overall range including morning and afternoon was 9.61:1 to 46.1:1. Data from Welby and CAMP was collected during the same time period.

Localized DMA+Weld County anthropogenic emission inventory have a NMOC/NOx ratio of approximately 1:1. When biogenic emissions are added to the inventory, the ratio

is about 2:1. The 2:1 NMOC/NOx ratio is typical for the areas outside of the DMA+Weld area both in state and out of state. Emission inventory data by itself does not take into account important atmospheric transport and photochemical reactions which ambient measurements do. The NMOC/NOx ratio used for the boundary conditions ranges from 8.5:1 for the western boundary to 45.9:1 at the northeast sector. As modeled, the boundary conditions account for about 50-60% of ozone produced in the area as well as the bulk of precursor NMOC/NOx. Between the boundary conditions NMOC/VOC ratio and the local emission inventories NMOC/VOC, the modeled NMOC/VOC ratio is well within the monitored ratios at CAMP and Welby overall.

26. A value of 8.1 RVP has been proposed as an option in the SIP. In the prehearing process and at the time of the hearing please explain how such a requirement would be made effective. Would it actually be a SIP requirement in a Colorado Regulation? Or would it need to be "worked out" with EPA in some fashion. What can the Commission actually do in this situation?

ANSWER: In Chapter II of the Ozone Action Plan, the State requests that the 8.1 psi (9.1 psi for ethanol blends) RVP level for the existing Denver 1-hour ozone attainment/maintenance area be made permanent upon approval of the plan. The AQCC is not establishing this level in regulation; the AQCC is petitioning EPA to set the RVP level at 8.1 psi.

27 In the prehearing process and at the time of the hearing please explain the EPA guidelines for conducting the modeling? Please identify what the EPA requirements are for this modeling to be considered "SIP" quality modeling results?

ANSWER: The requirement to do photochemical model is rooted in the EPA document, "Protocol for Early Action Compacts Designed to Achieve and Maintain the 8-hour Ozone Standard (June 19, 2002)" (http://www.epa.gov/ttn/naaqs/ozone/eac/20020619_eac_protocol.pdf) and is part of the Denver metro area Early Action Compact voluntary agreement. The EAC agreement sets forth a schedule for the development of technical information and the adoption and implementation of the necessary control measures into the state implementation plan (SIP) in order to comply with the 8-hour standard by December 31, 2007 and maintain the standard beyond that date.

The EPA document, "Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS (May 31, 1999)" contains the guidelines for conducting the photochemical modeling and weight-of evidence analysis. Additional model Guidelines are contained in the document, "Urban Airshed Model Guidance (UAM-IV)"(http://www.epa.gov/scram001/tt25.htm) and in the document, "Frequently Asked Questions on Implementing the DRAFT 8-Hour Ozone Modeling

Guidance to Support Attainment Demonstrations for Early Action Compact (EPA 2/23/04)(http://www.epa.gov/scram001/guidance/guide/eac-ozone-update1.pdf).

The elements of a "SIP" quality modeling exercise include:

1) Preparing an Ozone Modeling Protocol, consistent with EPA requirements
2) Identification and justification of one or more 8-hr ozone modeling episodes
3) Develop suitable, internally consistent emissions, meteorological and photochemical modeling domains
4) Construct dynamically and thermodynamically consistent meteorological inputs at appropriate grid scales for direct input to the emissions and photochemical models;
5) Process base year emissions inventories, taking into account appropriate temporal, spatial, and chemical speciation factors as well as adjusting the mobile source emissions to the specific pressure and temperature conditions of the modeling episode(s);
6) Produce the model-ready base-year inventories and perform additional quality assurance (QA) of the emissions data sets
7) Develop photochemical model base case modeling inputs for the selected modeling episode(s) and carry out base case model performance testing, diagnostic analysis, and pertinent sensitivity studies, including a check on mass consistency;
8) Evaluate the photochemical model's performance for the selected episode(s) and compare the results with EPA's performance objectives (EPA, 1991; 1999) for ozone modeling;
9) Perform pertinent diagnostic and investigative photochemical model sensitivity tests to better understand model performance, obtain more confidence that the model is working correctly, and obtain a preliminary estimate of ozone source-receptor relationships;
10) Develop model-ready year attainment year emissions files from emissions inventories and then perform future-year photochemical modeling to assess the likelihood of attainment of the 8-hour ozone NAAQS;
11) Perform across-the-board VOC and NOx emissions reduction sensitivity simulations to explore the ozone response for the modeling episode(s);
12) Perform additional future-year (2007 or 2012) control scenario simulations to estimate ozone levels in the Denver region under different local control regimes (if the future year baseline modeling does not show attainment with the 8-hr NAAQS);
13) Develop suitable "weight of evidence" analyses supporting the ozone attainment demonstration, consistent with EPA guidance;
14) Provide for a thorough and efficient transfer of modeling codes, data sets, and related information to the EPA.

In regards to element 17 above, a summary of EPA's performance objectives (EPA, 1991; 1999) include:

- Graphical Demonstration including:
    - Spatial distribution of estimated daily maximum 8-hour ozone concentrations with superimposed observations
    - Time series plots
    - Scatter plots
- Model Performance Statistics
    - Daily maximum 8-hr ozone (<±20%)
    - Normalized and Fractional Bias (<±15%)
    - Normalized and Fractional Gross Error (<35%)

28. EPA has identified a new 8-hour ozone nonattainment boundary that is greatly increased in area from the existing 1-hour ozone maintenance area boundary. In the prehearing process and at the time of the hearing, please explain the air quality basis for this enlarged boundary area and how the Division has worked with EPA to make any modifications to the boundary area definition and EPA's response.

ANSWER: See response to Question 5.

29. How is this Ozone Action Plan different than a State Implementation Element that the Commission would have considered for CO or PM10 that would be required to meet the minimum requirements under the nonattainment provisions of the act? How much earlier do we demonstrate compliance, what do we get, what do we give up in the process?

ANSWER: The Early Action Compact process is designed to achieve attainment of the 8-hour ozone standard faster than would be required under a nonattainment designation. A plan or "SIP" must be prepared with complex modeling and submitted to EPA by 12/31/04, controls have to be implemented by 12/31/05 and attainment demonstrated at all monitoring sites by 12/31/07. Like other SIPs, the plan goes to EPA for approval and controls become federally enforceable. Because EPA has offered the EAC as an alternative to the typical nonattainment/SIP process, any plan under the EAC framework would not be considered "more stringent than federally required".

In exchange for early attainment:

a. The State gains more flexibility in setting the control measures;
    - The State selects only those measures need for attainment
b. There is no transportation of general conformity requirements;
c. There is no nonattainment New Source Review (NSR) permitting requirements for major stationary sources;
d. Prevention of Significant Deterioration (PSD) permitting remains;
    - Under PSD, the required control is Best Available Control Technology (BACT), and the permitting threshold is 250 tpy

    - Under NSR, the required control is Lowest Achievable Emission Reduction (LAER) plus Offsets, and the permitting threshold is 100 tpy
- There is no stigma of a "nonattainment designation";
- There is no mandatory RACT requirements for existing sources in the new portions of the expanded nonattainment area;
- There are no mandatory contingency control measures; and
- Flexibility for setting gasoline RVP may be allowed (i.e., 8.1 psi RVP gasoline in lieu of 7.8 psi RVP gasoline) for the 7-county Denver metro area.

EPA has not promulgated the ozone implementation policy for the 8-hour standard, so it is difficult to compare the EAC process to the yet unknown nonattainment process. Generally, for a marginally violating area like Denver, a new SIP would not be required because it is presumed that the suite of existing federal and State measures would bring the area into compliance by April 2007. The controls would include conformity, NSR, RACT, and 7.8 psi RVP gasoline throughout the entire nonattainment area. If attainment is not demonstrated at the monitors, and the Denver area would most likely fall into this category, the area would be "bumped up" to a moderate designation, and attainment would have to be demonstrated by 2010. Complex modeling and additional measures would be needed to demonstrate attainment, by April 2010.

30. At the hearing and in the prehearing documents please present a complete picture of how this whole process started out including all of the gory details of the work and efforts of different parties involved in the development of the "proposal" and how we got to where we are today from where we started.

ANSWER: In April 2003, the AQCC adopted an attainment designation for the entire state, based on 2000-2002 monitoring data. Based on this three-year data period, the Denver area was able to demonstrate compliance with the standard, with maximum levels being just slightly below the 0.085 ppm standard. It was hoped that local voluntary measures like: voluntary reductions in the vapor pressure of gasoline, gas cap replacement programs and other voluntary measures, would reduce ozone sufficiently to maintain compliance with the standard. However, during the summer of 2003 some of the highest ozone levels recorded in over fifteen years resulting in the new standard being violated at three monitoring stations. In December 2003, EPA notified the State that the area would be designated as nonattainment based on the 2001-2003 monitoring data.

In anticipation of the potential threat of the area violating the 8-hour standard, the EAC process was endorsed and submitted to EPA in December 2002. Technical work began shortly thereafter, and a contractor to perform photochemical modeling was hired in the spring of 2003. The Division and RAQC staff proceeded to develop emission inventories, modeling inputs, and to scope out potential control measures throughout 2003. Stakeholders representing industry, government agencies, environmental groups, academia, and citizens met frequently to review, discuss and debate the potential control

measures and modeling work. Based on all of this work, the RAQC and the APCD proposed the draft plan to the AQCC in December 2003. Also in December 2003, the EPA presented the State with the recommended 11 county nonattainment area. In January and February 2004, frequent meetings and discussions occurred with interested parties, and refinements to the modeling proposal were made.

The AQCC Party Status List provides an overview of those who contributed to the formation of the proposed plan and the regulations.