5.0 RECOMMENDATIONS FOR PHASE II

Phase I of the Attribution of Haze project was designed to provide state and tribal air regulators with an initial, regional assessment of the attribution of haze within the WRAP region for their Class I areas and to develop an effective framework for Phase II of the project. The goals for Phase II are to:

- Refine Phase I techniques for use in Phase II.
- Reduce uncertainty and address the remaining uncertainty in modeled data and attribution results.
- Analyze the differences between modeled results for 2002 and the projected 2018 base case, and between the 2018 base case and 2018 results projected with various control strategies.
- Develop additional analytical approaches (e.g., receptor modeling, trends analysis, determination of the representativeness of baseline data set).
- Make regional haze technical and ancillary data and desired analysis tools directly available to states and tribes through a Web site.

The Phase II approach is intended to focus on regional analyses of regional emissions reductions from technology requirements and/or emissions management programs, and include an assessment of the impact from WRAP states to nearby Class I areas in CENRAP. The exact scope of the Phase II approach is to be determined. The Phase II methods are not intended to identify specific or localized additional control technologies or strategies, although they may provide some useful information in this regard. Individual point sources and local or Class I area-specific control programs will not be addressed directly by the AoH workgroup. Further analyses by individual states and tribes for smaller geographic areas may be necessary for some Class I areas.

Phase II efforts will include identification of the impacts of both controllable and uncontrollable, and natural and anthropogenic emissions. The effects of various control strategies on visibility improvement by 2018 will be used as part of the analysis of reasonable progress demonstration, as required by the Regional Haze Rule. Implications for reaching natural visibility conditions will also be investigated. Projected 2018 emissions and associated modeled visibility impacts based on the various control strategies will necessarily be more uncertain than those for year 2002.

Table 5-1 presents a tentative schedule for Phase II of the AoH project. Phase II is scheduled to be completed by October 2006, following the WRAP Strategic Plan, and in anticipation of Regional Haze SIP and TIP deadlines of December 2007.

Table 5-1

Attribution of Haze Project, Phase II
Tentative Schedule

Date	Action/Deliverables
Mar – Jun 2005	Test/evaluate analyses and improvements recommended in AoH Phase I.
Jun 2005	First Phase II meeting: review results and next steps, confirm Phase II requirements and schedule.
Sep 2005	Meeting to review and electronically publish 2002 attribution based on updated EIs.
Dec 2005	Meeting to review and electronically publish 2018 base case results.
Jan – Jul 2006	Several meetings to review and electronically publish 2018 control scenarios' attribution results.
May – Jul 2006	States and Tribes to conduct additional local or Class I area-specific analyses.
Aug 2006	Electronically publish Phase II draft report. This is the draft regional Technical Support Document.
Sep 2006	End of comment period on draft report.
Oct 2006	Electronically publish final Phase II report. This is the final regional Technical Support Document.

5.1 RECOMMENDATIONS

The Attribution of Haze Phase I project, in large part, was intended as a necessary learning experience for Phase II. The process was developed to address the specific goals of Phase I and encompassed specific analyses and presentations of emissions inventories, monitoring data, and modeling results, and the use of a weight of evidence approach to draw conclusions. The participation of the AoH workgroup in Phase I development provided a broad representation of individuals with technical and planning/policy experience, and included staff from state, tribal, federal land managers, industry, and environmental groups. The following recommendations are based on lessons learned throughout Phase I and focus on improvements in the data, analysis techniques, and the AoH workgroup process that can be made for Phase II. Since implementation of these recommendations will be dependent on the time and resources available during Phase II, the recommendations are presented as required steps, high priority, and lower priority. The priority level for each recommendation is based on a qualitative assessment of its impact on attribution results, feasibility, required effort, and contribution to the overall credibility of Phase II results.

Required Steps

1. **Use the Phase I process as a model for Phase II.** The AoH process followed in Phase I was successful in developing analytical methods and data presentations which, with some refinement, will be useful for Phase II. Additional tools and products will be required in Phase II as the primary focus of the project shifts to analyzing differences in attribution results from 2002 to 2018 and incorporating new data types, and these can be developed by the diverse input of the AoH workgroup and its contractors. A method for electronic submission of comments on the project Web site should be developed. This would encourage comments to be submitted throughout the duration of the project, allow for review of comments by AoH workgroup members at any time, foster discussions on specific topics as the project proceeds, and facilitate the collection and tabulation of comments for incorporation into final products.

2. **Define data quality objectives for Phase II.** Prior to the completion of data analyses in Phase II, the AoH workgroup should determine either quantitative (preferred) or qualitative data quality objectives for emissions data, measured data, and model results. For example, Phase I TSSA results have no measure of uncertainty other than that gleaned from model performance in general, and while TRA results do provide uncertainty measurements, further investigation into the interpretation of the "intercept" method and the "0-intercept" method is necessary. Phase II data quality objectives should be linked to minimum thresholds of confidence in results required to make findings on the visibility benefits of control strategies. These objectives will set criteria by which Phase II results can be interpreted and the visibility benefits of recommended control strategies analyzed.

3. **Assess the relative quality and importance of 2002 and 2018 emissions inventories.** This assessment should include the level of confidence in the emissions inventory development technique, estimated uncertainty, and magnitude of visibility impact associated with each species. For example, there is higher confidence and lower expected error in point source SO_2 EIs (determined by monitoring source emissions and mostly the result of controllable anthropogenic emissions) than in biogenic EIs (not measured directly but modeled based on land cover and meteorology, and include largely natural emissions sources). Each emitted species is important in the formation of one or more of the particulate species responsible for visibility impairment. The degree to which each species is responsible for particulate matter monitored in WRAP Class I areas will be a necessary finding of Phase II.

4. **Determine the relative importance of the six visibility-impairing species measured by the IMPROVE network at each site during the 2000-04 baseline monitoring period.** This analysis should include the estimated uncertainty, magnitude of visibility impact, and the relative loading of each species compared to natural conditions estimates. As with emissions, there is higher confidence and lower expected error in the measured SO_4 data (which are well-characterized with laboratory analyses and are mostly the result of controllable anthropogenic emissions) than in monitored coarse or fine dust data (which are not measured directly but aggregate many elements and ions, a substantial fraction of which includes largely natural emissions sources). The contribution, variation, and relative loading of each IMPROVE species used to report worst and best days' visibility is important for analyzing the visibility benefit of control strategies. The degree to which each species is

responsible for particulate matter monitored in WRAP and CENRAP Class I areas will be a necessary finding of Phase II.

5. **Define the Phase II methodology regarding the weight of evidence approach, attribution methods, and relevant control strategies.** The AoH workgroup should define specifically how the weight of evidence approach will be applied to evaluate the benefit of emissions reductions during the Phase II project, which data categories and results will be included in that approach, and how confidence in results is to be judged. Part of this process is to define the nature of attribution results achievable in Phase II, and to identify which control strategies can and should be effectively modeled in Phase II.

High Priority Recommendations

6. **Develop emissions inventories for Pacific off-shore shipping.** TRA results indicate large contributions from both the distant Pacific Ocean and near-coastal offshore shipping regions (30-300 km) that are not identified by TSSA, because no emission inventory was available. These inventories are important particularly because states may be able to assist in implementing controls on near-coastal offshore shipping emissions.

7. **To the degree possible, update emissions inventories from outside the WRAP.** The attribution results from within WRAP states are vital to the SIP and TIP process. Haze attributed to geographic regions outside of WRAP cannot be directly controlled by WRAP states. However, accurate identification of attribution within and outside WRAP is important to the overall uncertainty and credibility to project results. The TSSA method for modeling attribution is dependent on emissions inventories. Phase I EIs within the WRAP are the most complete within the modeling domain. These EIs will be updated prior to the start of Phase II. EIs outside of the WRAP require varying degrees of updating, depending on their sources. The EIs most in need of updating are those from Canada and Mexico, which are currently from 1995 and 1999, respectively, and do not cover all emissions sources. The TSSA results attribute less sulfate and nitrate to Canada and Mexico than expected, particularly in border states. TRA results indicate attributions from Canada and Mexico that are higher. Large uncertainties in sulfate attributed to Canada, for example, call into question the sulfate attributed to Montana, no matter how complete the EIs are for Montana. Updates to Canadian and Mexican inventories will be driven by time, resources, and sovereignty issues. Other RPOs across the U.S. have made substantial and detailed efforts to develop complete, high-quality inventories. The use of more complete EIs outside WRAP will help to better define attribution within WRAP and should lower associated uncertainties.

8. **Refine the TSSA method for a better understanding of contributions to the "Other" category.** Attributions falling into "Other" should ideally be equal to the sum of the pollutant emissions not attributed to point and mobile sources. In practice, however, it is believed that "Other" also contains accumulated model errors (for example, conservation of mass errors). Since the contributions attributed to "Other" are generally large (~20 to 70%), a better understanding of this category is required (see 9b, below). During the "interim" 2002 modeling efforts questions also arose regarding the accuracy of "Boundary Conditions" and "Initial Conditions", and possible errors in these categories may be related to errors in the "Other" category.

9. **Broaden the scope of the TSSA analysis to include attribution of species not tracked in Phase I.** In Phase I, TSSA was used to track point and mobile sources emitting SO_2 and NO_x, accounting for approximately 80% of these emissions within WRAP. However, particulate sulfate and nitrate combined contribute only 30 to 60% of all aerosol extinction at most WRAP region Class I areas. Therefore, a significant part of aerosol contribution can not be attributed using the tools of Phase I. Two methods for improvement should be considered:

    a) Other species could be tagged by source category as was done in Phase I. Efforts for this option should begin with organic carbon since of the species not tracked in Phase I it is generally the largest contributor to extinction. Biogenic and fire emissions would be the main source categories of interest for this analysis. Windblown dust emissions for fine soil and coarse mass could be tracked as well.

    b) Rather than tag specific source categories (e.g., point, mobile, area, etc.), apply tags to species (and/or subsets of species) emissions by state which are responsible for the six visibility-impairing particulate species. This analysis would not show source category impacts directly as was done in Phase I, but attribution results by state for each species could be compared with state EIs to estimate attribution by source category. This option, if determined to be feasible by the RMC, may lead to more comprehensive attribution results, reduce the magnitude of the "Other" category, and allow for more confident identification of controllable and uncontrollable visibility impacts.

10. **Define the application of CMAQ modeling results for estimating future visibility benefits from control strategies.** Attribution of 2018 modeling results will need to use a WRAP-defined procedure to scale 2002 monitoring and modeling data with 2018 modeling data to estimate the 2018 visibility changes. The AoH Workgroup will need to consider how to move from a specific year with known emissions and air quality data, to develop attribution results that are representative of the 2018 projection year. The EPA advises a procedure known as Relative Reduction Factors (RRF). The RMC should prepare their recommendation as to how to apply these RRFs or scaling factors to 2018 modeling data for review by the AoH workgroup in Phase II, as a critical input to the attribution work of the AoH workgroup.

Lower Priority Recommendations

11. **Refine the method used for Class I area cluster analysis based on Phase II results.** Refinements might include a more rigorous mathematical approach or inclusion of additional emissions/monitoring information.

12. **Continue to improve emissions estimates related to windblown dust both within and outside of the WRAP.** While refining the windblown dust EI would be useful in terms of overall completeness, the visibility effects of making this change are not expected to be large.

13. **Expand and refine the TRA method to yield additional results.** It is important to understand and address the limitations involved in a statistical technique like TRA. How TRA results can be effectively used to corroborate TSSA results for the model re-run of year

2002 should be defined. The following examples describe possible additions and refinements to the TRA method:

a) Apply the TRA method to nitrate attribution. Results may exhibit acceptable uncertainty. This method should be tested on several Class I areas first and the results evaluated by DRI prior to using it for the entire WRAP region. DRI suggests that this method should not be used for organics attribution due to the expected large uncertainties introduced by the random and chaotic nature (size, movement, timing) of wildfire events.

b) Apply the TRA method to generate contributions individually by all states within WRAP. Currently, states further from Class I areas are lumped together into geographic regions to improve method uncertainty. For several sample Class I areas, DRI should test the TRA method with all WRAP states identified as individual regions. If review of these test runs indicates that satisfactory uncertainty levels can be maintained, then all Class I areas should be treated this way.

c) Review possible "edge effects" on a case-by-case basis. Edge effects occur where a strong source region lies near the border of a political boundary, and the TRA does not account for sufficient trajectory residence time in that source region. Where edge effects are reasonably believed to be a problem, DRI should re-run the trajectory regression analysis ignoring political boundaries. Relevant state emissions inventories could be used to support attribution results. Since this is likely to be a labor intensive process, care should be taken to select only those candidates that would benefit from additional analyses.