

Management & Execution of WRAP/WESTAR Oil & Gas Emission Inventory Updates for the San Juan Basin of New Mexico and Colorado, and the Permian Basin of New Mexico and Texas

April 21, 2015

I. PURPOSE, OBJECTIVES AND RELEVANCE

Oil and gas (O&G) development in the inter-mountain western United States has undergone rapid increases over the last decade. The Permian Basin in New Mexico and Texas is the largest oil production basin in the United States and has seen production approximately double from 2010 to 2015. The San Juan Basin in New Mexico and Colorado is a major natural gas production basin and has over 20,000 wells; while oil and gas production in the San Juan Basin has declined in recent year the future development of the Mancos Shale formation represents a source of potential growth of oil and natural gas production in the basin. O&G development releases emissions of oxides of nitrogen (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), sulfur dioxide (SO₂), hazardous air pollutants (HAPs) and greenhouse gases (GHG). These emissions can lead to elevated air pollution levels that may threaten National Ambient Air Quality Standards (NAAQS), cause HAPs levels that may cause health effects and have potential adverse effects on air quality related values (AQRVs), which include visibility and acid deposition. To address these potential air quality and AQRV impacts requires an accurate and comprehensive emissions inventory of O&G sources.

The BLM New Mexico State Office (NMSO) and the State of New Mexico Environmental Department (NMED) Air Quality Bureau need up-to-date and accurate oil and gas emission inventories in the near future to address the potential air quality and AQRV impacts associated with oil and gas development in the region. They need a comprehensive O&G emissions inventory that can be used for air quality modeling and planning. The objective of this work is to develop the **input data** that will be used to develop a detailed and comprehensive O&G emissions inventory for the 2014 baseline year and a projection 5-7 years in the future using the WRAP Phase III methodology and procedures. This work will allow the BLM to obtain more accurate air quality and AQRV impact assessments due to current and future O&G development activities in New Mexico.

Up-to-date, detailed, and comprehensive O&G emission inventories for the San Juan and Permian Basins will allow BLM and other agencies to perform more accurate air quality planning that will result in numerous benefits to the public. These emission inventories would more accurately characterize 2014 emission levels and future midterm year emissions. The use of these inventories in future air quality analyses as part of NEPA actions and federal/state rulemakings would allow for a more accurate basis upon which to make effective air resources management decisions related to National Ambient Air Quality Standards (NAAQS) designed to protect public health, O&G-associated HAPs emissions related to cancer risk, visibility impacts, and acid deposition which effect ecosystems health.

As described in the section III below (Qualifications, Experience and Past Performance), WRAP/WESTAR and ENVIRON have conducted numerous oil and gas inventories in the inter-mountain west that are the standard for regional air quality planning efforts. Of particular relevance to this project is the ongoing Western Air Quality Data Warehouse (WAQDW) and associated Western States Air Quality Study (WSAQS) regional modeling efforts being coordinated by WRAP/WESTAR. Under direction from WRAP/WESTAR, ENVIRON and University of North Carolina at Chapel Hill (UNC) have developed photochemical grid model (PGM) modeling databases for the western U.S. and the 2008 and 2011 calendar years. WSAQS also develop 2011 O&G emissions for Basins in Colorado, Utah and Wyoming using the WRAP Phase III methodology. The WSAQS 2008 and 2011 PGM modeling databases and results are being housed in the WAQDW. In 2015, WSAQS will develop a 2014 PGM modeling database and 2014 O&G emissions.

II. TECHNICAL APPROACH

The technical approach for developing the inventory inputs for the San Juan Basin in both New Mexico and Colorado and the Permian Basin that covers the active O&G development in those basins is presented below. This technical approach **for the San Juan Basin** mirrors the procedures used to develop inventory inputs in the WRAP Phase III and Montana-Dakotas study development of basin-level inventories performed by ENVIRON under the auspices of WRAP, and utilizes the technical and project experience and management skills of ENVIRON and WRAP/WESTAR staff. The technical approach **for the Permian Basin** is also similar, but rather than a survey component will include a review of applicable area source input data sources to derive the inputs necessary to develop the emission inventory. A survey approach in the Permian Basin was considered, but not selected for this work because of challenges associated with obtaining sufficient operator response in that basin.

ENVIRON has extensive experience developing the inventory inputs using the WRAP Phase III methodology that is summarized below, having completed baseline and projected inventories for eight (8) basins as part of the WRAP Phase III study and two (2) basins as part of the Montana-Dakotas study in the Intermountain West. WRAP/WESTAR staff have managed the ENVIRON work to develop these inventories, provided technical and coordination assistance to ENVIRON and the affected stakeholders, and served to more closely connect the operators and state/EPA regulators through the collaborative nature of the data collection, analysis, and dissemination in the Phase III and Montana-Dakotas projects. More details on the emission development methodology can be found in the numerous reports, spreadsheets and displays on the WRAP's Phase III project web pages^{1,2} and the Montana-Dakotas project web page³.

In general the technical approach for developing the Permian Basin and San Juan Basin emission inventory inputs follows a number of key steps that are listed below; more details can be found in the WRAP Phase III inventory development reports².

- (1) Production statistics compilation: ENVIRON proposes to use a commercially available [IHS] database (for which BLM has a license for use) to compile production statistics for both basins including historic data; by well type production statistics that include well counts, spud counts, and gas, oil and condensate production;
- (2) Survey process (San Juan Basin): A survey process would be conducted similar to the approach used in the WRAP Phase III and Montana-Dakotas projects that targets the top companies in each basin with surveys that request data on wellhead equipment and processes; the survey process would include identification of companies, outreach, development of a survey instrument, transmittal of surveys, and compilation of the survey data;
- (3) Survey data aggregation (San Juan Basin): The survey responses from companies operating in each basin in the baseline year would be aggregated using an activity-surrogate-weighted methodology to form the required input data for calculation of emissions from survey-based source categories;
- (4) Review of available inventory input data (Permian Basin): A review of available well site emission inventory input data will be conducted to develop Permian Basin emission input factors. Sources of

¹ http://www.wrapair.org/forums/ogwg/PhaseIII_Inventory.html

² <http://www.wrapair2.org/emissions.aspx>

³ <http://www.wrapair2.org/ND-SD-MT.aspx>

input data to be reviewed include the Texas oil and gas emission inventory⁴ and data available as part of EPA Subpart W reporting⁵.

- (5) Permit data compilation: Some midstream sources, particularly larger sources such as gas processing plants and large compressor stations, may be permitted by state agencies and/or EPA for tribal sources; data from permits would be gathered from the agencies and compiled as the permitted point sources in the inventory;
- (6) Projected activity: BLM would be queried for information related to well decline curves by formation and oil and gas development scenarios to develop inputs for the “midterm” projected inventories. Data received from BLM would be analyzed along with historical data trends to develop recommendations for future oil and gas activity forecasts;

A detailed description of each of these steps is provided below.

Temporal and Geographic Scope

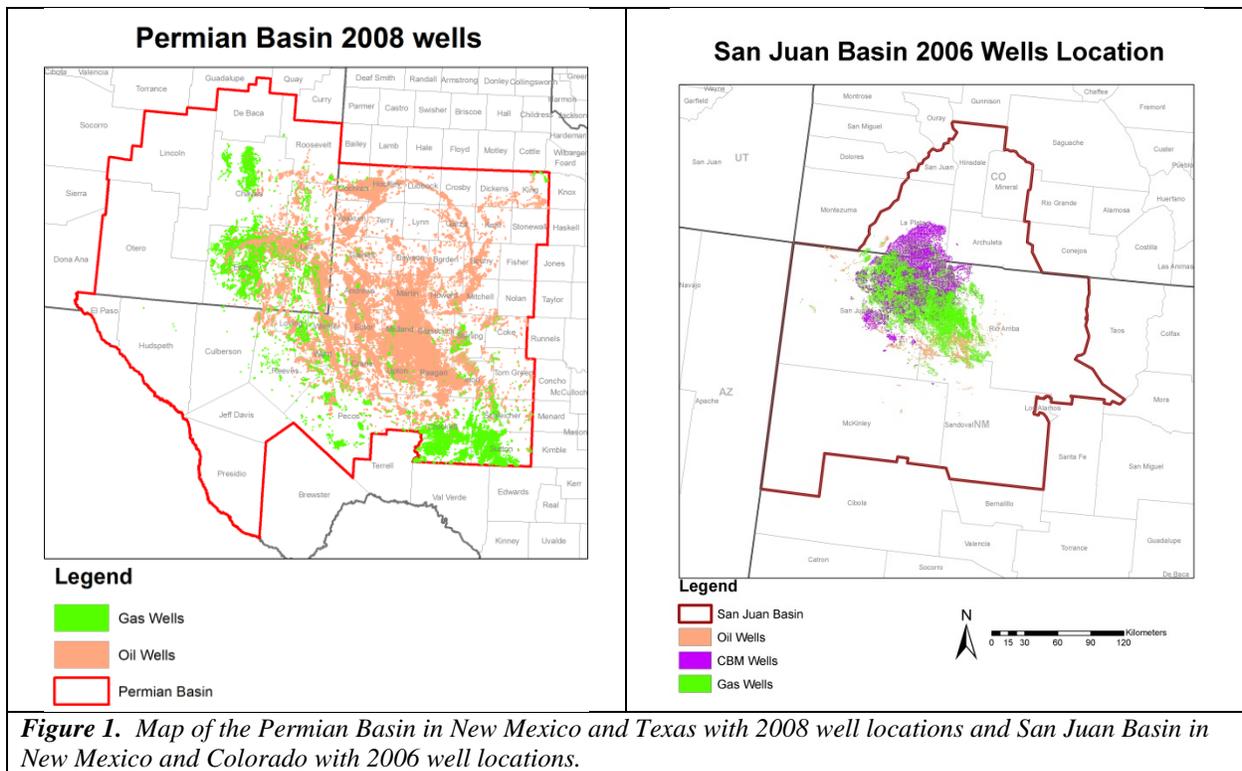
The inventories which will be developed as part of the next phase of this project (this technical approach only considers inventory input data compilation) will consider both a baseline year and a midterm projected year. For the baseline year inventory input data compilation, we propose to use 2014 as this will be the most current year for which a complete, reliable data set on production statistics will be available. Because of the rapidly changing nature of oil and gas production, the use of a 2014 baseline year is critical to capture the recent increase in oil production in the Permian basin. A similar baseline year would be used for the San Juan Basin. 2014 is also a National Emissions Inventory (NEI) triennial update year. These inventories will be made available to the respective states for their 2014 NEI reporting, or reported on the states’ behalf with their prior approval.

The geographic scope of the inventories will be the San Juan Basin in New Mexico and Colorado and the Permian Basin in New Mexico and Texas. For the purposes of this study, we recommend that the boundaries for the San Juan Basin be based on the aggregation of the North San Juan and South San Juan basins as defined in the WRAP Phase III project and boundaries for the Permian Basin be consistent with the Permian Basin definition used in the West-wide Jumpstart Air Quality Modeling Study (WestJumpAQMS). Using these definitions is consistent with previous emission inventories developed for these basins and also allows for the efficient development of county-level emission inventories for use by state agencies in ongoing inventory development and for use in air quality modeling studies.

Figure 1 shows the proposed boundaries of the San Juan and Permian Basins that we recommend for use in this project. Overlaid on these figures are well locations (current as of 2006 for the San Juan Basin that were compiled in the initial stages of the WRAP Phase III study and current as of 2008 for the Permian Basin that were compiled in the initial stages of the WestJumpAQMS study). These well locations and statistics will be updated to the current 2014 base year.

⁴ Eastern Research Group, Inc. (ERG). 2010. Characterization of Oil and Gas Production Equipment and Develop a Methodology to Estimate Statewide Emissions: Final Report.
<http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5820784003FY1026-20101124-ergi-oilGasEmissionsInventory.pdf>

⁵ <http://www.epa.gov/ghgreporting/reporters/subpart/w.html>



Production Statistics Compilation (Permian and San Juan Basins)

Oil and gas related activity data in the Permian and San Juan Basins will be obtained from the IHS Enerdeq database queried via online interface. The IHS database uses data from each state’s Oil and Gas Conservation Commission (OGCC) or equivalent as a source of information for oil and gas activity. The IHS database is typically more accurate and complete than the OGCC databases from which it obtains data. The use of the IHS database is also consistent with the methodology used in the WRAP Phase III and Montana-Dakotas projects. This technical approach assumes that BLM would make available to ENVIRON a license access to the IHS database through a third-party licensing arrangement or other comparable arrangement.

Two types of data will be queried from the Enerdeq database: production data and well data. Production data includes information relevant to producing wells in the basin while well data includes information relevant to drilling activity (“spuds”) and completions in the basin. Production data will be obtained for the counties that make up the Permian and San Juan Basins in the form of 298 Production files which will be processed through a PERL script developed by ENVIRON; extractions of the following data relevant to the emissions inventory development will be conducted:

1. Baseline year active wells by well type, i.e., wells that reported any oil or gas production in the baseline year 2014.
2. Baseline year oil, gas, and water production by well and by well type.

The production data are available by API number. The API number in the IHS database consists of 14 digits as follows:

- Digits 1 to 2: state identifier
- Digits 3 to 5: county identifier
- Digits 6 to 10: borehole identifier

- Digits 11 to 12: sidetracks
- Digits 13 to 14: event sequence code (recompletions)

Based on the expectation that the first 10 digits, which include geographic and borehole identifiers, would predict unique sets of well head equipment, the unique wells will be identified by the first 10 digits of the API number.

Well data will also be obtained from the IHS Enerdeq database for the counties that make up the Permian and San Juan Basins in the form of “297” well data. The “297” well data contain information regarding spuds and completions. The “297” well data will be processed with a PERL script that ENVIRON has developed as part of past Phase III basin inventory work to arrive at a database of by-API-number, spud and completion dates with latitude and longitude information. Drilling events in the baseline year will be identified by indication that the spud occurred within that year. If the well API number indicates the well was a recompletion, it will not be counted as a drilling event, though if the API number indicates the well was a sidetrack, it will be counted as a drilling event.

The production data and well data will be used to develop historical oil and gas activity trends and in the San Juan Basin to identify candidate producers to survey.

Survey Process (San Juan Basin)

Our team will leverage our extensive experience with conducting surveys and gathering survey-based data from the oil and gas industry. ENVIRON has led the survey development and surveying process for all WRAP Phase III basins, the Montana-Dakotas project, and the CenSARA oil and gas inventory study⁶ which is also survey-based. Using our experience in this area, we propose the following survey process for developing well site inventory inputs for the San Juan Basin.

Survey Instrument Development

ENVIRON will prepare a spreadsheet-based survey instrument for use in the San Juan Basin well site inventory input development. The survey instrument will request detailed equipment, process, controls and chemical composition data for all major source categories associated with upstream oil and gas development. ENVIRON has already reviewed the permitting requirements and thresholds in New Mexico and Colorado and determined the sources that will be unpermitted in these states as shown in Table 1.

⁶ ENVIRON, 2012. 2011 Oil and Gas Emission Inventory Enhancement Project for CenSARA States.

Table 1. Survey-based sources in New Mexico and Colorado.

Survey-based Source Category	New Mexico	Colorado
Drill Rigs	Y	Y
Completions and Recompletion Venting and Flaring	Y	Y
Fracing Engines	Y	Y
Mud Degassing	Y	Y
Blowdowns	Y	Y
Condensate and Oil Tanks	Y	[1]
Dehydrators	Y	N
Gas Plant Truck Loading	Y	Y
Oil and Condensate Well site Truck Loading	Y	Y
Heaters	Y	Y
Fugitives Devices	Y	Y
Pneumatic Controllers	Y	Y
Pneumatic Pumps	Y	Y
Workover Rigs	Y	Y
Compressor Engine Startup/Shutdown	Y	N
Compressor Engine Fugitives	Y	N
Well site Production Engines		
Artificial Lift Engines	Y	N
CBM water pump/dewatering engines	Y	N
Compressor Engines	Y	N
Miscellaneous engines	Y	N
Exempt Engines	N	Y

[1] ENVIRON would consult with CDPHE to determine whether to include oil and condensate tanks in the survey.

The list of source categories to be surveyed will be based on the WRAP Phase III inventories, however special consideration will be given to engines associated with coalbed methane (CBM) wells. It should be noted that on-road mobile sources and most off-road mobile sources (with the exception of drilling/workover rigs, fracing engines, and some portable engine types) are not considered a part of this inventory study. A draft of the survey spreadsheets will be provided to BLM for review and comment and finalized with BLM's approval.

Outreach

The IHS database analysis of both the San Juan Basins' production statistics will include the development of a ranked list of oil and gas companies' production levels and well ownership. This includes gas production ownership, oil/condensate production ownership, and well ownership. Companies representing the top 70% of ownership in each basin will be identified as targets for the survey process. ENVIRON will review this list with BLM, and modify it as necessary if BLM wishes to expand or reduce the number of companies. If the number of companies required to achieve 70% ownership exceeds 20 in either basin individually, ENVIRON will discuss the option of limiting the survey to the top 20 companies in that basin. Past survey efforts indicate that gathering more than 20 surveys will require significantly more resources and time than may be possible in the scope of this study.

Once the ranked list of companies is identified, the Project Team will conduct an outreach effort designed to inform these companies. We will discuss the reasons behind the project, the benefits to the involved stakeholders of compiling these emission inventories, the methodology to be used to complete the inventories, as well as assuring and clarifying that ENVIRON will hold the companies' survey response data confidential and aggregate those data to the Basin level, and review the level of involvement required of the companies to complete the project. This work will include identification of primary contacts within each organization, explanation to them of the survey content, procedures for distribution and response to

the survey requests and the proposed schedule the companies would be requested to adhere to in order to meet the project timetable. It is envisioned that this initial outreach effort will include electronic and telephone contact, and probably will require scheduling one or more in-person meetings with the companies near their district offices.

We will designate a Survey Coordinator (SC) within our Project Team who can coordinate the collection of the survey responses with BLM. We also anticipate that BLM will assist in getting the operators in these two basins to respond to the survey. Once the surveys are distributed, the SC will conduct follow-up to assure timely progress to obtain the necessary responses. This will include periodic checks on the status of the data collection, and identification of any problems and reasonable assistance for individual companies with survey completion and/or quality of response. The SC will serve as the primary point of contact to assist industry participants with questions, and to provide technical support to industry staff in their data compilation and submission. It is anticipated that the Project Team will make a **trip to a central meeting location** to coordinate inputs to survey responses and discuss the survey effort with the San Juan Basin operators, with BLM NMSO participation to assure that sufficient, representative, and complete survey responses are received so that detailed and comprehensive O&G emission inventories can be generated.

Detailed survey data organized at the field or formation level would be requested from participating companies. Organization of survey data into more granular categories can provide valuable information with respect to different emission regimes by field/formation. The gathering of survey data by field/formation will require participating companies to submit more survey data. ENVIRON will work closely with BLM and other stakeholders to determine the specific individual or groupings of fields/formation for which to gather more granular data.

Survey Aggregation and Input Factors Development (San Juan Basin)

Once information is received from the participating companies in each basin and from the States, these survey data will be compiled. Compilation includes the development of summary spreadsheets that incorporate the survey responses of each company by source category. These compilation spreadsheets form the basis of the inventory input factors that will be used in the next phase of this work to estimate by-source-category emissions.

The survey data responses will be aggregated by response type using a weighted averaging scheme to combine company responses per source category. For each source category a production statistic surrogate will be assigned, for example well counts will be assigned the surrogate for the pneumatic device emissions. The input data for each source category – equipment, process-related data, gas compositions, emission factors, etc. – will be aggregated by the weighted average contribution of each company using the surrogate as the weighting factor. This methodology allows each company's source data to impact the emissions from that source category in proportion to the company's ownership of the surrogate assigned to that category. This task can be challenging considering that many companies track equipment and process data in different formats and with varying degrees of precision, and may be willing to share only high-level summary data or very detailed data. ENVIRON will leverage our experience with reviewing and aggregating survey data from the past Phase III studies and other relevant project experience. In general, every effort will be made to incorporate company data in whatever format it is received. As part of the survey data aggregation, quality assurance/quality control (QA/QC) review will occur – company data identified as outliers or that clearly indicates that the data is inconsistent with other data will be flagged for further review. Follow-up discussions may be conducted with companies to clarify survey responses as part of the QA/QC process, or some data may be restricted from further use in the inventory analysis if determined to be incorrectly submitted or inconsistent.

Natural gas composition data, including produced primary gas (associated with conventional and CBM gas wells), produced associated gas (associated with oil wells), condensate tank flash gas, oil tank flash gas, and dehydrator vented gas compositions will also be gathered and average profiles will be compiled as part of the inventory input factors development.

The end result of this task will be by source category inventory input factors that will be used in the next phase of this work to estimate well site emissions. The input factors will be summarized in a technical memorandum and associated spreadsheet.

Consistent with the discussion above on survey outreach survey data would be compiled into emission inventory input factors by field/formation. Field/formation granularity will allow for finer spatial resolution with respect to emission inventory inputs that are compiled from the survey data. Additional effort will be required to aggregate this data and compile emission inventory input factors with field/formation granularity than if basin level survey data were used.

Review of Available Inventory Input Data (Permian Basin)

Conducting a survey in the Permian Basin similar to the one proposed for the San Juan Basin is **not** expected to yield adequate operator participation without New Mexico Environment Department (NMED) and Texas Commission on Environmental Quality (TCEQ) requiring operators to respond. It is **not** expected that NMED and TCEQ would support such a mandatory survey. Therefore, we propose to develop Permian Basin well-site input factors based on data available from other studies and/or reporting. TCEQ has an oil and gas emission inventory that is based primarily on an ERG (2010) report⁴, but with some significant updates to source categories such as compressor engines. We would review available well site emission inventory data from the Texas oil and gas emission inventory⁴ and other sources of available data such as EPA Subpart W reporting⁵. The review would be documented in a technical memorandum which would include a listing of available input factors and recommendations for input factors to use to estimate Permian Basin well-site emissions.

Permit Data Compilation (Permian and San Juan Basins)

Emissions from large sources in the San Juan and Permian Basins, including compressor stations, gas processing plants, and associated equipment will not be estimated based on input factors estimated based on survey or other data sources. For these large sources, permit data gathered by the NMED, Colorado Department of Public Health and Environment (CDPHE), TCEQ, and/or EPA Region 9, Region 8, and Region 6 offices (for tribal sources) will be queried. ENVIRON has worked extensively with state air agencies and EPA databases on permitted sources throughout the Rocky Mountain states and will structure queries to these agencies leveraging that experience. For purposes of consistency with the WRAP Phase III inventories, queries will use a combination of SCC and SIC/NAICS codes developed in the Phase III study to identify oil and gas sources that are within the permit databases maintained by NMED, CDPHE, TCEQ, and EPA. The SCCs used to report the resulting emissions inventory will be those used by BLM, EPA, States, WRAP/WESTAR, and others in regional photochemical modeling studies. Where actual emissions are provided for permitted sources these will be used in place of potentials-to-emit. Location data in the form of latitudes/longitudes and county codes (FIPS) will also be compiled. The status of permitted sources will be reviewed to exclude any sources that were inactive during the baseline year. If necessary, follow-up will be conducted with state agencies to address any issues or questions that arise in the process of compiling the permit data.

Regarding these data for large permitted midstream sources, the Project Coordinator (PC) will work with New Mexico, Colorado, and Texas State air programs, and with EPA Region 9, Region 8, and Region 6 to obtain the necessary permit data for use by ENVIRON. ENVIRON will identify the specific data

needed and the PC will serve as liaison to convey the requests to the Federal/State agencies, as well as to track the progress in compilation and submittal of what data is available from those agencies.

Reporting and Distribution (Permian and San Juan Basins)

The PC will coordinate reviews with BLM and state air programs during the project, as well as organize and schedule data publication and facilitate distribution of work products. Data and technical memoranda would be posted on the Western Regional Air Partnership website for reference and recall by any interested stakeholder.

Project Schedule

This project would begin on May 1, 2015. The San Juan Basin and Permian Basin work would be completed October 30, 2015.

Table 2. Draft Schedule.

<u>Task</u>	<u>Lead, Participant</u>	<u>Description</u>	<u>Basin</u>	<u>Target Date</u>
1	ENVIRON, PC/SC	Prepare Ranked List of Companies	SJ	5/8/2015
2	SC	Identify Contacts from Ranked List	SJ	5/15/2015
3	SC	Identify Contacts from Agencies	SJ	5/15/2015
4	SC	Schedule Outreach Calls/Meetings	SJ	5/22/2015
5	ENVIRON, PC	Prepare Query for State/Federal Agencies	SJ, Permian	5/27/2015
6	SC	Distribute Agency Queries	SJ	6/3/2015
7	SC	Hold Outreach Calls/Meetings	SJ	6/10/2015
8	ENVIRON, SC	Prepare Survey Instrument	SJ	6/22/2015
9	SC	Distribute Survey Instruments	SJ	6/26/2015
10	ENVIRON	Complete Permian Basin Input Factors Review	Permian	7/17/2015
11	Agencies	Complete/Submit Query Response	SJ, Permian	7/20/2015
12	ENVIRON, PC/SC	Compile Query Data	SJ	8/17/2015
13	Companies	Complete/Submit Survey Instruments	SJ	8/21/2015
14	ENVIRON, SC	Compile Survey Data	SJ	9/18/2015
15	ENVIRON	Complete Survey Data Analysis	SJ	10/2/2015
16	ENVIRON	Complete Draft Memoranda/Spreadsheets	SJ, Permian	10/16/2015
17	BLM	Memoranda Review & Comment	SJ, Permian	10/23/2015
18	ENVIRON, PC/SC	Complete Final Memoranda/Spreadsheets	SJ, Permian	10/30/2015

III. QUALIFICATIONS, EXPERIENCE AND PAST PERFORMANCE

We have assembled a Project Team that has noted experts in the development of oil and gas emissions inventories that consists of WRAP/WESTAR and ENVIRON. Mr. Tom Moore of the WRAP/WESTAR will be the PC, a role he has performing in several O&G emissions development studies led by the WRAP. Mr. Moore has been the technical coordinator of the

WRAP activities for more than a decade. At ENVIRON, Mr. Ralph Morris would be Principal-in-Charge (PIC). Mr. Morris has over 35 years' experience and has managed numerous air quality studies of the impacts of oil and gas emissions including BLM RMPs, EISs and EAs as well as ozone, PM_{2.5} and visibility SIPs. Dr. Amnon Bar-Ilan and Mr. John Grant of ENVIRON would be Co-Principal Investigators for the proposed study; Mr. Bar-Ilan has been the Principal Investigator for and Mr. Grant has been integral to the success of the WRAP Phase III study and the Montana-Dakotas study. Dr. Bar-Ilan and Mr. Grant are recognized experts on oil and gas emission inventories and both have led numerous studies in their development. Mr. Lee Gribovicz would serve as the SC, a role he is ideally suited for given his long history of dealing with O&G emissions when he worked for the Wyoming DEQ, participation in WRAP O&G technical working groups and providing WRAP staff support for studies of the Williston and Great Plains Basins. The Project Team has a long history in the successful development of oil and gas emissions inventories in numerous studies. Table 3 below lists several studies that included the development of oil and gas emissions inventories with a contact person that BLM can contact to demonstrate the Project Team's successful past performance.

The Western Regional Air Partnership (WRAP) and the Western Energy Alliance (WEA) funded ENVIRON International Corporation to develop detailed and comprehensive O&G emissions for 8 O&G Basins in the inter-mountain west (the WRAP Phase III project), completed by ENVIRON in 2013. ENVIRON performed the WRAP Phase III project under project management from the Western Governors' Association (WGA)/ Western States Air Resources Council (WESTAR) using the same team structure and personnel we propose to use in this study. The Phase III study is an important part of the suite of emissions and modeling studies conducted through WRAP's regional technical analysis program, that has supported air quality management and planning activities of western states and federal agencies. WRAP Phase III O&G emissions have been developed for the 2006 baseline year for the South San Juan Basin in New Mexico, the North San Juan, Piceance and Denver-Julesburg Basins in Colorado, the Uinta Basin in Utah, and the Greater Green River, Powder River and Wind River Basins in Wyoming. The WRAP Phase III emissions inventories have proven to be a valuable resource for air quality modeling and planning including BLM Resource Management Plans (RMPs) and Environmental Impact Statements (EISs) and the Denver ozone State Implementation Plan (SIP).

The BLM recently supported a project through a financial assistance cooperative agreement with the Western Governors' Association (WGA) to produce a regional air modeling framework that supports subsequent quantitative evaluation of air pollution control strategies in the West, using Phase III emissions and other western-specific data, called the West-wide Jumpstart Air Quality Modeling Study (WestJumpAQMS), completed by ENVIRON September 2013. The WRAP and ENVIRON under the administration of the WGA performed the work. Effective October 1, 2013, all WRAP projects were transferred from the WGA to WESTAR. The WRAP's work started in 2010 and involved collaborative funding and participation by the BLM, the EPA, other federal land managers, western States, and industry. The WRAP membership includes western States, federally-recognized tribes, local air agencies within the states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming, the U.S. Forest Service (FS), National Park Service (NPS), Bureau of Land Management, U.S. Fish and Wildlife Service (FWS), Environmental Protection Agency (EPA), industry representatives, representatives of non-

governmental organizations, and the public. The WRAP provides a venue for its membership to develop a common understanding of current and future air quality issues and develop and maintain databases to support studies of these issues.

The WRAP and the Bureau of Land Management (BLM) funded ENVIRON to develop another detailed and comprehensive emission inventory for the Willison and Great Plains Basins (the Montana-Dakotas project). Similar to the WRAP Phase III study, ENVIRON performed the Williston and Great Plains inventory study (the Montana-Dakotas project) under project management from the WGA/WESTAR using the same team structure and personnel we propose to use in this study. The Williston and Great Plains inventory is supporting air quality management and planning activities of western states and federal agencies.

WRAP/WESTAR is also coordinating the ongoing Western Air Quality Data Warehouse (WAQDW) and associated Western States Air Quality Study (WSAQS) regional modeling efforts. Under direction from WRAP/WESTAR, ENVIRON and University of North Carolina at Chapel Hill (UNC) have developed photochemical grid model (PGM) modeling databases for the western U.S. and the 2008 and 2011 calendar years. WSAQS also develop 2011 O&G emissions for Basins in Colorado, Utah and Wyoming using the WRAP Phase III methodology. The WSAQS 2008 and 2011 PGM modeling databases and results are being housed in the WAQDW. In 2015, WSAQS will develop a 2014 PGM modeling database and 2014 O&G emissions.

Table 3. Past oil and gas emission development projects for the Project Team.

Project Title and Description	Client Contact, Affiliation, Phone
<p>WRAP/IPAMS Phase III Oil and Gas Emissions Inventory. ENVIRON is conducting a comprehensive emissions inventory development project jointly sponsored by the Western Regional Air Partnership (WRAP) and the Independent Petroleum Association of Mountain States (IPAMS now WEA). The project, known as Phase III, builds from two earlier region-wide oil and gas inventory projects sponsored by WRAP. The Phase III project is the most comprehensive regional inventory conducted to date of all oil and gas activity including major and minor sources of all criteria pollutants in the Rocky Mountains. The Phase III project when completed will cover all major development basins in the Rocky Mountain region, producing baseline 2006 and projected 2012 oil and gas emissions inventories for the region for use in modeling and other studies.</p>	<p>Tom Moore Western States Air Resources Council (970) 491-8837 NM, CO, UT, WY, MT, SD and ND 2008-present</p>
<p>Three-State Air Quality Modeling Study. ENVIRON has developed 2011 and 2020 O&G emission inventories for the Intermountain West O&G Basins by forecasting emissions from the 2008 inventory developed as part of the WestJumpAQMS. ENVIRON also compiled 2011 base year and 2020 forecast year permitted source O&G emissions for the Raton and Paradox Basins. Inventory enhancements were performed including adding fracing engine emissions to the basins from which they were missing and analyzing Tribal Minor Source Review Reporting in the Uinta Basin to develop updates to Tribal area well site sources.</p>	<p>Tom Moore Western States Air Resources Council (970) 491-8837 NM, CO, UT, WY, MT, SD and ND 2008-present</p>
<p>BLM Colorado Air Resource Management Modeling Study. ENVIRON has performed emissions and photochemical grid modeling to assess the AQ/AQRV impacts associated with O&G and other developments within the BLM Colorado FOs. ENVIRON used a CAMx 2008 4-km modeling domain database developed by WestJumpAQMS and projected emissions to 2011 and 2021. Ozone and Particulate source apportionment modeling was conducted to obtain separate contributions due to O&G and other activities (e.g., mining) on federal and non-federal lands within each Colorado FO.</p>	<p>Chad Meister BLM Colorado (303) 239-3949 Colorado 2012-2015</p>
<p>BLM Mancos Shale Air Assessment. ENVIRON has developed emissions estimates of the Mancos Shale formation and expanded the photochemical grid modeling analysis conducted as part of the BLM Colorado Air Resource Management Modeling Study to assess the AQ/AQRV impacts associated with O&G development of the Mancos Shale. The emissions analysis included working closely with BLM specialists to obtain representative emission inventory inputs and RFD estimates of Mancos Shale development. Mancos Shale impacts AQ/AQRV impacts were analyzed with Ozone and Particulate source apportionment modeling to obtain Mancos Shale specific contributions.</p>	<p>Mary Uhl BLM New Mexico (505) 954-2174 New Mexico 2014-present</p>
<p>Piceance Pilot Project (P3) Study of Oil and Gas Mobile Source Emissions. ENVIRON is working under contract to the U.S. EPA to study on-road and off-road mobile source emissions associated with oil and gas activity in the Piceance Basin in Northwestern Colorado. The project is directed by a technical steering committee composed of WRAP staff, environmental staff from Colorado and Wyoming, and industry participants. ENVIRON is developing a 2009 first-of-its-kind emissions inventory of oil and gas mobile sources, including trucking, construction and maintenance equipment, and commute vehicles associated with oil and gas development activities.</p>	<p>Scott Jackson U.S. EPA Region 8 (303) 312-6107 Colorado 2009-2012</p>
<p>BLM Grand Junction RMP Air Quality Assessment. ENVIRON is performing the emissions, air quality and air quality related values (AQRV) analysis for the Resource Management Plan (RMP) revision for BLM's Colorado Grand Junction Field Office (GJFO). Working closely with the GJFO and State of Colorado BLM Office, ENVIRON has prepared a Modeling Protocol that discusses how development in the GJFO area will affect air quality and AQRV in the region. In particular, the effects of oil and gas development, off terrain vehicle (OTV) and other uses impacts on air quality will be investigated.</p>	<p>Melissa Hovey BLM Colorado (303) 239-3736 Colorado 2009-present</p>
<p>Uinta Basin Air Quality Study. ENVIRON performed the Uinta Basin Air Quality Study (UBAQS) to address the cumulative air quality and air quality related values due to oil and gas development activities throughout the Uinta Basin and nearby areas. The CMAQ model was used to simulate the 2005 and 2006 annual periods for a 12 km domain covering eastern Utah and western Colorado and a model performance evaluation conducted. Simulations were then conducted for a 2006 baseline and a 2012 future year.</p>	<p>Kathleen Sgamma Western Energy Alliance (303) 623-0987x226 Utah, 2008-9</p>
<p>BLM Continental Divide-Creston EIS Natural Gas Project. ENVIRON is performing the air quality and AQRV assessment of the Continental Divide-Creston (CD-C) oil and gas (O&G) infill project for the BLM Rawlins Field Office. The CD-C O&G infill project plans to drill over 10,000 wells in an area in Sweetwater and Carbon Counties, Wyoming. The effects of the CD-C O&G development will be assessed for ozone and other criteria pollutants, visibility and deposition as well as greenhouse gases (GHG). This is one of the first BLM EISs where a photochemical grid model (PGM) will be used to assess ozone as well as far-field air quality and AQRV issues.</p>	<p>Charis Tuers BLM Wyoming (307) 775-6099 Wyoming 2007-present</p>

Project Title and Description	Client Contact, Affiliation, Phone
<p>BLM Moxa Arch O&G Gas Infill Project EIS. ENVIRON is performing the AQ and AQRV assessment of the Moxa Arch O&G infill development project in Sweetwater, Lincoln and Uinta Counties, Wyoming. The CAMx photochemical grid model is currently being applied to estimate the ozone impacts due to the Moxa Arch project as well as a replacement to CALPUFF for the far-field modeling. The Moxa Arch area is close to ozone monitors in Sublette County that have measured violations of the ozone NAAQS. Moxa Arch is also fairly close to Class I areas where visibility and deposition impacts are a concern.</p>	<p>Charis Tuers BLM Wyoming (307) 775-6099</p> <p>Wyoming 2007-present</p>
<p>Denver 8-Hour Ozone SIP Modeling. ENVIRON led the MM5 meteorological, SMOKE emissions and CAMx photochemical modeling on a 36/12/4 km domain and a June-July 2006 episode to support the development of the 2008 Denver ozone SIP. Oil and gas emissions for the Denver-Julesburg Basin were an important part of the Denver ozone control plan. Under extreme time constraints, the Denver 2008 SIP hour ozone attainment demonstration modeling was completed in August 2008 so that the Colorado 8-hour ozone SIP is on track to be completed in 2008.</p>	<p>Jerry Dilley Denver RAQC (303) 629-5450 x240 Denver; Colorado; 2007-2008</p>
<p>Four Corners Air Quality Task Force Modeling. ENVIRON performed emissions and air quality modeling of the western U.S. for the Four Corners Air Quality Task Force (FCAQTF). The FCAQTF were concerned that increased oil and gas (O&G) development in the region could endanger the new 8-hour ozone NAAQS and cause visibility and deposition impacts at nearby Class I areas. ENVIRON set up the MM5/SMOKE/CAMx modeling system on a 36/12/4 km grid for the 2005 calendar year. Emissions were projected to 2018 and various 2018 emissions mitigation scenarios were analyzed to assess their effects on ozone, PM, visibility and deposition.</p>	<p>Rita Bates New Mexico Air Quality Bureau (505) 827-1494 Four Corners; NM+CO+UT+AZ 2007-2010</p>
<p>WRAP Regional Modeling Center (RMC). ENVIRON was part of the Western Regional Air Partnership (WRAP) Regional Modeling Center (RMC). The WRAP RMC set up and ran the MM5 meteorological, SMOKE emissions and CMAQ and CAMx air quality models on a 36/12 km domain to address visibility degradation at sensitive Class I areas throughout the West.</p>	<p>Tom Moore, WRAP (970) 491-8837 Western U.S. 2001-2009</p>