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Air Quality Specialist Report

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Apache-Sitgreaves National Forests

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Air Quality

The purpose of this specialist's report is to examine the potential impacts on air quality from the proposed action and other proposed alternatives as part of the implementation of the 2005 Travel Management Rule (TMR) on the Apache-Sitgreaves National Forests (Forests). This assessment is based on defining the existing conditions, determining management guidelines from the Apache-Sitgreaves National Forests Land and Resource Management Plan (Forest Plan) and the 2005 TMR, and analyzing key components of the various alternatives, which include route designations, dispersed camping corridors, motorized big-game retrieval, and designated Areas. Several issues related to air quality were identified through the scoping process.

Analysis Topics

Issues and Key Resource Questions:

The draft EIS has identified four key issues to be addressed in alternatives and discussion in the EIS. These are as follows:

Issue #1: Motorized access for dispersed camping

Issue #2: Motorized big game retrieval

Issue #3: Impacts to resources from motorized use

Issue #4: Economics

Issue #3 will be addressed within this specialist report, broken down into several air quality related topics.

Adverse air-quality impacts associated with standard motor vehicle and off highway vehicle (OHV) use on the Forests are of concern. Scoping comments suggest OHV use as the primary cause of air-quality issues, including dust, on the Forests.

Representative quotations are as follows:

> *"…Because of the noise, erosion, air pollution, and other damage from off-road vehicles, areas used by ORVs are not attractive to quiet, nature-based recreationists, which comprises a majority of the recreational visitors to your Forests."*
>
> *"All proposals make sense: less noise, dust, air and soil pollution. Restricting off road travel lowers fire hazards and damage to natural terrain."*

Questions to be answered in analysis of air quality on the Forests as it relates to travel management are as follows:

- How will designations affect the Federal and state effort to maintain the National Ambient Air Quality Standards?
- How will designations impact the amount of emissions/dust?
- How will designations add to emissions/dust in nearby population centers?
- How will designation affect climate change/global warming?

Description of Affected Environment's Existing Conditions

Air pollution can affect human health, reduce visibility, and contribute acidic deposition in sensitive, high-elevation lakes. Air quality on the Forests is affected by various factors. Industrial sources near the Forests, such as power plants, mines, and oil and gas extraction activities, contribute to local and regional air pollution. Urbanization and resort development near the Forests may create hazardous emissions that affect a wider area. These sources include wood smoke and dust from dried de-icing compounds on paved roads in winter. De-icing compounds can affect air quality on paved roads as well as forest health by killing trees and eventually affecting ground water quality. Wildfires on public or private land are also an air quality concern because the smoke can inundate communities and other sensitive areas.

Air pollutants generated by motor vehicles on the Forests include tailpipe emissions and dust from travel over dry, unpaved road surfaces. Off-road travel can also have impacts by disturbing soils and creating dust and tailpipe emissions.

This report provides information about local and regional air quality and evaluates potential impacts to health (i.e., violating standards) and regional visibility. It also discusses climate change, both in terms of the impact the action alternatives might have through direct emissions and in terms of the way in which the Forests may be receivers of impacts created by global trends in greenhouse gas emissions.

Background Concentrations

Ambient air monitoring and meteorology recording is conducted at a number of locations near the Forests. The nearest facility with a complete air quality data set is in Springerville, Arizona, at the northeast corner of the Forests. This station measures nitrogen dioxide (NO_2) and sulfur dioxide (SO_2), and there are two sites that measure particulate matter (PM). Maximum 24-hour average PM_{10} concentrations at Springerville were 129 micrograms per cubic meter ($\mu g/m^3$) in 2004; 198 $\mu g/m^3$ in 2005; and 298 $\mu g/m^3$ in 2006. The State of Arizona also operates an intermittent monitoring station in Show Low to measure smoke from local or regional sources. This station is also used occasionally to verify PM_{10} attainment status. The maximum 24-hour PM_{10} values measured from 2004 to 2006 were 41 $\mu g/m^3$, 37 $\mu g/m^3$, and 58 $\mu g/m^3$, respectively (ADEQ 2008, 52 and 61).

The U.S. Environmental Protection Agency (EPA) rates air quality for all criteria pollutants on a scale called the Air Quality Index (AQI). In many urban areas, the AQI is calculated daily and is reported in newspapers and on television weathercasts. The EPA (AIRNow 2007) explains the AQI this way:

> "Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution, and the greater the health concerns. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 300 represents hazardous air quality.
>
> An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy—at first for certain sensitive groups of people, then for everyone as AQI values get higher."

The State of Arizona publishes an annual air-quality report that provides summaries for the AQI by county. The Forests are located in portions of four counties, and the AQI for the most recent 3 full years of data is shown in Table 1.

Table 1. Counties with Occurrences of an Air Quality Index of 100 or Less (lower = better, 0 = best), 2005—2007

County*	2005	2006	2007
Apache	1	1	0
Navajo	1	1	0
Coconino	1	1	1

*Note: No data for Greenlee County are available.

Existing Emissions Sources

A number of primary emission sources exist on the Forests. Emissions can be roughly divided into human-caused (anthropogenic) and natural sources. These emissions may impact the health of visitors and residents and may impair scenic vistas in the region. Anthropogenic emissions vary according to the season. In colder months, residential wood smoke is a large source of PM and other compounds in localized areas (settlements, campgrounds). In drier summer months, motor vehicles can stir up dust on dirt roads and emit exhaust pollutants.

Important stationary sources include the Coronado Generating Station near St. Johns (north of Springerville). This coal-fired power plant emits SO_2, nitrogen oxides (NO_x), and PM that, under some atmospheric conditions, impairs visibility over a wide area. The plant's owners, Salt River Project, recently reached a permit-violation settlement with the EPA that will result in new scrubbers being installed. This settlement will reduce combined SO_2 and NO_x emissions by more than 21,000 tons each year. Salt River Project will also spend at least $750,000 replacing pre-1988 wood stoves with EPA-certified stoves or other clean heating devices in St. Johns, Springerville, and Show Low. These two actions, which will take place over the next 5 to 6 years, will substantially improve visibility, reduce ozone (O_3) smog potential, and protect human health in the northern part of the Forests.

Vehicle emissions include NO_x, hydrocarbons, fine PM, and carbon monoxide (CO). Travel on unsurfaced roads can substantially increase local atmospheric concentrations of fine PM unless those roads are treated for dust abatement. Surfaced roads, where cinders and sand are applied to facilitate traction during icy conditions, can result in significant short-term dust once the roads dry out.

Natural sources on the Forests fall into two broad categories: (1) fine PM that reduces visibility and may impact health; and (2) everything else. Fine PM comes from naturally occurring fires (e.g., started by lightning) and windblown soil and dust (which may include ash). Non-PM sources usually are complex organic molecules emitted by vegetation (such as terpenes from conifer trees). Terpenes and similar natural volatile organic compounds (VOCs) react with O_3 to form a whitish haze. The Great Smoky Mountains derive their name from the haze generated this way. Terpenes and other organic molecules can produce a haze over the Forests when O_3 is present in sufficient quantities, just as in the Great Smoky Mountains (Appalachian Mountains). The O_3

needed for this reaction would likely come from Phoenix or other large urban area, or it could be generated by emissions from local sources such as the Coronado power plant near St. Johns. On occasion, Arizona is also impacted by air pollution originating from as far away as Los Angeles (verified at the Grand Canyon).

Visibility

One of the primary attributes of Western public lands is the ability to see extraordinary and dramatic vistas. Air monitoring has been conducted for about 30 years at many of the Western parks, and various techniques have been used to measure and describe visibility. Visibility is usually expressed in terms of light extinction or diminishment of visible sight (e.g., one can see for 100 miles on an unpolluted day but for only 50 miles on a day with considerable haze). Four Class I areas near the Forests are shown in Table 2. Class I areas include wilderness areas 5,000 acres or more in size and designated as such before August 8, 1977.

Table 2. Sources of Visibility Reducing Compounds in Class I Areas in Arizona

Compound	Sulfates	Crustal Materials (soil dust)	Elemental Carbon (soot)	Organic Carbon	Nitrates
Sources	Utility and industrial boilers	Roads, construction, and agriculture	Combustion of wood, diesel, and other materials	Autos, trucks, and industrial processes	Motor vehicles and industrial boilers
Chiricahua Wilderness	59%	18%	5%	13%	5%
Grand Canyon National Park	43%	24%	8.5%	16%	8.5%
Petrified Forest National Park	36%	29%	8%	19%	8%
Tonto Wilderness	32%	27%	9%	23%	9%

Source: EPA (2008b)

Table 2 shows that sulfates (primarily from coal-burning power plants) are the primary source of visibility impairment. Nitrates from power plants are significant as well. Because the Coronado Generating Station, the primary stationary source near the Forests, plans on installing scrubbers, soil dust will become a more significant part of overall visibility impairment. Driving all terrain vehicles (ATVs) and other motor vehicles on dirt roads on the Forests will therefore become a more important potential source of visibility impairment.

Climate Change

Climate change describes the variation in Earth's global and regional atmosphere over time. The current rise in the Earth's average surface temperature is known as global warming. The earth is warmed by the sun's radiation, and atmospheric characteristics contribute to the efficiency of trapping heat. Greenhouse gases (GHGs) are those that

absorb infrared radiation in the atmosphere and tend to increase the planet's temperature. According to the EPA, overall, the most abundant and dominant greenhouse gas in the (Earth's) atmosphere is water vapor. Atmospheric water can exist in several physical states, including gaseous, liquid, and solid. Human activities are not believed to affect directly the average global concentration of water vapor, however the radiative forcing produced by the increased concentrations of other greenhouse gases has been claimed to indirectly affect the Earths thermal regime. While a warmer atmosphere has increased water holding capacity, increased concentrations of water vapor affects the formation of clouds, which can both absorb and reflect solar and terrestrial radiation (USEPA 2002). The exact state of the Earths thermal regime is in constant state of flux and point-in-time conditions are generally unknown.

While this report's primary focus regards what effects various TMR alternatives have, it is necessary to tie effects back to the cause of climate change to determine whether or not alternatives are contributing to undesirable conditions, and if so, how much. It is an accepted fact that climate change is currently resulting in warmer conditions; however, the ultimate cause is still debated. When dealing with global-scale issues or "effects," drawing undeniable conclusions regarding causes are neither simple nor straightforward and obvious. As a government entity, the Forest Service is required to consider and discuss contrary evidence, which leads to the following very brief overview regarding the causes of climate change.

There are two primary schools of thought (among others) regarding the ultimate cause of climate change and global warming. One is the anthropogenic cause or homocentric theory that places responsibility on the human species for contributing greenhouse gases. Greenhouse gas (GHG) emission sources include fossil fuel combustion (CO_2), changes in land-use practices (e.g., deforestation and chemical fertilizer use in agriculture) and production of several classes of halogenated substances that contain fluorine, chlorine, or bromine (USEPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2006, Executive Summary). Aerosols that cool the planet are sulfates and soil particles, emitted primarily by coal burning and land use clearing, respectively (Earth Systems United Nations Environment Programme; Climate Change Science Compendium 2009). According to the Intergovernmental Panel on Climate Change (IPCC), "Increases in GHGs tend to warm the surface while the net effect of increases in aerosols tends to cool it. The net effect due to human activities since the pre-industrial era is one of warming. In comparison, changes in solar irradiance are estimated to have caused a small warming effect." The primary blame is placed on CO_2, however the overwhelming role of water vapor in atmospheric heat attenuation is not considered. (Climate Change 2007: Synthesis Report Summary for Policymakers, IPCC)

The other school of thought contributes climate change to natural causes, such as changes in the sun's cyclic energy output and the complex interactions that result from warming, such as CO_2 gas releases from oceans, higher evaporation rates, higher methane releases from arctic soils, cloud-forming cosmic rays being altered by the sun's activity level, etc. One of the major differences between the two schools of thought is that the homocentric theory almost always ignores water vapor as an important greenhouse gas, thereby focusing more attention on the other gases which proportionally, however, play a minor overall part in the Earth's total heat attenuation (Landscheidt 1998, Hieb 2003, Svensmark and Calder 2008). The following brief discussion only addresses CO_2 which

TMR alternatives may affect. Other greenhouse gases are not significantly affected by TMR alternatives.

The school of thought attributing climatic changes to natural causes considers numerous interactions that happen across the globe, including anthropogenic contributions, the Earth's changing orbits, as well as effects stemming from the sun and even our galaxy, such as cosmic rays (Svensmark and Calder 2008). When including water vapor's role in heat attenuation, total natural and anthropogenic atmospheric CO_2 contributes 3.6 percent to the greenhouse effect, with the anthropogenic portion of CO_2 contributing 0.117 percent. Of the total amount of CO_2 in the atmosphere (100 percent), the anthropogenic contribution is only 3.225 percent of the whole (Hieb 2003). When including water vapor, the total of all anthropogenic greenhouse gas contributions add up to only 0.28 percent of the whole greenhouse effect (Hieb 2003). No matter what turns out to be the ultimate cause of climate change, the total anthropogenic influence is miniscule when viewed on a global scale. When evaluating the effects of various TMR alternatives, all one can say is which alternative might contribute most or least to climate change; however, any attempt to quantify such contributions would result in insignificance.

Climate change may be currently impacting Arizona and the desert Southwest in a number of ways (Seager et al. 2007). Climate change may be affecting Arizona by causing a drier climate. According to research published by the American Association for the Advancement of Science, "there is a broad consensus among climate models that this region (the desert Southwest) will dry in the 21st century and that the transition to a more arid climate should already be under way. If these models are correct, the levels of aridity of the recent multiyear drought or the Dust Bowl and the 1950s droughts will become the new climatology of the American Southwest within a time frame of years to decades." (Seager et al. 2007)

The Forests could experience several possible impacts in coming decades as a result of climate change. The first is the potential for increased frequency and intensity in forest fires. Visitors to the Forests may face more fires danger from a longer fire season and drier fuels. This could mean new or more extended periods of road closures. These closures could occur to both minimize potential fire ignition and to protect the public from wildfire hazard.

Insect infestations are often associated with warmer or drier weather. For example, in the past decade, Alaska and the entire Western U.S. have witnessed a record loss of forests to fires and spruce bark beetles. Since 1987, nearly four million acres of mature white spruce forest on the Kenai Peninsula have been killed by a growing population of spruce bark beetles. Scientists attribute the beetle infestation to rising average temperatures in south-central Alaska in both winter and summer. More beetle larvae can survive, and higher summer temperatures allow the insects to mature faster and complete a 2-year life cycle in 1 year. The trees, which previously lived in balance with the beetles, do not have enough natural defenses against this assault (Hansen et al. 2001; Berg et al. 2006). Similar outbreaks are now occurring in northeast Arizona and New Mexico (USDA/USFS 2009). The Forests have extensive spruce beetle infestations on Mt. Baldy. In the past, the Forests similarly had significant die-back of pinyon pine at its outer ecological edge near grasslands and have had fires in ponderosa pine dominated areas, which revegetate with warmer and drier ecotypes such as pinyon and juniper woodlands.

These changes may affect how the Forests manage road use, with the potential of closures in areas subject to fire damage and subsequent erosion.

In coming years, climate change may cause some or all of following on the Forests: precipitation regimes may change (e.g., more rain in summer and drier winters); more frequent droughts with insect impacts to forests; less winter snow pack and reduced spring runoff with effects on fish and wildlife; and invasion of new species as a result of milder winters. Stronger storms may cause localized floods, stream course alteration, and erosion. If droughts are protracted, fires may be widespread and unstoppable, with subsequent habitat changes, such as wooded areas transforming to grass or brush land.

Relevant Laws, Regulations, and Policy that Apply

Federal Clean Air Act

The Clean Air Act outlines different levels or classes of air-quality protection. Generally, Class I areas are the most pristine, and any sources located in or near them have strict emission limits set by regulatory agencies. These areas have the most stringent degree of protection from emission sources that can cause air-quality degradation. Under the Clean Air Act, Federal agencies generally have an affirmative responsibility to protect the air quality-related values within a Class I area. These responsibilities focus on protecting views and expansive vistas; subsequently, human health is also protected through lessened respirable PM and other pollutants (SO_2).

In Class II areas, regulators set emission limits to meet or maintain the criteria pollutant standards (discussed further below). Class II areas usually experience ambient pollution levels that limit visibility for many days of the year. Any area that is not designated Class I is by default considered Class II.

The Forests are categorized as Class II. The State of Arizona has various areas designated Class I, as shown in Table 3 below.

Table 3. Federal Air Quality Designation

Federal Classification	Geographic Area (on or within 100 miles of the Forests)
Class I areas	Grand Canyon National Park
	Petrified Forest National Park
	Mazatal, Sycamore Canyon, Pine Mountain, Mount Baldy (on the Forests), Superstition, and Sierra Ancha Wilderness Areas
	Yavapai-Apache Reservation
Class II areas	All other geographic areas in Arizona not designated Class I

Source: EPA (2008)

Regulated Air Quality Compounds

The Clean Air Act authorizes the EPA to set standards for various air pollutants. Table 4 shows the seven federally regulated criteria pollutants. These are called criteria pollutants

because they (1) identify a chemical compound, (2) describe a time period for measurement, and (3) define a maximum concentration.

Table 4. Federal Criteria Pollutant Standards

Pollutant	Averaging time	Primary Standard	Secondary Standard
Ozone	8 hours	147 µg/m^3	Same as primary
Respirable PM 10	24 hours	150 µg/m^3	Same as primary
Respirable PM 2.5	24 hours	35 µg/m^3	Same as primary
	Annual arithmetic mean	15 µg/m^3	
Carbon Monoxide	8 hours	10,000 µg/m^3	None
	1 hours	40,000 µg/m^3	
Nitrogen Dioxide	Annual arithmetic mean	100 µg/m^3	Same as primary
Sulfur Dioxide	Annual arithmetic mean	80 µg/m^3	None
	24 hours	365 µg/m^3	
	3 hours	None	1,300 µg/m^3
Lead	Calendar quarter	1.5 µg/m^3	Same as primary

Source: EPA (2008)
Note: µg/m^3 = micrograms per cubic meter.

Summary of Alternatives

Five action alternatives are being considered for the Forests EIS. All alternatives are compared to Alternative A which serves as the existing baseline. Alternative A is the No Action Alternative; it allows cross-country motorized travel across much of the Forests and is not in compliance with the TMR of 2005. Alternative C features of travel management would be the same as Alternative A except cross-country travel would be prohibited (this is the case for all newly proposed alternatives, B through E) and motorized trails greater than 50 inches wide would be added to the system. Alternative B is the Modified Proposed Action developed by the Forests. Alternative E, in general, would decrease motorized access across the Forests, and Alternative D would increase motorized access. Table 5 displays the percent change in total Forest road density by alterantive. This table display the total resulting road mileage within the Forests by alternative which includes all roads, whether Forest Service, state, county, and/or private.

Table 5. Open Road and Motorized Trail Mileage by Alternative.

Indicator Criteria Affecting Potentially Affecting Air Quality	Alternative A — existing condition	Alternative B — Modified Proposed Action	Alternative C	Alternative D	Alternative E
Open roads (including motorized trails greater than 50 inches, and motorized trails less than 50 inches)	2,988	3,027 +39 +1.3%	3,016 +28 +0.9%	3,032 +44 +1.5%	2,678 -310 -10.4%

Methodology and Analysis Process

The air-quality impacts associated with the management of roadways within the Forests are primarily related to vehicular activity. Other internal and external sources may contribute to diminished air quality in the area, but the amount of vehicular activity and associated emissions are directly related to roadway use.

Vehicular emissions consist of multiple pollutants. Those pollutants are regulated under the National Ambient Air Quality Standards.

Carbon monoxide (CO) is a colorless, odorless gas that primarily affects the cardiovascular system; vehicular emissions are a major source. Nitrogen dioxide (N_2O) is a gas that impairs the respiratory system; major sources are power plants and vehicular emissions. Ozone is created through a complex reaction of hydrocarbons and oxides of nitrogen with sunlight as the primary catalyst. Ozone affects the respiratory system. Sources of the ozone precursors include vehicle emissions, power plants, and other combustion sources.

Particulate matter refers to small aerosols that are suspended in the atmosphere and may cause irritation and damage to the respiratory system; vehicular emissions, brake and tire wear, and the re-entrainment of road dust by vehicular activity are sources. PM_{10} refers to particulate matter with aerodynamic diameters less than 10 micron; $PM_{2.5}$ refers to particles with diameters less than 2.5 micron. SO_2 is a colorless gas generated by the combustion of sulfur-containing fuels, primarily affecting the respiratory system; major sources are power plants. Lead and its compounds damage the cardiovascular, renal, and nervous systems; the primary source is vehicles using leaded gasoline, and smelters. Today, lead has been eliminated as a gasoline additive; however as a result of decade's use of leaded fuels, lead is now a common trace pollutant in surface soils. Smelters are also not used much anymore for industrial processing of metals, having been replaced with cold acid-leaching processes. However, as a result of historic use of smelters, several low melting/boiling point metals are now found as surface soil pollutants. Among these are lead and mercury.

There are many factors that determine the total emissions of each of the pollutants. Factors such as vehicle speed, vehicle weight, vehicle types, number of wheels, vehicle-miles traveled (VMT), road surface characteristics, average temperature, fuel characteristics, inspection/maintenance program requirements, and other ancillary inputs are required to quantify these emissions. A quantitative analysis of these emissions and

their associated impacts is more meaningful for project-specific applications. For this regional analysis, a qualitative approach is taken.

The impacts to air quality from vehicular activity on the Forests are directly related to the number of miles that the vehicles travel. Of the emissions associated with vehicular activity on the Forests roadways, re-entrained dust is anticipated to have the greatest impact on the air quality of the area, although the total emissions of all the pollutants are related to the VMT. Although there is an obvious relationship between vehicle miles traveled and air pollution from dust and exhaust, there is no direct relationship between mileage of available roads and actual miles traveled. This is more of a function of peak usage times such as during summer holidays when the Forests get high use. Contrarily, during winter, the same Forest roads generate almost no usage and associated pollution.

For particulate matter associated with re-entrained dust, emissions in pounds per mile increase with speed, assuming all other factors remain constant. The impacts associated with particulate matter are primarily dependent upon the particle size, although atmospheric conditions are also important. As the size of the particle decreases, the distance that the particle may travel from its source increases. The largest particles (greater than 30 micron) resulting from the disturbance of the road surface will settle within several hundred feet of the source and are considered localized impacts. The smaller particles, such as PM_{10} and $PM_{2.5}$, have the potential to impact greater distances due to their size and the influence of turbulence on their movement. Those particles that are extremely fine (less than 1 micron) can contribute to the degradation of visibility.

Analysis of Alternatives Methodology

The analysis of the alternatives utilized the number of miles of roadway and trails that are available for vehicular activity as a basis for comparison of potential air-quality impacts from the alternatives; quantification of impacts was not performed. This analysis focused on those roadways and trails that are likely to have the largest contribution to increased levels of particulate matter due to re-entrained dust. This includes unsurfaced, high-clearance roadways (Maintenance Level 2), gravel-surfaced roadways (Maintenance Levels 3 and 4), and motorized trails. Paved roadways (Maintenance Level 5) are likely to contribute little re-entrained dust.

This analysis discusses direct and indirect impacts associated with each alternative. The direct impacts are determined by the number of miles of accessible roadways/motorized trails. The percent change in the miles of accessible roadways/motorized trails when compared to the No Action Alternative will be provided. The indirect impacts will examine the effects of actions taken in the alternative that may alter the number of VMT. It will also examine impacts to the air quality from sources other than vehicles that may be affected by changes in roadway accessibility.

Because of the qualitative approach taken in this analysis, several assumptions are necessary for comparison of the proposed alternative actions. These include the following:

- The total miles of accessible roads and motorized trails are directly proportional to their impacts on the air quality,
- All roadway characteristics are identical (moisture content, silt content, etc.),

- All vehicle speeds are roughly comparable,
- All vehicle types are identical,
- The number of vehicles per mile is identical for all roadways/trails, and
- No new road construction occurs under any alternative.

Effects Analysis

Direct and Indirect Effects

Each of the proposed alternative actions on air quality is summarized below and the anticipated direct and indirect effects identified.

Alternative A — No Action

The No Action Alternative proposes no change to existing motorized travel management. Routes that are currently open or closed would remain so, and cross-country travel would be allowed except in designated closure areas.

Direct Effects: Baseline. Direct effects of the existing road network are not analyzed as only net changes from existing conditions are addressed. However, the existing road network has some negative effects, most of which are not proposed to be changed by an alternative in the TMR process. Road improvements to the existing network are addressed as individual projects as funding becomes available, rather than proposed as a large Forest-wide package of improvements under any alternative within this EIS.

Indirect Effects: Baseline. See discussion above under Direct Effects.

Alternative B — Modified Proposed Action

The Modified Proposed Action provides for the following modifications from the No Action Alternative (A):

- Reduces miles of Maintenance Levels 2 through 5 roadways
- Increases miles of motorized trails
- Increases total miles of road/motorized trail
- Designates and places restrictions on roadways
- Written authorization required for cross-county motorized travel
- One vehicle allowed for cross-country motorized big-game retrieval per harvested animal
- Places additional restrictions on motorized big-game retrieval
- Decreases acres available for dispersed camping
- Restricts cross-country motorized travel into eight Areas

Direct Effects: The total number of miles of accessible roadways/trails is increased from the No Action Alternative; the direct impact would be considered increased (1.3%) and, combined with much more limited cross-country travel, could result in a regional negligible reduced impact through a small reduction in the vehicle miles traveled and adverse air-quality impacts from dust and vehicular emissions. Designated Areas on the Forests where use is concentrated would likely see a local adverse impact on air quality, as would watersheds where open-road density increases. These watersheds include those of the Middle Black River, Coyote Creek, Apache Creek—Upper Gila River, Pueblo

Creek—San Francisco River, Big Hollow Wash, and Upper North Fork White River. Some watersheds on the Forests that would see the most significant reduction in open-road density could potentially see a long-term beneficial impact on air quality. These include those of Upper and Lower Chevelon Canyon and Upper and Lower Clear Creek. Air-quality effects associated with dispersed camping corridors may include vehicle emissions and campfire smoke. Effects from cross-country motorized big-game retrieval would be sporadic and largely from vehicle emissions. These other aspects of travel management would not appreciably impact ambient air quality on the Forests.

Although the number of miles of roadways/trails decreases slightly, the additional restrictions on motorized travel, such as specifying the seasons of use, the types of vehicles that may use the roadways and the type of use of the roadways, and restrictions on cross-country motorized big-game retrieval may further reduce the regional vehicle miles traveled and air-quality impacts. Conversely, expanding motorized travel into limited areas may locally increase impacts on the air quality.

Indirect Effects: The indirect effects of Alternative B on air quality are extremely limited considering off-Forest effects or effects that occur. Due to less overall access to Forest lands from cross-country travel, this could theoretically translate into less vehicular exhaust and incidental dust, however actual differences may be immeasurable. Overall road and motorized trail mileage is increased slightly in this alternative which could be interpreted as producing slightly more air pollution than Alternative A.

Vehicular emissions could be conceived to interact with other compounds in the air; however the amount attributable to this alternative is not measurable. Compared to Alternative A, Alternative B could be expected to have somewhat less indirect impact based on lower overall access to the Forests.

Alternative C

Alternative C is identical to the No Action Alternative except that public cross-country travel would be prohibited except by written authorization and approximately 31 miles of motorized trails greater than 50 inches wide would be designated to access identified dispersed campsites. These existing motorized trails are approximately 8 feet wide (vehicle width) and approximately 100 feet in length and scattered Forests-wide.

Direct Effects: The total number of miles of accessible roadways/trails is increased from the No Action Alternative; the direct impact would be considered increased (1 percent) and combined with much more limited cross-country travel could result in a regional negligible adverse impact through an increase in the vehicle miles traveled and adverse air-quality impacts from dust and vehicular emissions. Effects from cross-country motorized big-game retrieval would be sporadic and largely from vehicle emissions. These other aspects of travel management would not appreciably impact ambient air quality on the Forests.

Although the number of miles of roadways/trails increases slightly, the additional restrictions on motorized travel, such as specifying the seasons of use, the types of vehicles that may use the roadways and the type of use of the roadways, and restrictions on cross-country motorized big-game retrieval may further reduce the regional vehicle miles traveled and air-quality impacts. Conversely, expanding motorized travel into limited areas may locally increase impacts on air quality.

Indirect Effects: The indirect effects of Alternative C on air quality are extremely limited considering off-Forest effects or effects that occur at a later time. Due to less overall access to Forest lands from cross-country travel, this could theoretically translate into less vehicular exhaust and incidental dust; however actual differences may be immeasurable. As most off-road travel occurs at slow speeds, not much dust gets created during this activity.

Vehicular emissions could be conceived to interact with other compounds in the air; however the amount attributable to this alternative is not measurable. Compared to Alternative A, Alternative C could be expected to have somewhat less indirect impact.

Alternative D

Alternative D provides for the following modifications from the No Action Alternative:

- Reduces miles of Maintenance Level 2 roadways
- Increases miles of Maintenance Levels 3 through 5 roadways
- Increases miles of motorized trails
- Increases total miles of roadways/motorized trails
- Designates and places restrictions on roadways
- Written authorization required for cross-county motorized travel
- Places additional restrictions on motorized big-game retrieval
- Decreases acres available for dispersed camping
- Restricts cross-country motorized travel into eight Areas

Direct Effects: The total number of miles of accessible roadways/trails is increased from the No Action Alternative; the direct impact would be considered increased (+3.7%). This may result in an increase in vehicle miles traveled and somewhat greater adverse air-quality impacts regionally from particulate matter and vehicular emissions and there would potentially be a local increase in vehicle emissions and dust in these areas. Designated Areas on the Forests where use is concentrated can potentially see a local adverse impact on air quality, as would watersheds where open-road density increases significantly. Watersheds where open-road density increases significantly would likely see an adverse impact to air quality. These watersheds include those of Coyote Creek, Middle and Upper Black River, Nutrioso Creek, Carnero Creek—Little Colorado River Headwaters, South Fork Little Colorado River—Little Colorado River Headwaters, Centerfire Creek—San Francisco River, Pueblo Creek—San Francisco River, Apache Creek—Upper Gila River, Big Hollow Wash, and Upper North Fork White River. Some watersheds on the Forests that would see the most significant reduction in open-road density would likely see a long-term beneficial impact on air quality. These include those of Upper and Lower Chevelon Canyon and Upper and Lower Clear Creek. Air-quality effects associated with dispersed camping corridors may include vehicle emissions and campfire smoke. Effects from cross-country motorized big-game retrieval would be sporadic and largely from vehicle emissions. These other aspects of travel management will not appreciably impact ambient air quality on the Forests.

Although the number of miles of accessible roadway/trails increases under this alternative, the additional restrictions on motorized travel, such as specifying the seasons of use, the types of vehicles that may use the roadways and the type of use of the roadways, and restrictions on cross-country motorized big-game retrieval may reduce the

vehicle miles traveled and air-quality impacts. Conversely, expanding motorized travel into Areas may increase vehicle miles traveled and air-quality impacts.

Indirect Effects: The indirect effects of Alternative D on air quality are extremely limited considering off-Forest effects, or effects that occur at a later time. Due to somewhat less overall access to Forest lands from road mileage, this could theoretically translate into less vehicular exhaust and incidental dust, however actual differences may be immeasurable. Due to less overall road and motorized trail mileage, this alternative could be assumed to produce lower air quality impacts. Considering incidental dust produced from unpaved roads, this effect is not anticipated to be carried off-Forest as dust normally settles out fairly quickly.

Vehicular emissions could be conceived to interact with other compounds in the air; however the amount attributable to this alternative is not measurable. Compared to Alternative A, Alternative D could be expected to have somewhat less of an indirect impact based on more restrictive access across the Forests.

Alternative E

Alternative E provides for the following modifications from the No Action Alternative:

- Reduces miles of Maintenance Levels 2 through 5 roadways
- Increases miles of motorized trails
- Reduces total miles of roadways/motorized trails
- Designates and places restrictions on roadways
- Written authorization required for cross-county motorized travel
- Cross-country motorized big-game retrieval not allowed
- Decreases acres available for dispersed camping

Direct Effects: The total number of miles of accessible roadways/trails is reduced from the No Action Alternative by 13 percent. This may result in a reduction of vehicle miles traveled and reduced adverse air-quality impacts regionally from dust and vehicular emissions, and, as there are no designated Areas, there would be no local increase in particulate matter or vehicle emissions in these areas. Some watersheds on the Forests that would see the most significant reduction in open-road density would likely see a long-term beneficial impact on air quality. These include those of Upper and Lower Chevelon Canyon, Carrizo Creek, Chase Creek—San Francisco River, and Upper and Lower Clear Creek. Watersheds where open-road density increases significantly would likely see an adverse impact to air quality. These watersheds include those of Coyote Creek, Carnero Creek—Little Colorado River Headwaters, Apache Creek—Upper Gila River, Big Hollow Wash, and Upper North Fork White River. Air-quality effects associated with dispersed camping corridors may include vehicle emissions and campfire smoke. These other aspects of travel management would not appreciably impact ambient air quality on the Forests.

The additional restrictions on motorized travel, such as specifying the seasons of use, the types of vehicles that may use the roadways and the type of use of the roadways, and the elimination of cross-county motorized big-game retrieval may further reduce the vehicle miles traveled and air-quality impacts.

Indirect Effects: The indirect effects of Alternative E on air quality are extremely limited considering off-Forest effects or effects that occur at a later time. Due to less overall

access to Forest lands from cross-country travel, this could theoretically translate into less vehicular exhaust and incidental dust; however actual differences may be immeasurable. Due to the least overall road and motorized trail mileage, this alternative could be assumed to produce the least air quality impacts. Considering incidental dust produced from unpaved roads, this effect is not anticipated to be carried off-Forest as dust normally settles out fairly quickly.

Vehicular emissions could be conceived to interact with other compounds in the air; however the amount attributable to this alternative is not measurable. Compared to Alternative A, Alternative E could be expected to have somewhat less indirect impact.

Impact Summary

Direct Effects

A summary and ranking of the direct impacts associated with the proposed alternatives is provided in Table 6. The ranking ranges from 1 to 5, with the lowest number representing the least impact. This is based on total open road mileage, which may have no bearing on actual traffic density. It is assumed that traffic density may increase into the future; however there are no available predictions of this effect within the Forests.

Table 6. Summary and Ranking of Air Impacts

Rank	Alternative	Impact	% Change in Miles of Roadway/Trails
1	E	Reduced / least	-10.4
2	B	Reduced	-1.6
3	A	Baseline	0.0
4	C	Increased	+0.9
5	D	Increased / most	+1.5

The direct impact to air quality associated with each of the proposed alternatives is minimal. Changes in the miles of accessible roadway/trails are generally low and are considered within the range of variability. It does not necessarily follow that the vehicle miles traveled parallels available road mileage. Increased concentrations of particulate matter along roadways due to re-entrained dust from public activity are, for the most part, localized and short-term with peaks during holidays. Impacts become more pronounced when associated with commercial activities such as timber harvesting where consistently high volumes of large vehicles can greatly increase particulate concentrations near the roadway. However, another activity that is associated with some degree of incidental dust generation is road maintenance and operations associated with crushing and hauling gravel for surfacing. Although these are short-term impacts, it is an impact that relates to existing road mileage.

Indirect Effects

Indirect effects are caused by the action alternative and its alternatives, but they occur at a later time or distance from the triggering action. In terms of air quality, downwind impacts of dust or pollutants generated on Forest roads could conceivably play a role.

However, dust generated on unpaved roads generally does not travel far and normally settles out within a short distance of the point of generation. Larger particle sizes of road dust drop out within tens of feet, while smallest particle sizes will drop out well within a quarter mile. Unless a high ambient wind velocity carries road dust a farther distance, most dust generated on the Forests does not leave the Forests.

In terms of effects of common exhaust constituents, dilution and air mixing reduces its potential effects to insignificance within a short distance. Although sources of pollution, such as vehicles, can pose a problem when operated in close quarters such as a city, the number of vehicles operating across the whole Forest is not deemed to measurably impact off-Forest air quality. In addition, most vehicles traversing the Forests on the road network are approved to meet EPA emission standards, which effectively reduce off-Forest impacts even further. The indirect impacts to air quality associated with each of the proposed alternatives are minimal and non-measurable.

Cumulative Effects

Cumulative impacts for air quality consider the impacts of the proposed alternatives with past, present, and future actions. Those activities which may result in an adverse impact to air quality include the following:

- Uncontrolled forest fires
- Controlled burns
- Road re-construction (repair) or maintenance
- Commercial operations (timber harvesting, sand/gravel operations, etc.)
- Past activities that deposited air-borne toxins across Forest lands: historic use of leaded fuels (tetra-ethyl-lead) and deposits left from historic smelters (mercury).
- Continued use of ADOT de-icing compounds on state highways across the Forests. Road salts used by ADOT in liquid form (calcium chloride brine) dries on pavement surfaces to form white coating that turns into white dust in traffic which can result in local air quality exceedances. Road salts such as calcium chloride can and has killed trees and other vegetation and it can potentially affect surface and ground water quality as well.

Uncontrolled forest fires provide the greatest present impact on air quality to both a local and regional scale; the extent and duration of the fire are major factors determining their impact. Controlled burns, such as listed in the Forest's SOPA list, can also provide a negative impact on the local and regional air quality, but can be controlled and the impacts mitigated through limiting the size of the area and conducting the operation under favorable atmospheric conditions. Controlled burns are regulated through the Arizona Dept. of Environmental Quality in order to avoid too many controlled fires occurring at one time. The Travel Management alternatives would not be expected to coordinate with burning activities regarding air quality effects, meaning that given road impacts to air quality are discounted as negligible when controlled burns are planned. During extensive wildfires or broadcast burns public access and travel is normally restricted for safety reasons not necessarily tied to air quality concerns.

Road construction can provide localized, short-term impacts to air quality, but mitigation measures are generally required to minimize the impacts. Commercial operations that include the crushing, hauling, or mining of aggregate material or operations that require

constant and heavy use of the roadways by large vehicles may adversely impact the air quality if mitigation measures are not employed. Dust abatement has been used on occasion (water, calcium chloride or Road Oyl ™), and spot paving has been used to reduce both air and water quality effects of localized high traffic areas.

Changes in miles traveled and driving patterns affects fuel consumption, and therefore CO_2 emissions. The current state of science cannot support a direct calculation of climate changes resulting from a minor source such as driving on the Forests. If fuel consumption increases measurably as a result of Forest Service action, the resulting CO_2 emissions would contribute to a cumulative effect. Forest action that would allow increases in tree cover could provide a carbon sink that may offset the cumulative effect of increasing CO_2. On a global scale, all alternatives can be considered insignificant in terms of air quality effects and remotely related climate change concerns.

The main impacts to air quality within the state of Arizona focus on the limited amount of heavy industry located in the state (coal fired power plants, a pulp mill, large scale open pit mining) and large metropolitan areas such as greater Phoenix and Tucson. It was found during the nationwide air traffic shut-down immediately following the 9/11/2001 attacks that air traffic contributes a dominating amount of air pollution to Phoenix and Tucson, rather than vehicular traffic.

Cumulative effects to the Forest's only Class I airshed (Mt. Baldy Wilderness) is considered negligible for several reasons including the following: 1) Mt. Baldy is located upwind of all roads on the Forests. The primary wind direction is out of the southwest and the White Mountain Apache Reservation is located upwind of Mt. Baldy. This area has very few roads and little traffic. 2) The only roads located closest to the Wilderness area to the north and northeast are high standard roads which are slated for paving (State Highway 273, recently improved through large Federal Highways project). Other gravel roads to the northeast of the Wilderness receive lower amounts of traffic and less dust is generated from them. 3) Roads that can generate potential dust in proximity to the Wilderness are located one to two miles away, and road dust normally does not travel that far. Most road dust travels less than 1/8 mile before it settles out. Only during days experiencing high winds (often during spring) can dust travel farther, and then it would travel to the northeast and away from the Wilderness.

Potential visibility issues were considered in this analysis. As existing conditions are close to excellent (see Table 1), and none of the alternatives propose notable changes in the total open road mileage (see Table 5), it stands to reason that visibility will not measurably be affected by any of the alternatives. In terms of visibility, Table 6 may best summarize these effects relative to the existing condition.

Conclusions

The impacts to the ambient air quality of the Forests due to vehicular travel, whether through engine exhaust or re-entrained dust, are not expected to cause or contribute to an exceedance of the National Ambient Air Quality Standards. Implementation of any of the proposed alternatives, including the No Action Alternative, is anticipated to have no significant adverse long-term impacts on the air quality of the region.

Reference List

AIRNow. 2009. Air Quality Index: A guide to air quality and your health. Available at: http://airnow.gov/index.cfm?action=static.aqi. Accessed October 2008.

Arizona Department of Environmental Quality (ADEQ). 2008b. *State of Arizona Air Monitoring Network Plan for the Year 2008*. Final Report. Arizona Department of Environmental Quality Air Quality Division, Air Assessment Section. Dated June 30, 2008.

Berg, E.E.; Henry, J.D.; Fastiec, C.L.; De Volder, A.D.; Matsuokae, S.M. 2006. Spruce beetle outbreaks on the Kenai Peninsula, Alaska, and Kluane National Park and Reserve, Yukon Territory: Relationship to summer temperatures and regional differences in disturbance regimes. Forest Ecology and Management. 227(3): 219–232.

Hansen. E.M.; Bentz, B.J.; Turner, D.L. 2001. Temperature-based model for predicting univoltine brood proportions in spruce beetle (Coleoptera: Scolytidae).Canadian Entomologist. 133(6): 827–841.

Hieb, Monte. 2003. Global Warming: A Closer Look at the Numbers. 13 pgs, ill. Available at: *http://www.geocraft.com/WVFossils/greenhouse_data.html*. Accessed September 2009.

Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Synthesis Report*. Dated November 2007.

Landscheidt, Dr. Theodor. 1998. Solar Activity: A Dominant Factor in Climate Dynamics. 26 pgs. Available at: *http://landscheidt.auditblogs.com/papers-by-dr-theodor-landscheidt/*. Accessed September 2009.

National Aeronautics and Space Administration (NASA). 2005. Methane's impacts on climate change may be twice previous estimates. Available at: *http://www.nasa.gov/centers/goddard/news/topstory/2005/methane.html*. Accessed September 2008.

National Climatic Data Center. 2007. Annual climate review, U.S. summary. Available at: *http://www.ncdc.noaa.gov/oa/climate/research/2006/ann/us-summary.html*. Accessed September 2008.

Seager, R. et al. 2007. Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America SCIENCE VOL 316.

Svensmark, Henrick and Nigel Calder. 2008. The Chilling Stars: A Cosmic View of Climate Change. ISBN: 978-1840468-66-3. 268 pgs, ill. **BOOK**

University of Arizona. 1998. Preparing for a changing climate: Southwest regional assessment. Available at: *http://www.environment.arizona.edu/favicon.ico*. Accessed September 2008. **WEBSITE UNAVAILABLE (May 4, 2010)**

U.S. Environmental Protection Agency (EPA). 2008b. Visibility in Class I areas. Available at: *http://www.epa.gov/air.visibility/parks* . Accessed August 20, 2008.

United Nations Environment Programme. Climate Change Science Compendium, Chapter 1 Earth Systems. 2009

U.S. Department of Agriculture, U.S. Forest Service (USDA/USFS). 2009. The Western Bark Beetle Research Group: A Unique Collaboration with Forest Health Protection. Proceedings of a Symposium at the 2007 Society of American Foresters Conference. General Technical Report PNW-GTR-784. Portland, Oregon.

U.S. Environmental Protection Agency2002. Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2000. April 15, 2002. 430-R-02-003.

U.S. Environmental Protection Agency, US Methane Sources and Emissions. 2009. available at: *http://www.epa.gov/methane/sources.html* .

All references with exception of 2 (two) are available on CD.
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