Air Quality EPA Guidance for Oil and Gas Leasing
USFS Region 1

Mark T. Story
Hydrologist, Gallatin NF

Several National Forests in Region 1 will be required to conduct oil and gas leasing NEPA analysis during the next several years. The demands for more specific air quality impact disclosure in NEPA documents is increasing due to public interest, EPA direction, and the recent EPA conformity regulations. Several Forests will be faced with oil and gas leasing decisions associated with the next round of Forest Plan update.

The purpose of this guidance is to explain air quality considerations and outline methods for disclosure and analysis of oil and gas development in NEPA documents. This guidance consists of 2 sections-- Chapter III Affected Environment and Chapter IV Environmental Consequences. This document is designed to be used for site specific, area, and Forest wide oil and gas leasing NEPA disclosures. Several parts of this document (such as regulatory framework) can be directly read into NEPA documents. The level of disclosure will depend on the scope and issues of the NEPA document and specitivity of the reasonable development scenarios (RFD's).

CHAPTER III

REGULATORY FRAMEWORK

Air quality is managed through a complex series of federal and state laws and regulations. The primary federal acts include the Air Quality Act of 1967 which was followed by Clean Air Act Amendments in 1970, 1977, and 1990. The Clean Air Act Amendments of 1970 established uniform National Ambient Air Quality Standards (NAAQS). The amendments of 1977 established the Prevention of Significant Deterioration (PSD) process which sets increments of allowable increases in air quality for nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), and total suspended particulates (TSP). The Environmental Protection Agency (EPA) has the primary federal role of insuring compliance with the requirements of the Clean Air Act. The EPA issues national air quality regulations, approves and oversees state implementation plans, and conducts major enforcement actions. State air pollution control agencies have the primary responsibility for carrying out the requirements of the Clean Air Act through the development and execution of State Implementation Plans (SIP), which must provide for the attainment and maintenance of air quality standards.

MONTANA

The Clean Air Act of Montana (1980, 1983) is administered by the Air Quality Bureau (AQB) of the Department of Health and Environmental Sciences. The AQB's responsibilities include establishing emission control requirements and air quality standards, granting permits to facilities which are sources of regulated air pollutants, and monitoring ambient air quality at several locations throughout Montana. Major proposed projects which have the potential to emit more than 25 tons per year of any pollutant must obtain an air quality permit before beginning construction. The applicant also must demonstrate that the project will not violate state or federal Ambient Air Quality Standards. The air quality standards that typically would be relevant to oil and gas drilling and production apply to emissions of sulfur dioxide, carbon monoxide, nitrogen oxide, and fugitive particulates (TSP) such as dust. Other air quality regulations include those controlling hydrogen sulfide. Most drilling rigs are excluded from the Montana permit requirement procedures if the combined emissions of various diesel engines and turbines used in the operation do not emit more than 100 tons per year of any pollutant (most notably nitrogen oxide) regulated under the Montana Clean Air Act (State of Montana, Air Quality Rules, ARM 16.8 1102-k). Drilling operation emissions are generally exempt from the air quality permit requirements because they are of short duration and are likely to be 100 tons or less. However, drilling operations that require large rigs (greater than 2000 horsepower) which operate sufficiently long to emit more than 100 tons per year of any 1 pollutant may require an air quality permit. Montana does not have specific air regulations for oil and gas drilling.

IDAHO

In Idaho, air quality is regulated by the Idaho Dept. of Health and Welfare, Division of Environmental Quality (DEQ). No specific oil and gas drilling operation emission permit exemption exists. However, Idaho has a permit exemption for temporary sources of less than 1 year in duration (Idaho Administrative Procedures Act, Administrative Rules of Idaho 1601.01.012.07F) if the sources are "below regulatory concern". Although not specifically in the Idaho regulations, the "below regulatory concern" levels are usually considered about 10-15% of "significant" levels of emissions. These include 15 tons/yr of PM10, 25 ton/yr TSP, 100 tons/yr SO2, 100 tons/yr CO, and 40 tons/year of NOx. The PM10 are suspended particulates smaller than 10 microns in diameter. The PM10 particles can enter lung tissue and therefore have have more health significance than larger suspended particles such as dust. In order to obtain a temporary source exemption, the applicant must apply to the Idaho DEQ and request a letter of exemption concurrence (1410 N. Hilton, Boise, Idaho, 83060, 208-334-5898).

NORTH DAKOTA

Air quality in North Dakota is regulated by the North Dakota State Department of Health and Consolidated Laboratories (NDSDH). Oil production in North Dakota has grown substantially during the last 20 years which prompted NDSDH to adopt rules specific to the oil and gas production industry. These rules are found in "Control of Emissions from Oil and Gas Production Facilities", Chapter 33-15-20, of the North Dakota Air Pollution Control Rules. These rules establish a registration system for oil and gas wells and outline specific requirements for the control of emissions from oil and gas production facilities. North Dakota does not have drill rig emission permit requirements for non-significant sources (short of PSD "significance" levels). The North Dakota rules, however, require registration for any well which would emit 10 tons per year or more of any sulfur compound (SO2 & H2S). The form requires information concerning the oil and gas production of the well, production equipment at the well site, an analysis of the gas, and a list of air pollution control equipment. Although not a permitting process, the NDSDH determines from the registration information whether the oil production facility would comply with the North Dakota Air Pollution Control Rules, including applicable ambient air quality standards and PSD increments. To date, approximately 700 wells have been registered with the NDSDH. The North Dakota rules also require operators of oil and gas facilities to flare waste gas that contains hydrogen sulfide.

SOUTH DAKOTA

In South Dakota the Department of Natural Resources indirectly regulates compressor pump engines for oil and gas pipelines by requiring a permit for compressors with more than 3.5 million BTU per hour. Some of the permit provisions involve limits on particulate emissions. No permits are required for oil and gas well drill rigs. Although South Dakota has primacy for air quality regulation, the PSD permit program has not been delegated from EPA (which administers the PSD program in South Dakota). The South Dakota Department of Natural Resources has made application to administer the PSD program (Federal Register, 11/93) in South Dakota and anticipates the delegation will occur by the end of 1994. All applicable federal standards will be incorporated into the South Dakota program by reference.

<u>Conformity</u>

EPA regulations of 11/30/93 established conformity rules which require federal agencies to determine conformity of federal actions to state air quality implementation plans (SIP's). These rules stem from section 176(c) of the Clean Air Act which states that activities of all federal agencies must conform to the intent of the appropriate SIP and not:

*cause of contribute to any violations of ambient air quality standards
*increase the frequency of any existing violations
*impede a state's progress in meeting their air quality goals

These rules are designed to insure that state air quality laws act as boundaries for federal actions. However, each federal agency is responsible for making conformity determinations for projects it conducts or approves. At present the conformity rules only apply to non-attainent areas. Non-attainment areas in Region 1 are listed in Table 1. New rules are expected in 1994 which will expand the scope to attainment areas. The NEPA analysis methods described in this guidance will satisfy conformity requirements for attainment areas at least until EPA promulgates additional ones. For activities occuring in non-attainment areas, contact the Regional Office for additional direction.

Table 1. Non-attainment Areas in Region 1.

Montana

Kalispell (PM-10)Missoula (PM-10, CO)
Columbia Falls (PM-10)Libby (PM-10))
Whitefish (PM-10)Lame Deer (tribal) (PM-10)
Butte (PM-10)Polson (tribal) (PM-10)
Thompson Falls (PM-10)Ronan (tribal) (PM-10)

Great Falls (CO)Billings (CO, SO2))
Helena (SO2, Pb)

north Idaho (all PM-10)
PinehurstCoeur d'Alene (proposed)
SandpointSilver Valley (proposed)

National and State Ambient Air Quality Standards

Air pollution is controlled through ambient air quality and emission standards and permit requirements established under the Federal Clean Air Act Amendments (1977) and state air quality acts. There are two kinds of air quality standards. Primary standards are established at levels designed to protect human health. Secondary standards are set at levels designed to protect property, livestock, and vegetation from adverse effects of air pollutants. Montana, North Dakota, and South Dakota have assumed primacy from EPA for the implementation of federal air quality programs by adopting federal ambient air standards Table 2) and establishing stricter state standards for some pollutants (Table 3).

Table 1. National Air Quality Standards

Pollutant	Federal Primary Standard	Federal Secondary
PM-10	50 ug/m3 annual avg. 150 ug/m3 24-hr avg.*	None
Sulfur Dioxide	0.03 ppm annual avg. 0.14 ppm 24-hr avg.*	0.5 ppm 3-24 avg.*
Carbon Monoxide	9 ppm 8-hr avg.*	9 ppm 8-hr average*
Nitrogen Dioxide	0.05 ppm annual avg.	0.05 ppm annual avg.
Ozone	0.12 ppm annual avg.*	O.12 ppm ann. avg*
Lead	1.5 ug/m3 calendar quarter average	none
Floride	none	none

PM10 = particulate matter with an aerodynamic diameter of less than 10 microns.
ug/m3 = micrograms pollutant per cubic meter of sampled air
ppm = parts pollutant per million parts of sampled air
*Not to be exceeded more than once per year.

Table 3. State Air Quality Standards

Pollutant	Montana	North Dakota	South Dakota
PM-10	50 ug/m3 annual avg. 150 ug/m3 24-hr avg.*	50 ug/m3 annual avg. 150 ug/m3 24-hr avg.*	60 ug/m3 an avg 150 ug/m3 24-hr
Sulfur Dioxide	0.02 ppm annual avg. 0.10 ppm 24-hr avg.* 0.50 ppm 1-hr avg**	0.023 ppm annual avg. 0.099 ppm 24-hr avg.* 0.273 1 hour average	80 ug/m3 an avg 365 ug/m3 an av
Carbon Monoxide	23 ppm, hourly avg.* 9 ppm 8-hr avg.*	9 ppm 8-hr avg.* 35 ppm 1hr average	1300 ug/m3 for 3 hr avg
Nitrogen Dioxide	0.05 ppm annual avg. 0.30 ppm hourly avg.*	0.05 ppm annual avg. 0.1 ppm 1 hour	100 ug/m3 an av 250 ug/m3 24hr
Ozone	0.10 hourly avg.*	0.12 ppm annual avg.*	none
Lead	1.5 ug/m3 90-day average	1.5 ug/m3 calendar quarter average	1.5 ug/m3 qtr average
Foliar Floride	35 ug/g grazing season average 50 ug/g monthly avg.	none	none
Hydrogen Sulfide	0.05 ppm hourly avg.* 0.2 ppm, 1 hour 0.1 ppm, 24hr 0.02 ppm, 3 mth avg.	10 ppm max	none
Settled Particulate (dustfall)	10 mg/m2 30-day avg.	none	none
Visibility	particle scattering coefficient of 3x10-5 per meter annual average***	none	none

PM10 = particulate matter with an aerodynamic diameter of less than 10 microns.
ug/m3 = micrograms pollutant per cubic meter of sampled air
ppm = parts pollutant per million parts of sampled air

*Not to be exceeded more than once per year.
**Not be be exceeded more than 18 times per year.
***Applies to PSD mandatory Class I areas.

Prevention of Significant Deterioration

The Clean Air Act Amendments of 1977 established the Prevention of Significant Deterioration (PSD) regulations which set limits for increases in ambient pollution levels and established a system for preconstruction review of new major air pollution sources (Table 5). Three PSD classes have been established: Class I, Class II, and Class III. Class I areas consist of all international parks, National Parks greater than 5,000 acres, national wilderness areas greater than 5,000 acres and National Wildlife Refuges which existed on August 7, 1977 when the amendment was signed into law. The 16 R1 Class I areas are shown in Table 4.

Table 4. Class I Areas in Region I

Agency	Class I Area
Forest Service	Selway-Bitterroot Wilderness
	Anaconda-Pintler Wilderness
	Bob Marshall Wilderness
	Cabinet Mountains Wilderness
	Gates-Of-The-Mountains Wilderness
	Mission Mountains Wilderness
	Scapegoat Wilderness
	Hell's Canyon Wilderness*
National Park Service	Glacier National Park
	Yellowstone National Park
	Theodore Roosevelt National Park
Tribal	Northern Cheyenne Reservation
	Flathead Reservation
	Fort Peck Reservation
Fish & Wildlife Service	Red Rock Lake Wildlife Refuge
	UL Bend Wildlife Refuge

*Although Hell's Canyon is partially in Region 1 of the Forest Service, it is administered by the Wallowa-Whitman National Forest in Region 6.

Protection of air quality is provided to Class I areas by severely limiting the amount of additional human-caused air pollution which can be added. All other areas of the country, except non-attainment areas, are identified as Class II in which a greater amount of additional human-caused pollution may be added. In no case, however, may pollutant concentrations exceed the national or state ambient air quality standards. To date, no Class III areas have been designated in the US. Increments, which define the maximum allowable increases in concentrations of air pollutants, have been established for each of the three PSD classes. These increments restrict the extent to which pollution sources can contaminate the air. To date, increments have been established for sulfur dioxide, (SO2), particulates (PM10), and nitrogen dioxide (NO2).

Table 3. Montana and National PSD Increments (ug/m3)

Pollutant	Class 1	Class II	Class III
Sulfur Dioxide (SO2)			
Annual arithmetic mean	2	20	40
24-hour maximum*	5	91	182
3-hour maximum*	25	512	700
Particulates (PM10)			
Annual geometric mean	4	17	34
24-hour maximum*	8	30	60
Nitrogen Dioxide (NO2)			
Annual arithmetic mean	2.5	25	50

*Three-hour and 24-hour increments can be exceeded one time per year.

In addition to the increments, the PSD regulations also provide for protection of visibility in Class I areas and the use of Best Available Control Technology (BACT) for controlling emissions from major stationary sources and major modifications.

A PSD permit, which is administered by the state air quality agencies, is required for certain sources emitting or with the potential to emit 100 tons/year or greater of any regulated pollutant or any source emitting 250 tons/year or more of a pollutant. The PSD increments apply to routinely operating sources such as gas treatment plants or individual wells. They do not apply to temporary sources such as defined by ARM (Administrative Rules of Montana) 16.8 1102 (k) as "drilling rig stationary engine and turbines which do not have the potential to emit more that 100 tons per year of any pollutant regulated under the Montana Clean Air Act".

EXISTING AIR QUALITY

Existing air quality in the analysis area should be disclosed with as specific of information as possible. Frequently site specific air quality data is not available. Sources of local air quality data should be investigated including state air quality bureau monitoring information, Region 1 visibility monitoring stations, and private industry data. Some air quality information for an area is often available in previous NEPA documents. Usually recent mining NEPA documents or PSD permits have some (sometimes extensive) local air quality monitoring data and analysis. Many permitted mines have air monitoring requirements which are typically subcontracted to air consultants to analyze and report to the state air quality agencies. Large sources of air pollution in Montana and Idaho are listed in Appendix 8 and 9 of the R1 Air Resource Management Plan (USFS, 1993a).

Air quality monitoring data can be evaluated in the context of climatic conditions to disclose the anticipated existing air quality conditions for areas where air quality data is not available. This is a speculative exercise but several generalities are usually valid:

* dispersion of emissions in mountainous terrain, particularly ridges, is usually very high

* valley locations typically have much less wind dispersion than mountains, and are more subject to pollution concentration during temperature inversions. Valley locations typically have the greatest cumulative concentration of urban, industrial, and transportation emissions.

- up valley wind during daytime and down valley windy (cold air drainage) at night can dominate valley wind more than overall prevailing wind direction which is dominant on ridgetops.
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Existing air classification should be disclosed. This includes the air classification (PSD Class I or II), and existing air quality conditions (attainment or non-attainment). Most of the Region I areas which will be evaluated for oil and gas leasing are Class II attainment areas. Any Class I area within 100 km (62.5 miles) of of the leasing area to be evaluated must be identified.

CLIMATE

The variety of climatic conditions should be described in sufficient detail to facillitate disclosure of dispersion and concentration of oil and gas drilling emissions. The general climatic conditions and variation within the leasing area should also be disclosed. Many oil and gas NEPA documents have seperate climate sections which can be cross-referenced with some highlighting of the key factors describing winds and dispersion. Climatic factors which can be described for a variety of locations in the analysis area include:

* average annual precipitation
* monthly precipitation distribution
* average annual temperature
* monthly temperature distribution
* predominant wind direction
* average wind speed & wind roses (if available)
* atmospheric dispersion conditions (mixing height/stability class)
* total topographic wind variation (up and down valley, upslope wind
* frequency, locations, depth, and persistence of inversions.

Sources of climatic data include NOAA monthly and annual summaries of Montana, Idaho, North Dakota, or South Dakota weather data, National Weather Bureau summaries for a weather station, local NWS stations, RAWS network (BLM & FS), and NEPA documents for climatic descriptions. Appendix 7 of the USFS R1 Air Resource Management Plan (2580, 8/5/93) explains 7 additional sources including 1) National Climatic Data Center 2) Western Regional Climate Center (WRCC) 3) Soil Conservation Service Centralized Forecasting System (CFS) 4) Weather Information Management System (WIMS), 5) private consultants with weather databases 6) NASA Meteorological Master Directory 7) State Climatologists.

Chapter IV--ENVIRONMENTAL CONSEQUENCES

Potential air quality impacts from potential oil and gas energy development occur from several sources:

1) Particulates (dust) during construction and from vehicle traffic on unpaved roads; 2) carbon monoxide, hydrocarbons, and nitrogen oxide emissions from service vehicles (primarily pickup trucks and vans) 3) carbon monoxide and oxides of nitrogen from gasoline and diesel engines (including vehicle engines and stationary engines, such as electric generators); and 4) hydrogen sulfide and sulfur dioxide from flaring and/or treater firing.

Particulate Emissions

The amount of particulate dust depends on miles of unpaved road traveled, size of equipment and number of vehicles, silt content of the road bed material (potential for dust emissions), vehicle speed, weather (number of days with rainfall), and the duration of the operation. Dust abatement measures such as road treatments, stock pile wetting and other dust suppression agents can significantly reduce road dust. The gasoline and diesel engine emissions relate to the size (horsepower) and number of engines and duration. Hydrogen sulfide and sulfur dioxide emissions levels are highly speculative but depend on the amount, type, and control equipment for gas encountered in the drilling operation. Emissions can be estimated for each RFD drill site for dust particulate and diesel engine using methods outlined in the Technical Appendices of Oil and Gas Production in Montana (MBOGC, 1989).

Particulate emissions in the drilling operation are due mainly to vehicles driving to and from the sites. The median daily number of trips required to a drill site depends on drilling company personnel, support service, tool servicing, fuel supply, safety engineers, mud supplies, water hauling, septic disposal, corrosion control, road maintenance and others. This information should be available from the RFD. The HP-42 equation (MBOGC, 1989) used to estimate quantity of particulate emissions per vehicle mile traveled on an unpaved road consists of:

E (lbs/vmt) = K(5.9)(s/12)(S/30)(W/3).7(w/4).5(365-P/365)

Where: E = Emission factor in lbs per vmt (vehicle mile traveled)

K = particle size multiplier (dimensionless)

K varies with aero-dynamic particle size range in micrometers as follows:

size range	K
< 30um	0.8
< 15um	0.5
< 10um	0.3
< 5um	0.2
< 2.5um	O.095

s = Silt content of road surface material (%)

(The silt content of road surfaces typically varies from 4% to 30. Gravelled roads average about 5% and freshly graded dirt roads average about 25% silt. Silt content information can be obtained from a soil scientist and/or road engineer.)

S = Mean vehicle Speed (mph)

W = Mean vehicle weight (tons)

w = Mean number of wheels

P = Number of days with at least 0.01 inches of precipitation per year

For some sites NOAA monthly summaries or RAWS precipitation records are available. In the absence of site data the following average values from AP-42 (map of #days > 0.01" precipitation) can be used:

Northern Idaho and Western Montana--120 days
Central Montana--105 days
Eastern Montana, North & South Dakota--90 days

An example calculation for an RFD drill site in the Beartooth Mountains Oil and Gas Leasing FEIS (USFS, 1993b) used the following assumptions:

K = 0.80 (particles <30um)

s = 10%

S = 27 mph (median vehicle speed as given in AP-42 "Range of Source

Conditions" for Equation 1, pg. 11.2.1-3). W = 6 tons (mostly light duty vehicles needed during operating period)

w = 6 wheels

p = 100 (Redlodge p>0.01 = 104 in 1989 which was a nearly average precipitation year

E = .8(5.9)(5/12)(27/30)(6/3).7(6/4).5(265/365)

E = 2.8 lbs of particulate/vehicle mile traveled

trips/day = 12

days/year = 65

miles per round trip on unpaved roads = 12

The assumptions when entered in the E (lbs/vmt) equation produce an estimate of 2.8 lbs/vmt and 13 tons/year of particulates. Particulate emissions can then be compared to the air quality standards as explained in the air quality standard compliance section below. Particulate emissions can also be input to the air quality screening models described below to evaluate potential air quality standard compliance and visibility effects. As a general rule, particulates would need to exceed 50-100 tons/yr to pose much of an air quality concern.

Engine Emissions

Drill Rigs

Combustion engine emissions from drilling actvities include oxides of nitrogen, carbon, and sulfur. Emissions can be estimated using methods outlined in MBOGC (1989) and EPA (1979) for large diesel engines which are used to power the drill rigs, pumps, and auxillary equipment. The primary pollutants of concern are nitrogen oxide compounds (NOx) which are formed in the high temperature, pressure, and excess-air environment of combustion in diesel engines. Lesser amounts of carbon monoxide (CO) and hydrocarbons are also emitted. Some sulfur dioxide is emitted due to the burning of gasoline and diesel (which can contain minor amounts of sulfur).

The amount of engine emissions depends on drilling rig size (horsepower), gallons of diesel fuel burned per hour, the hours per day, and number of days the diesel rigs operate.

Drill rig sizes and fuel consumption are listed below for drill rigs typically used in Region 1 wildcat well sites:

size	drill rig horsepower	gallons diesel fuel used/hour\
S	800	40
M	1500	75
L	2100	100

Emissions can be estimated for an RFD well drilling rig by specifying the size of rig to be used, estimating the gallons of diesel fuel used per hour, and the hours/day and days/year of drill rig operation.

Emission factors (AP-42) for various pollutants in pounds of pollutants per 1000 gallons of diesel burned can be used from MBOGC (1989) including:

$\frac{\text{102\# carbon monoxide (CO)}}{\text{1000 gallons of diesel burned}}$ $\frac{\text{31.2\# sulfur dioxide (SO2)}}{\text{1000 gallons}}$

$\frac{\text{469\# NO2}}{\text{1000 gallons}}$ $\frac{\text{0.15\# hydrocarbons (HC)}}{\text{1000 gallons}}$

$\frac{\text{50\# particulates (TSP)}}{\text{1000 gallons}}$

Two example calculations of engine emissions for a Beartooth Mountain RFD drill site (USFS, 1993b) include:

Nitrogen Oxide--NO2

$$\frac{\text{469\# NO2}}{\text{1000 gal}} \times \frac{\text{75 gal}}{\text{hour}} \times \frac{\text{24hr}}{\text{day}} \times \text{70 days} \times \frac{\text{1 Ton}}{\text{2000\#}} = \text{29 tons/year}$$

Particulates

$$\frac{\text{50\#}}{\text{1000 gal}} \times \frac{\text{75 gal}}{\text{hour}} \times \frac{\text{24hr}}{\text{day}} \times \text{70 days} \times \frac{\text{1 Ton}}{\text{2000\#}} = \text{3.15 tons/yr}$$

Service Vehicle Engine Emissions

Vehicle engine emissions, which are transient and temporary in nature, are not usually added to station source emission inventories in PSD or other air quality permitting. Vehicle engines, however, are a cumulative source of emissions which can be estimated and disclosed in the NEPA process by using AP-42 emission factors. Several assumptions can be used to develop typical service vehicle emission factors:

1) The primary type of service vehicles are pickup trucks and vans and that the light duty, gasoline powered vehicle AP-42 emission factors are appropriate.

2) Average vehicle year is 1990 (non-California models).

3) Average vehicle speed is 10 mph (higher speed produces less emissions per mile)

4) Vehicle emissions will be accounted for within 30 miles of a drill site (vehicle emissions greater than 30 miles are generally non-cumulative with drill site emissions).

these emission factors are:

Carbon monoxide (CO)--18 grams, or 0.04 lb, or 0.00002 tons per mile traveled

Hydrocarbons (HC)--1.4 grams, or 0.003 lb, or 0.0000015 tons per mile traveled

Nitrogen oxides (NOx)--2.4 grams, or 0.005 lb, or 0.0000026 tons per mile traveled

Example: Assume a drill rig was served by 20 vehicles per day, 60 miles round trip per vehicle for a rig which took 70 days to drill.

Carbon monoxide (CO)

$$\frac{0.00002 \text{ tons CO}}{\text{mile}} \times \frac{60 \text{ miles}}{\text{day}} \times \frac{20 \text{ vehicles}}{\text{day}} \times \frac{70 \text{ days}}{\text{year}} = 1.7 \text{ tons CO/year}$$

$$\frac{0.0000015 \text{ tons HC}}{\text{mile}} \times \frac{60 \text{ miles}}{\text{day}} \times \frac{20 \text{ vehicles}}{\text{day}} \times \frac{70 \text{ days}}{\text{year}} = 0.13 \text{ tons HC/year}$$

$$\frac{0.0000026 \text{ tons NOx}}{\text{mile}} \times \frac{60 \text{ miles}}{\text{day}} \times \frac{20 \text{ vehicles}}{\text{day}} \times \frac{70 \text{ days}}{\text{year}} = 0.22 \text{ tons NOx/year}$$

Service vehicle emissions will generally be low (1% or less) when compared to the drill rig engine emissions.

Estimated emissions should then be evaluated for each well to see if 1) any parameter is greater that the PSD threshold of 100 tons/year and/or 2) combined emission levels are greater than 250 tons/year in which case the well is a "major source" subject to new source requirements in the PSD regulations. For most wells, emissions are too low to trigger a PSD permit. These emissions can also be input to the air quality screening models described below to evaluate for air quality standard compliance and visibility effects.

Hydrogen Sulfide

During drilling operations gas bearing zones may be encountered. The gas may contain sulfur compounds, particularly hydrogen sulfide (H_2S). Hydrogen sulfide is extremely hazardous to normal oil field operations because it contributes to adverse health effects and to metal fatigue in drilling equipment. Drilling and producing operations can be performed safely and without incident if the necessary precautions are taken and appropriate safety procedures are followed. It is imperative that proper safety equipment is used and is properly maintained with full compliance with all safety regulations as outlined in the MBOGC (1989).

Hydrogen sulfide presents a serious air quality concern because it is extremely toxic at concentrations of 500 parts per million (ppm) and higher, and has an offensive "rotten egg" odor detectable by most people at concentrations between 0.0015 and 0.0075 ppm. Adverse health responses, such as headaches, nausea, and shortness of breath have been detected at concentrations of 0.1 ppm. Several researchers have observed the onset of damage to conifers when H2S ranges from 0.03 to 0.10 ppm over several months as well as damage to agricultural crops at 0.3 ppm for one month. The Montana ambient air quality standard for H2S is 0.05 ppm, one hour average, not to be exceeded more than once per year (Montana Air Quality Bureau, 1991).

Under normal operating conditions, if H2S gas is encountered, the amount of gas reaching the surface at the well site would be minimal. If zones containing gas or fluids under pressure are encountered, the drilling mud system is adjusted to seal these zones. Drilling is discontinued until the pressure is stabilized and there is essentially no gas entering the hole. The small amount of gas that does reach the surface is vented from the system by use of a de-gasser unit and flared (burned). The State of Montana requires all non-recoverable gas containing more than 20 ppm of H2S be flared. In this way, the small amount of H2S is converted to less harmful sulfur dioxide (S02). The possibility and extent of H2S odor is dependent on the nature of the material encountered during drilling and on meteorological conditions (wind speed and direction). The extent of odors should be limited to the immediate drill site area, and would not be expected for prolonged periods.

It is difficult to assess the probability of encountering H2S for oil and gas wells unless several wells have been drilled in the vicinity of RFD scenario wells in the analysis area. A suggested method of dealing with the H2S issue in a NEPA document is to 1) describe the H2S hazard in oil and gas wells 2) disclose any known information relevant to H2S potential for RFD wells and/or formations in the analysis area 3) summarize State required procedures for handling H2S when encountered 4) list flaring requirements and any other mitigation or safety requirements for dealing with H2S in the NEPA document.

Air Quality Standard Compliance

Although drill site emissions are typically below the 100 tons/yr temporary drill rig exclusion in the Montana Clean Air Act (State of Montana, Air Quality Rules, ARM 16.8 1102(k)), as well as PSD significance levels, all emissions must be in compliance with State and National Ambient Air Quality Standards. Emission concentrations can be estimated for areas surrounding an RFD well using air quality models (EPA, 1986).

In order to estimate maximum emission concentrations in critical terrain locations adjacent to an RFD well, the SCREEN2 model (EPA, 1992) is recommended. This model is a PC application of EPA screening procedures (EPA, 1988) which was developed to estimate the dispersion of emission concentrations near adjacent terrain.

The SCREEN2 model is usually fairly conservative in that it will normally overpredict emission concentrations. For oil and gas leasing NEPA analysis the SCREEN2 model can be run with the complex terrain option which requires inputs of emissions rates (for the RFD wells NO2 and particulates), emissions variables (velocity, temperature), worst case meteorology (when dispersion is poorest--usually stable, cold weather periods), and the elevation and distance to the nearest prominent topographical feature (usually within 1 mile of the well site). The model then estimates the maximum 24 hour concentration of a pollutant in ug/m3 (micrograms per cubic meter) which can be converted to ppm for NO2 to allow a direct comparison to air quality standards.

SCREEN2 model results are for the emissions input into the model only and do not include "background concentration" levels. These levels should be added to the SCREEN2 results to get total concentration before comparing to ambient air quality standards. For example, if the background annual average concentration of TSP at the W.F. Red Lodge well above was 5 ug/m3, then the concentrations to be compared to the standard would be 5 ug/m3 + 6.1 ug/m3 = 11.1 ug/m3. If air quality standard exceedances are indicated several options or combinations are possible 1) rerun the model using actual onsite worst case meteorology 2) re-evaluate using a more detailed model such as COMPLEX 1 or other EPA recommended models 3) move the well site to an area with less topographic confinement and better wind dispersion 4) require more drill rig emission control equipment.

Visibility Analysis

In order to address the issue of potential emissions impacts on visibility,, the VISCREEN (EPA, 1992) visibility screening PC model can be run for RFD drill sites. This model is a PC version screening tool which was developed using the methods and assumptions in the "Workbook for Estimating Visibility Impairment", EPA (1980). The VISCREEN model calculates plume contrast against sky and terrain for an "observer" viewing a well site. In addition the model calculates the color change between the plume and background. Areas to be evaluated should include a view of concern such as toward a Class I area or an important scenic feature or vista. The VISCREEN model can be run with a Level 1 screening analysis in which default values for meteorology stability class and particulate size are used. Level 2 screening analysis allows the model user to input known site specific meteorology and particulate size information (primary particulates, soot, and sulfate particles). The VISCREEN model results include a "theta" angle of 10 degrees which is a "forward scattering" angle with the viewer looking into the sun backlighted plume. This allows an estimate of visibility during maximum plume contrast. The contrast "threshold" and therefore "plume" visibility is usually discernable by most observers at 0.05 contrast units which is normally used as a screening threshold criteria. The VISCREEN results are usually shown for plume vs sky and plume vs terrain which indicates that the forward scatter of plume vs terrain has higher contrast than plume vs sky. All modeled results need to be compared with the contrast criteria to estimate if RFD "plumes" would be perceptable by most observers.

An important variable in the VISCREEN model is the background visual range. Clean air has a greater visual range than dirty air but the same amount of pollution will cause a greater decrease in visual range in a clean air background than a dirty air background. The original VISCREEN documentation (EPA, 1988) provided a standard visual range map which suggested a background visual range of 110 kilometers for most of Region 1. The visibility analysis, however, is more conservative if higher (50% and 90%) standard visual range values are used. The percentages are based on a cumulative frequency of daily SVR values. For a 90% SVR visual range is better 10% of the time.

Acheson (1993) has documented much greater SVR for visibility cameras (IMPROVE protocols) in several wilderness areas in western Montana. Suggested background SVR values for the VISCREEN modeling include:

	50% SVR	100% SVR
Eastside Forests	150 km	250 km
Westside Forests	200 km	300 km

Both the SCREEN2 and VISCREEN models are EPA approved, PC format, menu driven, interactive models that are user friendly and do not require a high level of air quality expertise to run. Some familiarity with air quality analysis is useful in inputting appropriate data, selecting model options, and interpreting the modeling results.

Copies of the SCREEN2 and VISCREEN models can be obtained from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA, 22161, (703) 487-4850, and the Support Center for Regulatory Models (SCRAM) Bulletin Board System (BBS). The SCRAM BBS cay be accessed through a PC and modum at (919) 541-5742. Copies of the models can also be obtained from Ann Acheson RO (westside Forests) and Mark Story, Gallatin NF (eastside Forests).

Production

Emissions associated with oil and gas production are usually considerably less than the emissions from well drilling. The amount of air pollution generated over the life of an oil or gas well depends on the characteristics of the product and the production practices used. Wells which produce hydrogen sulfide in the oil, gas, or associated gas are much more likely to cause air pollution than wells which do not produce hydrogen sulfides. The MBOC, 1989 (Table 18, pg 103) lists typical sources and types of air pollutants from producing wells. For "sweet wells", such as the RFD wells, nitrogen oxides, sulfur dioxide, hydrogen sulfide, and carbon monoxide emissions are negligible. For "sour gas wells" drilled into formations with high hydrogen sulfide concentrations, however, H2S emissions could occur from breathing and working losses from storage tanks, fugitive losses from pipelines, seals, pumps, and flanges. Some associated sulfur dioxide could occur from flaring hydrogen sulfide or burning sour gas in compressors or ancillary equipment.

Literature Cited

Acheson, A.L., 1993, Region 1, Visibility Monitoring Summary Report, 1989-1992. USFS R1, 31 pp.

Montana Board of Oil and Gas Conservation, 1989, Programmatic Environmental Impact Statement on Oil and Gas Drilling in Montana. 242 pp. Helena, Montana.

Montana Board of Oil and Gas Conservation, 1989, Technical Appendix Volume, Oil and Gas Drilling Production in Montana. 292 pp. Helena, Montana.

Montana Department of Health and Environmental Sciences, 1991, State of Montana Air Quality Rules.

U.S. Environmental Protection Agency, 1979. Standards Support and Environmental Impact Statement, Volume 1: Stationary Internal Combustion Engines. EPA-450/2-78-125a. Research Triangle Park, NC.

U.S. Environmental Protection Agency. 1980. Workbook for Estimating Visibility Impairment. EPA-450/4-80-031. Research Triangle Park, N.C.

U.S. Environmental Protection Agency, 1988. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources - Draft for Public Comment. EPA-450-/4-88-010. Research Triangle Park, NC.

U.S. Environmental Protection Agency, 1988. Workbook for Plume Visual Impact Screening Analysis. EPA-450/4-88-015. Research Triangle Park, N.C.

U.S. Environmental Protection Agency, 1991. Draft SCREEN Model User's Guide.
Research Triangle Park, N.C.

U.S. Environmental Protection Agency, 1992. SCREEN2 Model User's Guide, EPA-450/4-92-006 and Workbook for Plume Visual Screening Analysis (EPA-454/R-92-023). Research Triangle Park, N.C.

U.S. Forest Service, 1993a, Revised Air Resource Management Program, July 1993. 36 pp. Missoula, Montana.

U.S. Forest Service, 1993b, Beartooth Mountains Oil and Gas Leasing Final Environmental Statement, Custer National Forest, Billings, Montana.