

**Drill Rig NO₂ Oil and Gas Field Study
2014 Colorado Field Study
2014 Colorado Model Evaluation Database
README File**

**Date: August 2020
Issued By: Colorado Field Study Workgroup**

Background and Next Steps:

The Drill Rig 1-hour Nitrogen Dioxide (NO₂) Collaborative Monitoring Study (2014 Colorado Field Study) was performed at two well pad sites in the Denver-Julesburg Basin near Platteville, Colorado over a six-week period in October and November of 2014. The objective of the study was to measure drill rig diesel generator emissions and associated ambient air concentrations in proximity to drill rigs to develop a model evaluation database. Ambient concentrations of NO₂ and oxides of nitrogen (NO_x) were measured continuously, along with various meteorological variables.

The 2014 Colorado Field Study was co-sponsored by the United States (U.S.) Bureau of Land Management (BLM) and the American Petroleum Institute (API). The Western States Air Resource Council (WESTAR) provided project oversight and was advised by a Study Management Team (SMT) with representation from BLM, API, the U.S. Environmental Protection Agency (EPA) and the Wyoming Department of Environmental Quality – Air Quality Division (WDEQ-AQD). The owner of the two well pads provided access to the test sites, while the drilling company provided logistical support to the contractor measurement teams. The Colorado Field Study Workgroup was formed to evaluate the data sets collected from the 2014 Colorado Field Study and to develop a model evaluation database. The agencies and organizations that participated in the workgroup included ERM, API, AECOM, Earth Systems Sciences (ESS), Bunyak Consulting (under contract with WESTAR), WESTAR-WRAP, City and County of Denver, EPA, and BLM.

The next steps for the Colorado Field Study Workgroup will be to initiate activities related to Phase 2 for the workgroup – data analysis and model evaluation using EPA’s AERMOD model and the 2014 Colorado Model Evaluation Database. The group will investigate AERMOD’s ability to predict air quality impacts resulting from drill rig operations based on the dispersion of total NO_x concentrations, downwash, and chemistry of NO_x to NO₂ conversion. The evaluations will include sensitivity studies and model to measurement comparisons. The 2014 Colorado Model Evaluation Database is also available for interested parties to conduct model evaluation studies.

These data sets and associated documents do not impose binding and enforceable requirements or obligations on any person or organization and are not final agency action. The development of the data sets does not imply any pre-approval for usage and no single or collection of data associated with this effort have been approved by any regulating agencies for air quality applications. These measurements of temporary sources do not reflect any violations of the 1-hour NO₂ National Ambient Air Quality Standard (NAAQS). The measurements taken during the 2014 Colorado Oil and Gas Drill Rig Field Study also reflect the emissions control technology that was used at the time of the study and not the emission control technology that may currently be used by oil and gas operators. The emissions from drilling rigs will continue to be reduced as the emission control technology continues to improve.

2014 Colorado Model Evaluation Database:

Measurement data collected during the 2014 Colorado Field Study and associated documentation were used to develop a model evaluation database (hereafter referred to as “2014 Colorado Model Evaluation Database”). The 2014 Colorado Model Evaluation Database consists of multiple datasets and supporting documentation. Briefly, the 2014 Colorado Model Evaluation Database contains the following data:

- Timeframe: October 10, 2014 to November 16, 2014.
- Sources: Two well pads with diesel-fired electric generators.
- Emissions: Continuous 5-minute and hourly emissions data and NO₂/NO_x in-stack ratios. Information on other local sources that could influence the monitoring data, such as generators for lighting, mobile sources, are also available.
- Meteorological Data: Continuous 5-minute and hourly meteorological data from on-site and off-site monitors, as well as representative upper air data observations.
- Pollutant Concentrations: Continuous 5-minute and hourly concentrations of NO_x, NO, NO₂, and ozone from on-site and off-site monitors.

The 2014 Colorado Model Evaluation Database includes the following files:

1. Main Documentation:

Technical Support Document (TSD) for the 2014 Colorado Model Evaluation Database and README file (this document):

- 2014_Colorado_ModelEvaluationDatabase_TSD.docx
- 2014_Colorado_ModelEvaluationDatabase_README.docx

2. Original Data Sets of the 2014 Colorado Field Study:

AECOM (a study contractor) collected the field study data and generated the original data sets. Amec Foster Wheeler (another study contractor) then conducted a Quality Assurance/Quality Control review of the AECOM data to generate a more refined data base. The Amec Foster Wheeler data base served as a starting point for the Colorado Field Study Workgroup's review and analysis of the field study data. These files are contained in the sub-folder titled “AFW_ORIGINAL_DATA” The .csv (text) files contain all 5-minute and hourly data including emissions, meteorology, and monitoring as noted in the file names. The spreadsheet provides descriptions of the fields contained in the .csv files:

- field_descriptions.xlsx
- emis_1h_fill.csv
- emis_5m_fill.csv
- met_1h_fill.csv
- met_5m_fill.csv
- monitor_1h_fill.csv
- monitor_5m_fill.csv

3. Supporting Documentation:

These reports provide additional details regarding the 2014 Colorado Field Study. These files are contained in the sub-folder titled “SUPPORTING_DOCUMENTATION”:

- WESTAR Drilling Rig 1-hour NO₂ and NO_x Emissions and Ambient Air Impacts, April 10, 2015, Revised August 7, 2018.
- Review of the Drill Rig 1-hour NO₂ Monitoring Study Data, Findings, Data Modification, and Work Completed, Contract No. 15-11. July 27, 2015.

4. Primary Hourly Data Sets of the 2014 Colorado Model Evaluation Database:

This comprehensive spreadsheet identifies all the calculations, substitutions, and interpolations carried out to develop the database. It also includes the original distribution files (as separate worksheets) for the purpose of comparison, and contains readme, index, and glossary worksheets that provide further detail regarding the spreadsheet contents. The primary source of information is in the consolidate worksheet, which contains all meteorological, emissions, and ambient data for each hourly period. The .csv file was created as a text file to contain all of the same data in a format that can be used as input to processing programs (python, R, etc).

- 2014_Colorado_ModelEvaluationDatabase_HOURLY.xlsx
- 2014_Colorado_ModelEvaluationDatabase_HOURLY_TEXT.csv

5. Primary 5-Minute Data Set of the 2014 Colorado Model Evaluation Database:

This spreadsheet contains a consolidated list of all 5-minute data developed from the original distribution files. No modifications were made to the 5-minute data (i.e. sub-hourly variations are not available for the hours when the hourly values were modified). Thus, any analysis that relies on the 5-minute data will be inconsistent with the final hourly data, and these inconsistencies should be noted accordingly. The primary source of information is in the consolidate worksheet, which contains all meteorological, emissions, and ambient data for each 5-minute period. The .csv file was created as a text file to contain all of the same data in a format that can be used as input to processing programs (python, R, etc).

- 2014_Colorado_ModelEvaluationDatabase_5min.xlsx
- 2014_Colorado_ModelEvaluationDatabase_5min_TEXT.csv

6. Vendor Files:

These files were obtained from public sources and contain certain emissions, stack, and operational data for the two types of generators used to power the drill rig. These data were used to provide a limited comparison with study data as explained in the TSD.

These files are contained in the sub-folder titled “SUPPORTING_DOCUMENTATION”:

- 3512b_CM20170327-10532-10349.pdf: CATERPILLAR 3512B Generator Set Electric Power Specifications; LEHE0301-04; Date: 21/03/2017; www.cat.com/electricpower
- C27_CM20170815-11465-45410.pdf: CATERPILLAR C27 Diesel Generator Sets; C27 PGBG; LEHE1212-03 (5-17); Date: 17/05/2017; www.cat.com/electricpower

7. Model Input Files and Associated Information Files:

These files were created to provide information on the physical layout of Pad 1 and Pad 2 including receptor locations, stack locations and characteristics, and building/structure information used to create downwash parameters. Receptor files that represent monitor locations, as well as 5-meter gridded receptors for each pad, to assist in evaluating spatial distribution patterns, are included. In addition, hourly ozone files, hourly emissions files, and hourly files containing background concentrations of NO_x and NO₂ are provided. All files are in a format compatible with U.S. EPA’s AERMOD model.¹ These files are contained in the sub-folder titled “MODEL_INPUT_FILES”. This folder also contains input files for the AERMET processor, along with spreadsheet files documenting the AERMET input files and the creation of hourly ozone and background concentrations. The file names are as follows:

- Pad1.src
- Pad2.src
- Pad1.rec
- Pad2a.rec
- Pad2b.rec

¹ AERMOD: <https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod>

- Pad2c.rec
- pad1_grid.rec
- pad2_grid.rec
- Pad1_BPIP.inp
- Pad2_BPIP.inp
- Pad1.bld
- Pad2.bld
- Colorado_HourlyNO₂_Pad1.dat
- Colorado_HourlyNO₂_Pad2.dat
- Colorado_HourlyNO_x_Pad1.dat
- Colorado_HourlyNO_x_Pad2.dat
- Colorado_NO_x_bg_ugm3_Pad1.dat
- Colorado_NO₂_bg_ugm3_Pad2.dat
- Colorado_NO_x_bg_ugm3_Pad1.dat
- Colorado_NO_x_bg_ugm3_Pad2.dat
- Colorado_NO₂_NO_x_ratios.txt
- Colorado_HourlyO₃_ppb_Pad1.dat
- Colorado_HourlyO₃_ppb_Pad2.dat
- Colorado_Ambient_Sequential_BackgroundAnalysis.xlsx
- Colorado_HourlyO₃_UpDownAnalysis.xlsx
- 2014_Colorado_ModelEvaluationDatabase_AERMET_Inputs_Readme.xlsx
- 2014_Colorado_ModelEvaluationDatabase_AERMET_Inputs.zip