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APPENDIX G
AIR RESOURCES MANAGEMENT PLAN

G.1 PURPOSE

The purposes of this Air Resources Management Plan (ARMP) are to:

1. Address air quality issues identified by the Bureau of Land Management (BLM) in its analysis of potential impacts on air quality resources for the Grand Junction Field Office (GJFO) Resource Management Plan and Environmental Impact Statement (RMP/EIS); and
2. Further clarify the air resources goals, objectives, and management actions set forth in Table 2-2 of the Draft RMP/EIS.

This ARMP describes air resources management actions and outlines BLM's commitments for managing air resources and authorized activities that have the potential to adversely impact air resources within the planning area. This plan also outlines specific requirements for proponents of projects that have the potential to generate air emissions and adversely impact air resources within the planning area.

G.2 GENERAL CONDITIONS

G.2.1 Modification of the ARMP

This ARMP may be modified as necessary to comply with law, regulation, and policy and to address new information and changing circumstances. Changes to the goals, objectives, or management actions set forth in the GJFO RMP/EIS would require maintenance or amendment of the RMP while changes to implementation, including modifying this ARMP, may be made without maintaining or amending the RMP.

G.2.2 BLM Responsibilities Under FLPMA and MLA

The BLM has the authority and responsibility under the Federal Land Policy and Management Act (FLPMA) to manage public lands in a manner that will protect the quality of air and atmospheric values. The BLM also has the responsibility under the Mineral Leasing Act (MLA) to implement the decisions of the GJFO DRMP/EIS in a manner that recognizes valid and existing leasing rights.

G.2.3 Actions to Protect Air Quality

The BLM may require specific actions and measures necessary to protect air resources and atmospheric values and in the absence of or in addition to effective control technologies, may manage the pace, place, density, and intensity of leasing and development to meet air quality goals and objectives.

G.2.4 Implementation of Control Measures

The BLM will ensure implementation of reasonable mitigation, control measures, and design features necessary to avoid significant impacts on air quality using appropriate mechanisms, including lease stipulations and conditions of approval, notices to lessees, and permit terms and conditions as provided for by law and consistent with lease rights and obligations.

G.2.5 Enforcement

The BLM will ensure air resource management strategies and control measures are enforceable by including implementation of this ARMP as a management action in the GJFO DRMP/EIS and by including project-specific conditions (both operator committed and required mitigation) in a Record of Decision (ROD) for each authorization.

G.2.6 National Air Quality MOU

The BLM will implement the provisions of this ARMP in accordance with the *Memorandum of Understanding Among the US Department of Agriculture, US Department of the Interior, and US Environmental Protection Agency, Regarding Air Quality Analyses and Mitigation for Federal Oil and Gas Decisions Through the NEPA Process*, signed June 23, 2011.

G.3 Air Quality Issues Identified for the Grand Junction Field Office

The air analysis included in the Grand Junction RMP/EIS identified potential air quality issues within the planning area. Air quality currently meets the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. However, air quality in this and neighboring airsheds and within this expanding oil and gas development region appears to be changing, as evidenced by recent ozone monitoring data from regulatory and non-regulatory monitors located within and north and northwest of the planning area. Visibility measurements near the planning area showed improved visibility conditions over the last several years. Atmospheric deposition monitoring has remained consistent over the last several years. However, the potential for future growth in mining and oil and gas development activities within the planning area from both BLM actions and non-

federal actions could adversely affect air quality in the region. The analysis identified the following specific issues:

- *Pollutants of Concern:* Elevated concentrations of $PM_{2.5}$ were measured within the planning area.[1]Elevated concentrations of ozone measured within the planning area have been observed in recent years. [2] In addition, the EPA issued a final rule April 30, 2012 designating Duchesne and Uintah counties of northwestern Utah as an ozone "unclassifiable" area. This designation implies that high background levels of ozone may be transported into the planning area and surrounding regions, and thus warrants the need for regional approaches to air quality management and ozone precursor mitigation.;
- *Magnitude of Estimated Emissions:* Significant increases in volatile organic compounds, NO_x, $PM_{2.5}$, and hazardous air pollutants were estimated to occur in the future from BLM authorized activities under Alternative D and for BLM and non-federal activities combined for all alternatives;
- *Emission Generating Activities:* Increases in emissions from coal mining, uranium mining, oil and gas development, and off-highway vehicle use were identified as having the potential to contribute to adverse air quality impacts;
- *Geographic Areas of High Potential:* Future oil and gas development and continued existing development is predicted to occur in the northwest portion of the planning area in the lower portion of the Piceance Basin. Existing and future development may expand in the northeast portions of the planning area with the advancement of drilling technologies. Emissions from these areas have the potential to add to elevated ozone concentrations being observed in the Piceance Basin as well as cause impacts at several Class I areas to the north and west. Potential future coal mining activities in the central portion of the planning area and uranium mining activities in several areas of high development potential could result in localized impacts from fugitive dust and could contribute to regional ozone formation.

G.4 ADAPTIVE MANAGEMENT FOR AIR RESOURCES

Adaptive management incorporates the principles of monitoring current conditions, predicting future impacts, and adapting management strategies to account for changing conditions. An adaptive air quality management approach allows the BLM to comply with NEPA and take the time necessary to complete

[1] Elevated concentrations are above background concentrations but below the NAAQS.
[2] At the Palisade monitor within the planning area and at the Rifle and Rangely monitors adjacent to the planning area, as at the Redwash and Ouray monitors nearby in Utah's Uintah Basin.

analyses to ensure that activity supported by a ROD avoids significant impacts, to air quality; while allowing for development of important domestic energy resources.

The BLM will implement the following adaptive management strategies to account for changing conditions and to protect air quality for the duration of the RMP. The strategy includes evaluating and addressing air quality on an on-going basis, including prior to the completion of supporting modeling. Components of this adaptive management strategy include 1) emissions tracking; 2) annual reviews of air resources management data; 3) annual analyses of current air resources management strategies; 4) identification and implementation of mitigation measures; (See Section G.8); and, 5) evaluation of the need for modifications to this ARMP.

G.4.1 Interim Air Resources Management Strategy

During the period between signing of the ROD for the GJFO Final RMP/EIS and the completion of the air resources modeling study to be conducted under Section G.9.0, the BLM commits to the following interim air resources management measures:

- BLM authorized oil and gas development activities within the planning area will not exceed development rates as averaged over the 5 year period immediately prior to signing of the ROD;
- If a monitored exceedance of a NAAQS or a CAAQS occurs at any State and Local Air Monitoring System (SLAMS) monitor located within the planning area, enhanced mitigation measures will be evaluated and selected as appropriate by the BLM, in cooperation with the CDPHE and EPA. The BLM will act to implement enhanced mitigation based on CDPHE's determination that the exceedance was not caused by an exceptional event and that federally authorized oil and gas activities caused or contributed to the exceedance. In this situation, the BLM will consider implementing the measures listed in Table G-1; and
- If a monitored exceedance of a NAAQS or CAAQS occurs at any SLAMS monitor located within the planning area, the BLM may request operators of oil and gas activities on federal lands within the planning area to implement contingency plans as described under G.8.3.

G.4.1 Emissions Tracking

Within one year of signing the ROD for the GJFO Final RMP/EIS, the BLM will establish and implement a mechanism to track annual emissions of criteria pollutant and volatile organic compound emissions from BLM authorized oil and gas activities within the planning area. The methods for tracking emissions will be developed in collaboration with the Colorado Department of Public Health and the Environment, Air Pollution Control Division (CDPHE) and with input from the Environmental Protection Agency (EPA) and the Colorado Oil and Gas

Conservation Commission (COGCC). The BLM will use reported emissions data to track total emissions from BLM authorized oil and gas and other activities within the planning area as a component of its adaptive management strategy.

G.4.2 Annual Review of Air Resources Data

Within one year of signing the ROD for the GJFO Final RMP/EIS, and annually thereafter, the BLM will conduct a review of relevant air resources management data in order to implement the adaptive management strategy included in this section. This annual review will include the following tasks:

a. Evaluation of current air monitoring data and trends from air monitoring sites located within the planning area or potentially affected area to determine the status of current air quality conditions within the planning area including measured concentrations approaching or exceeding National and Colorado Ambient Air Quality Standards (NAAQS and CAAQS);

b. Evaluation of current air monitoring data and trends from air monitoring sites located within the planning or potentially affected area to determine the status of current air quality conditions within the planning area including measured adverse impacts on air quality related values in Class I areas or sensitive Class II areas (as identified on a case-by-case basis by CDPHE, a federal land management agency, or tribal agency);

c. Initiate consultation with CDPHE, EPA, and other local, state, federal, and tribal agencies with responsibility for managing air resources to address appropriate responses to monitored exceedances of a NAAQS at any State and Local Air Monitoring System (SLAMS) monitor located within or affected by the planning area. Response to monitored exceedances may include modifications to this ARMP including additional modeling and mitigation requirements;

d. Review of annual emissions data from BLM authorized oil and gas activities within the planning area and comparison to emission levels analyzed in the GJFO RMP/EIS and the modeling study to be conducted under Section G.9.0, or the most recent interagency air impacts analysis;

e. Review of BLM authorized oil and gas activities within the planning area in the previous 12 months and comparison to the level of development analyzed in the GJFO RMP/EIS and the modeling study to be conducted under Section G.9.0, or the most recent interagency air impacts analysis, including number of wells drilled, number of producing wells, compressor stations installed, and centralized liquids gathering and gas treatment facilities constructed;

f. Evaluation of available oil and gas development projections received or identified within the planning area in the previous 12 months, for the coming three to five year period and comparison to the level of predicted future development analyzed in the GJFO RMP/EIS and the modeling study to be conducted under Section G.9.0, or the most recent interagency air impacts analysis; and,

g. Review of air quality modeling results from impact analyses conducted by BLM, CDPHE, or other federal or tribal agencies within the previous 12 months that affect or are affected by BLM-authorized activities within the planning area.

h. The BLM will provide a summary of the annual review analysis and make this available to the public.

G.4.3 Analysis of Current Air Resource Management Strategies

Based on the annual review of air resources management data (see Section G.4.2), the BLM, with input from other agencies involved in the authorization of oil and gas development activities or the management of air resources, will determine whether the air analysis conducted for the GJFO RMP/EIS and the modeling study conducted under Section G.9.0 (or the most recent interagency air impacts analysis) should be updated. Based on the emissions tracking, air monitoring data, air resources management modeling study, or other relevant air modeling data, and development projections, BLM will determine whether current air resources management strategies are meeting the goals and objectives established in the GJFO RMP/EIS. The BLM in collaboration with CDPHE and the EPA will adapt management strategies as necessary to effectively manage air resources within the planning area.

G.4.4 Modification of ARMP

Based on the annual review of air resources management data and evaluation of current strategies under Section G.4.3, BLM will determine whether this ARMP should be modified.

G.5 PERMITTING

G.5.1 Air Analysis for Authorized Activities

The BLM will, prior to authorization of any oil and gas development activity or other activity with the potential to generate emissions of regulated air pollutants, conduct an air analysis to determine the magnitude of potential emissions from the activity and address potential impacts on air quality.

G.5.2 Criteria for Informing Decisions

The BLM will consider the following criteria to identify pollutants of concern and inform decisions regarding the appropriate level of air analysis to be conducted for oil and gas development activities and may consider these criteria for other activities with the potential to generate emissions of regulated air pollutants:

a. magnitude of potential air emissions from the proposed activity;

b. duration of proposed activity;

c. proximity to a federally mandated Class I area, sensitive Class II area (as identified on a case-by-case basis by CDPHE or a federal land management or tribal agency), population center, or other sensitive receptor;

d. location within or adjacent to a non-attainment or maintenance area;

e. meteorological and geographic conditions;

f. existing air quality conditions including measured exceedances of NAAQS or CAAQS and measured adverse impacts on air quality related values;

g. intensity of existing and projected development in the area; and

h. issues identified during project scoping.

G.5.3 Emissions Inventory

The BLM will require the proponent of an oil and gas development activity as proposed in a permit application, plan of development, or Master Development Plan to submit an emissions inventory of direct and indirect emissions associated with the proposed project. BLM may require submittal of an emissions inventory for other proposed activities such as solid mineral development that have the potential to generate emissions of regulated air pollutants. The emissions inventory will include estimated emissions of regulated air pollutants from all sources related to the proposed activity, including fugitive emissions and greenhouse gas emissions, for each year for the life of the project. The BLM will review the emissions inventory to determine its completeness and accuracy. Emission control measures included in the emissions inventory assumptions and relied upon to determine project impacts, will become Operator Committed Measures in the Record of Decision for the authorized activity. If such emission control assumptions do not lend themselves to mitigation measures that can be enforced via stipulations, BLM will require other mitigation measures with a similar air quality benefit.

G.5.4 Emissions Reduction Plan

The BLM will require the proponent of an oil and gas development project that has the potential to emit any regulated air pollutant to provide an emissions reduction plan that includes a detailed description of operator committed measures to reduce project related air pollutant emissions including greenhouse gases and fugitive dust. BLM may require submittal of an emissions reduction plan for other proposed activities such as solid mineral development that have the potential to generate emissions of regulated air pollutants. Project proponents for oil and gas development projects should refer to **Appendix H**, Best Management Practices and Standard Operating Procedures, as a reference

for potential emission reduction technologies and strategies. The list is not intended to preclude the use of other effective air pollution control technologies that may be proposed. Details of operator committed measures submitted by the applicant will be included in and enforced as a condition of the BLM-issued authorization.

G.5.5 Submission of Actual Emissions Data

The BLM will include, as a Condition of Approval for an oil and gas authorization, a requirement that the proponent submit actual emissions data on a periodic basis for criteria pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gas emissions related to the authorized action if the air analysis results show that the project has the potential to cause adverse impacts. BLM may request this data from all oil and gas authorizations to evaluate progress in meeting air quality goals. Emissions data submitted to CDPHE as required in applicable air permits, drilling and production data provided to COGCC, and emissions data submitted to EPA under the Greenhouse Gas Reporting Rule (40 CFR Part 98 Subpart W) will be accepted. The BLM may require or request actual emissions submittals from other emission generating activities such as solid mineral development as determined on a case-by-case basis using the criteria in Section G.5.2.

G.6 MONITORING

The BLM recognizes that ambient air monitoring provides valuable data for determining current and background concentrations of air pollutants, describing long term trends in air pollutant concentrations, and evaluating the effectiveness of air control strategies. As part of a comprehensive air management plan for the planning area, the BLM commits to the measures described in this section with regards to ambient air monitoring.

G.6.1 Air Monitoring Network

The BLM will facilitate a cooperative effort with industry, CDPHE, Forest Service, National Park Service, EPA, local counties, or other entities to establish, fund, operate, and maintain a comprehensive air monitoring network within the planning area and potentially affected areas. The BLM will facilitate the sharing of air monitoring data collected by the air monitoring network with other agencies and the public.

G.6.2 Pre-Construction Air Monitoring

The BLM may require project proponents of oil and gas development proposals or proponents of other emission generating projects, such as solid mineral development, to submit pre-construction air monitoring data from a site within or adjacent to the proposed development area. The purpose of this air monitoring is to establish baseline air quality conditions prior to development at the site. The requirement for monitoring will be determined by BLM based on the absence of existing representative air monitoring data and the criteria listed in Section G.5.2 of this ARMP. If BLM determines that baseline monitoring is

necessary, the project proponent must provide a minimum of one year of baseline ambient air monitoring data for the pollutants of concern obtained from a site that meets CDPHE air monitoring standards within 50 km of the project boundary, and that covers the year immediately prior to the proposed project submittal. The project proponent will be responsible for siting, installing, operating, and maintaining any air monitoring equipment in the absence of existing representative air monitoring data.

G.6.3 Life of Project Air Monitoring

The BLM may require proponents or operators of oil and gas development projects or proponents of other emission generating projects such as solid mineral development to conduct air monitoring for the life of the project based on the absence of representative air monitoring data and the criteria listed in Section G.5.2 of this ARMP. The purpose of this air monitoring is to determine impacts attributable to the project over time and to determine the effectiveness of BLM's management actions related to the project. The project proponent will be responsible for siting, installing, operating, and maintaining any air monitoring equipment in the absence of existing representative air monitoring .

G.6.4 Collaboration with CDPHE on Air Monitoring Data

The BLM will work cooperatively with CDPHE to determine a mechanism to submit, track, and approve pre-construction and life of project air monitoring siting and operation and monitoring data. BLM will work with CDPHE to ensure that ambient air monitoring data collected as a condition of approval for BLM authorized activities will be made publicly available.

G.7 MODELING

The BLM recognizes that air dispersion and photochemical grid models are useful tools for predicting project-specific impacts on air quality, predicting the potential effectiveness of control measures and strategies, and for predicting trends in regional concentrations of air pollutants. As part of a comprehensive air management plan for the planning area, the BLM commits to the measures described in this section with regards to air quality modeling.

G.7.1 Modeling and Adaptive Management

The BLM has identified air modeling as a significant component of its adaptive management strategy for managing air resources as outlined in Section G.4.0 of this ARMP. The BLM will use regional air modeling as described in Section G.9.0 and project-specific modeling as determined necessary under Section G.7.2 in conjunction with other air analysis tools for developing air resource management strategies as part of its approach to fulfill responsibilities under FLPMA and to evaluate direct, indirect, and cumulative impacts under NEPA.

G.7.2 Project-specific Modeling

The BLM may require that project-specific air quality modeling be conducted to analyze potential impacts from a proposed oil and gas development project or other proposed activities such as solid mineral development that have the

potential to emit regulated air pollutants. Air quality modeling may be required for pollutants of concern in the absence of other available data to ensure compliance with laws and regulations or to determine the effectiveness of air emission control strategies. The BLM may allow project proponents to provide results from other modeling analyses that include the proposed project upon review and approval by BLM. The BLM will not require an air modeling analysis when the project proponent can demonstrate that the project will result in no net increase in emissions of the pollutants of concern. The decision for conducting air quality modeling will be based on criteria listed in Section G.5.2 of this ARMP.

G.7.3 Modeling Protocol

The BLM will determine the parameters required for a project-specific modeling analysis through the development of a modeling protocol for each analysis.

G.7.4 Regional Air Modeling

The BLM will support and participate in regional modeling efforts through multi-state and/or multi-agency organizations such as Western Governors' Association – Western Regional Air Partnership (WRAP) and the Federal Leadership Forum (FLF). In addition, BLM will, contingent upon available funding, conduct and facilitate regional air modeling as outlined in Section G.9.0.

G.8 MITIGATION

The BLM recognizes that many of the activities that it authorizes, permits, or allows generate air pollutant emissions that have the potential to adversely impact air quality. The primary mechanism to reduce air quality impacts is to reduce emissions (mitigation). Identification and implementation of appropriate emission reduction measures is effective at the project authorization stage where the proposed action is defined in terms of temporal and spatial characteristics and technological specifications. The project-specific information allows for the development of an emissions inventory and impact analysis which is used to determine effective mitigation in response to identified adverse impacts. The BLM commits to the measures described in this section for reducing emissions from its authorized activities.

G.8.1 Project-specific Mitigation

The BLM will require air quality mitigation measures and strategies within its authority (and in consultation with local, state, federal, and tribal agencies with responsibility for managing air resources) in addition to regulatory requirements and proponent committed emission reduction measures, and for emission sources not otherwise regulated by CDPHE or EPA, if the air quality analysis shows potential future impacts on NAAQS or CAAQS or impacts above specific levels of concern for air quality related values in Class I or sensitive Class II areas (as identified on a case-by-case basis by CDPHE or a federal land management or tribal agency) due to the proposed project.

Development Prior to Completion of Modeling

During the period between the signing of the ROD for the GJFO Final RMP/EIS and the completion of the regional air quality modeling study conducted under Section G.9.1, the BLM will not allow BLM authorized oil and gas development activities within the planning area to exceed development rates as averaged over the 5 year period immediately prior to signing the ROD.

G.8.2 Minimizing Air Emissions

The proponent of an oil and gas development project will be required to minimize air pollutant emissions by:

a. complying with all applicable state and federal regulations (including application of best available control technology);

b. submitting an emissions reduction plan (Section G.5.4); and

c. applying mitigation including but not limited to best management practices, emissions offsets, and other control technologies or strategies identified in an air quality analysis (Section G.5.1) or comprehensive interagency air resources management strategy (Section G.9.5.1) and as otherwise required by BLM if the regional air quality modeling study conducted under Section G.9.1 predicts significant cumulative impacts on air resources.

G.8.3 Contingency Plan

The BLM may require project proponents for oil and gas development projects, or other proposed activities with the potential to generate substantial air emissions, to submit a contingency plan that provides for reduced operations in the event of an air quality episode such as a monitored exceedance. Specific operations and pollutants to be addressed in the contingency plan will be determined by the BLM on a case-by-case basis taking into account existing air quality and pollutants emitted by the project. Examples of temporary episode response control measures that could be included in operator committed contingency plans and that may be appropriate to implement immediately after an air quality episode include:

- Temporarily reducing drilling operations during specified periods;
- Temporarily reducing completion or well stimulation operations during specified periods;
- Limiting or controlling blowdowns during specified periods; and
- Limiting other non-essential emission generating operations during specified periods.

BLM may require project proponents to include in the contingency plan, emission control measures that could be implemented in the event of a monitored ozone violation. Examples of violation response control measures

that may be appropriate to implement within one year of a monitored NAAQS violation include:

- Using improved (low emission) engine technology on drill rig, completion, and compressor engines;
- Constructing centralized gathering facilities for product treatment and storage;
- Installing plunger lift systems with smart automation;
- Employing a monthly FLIR program to reduce VOCs;
- Enhancing a direct inspection and maintenance program;
- Tank load out vapor recover; and
- Enhanced VOC emission controls on production equipment.

G.9 COMPREHENSIVE INTERAGENCY AIR RESOURCES MANAGEMENT STRATEGY

Based on the air emissions analysis conducted for this RMP, BLM has identified the potential for adverse impacts on air quality from BLM's projected oil and gas authorizations combined with projected oil and gas development outside of BLM's jurisdiction. The BLM will work collaboratively with other local, state, federal, and tribal agencies involved in the authorization of oil and gas development and the management of air resources to develop a comprehensive strategy to manage air quality impacts from oil and gas development in western Colorado.

G.9.1 Western Colorado Air Resources Management Modeling Study

BLM will conduct a regional air quality modeling study entitled the Western Colorado Air Resources Management Modeling Study (West-CARMMS), within 12 months of signing the GJFO Final RMP/EIS ROD, to assess predicted impacts on air quality from projected increases in oil and gas development.

a. The West-CARMMS will be funded and managed by BLM. The study will be designed and a modeling protocol developed with involvement from appropriate local, state, federal, and tribal agencies involved in the management of air resources and the authorization and regulation of oil and gas development.

b. The West-CARMMS will include potential impacts using projections of oil and gas development up to a maximum of ten years in the future to reflect realistic estimations of development projections and technology improvements.

c. The West-CARMMS results will include the predicted impacts from projected BLM oil and gas authorizations within the GJFO as well as cumulative impacts from all projected oil and gas development within the region.

d. The West-CARMMS results for the cumulative analysis of oil and gas development impacts will be made available to all agencies involved in oil and gas development and air resource management as a key component of developing the comprehensive air resources management strategy.

e. The West-CARMMS results and analysis will be made publicly available.

G.9.2 Interagency Evaluation of Modeling Results

The BLM will facilitate an interagency process to ensure that a comprehensive strategy is developed to manage air quality impacts from future oil and gas development within the region. The local, state, federal, and Tribal agencies involved in the regulation of air quality and the authorization of oil and gas development would evaluate modeling results from West-CARMMS or other future modeling studies and identify potential air quality concerns and necessary reductions in air emissions. If the modeling predicts significant impacts, these agencies would use their respective authorities to implement enhanced emission control strategies, operating limitations, equipment standards, and/or pacing of development as necessary to ensure continued compliance with applicable ambient air quality standards, including those Best Management Practices listed in section G.10.

G.9.3 Future Modeling Studies

Future updates to the West-CARMMS to assess impacts from oil and gas development may be conducted through a collaborative interagency funding and management mechanism for the study.

G.10 Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Table G-1 displays the emission reduction measures, their potential environmental benefits and liabilities, and feasibility.

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Control Strategies for Drilling and Compression			
Multi-well pad directional or horizontal drilling.	When compared to single pad vertical drilling, reduces construction related emissions, decreases surface disturbance, reduces habitat fragmentation.	Could result in higher air impacts in one area with longer sustained drilling times.	Depends on geological strata.

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Improved engine technology (Tier 2 or 4) for diesel drill rig engines.	Reduced NOx, PM, CO, and VOC emissions.		Dependent on availability of technology from engine manufacturers.
Selective Catalytic Reduction (SCR) for drill rig engines and/or compressors.	NO_x emissions reduction, potential decreased formation of visibility impairing compounds and ozone. NOx control efficiency of 95% achieved on drill rig engines. NOx emission rate of 0.1 g/hp-hr achieved for compressors.	Potential NH3 emissions and formation of visibility impairing ammonium nitrate. Regeneration/disposal of catalyst can produce hazardous waste.	Not applicable to 2-stroke engines.
Non-selective catalytic reduction (NSCR) for drill rig engines and/or compressors.	NOx emissions reduction, potential decreased formation of visibility impairing compounds, and ozone. NOx control efficiency of 80-90% achieved for drill rig engines. NOx emission rate of 0.7 g/hp-hr achieved for compressor engines greater than 100 hp.	Regeneration/disposal of catalysts can produce hazardous waste.	Not applicable to lean burn or 2-stroke engines.
Natural Gas fired drill rig engines.	NOx emissions reduction, potential decreased formation of visibility impairing compounds, and ozone.	May require construction of infrastructure (pipelines and/or gas treatment equipment). May require onsite gas storage. May require additional engines to supplement needed torque.	Requires onsite processing of field gas.
Electrification of drill rig engines and/or compressors	Decreased emissions at the source. Transfers emissions to more efficiently controlled source (EGU).	Displaces emissions to EGU. Temporary increase in emissions with construction of power lines.	Depends on availability of power and transmission lines.

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Improved engine technology (Tier 2, 3 or 4) for all mobile and non-road diesel engines.	Reduced NOx, PM, CO, and VOC emissions.		Dependent on availability of technology from engine manufacturers.
Reduced emission (a.k.a. "green") completions.	Reduction in VOC and CH4 emissions. Reduces or eliminate flaring and venting and associated emissions. Reduces or eliminates open pits and associated evaporative emissions. Increased recovery of gas to pipeline rather than atmosphere.	Temporary increase in truck traffic and associated emissions due to delivery of onsite equipment or due to construction of infrastructure.	Need adequate pressure and flow. Need onsite infrastructure (tanks/dehydrator). Availability of sales line. Green completion required where feasible per COGCC Rule 805(b)(3) and NSPS 40 CFR 63 OOOO.
Flaring of completion emissions	Reduces methane, VOC, and some HAP emissions	Converts CH4 to CO2	
Minimize/eliminate venting and/or use closed loop process where possible during "blow downs".	Reduces methane, VOC, and some HAP emissions		
Eliminate evaporation pits for drilling fluids.	Reduces VOC and GHG emissions. Reduces potential for soil and water contamination. Reduces odors.	May increase truck traffic and associated emissions. May increase pad size.	Requires tank and/or pipeline infrastructure.
Electrification of wellhead compression/ pumping.	Reduces local emissions of fossil fuel combustion and transfers to more easily controlled source.	Displaces emissions to EGU.	Depends on availability of power and transmission lines.
Wind (or other renewable) generated power for compressors.	Low or no emissions.	May require construction of infrastructure. Visual impacts. Potential wildlife impacts.	Depends on availability of power and transmission lines.
Compressor seals – replace wet with dry or use mechanical seal.	Reduce gas venting (VOC and GHG emissions).		May be costly or not mechanically feasible.

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Compressor rod packing system – use monitoring and replacement system.	Reduce gas leaks (VOC and GHG emissions).		Requires establishing a monitoring system and doing replacements.
Control Strategies Utilizing Centralized Systems			
Centralization (or consolidation) of gas processing facilities (e.g., separation, dehydration, sweetening).	Reduces vehicle miles traveled (truck traffic) and associated emissions. Reduced VOC and GHG emissions from individual dehydration/ separator units.	Temporary increase in construction associated emissions. Higher potential for pipe leaks/groundwater impacts.	Requires pipeline infrastructure.
Liquids Gathering systems (for condensate and produced water).	Reduces vehicle miles traveled and associated emissions. Reduced VOC and GHG emissions from tanks, truck loading/unloading, and multiple production facilities.	Temporary increase in construction associated emissions. Higher potential for pipe leaks/groundwater impacts.	Requires pipeline infrastructure.
Water and/or fracturing liquids delivery system.	Reduced long term truck traffic and associated emissions.	Temporary increase in construction associated emissions. Higher potential for pipe leaks/groundwater impacts.	Requires pipeline infrastructure. Not feasible for some terrain.
Control Strategies for Tanks, Separators, and Dehydrators			
Eliminate use of open top tanks.	Reduced VOC and GHG emissions.		
Capture and control of flashing emissions from all storage tanks and separation vessels with vapor recovery and/or thermal combustion units.	Reduces VOC and GHG emissions.	Pressure build up on older tanks can lead to uncontrolled rupture.	

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Capture and control of produced water, crude oil, and condensate tank emissions.	Reduces VOC and GHG emissions.		95% VOC control required by COGCC in some areas and by CDPHE statewide with applicability thresholds
Capture and control of dehydration equipment emissions with condensers, vapor recovery, and/or thermal combustion.	Reduces VOC, HAP, and GHG emissions.		90% VOC control required by COGCC in some areas and by CDPHE statewide with applicability thresholds
Use zero emissions dehydrators or use desiccants dehydrators.	Reduces VOC, HAP, and GHG emissions.	Requires desiccants (salt tablets and forms a brine solution that must be disposed of.	Can be as effective as Triethylene glycol (TEG) dehydration.
Control Strategies for Misc. Fugitive VOC Emissions			
Install plunger lift systems to reduce well blow downs.	Reduces VOC and GHG emissions.		Can be more efficient at fluids removal than other methods, must have adequate pressure.
Install and maintain low VOC emitting seals, valves, hatches on production equipment.	Reduces VOC and GHG emissions.		
Initiate equipment leak detection and repair program (e.g., including use of FLIR infrared cameras, grab samples, organic vapor detection devices, and/or visual inspection).	Reduction in VOC and GHG emissions.		
Install or convert gas operated pneumatic devices to electric, solar, or instrument (or compressed) air driven devices/controllers.	Reduces VOC and GHG emissions.	Electric or compressed air driven operations can displace or increase combustion emissions.	

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Use "low" or "no bleed" gas operated pneumatic devices/controllers.	Reduces VOC and GHG emissions.		Required by COGCC and by CDPHE in non-attainment area.
Use closed loop system or thermal combustion for gas operated pneumatic pump emissions.	Reduces VOC and GHG emissions.		
Install or convert gas operated pneumatic pumps to electric, solar, or instrument (or compressed) air driven pumps.	Reduces VOC and GHG emissions.	Electric or compressed air driven operations can displace or increase combustion emissions.	
Install vapor recovery on truck loading/unloading operations at tanks.	Reduces emissions of VOC and GHG emissions.	Pressure build up on older tanks can lead to uncontrolled rupture.	
Control Strategies for Fugitive Dust and Vehicle Emissions			
Unpaved surface treatments including watering, chemical suppressants, and gravel.	20% - 80% control of fugitive dust (particulates) from vehicle traffic.	Potential impacts to water and vegetation from runoff of suppressants.	
Use remote telemetry and automation of wellhead equipment.	Reduces vehicle traffic and associated emissions.		
Speed limit control and enforcement on unpaved roads.	Reduction of fugitive dust emissions.		
Reduce commuter vehicle trips through car pools, commuter vans or buses, innovative work schedules, or work camps.	Reduced combustion emissions, reduced fugitive dust emissions, reduced ozone formation, reduced impacts to visibility.		
Miscellaneous Control Strategies			
Use of ultra-low sulfur diesel (e.g., in engines, compressors, construction equipment).	Reduces emissions of particulates and sulfates.		Fuel not readily available in some areas.

Table G-1
Best Management Practices and Air Emission Reduction Strategies for Oil and Gas Development

Emission Reduction Measure	Potential Environmental Benefits	Potential Environmental Liabilities	Feasibility
Reduce unnecessary vehicle idling.	Reduced combustion emissions, reduced ozone formation, reduced impacts to visibility, reduced fuel consumption.		
Reduced pace of (phased) development.	Peak emissions of all pollutants reduced.	Emissions generated at a lower rate but for a longer period. LOP, duration of impacts is longer.	May not be economically viable or feasible if multiple mineral interests.

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