ENVIRON

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FINAL EMISSIONS TECHNICAL MEMORANDUM No. 4c

To: Tom Moore, Western Governors' Association (WGA) (WRAP)

From: Amnon Bar-Ilan and Ralph Morris, ENVIRON International Corporation

Subject: Source of Oil and Gas Emissions for the WestJumpAQMS 2008 Photochemical Modeling

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INTRODUCTION

ENVIRON International Corporation (ENVIRON), Alpine Geophysics, LLC (Alpine) and the University of North Carolina (UNC) at Chapel Hill Institute for Environment are performing the West-wide Jump Start Air Quality Modeling Study (WestJumpAQMS) managed by the Western Governors' Association (WGA). WestJumpAQMS is setting up the CAMx and CMAQ photochemical grid models for the 2008 calendar year (plus spin up days for the end of December 2007) on a 36 km CONUS, 12 km WESTUS and several 4 km Inter-Mountain West domains. The WestJumpAQMS Team are currently compiling emissions to be used for the 2008 base case modeling, with the 2008 National Emissions Inventory (NEI) being a major data source. Thirteen Technical Memorandums discussing the sources of the 2008 emissions by major source sector are being prepared as part of the WestJumpAQMS:

1. Point Sources including Electrical Generating Units (EGUs) and Non-EGUs;
2. Area plus Non-Road Mobile Sources;
3. On-Road Mobile Sources that will be based on MOVES;
4. Oil and Gas Sources;
5. Fires Emissions including wildfire, prescribed burns and agricultural burning;
6. Fugitive Dust Sources;
7. Off-Shore Shipping Sources;
8. Ammonia Emissions;
9. Biogenic Emissions;
10. Eastern USA Emissions;
11. Mexico/Canada;
12. Sea Salt and Lightening Emissions; and
13. Emissions Modeling Parameters including spatial surrogates, temporal adjustment parameters and chemical (VOC and PM) speciation profiles.

This document forms part of WestJumpAQMS Emissions Technical Memorandum Number 4 series that discusses the methodology and results for the 2008 emissions for the oil and gas

(O&G) exploration and production source sector. Note that downstream oil and gas emissions (e.g., refining) will be addressed under the point and area source categories. The update of the 2008 O&G emissions will be performed under Task 1C of Phase I of the WestJumpAQMS. Details on the entire WestJumpAQMS are provided in the WestJumpAQMS Scope of Work[1] and Modeling Plan[2].

The O&G Emissions Technical Memoranda series are sub-divided into 5 separate documents of which this is the third. The 5 documents are shown below in Table 1. Because of the variation in activities and key data sources among the various states and regions in the WRAP Phase III analysis, it was determined that 5 separate memoranda would be generated to describe the development of the oil and gas projected 2008 emissions. This is discussed in more detail below.

Table 1. WestJumpAQMS O&G emissions technical memoranda.

Technical Memorandum	
4a: 2008 O&G Emissions for Colorado Basins (Denver-Julesburg, Piceance, and North San Juan)	
4b: 2008 O&G Emissions for the South San Juan (NM) and Uinta (UT) Basins	
4c: 2008 O&G Emissions for Wyoming Basins (Greater Green River, Powder River and Wind River)	✓
4d: 2008 O&G Emissions for the Permian Basin (NM and TX)	
4e: 2008 O&G Emissions for Other Areas	

BACKGROUND

The WestJumpAQMS study will develop oil and gas emissions for 2008 for use in the regional photochemical ozone modeling. The O&G emissions will be developed in stages based on the geographic region and the type of information available to develop the inventories:

1. Projections to 2008 using the WRAP Phase III project inventories for the Rocky Mountain region including the Denver-Julesburg (D-J) Basin (CO), Piceance Basin (CO), Uinta Basin (UT), North San Juan Basin (CO), South San Juan Basin (NM), Wind River Basin (WY), Powder River Basin (WY), Greater Green River Basin (WY), and the Williston Basin (MT and ND, pending);
2. Development of an independent 2008 Permian Basin (NM and TX) O&G emission inventory; and
3. For remaining Basins, use states' 2008 NEI-reported O&G emission inventories.

WRAP Phase III Inventory Projections

The WRAP Phase III 2006 baseline O&G inventories represent the results of a multiyear effort and represent the most comprehensive and complete O&G inventory ever developed for the Rocky Mountain States[3]. Alternatives include the NEI inventory[4] that is incomplete and the WRAP Phase II O&G inventory[5] that is deficient in VOC emissions since it was designed to

[1] http://www.wrapair2.org/pdf/WestJumpAQMS_SoW_July20_2011revision.pdf
[2] http://www.wrapair2.org/pdf/WestJumpAQMS_Modeling_Plan_Sep30_2011v2.pdf
[3] http://www.wrapair2.org/PhaseIII.aspx
[4] http://www.epa.gov/ttnchie1/net/2005inventory.html
[5] http://wrapair.org/forums/ogwg/documents/2007-10_Phase_II_O&G_Final%29Report%28v10-07%20rev.s%29.pdf

support baseline regional haze planning. Thus, the WRAP Phase III O&G inventory represents the best data available for the Rocky Mountain States. These projections use 2008 production statistics as surrogates to scale emissions from the various source categories considered in Phase III. Reductions in the scaled emissions resulting from controls required by on-the-books federal and state regulations are also considered.

The 2008 updated inventories for the Phase III basins will be formatted identically to the baseline 2006 inventories generated for the Phase III study. The 2008 O&G emissions for the Phase III Basins will also be processed into the IDA format used by the SMOKE emissions modeling system. The O&G emissions will include information for both area and point sources. New 2008 spatial surrogate data will also be developed that will be used to spatially allocate the O&G area source emissions to the air quality model grid cells in the SMOKE emissions modeling.

2008 emissions inventory projections for the Phase III basins will be presented in Emissions Technical Memoranda 4a, 4b, and 4c, of which this is the third memorandum (4c). The WRAP Phase III inventory projections are split into separate memos to reflect where similar methodologies were used for groups of basins. The Colorado basins are grouped into a single memo since the methodology for these basins uses a comprehensive permitted sources data set developed by the CDPHE which reflects the low threshold for permitting emission sources (2 tpy of any criteria pollutant) throughout Colorado. In addition, Regulation 7 in Colorado requires regionally-specific analysis of the impacts of the elements of Regulation 7 on specific O&G sources. The Uinta Basin in Utah and South San Juan Basin in New Mexico are grouped because both states have similar emissions permitting thresholds and therefore both of these Phase III inventories were developed primarily using survey data for unpermitted point and area sources. No specific state regulations were identified for O&G sources in Utah and New Mexico that would impact the 2008 projections. The Wyoming Basins, including the Wind River, Powder River and Greater Green River (Southwest Wyoming) Basins, were similarly grouped because the methodology for developing these inventories relied on unique data sets available in Wyoming through the work of the Wyoming DEQ. These include a highly detailed permitted emissions database, a specialized inventory developed for the Jonah-Pinedale Anticline Development (JPAD) area, and detailed engine emissions from the WYDEQ inventory database. In addition the projections for Wyoming account for a variety of state regulations impacting emissions from specific sources. These variations in the basins led to the grouping of the 2008 WestJump projections into memos 4a, 4b, and 4c in this series.

2008 Emission Inventory for the Permian Basin

O&G emissions for the Permian Basin are available from the NEI, but these data are much lower quality than the WRAP Phase III database. A study prepared by Applied EnviroSolutions, Inc. (AES) on 2007 O&G emissions in the New Mexico portion of the Permian Basin is also available that is of higher quality data. The AES data will be used to develop a comprehensive inventory of the Permian Basin including activities in Texas. The AES study was commissioned for the Bureau of Land Management (BLM) Carlsbad Field Office (CFO), and used a methodology developed by ENVIRON for the Central Regional Air Planning Association (CENRAP)[6]. The preparation of the 2008 inventory for the Permian Basin will expand on the AES study, including

[6] http://www.cenrap.org/html/presentations.php

both additional emissions estimates in the New Mexico portion of the basin and new emissions estimates for the Texas portion of the basin. The steps in developing the Permian Basin inventory will be described in Emissions Technical Memorandum 4d.

Remainder Basins – use States' 2008 NEI-reported O&G Emissions

Oil and gas emissions for states not covered by the WRAP Phase III and Permian Basin updates (i.e., states than New Mexico, Colorado, Utah, Wyoming, North Dakota and Montana and Basins not covered by Phase III in these 6 states) will be based on the 2008 NEI emissions inventory. The 2008 NEI represents O&G area source emissions reported to the EPA for counties/states that are not part of the Phase III study or the Permian Basin inventory developed as part of the WestJump analysis. These represent the best O&G emissions data available for these states. Emissions inventories for the remaining states in the WestJump domain will be presented in Emissions Technical Memoranda 4e.

Off-Shore Oil and Gas Production Emissions

Within the WestJump modeling domains there are two main areas of off-shore oil and gas production where emissions are needed: (1) off the coast of California; and (2) within the Gulf of Mexico. Of these two, the Gulf of Mexico has by far much greater emissions. Off-shore oil and gas emissions off the coast of California are relatively close to shore and are included in the California inventories, like in the 2008 NEI. The Bureau of Ocean Energy Management (BOEM; formerly MMS) has released a draft version of 2008 oil and gas emissions in the Gulf Coast region. This inventory is superior and will replace the 2005 MMS inventory currently being used for PGM modeling. This inventory contain 2008 emissions estimate for both platform and non-platform oil and gas production emissions in the Gulf. The SMOKE modeling input files are currently under development, and will be available for use in the WestJump emissions modeling task. Emissions inventories for offshore O&G activities in the WestJump domain will also be presented in Emissions Technical Memoranda 4e.

Canada and Mexico

Canada's O&G emissions will be based on the 2006 emissions inventory developed by Environment Canada (EC) from the 2006 National Emissions Release Inventory (NPRI). The 2006 EC inventory is utilized rather than newer NPRI data (e.g., 2008) because it has been used in SMOKE emissions modeling and has added the numerous cross-reference fields to the emissions needed to support SMOKE emissions modeling. Note that higher quality O&G emissions are available for the Alberta oil sands region from Alberta Environment. However, these data are not publicly available and are far away from the western states in the most northern section of the WestJump 36 km modeling domain. For Mexico, a comprehensive emissions inventory was originally developed for the 1999 year. More recently this inventory has been projected to several future years (2008, 2012 and 2030). The O&G emissions in the 2008 Mexico emissions will be used for this study. Emissions inventories for O&G activities in Canada and Mexico in the WestJump domain will be presented in a technical memorandum for Canada/Mexico (item 11 in the WestJump emission sector list).

METHODOLOGY AND RESULTS FOR WYOMING BASINS

Below we describe the results of the emissions inventory analysis for the third group of WRAP Phase III Basins to be projected to 2008. These include the Wind River Basin, the Powder River Basin, and the Southwest Wyoming Basin (also referred to as the Greater Green River Basin), all in Wyoming. The general methodology for all Wyoming Basins is presented first, followed by discussion and results for each basin separately. Where variations in the O&G operations and the type of data used in the projections were observed among these 3 Wyoming basins, those variations are discussed for each basin.

In the Wyoming basins the inventories were developed using a combination of bottom-up inventory estimates for "surveyed" sources, and data obtained from several detailed permit databases maintained by the Wyoming Department of Environmental Quality (WYDEQ). The databases used in this analysis included the permitted sources data, and an inventory database for emissions from engines. Because of the level of detail and quality of the database, all compressor and other engine emissions were obtained directly from this database. In addition, facility emissions of other criteria pollutants were also obtained from the WYDEQ permitted sources databases. One further source of data unique to the Wyoming Basins is the inventory for the Upper Green River Basin (UGRB) developed by the WYDEQ to assess wintertime ozone occurrences in the Southwest Wyoming Basin. This inventory was based on a comprehensive survey process conducted by WYDEQ primarily in Sublette County and the inventory and its utilization are described below in more detail.

METHODOLOGY

The 2008 projected oil and gas inventories for the Wyoming Basins were developed following 2 primary steps:

1. 2008 production statistics data were derived using the IHS Global Insight database and ratios of the 2008 and 2006 production statistics were used to develop scaling factors and these were applied to the 2006 surveyed area source and permitted point source inventories creating the "uncontrolled" 2008 projections for all sources;
2. Controls originating from state and federal regulations or natural turnover of equipment were modeled and applied to the uncontrolled 2008 emissions projections to develop the final 2008 source emissions projections;

These steps are described in more detail below. It should be noted that the exact process of implementing these steps differs for each of the Wyoming Basins. The overall methodology for generating these projections closely follows that used in the WRAP Phase III projects for the midterm projections[7,8,9].

[7] http://www.wrapair.org/forums/ogwg/documents/2010-07_%2712%20Projections;%20WindRiver%20Basin%20Technical%20Memo%20%2807-14%29.pdf
[8] http://www.wrapair2.org/pdf/2015_Proj_Emiss_Powder_River_Basin_112712.pdf
[9] http://www.wrapair2.org/pdf/2015_Proj_Emiss_SWWY_Basin_112712.pdf

Permitted Point Sources

In the 2006 baseline WRAP Phase III emission inventories for Wyoming, data on permitted point sources was obtained directly from the WYDEQ. The reporting thresholds in Wyoming for a point source vary by region and by source but for some categories were considered extremely detailed. As noted above, WYDEQ gathered extensive data on actual engine emissions down to a very low threshold. This inventory database was considered the most reliable source of engine emissions in the state and was used to represent all engine emissions in all Wyoming Basins. In addition the WYDEQ permitted sources database captured emissions from most large facilities (Title V) and midstream facilities including compressor stations and associated sources. Sources not covered by the permitted sources database or inventory database were considered "surveyed sources" and are described separately below.

Permitted point source emissions, with the exception of emissions in Sublette County (described in more detail below), were projected from 2006 to 2008 using the production statistics and scaling factors for each basin. A controls analysis was conducted to adjust the projected 2008 permitted sources emissions to account for any reasonably expected implementation of federal/state controls requirements in the period 2006-2008.

In the WRAP Phase III 2006 emission inventory, oil and gas permitted sources were identified through a combination of a list of midstream companies identified through engine ownership, and a search on the SCC/SIC codes associated with the upstream oil and gas sector. The SCCs and SICs for oil and gas sources are:

- all of the SCCs 202002*, 310*, 404003* (where * indicates all sub-SCCs for the SCC)
- and only those with the following SICs: 13*, 492*, 4612

This filtering of the WYDEQ permitted sources databases identifies the upstream oil and gas exploration and production sector separately from the downstream sector which may include gas transmission, storage and distribution and/or oil refining and transmission and distribution. These downstream sectors are not part of this inventory.

Production Statistics and Scaling Factors for Surveyed Sources

The 2008 production statistics for the Wyoming Basins were derived from the IHS database, a commercial database that was used extensively in the WRAP Phase III work. The IHS database obtains well location, activity, status, production, and drilling data from state oil and gas conservation commissions (or their equivalent) in each state in the Intermountain West. The advantage of using the IHS database is that the data in the IHS database is of significantly higher quality than the raw wells and production data from the state agencies. Significant effort is placed on obtaining accurate well locations, gap-filling missing data fields, and updating data as it is reported. For these reasons the Phase III study chose to use the IHS database, and this was extended to the WestJump study.

Oil and gas related activity data for each basin were obtained from the IHS Enerdeq database queried via online interface. The IHS database uses data from the Wyoming Oil and Gas Conservation Commission (WOGCC). Two types of data were queried from the Enerdeq database: production data and well data. Production data includes information relevant to

producing wells while well data includes information relevant to drilling activity ("spuds") and completions.

Production data were obtained by county for each 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 input files for each basin were loaded into the PowerTools application. From the ACCESS database created by PowerTools for each basin, extractions of the following data relevant to the emissions inventory development were made:

1. 2008 active wells, i.e. wells that reported any oil or gas production in 2008.
2. 2008 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 all counties in each 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 2008 were identified by indication that the spud occurred within 2008. 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.

A summary of the production statistics in 2006 and 2008 for the Wind River, Powder River and Southwest Wyoming Basins in Wyoming are presented in Table 2. It should be noted that these are overall summary statistics, more detailed breakdown on the type of gas well (CBM vs. conventional) or type of gas and oil production are used in the scaling factors. The detailed oil and gas production statistics are available as part of the summary emissions spreadsheets that accompany each basin inventory.

Table 2. Comparison of 2006 and 2008 O&G production statistics for Wyoming Basins.

	Wind River Basin		Powder River Basin		Southwest Wyoming Basin	
	2006	2008	2006	2008	2006	2008
Gas Production (mcf)	198,190,024	141,577,755	452,813,743	607,467,975	1,468,167,385	1,735,260,915
Condensate Production (bbl)	479,547	444,469	517,225	479,145	9,785,073	11,785,880
Oil Production (bbl)	2,563,912	2,565,847	19,145,671	18,378,654	6,324,849	5,548,836
Well Count	1,350	1,389	25,652	27,256	9,173	11,072
Spud Count	98	53	3,275	2,086	1,146	1,418

Ratios of the production statistics in 2008 to those in 2006 were generated to create activity scaling factors that were applied to all source categories in the 2006 baseline emissions. The mapping of the source category to the production statistic surrogate was described in detail in the WRAP Phase III project.

Scaling factors for the various production statistics in the Wind River, Powder River and Southwest Wyoming Basins in Wyoming are presented below in Tables 3-6. It should be noted that in the Wind River Basin, some production occurs on Indian Tribal land in Fremont County and in the Powder River Basin some minor production occurs on Indian Tribal land in the Montana portion of the Basin. Sources on Indian Tribal land are assumed to be subject to federal regulations but not state regulations, and therefore are projected separately to account for this difference. Tables 3, 4 and 5 show the scaling factors for tribal and nontribal land separately. For the Wind River Basin, the tribal and non-tribal scaling factors were applied separately. For the Powder River Basin the methodology used was to scale the 2006 baseline Phase III inventories by the basin-wide scaling factors, and then develop county-level emissions by using the 2008 county production, well count and spud count fractions including tribal and non-tribal splits. For the Southwest Wyoming Basin, scaling factors were developed for each county in the basin, although it is noted that no scaling was conducted for Sublette County as 2008 emissions for Sublette County were obtained directly from the UGRB inventory (described further below).

Table 3. 2006 to 2008 activity scaling factors for the Wind River Basin in Wyoming.

County	Gas Production	Oil Production	Condensate Production	Well Count	Spud Count
Fremont (Non-Tribal)	0.69	0.98	0.94	1.03	0.48
Fremont (Tribal)	1.54	1.01	0.64	1.03	1.29
Basin-wide	**0.71**	**1.00**	**0.93**	**1.03**	**0.54**

Table 4. 2006 to 2008 activity scaling factors for the Powder River Basin in Wyoming.

County	Conv. Gas Production	CBM Gas Production	Conv. Well Count	CBM Well Count	Spuds	Gas Well Condensate Production	Oil Well Oil Production	Total Gas Production	Total Well Count
Basin-Wide	**0.84**	**1.42**	**0.99**	**1.09**	**0.64**	**0.93**	**0.96**	**1.34**	**1.06**

Table 5. 2008 county-level allocation factors for the Powder River Basin in Wyoming.

County	Conv. Gas Production	CBM Gas Production	Conv. Well Count	CBM Well Count	Spuds	Gas Well Condensate Production	Oil Well Oil Production	Total Gas Production	Total Well Count
Campbell (WY)	22.07%	27.81%	26.36%	64.94%	47.03%	28.30%	43.82%	27.30%	54.01%
Converse (WY)	16.20%	0.03%	13.47%	0.09%	1.39%	23.41%	9.22%	1.46%	3.88%
Crook (WY)	0.08%	0.00%	6.01%	0.00%	0.96%	5.76%	8.03%	0.01%	1.70%
Johnson (WY)	0.79%	57.30%	3.85%	14.73%	28.19%	1.95%	5.78%	52.29%	11.65%
Natrona (WY)	53.17%	0.00%	27.98%	0.01%	2.73%	39.37%	22.38%	4.72%	7.93%
Niobrara (WY)	3.55%	0.00%	3.50%	0.00%	0.96%	0.00%	2.68%	0.31%	0.99%
Sheridan (WY)	0.09%	12.33%	0.19%	15.76%	13.85%	0.01%	0.15%	11.24%	11.35%
Weston (WY)	3.13%	0.00%	16.59%	0.00%	2.54%	1.20%	5.38%	0.28%	4.70%
Big Horn (MT) (Tribal)	0.00%	0.00%	0.49%	0.00%	0.58%	0.00%	0.32%	0.00%	0.14%
Big Horn (MT) (Non-Tribal)	0.77%	2.53%	0.57%	4.47%	1.77%	0.00%	0.00%	2.37%	3.37%
Powder River (MT) (Tribal)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Powder River (MT) (Non-Tribal)	0.14%	0.00%	1.00%	0.00%	0.00%	0.00%	2.23%	0.01%	0.28%
Basin-Wide									

Table 6. 2006 to 2008 activity scaling factors for the Southwest Wyoming Basin in Wyoming.

County	Gas Well Count	Oil Well Count	Gas Well Condensate Production	Oil Well Oil Production	Conv. Gas Production	Spuds	Total Gas Production	Total Oil Production	Total Well Count	Conv. Well Count
Albany (WY)	1.00	1.19	0.00	0.74	0.97	0.00	0.97	0.74	1.18	1.18
Carbon (WY)	1.21	1.01	1.00	0.73	1.01	1.33	1.09	0.89	1.30	1.18
Lincoln (WY)	1.12	1.03	1.09	0.92	1.05	1.00	1.05	1.06	1.12	1.12
Sublette (WY)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sweetwater (WY)	1.15	1.11	1.08	1.00	1.01	1.07	1.01	1.03	1.13	1.15
Uinta (WY)	1.06	1.00	0.74	0.66	0.91	1.10	0.91	0.69	1.05	1.04
Daggett (UT)	1.00	0.00	1.02	0.00	0.93	0.00	0.93	1.02	1.00	1.00
Summit (UT)	0.93	1.08	0.61	0.97	0.92	0.00	0.92	0.80	0.96	0.96
Basin-Wide	**1.22**	**1.02**	**1.20**	**0.88**	**1.18**	**1.24**	**1.18**	**1.08**	**1.21**	**1.19**

* Emissions in Sublette County were not projected from 2006 to 2008; the 2008 Sublette County UGRB inventory was used directly.

Controls Analysis

Following the development of the 2008 production statistics and scaling factors from 2006 to 2008, the scaling factors were applied to the 2006 baseline inventories to generate 2008 "uncontrolled" emission inventories. The uncontrolled inventories were then modified to include any controls on emissions resulting from on-the-books federal or state regulations. Given the short period between 2006 and 2008, natural turnover of equipment (such as for the drilling rig fleet or compressor engine inventory) was not considered. A summary of the controls due to federal/state regulations and their application to the Wyoming basins is shown below in Table 7:

Table 7. Summary of regulatory controls and their implementation for the 2008 projections of Wyoming Basins.

Source Category	Regulation	Enforcing Agency	Effective Date	Proposed Implementation in the 2008 Wyoming Basin Emissions Projections[a]
Drill Rigs	Nonroad engine Tier standards (1-4)	US EPA	Phase in from 1996 - 2014	None – turnover of drill rig engines is considered too slow to be affected by Tier standards.
Workover Rigs	Nonroad engine Tier standards (1-4)	US EPA	Phase in from 1996 - 2014	None – turnover of drill rig engines is considered too slow to be affected by Tier standards.
All New Nonroad Engines	New Source Performance Stds. (NSPS)	US EPA	Phase in beginning 2006	Permitted Emissions from WYDEQ databases
New or Relocated Stationary Engines	Wyoming BACT Requirement	WYDEQ	Phase in from 2007 - 2008	2 g/bhp-hr (2007) or 1 g/bhp-hr (2008) requirement for new or relocated engines; BACT requirements applied to grown emissions if growth in gas production is projected
Glycol Dehydrators	Wyoming BACT Requirement	WYDEQ	2007	98% control required for new/modified tanks meeting BACT criteria; 98% control applied to grown emissions if growth in gas production is projected
Condensate Tanks	Wyoming BACT Requirement	WYDEQ	2007	98% control required for new/modified tanks meeting BACT criteria; 98% control applied to grown emissions if growth in condensate/oil production is projected
Pneumatic Devices	Wyoming BACT Requirement	WYDEQ	2010	None – effective date of the regulation is after 2008
Pneumatic Pumps	Wyoming BACT Requirement	WYDEQ	2010	None – effective date of the regulation is after 2008

a – Implementation of the regulatory controls differs in the Indian tribal land portions of the Wind River and Powder River Basins as described in further detail below;

b – Information about the State of Wyoming's BACT requirements for oil and gas emissions sources can be found at (*http://deq.state.wy.us/aqd/Oil%20and%20Gas/March%202010%20FINAL%20O&G%20GUIDANCE.pdf*).

As noted in Table 6, natural turnover of equipment in the drilling rig and workover rig fleets was considered too slow to have a measurable impact on emissions from these sources categories in the two-year time frame between 2006 and 2008. Thus no controls assumptions were implemented for these two source categories. With respect to controls requirements on engines arising from the federal NSPS and Wyoming BACT requirements, it was assumed that all

engines currently in use in 2006 would remain in use in 2008 (no turnover). Thus the engine emissions requirements were applied only if growth in gas production occurred, which was considered a trigger for growth in the horsepower of compression required in the Wyoming basins.

Wyoming BACT requirements for VOC emissions sources including dehydrators and tanks were similarly assumed to apply only if growth was projected in the appropriate surrogate. For dehydrators the surrogate was gas production and for tanks the surrogates were either condensate production or oil production as appropriate. No controls requirements were applied to the existing dehydrator and tank emissions sources. As noted in Table 7, only the recent 2010 revisions of the Wyoming BACT requirements contained specific controls requirements for pneumatic devices and pneumatic pumps. Because these revisions were implemented after 2008, no controls requirements were applied to these two source categories.

No state-level controls requirements were applied to emissions sources on Indian tribal land in the Wind River and Powder River Basins. Only federal controls requirements were assumed to apply on tribal land.

Gas Composition Analysis

The analysis of vented, fugitive, and tank emissions sources uses gas composition data collected as part of the 2006 survey and data gathering process for the Phase III inventories for the Wyoming basins. No updates were made to the speciation profiles assigned to the oil and gas source categories for the 2008 WestJump inventory. These speciation profiles, including standard speciation profiles applied to combustion sources, are summarized in Memo 13 of the WestJump AQMS.

WIND RIVER BASIN – OBSERVATIONS AND RESULTS

As noted above, both surveyed sources and permitted sources were projected and subsequently controlled using the methodology described above. A new analysis and compilation of 2008 permitted point source data was not conducted.

The Wind River Basin as defined in the Phase III project consists only of Fremont County in Wyoming. Therefore it was reasonable to assess the projected growth of oil and gas production statistics from 2006 to 2008 for the tribal and non-tribal portions of the county separately. Scaling factors (growth or decline) were developed for tribal and non-tribal land and the source categories in the county were projected separately using these two sets of scaling factors.

For the Wind River Basin, the full federal and state controls analysis was applied only to the sources on non-tribal land. For sources on tribal land only federal controls requirements were applied. It should be noted that gas production is observed to decline in the Wind River Basin between 2006 and 2008, and therefore no additional controls associated with gas dehydrators and compressor engines were assumed. Existing dehydrators and compressor engines were assumed to be capable of handling the gas production in 2008 and no turnover in existing equipment was assumed. Condensate production is also observed to decline between 2006

and 2008, and oil production growth is negligible at 0.1%, therefore no controls were applied to the projected condensate/oil tank emissions in 2008.

Results

The 2008 projected O&G emissions for the Wind River Basin are shown below in a series of tables and graphs summarizing the quantitative results by source category, by county and by pollutant. Table 8 below provides an overall summary of the Wind River Basin emissions on a basin-wide level with comparison to the 2006 inventory. Table 8 shows that all pollutant emissions in the Wind River Basin are declining between 2006 and 2008. This reflects the fact that basin-wide gas production, condensate production and drilling have declined between 2006 and 2008. Oil production is essentially unchanged between 2006 and 2008, and well counts have increased slightly in this period. Despite the small well count increases which lead to increases in certain source categories (i.e. pneumatic devices and fugitive emissions), the larger reduction in gas and condensate production and drilling activity lead to overall decline in emissions during this period.

Table 8. Comparison of overall 2008 WestJump Inventory for the Wind River Basin with 2006 WRAP Phase III Inventory[10].

	NOx [tpy]	VOC [tpy]	CO [tpy]	PM [tpy]	SOx [tpy]
2008 WestJump	1,335	10,993	2,062	31	1,276
2006 Phase III	1,814	11,981	2,840	37	1,792
% Change	-26.4%	-8.3%	-27.4%	-18.0%	-28.8%

Tables 9, 10 and 11 below show the 2008 O&G emissions in the Wind River Basin by-county and by-source-category respectively (for NOx and VOC emissions only). Figures 1 and 2 show the breakdown of the 2008 NOx and VOC emissions for the Wind River Basin by source category. Figures 3 and 4 show the breakdown of the 2008 NOx and VOC emissions by tribal and non-tribal emission sources.

NOx emissions in the Wind River Basin are dominated by compressor engines, with heaters and drilling rigs being the only other significant NOx sources. Collectively these sources account for approximately 90% of NOx emissions in 2008. Relative to the Phase III 2006 baseline inventory, drilling rigs represent a smaller fraction of the total 2008 NOx emissions inventory, which is consistent with the finding that spud counts have decreased in 2008 relative to 2006. In addition compressor engine NOx, representing the largest NOx category in both 2006 and 2008, has decreased in 2008 in proportion to the total NOx inventory. This reflects the decline in gas production between 2006 and 2008.

VOC emissions are dominated by pneumatic devices accounting for approximately 60% of VOC emissions in 2008, with well venting from blowdowns, gas dehydration and condensate tanks representing another 29% of VOC emissions in 2008. Gas dehydration emissions have

[10] WRAP Phase III technical memorandum for the 2006 baseline emissions for the Wind River Basin: http://www.wrapair.org/forums/ogwg/documents/2010-07_%2706%20Baseline;%20Wind%20RiverBasin%20Technical%20Memo%20%2807-14%29.pdf

decreased as a proportion of the total basin-wide VOC emissions as a result of the decrease in gas production between 2006 and 2008. Pneumatic device emissions have increased proportionally as a result of the slight increase in the number of active wells, as pneumatic device emissions are estimated on a count basis that scales with the number of active wells.

Table 9. Summary of the projected 2008 O&G emissions by county in the Wind River Basin.

County	NOx [tons/yr]	VOC [tons/yr]	CO [tons/yr]	SOx [tons/yr]	PM [tons/yr]
Fremont (Non-Tribal)	1,047	8,269	1,711	1,209	23
Fremont (Tribal)	289	2,723	351	67	8
Totals	**1,335**	**10,993**	**2,062**	**1,276**	**31**

Table 10. NOx emissions by source category for the 2008 projected O&G emission inventory in the Wind River Basin.

County	Compressor Engines	Drill Rigs	Heaters	Workover Rigs	Glycol Dehydrator	Other Categories	Totals
Fremont (Non-Tribal)	759	98	118	45	5	22	1,047
Fremont (Tribal)	163	20	49	19	7	30	289
Totals	**922**	**118**	**168**	**64**	**12**	**52**	**1,335**

Table 11. VOC emissions by source category for the 2008 projected O&G emission inventory in the Wind River Basin.

County	Compressor Engines	Pneumatic Devices	Venting – Blowdowns	Glycol Dehydrator	Condensate Tanks	Oil Tanks	Fugitives	Other Categories	Totals
Fremont (Non-Tribal)	121	4,582	1,370	898	690	131	244	233	8,269
Fremont (Tribal)	36	1,952	71	48	28	318	109	161	2,723
Totals	**157**	**6,534**	**1,441**	**946**	**718**	**449**	**353**	**394**	**10,993**

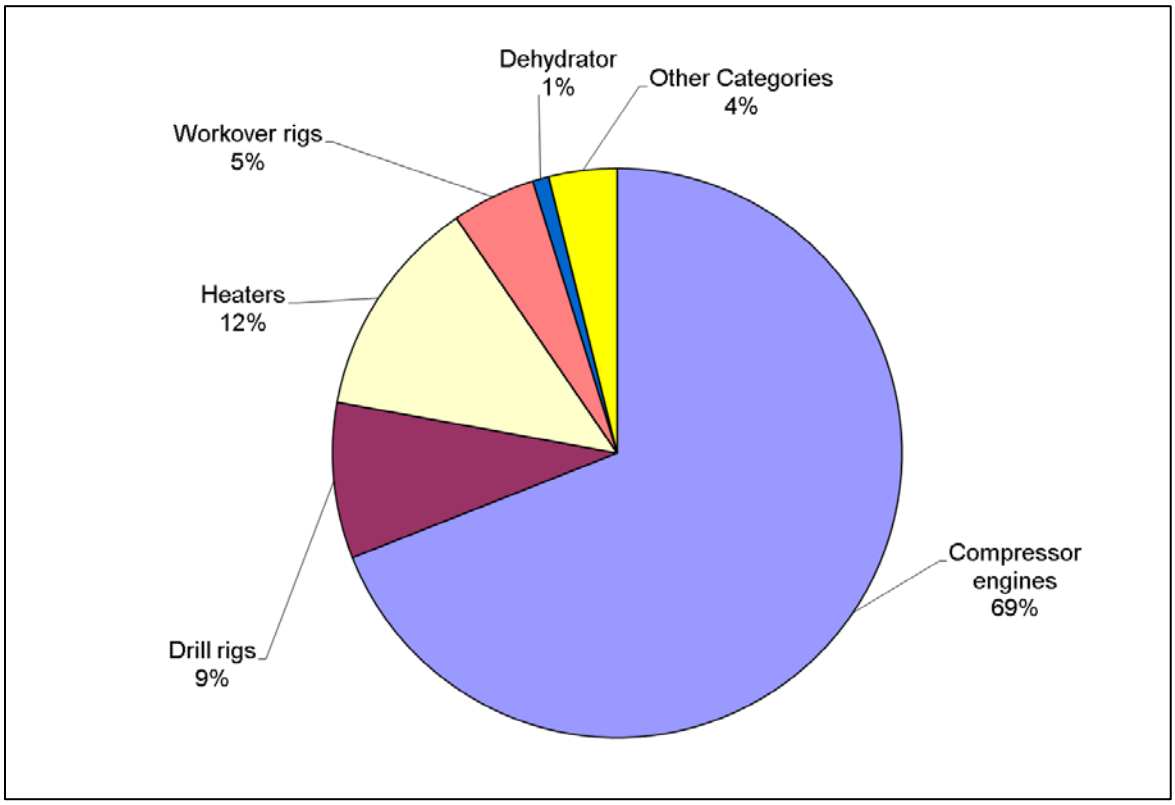

Figure 1. 2008 Wind River Basin projected NOx emissions by source category.

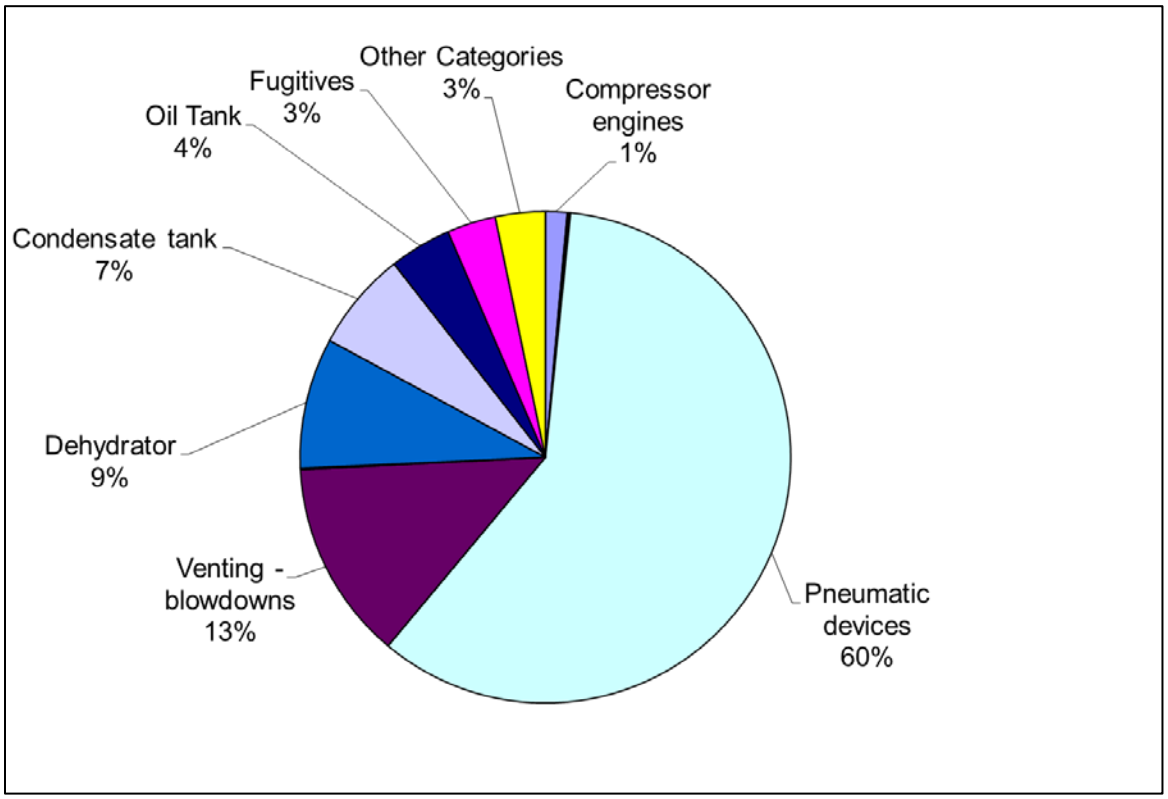

Figure 2. 2008 Wind River Basin projected VOC emissions by source category.

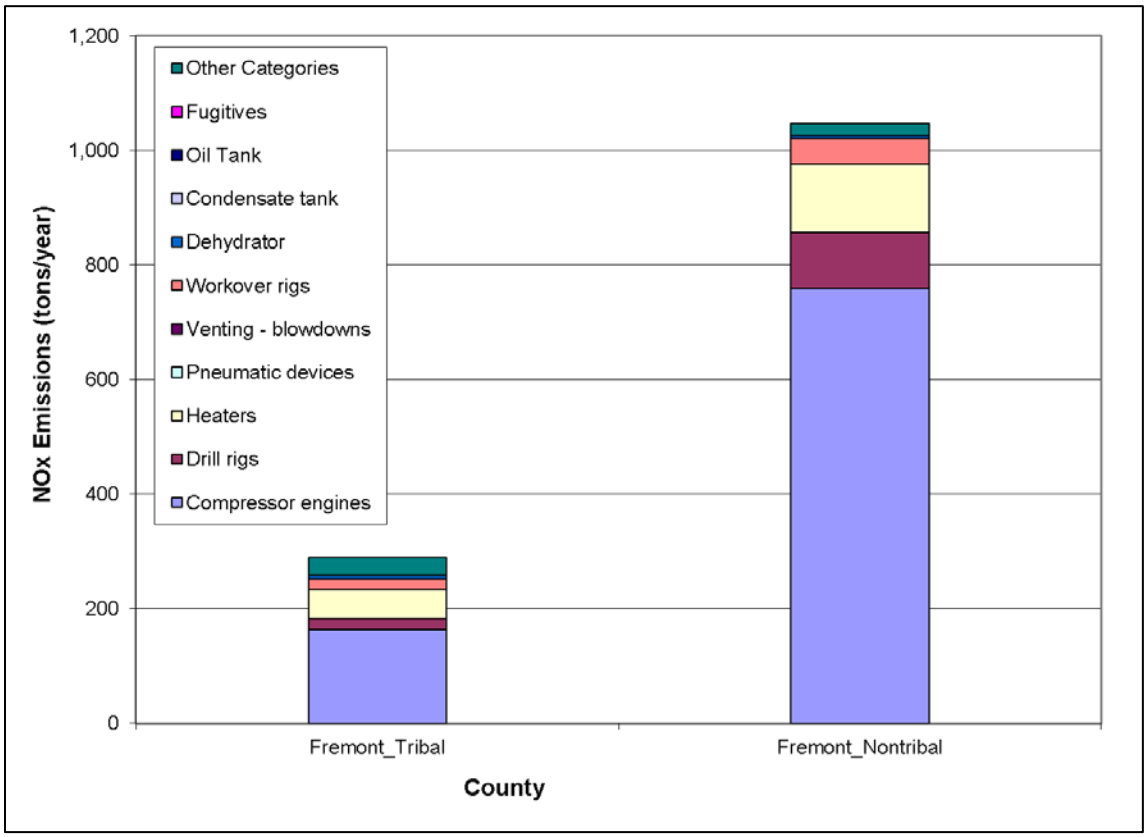

Figure 3. 2008 Wind River Basin projected NOx emissions by tribal vs. non-tribal land.

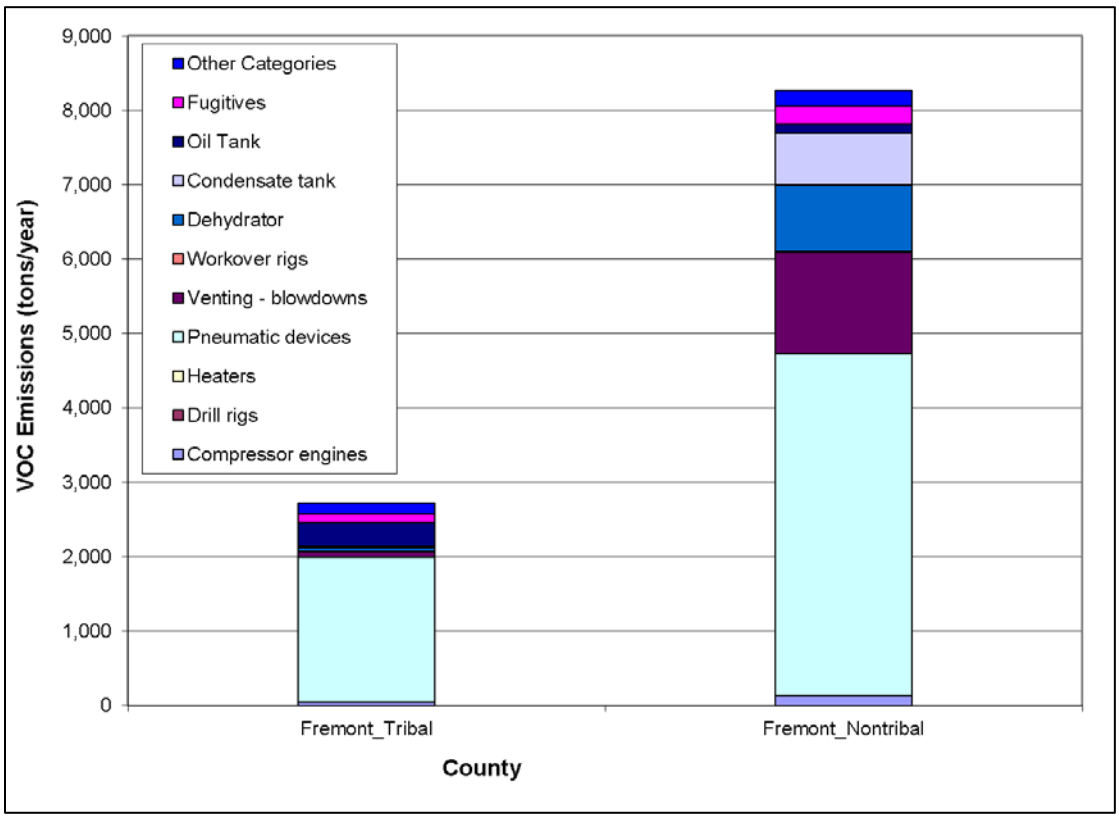

Figure 4. 2008 Wind River Basin projected VOC emissions by tribal vs. non-tribal land.

POWDER RIVER BASIN – OBSERVATIONS AND RESULTS

As noted above, both surveyed sources and permitted sources were projected and subsequently controlled using the methodology described above. A new analysis and compilation of 2008 permitted point source data was not conducted.

It is noted that in the Powder River Basin there were counties for which no oil and gas activity in particular surrogates was identified in 2006, but for which new activity in those surrogates was identified in 2008 (for example, new CBM gas production areas in 2008 where no CBM gas production was occurring in 2006). It was therefore not feasible to develop scaling factors by county and by tribal and non-tribal land as this would result in dividing 2008 activity by zero in certain cases. It was therefore necessary to use a different method to forecast 2006 emissions to 2008 for the Powder River Basin.

For each source category, total basin-wide emissions were forecasted to 2008 based on the ratio of 2008 activity to 2006 activity for the surrogate. The forecasted 2008 total emissions were then disaggregated to each county based on the fraction of activity in each county for the associated surrogate. Tribal and non-tribal emissions were also allocated based on the fraction of each surrogate occurring on tribal and non-tribal land in each county in 2008.

A controls analysis based on the federal and state regulations summarized in Table 7 was conducted for the Powder River Basin. Although gas production is projected to increase, this is primarily in the form of CBM gas production – conventional gas production is projected to decrease from 2006 to 2008. Because of the low VOC content of CBM gas, dehydrator emissions are dominated by conventional gas production and due to its decline in this time period no additional controls were applied to this source category. Condensate and oil production are observed to decline between 2006 and 2008 and therefore no additional controls were applied to this source category. Controls associated with engines (NSPS and Wyoming BACT requirements) were applied to compressor engines, artificial lift engines, and miscellaneous as appropriate.

Results

The 2008 projected O&G emissions for the Powder River Basin are shown below in a series of tables and graphs summarizing the quantitative results by source category, by county and by pollutant. Table 12 below provides an overall summary of the Powder River Basin emissions on a basin-wide level with comparison to the 2006 inventory. Gas production in the Powder River Basin has increased from 2006 to 2008, but the majority of the increase is driven by CBM gas production which contains low VOC. The overall increase in gas production drives an increase in compression NOx, although this increase is somewhat mitigated by the controls requirements for engines in Wyoming through the NSPS and Wyoming BACT requirements. However drilling was a very significant source category in the Powder River Basin in the 2006 baseline inventory, representing approximately 27% of basin-wide NOx emissions in 2006. This is the highest fraction represented by drilling NOx emissions in any Phase III basin, and more wells were drilled in the Powder River Basin in 2006 than any other Phase III basin. The sharp decline in the number of wells drilled between 2006 and 2008 drives a slight overall NOx reduction in basin-wide emissions. As noted above, although there is an increase in gas production, it is primarily in low-VOC CBM gas production. Condensate and oil production are

observed to decrease between 2006 and 2008. Thus VOC emissions increases in the Powder River Basin are modest.

Table 12. Comparison of overall 2008 WestJump Inventory for the Powder River Basin with 2006 WRAP Phase III Inventory[11].

	NOx [tpy]	VOC [tpy]	CO [tpy]	PM [tpy]	SOx [tpy]
2008 WestJump	20,980	14,787	15,445	666	596
2006 Phase III	21,086	14,367	12,873	682	609
% Change	-0.5%	+2.9%	+20.0%	-2.3%	-2.1%

Tables 13, 14 and 15 below show the 2008 O&G emissions in the Powder River Basin by-county and by-source-category respectively (for NOx and VOC emissions only). Figures 5 and 6 show the breakdown of the 2008 NOx and VOC emissions for the Powder River Basin by source category. Figures 7 and 8 show the breakdown of the 2008 NOx and VOC emissions by tribal and non-tribal areas for each county.

Emissions from O&G activities in the Powder River Basin are still concentrated in Campbell and Johnson Counties with additional activity in Converse, Natrona and Sheridan Counties. This finding is similar to the Phase III 2006 baseline inventory for the Powder River Basin. NOx emissions are comprised of compressor engines, miscellaneous engines and drilling rigs which collectively account for 91% of 2008 NOx emissions basin-wide. It is noted that drilling rig emissions are a significantly lower portion of the 2008 NOx emissions than in 2006, whereas compressor engines and miscellaneous engines are a larger portion of the 2008 NOx emissions than in 2006. This reflects the significant decrease in drilling activity between 2006 and 2008, and the growth in CBM gas production during this time period. It should be noted that the growth in compression emissions (driven by growth in gas production) is assumed to meet the NSPS and Wyoming BACT requirements for NOx emissions.

VOC emissions are distributed among a number of source categories. The three largest source categories are compressor engine exhaust emissions, venting from pneumatic devices, and fugitives which together account for approximately 67% of the 2008 basin-wide VOC emissions. The remainder of the basin-wide VOC emissions is distributed across a number of venting and fugitive source categories. This is reasonably consistent with the findings of the Phase III 2006 baseline inventory. As noted above, although significant increases in overall gas production in the basin are observed between 2006 and 2008, most of these increases are from growth in CBM gas production which has a low VOC content. Conventional gas and condensate/oil production are observed to decline in the basin from 2006 to 2008. The modest increases in VOC emissions observed in the 2008 Powder River Basin are primarily from increases in the number of wells, and increases in the compression requirements and hence compressor exhaust VOC emissions.

[11] WRAP Phase III technical memorandum for the 2006 baseline emissions for the Powder River Basin: http://www.wrapair2.org/pdf/2006_Baseline_Emiss_Powder_River_Basin_092311.pdf

Table 13. Summary of the projected 2008 O&G emissions by county in the Powder River Basin.

County	NOx [tons/yr]	VOC [tons/yr]	CO [tons/yr]	SOx [tons/yr]	PM [tons/yr]
Campbell (WY)	9,832	6,394	8,036	316	346
Converse (WY)	2,527	1,083	626	21	24
Crook (WY)	167	451	128	10	12
Johnson (WY)	4,025	2,214	2,661	82	97
Natrona (WY)	1,564	2,459	576	43	49
Niobrara (WY)	153	261	132	6	7
Sheridan (WY)	1,563	588	1,439	69	74
Weston (WY)	440	998	352	26	28
Big Horn (MT) (Tribal)	241	43	128	1	2
Big Horn (MT) (Non-Tribal)	442	212	1,344	20	27
Powder River (MT) (Tribal)	0	0	0	0	0
Powder River (MT) (Non-Tribal)	26	84	23	1	2
Basin-Wide	**20,980**	**14,787**	**15,445**	**596**	**666**

Table 14. NOx emissions by source category for the 2008 projected O&G emission inventory in the Powder River Basin.

County	Compressor Engines	Drill Rigs	Heaters	Miscellaneous Engines	Artificial Lift	Glycol Dehydrator	Other Categories	Totals
Campbell (WY)	4,861	1,736	209	2,373	197	8	448	**9,832**
Converse (WY)	2,178	51	52	170	41	1	33	**2,527**
Crook (WY)	0	35	6	75	36	0	14	**167**
Johnson (WY)	2,295	1,041	43	512	26	13	95	**4,025**
Natrona (WY)	893	101	44	348	101	1	77	**1,564**
Niobrara (WY)	50	35	4	44	12	0	8	**153**
Sheridan (WY)	399	511	42	499	1	2	108	**1,563**
Weston (WY)	58	94	20	207	24	0	37	**440**
Big Horn (MT) (Tribal)	0	21	1	6	1	0	212	**241**
Big Horn (MT) (Non-Tribal)	188	65	14	148	0	1	27	**442**
Powder River (MT) (Tribal)	0	0	0	0	0	0	0	**0**
Powder River (MT) (Non-Tribal)	0	0	1	12	10	0	2	**26**
Basin-Wide	**10,921**	**3,691**	**436**	**4,395**	**450**	**27**	**1,061**	**20,980**

Table 15. VOC emissions by source category for the 2008 projected O&G emission inventory in the Powder River Basin.

County	Compressor Engines	Pneumatic Devices	Fugitives	Venting - Initial Completions	Venting - Recompletions	Glycol Dehydrator	Oil Well Truck Loading	Miscellaneous Engines	Other Categories	Totals
Campbell (WY)	3,169	747	523	206	293	162	363	288	643	**6,394**
Converse (WY)	31	382	267	6	9	117	76	21	175	**1,083**
Crook (WY)	0	170	119	4	6	1	67	9	75	**451**
Johnson (WY)	1,503	109	77	123	175	11	48	62	106	**2,214**
Natrona (WY)	8	792	554	12	17	384	185	42	463	**2,459**
Niobrara (WY)	1	99	69	4	6	26	22	5	28	**261**
Sheridan (WY)	313	6	4	61	86	2	1	61	55	**588**
Weston (WY)	22	470	329	11	16	23	45	25	58	**998**
Big Horn (MT) (Tribal)	0	14	10	3	4	0	3	1	10	**43**
Big Horn (MT) (Non-Tribal)	131	16	11	8	11	8	0	18	9	**212**
Powder River (MT) (Tribal)	0	0	0	0	0	0	0	0	0	**0**
Powder River (MT) (Non-Tribal)	0	28	20	0	0	1	18	2	15	**84**
Basin-Wide	**5,178**	**2,833**	**1,983**	**437**	**622**	**734**	**829**	**534**	**1,639**	**14,787**

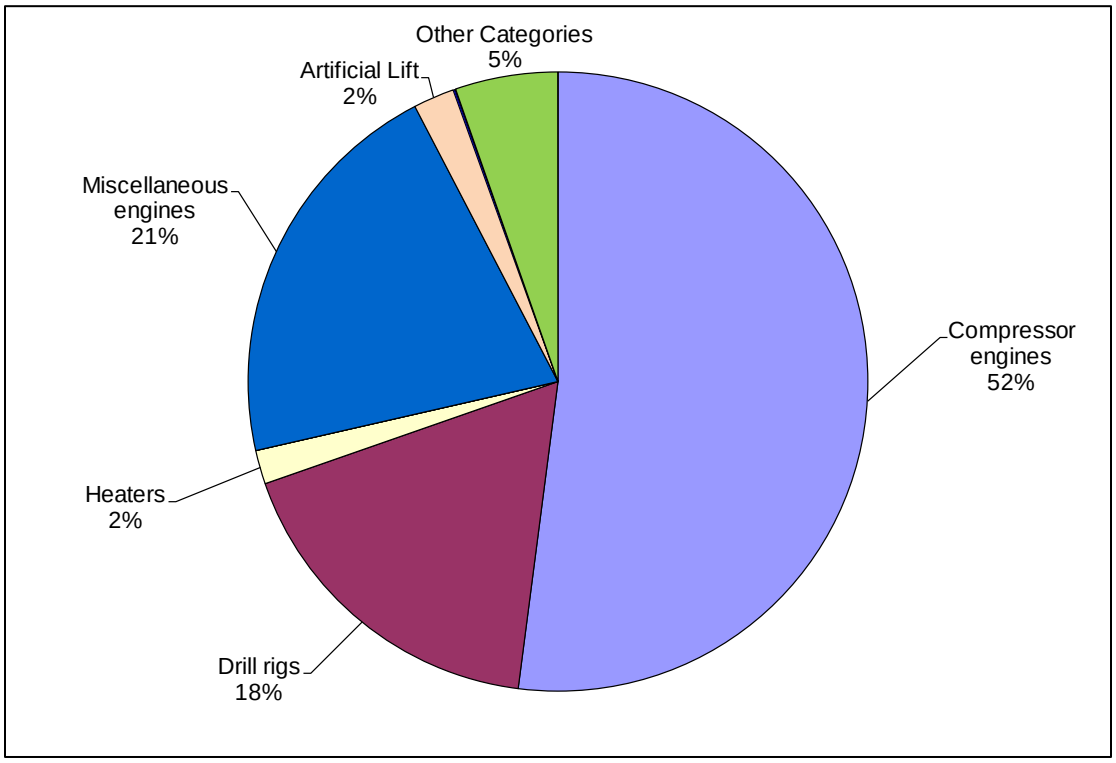

Figure 5. 2008 Powder River Basin projected NOx emissions by source category.

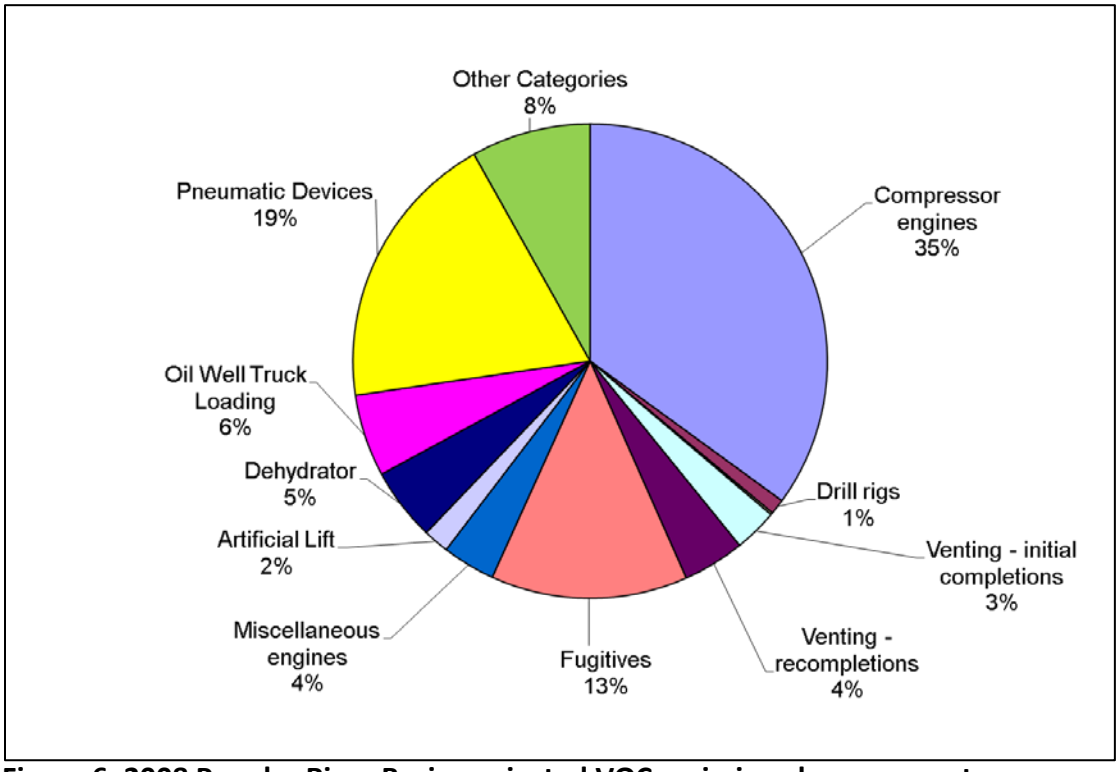

Figure 6. 2008 Powder River Basin projected VOC emissions by source category.

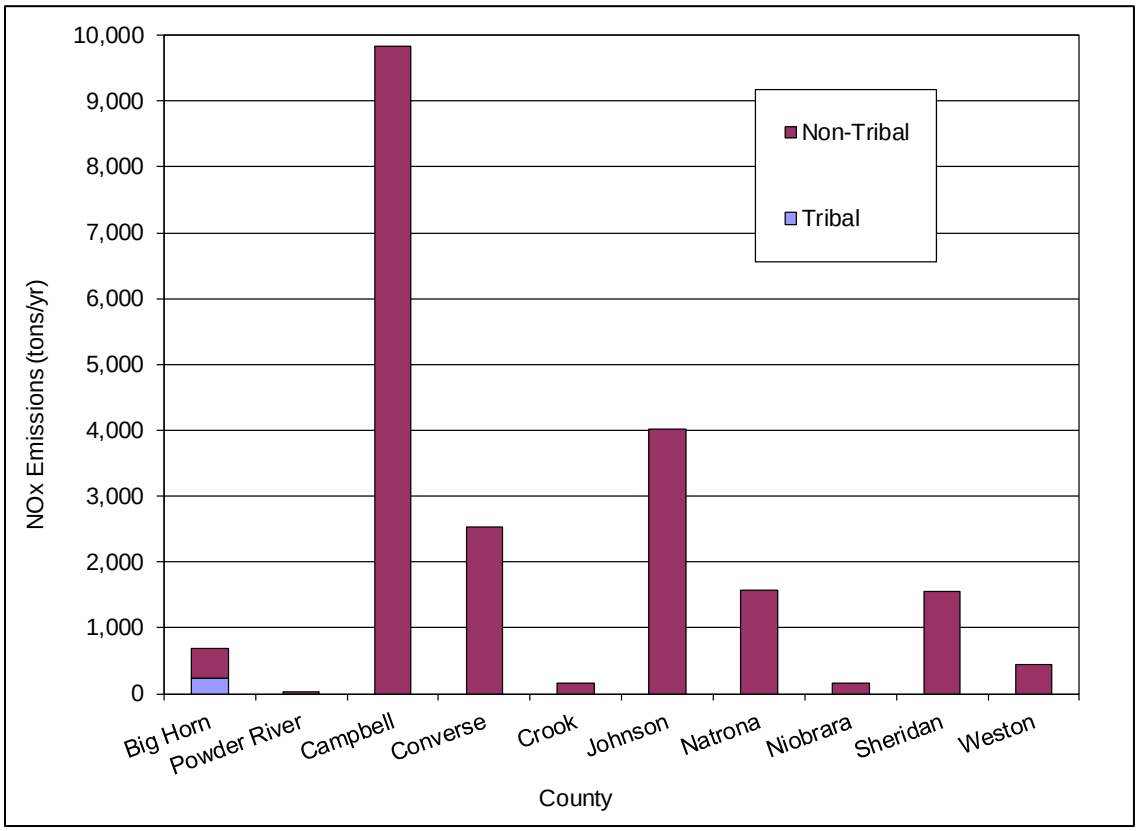

Figure 7. 2008 Powder River Basin projected NOx emissions by tribal vs. non-tribal land.

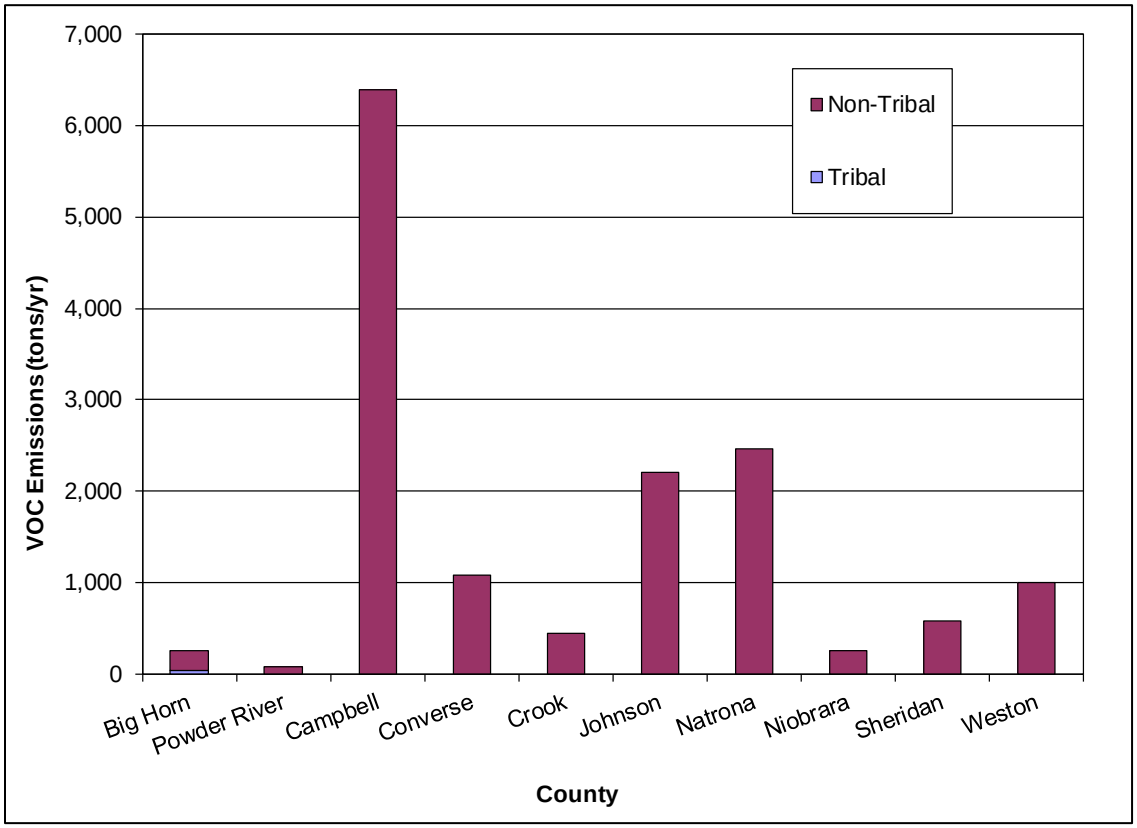

Figure 8. 2008 Powder River Basin projected VOC emissions by tribal vs. non-tribal land.

SOUTHWEST WYOMING BASIN – OBSERVATIONS AND RESULTS

The Southwest Wyoming Basin includes the Jonah-Pinedale Anticline Development (JPAD) area in Sublette County, which is classified separately from other oil and gas development areas in Wyoming for purposes of air quality regulations. The other counties in the basin fall within the Concentrated Development Area (CDA), which is also classified separately from other oil and gas development areas in Wyoming. In the 2006 baseline inventory for the Southwest Wyoming Basin the JPAD area was treated separately from other portions of the basin in that the WYDEQ had developed a highly detailed survey- and permit-based inventory of all upstream and downstream oil and gas sources in the JPAD. 2008 is the first year for which an expanded inventory – developed using the same methodological approach as the JPAD inventory – is now available for all of Sublette County including the JPAD area. Because of the availability of this expanded inventory the WestJump projections use the 2008 Upper Green River Basin (UGRB) inventory for Sublette County in its entirety, rather than projecting emissions in Sublette County from 2006.

The Sublette County UGRB inventory does not provide the complete list of all point source facilities, but does summarize emissions from both midstream/downstream facilities and from upstream production sites by source category. These by-source-category summaries were incorporated into the 2008 projected inventories using the best fit possible to the Phase III category list. Because of this change in the methodology for estimating the total basin-wide 2008 emissions relative to the 2006 baseline Phase III inventory, it is difficult to conduct a detailed comparison of the results of the two inventories. However a high-level comparison is provided below.

All regulatory controls requirements were considered for the counties other than Sublette in the Southwest Wyoming Basin. This includes federal regulations and the CDA-applicable Wyoming BACT requirements for oil and gas sources.

Results

The 2008 projected O&G emissions for the Southwest Wyoming Basin are shown below in a series of tables and graphs summarizing the quantitative results by source category, by county and by pollutant. Table 16 below provides an overall summary of the Southwest Wyoming Basin emissions on a basin-wide level with comparison to the 2006 inventory. Gas production, condensate production, well counts and drilling has increased in the Southwest Wyoming Basin from 2006 to 2008. This is reflected in the NOx emissions increases observed in Table 16 which are driven by a combination of gas production increases and increases in the number of active wells. It is noted that major NOx sources in this basin are subject to controls requirements through the NSPS and Wyoming BACT requirements which were applied to the grown portion of emissions. However VOC emissions are observed to decrease during this time period. This is likely due to the change in methodology between the 2006 Phase III inventory and this 2008 projection in which the emissions in Sublette County are obtained directly from the WYDEQ UGRB inventory. Sublette County represents a significant fraction of gas and condensate production in the Southwest Wyoming Basin and thus this revised methodology for Sublette County is expected to have an impact on the basin-wide emissions. NOx emissions are comprised almost exclusively of data from permitted sources and thus are less subject to this variation in the Sublette County emissions methodology.

Table 16. Comparison of overall 2008 WestJump inventory for the Southwest Wyoming Basin with 2006 WRAP Phase III inventory[12].

	NOx [tpy]	VOC [tpy]	CO [tpy]	PM [tpy]	SOx [tpy]
2008 WestJump	23,824	87,374	16,024	679	6,030
2006 Phase III	21,569	94,013	13,150	541	5,259
% Change	+10.5%	-7.1%	+21.9%	+25.5%	+14.7%

Tables 17, 18 and 19 below show the 2008 O&G emissions in the Southwest Wyoming Basin by-county and by-source-category respectively (for NOx and VOC emissions only). Figures 9 and 10 show the breakdown of the 2008 NOx and VOC emissions for the Southwest Wyoming Basin by source category. Figures 11 and 12 show the breakdown of the 2008 NOx and VOC emissions by county.

Emissions from O&G activities in the Southwest Wyoming Basin are concentrated in Sublette, Sweetwater and Carbon Counties with some additional production activity in Lincoln and Uinta Counties as was observed in the WRAP Phase III baseline 2006 inventory for the Southwest Wyoming Basin. NOx emissions are dominated by compressor engines with additional NOx emissions from drilling rigs and heaters. "Other categories" in the context of the Southwest Wyoming Basin include NOx sources at centralized facilities which may include flaring, process heaters or NOx emissions from unspecified source categories. These findings are relatively consistent with the 2006 baseline inventory for the Southwest Wyoming Basin, although it is noted that compressor engines are a smaller percentage of total basin-wide NOx in 2008 than in 2006. This may be due to the stringent controls requirements in the Southwest Wyoming Basin including both the JPAD area and CDA.

VOC emissions are comprised of a number of source categories including condensate tanks, fugitive emissions, pneumatic devices and pneumatic pumps, and dehydrators collectively representing 90% of basin-wide VOC emissions. This is consistent with findings of other basins where both gas and condensate are produced in significant quantities. This finding is also consistent with the 2006 baseline inventory for the Southwest Wyoming Basin. It is noted that the methodology for determining 2008 emissions in Sublette County, which represents a significant portion of the basin-wide VOC emissions total, differs from that used in the 2006 baseline inventory. The 2006 baseline inventory used a combination of the WYDEQ JPAD inventory and survey-based data and permit data to develop a complete inventory for Sublette County. In the 2008 update, all emissions in Sublette County are obtained directly from the WYDEQ UGRB inventory. This makes a direct comparison of the two emissions inventories difficult for VOC emissions particularly, as many of the VOC emissions source categories are not estimated based on permit data.

[12]. http://www.wrapair2.org/pdf/2006_Baseline_Emiss_SWWY_Basin_120712.pdf

Table 17. Summary of the projected 2008 O&G emissions by county in the Southwest Wyoming Basin.

County	NOx [tons/yr]	VOC [tons/yr]	CO [tons/yr]	SOx [tons/yr]	PM [tons/yr]
Albany (WY)	1,870	274	229	0	19
Carbon (WY)	3,875	15,336	1,898	91	113
Lincoln (WY)	1,306	16,104	1,067	2,635	106
Sublette (WY)*	7,759	15,251	5,578	129	249
Sweetwater (WY)	6,401	28,734	4,371	259	154
Uinta (WY)	2,586	9,954	2,859	2,916	35
Daggett (UT)	5	108	4	0	0
Summit (UT)	24	1,613	19	1	2
Basin-Wide	**23,824**	**87,374**	**16,024**	**6,030**	**679**

* Emissions in Sublette County are obtained directly from the WYDEQ UGRB inventory.

Table 18. NOx emissions by source category for the 2008 Projected O&G emission inventory in the Southwest Wyoming Basin.

County	Compressor Engines	Drill Rigs	Heaters	Dehydrators	Other Categories	Totals
Albany (WY)	1,853	0	17	0	0	**1,870**
Carbon (WY)	2,229	789	604	38	214	**3,875**
Lincoln (WY)	435	275	457	24	115	**1,306**
Sublette (WY)*	1,506	2,932	812	20	2,488	**7,759**
Sweetwater (WY)	4,227	765	915	97	396	**6,401**
Uinta (WY)	1,568	59	224	50	686	**2,586**
Daggett (UT)	0	0	4	0	0	**5**
Summit (UT)	0	5	15	3	0	**24**
Basin-Wide	**11,818**	**4,825**	**3,048**	**233**	**3,900**	**23,824**

* Emissions in Sublette County are obtained directly from the WYDEQ UGRB inventory.

Table 19. VOC emissions by source category for the 2008 projected O&G emission inventory in the Southwest Wyoming Basin.

County	Compressor Engines	Pneumatic Devices	Pneumatic Pumps	Fugitives	Dehydrators	Condensate Tanks	Oil Tanks	Venting – Initial Completions	Venting - Recompletions	Other Categories	Totals
Albany (WY)	24	79	23	116	0	0	23	0	0	7	274
Carbon (WY)	465	3,547	970	5,038	857	3,756	81	162	151	310	15,336
Lincoln (WY)	84	2,902	826	4,291	624	6,594	67	54	58	603	16,104
Sublette (WY)*	860	0	4,153	2,006	3,711	2,431	0	293	0	1,797	15,251
Sweetwater (WY)	596	6,458	1,821	9,526	1,779	6,279	533	329	336	1,076	28,734
Uinta (WY)	189	848	241	1,270	1,143	5,683	352	4	3	220	9,954
Daggett (UT)	0	34	10	49	8	8	0	0	0	0	108
Summit (UT)	0	115	33	169	72	1,092	93	0	0	40	1,613
Basin-Wide	**2,219**	**13,983**	**8,076**	**22,467**	**8,193**	**25,842**	**1,149**	**842**	**549**	**4,054**	**87,374**

* Emissions in Sublette County are obtained directly from the WYDEQ UGRB inventory.

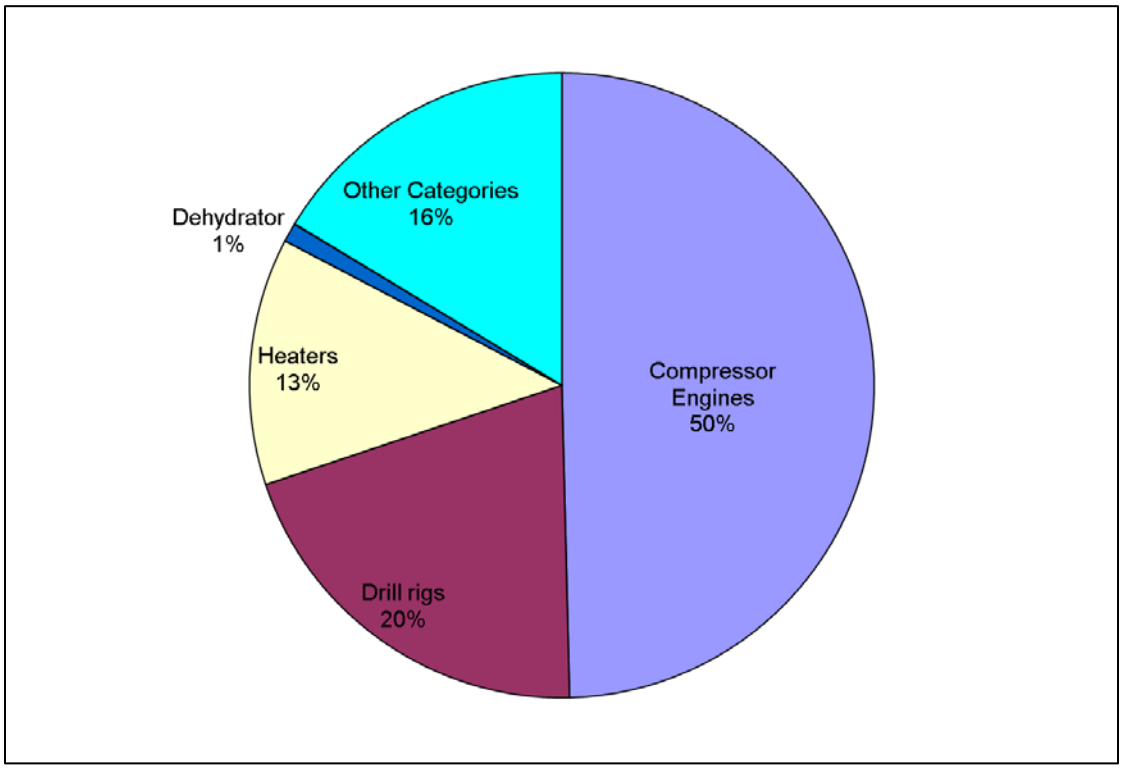

Figure 9. 2008 Southwest Wyoming Basin projected NOx emissions by source category.

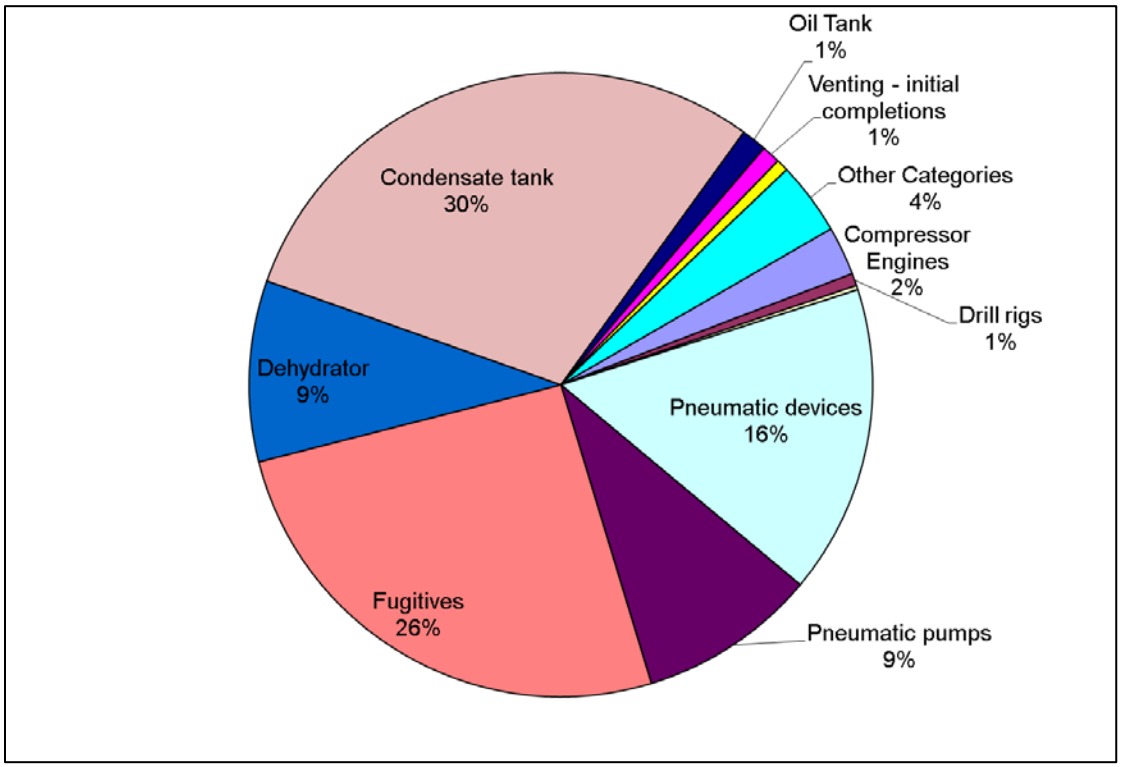

Figure 10. 2008 Southwest Wyoming Basin projected VOC emissions by source category.

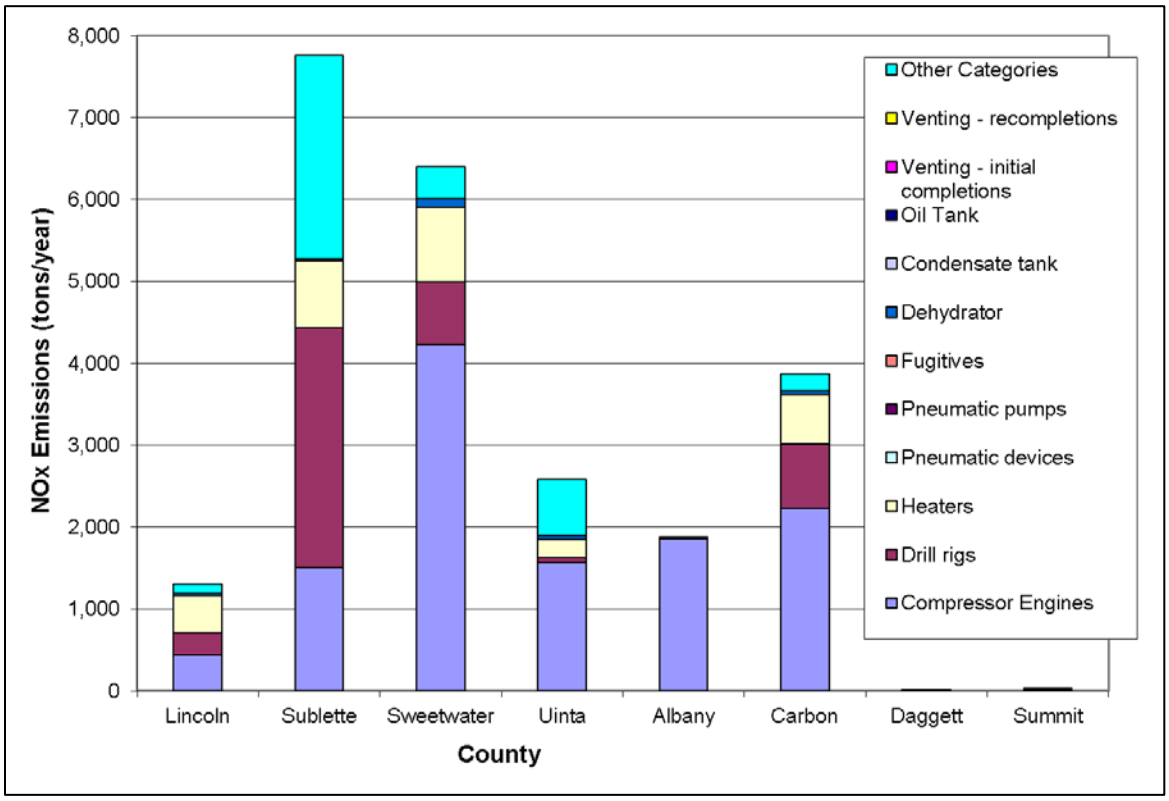

Figure 11. 2008 Southwest Wyoming Basin projected NOx emissions by county.

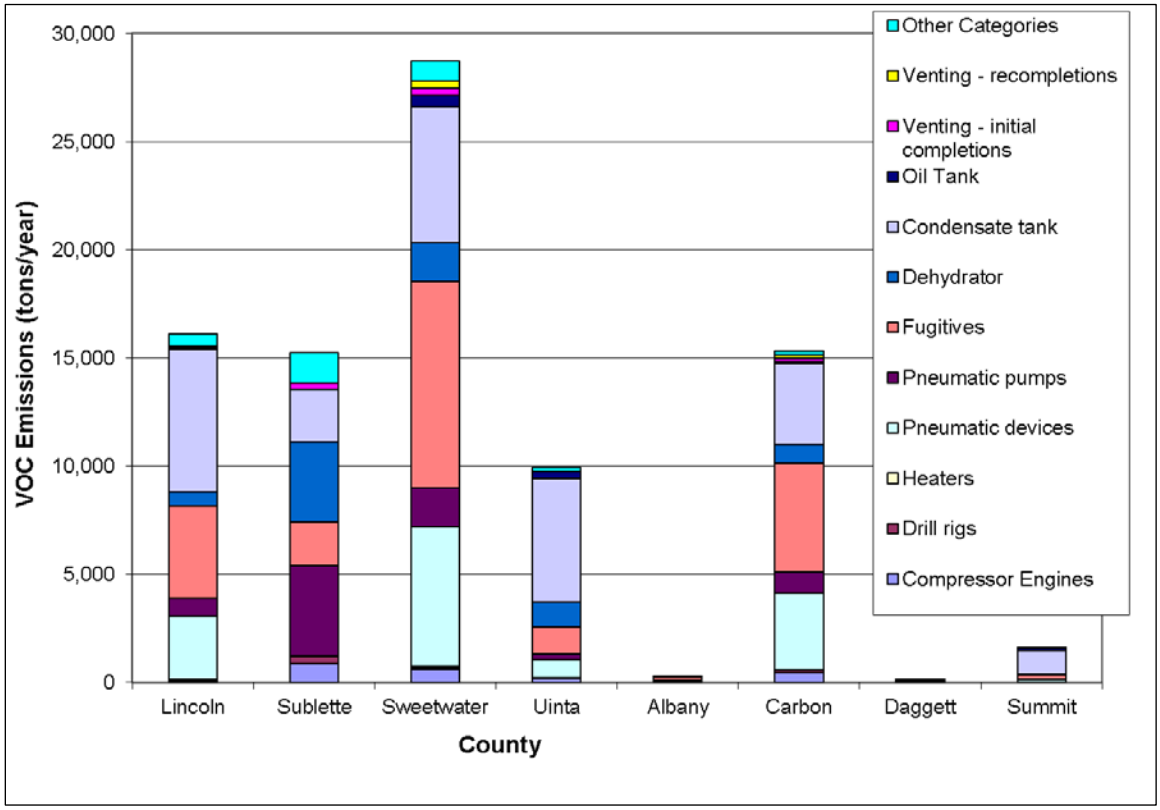

Figure 12. 2008 Southwest Wyoming Basin projected VOC emissions by county.

APPENDIX A

Detailed Emission Inventory Spreadsheets

Detailed Emission Inventory Spreadsheets

Detailed spreadsheets accompany the 2008 WestJump projected emission inventories for each basin. These spreadsheets contain greater detail on the emissions inventory including control factors, and more detailed breakdown of emissions by all source categories within a basin. The reader is referred to these accompanying spreadsheets for more quantitative information on the inventory results.