Introduction

The Three-State Study Data Warehouse Pilot (3SSDW) was initiated through a memorandum of understanding (MOU) early in the year 2011 as a follow on to the activities of the Federal Leadership Forum. The signatories include:

- U.S. Bureau of Land Management state offices in Wyoming, Utah, and Colorado
- U.S. Forest Service Regions 2 and 4
- National Park Service
- Environmental Protection Agency
- Utah Department of Environmental Quality
- Colorado Department of Public Health and Environment
- Wyoming Department of Environmental Quality

Leadership from each signatory is represented on the Governing Board that has charted the overall course of the project, while the day-to-day oversight of 3SSDW activities has been delegated to a Steering Committee. The Steering Committee also has representatives of each agency. In addition, there has been a technical committee which reviews protocols and analysis results toward making recommendations to the Steering Committee as to how technical work should be conducted and how analysis results should best be used.

The primary direction of the pilot work has been to increase the quality of information that could be utilized in air quality planning in the states of Utah, Colorado, and Wyoming in a commonly agreed to way, especially as it relates to oil and gas development. The main objectives have been to:

- Provide storage and access to consistent, sufficient, comparable, and high-quality technical data.
- Provide consistent protocols for technical data and analysis of air quality impacts by the 3SSDW cooperating agencies from oil and gas development projects in the study area.
- Initiate and support collaborative work by the federal and state cooperators on the air quality analyses for National Environmental Policy Act (NEPA) planning and for State planning activities.

The participants chose to focus on ozone in this initial effort.

The initial pilot phase of the project was initiated in 2011 and will culminate in 2014. This work has included or will include:

- Developing and implementing a data warehouse to house and make available air quality modeling inputs and results.
- Designing and implementing an expanded ozone monitoring effort in the area of interest.
- Improving 2008 emission inventories provided by the West-wide Jumpstart Air Quality Modeling Study (WestJumpAQMS) and developing 2011 emission inventories based on the WestJumpAQMS methodologies.
- Developing estimates of emissions for future years.
- Performing 2008 regional photochemical modeling with emissions improvements and WestJumpAQMS meteorological data, focused on the Three-State region and incorporating data and producing results across the western U.S.
- Developing meteorological and emissions model inputs for the year 2011 and performing 2011 photochemical modeling, focused on the Three-State region and incorporating data and producing results across the western U.S.
- Performing future year and other 2008 regional photochemical modeling with emissions improvements and WestJumpAQMS meteorological data, focused on the Three-State region and incorporating data and producing results across the western U.S.

This work plan is intended to set out the ongoing efforts of the Three-State Study collaborators for the next three years after the pilot project is complete. First and foremost, this entails a commitment to maintain the data warehouse and keep its contents up-to-date and available for the foreseeable future.

Assumptions

There are several assumptions based on this previous work that will dictate the direction of the ongoing project, which are:

- The technical protocols developed for emission inventories and air quality modeling will be the starting point for subsequent work. The technical protocols will be modified as the need is identified. For example, the geographic area of interest may become larger as interest in and knowledge of the project grows.
- For NEPA projects, the participating agencies will direct contractors to the data warehouse to obtain modeling files for NEPA efforts that require oil and gas air quality impact assessments. It is expected that these efforts will rely on the model simulations for the base year performance evaluation and will use model input data from the data warehouse to support assessments of future air quality impacts. The usefulness and accuracy of the model for predicting future air

quality impacts will depend on how well the model performs in the base case simulation. Therefore, a key goal of the project is to demonstrate acceptable performance in the model base case simulation.

- The data warehouse operation will be ongoing and will provide for prompt responses to data requests and will ensure the maintenance of high quality information.
- The data warehouse will serve as the repository for the data and results from NEPA project analyses.
- Ozone monitoring will be maintained at a level appropriate to representing air quality conditions in the region and to evaluate air quality modeling.

Goals

The goals of the ongoing effort are:

- Maintaining high quality and sustainable technical capacity that was developed in the pilot study.
- Operating and maintaining an ongoing data warehouse with up-to-date data.
- Ensuring the ability to characterize air quality in the region at a high level.
- Working under analysis protocols and data criteria that are commonly agreed to.
- Establishing a future funding mechanism to ensure sustainability of monitoring sites and modeling platform and to provide for ongoing federal oversight of the warehouse.
- Implementing effective communication about the project both inside and outside the participating agencies.

Work Plan Tasks

There are six main areas of activity related to the above goals for the ongoing project.

1. Data warehouse maintenance and updates.
2. Ambient monitoring to characterize regional-scale air quality and to assist the evaluation of air quality modeling.
3. Complete remaining tasks for the 2011 air quality modeling including CMAQ modeling and model performance evaluation and potential CAMx and CMAQ model improvements. Protocols for the 2011 air quality modeling will need to be developed and revised.
4. Development of a 2014 emission inventory and appropriate future year inventories based on the methodologies used in the 2011 air quality modeling.

5. Complete air quality modeling work for 2014, including a model performance evaluation and potential model improvements. Protocols for the 2014 modeling will need to be developed using the 2011 work as a foundation.
6. Creation and implementation of an efficient administrative structure for managing and coordinating the activities of the project including communications and outreach.

Following is an expanded discussion of each of these elements of the ongoing project.

1. Data Warehouse

Operations and Maintenance

The data warehouse will contain large volumes of air quality modeling input and output data along with all available high quality ambient monitoring data in the region. The current project will populate the data warehouse with modeling data for 2008 and 2011, as well as future years. The modeling data for 2008 will include the pilot project and the WestJumpAQMS modeling products. These data and analysis results have all been developed using commonly agreed to methods and protocols. The maintenance and storage of other air quality modeling products will be further defined by workgroups comprised of the participating agencies prior to the completion of the pilot project. The data warehouse will also provide tools for visualizing and quality assuring (QA) modeling results, along with data mining capabilities for various types of data housed within the data warehouse. The processes for acquiring, returning, storing, and visualizing data from the Warehouse will be further defined by various workgroups comprised of the participating agencies prior to the completion of the pilot project.

The data warehouse capabilities will likely be characterized by different requirements for project cooperators than for outside entities and might be different depending on the data being asked for. Possible elements might include the requestor providing a brief project description to the cooperators and providing a brief summary of the results of the project or a project report upon completion of the project, whichever is most appropriate. For those outside the cooperating agencies a data use agreement is a likely requirement. Making operational decisions with regard to the data warehouse will almost certainly impact the level of effort required and will likely result in a revised work plan.

Review and Update

One goal of the data warehouse is to make it even better over time and ensuring that it is maintained at a high level of reliability. This will require periodic updates as the volume of data grows, as improvements are identified, and as software changes. Getting ready for the 2014 emission inventory, additional work on future year inventories, and associated modeling work will provide a good opportunity to review how the data warehouse is operating and to update as is deemed necessary.

2. Ambient Monitoring

During the course of the pilot project, an ambient monitoring network assessment was undertaken by a team of technical experts from the participating agencies. The group made recommendations regarding the long-term ambient monitoring effort. These recommendations include maintaining four of the five sites that were added for the pilot study. The U.S. Forest Service is also adding sites and closing sites that have been a part of this recent evaluation. The overall monitoring network that is recommended is as follows:

- Colorado – Douglass Pass, Kremmling, Holy Cross, Deadman Pass, Dinosaur East, Paradox, and Walden (if high priority site at Hiawatha, WY is funded)
- Wyoming – Medicine Bow and Hiawatha
- Utah – Snowbird, Fruitland, Price, and Escalante

Five lower priority existing sites may be closed down at about the same time as the new sites are installed. Six of the sites will be funded completely or partially with Three State Study monies.

Review monitoring network

It will be necessary to review the monitoring network periodically to ensure it is still meeting the needs of the project in a similar way to what has been done for the pilot project. Performing that evaluation once in a three year technical cycle seems appropriate until such time as the network configuration becomes stable and few changes are recommended during the review process.

3. Perform Follow-up 2011 Air Quality Modeling

There are missing elements in the pilot study work that will need attention. First, it has become increasingly important that the Community Multiscale Air Quality (CMAQ)

model be run in addition to the Community Air Quality Model with Extensions (CAMx) model to give the participating agencies and their contractors more flexibility in conducting various analyses. Second, there have been substantial advances in understanding and characterizing winter ozone formation within the meteorological and photochemical grid models. There may be tasks under this plan to attempt to improve model performance in the winter that focus on regional versus local analysis questions, as well as on improving meteorological modeling, oil and gas emission inventories and photochemistry in the air quality models. Third, photochemical grid models have been recently evaluated and tested for predicting impacts on air quality related values (AQRVs), such as visibility and deposition. To ensure the models can characterize and predict air quality impacts at a high level of accuracy, the Three State Study, with the assistance of the participating agencies that have been active in such research, will review the advances made with the meteorological and photochemical grid models to determine whether model improvements and additional model simulations are necessary. Finally, this additional 2011 modeling should include key source apportionment model runs that have not been accomplished in the pilot project.

Review and Update 2011 Protocols and Related Activities

The 2011 modeling products from the pilot study may need to be revised or updated to account for the additional 2011 modeling work and model improvements described above, including protocol documents. The cooperators may also be asked to serve as a sounding board for special-study projects planning to use the 2011 modeling platform. In particular, NPS is planning to use the 2011 modeling platform for nitrogen deposition studies in the Greater Yellowstone area. Therefore, the cooperators may be asked to participate in the up-front design of the project and/or review the results at the end of the study.

4. Emissions Inventory

The intent of the project as it goes forward is to develop a complete set of base year emissions inventory data corresponding to the National Emissions Inventory (NEI) which is released every three years. The first NEI year after the completion of the pilot study is 2014 and hence this will be the focus of new technical work during the life of this 3-year work plan. Additionally, the intent of the project is to develop a future year base case emissions inventory that includes projected future emissions changes relative to the 2014 base year inventory. The future year base case inventory represents a “no action” future year inventory that can be used as a basis for evaluating effects of proposed oil and gas development projects.

Develop 2014 Inventories Protocols and Procedures

The first step is to review how the technical work was accomplished during the pilot phase of the project and to develop a new emission inventory protocol document for 2014. The protocol will be reviewed and approved by the participating agencies. Given the evolving nature of oil and gas inventory development, changes to activity data or emission factors are likely to occur. This review will be for both base year and future year emissions estimates.

Develop 2014 Inventories

It may be necessary to develop inventory products based on the 2011 emission inventory to get a head start on assessing how the model is performing for the 2014 base year. Later on the 2014 NEI will serve as the starting point for most point and area source categories. Oil and gas emissions estimates will focus on updates based on work over the intervening three years. Other categories will be reviewed on a case-by-case basis.

Emissions estimates for mobile sources and biogenic emissions for 2014 will be developed using the Motor Vehicle Emission Simulator (MOVES) and Model of Emissions of Gases and Aerosols from Nature (MEGAN). The Sparse Matrix Operator Kernel Emissions (SMOKE) model will be used to develop model-ready gridded emissions files and to perform quality assurance of the emissions data.

Development and Continuing Improvement Efforts for Future Year Inventories

This task includes review of the data used to project a future year emissions inventory in the pilot study and development of emissions forecasting protocols based on improving and further developing methodologies used in the 2011. This task may include significant updates to projections of future year oil and gas emissions and will also include development of gridded emissions data for future projections of area, point and mobile source emissions. SMOKE will also be used to develop model-ready gridded emissions files and QA reports.

5. Meteorological and Air Quality Modeling

The intent of this project as time goes on is to continue to perform updated air quality modeling based on each three-year NEI update. Such modeling is comprised of three parts: meteorological modeling, emissions modeling, and photochemical grid modeling.

Plan for 2014 and Future Year Modeling

A review of the lessons learned from the pilot study will precede the actual air quality modeling using the 2014 inventory and future year estimates to assist in improving the quality of the products. It will be necessary to develop a plan specific to the 2014 base year modeling and associated future year work. This plan will be largely based on the methodology used for the 2011 modeling, with appropriate changes that are identified by and agreed to by the participating agencies. Modeling is an area where there may be opportunities for collaboration that could help make limited resources go further and hence should be a part of the planning process. For example, there are special studies led by university researchers and state agencies that also focus on the oil and gas industry and air quality.

Perform Air Quality Modeling

Meteorological data will likely be modeled for 2014 using the Weather Research and Forecasting (WRF) model producing nested 36 kilometer (km), 12 km, and 4 km gridded data. Air quality model simulations and performance evaluations will be completed using both the CAMx and CMAQ models. Base year model runs for 2014 will be completed, including a comprehensive model performance evaluation and comparison of the CAMx and CMAQ results. Model simulations will also be performed for the projected future year. This modeling for 2014 may also include source apportionment and other diagnostic analysis as directed by the Steering Committee. Whether these are done and how many will be done is dictated by the needs of the participating agencies. Once all the work is done and the data sets are loaded in the data warehouse it will be necessary to ensure appropriate documentation is completed and loaded into the appropriate area of the data warehouse.

Of particular interest, there is a need to synthesize the results from the three modeling efforts for 2008, 2011 and 2014 by comparing trends in emissions and associated changes in modeled air quality conditions for these base years as well as future years, especially with relevance to oil and gas activities. Appropriate information about the overall model performance and uncertainties, sensitivities and changes in methodologies should be included. This report should be appropriate for informing decision-makers in the cooperating agencies and the public as to the state of air quality in the region.

6. Administrative

Project Coordination

It will be necessary for there to be a project lead that ensures that the appropriate technical resources are available when they are needed to accomplish the tasks outlined above and to get them done in a cost effective and timely way. This would include:

1) bidding and awarding contracts to perform the technical work which includes data warehouse activities, emission inventory development and modeling in consultation with the Technical and Steering Committees;
2) overseeing and coordinating these contractors in consultation with the Technical Committee and with approval of final work products by the Steering Committee;
3) providing regular updates to the Governing Board and the Steering Committee;
4) promoting collaboration with other projects that may be synergistic;
5) facilitating technical training and capacity building within participating agencies as needed;
6) managing the receipt and use of project monies;
7) coordinating the communications and outreach activities; and
8) providing logistical and facilitation support, as needed.

It is also very likely that users, both from public agencies and private interests, from within and well beyond the Three-State region will request use of the modeling inputs. To accommodate the users' needs, it is anticipated that the capacity of the data warehouse will need to be separately and additionally supported by the users external to the Three-State cooperators. The project lead will need to discuss the procedures and protocols for entities beyond the Three-State region.

Financial Management

To ensure the data warehouse, modeling efforts, and monitoring network are able to continue for the foreseeable future, it is important to develop and implement a strategy for ensuring that sufficient funding and resources are available.

Communications and Outreach

Effective communications with respect to the project is essential for maintaining support for the work both inside and outside of the participating agencies. This will entail an ongoing commitment to build upon and strengthen the intended message which will generally focus on the accomplishments of the project and the benefits derived from them, as well as describing what is planned for the future. The primary communications tools so far have been a brochure about the project, presenting at various meetings and conferences, and a website that is under development. These have been reasonably

effective. Building on these tools will be the main direction for communications and outreach.

Conclusion

The accomplishments of the Three State Air Quality Study pilot phase need to not be lost. This three-year work plan is intended to work toward maintaining those accomplishments and to build on them over the course of the next three years. Although there are currently some resources available to commence this next phase, it will be necessary to bring in more in order to fully accomplish what is deemed to be necessary to support air quality planning activities in the region. Achieving the tasks set forth here will require a considerable amount of time, energy, and resources.