Oil and Gas Mobile Sources Pilot Study

Prepared for:
U.S. Environmental Protection Agency
Work Assignment 4-08

Prepared by:
Amnon Bar-Ilan
John Grant
Rajashi Parikh
Ralph Morris
ENVIRON International Corporation
773 San Marin Drive, Suite 2115
Novato, California, 94945
www.environcorp.com

and

Doug Henderer
Kleinfelder/Buys and Associates, Inc.

July 2011
Project Number:
06- 20443

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Executive Summary

This report presents the methodology and findings of a pilot study conducted to estimate an emission inventory of criteria pollutants from mobile sources associated with onshore oil and gas development in the Piceance Basin of Northwestern Colorado. This study builds on several past inventory projects that have examined emissions from oil and gas development activities both in the Piceance Basin and in the Intermountain West generally. These include the WRAP Phase I, Phase II and Phase III inventory projects that have developed point and area source emissions inventories of oil and gas exploration and production sources. With the exception of certain major off-road mobile sources such as drilling and workover rigs, mobile sources have not been studied as part of the WRAP inventories. This study attempts to estimate these emissions and compare them to the existing point and area source inventories in the Rocky Mountain region.

The study uses the methodologies developed as part of the Phase III inventory. A working group of technical experts was convened for this project including members of the oil and gas industry operating in the Piceance Basin. Survey forms were developed requesting detailed data on off-road equipment and on-road vehicles used for various phases of oil and gas production, including well construction, well drilling, well completions (including fracturing), and production operations. The surveys were accompanied by an extensive outreach effort to ensure as much response as possible from the oil and gas operators. The oil and gas companies participating in the study, and who provided survey data responses, represented 63% of well ownership in the basin, 65% of gas production in the basin, and 78% of oil production in the basin. This was a sufficiently large percentage of production and well ownership that the responses were considered representative of all oil and gas production in the basin.

The survey responses were used to develop aggregated survey data, representing equipment counts, activity, emission factors, controls, and other key data inputs needed to develop emissions factors for on-road vehicles and off-road equipment used in the oil and gas fields. The study focuses on activities that occur within oil and gas fields, as it was determined that on-road vehicle activity on public roadways throughout the Piceance Basin is already inventoried through traditional county-level mobile source inventories developed in Colorado. It would not be possible to reconcile an independent estimate of these mobile source activities from oil and gas sources separately from all other mobile source activities. The aggregated survey data was developed for both within-field activities and the complete off-site activities of mobile sources, but emissions estimates were limited to activities within oil and gas fields. A field verification effort was also undertaken as part of the study to verify and support the data gathered as part of the survey. The field verification employed automated traffic counters and manual traffic counts to evaluate on-road vehicle activity associated with drilling rig moves, hydraulic fracturing events and production operations. Field verification results were used to compare to the survey data, and where necessary to adjust the data prior to its use in emissions estimates.

Inventory development used the latest emissions factor modeling methods and tools, including the EPA NONROAD and MOVES models and EPA guidance to estimate fugitive dust emissions. These tools were used to develop annual emissions inventories of oil and gas mobile sources for all criteria pollutants for the calendar year 2009, by county in the Piceance Basin and by mobile source category. Results of the mobile source inventory of within-field mobile source activities for the Piceance Basin are presented below in Table ES-1.

Table ES-1. 2009 emissions of all criteria pollutants by county for the Piceance Basin.

County	NOx (tons/yr)	CO (tons/yr)	Total VOC (tons/yr)	SOx (tons/yr)	Total PM10 (tons/yr)	Fugitive Dust PM10 (tons/yr)	Total PM2.5 (tons/yr)	Fugitive Dust PM2.5 (tons/yr)
Delta	0	0	0	0	1	1	0	0
Garfield	758	325	61	14	6,273	6,226	1,505	1,460
Gunnison	2	1	0	0	10	10	2	2
Mesa	67	30	6	1	657	652	158	154
Moffat	42	18	3	1	380	377	91	89
Rio Blanco	185	81	15	3	1,695	1,684	408	397
Routt	3	1	0	0	23	23	6	5
Totals	**1,055**	**455**	**86**	**19**	**9,039**	**8,974**	**2,171**	**2,109**

The results were compared to the inventory findings of the WRAP Phase III study of point and area sources of oil and gas. The comparison indicated that within-field activities represent a small fraction of the total emissions from oil and gas activities in the Piceance Basin for all pollutants but PM10. Oil and gas mobile source PM10 emissions, arising primarily from fugitive dust from on-road vehicle travel on unpaved and paved roadways, represent a significant fraction of total PM10 emissions from this sector.

Unit-level emissions factors representing within-field oil and gas mobile source emissions were developed using total by-source-category emissions from this pilot study and surrogates representing various oil and gas activity parameters. These unit-level factors are intended for use in generalizing the results of this study to other basins. A number of caveats with the unit-level emission factor generation are noted, including the specifics of the activities and configurations of oil and gas development in the Piceance Basin, and the applicability of these findings to other oil and gas development basins. Nevertheless, this study represents a first attempt to consistently inventory oil and gas mobile source emissions on a basin-wide level.

1.0 Introduction

This report presents the methodology and findings of a pilot study conducted to estimate an emission inventory of criteria pollutants from mobile sources associated with onshore oil and gas development in the Piceance Basin of Northwestern Colorado. This study builds on several past inventory projects that have examined emissions from oil and gas development activities both in the Piceance Basin and throughout the Intermountain West.

The Western Regional Air Partnership (WRAP) has sponsored two phases of oil and gas inventory development in the past decade, including the WRAP Phase I (Russell, et al., 2005) and Phase II (Bar-Ilan, et al., 2007) studies which were the first studies to attempt to comprehensively inventory emissions arising from oil and gas exploration and production activities. The Phase I project developed point and area source emission inventories for oil and gas activities for all Western states within the boundaries of the WRAP on by-county and by-source-category levels, including on tribal and non-tribal land. While the Phase I inventory estimated VOC emissions from a number of oil and gas processes, the focus of the Phase I inventory was on NOx and SOx emissions and their impacts on regional haze. Compressor engines and drilling rigs, as major sources of NOx and SOx, were one area of focus of the Phase I inventory. The Phase I study was limited in terms of participation from industry, and major assumptions were incorporated into the inventory development process. This was followed by the Phase II inventory, which studied compressor engines and drilling rigs in more detail using information gathered from oil and gas companies operating in the Intermountain West through a survey process. The study also updated the SOx emissions inventory from large gas plants associated with the oil and gas industry.

In addition to the Phase I and Phase II studies, a number of smaller studies have developed emissions inventories of oil and gas activities in specific geographic regions. The New Mexico Environment Department (NMED) sponsored a study to inventory ozone precursor emissions (NOx and VOC primarily) in the Four Corners region of Northwestern New Mexico (Pollack, et al., 2006). This study was limited to Rio Arriba and San Juan Counties in the South San Juan Basin, but these two counties accounted for the vast majority of 2002 and 2005 production of gas in the Basin. This study developed detailed surveys, assembled a working group consisting of project staff and oil and gas company representatives, and gathered a highly detailed data set on emissions and equipment at oil and gas well sites throughout these two counties. The Wyoming Department of Environmental Quality (WYDEQ) has also conducted emission inventories of oil and gas activities both statewide (Pollack, et al., 2005) and for the Jonah-Pinedale Anticline Development (JPAD) area specifically (WYDEQ, 2008). These inventories relied on a combination of permit data submitted to the WYDEQ by oil and gas companies operating in the various development regions in the state, or through more detailed requests for survey information from the oil and gas companies. Both of these studies developed high quality inventories but were limited in geographic scope.

In 2007 the WRAP jointly co-sponsored a Phase III inventory development project with the Western Energy Alliance (formerly the Independent Petroleum Association of Mountain States – IPAMS). The objective of Phase III was to build on the Phase I and II inventories, but using the detailed methodologies of the focused inventory projects. For the Phase III project, a technical working group was gathered consisting of WRAP, Western Energy Alliance, and many independent and major oil and gas companies operating in the region. The Phase III project has developed the most comprehensive and detailed emission inventories to date for the oil and gas development basins in the Intermountain West. Phase III focuses on both area and point sources and includes all criteria pollutants from major and minor source categories including combustion and non-combustion sources. The Phase III project aims to complete inventories for 9 major basins of oil and gas development, for a 2006 baseline year and projections to 2012. Thus far, 7 of these basin inventories have been completed and the remaining 2 basins are anticipated to be completed by the end of 2011, with all results being made publicly available through the WRAP. As with the approaches used by NMED and WYDEQ, the Phase III project combines detailed survey data and analysis of permits submitted to respective state agencies to assemble a highly detailed and comprehensive emissions inventory of oil and gas activities. The same basic methodologies, adapted for the specifics of each basin, are used throughout the study area of the project to generate regionally-consistent emission inventories.

1.1 OBJECTIVES

The Phase III project covers over 20 different source categories of emissions for any single basin, depending on the characteristics of the basin and the type of production and equipment in use. Most of these sources are classified as point sources (large gas plants, compressor stations, or other stationary facilities) or area sources depending on the type of data available for the basin. Some of the source categories captured in the Phase III project are classified as mobile sources, but these are limited to drilling rigs, workover rigs and some portable equipment such as generators which may be considered mobile sources. Members of the WRAP oil and gas working group have questioned whether on-road and off-road mobile sources associated with oil and gas development – including such sources as heavy-duty trucks, light-duty vehicles bringing employees to and from well sites, construction equipment used to develop well pads and roadways – are significant contributors to the Phase III inventories of point and area sources. This pilot study aims to address this question by developing a first-of-its-kind detailed basin-wide emission inventory of oil and gas mobile sources. Specifically, the objectives of this study are:

1. To review available literature from past studies in the Rocky Mountain region on oil and gas mobile source activities and emissions and summarize these. This objective has already been completed and summarized in the form of a background research report;
2. To gather survey data on mobile source activity at oil and gas development sites in the Piceance Basin in Northwestern Colorado for both in-field activities and the complete trips associated with these vehicles in and out of field;
3. To use the gathered survey data to develop a detailed emission inventory of oil and gas mobile sources in the Piceance Basin, including field verification to support the survey findings;
4. To develop unit-level emissions factors from the pilot study inventory results and the activity levels in the Piceance Basin, which could in turn be applied to other basins;
5. To compare the findings of the Piceance Basin mobile source inventory to the existing WRAP Phase III point and area source inventory and determine whether mobile source emissions represent a significant fraction of the point and area source emissions.

The report below provides more details on the temporal and geographic scope of this pilot study, the methodologies used and results, and the comparison of these results with the point and area source inventory. It should be noted that this study is a pilot study, and therefore represents a first attempt to gather the data needed to develop a detailed oil and gas mobile source emission inventory. This pilot study relies on survey data gathered from oil and gas companies and limited field verification results. As discussed below, survey data could not be obtained for all companies operating in the Piceance Basin, and therefore the generalization of the survey data to basin-wide activities may not be representative of the practices of all companies operating in the basin. The generation of unit-level emissions factors from this pilot study, and their use in other basins, also carry the same caveat that this pilot study inventory is based on a limited set of survey data and may not be representative of practices in other basins. Future studies of other basins that use the methodologies and approach of this pilot study may lead to more detailed and applicable results for other basins, but in the absence of any other information on oil and gas mobile sources, this pilot study represents a first attempt to inventory these mobile source categories.

2.0 Scope of Study and Data Collection

This section covers the temporal and geographic scope of this pilot study, and the development of surveys used to gather input data on equipment, vehicles, activity, emission factors, controls and other key oil and gas activity input data used to develop the emission inventories. This data is presented in detailed Appendices at the end of this document.

2.1 TEMPORAL AND GEOGRAPHIC SCOPE

This inventory considers a base year of 2009 for purposes of estimating emissions. All data requested from participating companies were for these companies' activities in the calendar year 2009. Similarly, all well count and production data for the basin obtained from the IHS database were for the calendar year 2009. Emissions from all source categories are assumed to be uniformly distributed throughout the year. In the initial outreach phase of this study, oil and gas operators indicated that data would not be easily available for calendar year 2006, so although 2006 aligns with the WRAP Phase III study (ENVIRON, 2009) 2009 was selected as the analysis year due to availability of data.

The geographic scope of this inventory is the Piceance Basin in Colorado. For the purposes of this study, the boundaries for the Piceance Basin were modified from those of the US Geological Survey (USGS) (USGS, 2008) to wholly include the counties of Chaffee, Delta, Eagle, Garfield, Gunnison, Lake, Mesa, Moffatt, Pitkin, Rio Blanco and Routt. The Piceance Basin Boundary used is consistent with the boundary used in the WRAP Phase III oil and gas emissions study (ENVIRON, 2009). It should be noted that frequently the Uinta and Piceance Basins are referred to collectively as a single basin (the "Uinta-Piceance Basin"). However, for purposes of this study, it is useful to define the borders of the Piceance Basin to be the portion of the Uinta-Piceance Basin that lies entirely within Colorado. Figure 1 shows the boundaries of the Piceance Basin. It is noted that there is no tribal land in the Piceance Basin.

In addition to the Piceance Basin boundaries described above, in which oil and gas mobile source emissions are being estimated, it is important to consider the spatial area within which to consider these emissions. On-road vehicles associated with oil and gas operations travel both within oil and gas fields on private roads and outside of oil and gas fields on public roads. The Colorado Department of Public Health and Environment (CDPHE) routinely develops on-road vehicle mobile source emission inventories. Input from the CDPHE indicates that on-road vehicle travel on public roads would be included in existing mobile source emission inventories while travel within oil and gas fields on private roads would not be included. The emissions from vehicle travel on major public roads in the counties making up the Piceance Basin (including interstate and state freeways, county roads, and other paved public roadways) are developed by CDPHE based on VMT data from Colorado Department of Transportation (CDOT) using a network of traffic counters deployed on these roadways. Review of this data indicated that reconciling an independent calculation of oil and gas mobile source emissions on public roadways with the existing inventory would not be possible, and therefore this study was limited to within-field emissions from on-road vehicles.

Figure 1. Piceance Basin boundary definition.

2.2 WELL COUNT AND PRODUCTION DATA

Oil and gas related activity data across the entire Piceance Basin were obtained from the IHS Enerdeq database queried via online interface. The IHS database uses data from the Colorado Oil and Gas Conservation Commission (COGCC) as a source of information for Colorado oil and gas activity. Two types of data were 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 were obtained for the counties that make up the Piceance Basin in the form of PowerTools input files. PowerTools is an IHS application which, given PowerTools inputs queried from an IHS database, analyzes, integrates, and summarizes production data in an ACCESS database. The Piceance Basin PowerTools input files were loaded into the PowerTools application. From the ACCESS database created by PowerTools, extractions of the following data relevant to the emissions inventory development were made:

1. 2009 active wells, i.e. wells that reported any oil or gas production in 2009.
2. 2009 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 were identified by the first 10 digits of the API number.

Well data were also obtained from the IHS Enerdeq database for the counties that make up the Piceance Basin in the form of "297" well data. The "297" well data contain information regarding spuds and completions. The "297"well data were processed with a PERL script to arrive at a database of by-API-number, spud and completion dates with latitude and longitude information. Drilling events in 2009 were identified by indication that the spud occurred within 2009. If the well API number indicated the well was a recompletion, it was not counted as a drilling event, though if the API number indicated the well was a sidetrack, it was counted as a drilling event.

The well counts and oil, gas and water production by county for the basin are presented in Table 1, and the spuds by county are presented in Table 2. It should be noted that there is not significant CBM gas production in the Piceance Basin; ENVIRON (2009) indicated that total CBM gas production in 2006 accounted for 0.2% of gas production in the basin as a whole.

Consistent with ENVIRON (2009) CBM gas production was not tracked separately from conventional gas production.

Table 1. 2009 well count and oil, gas and water production by county for the Piceance Basin.

County	Well Count	Oil Production [bbl]	Gas Production [mcf]	Water Production [bbl]
Chaffee	0	0	0	0
Delta	1	7	5,644	191
Eagle	0	0	0	0
Garfield	6,975	1,992,539	580,804,969	24,650,969
Gunnison	10	1,356	1,307,912	708,969
Lake	0	0	0	0
Mesa	744	109,470	35,017,833	1,668,872
Moffat	427	286,742	16,560,981	15,702,563
Pitkin	0	0	0	0
Rio Blanco	1,907	5,017,553	71,696,655	103,467,582
Routt	26	53,640	54,763	11,837
Total	10,090	7,461,307	705,448,757	146,210,983

Table 2. 2009 spud counts by county for the Piceance Basin.

County	Total Number of Spuds in 2006
Chaffee	0
Delta	0
Eagle	0
Garfield	744
Gunnison	5
Lake	0
Mesa	15
Moffat	24
Pitkin	0
Rio Blanco	103
Routt	2
Total	**893**

Figure 2 shows 2009 active well locations as well as spud locations. A majority of spudding locations are generally coincident with gas well field locations in Garfield County and oil well field locations in Rio Blanco County. Some additional isolated spudding locations occur elsewhere in the basin. Thus the number of spuds in Garfield County can be used as an indicator of the gas production activity in the Piceance Basin generally, and the number of spuds in Rio Blanco County can be used as an indicator of the oil production activity in the Piceance Basin generally. Significantly more activity related to gas production is occurring than related to oil production in the Piceance Basin in 2009, consistent with findings in the 2006 inventory for the Piceance Basin and other Phase III basin inventories.

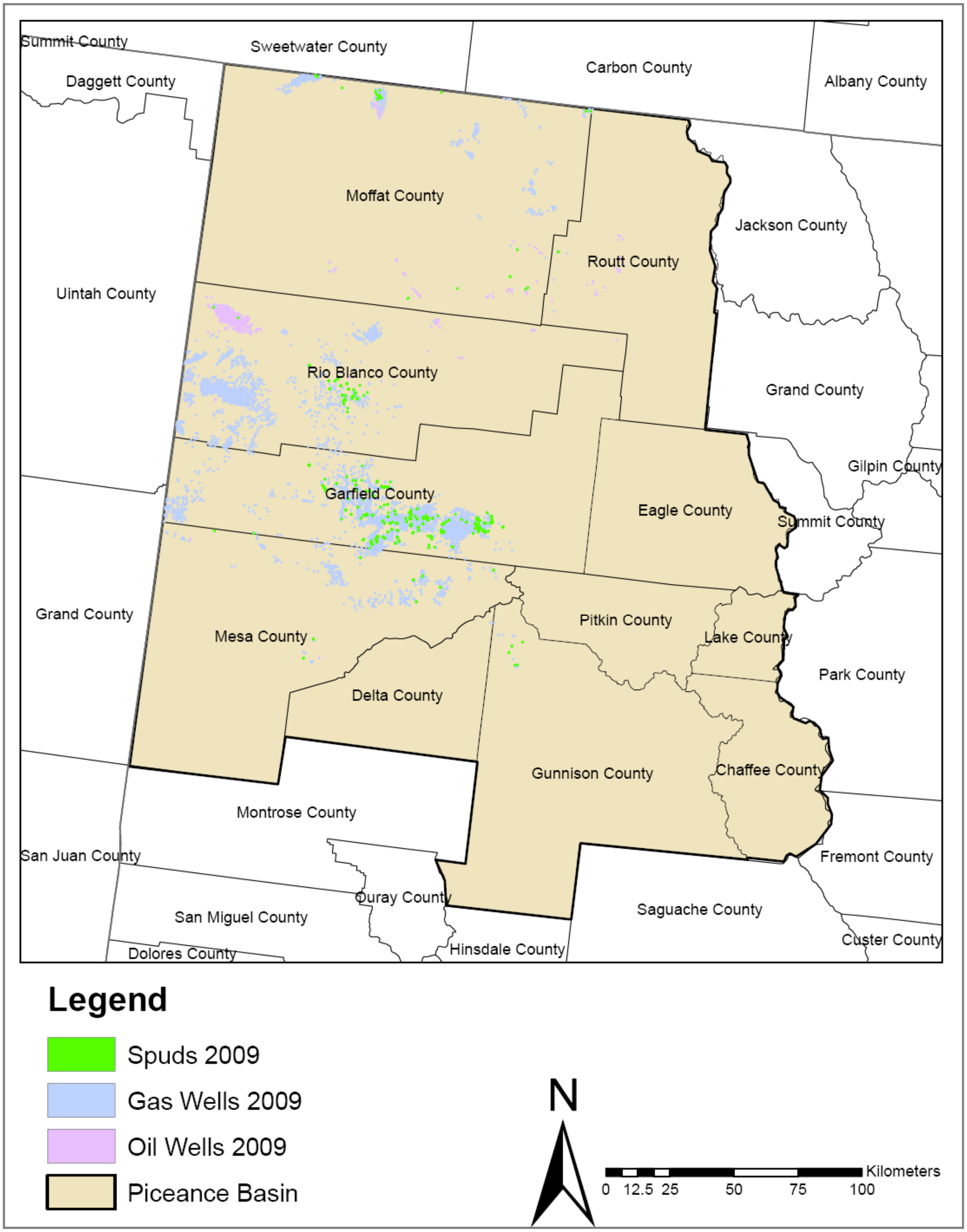

Figure 2. Piceance Basin gas well, oil well, and spud locations.

2.3 SURVEY DATA

Survey forms consisting of a spreadsheet with 15 individual tabs within which data was requested for specific source categories (included as Appendix A) were forwarded to participating operators in the Piceance basin. Within each spreadsheet specific data was requested related to each of the following mobile source categories:

- Well Pad Construction Equipment
- Pipeline Construction Equipment
- Fracing Equipment
- Refracing Equipment
- Maintenance Equipment
- Other Relocatable Equipment
- Disturbed Land (fugitive dust)
- Well Pad Construction Traffic
- Pipeline Construction Traffic
- Drill Rig Traffic
- Completion and Recompletion Traffic
- Production Traffic
- Maintenance Traffic
- Employee Commuter Traffic
- Ancillary Traffic

The companies participating in the survey process for the Piceance Basin represented 63% of well ownership in the basin, 65% of gas production in the basin, and 78% of oil production in the basin. This represented a sufficiently large percentage of oil and gas activity in the basin that it was felt that the responses obtained from the participating companies would be representative of all oil and gas operations in the basin.

The survey data was aggregated from the responses of participating companies to develop per-unit-activity input data for on-road vehicles, off-road equipment and fugitive dust sources as presented in Tables 3-5. Detailed inventory methodologies for each of the source categories are presented in Section 3. Extrapolation of these data was necessary to account for emissions from all oil and gas activity in the basin. The extrapolation methodology to obtain county-level and basin-wide emissions for each source category is described below, but is largely based on scaling by the proportional representation of the respondents of specific activity surrogates basin-wide. These include well counts, oil or gas production, drilling event counts, completion/recompletion event counts, as appropriate. It should be noted that surveys requested average data for those data types where ranges of data might be provided. For example, on-road vehicle speeds were reported in the survey as average speeds, and it should be noted that maximum speeds may be significantly higher than the average values, and minimum speeds may be significantly lower than the average values.

In the background research report summarizing the findings of previous studies, project-level NEPA analyses, or Bureau of Land Management (BLM) Resource Management Plans, data on truck and vehicle trip counts by activity were summarized. Two major studies reviewed in the background research report which presented detailed trip count data by vehicle type and activity type were the Final EIS for the Jonah-Pinedale Drilling Project ("Jonah-Pinedale Infill EIS"), and the Utah Department of Transportation (UDOT) study on oil and gas mobile source activities. Categorization of vehicle trips and activities are not directly comparable between the studies reviewed, either relative to each other or relative to this project. However, some qualitative comparisons can be made between the findings of those studies and this project.

Relative to the Jonah-Pinedale Infill EIS, the aggregated survey data indicates that heavy-duty truck trips estimated for the Piceance Basin for drilling rig moves compare reasonably well for the directional drilling activity in the Jonah-Pinedale Infill EIS. Completion heavy-duty truck trips are significantly less in the Piceance Basin as compared to the Jonah-Pinedale Infill EIS. Production traffic indicated significantly fewer heavy-duty truck trips per well or pad in the Piceance Basin as compared to the Jonah-Pinedale Infill EIS, particularly related to well workovers and water truck trips.

Relative to the UDOT study, comparisons are more difficult to make as the UDOT study presents only a range of truck trips, but not by truck type (heavy-duty, medium-duty or light-duty). Relative to the UDOT study for drilling rig move and completion traffic the aggregated survey data for the Piceance Basin is consistent with the low end of the range of truck trips indicated in the UDOT study. Production traffic indicated significantly fewer heavy-duty truck trips per well or pad in the Piceance Basin as compared to the UDOT study, particularly related to water truck trips. It should be noted that water management practices may differ significantly in the Piceance Basin relative to other development areas, or differ in the practices of the individual operators that provided survey data in this study relative to other operators.

Within-field VMT is summarized in Table 6 as basin-wide totals, and per well count and per spud totals. Light duty gasoline vehicles make the greatest contribution to VMT, making up over 50% of VMT for both paved and unpaved roads while light duty diesel vehicles account for 26% to 29% of VMT and heavy duty diesel vehicles account for between 12% and 18% of VMT across all roadway types. Of the light duty traffic, 84% of all VMT is from employee commuter traffic while 77% of heavy duty traffic is from drilling and completion associated activity.

Table 3. Weighted average on-road traffic data.

Activity	Vehicle Type	Fuel Type	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Visit per Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph), Paved Road	*Within-Field* Mean Vehicle Speed (mph), Unpaved Road	Round Trips per Activity
Drilling Traffic											
Drilling events	HDDT	Diesel	23.1	0.7	6.6	0.7	71.6	28.4	16.9	16.4	115.1
	LDT	Diesel	71.5	1.4	6.7	0.3	69.2	30.8	17.1	16.6	38.1
	LDT	Gasoline	96.8	1.7	7.5	0.5	62.2	37.8	24.2	15.8	30.0
Completion Traffic											
Completions	HDDT	Diesel	40.2	1.1	8.7	0.7	69.2	30.8	17.1	16.6	148.6
	LDT	Diesel	100.0	2.0	10.0	0.5	55.0	45.0	25.0	15.0	27.3
	LDT	Gasoline	100.0	2.0	10.0	0.5	55.0	45.0	25.0	15.0	13.7
Recompletion Traffic											
Recompletions	HDDT	Diesel	10.0	0.0	8.0	0.0	50.0	50.0	20.0	20.0	7.0
	LDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Gasoline	8.0	0.0	8.0	0.0	50.0	50.0	20.0	20.0	4.0
Production Traffic											
Total Well Count	HDDT	Diesel	37.8	0.9	8.2	0.3	75.6	24.4	25.0	17.3	3.3
	LDT	Diesel	100.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	2.8
	LDT	Gasoline	100.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	2.8
Employee Commuter											
Well Pad Construction	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	125.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	17.9
	LDT	Gasoline	113.9	1.8	8.9	0.4	67.9	32.1	17.9	16.4	51.7
Pipeline Construction	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	150.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	7.1
	LDT	Gasoline	131.7	1.8	8.9	0.4	67.9	32.1	17.9	16.4	17.7
Drilling	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	125.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	13.7
	LDT	Gasoline	112.7	1.7	8.7	0.3	69.2	30.8	17.1	16.6	52.3
Completion	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	125.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	17.1
	LDT	Gasoline	112.7	1.7	8.7	0.3	69.2	30.8	17.1	16.6	69.6
Recompletion	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	125.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	2.0
	LDT	Gasoline	125.0	2.5	10.0	0.5	55.0	45.0	25.0	15.0	4.0

Activity	Vehicle Type	Fuel Type	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Visit per Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph), Paved Road	*Within-Field* Mean Vehicle Speed (mph), Unpaved Road	Round Trips per Activity
Total Well Count	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	100.0	2.5	15.0	0.5	55.0	45.0	25.0	15.0	18.1
	LDT	Gasoline	100.0	2.5	15.0	0.5	55.0	45.0	25.0	15.0	40.2
Pipeline											
Well Pad Constructed	HDDT	Diesel	13.6	0.4	7.1	0.2	64.3	35.7	17.9	16.4	2.0
	LDT	Diesel	100.0	2.0	10.0	0.5	50.0	50.0	25.0	15.0	2.1
	LDT	Gasoline	100.0	2.0	10.0	0.5	50.0	50.0	25.0	15.0	2.1
Maintenance											
Total Well Count	HDDT	Diesel	100.0	3.0	10.0	0.5	55.0	45.0	25.0	15.0	0.9
	LDT	Diesel	100.0	2.0	10.0	0.3	55.0	45.0	25.0	15.0	0.4
	LDT	Gasoline	100.0	2.0	10.0	0.3	55.0	45.0	25.0	15.0	0.4
Ancillary											
Total Well Count	HDDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Diesel	-	-	-	-	-	-	-	-	-
	LDT	Gasoline	135.5	3.1	10.0	0.5	55.0	45.0	25.0	15.0	3.9
Construction											
Well Pad Construction	HDDT	Diesel	13.57	0.40	7.07	0.23	64.29	35.71	17.86	16.43	22.86
	LDT	Diesel	100.00	2.00	10.00	0.50	50.00	50.00	25.00	15.00	6.43
	LDT	Gasoline	100.00	2.00	10.00	0.50	50.00	50.00	25.00	15.00	6.43

Table 4. Weighted average equipment data.

Source Category	Fuel Type	Total HP/ Activity	No. Equipment/ Activity	Hours of Usage/ Equipment/Activity	Activity
Well Pad Construction	Diesel	764.3	4.0	21.2	Well Pad Construction
Fracing	Diesel	9000.0	6.0	3.7	Fracing Events
Refracing	Diesel	19441.5	28.2	0.9	Refracing Events
Pipeline Construction	Diesel	817.9	4.1	25.2	Well Pad Construction
Maintenance	Diesel	206.4	28.0	17.1	Total Well Count
Other Relocatable	Diesel	276.1	1.0	48.1	Total Well Count

Table 5. Weighted average wind erosion data.

Source Category	Disturbed Area (m^2)	Activity
Construction	31302.3	Well Pad Constructed

Table 6. VMT total, per well count, and per spud estimates (miles/year).

Vehicle Type	Fuel Type	Total Within-Field	Unpaved Road Within-Field	Paved Road Within-Field
Total Annual VMT				
HDDT	Diesel	2,375,123	1,653,014	722,109
LDT	Diesel	4,109,865	2,288,964	1,820,901
LDT	Gasoline	8,722,752	5,013,494	3,709,258
Totals		**15,207,739**	**8,955,472**	**6,252,267**
Total Annual VMT Per Well				
HDDT	Diesel	235	164	72
LDT	Diesel	407	227	180
LDT	Gasoline	864	497	368
Totals		**1,507**	**888**	**620**
Total Annual VMT Per Spud				
HDDT	Diesel	2,660	1,851	809
LDT	Diesel	4,602	2,563	2,039
LDT	Gasoline	9,768	5,614	4,154
Totals		**17,030**	**10,029**	**7,001**

It should be noted that in many instances surveyed companies did not provide information with respect to equipment/vehicle age and in those cases default MOVES model age distributions were used for on-road vehicles and default NONROAD model age distributions were used for off-road equipment.

It should also be noted that the mobile source emission estimates rely on data that is based on producer provided data which are not as rigorously documented as permitted sources. Much of the data provided for the mobile sources is based upon estimates and extrapolation from the survey responses. However the level of detail of the surveys and the extent of participation in the survey effort allow for developing emissions estimates of within field mobile sources, consistent with the goals of this pilot study. The emissions estimates also allow for analysis of the level and extent of these emissions in the basin, and estimation of the relative importance of these emissions in the context of oil and gas area and point source emissions.

3.0 Emission Calculation Methodologies

Emission estimates were built upon activity estimates from survey data provided by participating companies and emission factors derived from EPA emissions models and guidance documents. The following tools were used to estimate emissions rates for each process:

- Off-road equipment (exhaust and evaporative): EPA NONROAD2008a model
- On-road vehicles (exhaust, evaporative, brake wear, and tire wear): EPA MOVES2010a model
- Fugitive dust (wind erosion, road dust, and construction dust): EPA AP-42 Guidance

Quality assurance steps for emissions estimation compilation were as follows:

- Ensured that the draft summary emissions spreadsheets were developed accurately using the compiled survey data through quality assurance procedures and identification of outlying emissions estimations.
- Ensured that the methodologies for estimating the emissions were reviewed by the technical working group prior to utilization to generate the emissions.
- Ensured that emissions factor models were run accurately following EPA guidelines.

3.1 MOBILE SOURCE OFF-ROAD ENGINE EMISSIONS

The EPA NONROAD2008a model was used to compile emission factors for each equipment type included in participating company surveys. Diesel fuel sulfur content inputs were taken from EPA guidance (EPA, 2009).

Methodology

The participating companies provided a complete inventory of all engines used for the source categories shown in Table 7. Annual emission estimates were compiled for each category of equipment for which data was provided on a per-event basis or a per-year basis as described in Table 7.

Table 7. Equipment source category and emissions estimation parameters.

Equipment Source Category	Activity Parameter	Event Description	Scaling Surrogate	Fuel Type
Well Pad Construction	Event	Pads Constructed	Spuds	Diesel
Pipeline Construction	Event	Pads Constructed	Spuds	Diesel
Fracing	Event	Fracing Events	Spuds	Diesel
Refracing	Event	Refracing Events	Spuds	Diesel
Maintenance	Event	Maintenance Events	Active Well Count	Diesel
Other Relocatable	Annual	-	Active Well Count	Diesel

Annual emissions from an engine for those categories for which data was provided on a per event basis were estimated according to Equation 1:

Equation (1) $$E_{engine,i} = \frac{EF_i \times HP \times LF \times t_{event} \times n}{907{,}185}$$

where:

E_{engine} are emissions of pollutant *i* from an engine [ton/year/engine]
EF_i is the emissions factor of pollutant *i* [g/hp-hr]
HP is the horsepower of the engine [hp]
LF is the load factor of the engine
t_{event} is the number of hours the engine is used for per event [hr/event]
n is the number of events per year [events/year]

Annual emissions from an engine for those categories for which data was provided on a annual basis were estimated according to Equation 2:

Equation (2) $$E_{engine,i} = \frac{EF_i \times HP \times LF \times t_{annual}}{907{,}185}$$

where:

E_{engine} are emissions of pollutant *i* from an engine [ton/year/engine]
EF_i is the emissions factor of pollutant *i* [g/hp-hr]
HP is the horsepower of the engine [hp]
LF is the load factor of the engine
t_{annual} is the number of hours the engine is used annually [hr/year]
907,185 is a mass unit conversion [g/ton]

Extrapolation to Basin-Wide Emissions

Annual emissions from all engines used within each equipment category from the participating companies were summed. The total emissions from all participating companies were scaled by the ratio of the total basin wide activity to activity associated with participating company operations for the surrogate associated with each source category as identified in Table 7, following Equation 3:

Equation (3) $$E_{engine,TOTAL,i} = E_{engine,i} \frac{S_{TOTAL}}{S}$$

where:

$E_{engine,TOTAL,i}$ is the total emissions from engines used in source category *i* in the basin [ton/yr]
E_{engine} is the total emissions from engines used in source category *i* owned by the participating companies [ton/yr]
S_{TOTAL} is the total surrogate activity in the basin
S is the surrogate activity by the participating companies in the basin

County-level emissions were estimated by allocating the total basin-wide engine emissions for each source category into each county according to the fraction of total 2009 surrogate activity for each source category as identified in Table 8.

3.2 MOBILE SOURCE ON-ROAD VEHICLE EMISSIONS

For on-road vehicles, the MOVES model was used to develop running and idling emission factors from evaporative, exhaust, brake wear, and tire wear processes; running emission factor estimates were made by speed. The MOVES model was run as follows:

- Time resolution: 2009 annual average day
- Geographic resolution: Colorado statewide
- Vehicle classes, fuel types: Passenger car, light commercial truck, combination unit short haul
- Fuel types: diesel and gasoline
- Road type: Rural Unrestricted Access
- Speeds: The running emission factors were estimated at four speeds (10, 15,20,25 mph)

For source categories and vehicles types in which participating companies provided estimates of vehicle model year associated with vehicles used in the basin, MOVES by-model year emission factor output was used to represent vehicular emission rates; if information was not available with respect to vehicle model year, EPA default estimates of emission rates across all model years were used. It should be noted that vehicles were assumed to have the characteristics in the Colorado statewide MOVES dataset, since vehicles visiting oil and gas field locations may have originated from anywhere within state or out of state. To simplify the calculation, the Colorado statewide dataset was used.

AP-42 guidance was used to estimate emission rates of fugitive dust from vehicle travel on paved roads (EPA, 2011; Section 13.2.1) and unpaved roads (EPA, 2006; Section 13.2.2). Road dust emission factor estimation equations are shown in Equation 4 and Equation 5, respectively.

Equation (4) $$EF_{j,i} = k \times sL^{0.91} \times W^{1.02} \times \left(1 - \frac{P}{4N}\right)$$

where:

$EF_{j,i}$ is the emissions factor for vehicle type *j* of particle size *i* [g/mi]
k is the particle size multiplier for particle size range and units of interest (g/VMT)
sL is the road surface silt loading (g/m²), assumed 0.6 g/m² per AP-42 guidance
W is the mean vehicle weight (tons)
P is the number of days with at least 0.01 inch of precipitation in a year, assumed 76 days per NCDC (2011)
N is the number of days per year

Equation (5) $$EF_{j,i} = k \times \left[\left[\left(\frac{\left(\frac{s}{12}\right)^a \times \left(\frac{S}{30}\right)^d}{\left(\frac{M}{0.5}\right)^c} \right) - C \right] \times (1 - CE) \right] \times \left(1 - \frac{P}{4N} \right)$$

where:

$EF_{j,i}$ is the emissions factor for vehicle type *j* of particle size *i* [g/mi]
k, a, b, c are empirical constants
s is the road surface silt content (%), assumed 5.1% per AP-42 guidance
M is the road surface moisture content (%), assumed 2.4% per AP-42 guidance
S is the mean vehicle speed (mph)
C is the emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear (g/VMT)
CE is the efficiency associated with unpaved road dust emission control applied
P is the number of days with at least 0.01 inch of precipitation in a year, assumed 76 days per NCDC (2011)
N is the number of days per year

Emission estimates for traffic sources included only the activity participating companies provided for in-field vehicle operation. In-field activities include all activities that occur on private as opposed to public roads. Public road activity was not included because this activity is already included in on-road emissions developed by CDPHE as part of its emission inventory program. The difficulty in reconciling on-road emissions on public roadways is discussed above in terms of the scope of the emissions inventory for this study.

It is important to note that production traffic does not include traffic associated with midstream facility compressor station or gas plant operations because participating companies did not provide this data for the study. Additionally, pipeline construction emission estimates are for pipeline associated with connection of newly spudded wells to existing natural gas pipelines rather than installation of primary transmission lines associated with inter basin/interstate product transport. Major interstate gathering and transmission pipelines are typically installed early in the development phase of a basin, and because of their non-routine nature were not included in this annual inventory. Since no data was provided to capture the on-road traffic associated with compressor stations and gas plants in this inventory, this is noted as a limitation of this pilot study.

Methodology

The participating companies provided a complete inventory of all traffic associated with each source category shown in Table 8.

Table 8. Traffic source categories and associated emissions estimation parameters.

Traffic Category	Activity Parameter	Event Description	Scaling Surrogate
Drilling	Event	Drilling Events	Spuds
Completion	Event	Completions	Spuds
Recompletion	Event	Recompletions	Total Well Count
Production	Annual	-	Total Well Count
Employee Commuter	Event	Well Pad Construction	Spuds
	Event	Pipeline Construction	Spuds
	Event	Drilling	Spuds
	Event	Completion	Spuds
	Event	Recompletion	Total Well Count
	Annual	-	Total Well Count
Pipeline	Event	Well Pad Constructed	Spuds
Maintenance	Event	Maintenance Event	Total Well Count
Ancillary	Annual	-	Total Well Count
Construction	Event	Well Pad Construction	Spuds

The traffic data provided included the following trip information by vehicle type (heavy duty/light duty), fuel type (diesel/gasoline), and trip purpose:

- In-field and out-of-field round trip mileage estimates,
- In-field and out-of-field round trip idle time estimates,
- Number of vehicles used per event or annually,
- Average vehicle speed, and
- In-field and out-of-field estimates of the percentage of travel on paved an unpaved roads.

Annual vehicular exhaust, evaporative, and road dust emissions were estimated each vehicle and fuel type combination within each traffic category for which data was provided on a per event basis according to Equation 6.

Equation (6) $$E_{j,i} = \frac{EF_{j,i} \times m \times t_{event,j} \times n}{907{,}185}$$

where:

$E_{j,i}$ are emissions from vehicle type *j* of pollutant *i* [ton/year/vehicle]
$EF_{j,i}$ is the emissions factor for vehicle type *j* of pollutant *i* [g/mi] or [g/hr]
m is the mileage travelled or idle-hours per trip [mi/trip] or [hr/trip]
$t_{event,j}$ is the number of round trips incurred per well pad construction event for vehicle type *j* [trips/event/vehicle]
n is the number of well pad construction events per year [events/year]
907,185 is a mass unit conversion [g/ton]

Annual vehicular exhaust, evaporative, and road dust emissions were estimated for traffic source categories for which data was provided on an annual basis according to Equation 7.

Equation (7) $$E_{j,i} = \frac{EF_{j,i} \times m \times t_{annual,j}}{907{,}185}$$

where:

$E_{j,i}$ are emissions from vehicle type *j* of pollutant *i* for vehicles [ton/year/vehicle]
$EF_{j,i}$ is the emissions factor from vehicle type *j* of pollutant *i* [g/mi] or [g/hr]
m is the mileage travelled or idle-hours per trip [mi/trip] or [hr/trip]
$t_{annual,j}$ is the number of round trips incurred annually for vehicle type *j* [trips/year/vehicle]
907,185 is a mass unit conversion [g/ton]

Extrapolation to Basin-Wide Emissions

Annual emissions from all vehicle types within each traffic category from the participating companies were summed. The total emissions from all participating companies were scaled by the ratio of the total basin wide activity to activity associated with participating company operations for the surrogate associated with each source category as identified in Table 8 according to Equation 8:

Equation (8) $$E_{i,TOTAL} = E_{i,vehicle} \frac{S_{TOTAL}}{S}$$

where:

$E_{j,TOTAL}$ is the total emissions from vehicles used in traffic category *i* in the basin [ton/yr]
$E_{vehicle,i}$ is the total emissions from vehicles used in traffic category *i* owned by the participating companies [ton/yr]
S_{TOTAL} is the total surrogate activity in the basin
S is the surrogate activity by the participating companies in the basin

3.3 DISTURBED LAND (FUGITIVE DUST), WIND EROSION

AP-42 guidance was used to estimate emission rates of fugitive dust from construction operations (EPA, 1998, Section 11.9) and dust associated with wind erosion (EPA, 2006; Section 13.2.5).

Methodology

Estimates of fugitive dust associated with well pad and pipeline construction, motor grading maintenance, and wind erosion were developed based on AP-42 emission rates and activity data provided by participating companies in returned surveys for each source category shown in Table 9.

Table 9. Dust source categories and associated emissions estimation parameters.

Dust Category	Activity Parameter	Event Description	Scaling Surrogate
Wind Erosion	Event	Recompletions	Spuds
Well Pad and Pipeline Construction	Event	Well pad and associated pipeline construction	Spuds
Maintenance Equipment (Motor Grading)	Event	Maintenance Event	Total Well Count

Wind Erosion

Wind erosion fugitive dust emissions associated with construction operations were estimated based on AP-42 guidance for estimation of emissions from industrial wind erosion (EPA, 2006, Section 13.2.5). Wind erosion emissions were estimated based on Equations 9, 10, and 11:

Equation (9) $$E_{const} = \frac{P \times A \times r}{907{,}185}$$

where:

E_{const} are emissions from construction operations [ton/ pad]
P is the erosion potential [g/m^2]
A is the area over which construction is performed [m^2/pad]
r is the particle size multiplier for PM10 or PM2.5
907,185 is a mass unit conversion [g/ton]

Equation (10) $$P = 58 \times (u^* - u_t)^2 + 25(u^* - u_t)$$

where:

u^* is the friction velocity (m/s)
u_t is the threshold friction velocity (m/s)

Equation (11) $$P = 0 \quad for \quad (u^* \leq u_t)$$

Friction velocity estimates were made by multiplying the average annual fastest wind speed from Grand Junction station observational data (NIST, 2011) by 0.053. Particle size multiplier of 0.5 and 0.075 were assumed for PM10 and PM2.5 respectively per AP-42 guidance.

Construction Dust

Well pad and pipeline construction fugitive dust emissions associated with construction operations were estimated based on AP-42 guidance for estimation of emissions from western surface coal mining (EPA, 1998, Section 11.9) as no estimation methodology specific to oil and gas associated construction activities was available. While emission rates estimation methodology is derived from AP-42 guidance, activity is based on the number of hours that construction equipment is used in oil and gas construction or maintenance operations. Construction fugitive dust emissions were estimated according to Equation 12:

Equation (12) $E_{const,i} = EF_i * t_{event} * n / 2000$

where:

$E_{const,i}$ are emissions of fugitive dust from construction operations of pollutant *i* [ton/year/equipment]
EF_i is the emissions factor from of pollutant *i* [lb/hr/equipment]
n is the number of events per year [events/year]
t_{event} is the time operated per event [hours/event]
2000 is a mass unit conversion [lb/ton]

Construction dust emission factors were estimated according to Equations 13 and 14:

Equation (13) $EF_{PM10} = \left(\frac{1.0 \times s^{1.5}}{M^{1.4}} \right) \times (1 - C) * r$

where:

EF_{PM10} is the emissions factor from of PM10 [lb/hr]
s is the material silt content (%)
M is the material moisture content (%)
C is the control efficiency
r is the PM10 scaling factor, assumed 0.75 per AP-42 Guidance

Equation (14) $EF_{PM2.5} = \left(\frac{5.7 \times s^{1.2}}{M^{1.3}} \right) \times (1 - C) * r$

where:

$EF_{PM2.5}$ is the emissions factor from of PM2.5 [lb/hr]
0.75 is the fraction of particulate matter less than 2.5 microns
r is the PM10 scaling factor, assumed 0.105 per AP-42 Guidance

Default AP-42 guidance values for material moisture content and material silt content were used while control efficiency was assumed to be 50% for well pad and pipeline construction and motor grading operations for which participating companies indicated the usage of watering control in their surveys.

Extrapolation to Basin-Wide Emissions

Annual emissions from wind erosion were estimated by summing over all construction activities for the participating companies while construction fugitive dust emissions were estimated by summing over all pieces of equipment for well pad and pipeline construction and road grading associated with maintenance equipment. The total emissions for each category from all participating companies were scaled by the ratio of the total basin wide activity to activity associated with participating company operations for the surrogate associated with each dust category as identified in Table 9 according to Equation 15:

Equation (15) $$E_{i,TOTAL} = E_{i,vehicle} \frac{S_{TOTAL}}{S}$$

where:

$E_{j,TOTAL}$ is the total emissions fugitive dust emission from source category *i* in the basin [ton/yr]

$E_{dust,i}$ is the total emissions from source category *i* owned by the participating companies [ton/yr]

S_{TOTAL} is the total surrogate activity in the basin

S is the surrogate activity by the participating companies in the basin

4.0 Field Verification

In addition to the survey data gathering effort to collect information used in the emissions inventory analysis, a limited field verification study was conducted to gather primary data on certain activities and equipment to support the survey effort. The field verification was intended to both collect data to be used as a comparison against data reported in the surveys, and to iteratively adjust survey data to reflect actual vehicle and equipment count data. In practice, the resources and schedule of this pilot study limited the field verification to only a short period of time and focused the verification on specific activities. The field verification occurred over the period April 7-16 2011 at two primary sites in Garfield County Colorado: one located approximately 10 miles south of Rulison, Colorado and another located approximately 7 miles south of Silt, Colorado.

4.1 FIELD VERIFICATION PROCEDURE

Based on review of the operator provided surveys, it was determined that three predominant oil and gas field activities would be evaluated for the field verification effort. Those activities were a drilling rig move, a well completion (hydraulic fracturing) event, and regular production operations traffic. Additionally, a central water management facility was extracted from the production operations field verification effort based upon field observations. Counts of on-road vehicle by vehicle type were obtained through the use of automated vehicle counters, and this was supported by selected manual vehicle counts and manual observations. The field verification did not consider off-road equipment associated with these 3 activities as this was beyond the scope and resources of this pilot study.

The vehicle counters used were able to classify the type of vehicle that drove over them. The counters used the Federal Highway Administration 13-Category Scheme (ref) for vehicle classification as follows:

1. Motorcycles
2. Passenger cars (with 1- or 2-axle trailers)
3. Two-axle four tire single units; pickup or van with 1- or 2-axle trailers
4. Buses
5. 2D – two-axle, six tire single unit; includes handicap equipped and mini-school buses

6. 3 axles single unit
7. 4 or more axles single unit
8. 3-4 axles, single trailer
9. 5 axles, single trailer
10. 6 or more axles single trailer
11. 5 or less axles, multi-trailers
12. 6 axles, multi-trailers
13. 7 or more axles, multi-trailers

The counters utilized were MetroCount 5600 models, and raw data extracted from the counters were analyzed using the MetroCount Traffic Executive v3.2 software. The counters had two detection tubes deployed across the road set 3 feet apart from each other. Vehicle direction was determined based on which tube was driven over first. Vehicle speed was determined based on the time between a drive-over being registered on tube A, and being registered on tube B (for the same axle). Vehicle class was determined based on the number of axles and the time between axle hits on the detection tubes. Classifying traffic counters were set up per manufacturer default factory settings and deployed per manufacturer specifications. The raw counter data was initially interpreted by manufacturer supplied software; subsequently, corrections were made based on manual traffic counts and observations. All 'coercion' data (referring to counts registered by the traffic counters but for which the vehicle type was unclassifiable) was placed into class 14, unclassifiable vehicles. During manual observations, data was collected based on number of axles (so as to directly compare with counter data) in addition to the vehicle being either a light-duty, medium-duty or heavy duty vehicle. All field observations were recorded on standardized data collection forms.

The field verification was limited given the scheduling and resource constraints of this pilot study, and therefore was focused on event types that were expected to generate significant numbers of vehicle trips and therefore emissions. Additional field studies and traffic counts are recommended to improve the overall quality and accuracy of the field verification and subsequently the activity data assumptions used in this study.

Rig Move

Traffic counter deployment, timing and location were based on site layout and input from the oil and gas operator. Based on initial scheduling, the counter would have been deployed one day prior to commencing rig move activities. Once in the field, however, it was discovered that the rig move was initiated prior to deployment of the counter. The early rig move was due to an unexpected schedule adjustment made by the oil and gas operator. Operator schedules and deadlines for completion of the field verification effort precluded monitoring subsequent rig moves; therefore the decision was made to monitor the remaining portion of the planned rig move. The traffic counter was located on the only within-field road that led to the pad where the rig was being dismantled and moved offsite. This was the only pad served by the field road. Oil and gas traffic was not allowed on the side road near the pad and the field road had two sets of gates prior to the counter location that prevented any traffic from the general public from accessing this road. Based on these features of the site, it was determined that the counter location only captured oil and gas traffic associated with the move of the rig from the selected pad.

Following the initial deployment of the traffic counter, it was observed that vehicles were traveling slowly, and sometimes stopping, at the location where the counter was initially deployed. This resulted in erroneous readings from the counters, and so to improve data accuracy the counter was redeployed to a location where vehicles were more likely to travel at a consistent speed. Manual observations supported the counter data showing that vehicles typically drove very slowly at the initial location.

The counter was removed prior to rig move completion due to the scheduling and resource constraints for the field verification effort for this pilot study. However, as a normal practice the oil and gas operator did record a log of all of the large pieces of equipment moved during the rig move, including equipment type and the date and time of entry and exit from the pad. The operator records in conjunction with the captured traffic counter data allowed for the extrapolation of the traffic counts for the entire rig move.

Following the downloading and processing of the traffic counter data, adjustments to the raw data were made based in part upon the manual counts and observations. The raw traffic count data were managed as follows:

- Class 1 (motorcycle) data were reclassified as 3-axle vehicles under the assumption that the front axle of the vehicle was not capture by the counter;
- Class 4 (bus) data were reclassified as 3-axle vehicles assuming that the slow vehicle speeds resulted in longer delay times between axle hits; and
- Class 14 (unclassifiable) data were reclassified as 4+ axle vehicles.

Well Completion Event

The selected well completion event was located at a central pad where storage tanks and a portion of the completion equipment are maintained and utilized for extended periods of time. The well completion operations occur on this central pad with the fracture fluids being delivered to the nearby wells that are being completed. The completion event was scheduled to occur over three days, 5 wells were completed per day, for a total of 15 well completions. Traffic counter deployment timing and location were based on site layout and oil and gas operator input. Based on initial scheduling the counter would have been deployed prior to commencing the completion event. Once in the field, however, it was discovered that the operator was behind schedule on the fracturing event due to unexpected schedule adjustments. The counter was deployed early (prior to the event) so as to capture as much vehicle traffic as possible from the fracturing event.

The counter was located on the only field road that led to the area. The field road was solely used by the oil and gas operator and only oil and gas related traffic was permitted to use the road. The counter captured traffic for the well completion event, and 8 production pads and a central water management site that were located beyond the production pad location. The counter location was chosen based on local vehicle traffic patterns. Well completion event vehicle counts were determined by taking completion event entry data and subtracting production counter entry data. Entry data was used, instead of exit or the average, due to the inability to capture all completion event exit traffic.

The counter was removed prior to the completion of the well fracture events due to the scheduling and resource constraints for the field verification effort for this pilot study. The counter captured the materials and equipment brought in for the completion event as well as two full days of the event and the majority of the operations for the third day. Manual observations noted that the slow speeds of vehicles, 3+ axle vehicles entering or exiting while not loaded and soft road surfaces (which were muddy due to storm water) likely contributed to traffic counter misclassification of some vehicles. The processing of the traffic counter data is discussed below. It is also noted that one of the production sites was being used as a staging area for 4+ axle vehicles associated with the completion event. No other 4+ axle traffic was observed for production related operations. Therefore, 4+ axle production counter data was not subtracted from 4+ axle completion event data, in order to avoid the possibility of results that would underestimate the trip volumes for 4+ axle vehicles.

Subsequent to the downloading and processing of the traffic counter data, adjustments to the raw data were made based in part upon the manual counts and observations. The raw traffic count data were managed as follows:

- Class 1 (motorcycle) data were reclassified as 3-axle vehicles with the assumption that the front axle of the vehicle was not capture by the counter;
- Class 4 (bus) data were reclassified as 3-axle vehicles assuming that the slow vehicle speeds resulted in longer delay times between axle hits;
- Class 7 (4-axle) data were reclassified as 3-axle vehicles assuming that ground conditions or vehicle speed resulted in an extra axle hit; and
- Class 14 (unclassifiable) data were reclassified as 3-axle vehicles.

<u>Production Sites</u>

Traffic counter deployment timing and location were based on site layout and the oil and gas operator input. The counter was deployed on a roadway after the well completion event pad entrance, in order to ensure that only production-related traffic was being captured. Once in the field, however, it was discovered that one of the production pads also included a central water management site co-located with the production pad. The water management site was a central location to which produced water from other well sites and pads was delivered, unloaded to storage tanks and subsequently distributed via pipeline within the field.

Production vehicle counts were determined by averaging the entry and exit counts for the production pad and subtracting the average of the entry and exit counts for the water management site. This adjustment was made because water management traffic would trigger a detection event in the traffic counter in route to the water management site. Since the water management site was located on a production pad, (and this data is subtracted from production counter data) the production counter captured activity from 6 pads with a total of 85 wells. Manual observations noted that vehicles typically drove very slowly, and that vehicles turning, 3+ axle vehicles entering or exiting while not loaded, and soft road surfaces may have led to misclassification of some vehicles.

Following the downloading and processing of the traffic counter data, adjustments to the raw data were made based in part upon the manual counts and observations. The raw traffic count data were managed as follows:

- Class 1 (motorcycle) data were reclassified as 3-axle vehicles with the assumption that the front axle of the vehicle was not capture by the counter;
- Class 4 (bus) data were reclassified as 3-axle vehicles assuming that the slow vehicle speeds resulted in longer delay times between axle hits;
- Class 7 (4-axle) data were reclassified as 3-axle vehicles assuming that ground conditions or vehicle speed resulted in an extra axle hit; and
- Class 14 (unclassifiable) data were reclassified as 3-axle vehicles.

Central Water Management Site

The central water management site served as a facility where trucks deliver produced water from other pads, unload this water to storage tanks, and subsequently distributes the water within the field. The water management site was located on one of the seven production pads with a total of 16 wells located on the pad. Traffic counter deployment timing and location were based on site layout and oil and gas operator input. The counter was deployed past the production counter on a side road leading to the water management site, in order to isolate counts of vehicles entering the water management site and to subsequently use this to correct for the vehicle counts at the production site.

Water management vehicle counts were determined by averaging the entry and exit data for the water management site counter only. Manual observations noted that vehicles typically drove very slowly and that vehicles that were turning, 3+ axle vehicles entering or exiting while not loaded, and soft road surfaces may have led to misclassification of some vehicles. It was also noted that vehicles entering the water disposal site were almost exclusively using the site to offload produced water, but a small fraction of vehicles visited well pad production equipment co-located on the same pad as the central water management site.

Following the downloading and processing of the traffic counter data, adjustments to the raw data were made based in part upon the manual counts and observations. The raw traffic count data were managed as follows:

- Class 1 (motorcycle) data were reclassified as 3-axle vehicles with the assumption that the front axle of the vehicle was not capture by the counter;
- Class 4 (bus) data were reclassified as 3-axle vehicles assuming that the slow vehicle speeds resulted in longer delay times between axle hits;
- Class 7 (4-axle) data were reclassified as 3-axle vehicles assuming that ground conditions or vehicle speed resulted in an extra axle hit; and
- Class 14 (unclassifiable) data were reclassified as 3-axle vehicles.

4.2 COMPARISON OF FIELD VERIFICATION RESULTS WITH AGGREGATED SURVEY DATA

Table 10 presents compiled data from the survey and field verification. With the exception of heavy duty trucks associated with drilling traffic, differences between the field verification and survey data are less than 70%. Because the sample size associated with the field verification data collection was not deemed sufficient to be representative of operations over the entire Piceance Basin, the field verification data was not used to adjust activity estimates compiled in the surveys and used to estimate emissions. However, comparison of field verification data to the compiled survey data allowed for checks on the reasonableness of the survey values. Initial comparison of production traffic counts per well between the compiled survey data and the field verification data showed estimates that were considerably different. Follow-up with the participating companies allowed for confirmation of the survey data and recompilation of the survey data based on revisions from the surveyed producer input; the result was production traffic survey data that reflected field operations more closely and was similar in magnitude to the field verification data. The survey data generally estimated higher heavy-duty truck trip counts than the observed data in the field verification, with the exception of the drilling rig move. For the drilling rig move, higher heavy-duty truck trip counts were observed in the field verification than in the survey data, but the incomplete gathering of field verification data on the rig move did not allow for use of the field verification data to adjust the surveys.

Table 10. Field verification and compiled survey data for categories subject to field verification.

Source Category	Vehicle Type	Compiled Survey Data		Field Verification	
		Round Trips / Activity	Activity Metric (associated survey)	Round Trips / Activity[1]	Activity
Drilling Traffic	HDT	27[2]	drilling events (drilling traffic, employee trips)	76	rig move, drilling event
	LDT	134		118	
Completion Traffic	HDT	149	completions (completion traffic, employee trips)	83	multi-pad fracturing event
	LDT	128		186	
Production Site Traffic	HDT	4.2	total well count (maintenance traffic, employee trips, ancillary traffic, production traffic)	6.7[3]	well count
	LDT	68.5		31.8	
Central Water Management Site	HDT	27,495	total well count (production traffic, water hauling trips)	11,544	individual water pad central gathering point

1. LDT includes all 2-axle vehicles, HDT includes all 3- and 4-axle vehicles.
2. Includes only trips related to rig moves and materials transport (cement, water, and fuel truck trips were excluded). Operator estimates indicate 115 total HDT trips per spud. Because the field verification data only included heavy truck trip counts for a rig move rather than for an entire drilling operation, in order to compare field verification data with survey data only heavy duty truck activity associated with a rig move is included. Based on analysis of the survey data, the types of trips not relevant to a rig move were estimated to be trips associated with cement, water, and fuel trucks.
3. HDT estimates are unreliable due to presence of a gathering point for water from wells in addition to those on the 6 pads at the production site. HDT trips visiting the water production site were not always associated with the production sites for which the traffic counters were capturing data (i.e. trucks from other production sites visited the water site). The number of wells or well pads served by trucks visiting the water production site was unknown, therefore, there was not sufficient information to scale the trips by number of wells or pads to arrive at trips/well or trips/pad for comparison with the survey data.

5.0 Results

Presented below are summaries of (1) emission estimates associated with mobile sources, (2) unit level activity and emissions, (3) comparison of oil and gas sector mobile source emission estimates and oil and gas sector point and area source emission estimates.

It is important to note the following caveats when interpreting these results, especially for understanding the relationship between the oil and gas mobile source emissions developed as part of this study – which are focused on the Piceance Basin – and oil and gas mobile source emissions for other areas:

- For all traffic that visit well pads to service or maintain wellhead equipment, the typical number of wells per pad is an important variable that can vary significantly from field to field and operator to operator.
- Differences in both well pad configurations and the terrain upon which well pads are constructed are expected to vary from basin to basin.
- Drilling operations may be conducted at a single pad where multiple wells are drilled consecutively by a single rig. The traffic emissions associated with multiple wells drilled on a single pad may be considerably different than multiple single wells drilled on individual pads.
- Fracturing operations may be conducted at a single pad where multiple wells are fractured consecutively by a single set of fracturing equipment. The fracturing equipment and road traffic emissions associated with multiple wells fractured consecutively on a single pad may be considerably different than multiple single wells fractured on individual pads.
- Emissions and activity estimates have been provided below on a per pad or per spud basis; however, no information for the total number of pads in the basin was available to develop similar estimates on a per pad basis. Because the number of wells or spuds per pad can vary significantly from area to area, emissions and activity for which operations are expected to be conducted on a per pad basis are not easily extrapolated from area to area.
- The level of activity associated with trucks that transport water and liquid product is dependent on whether water and/or liquid product pipeline gathering systems are used to (1) convey liquids to a central gathering point from which it is transported by truck to a refinery or processing facility or (2) convey liquids directly to a refinery or processing facility. For example, oil is conveyed via pipeline in Rio Blanco County directly to refineries which leads to lower truck activity relative to an oil field where no such liquid gathering pipeline exists
- Area specific in-field development configurations are expected to influence round trip travel distances. Specifically, there are cases in which wells may be located adjacent to public roadways in which case round trip distance within the field could be significantly less than for more remote wells located in development areas.
- Gas pipeline related construction activities considered in this study are only related to the connection of existing, well developed gas pipeline infrastructure to a newly developed well in the Piceance Basin. In areas where gas pipeline infrastructure is not as developed and or field configuration is significantly different, higher levels of activity related to gas

pipeline construction would be expected. Further, the activities associated with the construction of larger interstate pipelines were not included in this study.

5.1 PICEANCE BASIN EMISSIONS

Results of the mobile source emission estimates are presented below on a county level and as summaries for the entire Piceance Basin as a series of pie charts and bar graphs. The quantitative emissions summaries are presented in Tables11 through 14.

Figure 3, 4, and 5 show NOx, VOC, and PM10 emissions, respectively, by source category. Emissions of NOx, VOC, and PM10 are primarily concentrated in Garfield and Rio Blanco Counties, with additional minor emissions in Moffat and Mesa Counties. Garfield County accounts for the majority of gas and condensate production in the Piceance Basin, while Rio Blanco County accounts for the majority of oil production in the basin and is the second highest contributor to gas and condensate production in the basin.

Figure 6 shows that other relocatable equipment contributes a majority of NOx emissions. These equipment primarily consist of water pumps, portable generators and snowblowers. The emissions from this category are dominated by water pumps. Moreover, off-road equipment accounts for 87% of mobile source NOx emissions with the remaining 13% emitted from onroad vehicles. Figure 7 also shows a majority of VOC emissions (51%) from other relocatable equipment and similar contributions from off-road equipment (79%) and onroad vehicles (21%). Figure 8 shows PM10 emissions dominated by employee commuter traffic sources. Notably fugitive dust accounts for 99% of PM10 emissions with almost all fugitive dust accounted for by road dust. It should be noted that the assumptions used in the fugitive dust calculations have inherent uncertainty, and the use of different emission factors – particularly those for industrial sites – would lead to lower fugitive dust emissions by employee commute vehicles.

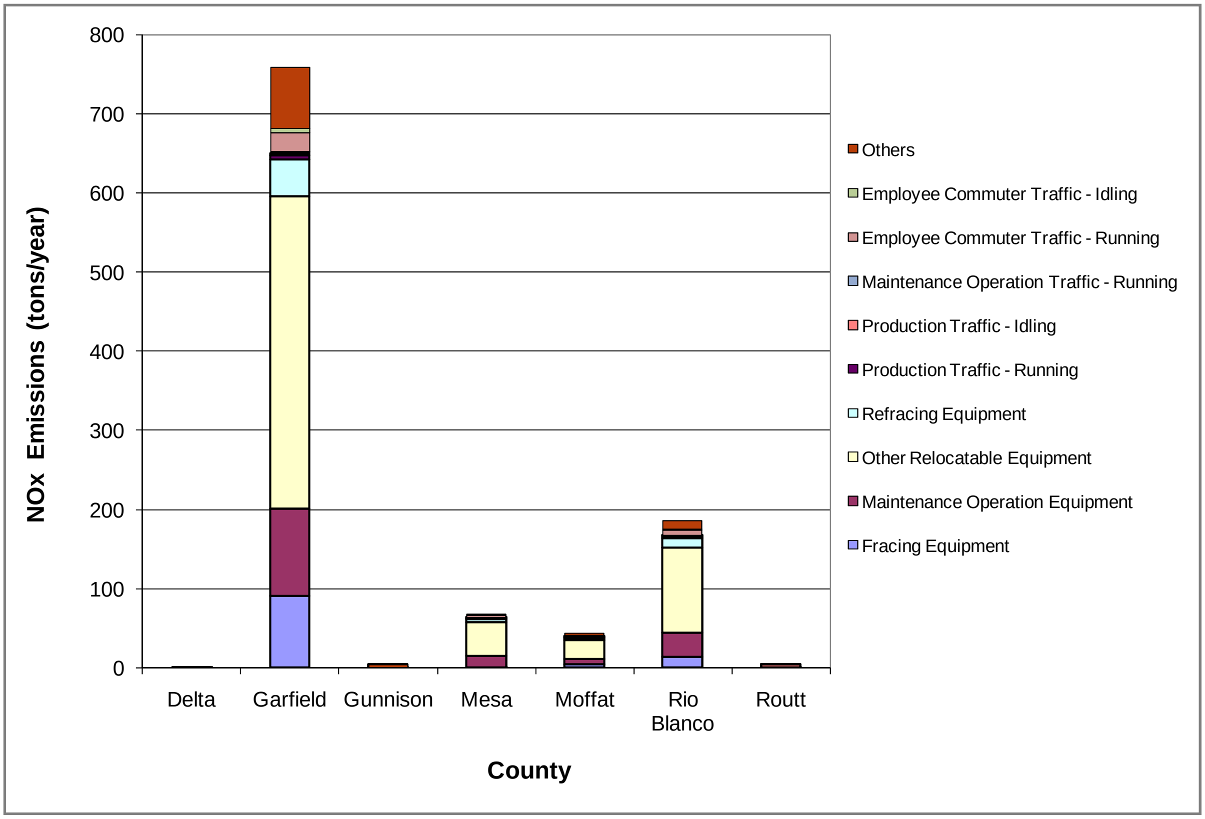

Figure 3. 2009 NOx emissions by source category and by county in the Piceance Basin.

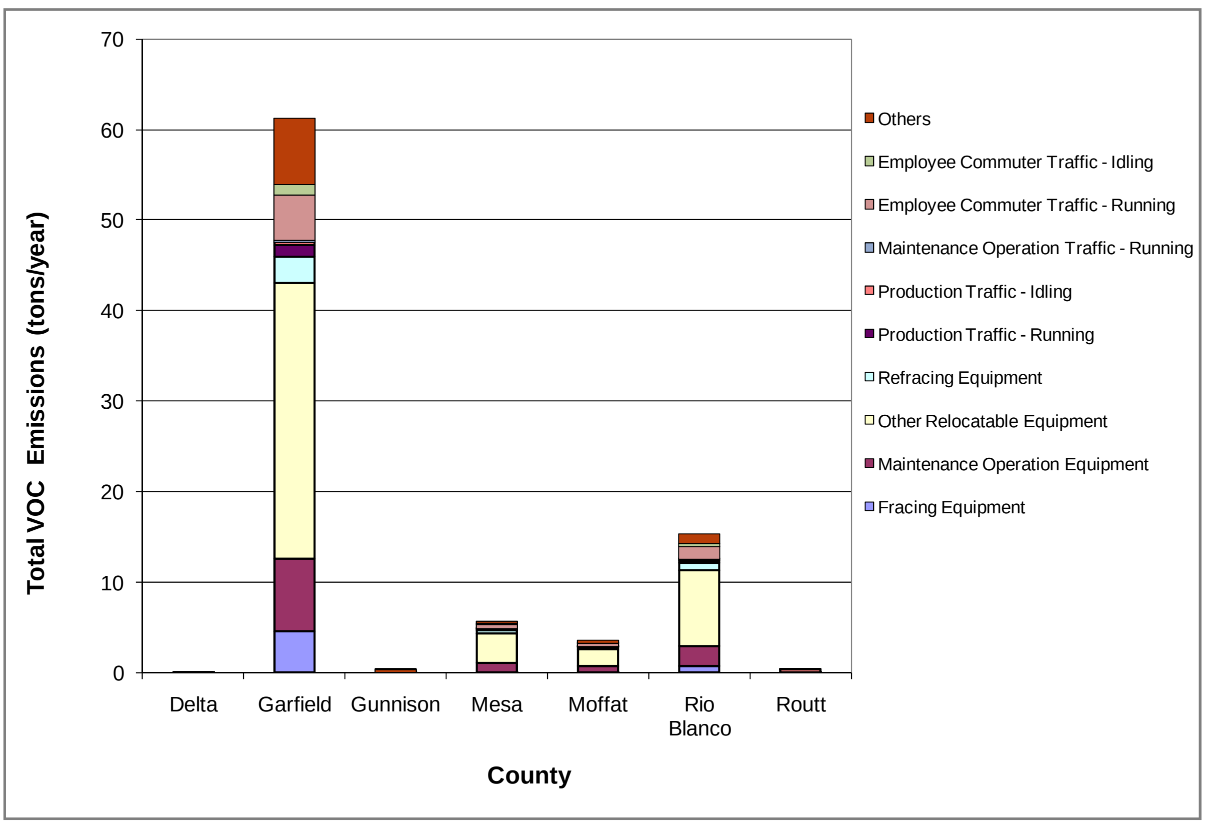

Figure 4. 2009 VOC emissions by source category and by county in the Piceance Basin.

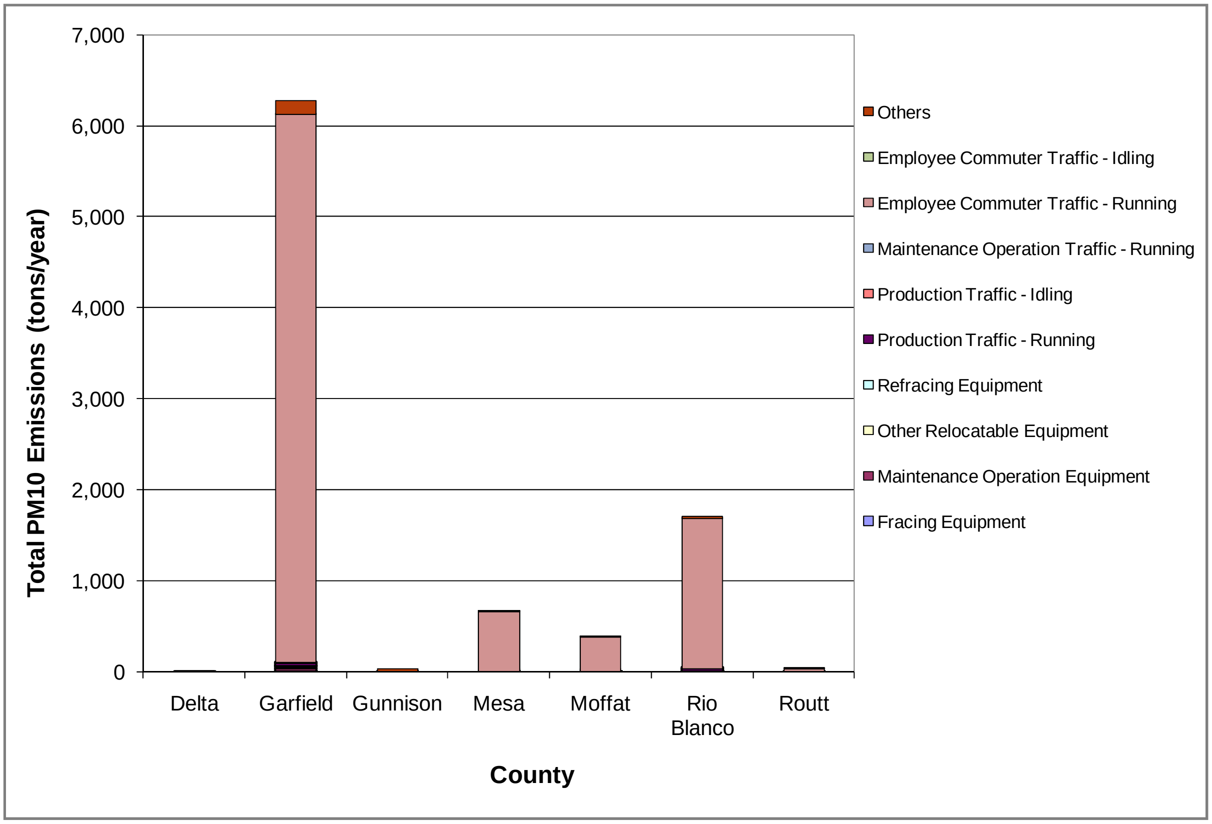

Figure 5. 2009 PM10 emissions by source category and by county in the Piceance Basin.

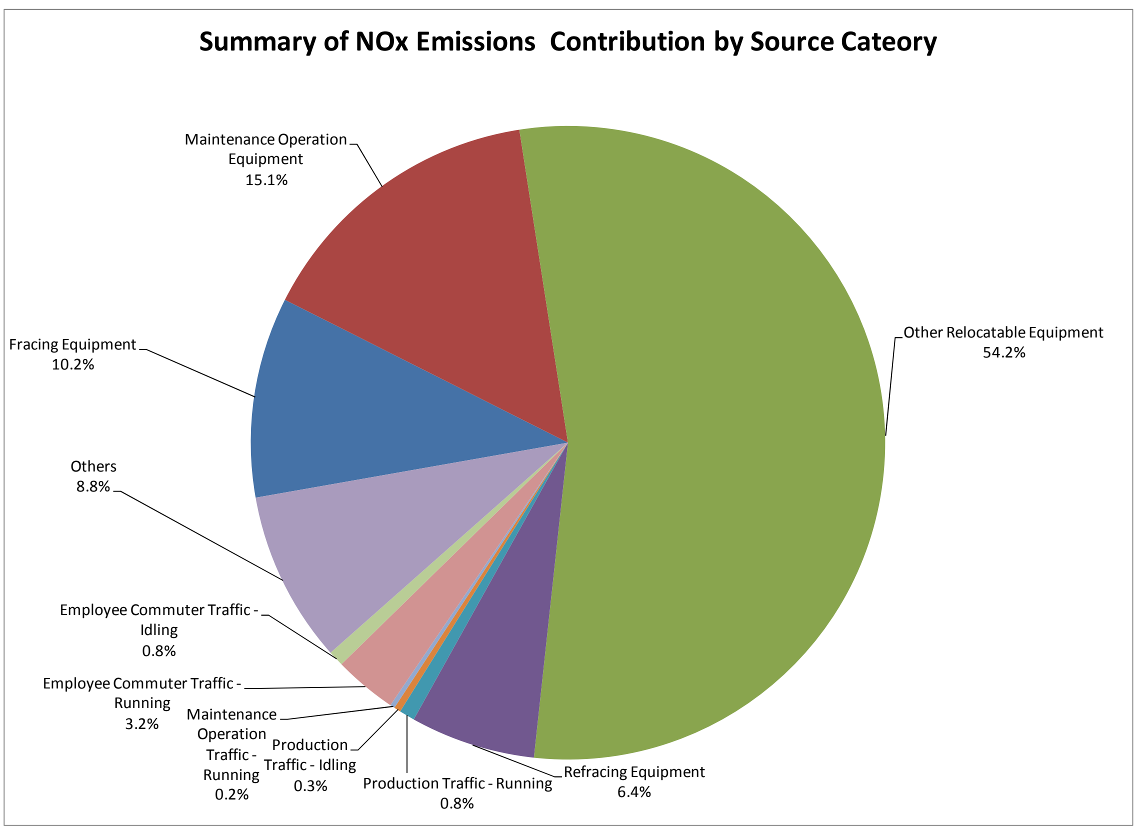

Figure 6. Piceance Basin NOx emissions proportional contributions by source category.

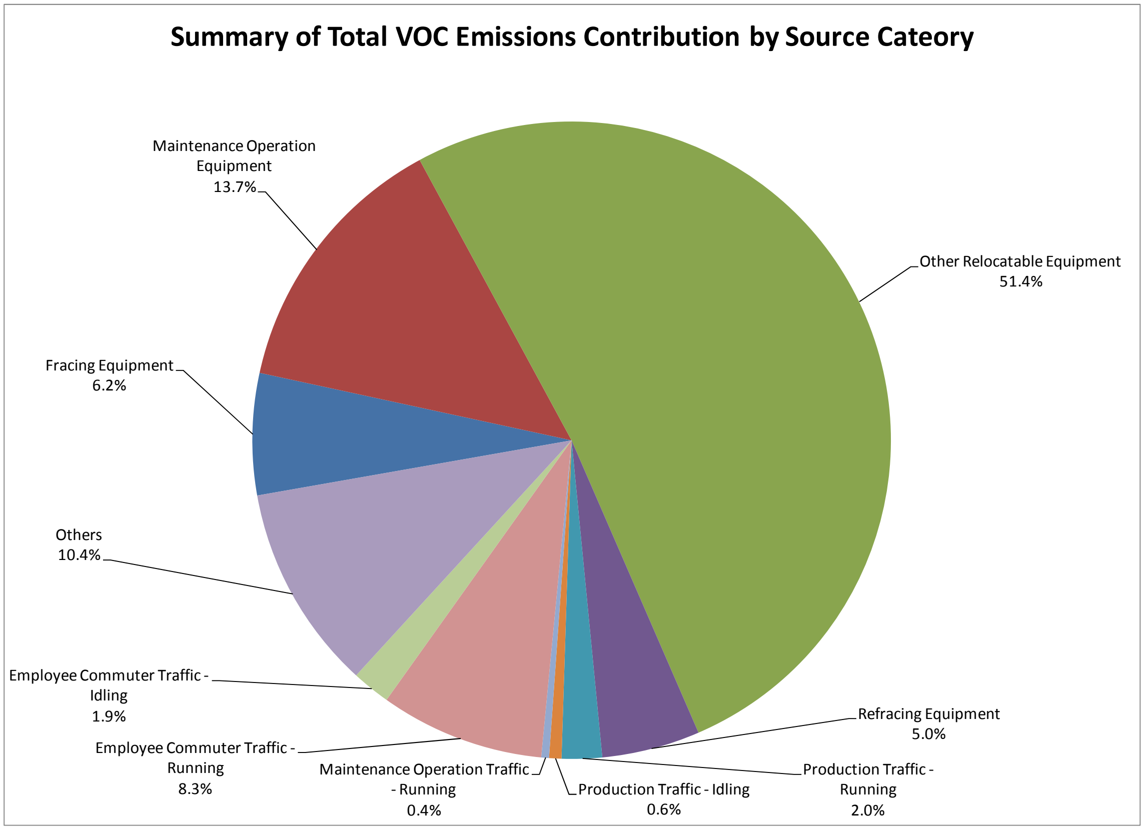

Figure 7. Piceance Basin VOC emissions proportional contributions by source category.

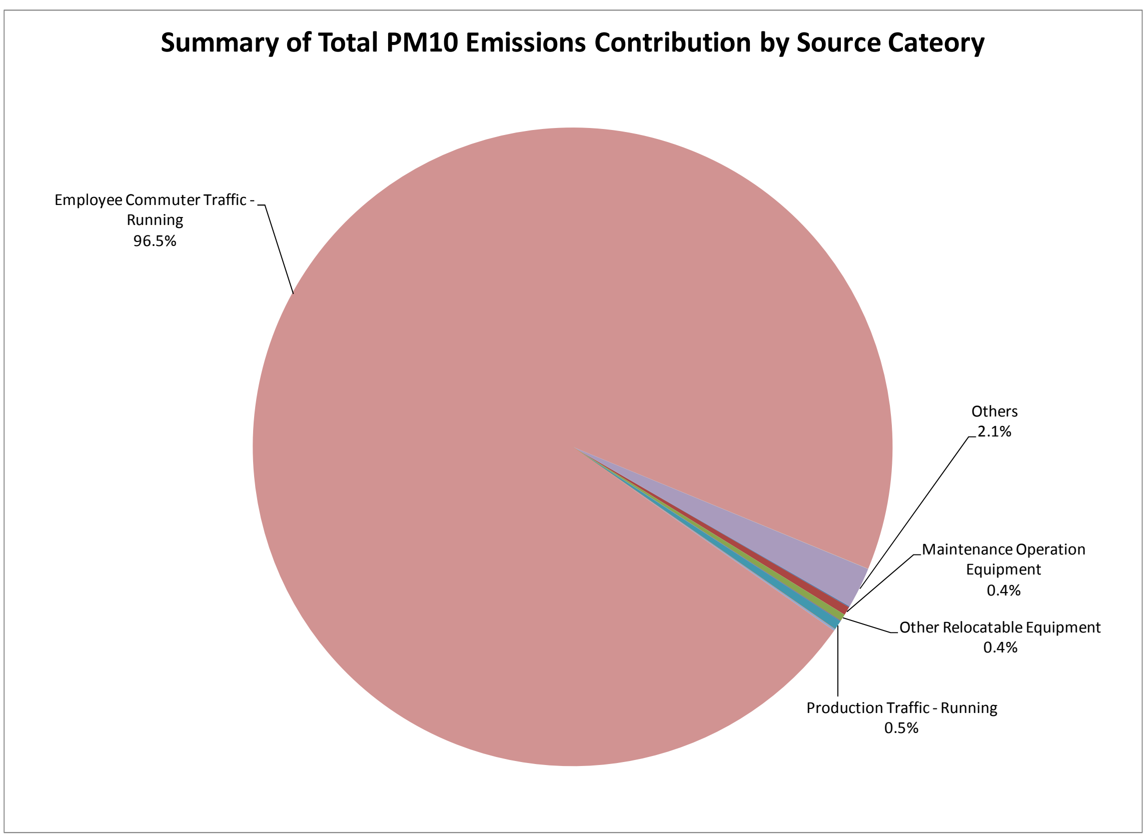

Figure 8. Piceance Basin PM10 emissions proportional contributions by source category.

Table 11. 2009 emissions of all criteria pollutants by county for the Piceance Basin.

County	NOx (tons/yr)	CO (tons/yr)	Total VOC (tons/yr)	SOx (tons/yr)	Total PM10 (tons/yr)	Fugitive Dust PM10 (tons/yr)	Total PM2.5 (tons/yr)	Fugitive Dust PM2.5 (tons/yr)
Delta	0	0	0	0	1	1	0	0
Garfield	758	325	61	14	6,273	6,226	1,505	1,460
Gunnison	2	1	0	0	10	10	2	2
Mesa	67	30	6	1	657	652	158	154
Moffat	42	18	3	1	380	377	91	89
Rio Blanco	185	81	15	3	1,695	1,684	408	397
Routt	3	1	0	0	23	23	6	5
Totals	**1,055**	**455**	**86**	**19**	**9,039**	**8,974**	**2,171**	**2,109**

Table 12. 2009 NOx emissions by county and by source category for the Piceance Basin (tons/year).

Source Category	Delta	Garfield	Gunnison	Mesa	Moffat	Rio Blanco	Routt	Total
Fracing Equipment	0	90	1	2	3	12	0	**108**
Maintenance Operation Equipment	0	110	0	12	7	30	0	**159**
Other Relocatable Equipment	0	395	1	42	24	108	1	**572**
Refracing Equipment	0	46	0	5	3	13	0	**67**
Production Traffic – Running	0	6	0	1	0	2	0	**8**
Production Traffic – Idling	0	3	0	0	0	1	0	**4**
Maintenance Operation Traffic - Running	0	2	0	0	0	0	0	**3**
Employee Commuter Traffic - Running	0	23	0	2	1	6	0	**34**
Employee Commuter Traffic - Idling	0	6	0	1	0	2	0	**8**
Others	0	77	1	2	3	11	0	**92**
Totals	**0**	**758**	**2**	**67**	**42**	**185**	**3**	**1,055**

Table 13. 2009 VOC emissions by county and by source category for the Piceance Basin (tons/year).

Source Category	Delta	Garfield	Gunnison	Mesa	Moffat	Rio Blanco	Routt	Total
Fracing Equipment	0	4	0	0	0	1	0	**5**
Maintenance Operation Equipment	0	8	0	1	0	2	0	**12**
Other Relocatable Equipment	0	30	0	3	2	8	0	**44**
Refracing Equipment	0	3	0	0	0	1	0	**4**
Production Traffic – Running	0	1	0	0	0	0	0	**2**
Production Traffic – Idling	0	0	0	0	0	0	0	**1**
Maintenance Operation Traffic - Running	0	0	0	0	0	0	0	**0**
Employee Commuter Traffic - Running	0	5	0	1	0	1	0	**7**
Employee Commuter Traffic - Idling	0	1	0	0	0	0	0	**2**
Others	0	7	0	0	0	1	0	**9**
Totals	**0**	**61**	**0**	**6**	**3**	**15**	**0**	**86**

Table 14. 2009 PM10 emissions by county and by source category for the Piceance Basin (tons/year).

Source Category	Delta	Garfield	Gunnison	Mesa	Moffat	Rio Blanco	Routt	Total
Fracing Equipment	0	3	0	0	0	0	0	**4**
Maintenance Operation Equipment	0	27	0	3	2	7	0	**39**
Other Relocatable Equipment	0	22	0	2	1	6	0	**32**
Refracing Equipment	0	2	0	0	0	1	0	**3**
Production Traffic – Running	0	30	0	3	2	8	0	**43**
Production Traffic – Idling	0	0	0	0	0	0	0	**0**
Maintenance Operation Traffic - Running	0	6	0	1	0	2	0	**9**
Employee Commuter Traffic - Running	1	6,028	9	643	369	1,648	22	**8,720**
Employee Commuter Traffic - Idling	0	0	0	0	0	0	0	**1**
Others	0	154	1	4	5	23	0	**189**
Totals	**1**	**6,273**	**10**	**657**	**380**	**1,695**	**23**	**9,039**

5.2 ADDITIONAL EMISSIONS SUMMARIES

Unit level emissions

Unit level emissions or emissions per unit of surrogate activity by source category shown in Table 15 are generally consistent with respect to relative magnitude by source category to the summary results presented in Figures 2 through 3a above.

Comparison with Phase III Oil and Gas Emissions

Phase III oil and gas source emissions have not been developed for 2009. In order to be able to compare Piceance 2009 mobile source emissions with Piceance 2009 oil and gas emissions, Phase III 2006 emissions (ENVIRON, 2009) were projected to 2009 based on the change in oil and gas activity surrogates most closely associated with each source category. It should be noted that changes in emissions control from 2006 to 2009 was not considered in these projections as the development of 2009 projected Piceance Basin point and area source emissions was not part of the scope of this project. These projections are expected to be developed for all WRAP Phase III project study basins as part of a future "Phase IV" study.

Figures 9, 10, and 11 below summarize contributions by Phase III oil and gas sources and mobile sources to overall oil and gas emissions inventory across all mobile and Phase III emission sources. Figure 9 shows construction, drilling, and completion phase emissions dominated by Phase III sources for NOx, CO, and VOC, with approximately 21% of PM10 emissions from mobile sources and the remaining 79% from Phase III sources. Similarly for production phase emissions (see Figure 10), NOx, CO, and VOC emissions are dominated by Phase III sources while PM10 emissions are dominated by mobile sources due primarily to fugitive road dust. Across all phases (see Figure 11), NOx, CO, and VOC emissions are dominated by Phase III sources while PM10 emissions are dominated by mobile sources.

Emissions from on-road mobile sources are highly controlled, relative to the distributed minor area source emissions from stationary sources, and the emissions from off-road equipment (such as drilling rigs) which were included as part of Phase III. For VOC emissions particularly, off-road equipment is primarily diesel-fuelled and thus not expected to have significant VOC emissions. The only pollutant for which the within-field mobile source emissions are significant in comparison to the Phase III point and area emissions is PM10, driven primarily by fugitive dust from on-road vehicle travel on unpaved roads and mechanical dust from well pad construction.

Table 15. 2009 Piceance Basin emissions per unit of activity.

Source Category	Activity Surrogate	NOx (lbs/activity)	CO (lbs/activity)	Total VOC (lbs/activity)	TotalPM10 (lbs/activity)	SOx (lbs/activity)	Total PM2.5 (lbs/activity)
Construction Dust, Fugitive	Spuds	-	-	-	9.31	-	5.12
Construction Dust, Wind Erosion	Spuds	-	-	-	25.23	-	3.78
Construction Traffic, Pipeline - Idling	Spuds	0.05	0.05	0.01	0.00	0.00	0.00
Construction Traffic, Drilling - Idling	Spuds	24.93	11.75	2.65	1.38	0.09	1.34
Completion Traffic – Idling	Spuds	58.99	21.52	5.38	3.14	0.22	3.05
Recompletion Traffic – Idling	well count	-	-	-	-	-	-
Production Traffic – Idling	well count	0.72	0.56	0.11	0.04	0.00	0.04
Maintenance Operation Traffic - Idling	well count	0.22	0.09	0.02	0.01	0.00	0.01
Employee Commuter Traffic - Idling	well count	1.66	1.75	0.33	0.11	0.01	0.11
Ancillary Traffic – Idling	well count	0.04	0.26	0.02	0.00	0.00	0.00
Construction Traffic, Well Pad - Idling	Spuds	0.35	0.21	0.04	0.02	0.00	0.02
Well Pad Construction Equipment	Spuds	12.49	4.94	0.83	0.79	0.26	0.77
Pipeline Construction Equipment	Spuds	14.29	5.62	1.27	1.08	0.32	1.05
Fracing Equipment	Spuds	241.68	49.14	11.85	9.11	6.15	8.84
Refracing Equipment	well count	13.32	3.40	0.85	0.58	0.25	0.56
Other Relocatable Equipment	well count	113.31	38.39	8.73	6.33	2.38	6.14
Maintenance Operation Equipment	well count	31.60	10.38	2.33	7.80	0.49	5.69
Construction Traffic, Well Pad - Running	Spuds	1.08	1.02	0.13	3.87	0.00	0.48
Construction Traffic, Pipeline - Running	Spuds	0.15	0.28	0.03	0.65	0.00	0.08
Construction Traffic, Drilling - Running	Spuds	38.67	31.10	4.36	134.95	0.16	17.28
Completion Traffic – Running	Spuds	51.67	27.71	4.42	199.60	0.21	23.87
Recompletion Traffic – Running	well count	0.10	0.05	0.01	0.37	0.00	0.05
Production Traffic – Running	well count	1.65	2.91	0.35	8.48	0.01	0.95
Maintenance Operation Traffic - Running	well count	0.50	0.51	0.07	1.70	0.00	0.22
Employee Commuter Traffic - Running	well count	6.71	17.63	1.41	1,728.38	0.04	410.37
Ancillary Traffic – Running	well count	0.04	0.78	0.03	3.38	0.00	0.34
Total Emissions Per Well Count		**209.20**	**90.27**	**16.99**	**1,791.61**	**3.85**	**430.29**
Total Emissions Per Spud Count		**2,363.75**	**1,019.91**	**191.99**	**20,243.36**	**43.55**	**4,861.81**

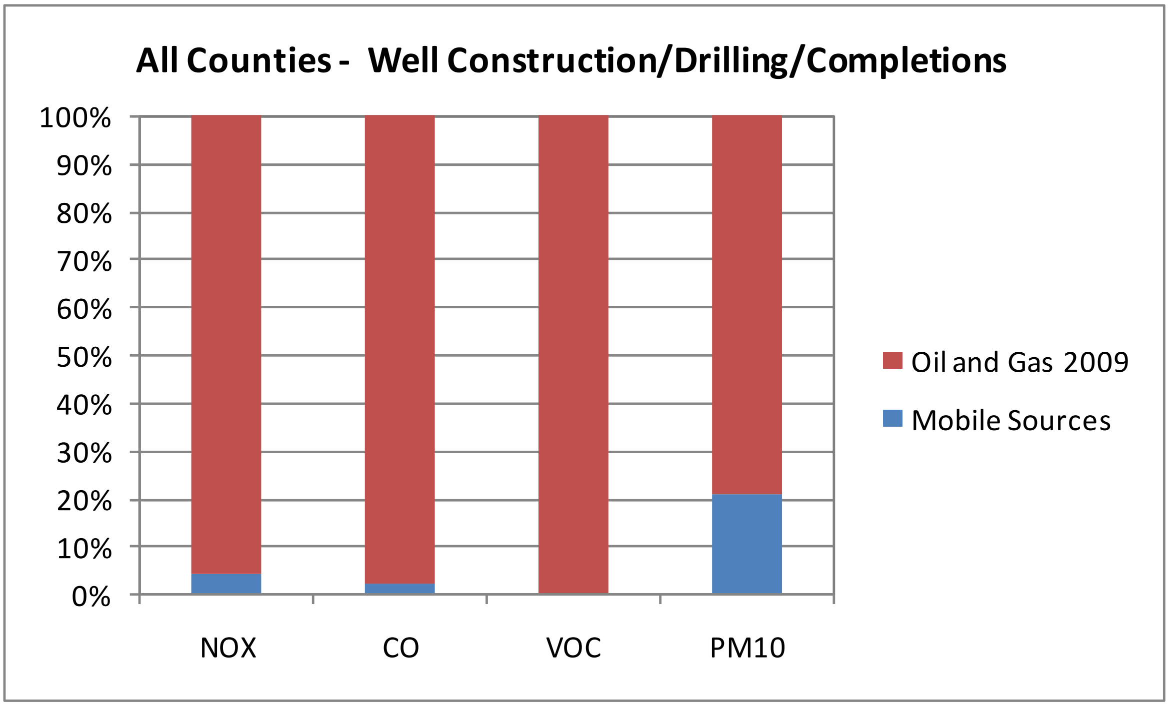

Figure 9. Piceance Basin construction, drilling, and completion phase emissions contributions from mobile sources and Phase III emission categories.

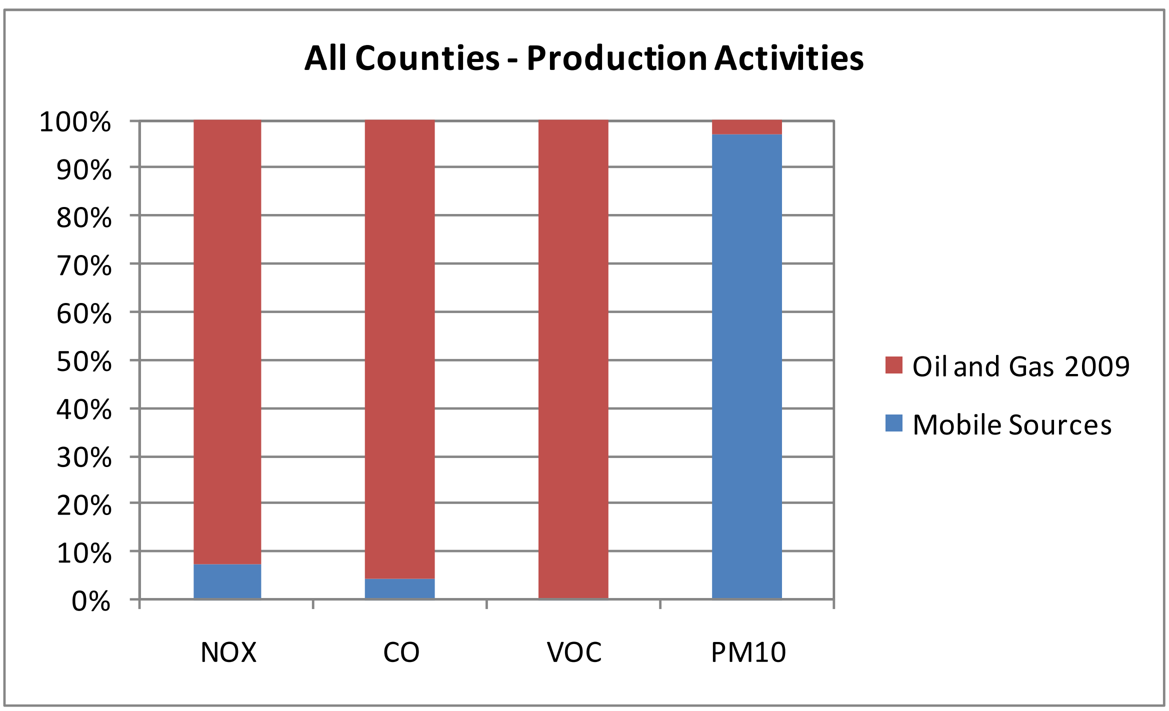

Figure 10. Piceance Basin production phase emissions contributions from mobile sources and Phase III emission categories.

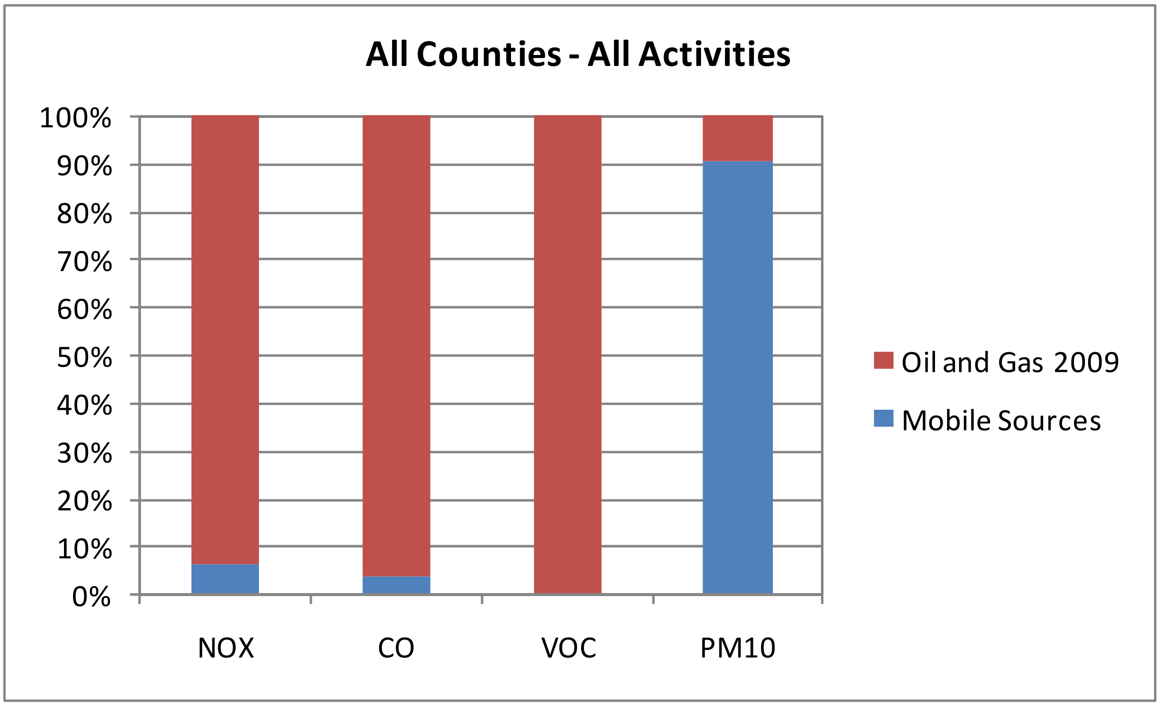

Figure 11. Piceance Basin total emissions contributions from mobile sources and Phase III emission categories.

6.0 Conclusions

This report presents the results of a pilot study to develop an emissions inventory of mobile sources associated with the oil and gas sector in the Piceance Basin in Northwestern Colorado. As described above, this inventory was limited to activities within the oil and gas fields, which largely consist of private, unpaved roads and the well and well pad sites at field locations away from paved public roads. This limitation of the inventory was imposed in order to estimate emissions which could be reconciled, and added to, existing mobile source inventories for Colorado. This limitation primarily applied to on-road vehicles, as off-road equipment was assumed to operate exclusively within the field.

The results indicate that, relative to the existing inventories of oil and gas area and point source equipment developed as part of the WRAP Phase III study, the oil and gas within-field mobile source equipment represent less than 10% of the total oil and gas sector emissions for most pollutants. The exception to this is the PM10 emissions, for which the mobile source sector contributes significant emissions in the form of fugitive dust from on-road vehicle travel on primarily unpaved roads, and primarily from regular employee vehicle visits to well sites during the production phase. Although not analyzed as part of this study, based on the total trip activity for on-road vehicles, oil and gas mobile sources may be significant sources of emissions.

As part of this pilot study, some survey data on activity and equipment was gathered from oil and gas companies. However, participation was limited and future studies in other basins may be able to gather more data and greater participation in the survey process. Due to the limited amount of survey data collected, and the limited nature of the field verification, quantitative uncertainty is difficult to measure for this study. However it is noted that there are a number of caveats in extending this data from the Piceance Basin to other basins using the unit-level emission factors. Future studies should focus more closely on gathering additional survey data from oil and gas companies, particularly small companies for which operations may differ significantly from those of major operators.

7.0 References

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Appendix A

Surveys to Oil and Gas Companies in the Piceance Basin

-- 2009 Piceance Basin Survey Request --

ITEMS TO COMPLETE IN THIS SURVEY FOR THE CALENDAR YEAR 2009

1. Producer Survey Summary
2. Well Pad Construction Equipment Data
3. Well Pad Construction Traffic Data
4. Pipeline Construction Equipment Data
5. Pipeline Construction Traffic Data
6. Disturbed Land Data
7. Fracing Equipment Data
8. Refracing Equipment Data
9. Other Relocatable Equipment Data
10. Drill Rig Traffic Data
11. Completion and Recompletion Traffic Data
12. Production Traffic Data
13. Maintenance Equipment Data
14. Maintenance Traffic Data
15. Employee Commuter Traffic Data
16. Ancillary Traffic Data

Geographical Extent of Data Requested

The basin boundaries are provided on the map to the right of this cell, bounded by the red line. The area encompassed by the Piceance Basin as described is the area for which data is being requested in this survey.

Piceance Basin Counties: Moffat, Routt, Rio Blanco, Garfield, Eagle, Mesa, Delta, Gunnison, Chaffee, Lake, and Pitkin

Introduction

In this survey information is being requested that will be used to estimate mobile source air emissions related to oil and gas production and transmission in the Intermountain West not previously included in WRAP Oil and Gas Emission Inventory Studies. **Survey data for the calendar year 2006 is being requested for mobile sources associated with oil and gas sector operations**. The survey asks to provide "average" or "representative" activity data for on-road and off-road mobile sources associated with construction and production activities for your company, because emissions will be developed on a per-well basis. Traffic data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on roads within an oil and gas field and activity on county-maintained and state/federal roadways. Please note that mobile source activity associated with the construction of compressor stations, gas plants, and natural gas liquids plants is not being requested but operation and maintenance data is being requested for these sources.

In the tabs that follow, please find a series of survey forms which ask for data on each oil and gas mobile source category in the Piceance Basin in Colorado.

If there are any questions about this survey, please refer them to Amnon Bar-Ilan who can be reached at (415) 899-0732, or at abarilan@environcorp.com.

As in previous WRAP Oil and Gas Emission Inventory Studies, **ENVIRON will hold as confidential all company-specific information provided; only aggregate information will be released.**

Informational Notes

In each tab, a full suite of survey data has been requested. If all survey data requested is not able to be provided for a given category, please provide all available information, leaving blank the items for which no information is available.

Throughout the survey, representative data for Piceance Basin operations in 2009 is requested. In the case that there are two or more distinct operational configurations or sets of activity, please provide two or more representative sets of data in the survey and note which data applies to which operation.

Note that the surveys request “representative” data, meaning data per unit of activity. For example, pipeline construction equipment refers to the likely mix of equipment used to construct pipeline per well pad, and per mile of pipeline. Similarly, the production traffic data request, for example, asks for data on the typical type(s) of tanker trucks used to load out condensate/oil, the frequency of visits, and the typical distance traveled by the truck within the field per tank visited.

The “representative” data you provide per well, per spud, per unit production or per another surrogate will be scaled up by the number of wells, number of spuds or total production in the Piceance Basin in a later step in the process. You are not required to provide information on each piece of equipment or vehicle you own/operate, or information on each individual activity conducted by your company.

If any of your responses require additional explanation, or deviate from the type of data being requested in a field, please provide the data and add some notations explaining your response. Notation boxes in yellow are at the right of each data tab.

Where drop-down menus are used in this survey spreadsheet, please select an item or select “other” if your response does not match the options in the menu. If you select “other”, please provide an explanation of your response.

Summary
Please note that the summary tab must be filled out completely; without a complete set of information in this tab any survey data provided may not be usable.

All Traffic Tabs
For the vehicle characteristics and trip data requested, it is expected that there will be variation over all of a producer’s operations in the Piceance Basin in 2009 in vehicle model year, trip distance, idle time, etc. Please provide representative/average data for all requested data. If your representative data varies across the different areas of your operations in the Piceance Basin, please provide more than one representative data response, and indicate for which field or geographic area the response applies.

All Equipment Tabs
For the equipment characteristics and activity data requested, it is expected that there will be variation over all of a producer’s operations in the Piceance Basin in 2009 in equipment technology, hours of operation, etc. Please provide representative/average data for Piceance Basin 2009 operations. As noted above, if representative data varies across different areas of your operations in the Piceance Basin, please provide more than one representative data response, and indicate for which field or geographic area the response applies.

“Tier Level or Technology Type” is being requested for each piece of representative equipment. If this information is unable to be provided, the equipment model year can be provided. If neither of these are known, please indicate that these are not known.

Pipeline Construction
Survey data is requested per length of pipeline. Here a length of pipeline should represent the average length of pipe laid per well pad constructed in the Piceance Basin in 2009. As noted above, if this varies across different areas of your operations in the Piceance Basin, please provide more than one representative data response, and indicate for which field or geographic area the response applies.

Completion and Recompletion Traffic
Please note that for completion and recompletion traffic, survey data is being requested for all traffic associated with these operations including traffic associated with fracing and refracing.

Production Traffic
Please include all traffic associated with routine production related activities such as condensate loading/transport.

Maintenance Traffic
Please include all traffic associated with routine and non-routine maintenance related activities. Where traffic may be classified as either production traffic or maintenance traffic, please include this traffic in the production traffic tab only.

1. Producer Survey Summary

To create an accurate oil and gas mobile source emissions inventory, it is very important to understand the completeness of the survey data that each producer provides. In this sheet we have provided a table in which you are asked to provide basic information about the data provided for each source category; without this information the survey data that you have provided in other tabs may not be able to be incorporated into this study. Please complete the remainder of the survey before completing this sheet.

COMPANY INFORMATION

Company name ______________________

Company contact name ______________________

Contact phone ______________________

Contact email ______________________

Please indicate by whom the survey was completed (Check only one)	If the survey completed by Contractor , please provide the list of Oil and Gas Production companies for which the contractor performs work
☐ Oil and Gas Operator	NA
☐ Oil and Gas Production Contractor	

Please check the counties in which your company had oil and gas related operations in 2009:

☐ Chaffee	☐ Mesa
☐ Delta	☐ Moffat
☐ Eagle	☐ Pitkin
☐ Garfield	☐ Rio Blanco
☐ Gunnison	☐ Routt
☐ Lake	

Please provide source category specific information below:

Source Category	**Survey Data Provided?** (please check Yes or No)	**If the survey data was not provided, please explain** (e.g. "no activity for this source category in the Piceance Basin by X company")	**If a survey was completed, please confirm that the survey was completed with respect to all of your operations in Piceance Basin in 2009?**	**If you checked "no" in column E, please explain**	**Notes**
Well Pad Construction Equipment	☐ Yes ☐ No		☐ Yes ☐ No		
Well Pad Construction Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Pipeline Construction Equipment	☐ Yes ☐ No		☐ Yes ☐ No		
Pipeline Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Disturbed Land	☐ Yes ☐ No		☐ Yes ☐ No		
Fracing Equipment Data	☐ Yes ☐ No		☐ Yes ☐ No		
Refracing Equipment Data	☐ Yes ☐ No		☐ Yes ☐ No		
Other Relocatable Equipment Data	☐ Yes ☐ No		☐ Yes ☐ No		
Drill Rig Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Completion and Recompletion Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Production Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Maintenance Equipment	☐ Yes ☐ No		☐ Yes ☐ No		
Maintenance Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Ancillary Traffic	☐ Yes ☐ No		☐ Yes ☐ No		
Employee Commuter Traffic	☐ Yes ☐ No		☐ Yes ☐ No		

2. 2009 PICEANCE BASIN WELL PAD CONSTRUCTION EQUIPMENT DATA

Please provide information below for well pad construction equipment used to construct a typical well pad(s) by your company (or its contractors) in the Piceance Basin in 2009 in item 2A, 2B, 2C and 2D. Please include all equipment typically used in well pad construction; some common equipment types are bulldozers, graders, loaders, and cranes. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

2A. 2009 NUMBER OF WELL PADS AND TOTAL FUEL CONSUMPTION PER WELL PAD DATA:

Well Type	No. of Well Pads Constructed in 2009	Well Pad Type(s) (example: vertical, horizontal)	Total Diesel Fuel Consumption for All Equipment for a Typical Well Pad (gallons/well pad)	Total Gasoline Fuel Consumption for All Equipment for a Typical Well Pad (gallons/well pad)	Total Natural Gas Fuel Consumption for All Equipment for a Typical Well Pad (cubic feet/well pad)
Conventional Gas					
Conventional Oil					
CBM					

2B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD CONSTRUCTION.

B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD CONSTRUCTION:	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY							
	Equipment Type	Fuel Type	If selected "other" fuel type, please specify type	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Well Pad	Construction Duration (days/pad)	Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / pad constructed)	Model Year	Load Factor (%)
Sample Equipment	*Grader*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*3*	*10*	*300*	*1995*	*70*
Equipment 1												
Equipment 2												
Equipment 3												
Equipment 4												
Equipment 5												
Equipment 6												

2B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD CONSTRUCTION (Continued).

	Emission Factors				
	NOx (g/bhp-hr)	**CO (g/bhp-hr)**	**VOC (g/bhp-hr)**	**PM10 (g/bhp-hr)**	**Emission Factors Estimation Documentation**
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

2C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD CONSTRUCTION:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY						
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/ Counties of Operation	No. of This Equipment Used per Well Pad	Construction Duration (days/pad)	Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / pad constructed)	Model Year	Load Factor (%)
Sample Equipment	*Grader*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*3*	*10*	*300*	*1995*	*70*
Equipment 1												
Equipment 2												
Equipment 3												
Equipment 4												
Equipment 5												
Equipment 6												

2C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD CONSTRUCTION (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

2D. 2009 TYPICAL CBM WELL PAD CONSTRUCTION:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY						
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Well Pad	Construction Duration (days/pad)	Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / pad constructed)	Model Year	Load Factor (%)
Sample Equipment	*Grader*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*3*	*10*	*300*	*1995*	*70*
Equipment 1												
Equipment 2												
Equipment 3												
Equipment 4												
Equipment 5												
Equipment 6												

2D. 2009 TYPICAL CBM WELL PAD CONSTRUCTION (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

3. 2009 PICEANCE BASIN WELL PAD CONSTRUCTION ROAD TRAFFIC

Please provide information below related to typical vehicle traffic associated with well pad construction by your company (or its contractors) in the Piceance Basin in 2009 in item 3A, 3B, 3C, and 3D. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

3A. 2009 NUMBER OF WELL PADS:

Well Type	No. of Well Pads Constructed in 2009
Conventional Gas	*same as in tab 'Well Pad Construction'*
Conventional Oil	*same as in tab 'Well Pad Construction'*
CBM	*same as in tab 'Well Pad Construction'*

3B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD CONSTRUCTION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / pad constructed)	No. of Vehicles Used per Pad
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

3B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD CONSTRUCTION DATA (Continued):

	TRIP DATA												
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Pad	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

3B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD CONSTRUCTION DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

3C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD CONSTRUCTION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / pad constructed)	No. of Vehicles Used per Pad
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

3C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD CONSTRUCTION DATA (Continued):

	TRIP DATA												
										***Within-Field* Mean Vehicle Speed (mph)**			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Pad	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

3C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD CONSTRUCTION DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

3D. 2009 TYPICAL CBM WELL PAD CONSTRUCTION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / pad constructed)	No. of Vehicles Used per Pad
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

3D. 2009 TYPICAL CBM WELL PAD CONSTRUCTION DATA (Continued):

	TRIP DATA												
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Pad	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

3D. 2009 TYPICAL CBM WELL PAD CONSTRUCTION DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

4. 2009 PICEANCE BASIN PIPELINE CONSTRUCTION EQUIPMENT DATA

Please provide information below for pipeline construction equipment used at typical pipeline constructed by your company (or its contractors) in the Piceance Basin in 2009 in item 4A, 4B, 4C, and 4D. Please include all equipment used in typical pipeline construction; some common equipment types are bulldozers, graders, loaders, and cranes. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

4A. 2009 TOTAL LENGTH OF PIPELINE ADDED PER WELL PAD AND TOTAL FUEL CONSUMPTION PER WELL PAD DATA:

Well Type	Length of Pipeline Constructed Per Well Pad in 2009	Total Diesel Fuel Consumption for All Equipment for Total Length of Pipeline Constructed for a Typical Well Pad (gallons / well pad)	Total Gasoline Fuel Consumption for All Equipment for Total Length of Pipeline Constructed for a Typical Well Pad (gallons / well pad)	Total Natural Gas Fuel Consumption for All Equipment for Total Length of Pipeline Constructed for a Typical Well Pad (cubic feet/ well pad)
Conventional Gas				
Conventional Oil				
CBM				

4B. 2009 TYPICAL CONVENTIONAL GAS WELL PADS ASSOCIATED PIPELINE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Grader*	*Diesel*		*400*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

4B. 2009 TYPICAL CONVENTIONAL GAS WELL PADS ASSOCIATED PIPELINE DATA (Continued):

	EQUIPMENT ACTIVITY							Emission Factors				Emission Factors Estimation Documentation
	County/ Counties of Operation	No. of This Equipment Used per Length of Pipeline Segment Identified in 5A		Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / length of pipeline)	Model Year	Load Factor (%)	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*	*10*	*200*	*1995*	*70*	*5.46*	*1.44*	*0.35*	*0.36*	
Equipment 1												
Equipment 2												
Equipment 3												
Equipment 4												
Equipment 5												
Equipment 6												

4C. 2009 TYPICAL CONVENTIONAL OIL WELL PADS ASSOCIATED PIPELINE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Grader*	*Diesel*		*400*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

4C. 2009 TYPICAL CONVENTIONAL OIL WELL PADS ASSOCIATED PIPELINE DATA (Continued):

	EQUIPMENT ACTIVITY						
	County/Counties of Operation	No. of This Equipment Used per Length of Pipeline Segment Identified in 5A	Construction Duration (days/per length of pipeline)	Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / length of pipeline)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1							
Equipment 2							
Equipment 3							
Equipment 4							
Equipment 5							
Equipment 6							

4C. 2009 TYPICAL CONVENTIONAL OIL WELL PADS ASSOCIATED PIPELINE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.44*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

4D. 2009 TYPICAL CBM WELL PADS ASSOCIATED PIPELINE DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY							
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horse-power	Tier Level or Technology Type	County/ Counties of Operation	No. of This Equipment Used per Length of Pipeline Segment Identified in 5A	Construction Duration (days/per length of pipeline)	Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / length of pipeline)	Model Year	Load Factor (%)
Sample Equipment	*Grader*	*Diesel*		*400*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1												
Equipment 2												
Equipment 3												
Equipment 4												
Equipment 5												
Equipment 6												

4D. 2009 TYPICAL CBM WELL PADS ASSOCIATED PIPELINE DATA (Continued):

	EQUIPMENT ACTIVITY						
	County/Counties of Operation	No. of This Equipment Used per Length of Pipeline Segment Identified in 5A	Construction Duration (days/per length of pipeline)	Construction Duration (hrs/day)	Fuel Consumption (gallons / equipment / length of pipeline)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1							
Equipment 2							
Equipment 3							
Equipment 4							
Equipment 5							
Equipment 6							

4D. 2009 TYPICAL CBM WELL PADS ASSOCIATED PIPELINE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.44*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

5. 2009 PICEANCE BASIN PIPELINE CONSTRUCTION ROAD TRAFFIC

Please provide information below related to vehicle traffic associated with typical pipeline construction per well pad by your company (or its contractors) in the Piceance Basin in 2009 in item 5A, 5B, 5C, and 5D. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

5A.2009 TOTAL LENGTH OF PIPELINE ADDED PER WELL PAD:

Well Type	Length of Pipeline Constructed Per Well Pad in 2009
Conventional Gas	*same as in tab 'Pipeline Construction'*
Conventional Oil	*same as in tab 'Pipeline Construction'*
CBM	*same as in tab 'Pipeline Construction'*

5B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD ASSOCIATED PIPELINE DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / length of pipeline)	No. of Vehicles Used per Length of Pipeline Segment Identified in 5A
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

5B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD ASSOCIATED PIPELINE DATA (Continued):

	TRIP DATA												
										Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Pad per Pipeline Segment	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Pad per Pipeline Segment (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

5B. 2009 TYPICAL CONVENTIONAL GAS WELL PAD ASSOCIATED PIPELINE DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

5C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD ASSOCIATED PIPELINE DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / length of pipeline)	No. of Vehicles Used per Length of Pipeline Segment Identified in 5A
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

5C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD ASSOCIATED PIPELINE DATA (Continued):

	TRIP DATA												
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Pad per Pipeline Segment	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Pad per Pipeline Segment (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph): Paved Road	*Within-Field* Mean Vehicle Speed (mph): Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

5C. 2009 TYPICAL CONVENTIONAL OIL WELL PAD ASSOCIATED PIPELINE DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

5D. 2009 TYPICAL CBM WELL PAD ASSOCIATED PIPELINE DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / length of pipeline)	No. of Vehicles Used per Length of Pipeline Segment Identified in 5A
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

5D. 2009 TYPICAL CBM WELL PAD ASSOCIATED PIPELINE DATA (Continued):

	TRIP DATA												
										Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Pad per Pipeline Segment	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Pad per Pipeline Segment (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

5D. 2009 TYPICAL CBM WELL PAD ASSOCIATED PIPELINE DATA (Continued):

	Tailpipe Exhaust Emission Factors				
If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
	1.658	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*

6. 2009 PICEANCE BASIN DISTURBED LAND

Please provide information below related to area disturbed due to typical well pad, access road and pipeline construction by your company (or its contractors) in the Piceance Basin in 2009 in item 6A, 6B, 6C and 6D. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

6A. 2009 NUMBER OF NEW WELL PADS:

Well Type	No. of Well Pads Constructed in 2009
Conventional Gas	*same as in tab 'Well Pad Construction'*
Conventional Oil	*same as in tab 'Well Pad Construction'*
CBM	*same as in tab 'Well Pad Construction'*

6B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA:

Survey Id	County/Counties of Operation	Total Area of Land Disturbed to Construct one Well Pad (acres)	Access Road Length per New Pad (feet)	Access Road ROW (feet)	Distance of pipeline per Well or Pad (miles)	Pipeline ROW (feet)
Sample well	*Moffatt, Rio Blanco*	*3.7*	*875*	*30*	*0.17*	*20*

6C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA:

Survey Id	County/Counties of Operation	Total Area of Land Disturbed to Construct one Well Pad (acres)	Access Road Length per New Pad (feet)	Access Road ROW (feet)	Distance of pipeline per Well or Pad (miles)	Pipeline ROW (feet)
Sample well	*Moffatt, Rio Blanco*	*3.7*	*875*	*30*	*0.17*	*20*

6D. 2009 TYPICAL CONVENTIONAL CBM WELL DATA:

Survey Id	County/Counties of Operation	Total Area of Land Disturbed to Construct one Well Pad (acres)	Access Road Length per New Pad (feet)	Access Road ROW (feet)	Distance of pipeline per Well or Pad (miles)	Pipeline ROW (feet)
Sample well	*Moffatt, Rio Blanco*	*3.7*	*875*	*30*	*0.17*	*20*

7. 2009 PICEANCE BASIN FRACING EQUIPMENT DATA

Please provide information below for equipment used for fracing activity used by your company (or its contractors) in the Piceance Basin in 2009 in item 7A, 7B, 7C and 7D. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

7A. 2009 NUMBER OF WELL COMPLETIONS AND TOTAL FUEL CONSUMPTION PER FRACING EVENT DATA:

Well Type	No. of Fracing Events in 2009	Total Diesel Fuel Consumption for All Equipment for a Typical Fracing Event (gallons/fracing event)	Total Gasoline Fuel Consumption for All Equipment for a Typical Fracing Event (gallons/fracing event)	Total Natural Gas Fuel Consumption for All Equipment for a Typical Fracing Event (cubic feet/fracing event)
Conventional Gas				
Conventional Oil				
CBM				

7B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/ Counties of Operation	No. of This Equipment Used per Fracing Event	Hours of use (hours/fracing event)	Fuel Consumption (gallons / equipment / fracing event)	Model Year	Load Factor (%)
Sample Equipment	*Frac Pump*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

7B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

7C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Fracing Event	Hours of use (hours/fracing event)	Fuel Consumption (gallons / equipment / fracing event)	Model Year	Load Factor (%)
Sample Equipment	*Frac Pump*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

7C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

7D. 2009 TYPICAL CBM WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Fracing Event	Hours of use (hours/fracing event)	Fuel Consumption (gallons / equipment / fracing event)	Model Year	Load Factor (%)
Sample Equipment	*Frac Pump*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

7D. 2009 TYPICAL CBM WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

8. 2009 PICEANCE BASIN REFRACING EQUIPMENT DATA

Please provide information below for equipment used for refracing activity by your company (or its contractors) in the Piceance Basin in 2009 in item 8A, 8B, 8C and 8D. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

8A. 2009 NUMBER OF WELL RECOMPLETIONS AND TOTAL FUEL CONSUMPTION PER REFRACING EVENT DATA:

Well Type	No. of Refracing Events in 2009	Total Diesel Fuel Consumption for All Equipment for a Typical Refracing Event (gallons/refracing event)	Total Gasoline Fuel Consumption for All Equipment for a Typical Refracing Event (gallons/refracing event)	Total Natural Gas Fuel Consumption for All Equipment for a Typical Refracing Event (cubic feet/refracing event)
Conventional Gas				
Conventional Oil				
CBM				

8B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/ Counties of Operation	No. of This Equipment Used per Refracing Event	Hours of use (hours/refracing event)	Fuel Consumption (gallons / equipment / refracing event)	Model Year	Load Factor (%)
Sample Equipment	*Frac Pump*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

8B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (continued):

	Emission Factors				Emission Factors Estimation Documentation
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

8C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/ Counties of Operation	No. of This Equipment Used per Refracing Event	Hours of use (hours/refracing event)	Fuel Consumption (gallons / equipment / refracing event)	Model Year	Load Factor (%)
Sample Equipment	*Frac Pump*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

8C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

8D. 2009 TYPICAL CBM WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/ Counties of Operation	No. of This Equipment Used per Refracing Event	Hours of use (hours/refracing event)	Fuel Consumption (gallons / equipment / refracing event)	Model Year
Sample Equipment	*Frac Pump*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*
Equipment 1										
Equipment 2										
Equipment 3										
Equipment 4										
Equipment 5										
Equipment 6										

8D. 2009 TYPICAL CBM WELL DATA (Continued):

	EQUIPMENT ACTIVITY	Emission Factors				
	Load Factor (%)	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*70*	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1						
Equipment 2						
Equipment 3						
Equipment 4						
Equipment 5						
Equipment 6						

9. 2009 PICEANCE BASIN OTHER RELOCATABLE EQUIPMENT DATA

Please provide information below for relocatable engines not used for fracing and refracing by your company (or its contractors) in the Piceance Basin in 2009 in item 9A, 9B, 9C, 9D, and 9E. Please include all relocatable engines; some common equipment types are generators, snow blowers, etc. Please do not include any engines data that were included under "Miscellaneous Engines" in the WRAP Phase III O&G Inventory by your company. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

APEN Sources: Activity from Portable Engines or any other sources that report under the Air Pollution Emission Notice (APEN) reporting requirements is not to be included in the tables below.

9A. 2009 NUMBER OF WELL COUNT AND TOTAL FUEL CONSUMPTION PER WELL DATA:

Well Type	No. of New Wells in 2009	Total Diesel Fuel Consumption for All Equipment for a Typical Well (gallons/well)	Total Gasoline Fuel Consumption for All Equipment for a Typical Well (gallons/well)	Total Natural Gas Fuel Consumption for All Equipment for a Typical Well (cubic feet/well)
Conventional Gas				
Conventional Oil				
CBM				
Other				

9B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Well	Hours of use (hours/year)	Fuel Consumption (gallons / equipment / year)	Model Year	Load Factor (%)
Sample Equipment	*Snow Blower*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

9B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

9C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Well	Hours of use (hours/year)	Fuel Consumption (gallons / equipment / year)	Model Year	Load Factor (%)
Sample Equipment	*Snow Blower*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

9C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

9D. 2009 TYPICAL CBM WELL DATA:

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Well	Hours of use (hours/year)	Fuel Consumption (gallons / equipment / year)	Model Year	Load Factor (%)
Sample Equipment	*Snow Blower*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

9D. 2009 TYPICAL CBM WELL DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

9E. 2009 OTHER LOCATION(S):

	EQUIPMENT PROPERTIES					EQUIPMENT ACTIVITY					
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type	County/Counties of Operation	No. of This Equipment Used per Well	Hours of use (hours/year)	Fuel Consumption (gallons / equipment / year)	Model Year	Load Factor (%)
Sample Equipment	*Snow Blower*	*Diesel*		*200*	*Tier 1*	*Moffatt, Rio Blanco*	*1*	*5*	*200*	*1995*	*70*
Equipment 1											
Equipment 2											
Equipment 3											
Equipment 4											
Equipment 5											
Equipment 6											

9E. 2009 OTHER LOCATION(S) (Continued:

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

10. 2009 PICEANCE BASIN DRILLING ROAD TRAFFIC

Please provide information below related to vehicle traffic associated with drilling by your company (or its contractors) in the Piceance Basin in 2009 in item 10A, 10B, 10C, and 10D. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

10A. 2009 NUMBER OF SPUDS:

Well Type	No. of Spuds Drilled in 2009
Conventional Gas	
Conventional Oil	
CBM	

10B. 2009 TYPICAL CONVENTIONAL GAS SPUD DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (rig move, material/supply delivery, other-please specify)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / spud)	No. of Vehicles Used per Drilling Event
Sample Truck	*moving rig*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

10B. 2009 TYPICAL CONVENTIONAL GAS SPUD DATA (Continued):

	TRIP DATA												
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Drilling Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Drilling Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph): Paved Road	*Within-Field* Mean Vehicle Speed (mph): Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

10B. 2009 TYPICAL CONVENTIONAL GAS SPUD DATA Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

10C. 2009 TYPICAL CONVENTIONAL OIL SPUD DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (rig move, material/supply delivery, other-please specify)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / spud)	No. of Vehicles Used per Drilling Event
Sample Truck	*moving rig*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

10C. 2009 TYPICAL CONVENTIONAL OIL SPUD DATA (Continued):

	TRIP DATA												
										Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Drilling Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Drilling Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

10C. 2009 TYPICAL CONVENTIONAL OIL SPUD DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

10D. 2009 TYPICAL CBM SPUD DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (rig move, material/supply delivery, other-please specify)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / spud)	No. of Vehicles Used per Drilling Event
Sample Truck	*moving rig*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

10D. 2009 TYPICAL CBM SPUD DATA (Continued):

	TRIP DATA											
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Drilling Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Drilling Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

10D. 2009 TYPICAL CBM SPUD DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

11. 2009 PICEANCE BASIN COMPLETION AND RECOMPLETION ROAD TRAFFIC

Please provide information below related to vehicle traffic associated with completions by your company (or its contractors) in the Piceance Basin in 2009 in item 11A, 11B, 11C, 11D, 11E, 11F, and 11G. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

11A. 2009 NUMBER OF COMPLETIONS AND RECOMPLETIONS:

Well Type	No. of Completions in 2009
Conventional Gas	
Conventional Oil	
CBM	
Well Type	**No. of Recompletions in 2009**
Conventional Gas	
Conventional Oil	
CBM	

11B. 2009 TYPICAL CONVENTIONAL GAS COMPLETION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / completion)	No. of Vehicles Used per Completion Event
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								

11B. 2009 TYPICAL CONVENTIONAL GAS COMPLETION DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Completion Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Completion Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												

11B. 2009 TYPICAL CONVENTIONAL GAS COMPLETION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

11C. 2009 TYPICAL CONVENTIONAL OIL COMPLETION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / completion)	No. of Vehicles Used per Completion Event
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

11C. 2009 TYPICAL CONVENTIONAL OIL COMPLETION DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Completion Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Completion Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

11C. 2009 TYPICAL CONVENTIONAL OIL COMPLETION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

11D. 2009 TYPICAL CBM COMPLETION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / completion)	No. of Vehicles Used per Completion Event
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

11D. 2009 TYPICAL CBM COMPLETION DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Completion Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Completion Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												
Truck 7												

11D. 2009 TYPICAL CBM COMPLETION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						
Truck 7						

11E. 2009 TYPICAL CONVENTIONAL GAS RECOMPLETION DATA

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / recompletion)	No. of Vehicles Used per Recompletion Event
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

11E. 2009 TYPICAL CONVENTIONAL GAS RECOMPLETION DATA (Continued):

	TRIP DATA											
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Recompletion Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Completion Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph): Paved Road	*Within-Field* Mean Vehicle Speed (mph): Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

11E. 2009 TYPICAL CONVENTIONAL GAS RECOMPLETION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

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1F. 2009 TYPICAL CONVENTIONAL OIL RECOMPLETION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / recompletion)	No. of Vehicles Used per Recompletion Event
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

11F. 2009 TYPICAL CONVENTIONAL OIL RECOMPLETION DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Recompletion Event	***Total*** Round Trip Distance (miles/trip)	***Total*** Engine-on Idle Time per Trip (hours/trip)	***Within-Field*** Round Trip Distance per Completion Event (miles/trip)	***Within Field*** Engine-on Idle Time per Trip (hours/ trip)	***Within-Field*** Percentage of Mileage on Unpaved Roads (%)	***Within-Field*** Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

11F. 2009 TYPICAL CONVENTIONAL OIL RECOMPLETION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

11G. 2009 TYPICAL CBM RECOMPLETION DATA:

	VEHICLE PROPERTIES							
	Purpose of The Trip (Bringing Equipment, Bringing Materials/Supplies)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / recompletion)	No. of Vehicles Used per Recompletion Event
Sample Truck	*Bringing Equipment*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

11G. 2009 TYPICAL CBM RECOMPLETION DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Recompletion Event	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Completion Event (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

11G. 2009 TYPICAL CBM RECOMPLETION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.658*	*25.14*	*1.775*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

12. 2009 PICEANCE BASIN PRODUCTION ROAD TRAFFIC

Please provide information below related vehicle traffic associated with production activity by your company (or its contractors) in the Piceance Basin in 2009 in item 12A, 12B, 12C 12D, 12E, and 12F. Typical production activity would include such activity as well site tank load-outs, compressor station tank load-outs, gas plant tank load-outs, new equipment to facilities, deliveries such as amine and methanol, load-out of produced water. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

12A. 2009 NUMBER OF WELLS/FACILITIES:

Type	No. of Wells/Facilities in 2009
Conventional Gas Wells	
Conventional Oil Wells	
CBM Wells	
Compressor Stations	
Gas Processing Plants	

12B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / well)	No. of Wells/Facilities Visited per Vehicle	No. of Visits per Well/Facility
Sample Truck	*Tank load-out*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*20*	*5*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

12B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Well/Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker , CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

12B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

12C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / well)	No. of Wells/Facilities Visited per Vehicle	No. of Visits per Well/Facility
Sample Truck	*Tank load-out*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*20*	*5*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

12C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Well/Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

12C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

12D. 2009 TYPICAL CBM WELL DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / well)	No. of Wells/Facilities Visited per Vehicle	No. of Visits per Well/Facility
Sample Truck	*Tank load-out*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*20*	*2*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

12D. 2009 TYPICAL CBM WELL DATA (Continued):

	TRIP DATA												
										Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Well/Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

12D. 2009 TYPICAL CBM WELL DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

12E. 2009 TYPICAL COMPRESSOR STATION DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / well)	No. of Wells/Facilities Visited per Vehicle	No. of Visits per Well/Facility
Sample Truck	*Tank load-out*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*1*	*1*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

12E. 2009 TYPICAL COMPRESSOR STATION DATA (Continued):

	TRIP DATA												
										Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Well/Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specify method
Sample Truck	*Meeker , CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1													
Truck 2													
Truck 3													
Truck 4													
Truck 5													
Truck 6													

12E. 2009 TYPICAL COMPRESSOR STATION DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

12F. 2009 TYPICAL GAS PROCESSING PLANT DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / well)	No. of Wells/Facilities Visited per Vehicle	No. of Visits per Well/Facility
Sample Truck	*Tank load-out*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*1*	*1*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

12F. 2009 TYPICAL GAS PROCESSING PLANT DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Well/Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

12F. 2009 TYPICAL GAS PROCESSING PLANT DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

13. 2009 PICEANCE BASIN MAINTENANCE EQUIPMENT DATA

Please provide information below for equipment used for maintenance by your company (or its contractors) in the Piceance Basin in 2009 in item 13A, 13B, 13C, 13D, 13E, 13F and 13G. Maintenance activity would include routine maintenance and maintenance due to system upsets and non-relocatable snow removal equipment at wells, compressor station, gas plants, and gas processing plants. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

13A. 2009 TOTAL FUEL CONSUMPTION PER MAINTENANCE OPERATION DATA:

Well Type	Total Diesel Fuel Consumption for All Equipment for a Typical Maintenance Operation (gallons/maintenance operation)	Total Gasoline Fuel Consumption for All Equipment for a Typical Maintenance Operation (gallons/maintenance operation)	Total Natural Gas Fuel Consumption for All Equipment for a Typical Maintenance Operation (cubic feet/maintenance operation)
Road Maintenance			
Conventional Gas			
Conventional Oil			
CBM			
Compressor Stations			
Gas Processing Plants			

13B. 2009 ROAD MAINTENANCE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Motor Grader*	*Diesel*		*200*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13B. 2009 ROAD MAINTENANCE DATA (Continued):

	EQUIPMENT ACTIVITY							
	County/Counties of Operation	No. of Maintenance Operations in 2009	No. of This Equipment Used per Maintenance Operation	Use Duration (days/maintenance operation)	Use Duration (hrs/day)	Fuel Consumption (gallons / equipment / operation)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
Equipment 5								
Equipment 6								

13B. 2009 ROAD MAINTENANCE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13C. 2009 CONVENTIONAL GAS WELL MAINTENANCE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Motor Grader*	*Diesel*		*200*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13C. 2009 CONVENTIONAL GAS WELL MAINTENANCE DATA (Continued):

	EQUIPMENT ACTIVITY							
	County/Counties of Operation	No. of Maintenance Operations in 2009	No. of This Equipment Used per Maintenance Operation	Use Duration (days/maintenance operation)	Use Duration (hrs/day)	Fuel Consumption (gallons / equipment / operation)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
Equipment 5								
Equipment 6								

13C. 2009 CONVENTIONAL GAS WELL MAINTENANCE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13D. 2009 CONVENTIONAL OIL WELL MAINTENANCE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Motor Grader*	*Diesel*		*200*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13D. 2009 CONVENTIONAL OIL WELL MAINTENANCE DATA (Continued):

	EQUIPMENT ACTIVITY							
	County/Counties of Operation	No. of Maintenance Operations in 2009	No. of This Equipment Used per Maintenance Operation	Use Duration (days/maintenance operation)	Use Duration (hrs/day)	Fuel Consumption (gallons / equipment / operation)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
Equipment 5								

13D. 2009 CONVENTIONAL OIL WELL MAINTENANCE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13E. 2009 CBM WELL MAINTENANCE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Motor Grader*	*Diesel*		*200*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13E. 2009 CBM WELL MAINTENANCE DATA (Continued):

	EQUIPMENT ACTIVITY							
	County/Counties of Operation	No. of Maintenance Operations in 2009	No. of This Equipment Used per Maintenance Operation	Use Duration (days/maintenance operation)	Use Duration (hrs/day)	Fuel Consumption (gallons / equipment / operation)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
Equipment 5								
Equipment 6								

13E. 2009 CBM WELL MAINTENANCE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13F. 2009 COMPRESSOR STATION MAINTENANCE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Motor Grader*	*Diesel*		*200*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13F. 2009 COMPRESSOR STATION MAINTENANCE DATA (Continued):

	EQUIPMENT ACTIVITY							
	County/Counties of Operation	No. of Maintenance Operations in 2009	No. of This Equipment Used per Maintenance Operation	Use Duration (days/maintenance operation)	Use Duration (hrs/day)	Fuel Consumption (gallons / equipment / operation)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
Equipment 5								
Equipment 6								

13F. 2009 COMPRESSOR STATION MAINTENANCE DATA (Continued):

	Emission Factors				
	NOx (g/bhp-hr)	CO (g/bhp-hr)	VOC (g/bhp-hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13G. 2009 GAS PROCESSING PLANT MAINTENANCE DATA:

	EQUIPMENT PROPERTIES				
	Equipment Type	Fuel Type (natural gas, gasoline, diesel, electric)	If "other" fuel type selected, please specify	Rated Horsepower	Tier Level or Technology Type
Sample Equipment	*Motor Grader*	*Diesel*		*200*	*Tier 1*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

13G. 2009 GAS PROCESSING PLANT MAINTENANCE DATA (Continued):

	EQUIPMENT ACTIVITY							
	County/Counties of Operation	No. of Maintenance Operations in 2009	No. of This Equipment Used per Maintenance Operation	Use Duration (days/maintenance operation)	Use Duration (hrs/day)	Fuel Consumption (gallons / equipment / operation)	Model Year	Load Factor (%)
Sample Equipment	*Moffatt, Rio Blanco*	*1*	*1*	*3*	*10*	*200*	*1995*	*70*
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
Equipment 5								
Equipment 6								

13G. 2009 GAS PROCESSING PLANT MAINTENANCE DATA (Continued):

	Emission Factors				
	NOx (g/bhp -hr)	CO (g/bhp -hr)	VOC (g/bhp -hr)	PM10 (g/bhp-hr)	Emission Factors Estimation Documentation
Sample Equipment	*5.46*	*1.24*	*0.35*	*0.36*	*emission factor from engine spec/rating plate and load factor documentation provided as attachment*
Equipment 1					
Equipment 2					
Equipment 3					
Equipment 4					
Equipment 5					
Equipment 6					

14. 2009 PICEANCE BASIN MAINTENANCE ROAD TRAFFIC

Please provide information below related to vehicle traffic associated with maintenance activity by your company (or its contractors) in the Piceance Basin in 2009 in item 14A, 14B, 14C, 14D, 14E, and 14F. Maintenance activity would include both routine maintenance; maintenance due to system upsets and maintenance required due to snow. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

14A. 2009 ROAD MAINTENANCE DATA:

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / operation)	No. of Vehicles Used per Maintenance Event
Sample Truck	*Road maintenance*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

14A. 2009 ROAD MAINTENANCE DATA:

	TRIP DATA													
											Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Maintenance Operations in 2009	No. of Round Trips per Vehicle per Maintenance Operation	*Total* Round Trip Distance (miles/trip)	*Total* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Round Trip Distance per Maintenance Operation (miles/trip)	*Within Field* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker, CO*	*Well site*	*400*	*11*	*0.5*	*6*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

14A. 2009 ROAD MAINTENANCE DATA (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

14B. 2009 CONVENTIONAL GAS WELL MAINTENANCE:

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / operation)	No. of Vehicles Used per Maintenance Event
Sample Truck	*Visits for Inspection and Repair*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

14B. 2009 CONVENTIONAL GAS WELL MAINTENANCE (Continued):

	TRIP DATA													
	Trip Origin	Trip Destination	No. of Maintenance Operations in 2009	No. of Round Trips per Vehicle per Maintenance Operation	*Total* Round Trip Distance (miles/trip)	*Total* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Round Trip Distance per Maintenance Operation (miles/trip)	*Within Field* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker , CO*	*Well site*	*5*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

14B. 2009 CONVENTIONAL GAS WELL MAINTENANCE (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

14C. 2009 CONVENTIONAL OIL WELL MAINTENANCE:

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / operation)	No. of Vehicles Used per Maintenance Event
Sample Truck	*Visits for Inspection and Repair*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

14C. 2009 CONVENTIONAL OIL WELL MAINTENANCE (Continued):

	TRIP DATA													
											Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Maintenance Operations in 2009	No. of Round Trips per Vehicle per Maintenance Operation	*Total* Round Trip Distance (miles/trip)	*Total* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Round Trip Distance per Maintenance Operation (miles/trip)	*Within Field* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Un-paved Road	Unpaved Road Within-Field Dust Suppressi on Method	If selected "other" dust suppres sion method, please specifiy method
Sample Truck	*Meeker , CO*	*Well site*	*5*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

14C. 2009 CONVENTIONAL OIL WELL MAINTENANCE (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

14D. 2009 CBM WELL MAINTENANCE:

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / operation)	No. of Vehicles Used per Maintenance Event
Sample Truck	*Visits for Inspection and Repair*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

14D. 2009 CBM WELL MAINTENANCE (Continued):

	TRIP DATA													
	Trip Origin	Trip Destination	No. of Maintenance Operations in 2009	No. of Round Trips per Vehicle per Maintenance Operation	*Total* Round Trip Distance (miles/trip)	*Total* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Round Trip Distance per Maintenance Operation (miles/trip)	*Within Field* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker , CO*	*Well site*	*5*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

14D. 2009 CBM WELL MAINTENANCE (Continued):

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

14E. 2009 COMPRESSOR STATION MAINTENANCE DATA :

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / operation)	No. of Vehicles Used per Maintenance Event
Sample Truck	*Regular Maintenance Visits*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*10*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

14E. 2009 COMPRESSOR STATION MAINTENANCE DATA (Continued) :

	TRIP DATA													
											Within-Field Mean Vehicle Speed (mph)			
	Trip Origin	Trip Destination	No. of Maintenance Operations in 2009	No. of Round Trips per Vehicle per Maintenance Operation	*Total* Round Trip Distance (miles/trip)	*Total* Engine -on Idle Time per Trip (hours /trip)	*Within-Field* Round Trip Distance per Maintenance Operation (miles/trip)	*Within Field* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker , CO*	*Well site*	*10*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

14E. 2009 COMPRESSOR STATION MAINTENANCE DATA (Continued) :

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

14F. 2009 GAS PROCESSING PLANT MAINTENANCE DATA :

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle / operation)	No. of Vehicles Used per Maintenance Event
Sample Truck	*Regular Maintenance Visits*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*10*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

14F. 2009 GAS PROCESSING PLANT MAINTENANCE DATA (Continued) :

	TRIP DATA													
	Trip Origin	Trip Destination	No. of Maintenance Operations in 2009	No. of Round Trips per Vehicle per Maintenance Operation	*Total* Round Trip Distance (miles/trip)	*Total* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Round Trip Distance per Maintenance Operation (miles/trip)	*Within Field* Engine -on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Un-paved Road	Unpaved Road Within-Field Dust Suppression Method	If selected "other" dust suppression method, please specifiy method
Sample Truck	*Meeker , CO*	*Well site*	*10*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*	
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

14F. 2009 GAS PROCESSING PLANT MAINTENANCE DATA (Continued) :

	Tailpipe Exhaust Emission Factors				
	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck	*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1					
Truck 2					
Truck 3					
Truck 4					
Truck 5					
Truck 6					

15. 2009 PICEANCE BASIN EMPLOYEE COMMUTER ROAD TRAFFIC

Please provide information below related to typical employee commute vehicle traffic associated with well pad construction, pipeline construction, drilling, completion, recompletion and production by your company (or its contractors) in the Piceance Basin in 2009 in item 15A, 15B, 15C , 15D, 15E, and 15F. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Note that worker/employee commutes associated with construction of compressor stations or gas plants should not be included, only employee commutes to these central facilities as part of regular maintenance or operations. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

15A. 2009 TOTAL NUMBER OF EMPLOYEE COMMUTER TRIPS DATA:

	Total No. of Employee Commuter Trips in 2009					
Well Type	**Well Pad Construction**	**Pipeline Construction**	**Drilling**	**Completion**	**Recompletion**	**Production**
Conventional Gas						
Conventional Oil						
CBM						
Compressor Stations	NA	NA	NA	NA	NA	
Gas Processing Plants	NA	NA	NA	NA	NA	

15B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip (Bringing workers)	**Activity Type for Employee Traffic (ex. Well Pad Construction, Pipeline Construction, Drilling, Completion, Recompletion, Production)**	**Vehicle Type**	**Model Year**	**Mean Vehicle Weight (lbs)**	**Fuel Type**	**If "other" fuel type selected, please specify**	**Fuel Consumption (gallons / vehicle /trip)**	**No. of Vehicles Used per Trip**
Sample Truck	*Bringing Workers*	*Well Pad Construction*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

15B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (Continued):

	TRIP DATA											
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Trip	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph): Paved Road	*Within-Field* Mean Vehicle Speed (mph): Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

15B. 2009 TYPICAL CONVENTIONAL GAS WELL DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

15C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	VEHICLE PROPERTIES								
	Purpose of The Trip (Bringing workers)	Activity Type for Employee Traffic (ex. Well Pad Construction, Pipeline Construction, Drilling, Completion, Recompletion, Production)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle /trip)	No. of Vehicles Used per Trip
Sample Truck	*Bringing Workers*	*Well Pad Construction*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

15C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Trip	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

15C. 2009 TYPICAL CONVENTIONAL OIL WELL DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

15D. 2009 TYPICAL CBM WELL DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip (Bringing workers)	Activity Type for Employee Traffic (ex. Well Pad Construction, Pipeline Construction, Drilling, Completion, Recompletion, Production)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle /trip)	No. of Vehicles Used per Trip
Sample Truck	*Bringing Workers*	*Well Pad Construction*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*200*	*7*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

15D. 2009 TYPICAL CBM WELL DATA (Continued):

	TRIP DATA											
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Trip	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	*Within-Field* Mean Vehicle Speed (mph) Paved Road	*Within-Field* Mean Vehicle Speed (mph) Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*10*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

15D. 2009 TYPICAL CBM WELL DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

15E. 2009 TYPICAL COMPRESSOR STATION DATA

	VEHICLE PROPERTIES								
	Purpose of The Trip (Bringing workers)	Activity Type for Employee Traffic (ex. Well Pad Construction, Pipeline Construction, Drilling, Completion, Recompletion, Production)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle /trip)	No. of Vehicles Used per Trip
Sample Truck	*Bringing Workers*	*Pickup trucks*	*1977*	*8,000*	*Diesel*	*Diesel*		*1*	*1*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

15E. 2009 TYPICAL COMPRESSOR STATION DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Trip	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

15E. 2009 TYPICAL COMPRESSOR STATION DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

15F. 2009 TYPICAL GAS PROCESSING PLANT DATA:

	VEHICLE PROPERTIES								
	Purpose of The Trip (Bringing workers)	Activity Type for Employee Traffic (ex. Well Pad Construction, Pipeline Construction, Drilling, Completion, Recompletion, Production)	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons / vehicle /trip)	No. of Vehicles Used per Trip
Sample Truck	*Bringing Workers*	*Pickup trucks*	*1977*	*8,000*	*Diesel*	*Diesel*		*1*	*1*
Truck 1									
Truck 2									
Truck 3									
Truck 4									
Truck 5									
Truck 6									

15F. 2009 TYPICAL GAS PROCESSING PLANT DATA (Continued):

	TRIP DATA											
										Within-Field Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Round Trips per Vehicle per Trip	*Total* Round Trip Distance per Trip (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Round Trip Distance per Trip (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Unpaved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*15*	*11*	*0.5*	*6*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1												
Truck 2												
Truck 3												
Truck 4												
Truck 5												
Truck 6												

15F. 2009 TYPICAL GAS PROCESSING PLANT DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

16. 2009 PICEANCE BASIN ANCILLARY TRAFFIC

Please provide information below related to vehicle traffic associated with ancillary activity by your company (or its contractors) in the Piceance Basin in 2009 in item 16A. Ancillary activity would include any activity not included in the previous traffic data collection tabs such as food delivery, telephone installation, etc. The on-road vehicles include but are not limited to heavy duty and medium duty diesel semi-trucks, light duty diesel delivery and service vehicles, as well as light duty gasoline truck and passenger cars. Trip data is requested separately for "within field" and "total trip". "Within field" refers only to travel on roads that are not county-signed, most of which are unpaved roads. "Total trip" refers to activity from the start of a trip to the end of a trip, including both activity on private roads within an oil and gas field and activity on publicly maintained roads. Please provide any notes or comments in the yellow highlighted cells to the right of the requested data and attach documentation for the assumptions where necessary.

16A. 2009 ANCILLARY ACTIVITY DATA:

	VEHICLE PROPERTIES							
	Activity	Vehicle Type	Model Year	Mean Vehicle Weight (lbs)	Fuel Type	If "other" fuel type selected, please specify	Fuel Consumption (gallons/ vehicle / year)	No. of Vehicles Used per Visit per Facility
Sample Truck	*Food Delivery*	*Pickup trucks*	*1977*	*8,000*	*Diesel*		*3300*	*7*
Truck 1								
Truck 2								
Truck 3								
Truck 4								
Truck 5								
Truck 6								

16A. 2009 ANCILLARY ACTIVITY DATA (Continued):

	TRIP DATA											*Within-Field* Mean Vehicle Speed (mph)		
	Trip Origin	Trip Destination	No. of Visits per Well/Facility in 2009	No. of Wells/ Facilities in 2009	No. of Round Trips per Vehicle per Visit per Well/Facility	*Total* Round Trip Distance (miles/trip)	*Total* Engine-on Idle Time per Trip (hours/ trip)	*Within-Field* Round Trip Distance per Visit per Facility (miles/trip)	*Within Field* Engine-on Idle Time per Trip (hours/ trip)	*Within-Field* Percentage of Mileage on Unpaved Roads (%)	*Within-Field* Percentage of Mileage on Paved Roads (%)	Paved Road	Un-paved Road	Unpaved Road Within-Field Dust Suppression Method
Sample Truck	*Meeker, CO*	*Well site*	*400*	*15*	*11*	*6*	*6*	*0.5*	*0.25*	*40*	*60*	*40*	*25*	*water*
Truck 1														
Truck 2														
Truck 3														
Truck 4														
Truck 5														
Truck 6														

16A. 2009 ANCILLARY ACTIVITY DATA (Continued):

	TRIP DATA	Tailpipe Exhaust Emission Factors				
	If selected "other" dust suppression method, please specifiy method	NOx (g/mi)	CO (g/mi)	VOC (g/mi)	PM10 (g/mi)	Emission Factors Estimation Documentation
Sample Truck		*1.638*	*25.14*	*1.773*	*0.0259*	*emission factor from engine spec/rating plate provided as attachment*
Truck 1						
Truck 2						
Truck 3						
Truck 4						
Truck 5						
Truck 6						

Appendix B

Modeled Emission Factors for On-Road Vehicles and Off-Road Equipment

Table B1. Off-road equipment emission rates (g/hp-hr) based on NONROAD2008a model output.

SCC	Equipment Description	HP Range	VOC Exhaust	VOC Evaporative	CO Exhaust	NOx Exhaust	SO2 Exhaust	PM10 Exhaust
2270002036	Diesel Excavators	300 to 600	0.221	0.004	1.721	4.226	0.115	0.242
2270002048	Diesel Graders	100 to 175	0.326	0.006	1.472	4.077	0.115	0.337
		300 to 600	0.239	0.005	1.829	4.456	0.115	0.253
2270002051	Diesel Off-highway Trucks	300 to 600	0.189	0.004	1.480	3.626	0.115	0.225
2270002066	Diesel Tractors/Loaders/ Backhoes	100 to 175	1.099	0.021	4.300	6.711	0.134	0.727
2270002078	Diesel Dumpers/Tenders	100 to 175	1.108	0.021	3.989	7.232	0.134	0.851
2270002081	Diesel Other Construction Equipment	100 to 175	0.388	0.007	1.845	4.815	0.115	0.370
		300 to 600	0.384	0.007	2.725	5.549	0.115	0.378
2270004036	Diesel Snowblowers (Commercial)	100 to 175	0.533	0.010	1.976	5.897	0.114	0.398
		175 to 300	0.497	0.009	1.820	5.681	0.114	0.358
2270006005	Diesel Light Commercial Generator Sets	175 to 300	0.525	0.010	1.936	5.826	0.114	0.378
2270006010	Diesel Light Commercial Pumps	75 to 100	0.751	0.014	3.327	5.976	0.126	0.646
		300 to 600	0.463	0.009	2.072	5.825	0.114	0.342
2270010010	Diesel Other Oil Field Equipment	300 to 600	0.265	0.005	1.354	4.903	0.114	0.215
		750 to 1000	0.432	0.008	1.609	6.506	0.114	0.280
		1200 to 2000	0.432	0.008	1.609	6.506	0.114	0.280
		2000 to 3000	0.432	0.008	1.609	6.506	0.114	0.280

Table B2. On-road vehicle moving vehicle (nonidle) emission rates (g/mi) based on MOVES model output.

Fuel Type	Speed	NOx	CO	VOC		Total PM10			Total PM2.5			SO2
		Exhaust	Exhaust	Exhaust	Evaporative	Exhaust	Brakewear	Tirewear	Exhaust	Brakewear	Tirewear	Exhaust
Heavy Duty Truck (Combination Short-haul Truck)												
Diesel	10	24.709	7.619	1.787	0.093	1.347	0.495	0.031	1.306	0.130	0.007	0.096
	15	21.537	6.012	1.234	0.085	1.282	0.283	0.029	1.243	0.074	0.007	0.087
	20	19.436	4.992	0.945	0.078	1.191	0.174	0.027	1.155	0.045	0.006	0.080
	25	17.841	4.492	0.800	0.072	1.118	0.151	0.025	1.084	0.040	0.006	0.074
Light Duty Truck (Light Commercial Truck)												
Gasoline	10	23.394	159.293	13.840	3.278	0.226	0.278	0.017	0.208	0.073	0.004	0.061
	15	23.188	194.240	12.799	2.607	0.230	0.162	0.016	0.211	0.042	0.004	0.059
	20	19.720	207.256	9.924	2.129	0.179	0.103	0.015	0.165	0.027	0.004	0.051
	25	18.273	208.481	8.797	1.863	0.179	0.091	0.014	0.165	0.024	0.003	0.048
Diesel	10	24.709	7.619	1.787	0.093	1.347	0.495	0.031	1.306	0.130	0.007	0.096
	15	21.537	6.012	1.234	0.085	1.282	0.283	0.029	1.243	0.074	0.007	0.087
	20	19.436	4.992	0.945	0.078	1.191	0.174	0.027	1.155	0.045	0.006	0.080
	25	17.841	4.492	0.800	0.072	1.118	0.151	0.025	1.084	0.040	0.006	0.074

Table B3. On-road vehicle non-moving vehicle (idle) emission rates (g/hr) based on MOVES model output.

Fuel Type	NOx	CO	VOC		PM10	PM2.5	SO2
	Exhaust	Exhaust	Exhaust	Evaporative	Exhaust	Exhaust	Exhaust
Heavy Duty Truck (Combination Short-haul Truck)							
Diesel	200.373	65.938	17.162	0.000	10.490	10.175	0.745
Light Duty Truck (Light Commercial Truck)							
Gasoline	154.182	859.247	96.298	18.728	1.949	1.794	0.426
Diesel	200.373	65.938	17.162	0.000	10.490	10.175	0.745

Appendix C

Field Verification Supporting Data

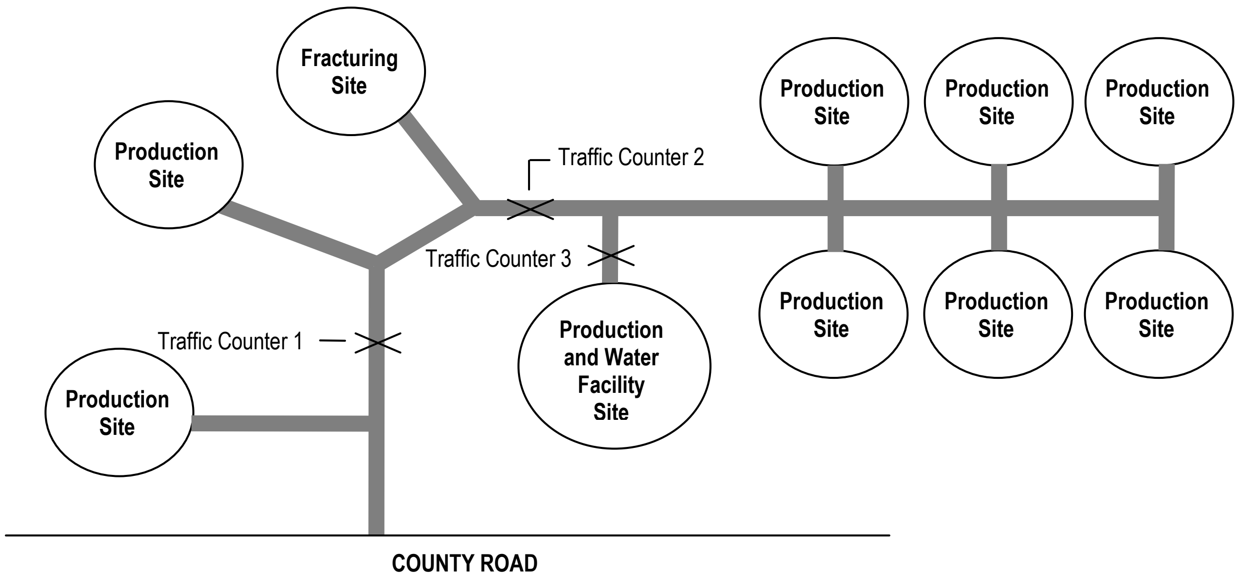

Figure C-1. Schematic of the field verification site for (1) a hydraulic fracturing event, and (2) a multi-well production pad site, including placement of traffic counters.

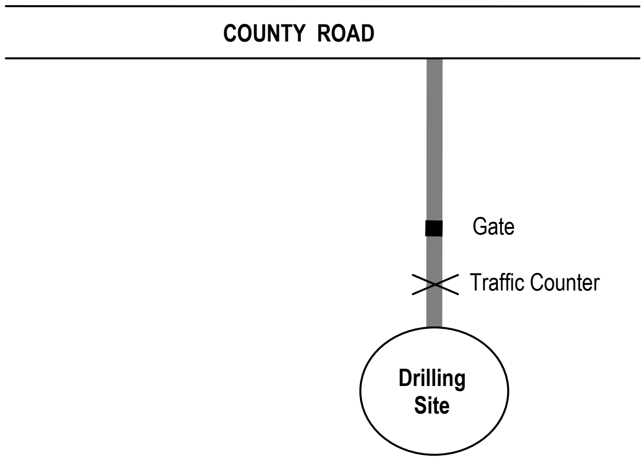

Figure C-2. Schematic of the field verification site for a drilling rig move event including placement of traffic counter.

MetroCount 5600 Series Roadside Unit. Hardware Specifications.

Internal battery	User replaceable battery pack 6V 18Ah, 4 D alkaline cells.
Battery life	290 days at 25°C in continuous Run mode.
Current drain	Run – less than 1.8mA. Stop – less than 100μA. Comms – less than 8mA.
Memory	512kB, 1MB and 2 MB CMOS RAM
RAM backup	3.6V Nickel Cadmium.
Baud rate	9,600 or 38,000bps, using Block method with Acknowledge.
Sensor type	Pneumatic tube.
Time resolution	Better than 1 ms.
Sensor spacing	800mm to 1200mm
Enclosure	Dual system with outer stainless steel road case and internal PVC Main System Unit.
Dimensions	Stainless steel road case – 350mm x 124mm x 95mm. PVC Main System Unit – 243mm x 107mm x 82mm.
Weight	Stainless steel road case – 2.5kg. Main System Unit without battery pack – 1.06kg. Battery pack – 570g.
Storage temp.	-20°C to 70°C.
Operating temp.	-10°C to 60°C with reduced battery life at temperature extremes.
Operating humidity	0 to 95%, non condensing.
Altitude	0 to 3000 metres.
Accessories	Traffic Executive ™ software. Operating and reference manual. Data communications cable.
Optional accessories	Traffic survey field kit. Notebook computer. Printer.

Estimated battery performance.

Based on measurements of 6V/18Ah alkaline battery pack at 25°C.

Duty Cycle	Example of Usage	Battery Life (approx.)
100%	Continuous surveys	290 days / 0.8 yr
50%	1 week survey / 1 week off	540 days/ 1.5 yrs
25%	1 week survey every 4 weeks	1,080 days / 3.0 yrs

Individual vehicle capacity.

Class / speed survey, ALL axles with spacings, 2 MB memory.

Road ADT (4 lanes)	Traffic Volume (PER LANE)	Days (approx.)
64,000 per day	16,000 per day	14
32,000 per day	8,000 per day	28
16,000 per day	4,000 per day	60
8,000 per day	2,000 per day	120

Individual axle capacity.

Count survey, single sensor, ALL axles.

Memory	Total Axle Events Logged (approx.)
512kB	250,000
1MB	500,000
2MB	1,000,000

MANUAL TRAFFIC COUNT FORM

Name ____________________
Company ____________________
City/State ____________________
Phone Number ____________________
Date ____________________
Location ____________________
Activity ____________________

Light Trucks = 2-axel 4-tire trucks ; Mid Duty Trucks = trucks without hinge; Heavy Duty Trucks = trucks with hinge.

Time	Enter			EXIT			TOTAL		
	Light Trucks	Mid Duty Trucks	Heavy Duty Trucks	Light Trucks	Mid Duty Trucks	Heavy Duty Trucks	Light Trucks	Mid Duty Trucks	Heavy Duty Trucks
0600-0615									
0615-0630									
0630-0645									
0645-0700									
0700-0715									
0715-0730									
0730-0745									
0745-0800									
0800-0815									
0815-0830									
0830-0845									
0845-0900									
0900-0915									
0915-0930									
0930-0945									
0945-1000									
1000-1015									
1015-1030									
1030-1045									
1045-1100									
1100-1115									
1115-1130									
1130-1145									
1145-1200									
1200-1215									
1215-1230									
1230-1245									
1245-1300									
1300-1315									
1315-1330									
1330-1345									
1345-1400									
1400-1415									
1415-1430									
1430-1445									
1445-1500									
1500-1515									
1515-1530									
1530-1545									
1545-1600									
1600-1615									
1615-1630									
1630-1645									
1645-1700									
1700-1715									
1715-1730									
1730-1745									
1745-1800									
1800-1815									
1815-1830									
1830-1845									
1845-1900									
1900-1915									
1915-1930									
1930-1945									
1945-2000									

Appendix D

Detailed Emission Inventory Results

Table D1. By source category and process emission estimates (tons/year).

Source Category	NOx (tons/yr)	CO (tons/yr)	VOC - Exhaust (tons/yr)	VOC - Evap (tons/yr)	PM10- Exhaust (tons/yr)	PM10- Tirewear (tons/yr)	PM10- Brakewear (tons/yr)	PM10- Fugitive Dust (tons/yr)	PM2.5- Exhaust (tons/yr)	PM2.5- Tirewear (tons/yr)	PM2.5- Brakewear (tons/yr)	PM2.5- Fugitive Dust (tons/yr)
Construction Dust, Fugitive	-	-	-	-	-	-	-	4.158	-	-	-	2.286
Construction Dust, Wind Erosion	-	-	-	-	-	-	-	11.266	-	-	-	1.690
Construction Traffic, Pipeline - Idling	0.022	0.021	0.003	<0.001	0.001	-	-	-	0.001	-	-	-
Construction Traffic, Drilling - Idling	11.129	5.246	1.152	0.033	0.615	-	-	-	0.597	-	-	-
Completion Traffic - Idling	26.340	9.610	2.388	0.016	1.403	-	-	-	1.361	-	-	-
Recompletion Traffic - Idling	-	-	-	-	-	-	-	-	-	-	-	-
Production Traffic - Idling	3.647	2.805	0.497	0.038	0.217	-	-	-	0.211	-	-	-
Maintenance Operation Traffic - Idling	1.097	0.479	0.107	0.003	0.059	-	-	-	0.058	-	-	-
Employee Commuter Traffic - Idling	8.369	8.819	1.562	0.106	0.580	-	-	-	0.562	-	-	-
Ancillary Traffic - Idling	0.222	1.297	0.058	0.058	0.005	-	-	-	0.005	-	-	-
Construction Traffic, Well Pad - Idling	0.157	0.093	0.018	0.001	0.009	-	-	-	0.009	-	-	-
Well Pad Construction Equipment	5.577	2.207	0.371	-	0.352	-	-	-	0.342	-	-	-
Pipeline Construction Equipment	6.380	2.509	0.568	-	0.484	-	-	-	0.470	-	-	-
Fracing Equipment	107.908	21.941	5.293	-	4.067	-	-	-	3.945	-	-	-
Refracing Equipment	67.210	17.134	4.264	-	2.917	-	-	-	2.830	-	-	-
Other Relocatable Equipment	571.656	193.667	44.048	-	31.911	-	-	-	30.954	-	-	-
Maintenance Operation Equipment	159.416	52.355	11.753	-	16.861	-	-	22.474	16.355	-	-	12.353
Construction Traffic, Well Pad - Running	0.481	0.456	0.053	0.008	0.028	0.001	0.005	1.693	0.027	<0.001	0.001	0.186
Construction Traffic, Pipeline - Running	0.065	0.124	0.013	0.002	0.003	<0.001	0.001	0.286	0.003	<0.001	<0.001	0.030
Construction Traffic, Drilling - Running	17.264	13.887	1.723	0.223	1.006	0.024	0.183	59.041	0.975	0.006	0.048	6.689
Completion Traffic - Running	23.071	12.374	1.790	0.185	1.376	0.032	0.220	87.495	1.335	0.008	0.058	9.258
Recompletion Traffic - Running	0.482	0.259	0.027	0.003	0.029	0.001	0.005	1.810	0.028	<0.001	0.001	0.216
Production Traffic - Running	8.330	14.672	1.494	0.253	0.454	0.012	0.077	42.214	0.440	0.003	0.020	4.312
Maintenance Operation Traffic - Running	2.528	2.549	0.293	0.042	0.145	0.004	0.027	8.381	0.141	0.001	0.007	0.962
Employee Commuter Traffic - Running	33.862	88.968	6.216	0.923	1.289	0.102	0.557	8,717.706	1.244	0.024	0.146	2,068.891
Ancillary Traffic - Running	0.201	3.917	0.091	0.046	0.006	0.004	0.022	17.039	0.006	0.001	0.006	1.699
Totals	**1,055.413**	**455.391**	**83.782**	**1.942**	**63.820**	**0.178**	**1.097**	**8,973.564**	**61.897**	**0.043**	**0.286**	**2,108.573**