Pinedale Anticline Record of Decision Milestone #3 Visibility Modeling **Requirements and Process**

Charis Tuers, BLM Air Resource Specialist

August 20, 2013

BLM
Wyoming State Office

Overview

- **Visibility Modeling Project History and Agency Involvement**
- **Record of Decision Final Visibility Goal**

Visibility Modeling Project History and Agency Involvement

- Two Bureau of Land Management (BLM) planning meetings:
  - February 23, 2012 to discuss ROD air quality modeling requirements
  - March 20, 2012 to discuss visibility modeling protocol development and also discussed planning for summer ozone modeling
- **May 22, 2012:** The BLM presented status of Pinedale Anticline Record of Decision (ROD) modeling project to Pinedale Anticline Working Group
- **July 20, 2012:** Meeting to review the draft visibility modeling protocol

Visibility Modeling Project History and Agency Involvement

- **October 15, 2012:** Meeting to discuss agency comments on the draft visibility modeling protocol
- **October 29, 2012:** Meeting to discuss the draft base case year 2015 emissions inventory
- **November 7, 2012:** Modeling protocol finalized and approved by BLM and Wyoming Department of Environmental Quality (WDEQ)
- **January 17, 2013:** Meeting to discuss the draft base case year 2015 emissions inventory report

Visibility Modeling Project History and Agency Involvement

- **February 26, 2013:** Base case year 2015 emissions inventory and report finalized and approved by BLM and WDEQ
- **April 5, 2013:** Meeting to discuss visibility modeling results
- **July 11, 2013:** Meeting to discuss draft visibility modeling report
- **August 2013:** Visibility modeling results and report finalized and approved by BLM and WDEQ

Record of Decision Final Visibility Goal

- The final goal for visibility is defined as Milestone #3 in Section 4.1.1 of the ROD:

  Within 78 months [or by March 12, 2015] after signing of this ROD modeled project related visibility impacts will be no greater than 0 days of visibility impairment over 1 dv at the Bridger Wilderness Area.

Record of Decision Final Visibility Goal

- The ROD includes several measures to mitigate visibility impacts, including reducing nitrogen oxide (NO_X) emissions.
- The focus of NO_X emissions for mitigation was based on the visibility modeling conducted for the Pinedale Anticline Supplemental Environmental Impact Statement.
- The operators have met the first two visibility milestones, outlined in the ROD, to reduce NO_X emissions and subsequent nitrate impacts on the Bridger Wilderness Area.

Pinedale Anticline Record of Decision Milestone #3 Visibility Modeling **Report Review**

Patrick McKean, AECOM

August 20, 2013

AECOM

Overview

- Evaluation of Visibility Observations at Bridger Wilderness Area
- Modeling Technical Methods
- Modeled Emissions Inventory
- Additional Mitigation Activities
- Emissions Processing and Dispersion Modeling System Quality Assurance Review
- Modeling Results

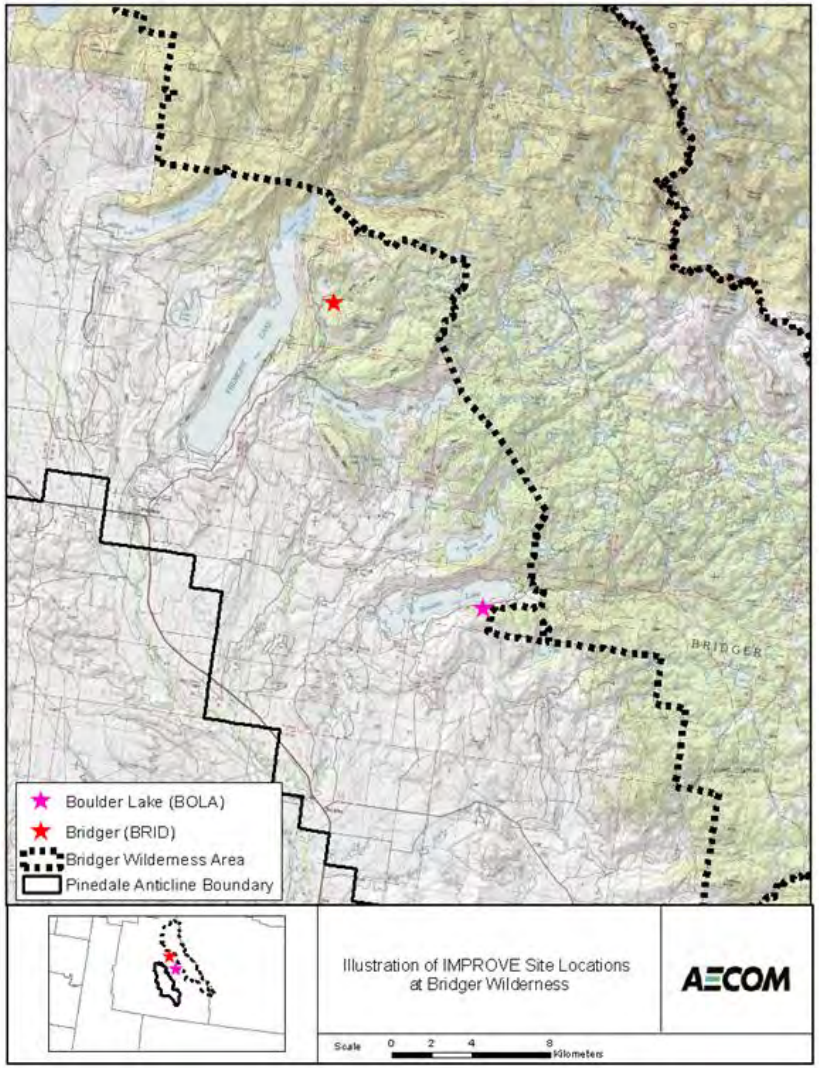
Evaluation of Visibility Observations at Bridger Wilderness Area

- CALPUFF model used in SEIS and ROD modeling.
- CALPUFF employs a simple chemical mechanism that has been shown to over-predict chemical transformation, especially nitrate (from NO_X emissions).
- To ensure effective mitigation is employed, known model conservatisms were considered in light of actual monitored visibility impairing species.

Evaluation of Visibility Observations at Bridger Wilderness Area

- Bridger (BRID) and Boulder Lake (BOLA) IMPROVE monitors about 17 km apart, and 20 km from PAPA operations.
- BRID monitor has been operating since 1988.
- BOLA monitor has been operational since August 26, 2009.
- South Pass (SOPA) IMPROVE monitor has been operational since January 2007.

Evaluation of Visibility Observations at Bridger Wilderness Area

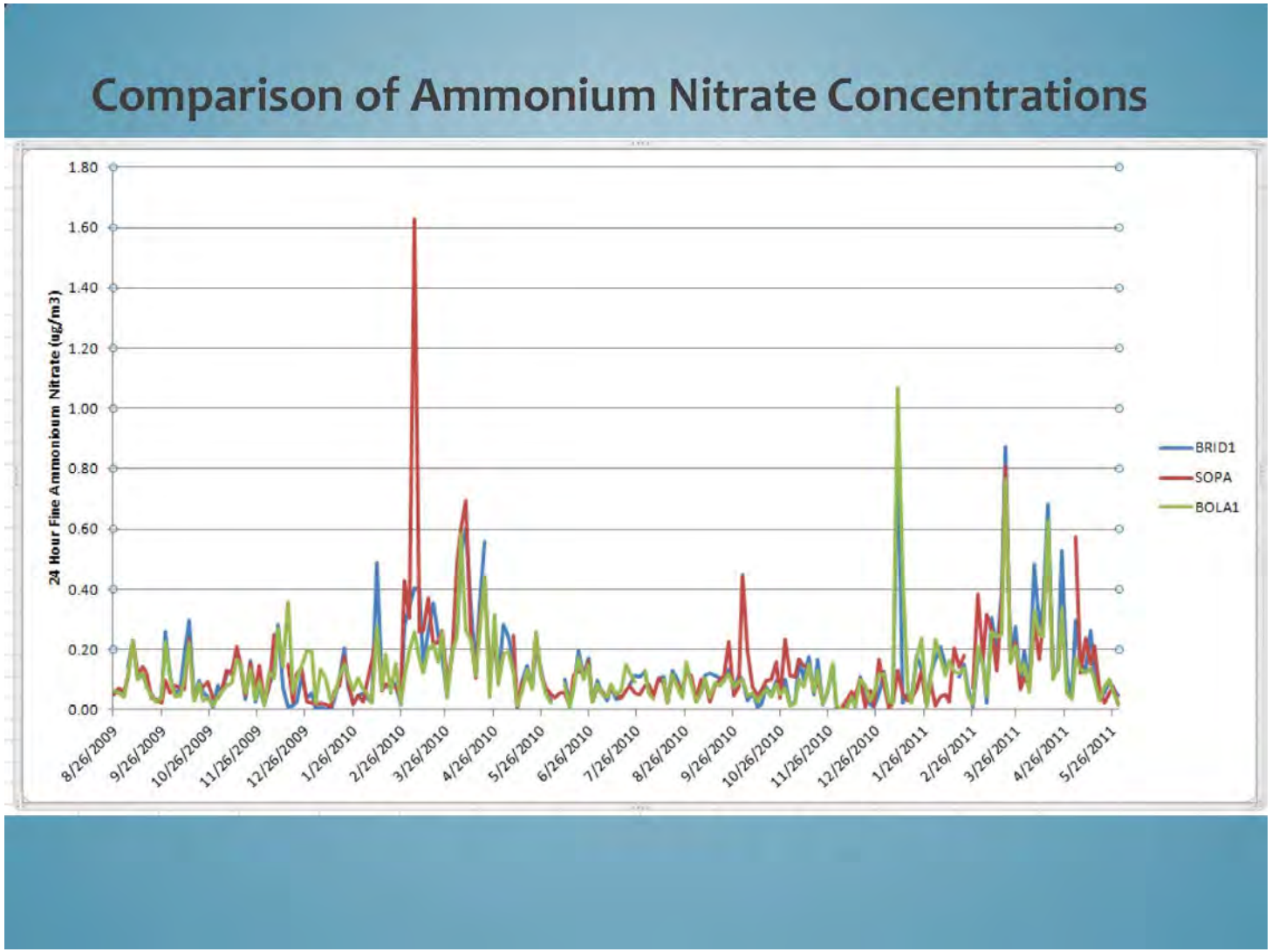


Evaluation of Visibility Observations at Bridger Wilderness Area

- "Monitors show no significant differences at this time, though they do show localized events." [1]
- USFS findings consistent with the analysis provided in the modeling report
  - Decreasing trend in total dv and low (and relatively unchanged) nitrate at BRID monitor
  - Since 1998, nitrate contribution to total visibility-impairing species is less than 10% for typical and worst days
  - Newer BOLA site has good correlation with BRID for nitrate and other visibility-impairing species

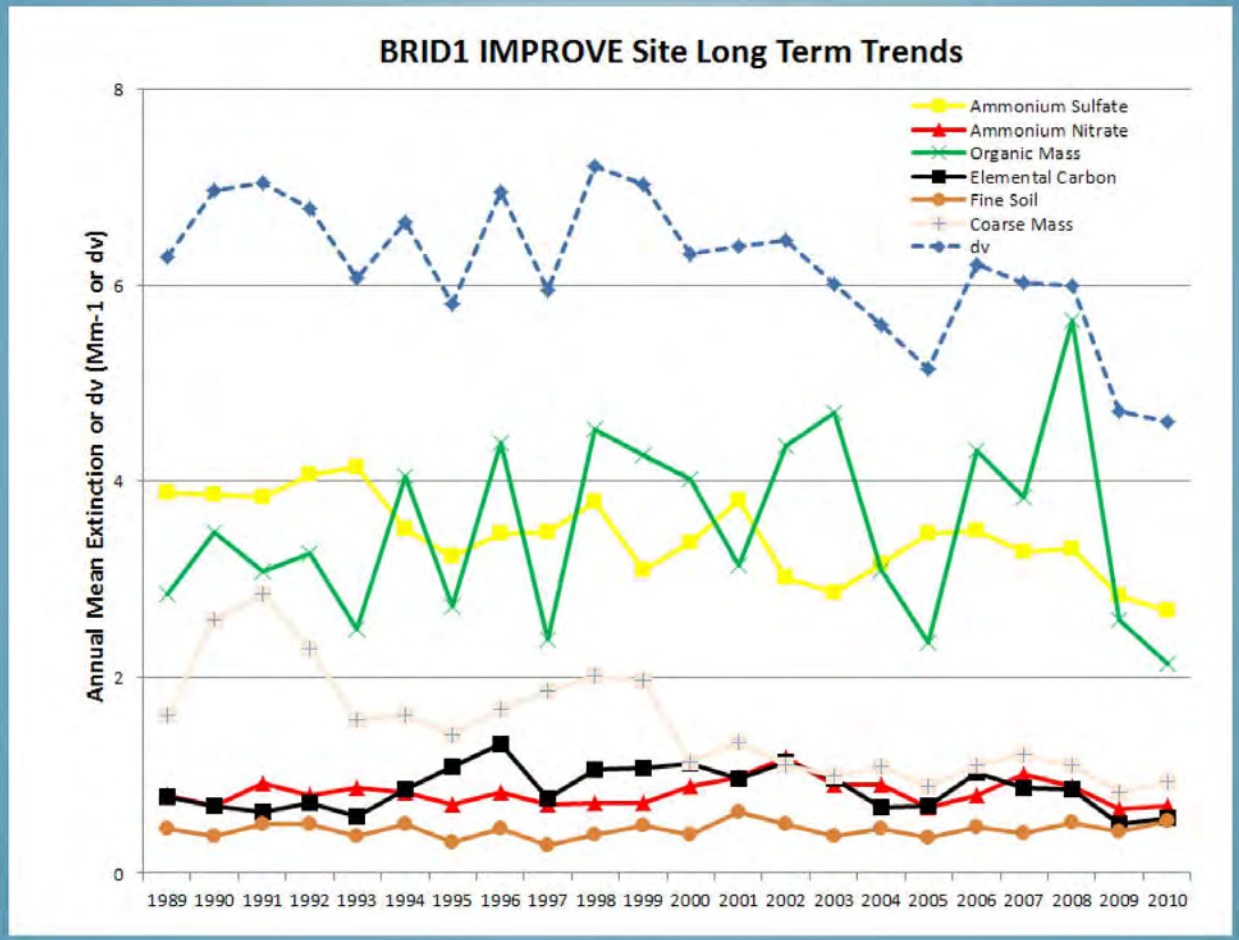
[1] Bridger-Teton National Forest Air Quality Data Summary (August 9, 2012), presented by Terry Svalberg of USFS

Evaluation of Visibility Observations at Bridger Wilderness Area



AECOM

Evaluation of Visibility Observations at Bridger Wilderness Area

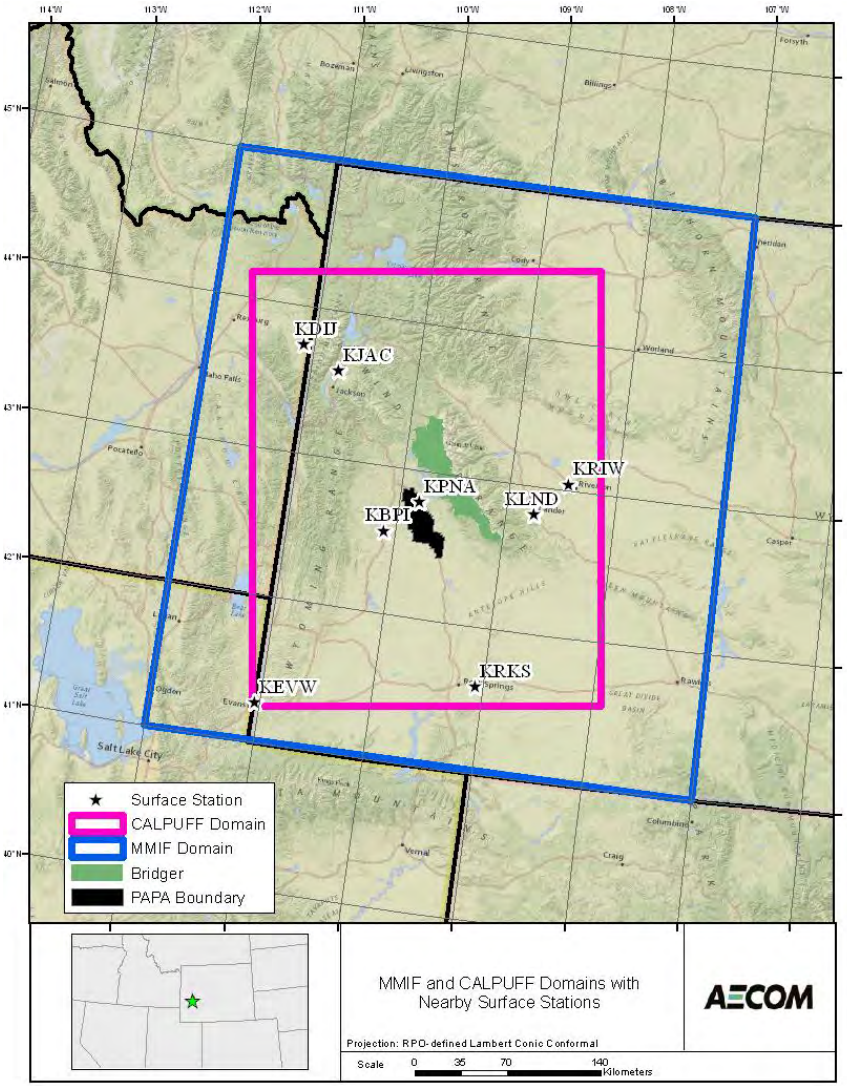


AECOM

Modeling Technical Methods

- Modeling domain defined in accordance with the WDEQ/BLM approved protocol to adequately assess impacts from the PAPA emissions sources
- Used EPA-approved version of the CALPUFF modeling system
- Meteorological data was processed with the MMIF processor provided by the software developer in fall 2012; the meteorological inputs used to simulate PAPA emissions dispersion were from the WRAP 2008 annual WRF simulation, in accordance with the approved protocol

Modeling Technical Methods



Modeling Technical Methods

- 2008 CALPUFF-ready meteorological files generated by MMIF were reviewed for quality assurance purposes, per EPA request during the project planning phase.
- Quantitative comparison of the MMIF performance evaluation statistics with the original WRF statistics showed minimal differences.
- Time series plots for winds and temperature confirm consistency between the MMIF-processed and original WRF simulation.

Modeling Technical Methods

- **Spatial plots showed that the underlying surface characteristics, as well as wind vectors on the maximum impact day, were consistent with the modeling results.**
- **Quality assurance checks showed that meteorological processing did not introduce any undesirable features and resulted in acceptable meteorological data for use in the Pinedale ROD Milestone #3 visibility modeling.**

Modeling Technical Methods

- All CALPUFF switch settings conformed to the EPA-recommended values and/or model defaults.
- The receptor locations for the Bridger WA were the same as used in the SEIS modeling.
- 2008 ozone data (concurrent with the met year simulation) from Boulder, Daniel, Jonah, and other stations within the domain were used for chemical transformations of emitted NO_X and SO_2 to nitrate and sulfate in CALPUFF.

Modeling Technical Methods

- **Background ammonia data:**
  - **Required for use in the chemical transformation of primary emissions of NO_X and SO_2**
  - **Previous modeling used conservative default values due to lack of local data**
  - **Shell has been collecting site-specific ammonia data, as required by the ROD**
  - **Average values collected by Shell from 2007-2011 were used in the ROD modeling**
  - **Post-processing was employed to re-partition the nitrate predictions using Shell background ammonia, per the approved protocol**

Modeling Technical Methods

- **The EPA-approved CALPOST processor was used to calculate the maximum visibility impacts from the PAPA sources at the Bridger WA receptors.[1]**
- **The PAPA maximum visibility impacts were determined by comparing the impacts of sulfate, nitrate, nitrogen dioxide, course particulate matter (PM), and fine PM from the PAPA sources to the annual average natural conditions at the Bridger WA in accordance with the approved protocol and FLAG 2010 guidance.**

[1] 98th percentile impacts not considered

Modeled Emissions Inventory

- **Base case emissions were developed by the operators to represent anticipated year 2015 operations.**
  - **20 drill rigs**
  - **498 wells drilled and completed**
  - **3,223 total wells in production by 12/31/2015**

Modeled Emissions Inventory

- **Each operator provided emissions for the various source categories:**
  - **Central Gathering/Liquids Facilities (CGF) and other permitted liquids handling facilities**
  - **Well pad production sources**
  - **Well pad production controls**
  - **Drill rigs**
  - **Well completions**
  - **Compressor stations**
  - **Gas plants**
  - **Construction mobile sources**

Modeled Emissions Inventory

- NO_X is the primary pollutant of concern for visibility modeling; SO_2 and PM emissions were also quantified.
- AECOM consolidated the data and prepared a base case inventory report, which was approved by the Stakeholders.
- Sample calculations were provided in the report when emissions were not obtained directly from permit applications, final construction permits, or annual emission inventories.

Modeled Emissions Inventory

- **WDEQ 2011 annual inventory was the basis for several aspects of the base case 2015 emissions, with some key differences applied to future year projections:**
  - **Number of wells**
  - **Number of drill rigs and drilling durations**
  - **Account for changes to how exhaust streams are currently handled at new and modified well pads**
  - **Updated emission factors for various sources (for example accounting for new equipment designs)**
  - **Seasonal and diurnal variations in operating conditions**

Modeled Emissions Inventory

- **After the base case was modeled, the operators identified sources whose emissions would be considered for additional mitigation to achieve the ROD Milestone #3 goal of zero days over 1.0 dv of visibility impairment:**
  - **Ultra: electrification of CGF#2, CGF#3, CGF#4, Boulder Section 8, and Warbonnet 15-26**
  - **Shell: electrification of Central CGF**
  - **Ultra, Shell, and QEP: all reducing their completion NO_X emissions by 10 percent**
  - **Note that a refined drill rig NO_X emission factor was also used for QEP based on actual test data**

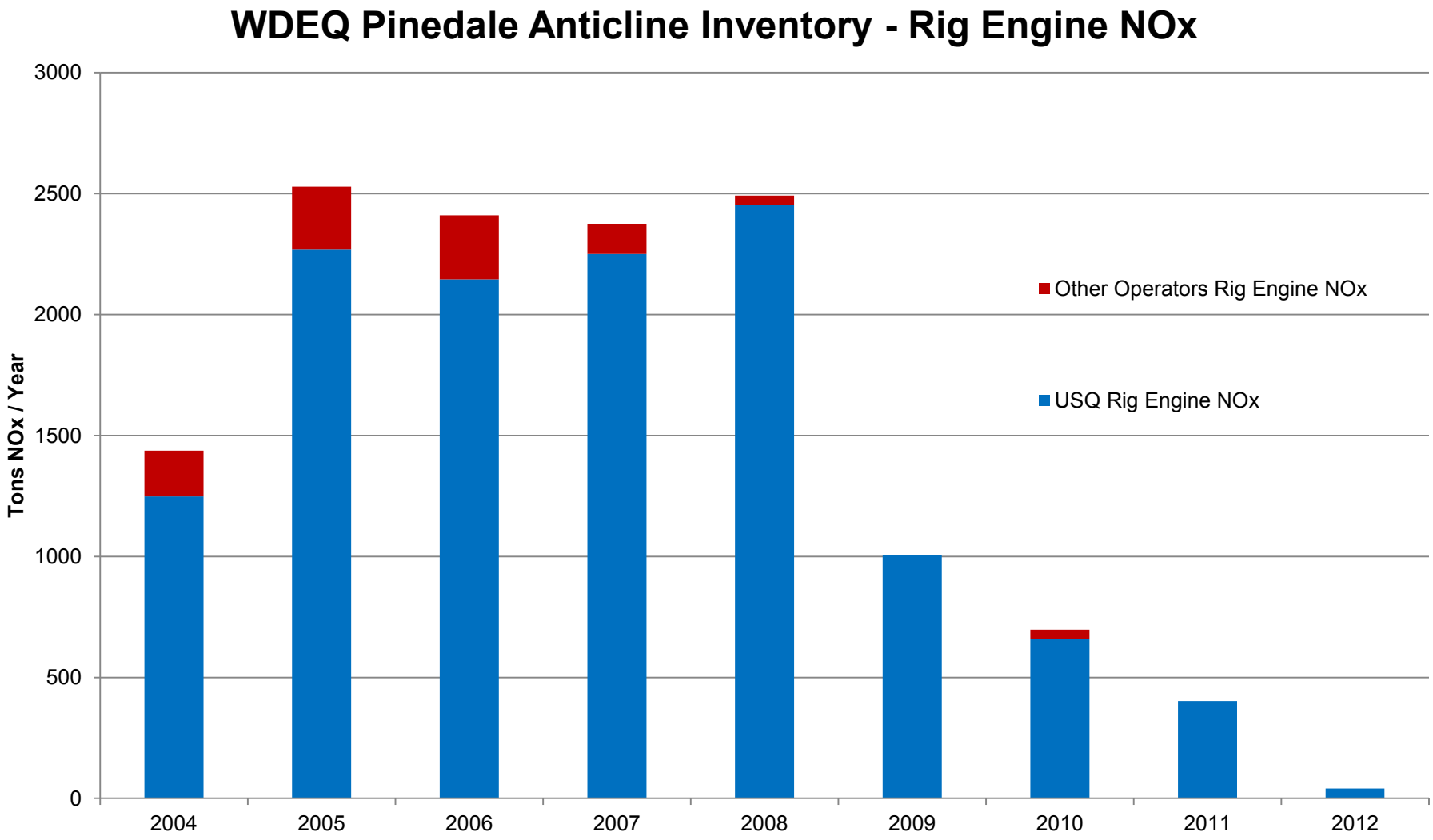
Modeled Emissions Inventory

- **Potential options for 10% reduction in completion emissions:**
  - **Replacement of engines with lower-emitting (e.g. Tier 4) engines**
  - **Substitution of fuels (e.g. replacement of diesel-fired engines with natural gas-fired or dual-fuel engines)**
  - **Installation of emission controls (e.g., selective catalytic reduction or non-selective catalytic reduction)**
  - **Reduction of amount of fuel combusted**
  - **Flexibility will encourage innovative solutions**

Additional Mitigation Activities

- **A number of additional NO_X emission reductions beyond those implemented for the visibility milestone targets have already taken place and were reflected in the base case inventory:**
  - **Drill rigs include newer and lower emitting engines, and Selective Catalytic Reduction (SCR) (see chart next slide)**
  - **Increased drill rig efficiencies have resulted in more wells drilled with fewer rigs**
  - **Many natural gas engines have been electrified**
  - **Exhaust emissions from pneumatic pumps have been rerouted to heaters for use as fuel instead of routing to combustors**
  - **Liquids gathering system resulted in a reduction in emissions from tank controls, as well as truck traffic**
  - **Installation of solar pumps**

Additional Mitigation Activities



AECOM

Additional Mitigation Activities

- **A number of additional NO_X emission mitigations have already taken place (con't):**
  - **Plains Exploration Company's Eagle Prospect Project (PXP) lease buy-out**
  - **Emission avoidance of as much as 762.1 tpy NO_X[1]**
  - **Partially funded by Pinedale Anticline Mitigation and Monitoring Fund**
  - **Air quality was one basis for the PXP lease buy-out approval, along with wildlife mitigation**

[1] Alternative B, Phase 2 proposed action; DEIS, AQTSD for the Eagle Prospect and Noble Basin Master Development Plan; Table 2.1, Section 2.1.4, page 20. December 10, 2010.

Emissions Processing and Dispersion Modeling System Quality Assurance Review

- Emissions provided in the base case inventory report, and mitigated emissions, were processed into CALPUFF-ready format
- Model input files were developed from quality-assured template files and computer scripts that automate the process of generating the dozens of required input files
- CALPUFF output files were quality-checked against the original input data sources

Modeling Results – Base Case Impacts

Maximum impacts (did not consider 98th percentile)

=> 1 day over 1.0 ddv with a max impact of 1.009 ddv

YEAR	DAY	RECEPTOR	DV(Total)	DV(BKG)	DELTA DV	%_SO4	%_NO3	%_PMF	%_NO2
2008	71	68	4.264	3.255	1.009	0.13	84.39	4.72	10.76
2008	104	167	4.141	3.208	0.933	0.18	95.15	2.65	2.03
2008	69	68	4.188	3.255	0.933	0.16	89.80	3.58	6.47
2008	84	167	4.070	3.255	0.815	0.21	82.17	5.45	12.17
2008	83	68	4.029	3.255	0.774	0.18	90.39	3.45	5.99
2008	97	361	3.956	3.208	0.748	0.12	94.57	1.70	3.60
2008	70	68	3.989	3.255	0.734	0.11	88.12	3.77	8.00
2008	68	68	3.945	3.255	0.690	0.11	93.60	2.34	3.94
2008	92	361	3.874	3.208	0.666	0.11	93.91	2.02	3.95
2008	90	167	3.882	3.255	0.627	0.17	94.61	1.66	3.56
2008	82	68	3.855	3.255	0.600	0.18	93.77	2.15	3.90
2008	100	8	3.805	3.208	0.597	0.11	97.11	1.24	1.54
2008	93	167	3.783	3.208	0.575	0.14	93.34	2.03	4.49
2008	73	167	3.813	3.255	0.558	0.09	88.34	3.01	8.56
2008	95	167	3.744	3.208	0.536	0.16	90.83	2.86	6.15
2008	85	167	3.775	3.255	0.520	0.07	66.15	10.91	22.87
2008	61	460	3.750	3.255	0.495	0.20	91.68	2.76	5.36
2008	286	678	3.625	3.139	0.486	0.07	89.71	1.72	8.49
2008	52	167	3.748	3.275	0.473	0.81	43.70	20.08	35.41
2008	130	68	3.680	3.215	0.465	0.04	85.36	2.85	11.74
2008	46	167	3.728	3.275	0.452	0.40	33.31	19.60	46.68
2008	2	167	3.794	3.343	0.451	0.47	28.78	23.05	47.70

```
--- Number of days with Delta-Deciview  =>   1.00:         1
---             Largest Delta-Deciview  =              1.009
```


AECOM

Modeling Results – Mitigated Impacts

Maximum impacts (did not consider 98th percentile)

=> 0 days over 1.0 ddv with a max impact of 0.996 ddv

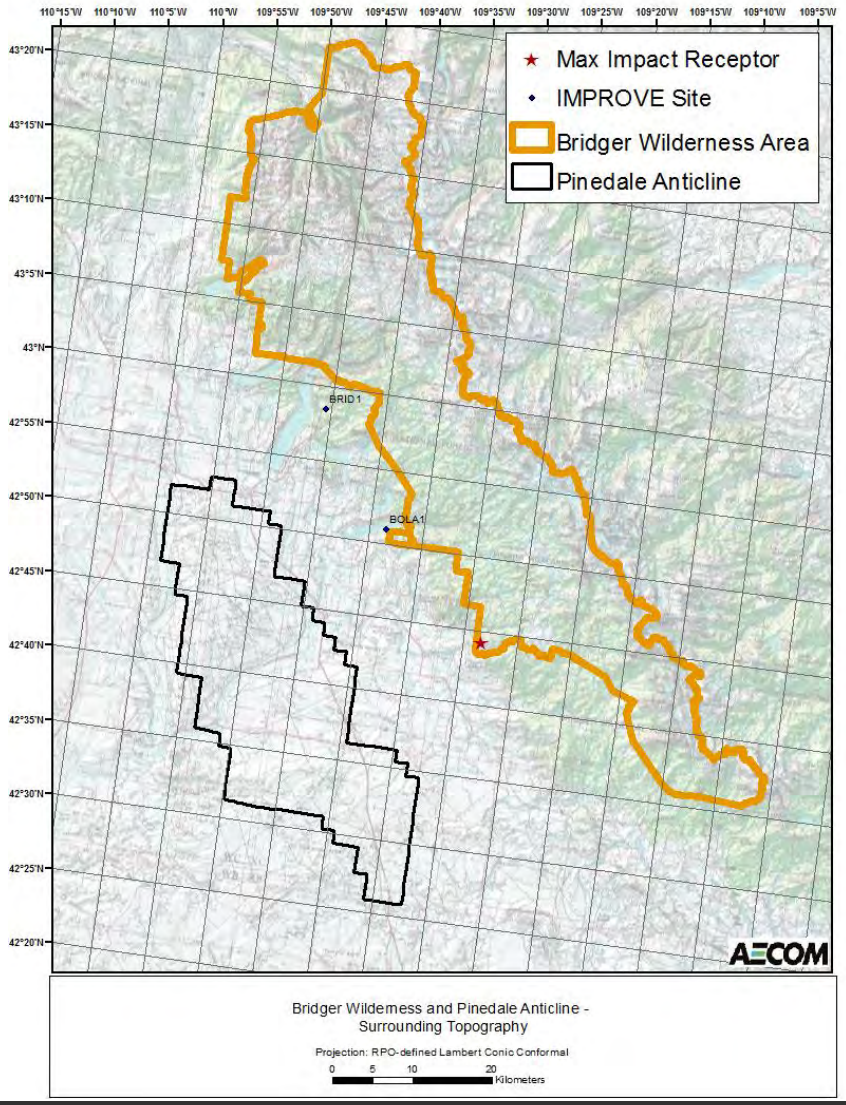
YEAR	DAY	RECEPTOR	DV(Total)	DV(BKG)	DELTA DV	%_SO4	%_NO3	%_PMF	%_NO2
2008	71	68	4.251	3.255	0.996	0.13	84.63	4.74	10.50
2008	69	68	4.173	3.255	0.918	0.16	90.02	3.57	6.24
2008	104	167	4.115	3.208	0.907	0.18	95.17	2.71	1.93
2008	84	167	4.051	3.255	0.796	0.20	82.51	5.49	11.80
2008	83	68	4.017	3.255	0.762	0.18	90.62	3.44	5.76
2008	97	361	3.939	3.208	0.731	0.12	94.65	1.71	3.52
2008	70	68	3.973	3.255	0.718	0.11	88.33	3.81	7.75
2008	68	68	3.934	3.255	0.679	0.11	93.73	2.36	3.80
2008	92	361	3.854	3.208	0.646	0.11	93.97	2.06	3.86
2008	90	167	3.872	3.255	0.618	0.16	94.78	1.63	3.43
2008	82	68	3.845	3.255	0.590	0.17	93.92	2.13	3.78
2008	100	8	3.792	3.208	0.584	0.11	97.14	1.25	1.50
2008	93	167	3.764	3.208	0.556	0.13	93.40	2.05	4.42
2008	73	167	3.802	3.255	0.547	0.09	88.48	3.02	8.41
2008	95	167	3.732	3.208	0.524	0.15	90.95	2.88	6.02
2008	85	167	3.746	3.255	0.491	0.07	65.85	11.53	22.55
2008	61	460	3.732	3.255	0.477	0.19	91.76	2.75	5.31
2008	286	678	3.602	3.139	0.463	0.07	89.72	1.76	8.45
2008	52	167	3.735	3.275	0.460	0.78	44.75	20.00	34.48
2008	130	68	3.662	3.215	0.447	0.04	85.25	2.90	11.80
2008	46	167	3.716	3.275	0.441	0.41	33.94	19.75	45.90
2008	2	167	3.779	3.343	0.436	0.46	29.34	23.25	46.94

```
--- Number of days with Delta-Deciview  =>   1.00:         0
---              Largest Delta-Deciview  =              0.996
```


AECOM

Modeling Results

- **Base case and mitigated impacts at same location**



Modeling Results

- **Key differences between the SEIS modeling inputs/methods compared to those described in the report:**
  - **More refined meteorological inputs were used in this ROD modeling, which consisted of 2008 4 km WRF prognostic data compared to the 36 km prognostic data used in the SEIS.**
  - **Concurrent ozone data was required when using 2008 meteorological data in this ROD modeling.**
  - **The source emission rates, locations, and spatial and temporal allocations were much more refined in this ROD modeling compared to the SEIS, and reflect the Operator's best estimate of future operations and emissions.**

Modeling Results

- **Key differences between the SEIS modeling inputs/methods compared to those described in the report (con't):**
  - **As required by the ROD, actual ambient ammonia concentrations were used in this ROD modeling rather than the default 1.0 parts per billion used in the SEIS.**
  - **Nitrate re-partitioning was employed in this ROD modeling, as approved in the modeling protocol.**
  - **The ROD visibility calculation methods followed the most recent version of the FLAG guidance (FLAG 2010), which has been updated since the SEIS to include the new IMPROVE equation among other things.**

Pinedale Anticline Record of Decision Milestone #3 Visibility Modeling **Compliance Timeline**

CHARIS TUERS, BLM AIR RESOURCE SPECIALIST

August 20, 2013

Compliance Timeline for Milestone #3 Visibility Goal

- **Compliance with Milestone #3 visibility goal will be determined in March 2015 when the Operators have successfully demonstrated that they have implemented emission reductions necessary to achieve zero days of visibility impairment over 1.0 ddv at the Bridger WA.**
- **The final demonstration will include an emissions inventory, which accounts for the field-wide emissions as of March 2015 and projects emissions from that point forward.**

Compliance Timeline for Milestone #3 Visibility Goal

- **The Operators will also submit a letter, which documents the specific technologies and/or methods for achieving the reductions associated with mitigation.**
- **During the 2014 Annual Planning Meeting, the Operators will provide an update of progress toward meeting the third visibility milestone.**
- **Absent an effective technology to achieve these reductions, adjustments in the pace or scale of development may be utilized to achieve zero days of modeled visibility impairment.**

Questions?