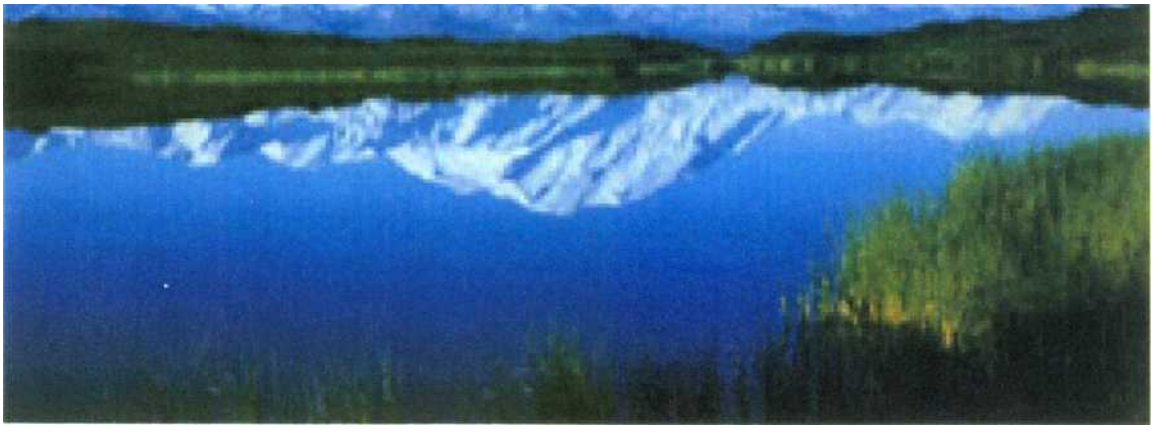
FINAL

2002 AIR EMISSIONS INVENTORY

DENALI NATIONAL PARK AND PRESERVE
ALASKA



U.S. NATIONAL PARK SERVICE

NOVEMBER 2003

FINAL

2002 AIR EMISSIONS INVENTORY

DENALI NATIONAL PARK AND PRESERVE
ALASKA

Prepared for:

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1. INTRODUCTION

1.1 BACKGROUND

In August of 1999, the National Park Service (NPS) embarked on the Natural Resource Challenge, a major effort to substantially improve how the NPS manages the natural resources under its care. As part of Natural Resource Challenge, the NPS Air Resources Division (ARD) was tasked with the responsibility of expanding efforts to monitor and understand air quality and related values in the parks. In addition, the NPS Environmental Leadership policy directs the NPS to manage the parks in a manner "that demonstrates sound environmental stewardship by implementing sustainable practices in all aspects of NPS management...." In order to achieve both of these objectives, it is necessary to gain an understanding of air pollution emissions that result from activities within the park. In this regard, development of an in-park air emissions inventory for Denali National Park and Preserve (NP & Pres) serves three functions. First, it provides an understanding of the sources and magnitude of in-park emissions and a basis for contrasting them with emissions from the surrounding area. Second, it identifies existing and potential strategies to mitigate in-park air emissions. Finally, it evaluates and ensures the compliance status of the park relative to state and federal air pollution regulations.

1.2 TYPICAL AIR EMISSION SOURCES

Typical air emission sources within NPS units include stationary, area, and mobile sources. Stationary sources can include fossil fuel-fired space and water heating equipment, generators, fuel storage tanks, and wastewater treatment plants. Area sources may include woodstoves, fireplaces, campfires, and prescribed burning. Mobile sources may include vehicles operated by visitors, tour operators, and NPS and concessioner employees, and nonroard vehicles and equipment.

The air pollutants that are addressed in this report are summarized in Table 1. Of the pollutants noted, ozone is not produced and emitted directly from stationary, area, or mobile sources, but rather it is formed as a result a chemical reaction of nitrogen oxides (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Carbon dioxide historically has not been considered a pollutant. However, in recent years, there has been much interest in its contribution to global climate warming since it is considered a greenhouse gas.

TABLE 1: AIR POLLUTANTS AND THEIR CHARACTERISTICS

Pollutant	Characteristics
Particulates (PM_{10})	• Mixture of solid particles and liquid droplets; fine particles (less than 10 micrometers) produced by fuel combustion, power plants, and diesel buses and trucks • Can aggravate asthma, produce acute respiratory symptoms, including aggravated coughing and difficult or painful breathing, and chronic bronchitis • Impairs visibility
Sulfur Dioxide ($S0_2$)	• Can cause temporary breathing difficulties for people with asthma • Reacts with other chemicals to form sulfate particles that are major cause of reduced visibility in many parts of the country • Main contributor to acid deposition
Nitrogen Oxides (NO_x)	• High temperature fuel combustion exhaust product • Can be an irritant to humans and participates in the formation of ozone • Reacts with other pollutants to form nitrate particles that are a significant contributor to visibility reduction in many parts of the country • Contributor to acid deposition
Carbon Monoxide (CO)	• Odorless, colorless gas produced by fuel combustion, particularly mobile sources • May cause chest pains and aggravate cardiovascular diseases, such as angina • May affect mental alertness and vision in healthy individuals
Volatile Organic Compounds (VOCs)	• Fuel combustion exhaust product • Consists of a wide variety of carbon-based molecules • Participates in the formation of ozone
Ozone (0_3)	• Not directly emitted by mobile, stationary, or area sources • Formed from complex reactions between NO_x and VOC emissions in the presence of sunlight • Occurs regionally due to multiplicity of sources • Can irritate the respiratory system • Can reduce lung function • Can aggravate asthma and increase susceptibility to respiratory infections • Can inflame and damage the lining of the lungs • Interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and harsh weather • Damages the leaves of trees and other plants
Carbon Dioxide ($CO_,$)	• Does not directly impair human health • A greenhouse gas that traps the earth's heat and contributes to global warming

1.3 INVENTORY METHODOLOGY

The methodology to accomplish the air emissions inventory was outlined in a protocol that was prepared at the initiation of the project (EA Engineering 2001). Tasks consisted of a site survey in August 2003, interviews with Denali NP & Pres personnel', review of applicable park records, emission calculations, review of applicable state and local air quality regulations, an assessment of mitigation measures and potential emission reduction initiatives, and report preparation. The data were used in conjunction with a number of manual and computer software computational

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tools to calculate emissions. Computational tools included U.S. Environmental Protection Agency (USEPA) emission factors such as the Factor Information Retrieval System (FIRE) database, USEPA *TANKS 4.0* model, U.S. Forest Service *First Order Fire Effects Model (FOFEM) 4.0* model, and USEPA *MOBILE6.2* mobile source emissions model. The Federal Aviation Administration model *Emissions and Dispersion Modeling System (EDMS)* was utilized to estimate emissions from aircraft. The year 2002 was selected as the basis for the air emission inventory since data for that year were the most recent available at the park. It should be noted that emissions are expected to vary from year to year due to fluctuations in visitation, prescribed and wildfires, and other activities. Additional information on emission estimation methodology, including emission factors, is provided in Appendices A and **B.**

1.4 PARK DESCRIPTION

Denali NP & Pres is located in central Alaska, approximately 73 miles southwest of Fairbanks. The park entrance is located 120 from Fairbanks on the George Parks Highway. In 1917, Congress established Mount McKinley National Park as a "game refuge" to "set apart as a public park for the benefit and enjoyment of the people ... for recreation purposes by the public and for the preservation of animals, birds, and fish and for the preservation of the natural curiosities and scenic beauties thereof . . ." In 1980, Congress passed the Alaska National Interest Lands Conservation Act (ANILCA) that enlarged and renamed the park as Denali National Park and Preserve.

Denali NP and Pres encompasses an area of six million acres, about the size of the state of New Hampshire. Most of the two million acres of the original park has been in protected status since 1917. This large size enables an array of flora and fauna to live together in a healthy natural ecosystem and provides excellent opportunities to study large subarctic ecosystems in settings primarily undisturbed by humans. Because of these values, the United Nations Man and the Biosphere Program designated the park an International Biosphere Reserve in 1976.

The park contains a major portion of the Alaska Range, one of the great mountain uplifts in North America. The Alaska Range is dominated by North America's highest peak, Mount McKinley, with its summit at 20,320 feet above sea level. Towering 18,000 feet above the adjacent lowlands, the mountain's dramatic vertical relief rivals any other mountain in the world, and it exceeds the vertical relief of Mount Everest over its plateau. A number of large glaciers originate in the park's high mountains, including some of the largest in North America, up to 45 miles long and 4 miles wide.

Denali NP & Pres has more than 10,000 mapped lakes, many of which are found in the northwest 1980 additions. The park is also significant for its diverse avian habitat that attracts birds from all over the world. The park's rich and varied vegetation includes alpine tundra, shrub-scrub tundra, mixed spruce-birch woodlands, taiga, wetlands, and extensive riparian areas. The subarctic plant communities in the park have adapted to long, bitterly cold winters. Even with these extreme conditions, more than 650 species of flowering plants inhabit the slopes and valleys of the park. A map of the park is provided in Figure 1. The developed areas at the park's eastern entrance are noted in Figure 2 and are depicted in the maps at the end of this section. These and other developed areas and/or functions are noted in Table 2.

Table 2: Denali National Park and Preserve Developed Areas

Name/Location	Function/Facilities
Entrance Area	Visitor Access Center, Mercantile Building (camp store), Campground, Bus Shop, Power House, Railroad Depot, Park Headquarters, Dog Kennel, Employee Residences, Airstrip
Savage River	Campground, Check Station
Sanctuary River	Campground, Ranger Station
Teklanika River	Campground
Igloo Creek	Campground, Ranger Station
Toklat River	Ranger Station, Employee Housing
Eielson	Visitor Center
Wonder Lake	Campground, Ranger Station
Kantishna	Camp Denali, North Face Lodge, Denali Backcountry Lodge, Kantishna Roadhouse (all in-holdings), Airstrip

1.5 AIR QUALITY STATUS

Air quality in the park and preserve is very good to excellent, with the notable exception of haze and smoke from wildfires in summer and, on a local basis, "fugitive" dust from the park road. NPS air quality monitoring has shown that Denali NP & Pres consistently has some of the best visibility and cleanest air measured in the country although parks in the Pacific Northwest often record lower annual ozone values, and western desert parks sometimes have fewer visibility-degrading particles in the air. The park's relatively clean air is due in part to low population density and relatively sparse industrial activity in the state.

However, there is a presence of airborne contaminants in the park that travel halfway around the world before reaching the park. Small but measurable amounts of pollution arrive in the park from Europe and Asia. These pollutants come from power plants, metal smelters, and other industrial sources and are transported over the North Pole and throughout the arctic regions in a phenomenon called arctic haze. Desert dust and agricultural contaminants can travel directly across the Pacific Ocean to reach the park. Airborne contaminants from other continents will

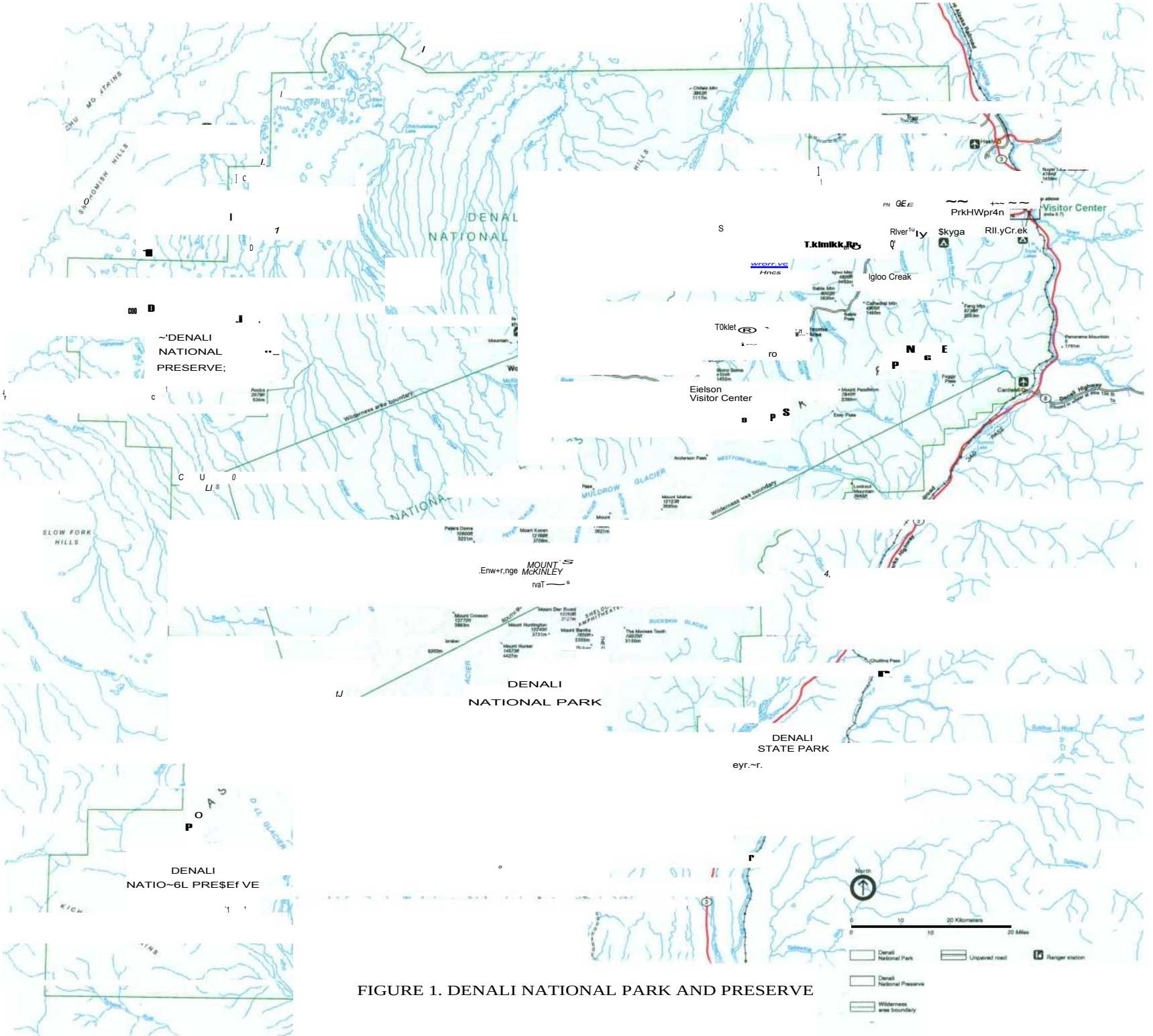

FIGURE 1. DENALI NATIONAL PARK AND PRESERVE

likely increase over time as the source areas grow and develop. Therefore, the park's clean air may eventually depend more on international treaties and the environmental policies of other countries than on U.S. laws designed to protect air quality.

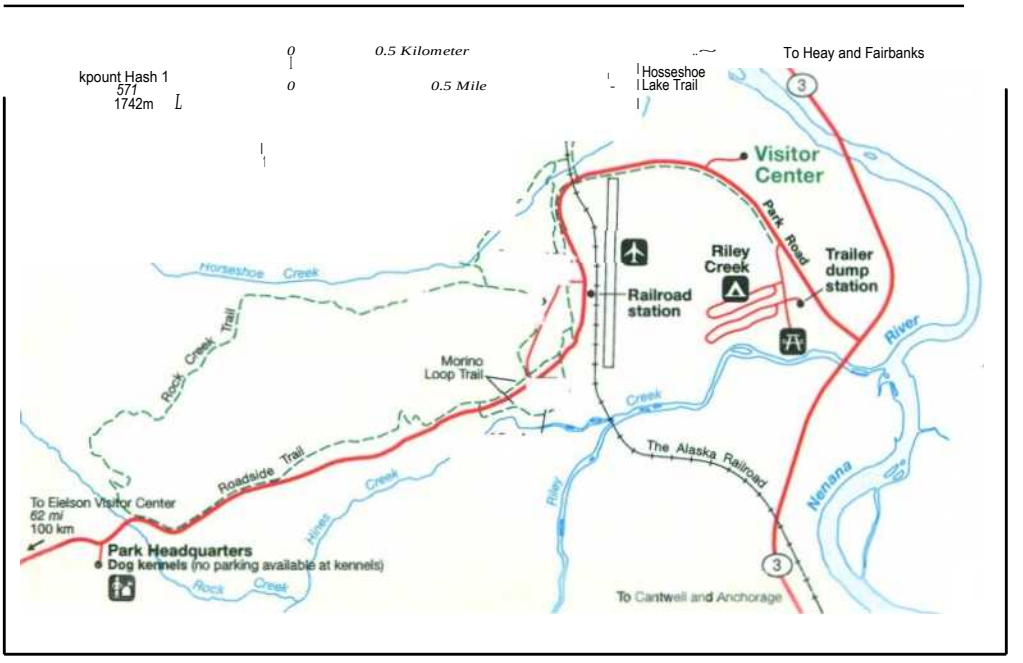

FIGURE 2. DENALI NATIONAL PARK ENTRANCE AREA

No exceedences of the National Ambient Air Quality Standards (NAAQS) have been documented in Denali NP & Pres where air quality data have been collected at a sampling station near park headquarters. According to the most recent monitoring data, the 3-year average 4 th highest daily maximum, 8-hour ozone measurement was 49 parts per billion (ppb), which compares to the 85 ppb standard. The highest 1-hour average maximum ozone concentration in 2002 was 69 ppb, which compares to a 125 ppb standard. Although these values are below the standard, there has been a significant degradation trend between 1993-2002 for both the 1-hour and 8-hour ozone standards (NPS 2003a).

In addition to the NPS ozone monitoring program, the park participates in three other national air sampling programs:

- The National Atmospheric Deposition Program/National Trends Network (NADP/NTN), that monitors acid precipitation
- The Interagency Monitoring of Protected Visual Environments (IMPROVE) program that monitors aerosols and

- The Clean Air Status and Trends Network (CASTNet) that measures dry deposition of particles and gases.

According to researchers, persistent organic compounds (POPs) are an emerging issue of concern for arctic and subarctic ecosystems. POPs include pesticides, such as DDT, chlordane, and toxaphene, and industrial chemicals and byproducts, such as PCBs, dioxins, and furans. These compounds bioaccumulate, and arctic ecosystems are sink areas for POPs from the lower latitudes. Evidence of their presence includes findings of relatively high concentrations of DDT in Aleutian bald eagles and relatively high concentrations of PCBs in Orcas from southeast Alaska. In a compilation of data from remote, high altitude lakes around the world, PCBs in Wonder Lake sediments were six times higher than any other lake tested. DDT levels also were relatively high (http://www.absc.usgs.gov/research/Denali USGS/conference/presentations/Air _Quality.pdf).

The 1977 amendments to the Clean Air Act (CAA) designated the original Mt. McKinley National Park as a Class I airshed, which requires the prevention of significant deterioration of air quality over baseline conditions. That classification was extended to cover the 1980 ANILCA additions to the park and preserve. Denali National Park and Preserve is the only national park unit in Alaska that is designated as a mandatory Class I airshed.

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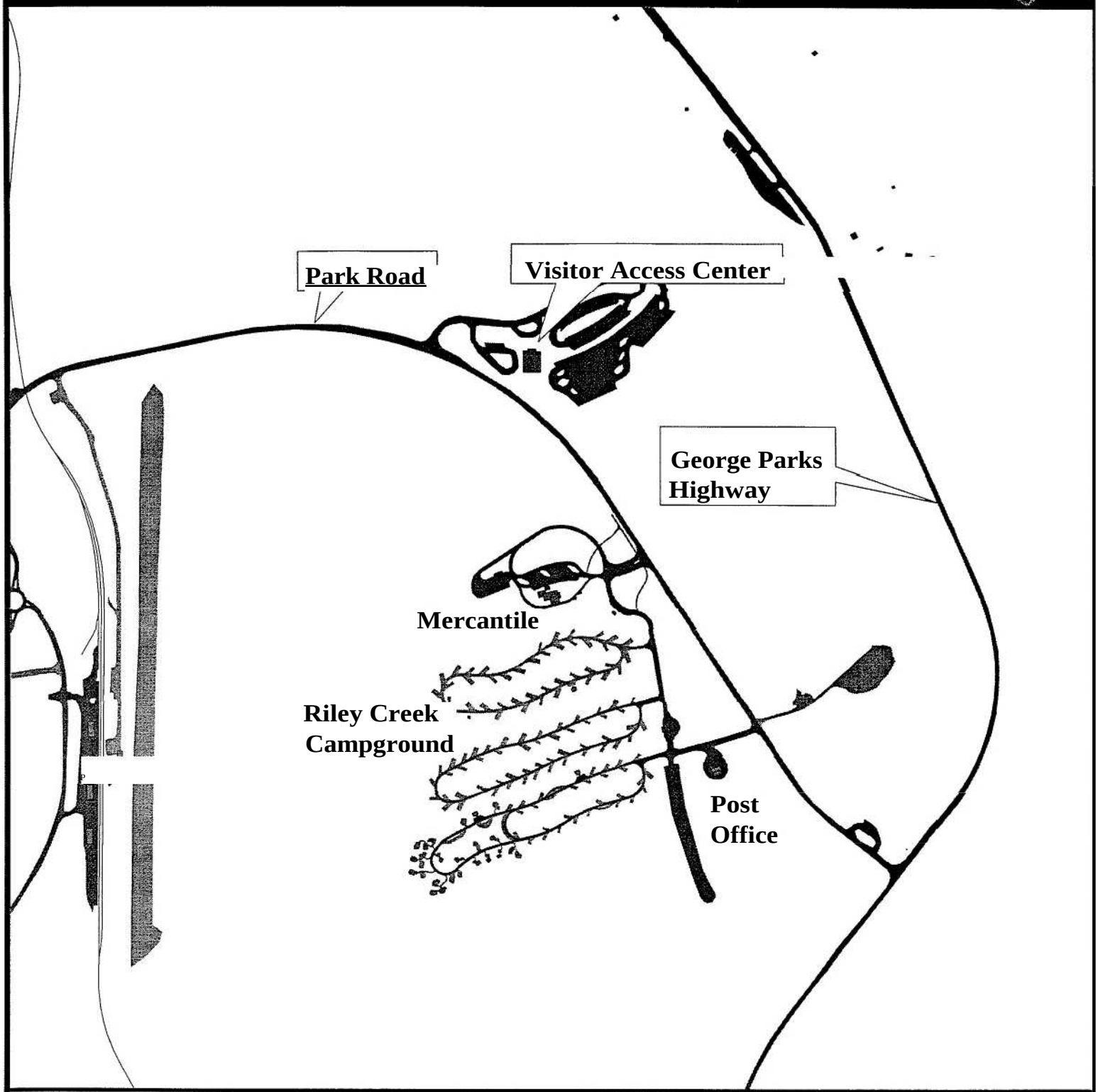


Denali National Park & Preserve

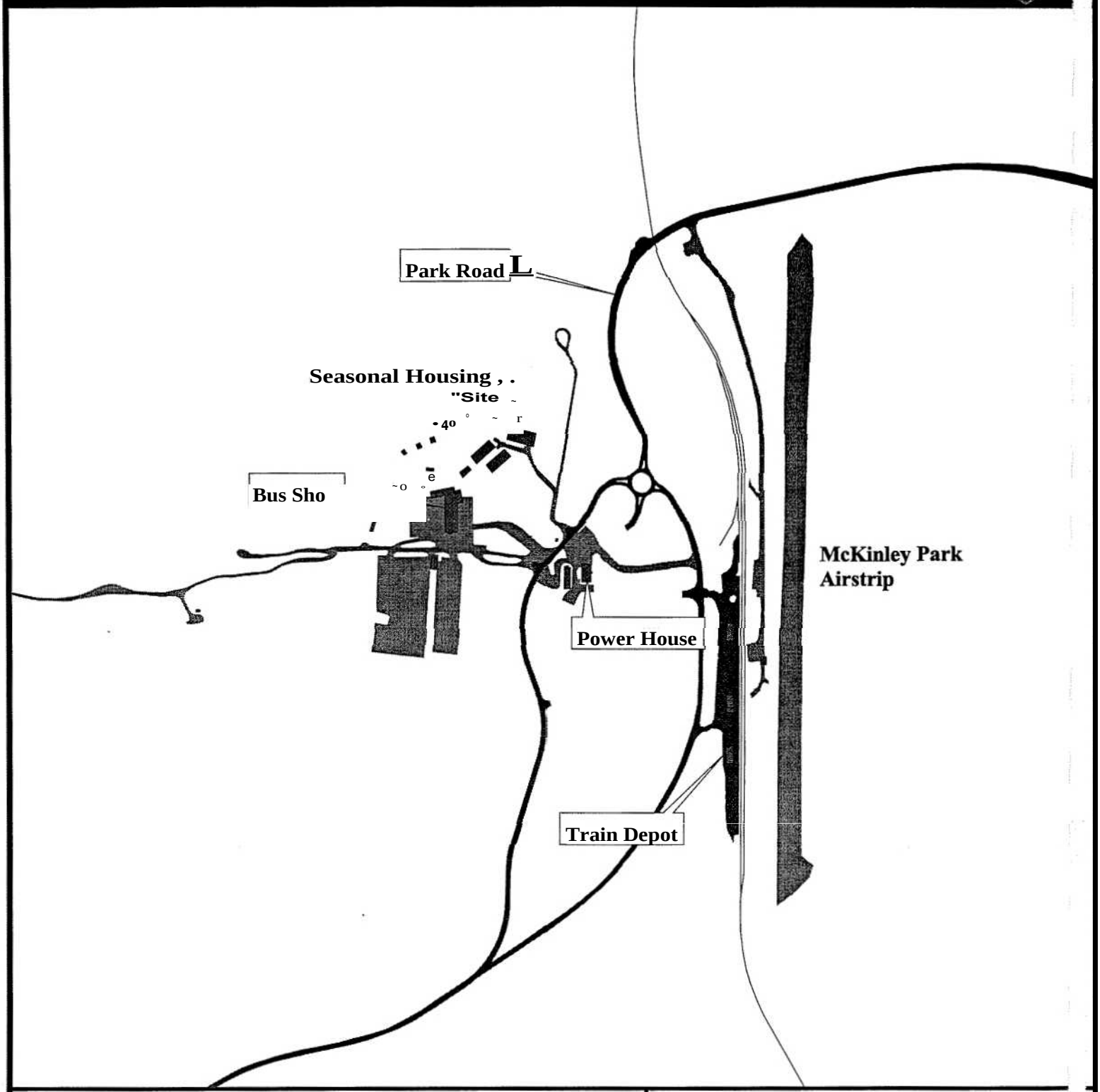
Mercantile, Visitor Access Center, and Riley Creek Campground

N
W E
S

0.075 0 0.075 0.15 0.225 0.3 Mile.

1 : 9,049 1 inch = 0.14 miles

National Park Service
U.S. Department of the Interior



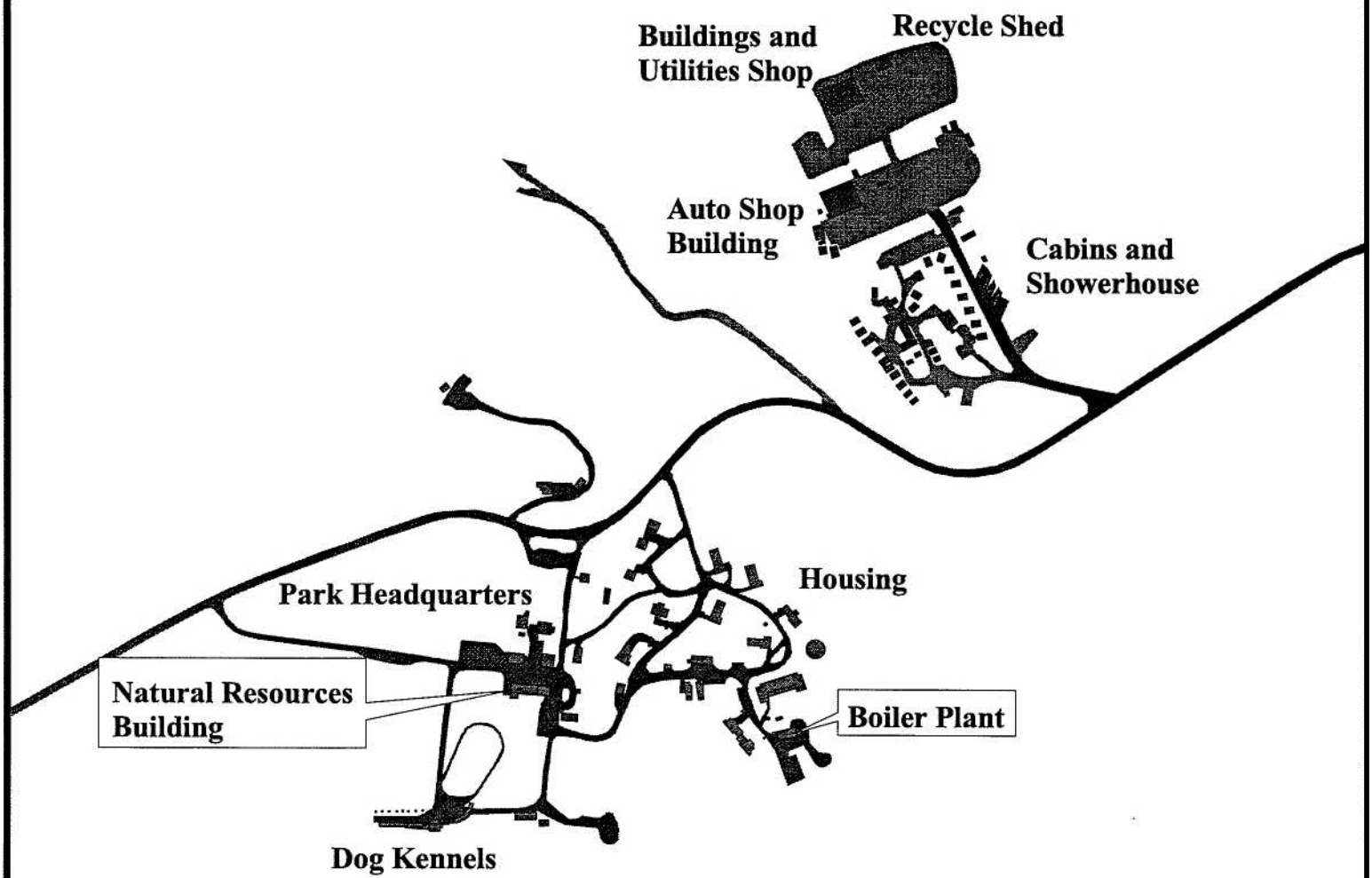
Denali National Park & Preserve

Airstrip, Train Depot, and Bus Shop

N
W E
S

0.05 0 0.05 0.1 0.15 0.2 0.25 Mile.,

1 : 7,839 1 inch = 0.12 miles



Denali National Park & Preserve

Headquarters Area

2. STATIONARY AND AREA SOURCE EMISSIONS

This section summarizes emissions from stationary and area sources at Denali NP & Pres for the year 2002. The discussion is divided into sections covering emissions from combustion sources, fuel storage sources, and area sources. The following emissions were calculated for most sources: particulate matter (PM10), sulfur dioxide (SO2), nitrogen oxides (NO,), carbon monoxide (CO), carbon dioxide (CO2), and volatile organic compounds (VOCs).

2.1 STATIONARY SOURCES

2.1.1 Space And Water Heating Equipment

Stationary combustion sources at Denali NP & Pres include approximately 45 NPS No. 1 fuel oil and propane space and water heating units, including approximately 15 employee housing heating units. The principal concessionaire, a joint venture by Doyon, Limited and ARAMARK, operates several used oil heating units. Table 3 provides an inventory of these heating units.

Criteria air emissions were calculated using the appropriate residential and commercial unit emission factors. For example, PM_{10} emissions from the two No. 1 fuel oil boilers at the Boiler Plant in the east end of the park are calculated as follows:

$$61{,}865\ gal/yr \times \frac{2.0\ lb\ PM10}{1{,}000\ gal} = 124\ lb\ PM/yr$$

Actual criteria pollutant emissions from space and water heating equipment are summarized in Table 4. Potential emissions also were calculated by assuming that the heating units were operated continuously during the year or 8,760 hours per year, and these emissions are summarized in Table 5.

TABLE 3: HEATING EQUIPMENT AT DENALI NP & PREs

Location	Capacity (Btu/hr)	Number	Fuel Type
Denali National Park and Preserve			
Boiler Plant	8,369,000	2	No. 1 Fuel Oil
Auto Shop	115,000	2	No. I Fuel Oil
P-251 Residence	114,000	1	No. 1 Fuel Oil
P51 6 Plex Apartments	1,358,000	2	No. 1 Fuel Oil
P 111 Residence	125,000	1	No. 1 Fuel Oil
B 106 Barn	117,000	1	No. 1 Fuel Oil
Butler Building	299,000	2	No. I Fuel Oil
Resource Management	175,000	1	No. 1 Fuel Oil
C Camp Dorm B-121	105,000	1	No. 1 Fuel Oil
Visitor Access Center	408,000	2	No. I Fuel Oil
Dispatch B-141	105,000	1	No. I Fuel Oil
Atco 1	68,000	1	No. 1 Fuel Oil
Atco 3 (at Visitor Access Center)	68,000	1	No. I Fuel Oil
Superintendent's Residence	189,000	1	No. 1 Fuel Oil
P-26 Residence	105,000	1	No. I Fuel Oil
P-27 Residence	68,000	1	No. 1 Fuel Oil
P-28 Residence	68,000	1	No. 1 Fuel Oil
P-34 Residence	189,000	1	No. I Fuel Oil
P-169/170 Panabodes	70,000	2	No. 1 Fuel Oil
B-21 Headquarters	140,000	1	No. 1 Fuel Oil
B-101 Interpretation	140,000	1	No. 1 Fuel Oil
Eielson Visitor Center	140,000	1	No. 1 Fuel Oil
East End Park Road	150,000	4	No. i Fuel Oil
C-Camp Shower	117,000	1	Propane
Apartments 12 & 13	175,000	4	Propane
P-171 Residence	11,700	1	Propane
C-Camp Rec Hall B-121	40,000	1	Propane
C-Camp West Row	20,000	11	Propane
C-Camp East Row	20,000	17	Propane
Igloo Cabin	35,000	1	Propane
East Fork Cabin	35,000	1	Propane
Toklat Ranger Cabin	35,000	1	Propane
Sanctuary Cabin	35,000	1	Propane
Toklat Pumphouse	35,000	1	Propane
Rock Creek	20,000	1	Propane
Hotel Treatment Building	20,000	1	Propane
Duplex North	20,000	2	Propane
Duplex South	20,000	2	Propane
Toklat Rec Hall	40,000	1	Propane
Toklat Cabin #235 & 236	20,000	1	Propane
Toklat Cabin #242	20,000	1	Propane
Toklat Cabin #241	20,000	1	Propane
Toklat Cabin #243	20,000	1	Propane
Toklat New Duplex	20,000	2	Propane
West End Park Road	150,000	2	Propane
West End Park Road	260,000	1	Propane
Auto Shop	500,000	1	Used Oil
Doyon, Limited **and ARAMARK**			
Bus Shop	240,000	1	Used Oil
Bus Shop	280,000	1	Used Oil

TABLE 4: 2002 ACTUAL CRITERIA EMISSIONS FROM HEATING EQUIPMENT AT DENALI NP & PRES

Location								
Nationa Park Service								
Boiler Plant	No. 1 Fuel Oil	61,865	124	4,392	1,237	309	1,330,098	21
Auto Shop		13,241	5	940	238	66	284,682	9
P-251 Residence		1,351	1	96	24	7	29,047	1
P51 6 Plex Apartments		1,674	3	119	33	8	35,991	1
P 111 Residence		929	0	66	17	5	19,974	1
B 106 Barn		386	0	27	7	2	8,299	0
Butler Building		5,277	2	375	95	26	113,456	4
Resource Mana • ement		451	0	32	8	2	9,697	0
C Camp Dorm B-121		1,330	1	94	24	7	28,595	1
Visitor Access Center		6,334	13	450	127	32	136,181	2
Dispatch B-141		1,390	1	99	25	7	29,885	1
Atco 1		1,470	1	104	26	7	31,605	1
Atco 3 (at VA Center)		1,104	0	78	20	6	23,736	1
Superintendent's Residence		359	0	25	6	2	7,719	0
P-26 Residence		624	0	44	11	3	13,416	0
P-27 Residence		592	0	42	11	3	12,728	0
P-28 Residence		592	0	42	11	3	12,728	0
P-34 Residence		777	0	55	14	4	16,706	1
P-169/170 Panabodes		469	0	33	8	2	10,084	0
B-21 Headquarters		148	0	11	3	1	3,182	0
B-101 Interpretation		106	0	8	2	1	2,279	0
Eielson Visitor Center		1,865	1	132	34	9	40,098	1
East End Park Road		400	0	28	7	2	8,600	0
C-Camp Shower	Propane	604	0	0	8	1	7,553	0
Apartments 12 & 13		3,615	1	0	51	7	45,188	1
P-171 Residence		60	0	0	1	0	755	0
C-Camp Rec Hall B-121		207	0	0	3	0	2,582	0
C-Camp West Row		1,136	0	0	16	2	14,202	0
C-Camp East Row		1,756	1	0	25	3	21,948	1
Igloo Cabin		181	0	0	3	0	2,259	0
East Fork Cabin		181	0	0	3	0	2,259	0
Toklat Ranger Cabin		181	0	0	3	0	2,259	0
Sanctuary Cabin		181	0	0	3	0	2,259	0
Toklat Pumphouse		181	0	0	3	0	2,259	0
Rock Creek		103		0	1	0	1,291	0
Hotel Treatment Building		103	0	0	1	0	1,291	0
Duplex North		207	0	0	3	0	2,582	0
Duplex South		207	0	0	3	0	2,582	0
Toklat Rec Hall		207	0	0	3	0	2,582	0
Toklat Cabin #235 & 236		103		0	1	0	1,291	0
Toklat Cabin #242		103	0	0	1	0	1,291	0
Toklat Cabin #241		103	0	0	1	0	1,291	0
Toklat Cabin #243		103	0	0	1	0	1,291	0
Toklat New Duplex		207	0		3	0	2,582	0
West End Park Road		1,549	1	0	22	3	19,366	0
West End Park Road		1,343	1	0	19	3	16,784	0
Auto Shop	Used Oil	1,000	255	500	19	5	22,000	1
		NPS Subtotal	413	7,794	2,185	519	2,388,531	52

Location	Fuel Type	Consumption (gal/yr)	PM_{10} (Ibs/yr)	SO2 (lbs/yr)	NO_X (Ibs/yr)	CO (ibs/yr)	CO2 (lbs/yr)	VOC (Ibs/yr)
Doyon, Limited and ARAMARK								
Bus Shop	sed 0'	1,500	21	510	17		33,000	
Bus Shop		1,500	21	510	17		33,000	
		Subtotal	42	1,020	33		66,000	
Denali National Park and Preserve Totals (			455f	8,814	2,218	524	2,454,5311	55

TABLE 5: 2002 POTENTIAL CRITERIA EMISSIONS FROM HEATING EQUIPMENT AT DENALI NP & PRES

Location	Fuel Type	Consumption (gal/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_x (Ibs/yr)	CO (Ibs/yr)	CO_2 (Ibs/,yr)	VOC (Ibs/yr)
National Park Service								
Boiler Plant	No. 1 Fuel Oil	1,047,321	2,095	74,360	20,946	5,237	22,517,392	356
Auto Shop		14,391	6	1,022	259	72	309,416	10
P-251 Residence		7,133	3	506	128	36	153,363	
P51 6 Plex Apai inents		169,944	340	12,066	3,399	850	3,653,796	58
P 111 Residence		7,821	3	555	141	39	168,161	6
B 106 Barn		7,321	3	520	132	37	157,398	5
Butler Building		37,418	15	2,657	674	187	804,481	27
Resource Management		10,950	4	777	197	55	235,425	8
C Camp Dorm B-121		6,570	3	466	118	33	141,255	5
Visitor Access Center		51,058	102	3,625	1,021	255	1,097,753	17
Dispatch B-141		6,570	3	466	118	33	141,255	5
Atco 1		4,255	2	302	77	21	91,479	3
Atco 3 (at VA Center)		4,255	2	302	77	21	91,479	3
Superintendent's Residence		11,826	5	840	213	59	254,259	8
P-26 Residence		6,570	3	466	118	33	141,255	5
P-27 Residence		4,255	2	302	77	21	91,479	3
P-28 Residence		4,255	2	302	77	21	91,479	3
P-34 Residence		11,826	5	840	213	59	254,259	8
P-169/170 Panabodes		8,760	4	622	158	44	188,340	6
B-21 Headquarters		8,760	4	622	158	44	188,340	6
B-101 Interpretation		8,760	4	622	158	44	188,340	6
Eielson Visitor Center		8,760		622	158	44	188,340	6
East End Park Road		37,543	15	2,666	676	188	807,171	27
C-Camp Shower	Propane	11,388	5	0	159	22	142,350	3
Apartments 12 & 13		68,133	27	1	954	129	851,667	20
P-171 Residence		1,139	0	0	16	2	14,235	0
C-Camp Rec Hall B-121		3,893	2	0	55	7	48,667	1
C-Camp West Row		21,413	9	0	300	41	267,667	6
C-Camp East Row		33,093	13	1	463	63	413,667	10
Igloo Cabin		3,407	1	0	48	6	42,583	1
East Fork Cabin		3,407	1	0	48	6	42,583	1
Toklat Ranger Cabin		3,407	1	0	48	6	42,583	1
Sanctuary Cabin		3,407	1	0	48		42,583	1
Toklat Pumphouse		3,407	1	0	48	6	42,583	1
Rock Creek		1,947	1	0	27	4	24,333	
Hotel Treatment Building		1,947	1	0	27	4	24,333	1
Duplex North		3,893	2	0	55	7	48,667	1
Duplex South		3,893	2	0	55	7	48,667	1
Toklat Rec Hall		3,893	2	0	55	7	48,667	1
Toklat Cabin #235 & 236		1,947	1	0	27		24,333	
Toklat Cabin #242		1,947	1	0	27	4	24,333	
Toklat Cabin #241		1,947		0	27	4	24,333	1
Toklat Cabin #243		1,947	1	0	27	4	24,333	1
Toklat New Duplex		3,893	2	0	55	7	48,667	1
West End Park Road		29,200	12	1	409	55	365,000	9
West End Park Road		25,307	10	0	354	48	316,333	8
Auto Shop	Used Oil	31,286	7,978	15,637	594	156	688,286	31
	NPS Subtotal		10,697	21,170	33,215	7,588	35,617,371	689

Location	Fuel Type	Consumption (gal/yr)	PM10 (lbs/yr)	SO_2 (lbs/yr)	NO_X (Ibs/yr)	CO (lbs/yr)	CO_2 (Ibs/yr)	VOC (lbs/yr)
Doyon, Limited and ARAMARK								
Bus Shop	sed Oi	15,017	210	5,106	165	26	330,377	1'D
Bus Shop		17,520	245	5,957	193	30	385,440	18
		Subtotal	456	11,063	358	55	715,817	
Denali National Park and Preserve Totals			11,152	132,232	33,573	7,643	36,333,188	722

2.1.2 Generators

2.1.2.1 Generator Emissions - Actual

Emissions were calculated by multiplying the unit rating of the generators by an estimated annual run time (hr/yr) to get the kW-hr/yr, and the appropriate emission factors were then applied. For example, actual PM_{10} emissions from the *600 kW* diesel generator in the Powerhouse are calculated as shown below. Actual generator criteria emissions are summarized in Table *6.*

$$600\ kW \times \frac{52\ hours}{year} \times \frac{1.34\ hp}{kW} \times \frac{0.0007\ lb\ PMIo}{hp\text{-}hr} = 29\ lb\ PMIo/yr$$

2.1.2.2 Generator Emissions - Potential

Potential emissions also were calculated for the generators, and the same emission factors that were used to calculate the actual emissions were used to calculate these potential emissions. Actual operating hours were used for generators that were actually operated more than *500* hours a year. Potential criteria generator emissions are summarized in Table *7.* To calculate potential emissions, EPA guidance on the number of hours of operation to assume was adopted.

> EPA does not recommend the use of *8,760* hours per year (i.e., full-year operation) for calculating PTE (potential to emit) for emergency generators ... The EPA believes that *500* hours is an appropriate default assumption for estimating the number of hours that an emergency generator could be expected to operate under worst-case conditions.'

' *Calculating Potential to Emit (PTE) for Emergency Generators,* Office of Air Quality Planning and Standards (MD-10), U.S. Environmental Protection Agency, 06 September 1995.

TABLE 6: 2002 ACTUAL DENALI NP & PRES GENERATOR CRITERIA EMISSIONS

Facility	Fuel	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (lbs/yr)	SO2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Powerhouse	Diesel	600	52	31,200	29	169	1,003	230	48,079	27
Headquarters	Diesel	113	52	5,876	17	16	244	53	9,055	20
Toklat	Diesel	55	8,760	481,800	1,420	1,324	20,014	4,313	742,454	1,620
Eielson Visitor Center	Diesel	32	260	8,320	25	23	346	74	12,821	28
Wonder Lake	Diesel	14	26	374	1	1	16	3	577	1
				Totals	1,493	1,533	21,623	4,673	812,986	1,696

TABLE 7: 2002 POTENTIAL DENALI NP & PRES GENERATOR CRITERIA EMISSIONS

Facility	Fuel	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (lbs/yr)	SO2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO2 (lbs/yr)	VOC (lbs/yr)
Powerhouse	Diesel	600	500	300,000	281	1,626	9,648	2,211	462,300	257
Headquarters	Diesel	113	500	56,500	167	155	2,347	506	87,067	190
Toklat	Diesel	55	8,760	481,800	1,420	1,324	20,014	4,313	742,454	1,620
Eielson Visitor Center	Diesel	32	500	16,000	47	44	665	143	24,656	54
Wonder Lake	Diesel	14	500	7,200	21	20	299	64	11,095	24
				Totals	1,937	3,169	32,973	7,237	1,327,572	2,146

2.1.3 Fuel Storage Tanks

Denali NP & Pres operates several gasoline and diesel fuel underground storage tanks (USTs) and aboveground storage tanks (ASTs) that serve NPS and concessionaire vehicles and other motorized equipment. There are also No. 2 fuel oil, diesel fuel, and propane tanks that serve heating equipment and generators.

There are two basic types of VOC emissions from storage tanks: working losses and standing losses. Working losses are composed of both withdrawal and refilling loss emissions. Withdrawal loss emissions result from the vaporization of liquid fuel residue on the inner surface of tank walls as the liquid levels in the tank are decreased and air is drawn into the tank. Refilling losses refer to fuel vapor releases to the air during the process of refilling the tank as the liquid level in the tank increases and pressurizes the vapor space. Standing losses describe those tank emissions from the vaporization of the liquid fuel in storage due to changes in ambient temperatures. VOC losses are also a direct function of the annual product throughput or tank turnovers.

VOC emissions from the park fuel storage tanks were calculated using the USEPA *TANKS4* software program. *TANKS4* is based on the emission estimation procedures from Chapter 7 of EPA's Compilation of Air Pollutant Emission Factors (AP-42) and uses chemical, meteorological, and other data to generate emission estimates for different types of storage tanks. Emissions from No. 2 and diesel fuel tanks are extremely small since the volatility of these fuels is extremely low compared to gasoline. Therefore, only emissions from gasoline USTs and ASTs were calculated and are summarized in Table 8.

TABLE 8: DENALI NP & PREs GASOLINE STORAGE TANK EMISSIONS

Location	**Type**	Volume (gal)	**Throughput** (gal/yr)	**VOC** (lbs/yr)	
National Park Service					
Automotive Shop	UST	**12,000**	45,072	144,	
Wonder Lake	AST	**500**	1,172	48	
Eielson Visitor Center	AST	**500**	3,017	55	
		NPS Total	49,261	247	
Doyon Limited and'ARAMARK					
East End Bus Shop	AST	500	1,000		
Denali NP & Pres Total				lbs	295
				tons	0.15

2.1.4 Wastewater Treatment Plants

Wastewater generated in Denali NP & Pres is treated in surface lagoons and septic tanks. Since these are passive systems rather than mechanical processes such as primary wastewater treatment plants, few VOC emissions are generated.

2.2 AREA SOURCES

2.2.1 Woodstoves/Fireplaces

The are about eight NPS woodstove in the park that are located at patrol cabins, and it was estimated that only about one-half of a cord of wood was burned in a year. The in-holding Camp Denali at Kantishna at the west end of the Park Road has seventeen cabins with small woodburing stoves for space heating. However, there were no data on the frequency of use or quantity of wood consumed by guests staying at these cabins. The estimated emissions from the patrol cabin are summarized in Table 9.

TABLE 9: WOODSTOVE AIR EMISSIONS FROM DENALI NP & PRES

Location	**Number**	**Fuel Consum s tion**	PM_{10} lbs/ r	SO_2 **lbs/ r**	NO_x **lbs/ r**	**CO** lbs/ r	**VOC lbs/ r**
Patrol Cabins	8	0.5 cords/yr	30			222	201

2.2.2 Campfires

There are three campgrounds with about 230 campsites where campfires are allowed within small fire rings. Park data indicate that there were approximately 12,875 campers in 2002, and it was estimated that only about 25 percent had a campfire. Assuming that approximately 2.5 campers occupy a campsite and that each campfire consumes approximately 15 lbs of wood, air emissions from campsites are summarized in Table 10.

TABLE **10: 2002** DENALI NP & PRES CAMPFIRE EMISSIONS

Campers	**Campfires**	**Fuel** tons/ r	PM_{10} **lbs/ r**	SO2 lbs/ r	NO_x lbs/ r	**CO** lbs/ r	**VOC lbs/** r
12,875	1,300	10	337		25	2,463	2,233

2.2.3 Wildfires and Prescribed Fires

Wildland fire consists of both wildfires and prescribed fires. Wildfires are ignited naturally, usually by lightening, while prescribed fires are ignited intentionally to achieve fire management

objectives in areas where the natural fire regime has been suppressed. Although Denali NP & Pres does not conduct prescribed burning, it is used elsewhere as a land treatment process to accomplish natural resource management objectives, including reducing the potential for destructive wildfires, eliminating excessive fuel buildup, controlling insects and disease, improving wildlife habitat and forage production, maintaining natural succession of plant communities, and restoring natural processes. Prescribed burning can be for either ecological restoration or ecological maintenance. By policy, only prescribed burning for ecological restoration is considered an anthropogenic source of emissions; however, for the purposes of this emissions inventory, all prescribed burning has been treated as an anthropogenic source.

Because of its large size and sparse habitation, most of the park is under a naturally regulated fire regime. Wildfires are not suppressed unless they occur near buildings or historic cabin sites, and since the natural fire cycle is generally uninterrupted, it is unnecessary to conduct prescribed burning. The total acreage of naturally ignited wildfires has been fairly consistent over the years. Park data from the last 56 years indicate that an average of 2,856 acres per year are consumed, and park fire officials provided information on the type of vegetation consumed. The First Order Fire Effects Model (FOFEM) was used to estimate emissions. FOFEM is a computer program developed by the Intermountain Fire Sciences Lab, U.S. Forest Service, to predict the effects of prescribed fire and wildfire in forests and rangelands throughout the U.S. In particular, it quantifies emissions of PM10, PM2.5, CO, and VOCs (as CH4) that are summarized in Table 11.

TABLE 11: WILDFIRE AIR EMISSIONS FROM DENALI NP & PRES

Fuel Type	*Acres*	*PM10 (lbs/yr)*	PM2.5 *(lbs/yr)*	*VOC*[1] *(lbs/yr)*	*Co (lbs/yr)*	*CO_2 (lbs/yr)*
		Wildfires				
Black Spruce	*1,285*	*1,521,677*	*1,290,341*	*755,698*	*16,176,812*	*129,113,762*
White Spruce	*428*	*359,428*	*304,592*	*177,358*	*3783,629*	*32,510,848*
Black Spruce - White Spruce	*714*	*2056,320*	*1,742,160*	*1,050,294*	*22,922,970*	*111,673,884*
Sedge Shrub Tundra	*428*	*1,285*	*1,285*	*428*	*2,999*	*844,376*
Total	*2,856*	*3,938,710*	*3,338,378*	*,983,778*	*42,886410*	*274,142,870*

As methane (CH_4)

2.2.4 Miscellaneous Area Sources

Miscellaneous area sources include food preparation, degreasers, paints and other surface coatings, lighter fluid consumption, consumer solvents, propane use by visitors in recreational vehicles, and highway maintenance, such as paving materials. However, data were not available for these relatively minor sources that have negligible emissions.

2.3 SUMMARY OF STATIONARY AND AREA SOURCE EMISSIONS

Table 12 summarizes the stationary and area source emissions calculated above in a format that allows comparison between the various sources as well as providing totals for each pollutant or pollutant category under consideration.

TABLE 12: SUMMARY OF 2002 STATIONARY AND AREA SOURCE EMISSIONS AT DENALI NP & PRES

Activity	Particulates PM)		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		Carbon Dioxide		VOCs	
	lbs/ r	tons/ r	lbs/ r	tons/ r	lbs/ r	tons/ r	lbs/ r	tons/ r	lbs/ r	tons/	lbs/	tons/
Stationary Sources'												
Heating Equipment	455	0.23	8,814	4.41	2,218	1.11	524	0.26	2,454,531	1,227	55	0.03
Generators	1,493	0.75	1,533	0.77	21,623	10.81	4,673	2.34	812,986	406.49	1,696	0.85
Gasoline Storage Tanks	--	--	--	--	--	--	--	--	--	--	295	0.15
Stationary Sources Subtotal	1,948	0.97	10,347	5.17	23,841	11.92	5,197	2.60	3,267,517	1,634	2,046	1.02
Area Sources												
Woodstoves	20	0.01	--	--	2	<0.01	222	0.06	--	--	201	0.05
Campfires	337	0.17	4	<0.01	25	0.01	2,463	1.23	--	--	2,233	1.12
Wildfires	3,938,710	1,969	--	--	--	--	42,886,410	21,443	274,142,870	137,071	1,983,778	992'
Area Sources To al	3,939,067	1,970	4	<0.01	27	0.01	42,889,095	21,445	274,142,870	137,071	1,986,212	993
Totals												
	Particulates (PM, 0)		Sulfur Dioxide		Ni ro:en Oxides		Carbon Monoxide		Carbon Dioxide		VOCs	
	lbs/ r											tons/ r
Totals without Wildfires	2,305	1.15	10,351	5.18	23,868	11.93	7,882	3.94	3,267,517	1,634	4,480	2.24
Totals with Wildfires	3,941,015	1,971	10,351	5.18	23,868	11.93	42,893,977	21,447	277,410,378	138,700	1,988,258	994

1 As methane

3. MOBILE SOURCE EMISSIONS

This section summarizes emissions from mobile sources at Denali NP & Pres for 2002. Mobile emission sources include highway and nonroad vehicles, including snowmobiles.

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

Visitor surveys have indicated that approximately 80 percent of visitors rode buses into the park interior, and the tour buses are accessed at the Visitor Access Center that is within a mile of the park's entrance. Visitor vehicles are allowed to travel only on the paved portion of the Park Road, which consists of the first 15 miles from the park's entrance. In addition to the tour buses, the concessionaire operates a shuttle bus system that operates within the entrance area of the park. The park also conducts an annual lottery permitting up to 400 private vehicles on each of four days to drive the length of the Park Road after the tour buses stop running in September.

Visitor vehicles often correlate well with the estimated number of recreational visitors arriving by private vehicles, which were estimated to be 200,000 out of a total of 311,335 visitors in 2002. Assuming a typical NPS people per vehicle ratio of 2.8, an estimated 71,430 visitor vehicles, other than the lottery vehicles, entered the park in 2002. Assuming an average of 10 miles travel per vehicle, the vehicle miles traveled by visitor vehicles were calculated and are presented in Table 13.

TABLE 13: ESTIMATED VISITOR VEHICLE TRAVEL IN DENALI NP & PRES

Destination	Visitor Vehicles/Yr	Vehicle Miles Traveled per Vehicle	Annual VMT
Entrance Area	71,430	10	714,300
Park Road Lottery	400	186	300,000
Total	711,830		1,014,300

The majority of mobile source emissions can be categorized as either exhaust or evaporative emissions. Exhaust emissions are related to the combustion of fuel in the engine and include VOC, NOx, CO, and PM1o. Exhaust emissions are dependent on a number of factors, including engine load, engine design and age, combustion efficiency, emissions equipment such as catalytic converters, and other factors. Evaporative emissions, which can occur while the vehicle is running or at rest, are related to the volatilization of fuel from vapor expansion, leaks and seepage, and fuel tank vapor displacement. Evaporative emissions are primarily dependent on daily temperature cycles and fuel volatility. In addition to vehicle exhaust, PM_{10} emissions also

result from brake and tire wear, as well as the re-entrainment of dust from paved and unpaved roads (referred to as fugitive dust).

Emission factors produced by the USEPA MOBILE6.2del were used in conjunction with VMT data in order to estimate mobile source emissions for VOC (both exhaust and evaporative), NOx, and CO for visitor vehicles. Similarly, emission factors produced by the PART5 model were used in conjunction with VMT data to estimate PM1p emissions. MOBILE6.2 produces exhaust and evaporative emission factors for the following classes of vehicles: Light Duty Gasoline Vehicles (LDGV), Light Duty Gasoline Trucks 1 (LDGT1), Light Duty Gasoline Trucks 2 (LDGT2), Heavy Duty Gasoline Vehicles (HDGV), Light Duty Diesel Vehicles (LDDV), Light Duty Diesel Trucks (LDDT), Heavy Duty Diesel Vehicles (HDDV), and Motorcycles. It also produces a composite emission factor for all vehicles based on the vehicle VMT mix supplied to the model. Inputs to the model include average vehicle speed, vehicle VMT mix, annual mileage accumulation rates and registration distributions by age, inspection and maintenance (UM) program information, fuel information, ambient temperature data, and others.

Both the MOBILE6.2 and PART5 models are typically used to support planning and modeling efforts in urban or regional areas and include default inputs suited for these applications. Therefore, it is suitable for applications over large, regional transportation networks. Application of the MOBILE6.2 model required the utilization of unique inputs that were representative of mobile source activity within the park. In particular, it was necessary to utilize unique inputs for the visitor vehicle VMT mix and the vehicle age distribution. The Center for Environmental Research and Technology within the College of Engineering at the University of California's Riverside Campus (CE-CERT) established park-specific vehicle fleet characterizations in developing air emission inventories for Zion National Park (CE-CERT, 2001). CE-CERT found that the distribution of vehicle ages in the park reflected a larger fraction of newer vehicles compared to the general vehicle population. The park-specific mix vehicle types and vehicle age distribution developed by CE-CERT have been applied in the mobile modeling for Denali NP & Pres.

In addition to park-specific age distribution, CE-CERT also developed park-specific modeling inputs for driving patterns that differ significantly from the default driving patterns typically used in mobile modeling, such as the Federal Test Procedure (FTP). In particular, they found that the FTP reflects both higher speeds and a wider range of speeds than observed in national parks. However, since the MOBILE6.2 model is not designed to readily incorporate unique driving pattern data, the default driving cycle remains the basis for the mobile source emission estimates

provided here.

Other important mobile modeling inputs that can significantly affect mobile emission factors are the average speed, fuel characteristics, and I/M program parameters. The average speed .input to the mobile model was 35 mph, and fuel volatility was assumed to be Reid vapor pressure (RVP) 9 (winter and summer)'. Finally, I/M program inputs were not included since there are no I/M programs in the areas near the park.

In order to account for seasonal differences in mobile emissions, separate MOBILE6.2 runs were performed to produce emission factors for winter and summer. However, only the summer factors were utilized to estimate emissions from visitor vehicles, concessionaire buses, and commercial tour buses since they operate only during the summer months. A composite emission factor for each season served as the basis for mobile source emission estimates for the NPS vehicles since they generally operate year round. Additional particulate emissions (or entrained road dust) from vehicles operating on paved and unpaved roads in Denali NP & Pres also were calculated based on VMT.

To calculate emissions from the unpaved portion of the Park Road, an empirical equation developed by EPA was used:

$$E = \frac{k(s/12)A\,a(W/3)^{\wedge}b}{(M/0.2)^{\wedge}c}$$

where k, a, b, and c are empirical constants provided by EPA and are:

k = 2.6 (for PM,0)

a = 0.8

b = 0.4

c = 0.3

The other equation variables are:

E = size-specific emission factor (lbs/VMT)

S = surface material silt content (%)

W = mean vehicle weight (tons)

M = surface material moisture content (%)

[1] Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA420-R-02-011, February 2002

Park officials provided broad estimates for S (5 percent), W (13 tons), and M (10 percent). In addition, a stabilizing dust palliative, calcium chloride, has been applied to 16 miles of the unpaved road, and park officials estimated its efficacy as very high, as much as 90 percent. Details of the visitor vehicle exhaust and entrained dust calculations are provided in Appendix B. A summary of visitor vehicle emissions is provided in Table 17 at the end of this section.

3.1.2 Concessionaire and Commercial Tour Buses

The concessionaire operates a fleet of 110 tour buses that transport visitors into the park's interior from mid-May until early September. In addition, they operate a fleet of shuttle buses in the park entrance area that transports visitors to the Visitor Access Center, Riley Campground, the Mercantile building, which is a camping supply store and shower facility, and some trailheads. Concessionaire officials estimated that these diesel tour and shuttle buses accumulate approximately 1.1 million miles of travel a year and that about 80 percent are accumulated on the unpaved portion of the Park Road.

Commercial tour buses associated primarily with cruise tour operators enter the park to transport visitors from nearby hotels to the Visitor Access Center and train depot. Commercial tour buses are not allowed to travel on the park road beyond the train depot and are estimated to travel only slightly less than 20,000 miles a year within the park.

Again, details of the concessionaire and commercial bus exhaust and entrained dust calculations are provided in Appendix B, and a summary of their emissions is provided in Table 17 at the end of this section.

3.1.3 GSA/NPS and Concessionaire Highway Vehicles

Denali NP & Pres operates a fleet of highway vehicles that are owned by the NPS or leased from the General Services Administration (GSA), and the principal concessionaire, ARAMARK, operates a significant fleet of tour and shuttle buses. A summary of NPS, GSA, and concessionaire vehicles and their estimated annual mileage is provided in Table 14, and emissions are summarized in Table 17 at the end of this section.

TABLE 14: NPS, GSA, AND CONCESSIONAIRE ROAD VEHICLES
AT DENALI NP & PRES

Vehicle Type	Number	Annual Usage (mi/yr)
NPSIGSA		
Light Duty Gasoline Vehicles		5,250
Light Duty Gasoline Trucks	11	66,000
Medium Duty Gasoline Trucks	94	558,000
Medium Duty Diesel Trucks	10	14,400
Heavy Duty Trucks	14	118,400
Total	136	762,050
ARAMARK		
Light Duty Gasoline Vehicles	5	1,000
Medium Duty Diesel Trucks	1	1,500
Heavy Duty Trucks	1	500
Tour and Shuttle Buses	110	1,100,000
Total	117	1,103,000

3.2 SNOWMOBILES

Snowmobile (snowmachine) use throughout Alaska has increased dramatically over the last decade (Denali 2003b). There is extensive use of the park south of the Alaska Range for recreational snowmobile use, primarily by Alaska residents from Anchorage and Fairbanks. Other year-round residents along the George Parks Highway also use the park for recreational activities. One area of significant snowmobile use in the park is in the Broad Pass area. Users park in pullouts along the George Parks Highway, often staying overnight in recreational vehicles, and explore lands to the north and south, including park lands (Denali 2003b). The number of "jumping off' points along the plowed roads to the south and east of the park lands and the speed at which snowmobile users can travel make accurate estimates of users difficult. However, the NPS estimated emissions from visitor machines for the 1998-99 winter season that are included in Table 17 (NPS 2001).

3.3 NPS NONROAD VEHICLES

The NPS also owns and operates nonroad motorized equipment that is used to maintain roads and grounds and for other purposes. There are records of the Denali NP & Pres equipment inventory, and the larger pieces of equipment for which there are usage data are noted in Table 15. Annual usage and emission factors from the USEPA nonroad emission database were used to calculate annual emissions that are provided in Table 17.

TABLE 15: NPS NONROAD VEHICLES AT DENALI NP & PREs

Vehicle Type	Number	Annual Usage (hrs/yr)
Tractor Mower	1	750
Dozer	3	2,250
Grader	5	3,750
Sweeper	2	1,500
Forklift	8	6,000
Roller/Compactor	2	1,500
Bobcat	3	2,250
Brush Chipper	1	750
Total	25	18,750

The NPS also operates a fleet of twelve 2-stroke and two 4-stroke engine snowmobiles. Park officials estimated that these machines were operated a total of approximately 14,000 mi/yr. Emission factors that were developed for the Yellowstone Winter Use Plans EIS (NPS 2003b) were used to estimate emissions, which are provided in Table 17 at the end of this section.

3.4 ALASKA RAILROAD

The privately operated Alaska Railroad operates from Seward to Fairbanks and travels through approximately 30 miles of the park. During the summer season, the railroad operates one passenger train from Anchorage northward and one from Fairbanks southward a day, with a stop in the park at the Train Depot in the entrance area. Railroad officials also estimated that approximately 950 freight train trips a year operate over the same tracks. Emissions were calculated for diesel engines using U.S. EPA locomotive emission factors and are summarized in Table 16.

TABLE 16: ALASKA RAILROAD EMISSIONS

Train	Trips/Yr	Miles/Yr[1]	Gal/Mi	Gal/Yr	PM_{10} (lb/yr)	NO_x (lb/yr)	CO (lb/yr)	HC (lb/yr)
Passenger	*312*	*8,845*	*6.7*	*59,263*	871	35,200	3,467	1,304
Freight	*950*	*26,933*	*6.7*	*180,448*	2,653	107,186	10,556	3,970
			Total	239,711	3,524	142,386	14,023	5,274

[1] 28.35 miles on-way within the park

3.5 AIRCRAFT

Aircraft are a principal means of access to most of the park and preserve outside the park road corridor. Much of the aircraft activity in the park is generated by businesses that provide air taxi and scenic tour services to visitors wanting to access or see remote parts of the park. Air taxis are commercial flights that take visitors and their equipment to a site, and scenic tours or "flightseeing" are flights in which visitors remain with their aircraft for the entire trip. Approximately 36 aviation companies based along George Parks Highway outside the park advertise air tours in portions of the park (Denali 2003b). The NPS does not have control over aircraft in the airspace above the park since air space is regulated by the Federal Aviation Administration (FAA). However, the NPS has regulatory authority over aircraft landings within the management boundaries of the park (Denali 2003b).

There are two maintained airstrips within the park, including the most active airstrip, McKinley Airstrip, in the park entrance area adjacent to the Train Depot and Kantishna Airstrip at the west end of the Park Road. A Park Ranger and airplane pilot[2] estimated that there are approximately 400 take-off and landing operations a year conducted on these two maintained airstrips and that almost all are single-engine piston aircraft. There are also an unknown number of landings in undeveloped areas. However, relatively few private airplanes land in undeveloped areas in the park because of weather, topography, glacier and snow conditions, the low number of adequate landing strips, and the need for special equipment and pilot proficiency for landing everywhere but on the two maintained landing strips (Denali 2003b). The approved method for calculating emissions from aircraft is based on the FAA model titled *Emissions and Dispersion Model System (EDMS).* This model calculates emissions only during the take-off and landing cycle, and they are summarized in Table 17.

3.6 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 17 summarizes the mobile source emissions calculated above in a format that allows comparison between the various sources as well as providing totals for each pollutant or pollutant category under consideration.

[2] Stanley A. Steck 907-683-9526

TABLE 17: SUMMARY OF 2002 MOBILE SOURCE EMISSIONS AT DENALI NP & PRES

Activity	Particulates (PM,o)		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Road Vehicles										
Visitor Vehicles	1,950"	0.97[1]			2,609[3]	1.30[3]	32,200[3]	16.10[3]	1,807[3]	0.90[3]
Lottery Visitor Vehicles on Park Road	65,122'	32.56[2]								
ARAMARK Tour and Shuttle Buses	485,181[1]	*242.59*[1]	1,867	0.93	40,138	20.07	15,730	7.87	1,186	0.59
Commercial Tour Buses	48	0.02	33	0.02	712	0.36	279	0.14	21	0.01
NPS and GSA Vehicles	1,531	0.77			6,424	3.21	33,800	16.90	1,623	0.81
ARAM ARK Road Vehicles	6	<0.01			25	0.01	66	0.03	5	<0.01
Road Vehicle Emission Subtotal	553,838	276.92	1,900	0.95	49,908	24.95	82,075	41.04	4,642	2.32
Nonroad Vehicles										
NPS Nonroad Vehicles	3,328	1.66			22,935	11.47	47,127	23.56	17,505	8.75
Public Snowmobiles	480	0.24			160	0.08	52,200	26.1	19,600	9.80
NPS Snowmobiles	33	0.02			35	0.02	6,244	3.12	2,278	1.14
Passenger and Freight Trains	3,524	1.76			142,388	71.19	14,023	7.01	5,274	2.64
Aircraft					10	<0.01	2,756	1.39	10	<0.01
Nonroad Vehicle Emission Subtotal	7,365	3.68			165,528	82.76	122,350	61.18	44,667	22.33
Totals										
	Particulates (PM,o)		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Totals	561,203	281			215,466	108	204,425	102	49,309	24.66

[1] Includes exhaust PM, o and road dust
[2] Road dust only
[3] Included in visitor vehicle totals above

4. DENALI NP & PRES AND REGIONALEMISSION SUMMARY

4.1 DENALI NP & PRES SUMMARY

A summary of Denali NP & Pres emissions is provided in Table 18.

TABLE 18: ESTIMATED ANNUAL EMISSIONS FROM DENALI NP & PRES

Source	PM_{10} (tons)	SO_2 (tons)	NO_x (tons)	CO (tons)	VOCs (tons)
Point Sources					
Heating Equipment	0.23	4.41	1.11	0.26	0.03
Generators	0.75	0.77	10.81	2.34	0.85
Gasoline Storage Tanks	--	--	--	--	0.15
Subtotal	0.97	5.18	11.93	2.60	1.02
Area Sources					
Woodstoves	<0.01	--	<0.01	0.06	0.05
Campfires	0.17	<0.01	0.01	1.23	1.12
Wildfires	1,969	--	--	21,443	992'
Subtotal	1,970	<0.01	0.01	21,445	993
Mobile Sources					
Road Vehicles	276[2]	0.95	24.95	41.04	2.32
NPS Nonroad Vehicles	1.66	--	11.47	23.56	8.75
Public Snowmobiles	0.24	--	0.08	26.1	9.80
NPS Snowmobiles	0.02	--	0.02	3.12	1.14
Passenger and Freight Trains	1.76	--	71.19	7.01	2.64
Aircraft	--	--	<0.01	1.376	<0.01
Subtotal	281	0.95	108	102	24.66
Totals					
Totals without Wildfires	282	6.13	120	106	27
Totals with Wildfires	2,252	6.12	120.51	21,549	1,019

[1] As methane

[2] Majority is entrained dust along the unpaved portion of the Park Road

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Denali and Matanuska-Susitna Boroughs and the State of Alaska were obtained from the 1999 National Emission Inventory (NEI) maintained by USEPA. However, data for point sources for the two boroughs were not available, and data for area and mobile sources in Denali Borough also were not available. The Alaska Department of Environmental Conservation indicated that a comprehensive inventory of all boroughs and other areas of Alaska had not been developed'.

Personal communication. Alice Edwards. Alaska Department of Environmental Conservation, Air Non-Point and Mobile Source Program. November 17, 2003.

It is important to note that differences may exist between the methodologies used to generate the park emission inventory and those used to generate the NEI. For example, here gasoline storage tanks have been included as stationary sources, while the NEI treats them as area sources. Table 19 provides a comparison of Denali NP & Pres emissions with those from the surrounding counties and the State of Alaska. For all pollutants, Denali NP & Pres emissions account for less than 1 percent of the surrounding counties point source emissions. Although the data in Table 19 indicate that Denali NP & Pres accounts for as much as one-third of the two counties totals from area sources, the EPA data for Denali Borough, which encompasses the majority of the park including the developed areas, do not reflect the emission inventory data developed in this study. A similar observation can be made for emissions from mobile sources.

TABLE 19: ESTIMATED ANNUAL EMISSIONS FROM DENALI NP & PRES, SURROUNDING BOROUGHS, AND THE STATE OF ALASKA

Area	PM_{10} (tons/yr)	SO_2 (tons/yr)	NO_Y (tons/yr)	CO (tons/yr)	VOC (tons/yr)
Point Sources					
Denali NP &Pres	0.97	5.17	11.92	2.60	1.02
Denali Borough'	239'	749'	1,526'	944'	21'
Matanuska-Susitna Borough	N.D.	N.D.	N.D.	N.D.	N.D.
Surrounding Borough Totals	239	749	1,526	944	21
Alaska Totals	2,800	3,126	15,330	6,969	1,621
Area **Sources**					
Denali NP & Pres	1,970	<0.01	0.01	21,445	993
Denali Borough	6	0	1	15	5
Matanuska-Susitna Borough	*6,643*	75	1,788	63,833	8,934
Surrounding Borough Totals	6,649	75	1,789	63,848	8,939
Alaska Totals	138,823	1,522	38,459	1,360,659	187,288
Mobile Sources					
Denali NP & Pres	281	0.95	108	102	24.66
Denali Borough	0	0	1	0	0
Matanuska-Susitna Borough	13,459	158	2,528	20,919	3,566
Surrounding Borough Totals	13,459	158	2,529	20,919	3,566
Alaska Totals	87,068	8,288	46,400	881,019	308,223

N.D. - No Data

' No EPA NEI data available; estimated potential emissions from the coal-fired Healy Power Plant (Alaska DEQ 2003)

5. COMPLIANCE AND RECOMMENDATIONS

5.1 COMPLIANCE

The Alaska Depai Unent of Environmental Conservation is the governing authority for regulating air pollution in the park. Park personnel should coordinate with the agency on permit issues relating to stationary sources, as well as prescribed burning activities. Prior to replacing or adding relatively large heating units, generators, and fuel storage tanks, the appropriate agency should be consulted regarding the need to obtain a permit to construct or a permit to operate such sources. For example, the Alaska Administrative Code Rule 18 ACC 50.300 exempts from its permit requirements fuel burning equipment with a rated capacity of less than 50 million Btus per hour heat input. Although the regulations do not directly address other sources that are likely to be found in the park, such as generators, park officials should communicate with Department officials before acquiring new equipment.

Regulation 18 AAC 50.065 notes that "controlled burning to manage forest land, vegetative cover, fisheries, or wildlife habitat, other than burning to combat a natural wildfire, requires written depai tuient approval if the area to be burned exceeds 40 acres yearly." However, the park does not conduct prescribed burning currently. The park is proposing to adopt a Hazardous Vegetative Fuel Treatment Plan to guide protection of the built environment in the park from wildfires fires (Denali 2002). The Fuel Plan would detail protocols for the removal of vegetation that could carry a wildfire fire toward structures and a maintenance plan for retaining competent fire breaks around the facilities.

Firefighting training also is authorized if it is conducted under conditions specified in the regulations. These and other selected regulations are included in Appendix D of this report.

Regulations do not specifically authorize recreational and ceremonial fires. However, general limitations noted in the regulations appear to not prevent them. These also are provided in Appendix D.

5.2 BUS SYSTEM

When the George Parks Highway between Anchorage and Fairbanks opened in 1972, it made it possible for many new visitors to drive to the park. Anticipating a dramatic increase in vehicular traffic with subsequent adverse impacts on wildlife, the park established a visitor bus system. The overwhelming majority of visitors use this extensive bus system.

Today, this system has many components to provide a variety of choices for visitors. These include:

- Entrance Area Shuttles
  - Riley Creek Loop Bus
  - Sled Dog Demonstration Bus (located at Park Headquarters)
  - Savage River Shuttle (Mile 15 at end of paved portion of the Park Road)
- **Bus** Tours (Denali Natural History Tour and Tundra Wilderness Tour)
- Visitor Transportation System (Park Shuttle that travels the length of the Park Road)
- Camper Bus (transportation for backpackers and overnight campers).

The park's concessionaire, Doyon/ARAMARK Joint Ventures, operates approximately 110 diesel-powered buses during the May to September visitor season. In addition to operating on a low sulfur fuel, the concessionaire has undertaken and is planning a number of actions to reduce air emissions from these buses. These include:

- Retrofit of particulate control devices on four current buses, with emission reductions up to 90 percent with ultra-low sulfur fuel (15 ppm)
- Planning to equip 14-16 additional buses with particulate control retrofit devices
- Purchasing California Air Resources Board certified buses that exceed current diesel engine air emission standards
- As part of a U.S. Depattinent of Energy (DOE) demonstration project, the park will operate three buses on a clean diesel fuel during the 2004 visitor season. The fuel will be produced from a refinery gas stream and will contain no sulfur, benzene, or toluene.
- Future bus purchases may be diesel/electric hybrids.

5.3 ALTERNATIVE ENERGY PROJECTS

Denali NP & Pres is an NPS Center for Environmental Innovation and has undertaken a number of innovations throughout the park. Examples include:

- Conversion of fuel oil heating equipment to cleaner burning propane as a first step toward the future possibility of utilizing natural gas. A satellite liquefied natural gas (LG) facility is planned for the entrance area in 2006 to provide for heating of buildings, as well as fuel for the bus fleet

- Replacement of the diesel-powered generator at the Eielson Visitor Center with a more efficient generator and battery system that reduces fuel use by 60 percent and planning to install photovolatic panels to reduce generator run time further
- Conversion of diesel fuel generator at the Wonder Lake Ranger Station with a propane hybrid generator system that reduces run time from 24 hours a day to six hours every four or five days
- Conversion of Toklat Road Camp housing area heating systems from electricity to propane. This conversion together with energy conservation measures led to a downsizing of the generator from 135 kW to 50 kW
- Utilization of solar photovoltaics and wind power at the Savage River Check Station
- Development of solar water pumping applications at three park campgrounds
- Based on an energy modeling and analysis study (ENSAR 2003), the design for the new Denali Visitor Center that will open in 2004 incorporates building photovoltaics, natural daylighting, and energy sensitive systems and exhibits
- Installation of compact fluorescent bulbs and light and motion sensors in buildings
- Installation of timer system for winter vehicle block heater plug-ins to reduce heating times.
- Conducted an energy reduction study of park facilities and systems to identify cost-effective energy conservation measures (DOE 2003).
- Developed an Environmental Innovation and Leadership policy statement that serves to describe the park's commitment to sustainable practices
- Appointed a Park Sustainability Coordinator
- Publishes an *Environmental Innovation & Leadership* newsletter for the park staff and community.

Further information on some of these initiatives is provided in Appendix E.

In August 2003, the park was presented with EPA's Champions for Environmental Leadership and Green Government Award. The park was selected for the award based on its commitment to the use of new technologies and alternative energy projects such as those described above. The park was one of three federal recipients in Alaska and the only Department of Interior recipient.

Denali National Park and Preserve also has been selected to be one of nine recipients of the Department of Interior's 2003 Environmental Achievement Award. The park's nomination was titled "It Takes a Team to Be Green," and it highlighted the numerous programs, projects and practices the park and staff has developed to encourage environmental responsibility and sustainability in all divisions and work areas. These activities include development of a sustainability policy statement for the park, expansion of the park's recycling program,

installation of renewable and alternative energy systems in park facilities, use of sustainability practices in new construction, and exploring the potential for mass transit between the park entrance and local businesses and communities. The nomination focused on the idea stated by Duane Elgin, author of *Voluntary Simplicity*, who said that "the character of a society is the cumulative result of countless small actions, day in and day out, of millions of people."

5.4 RECOMMENDATIONS

As noted above, actions to promote sustainable development in the design, retrofit, and construction of park facilities have associated air quality benefits. These include actions that reduce or replace consumption of conventional fossil fuels and/or reduce the consumption of other resources. Reductions in potable and non-potable water consumption also achieve concurrent reductions in energy consumption and associated air emissions. Acquisition of energy efficient appliances whenever possible also is an incremental energy saving measure that has associated air quality benefits.

Since the generators constitute the largest source of stationary source emissions, efforts to reduce their operating hours and sizes should continue to be a high priority. In addition to the actions described in the above section, the park has replaced two of its 2-stroke engine snowmobiles to 4-stroke models, and future procurements should accelerate the phase-out of existing 2-stroke machines. As noted in Chapter 3, approximately 16 miles of the 78 mile portion of the unpaved Park Road have been treated with a stabilizing dust palliative that park officials rate as having a high efficacy in reducing entrained dust. This program should continue to be expanded and its effectiveness monitored.

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APPENDIX A

FUEL DATA AND EMISSION FACTORS

FUEL DATA

Fuel	Heating Value	Sulfur Content
No. 2 Distillate Fuel Oil/Diesel	140,000 Btu/gal	0.05% by weight
Natural Gas	1,050 Btu/ft'	2,000 grains/10^6 ft^3
Propane	91,500 Btu/gal	0.18 grains/100 ft^3

STATIONARY SOURCE EMISSION FACTORS - BOILERS/HEATING UNITS

DISTILLATE OIL (DF-2) - CRITERIA POLLUTANTS

Combustor Type	Emission Factor (lb/1,000 gal fuel burned)				
	PM[a]	SO_2[b]	NO_X[c]	CO	VOC[d]
Residential Furnace[e]	0.4	142S	18	5	0.713
Boilers < 100 Million Btu/hr (Commercial/Institutional Combust.[f])	2	142S	20	5	0.34
Boilers < 100 Million Btu/hr (Industrial Boilers[g])	2	142S	20	5	0.2
Boilers > 100 Million Btu/hr (Utility Boilers[h])	2	157S	24	5	--

Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Tables 1.3-1 and 1.3-3.

NATURAL GAS - CRITERIA POLLUTANTS

Combustor Type (MMBtu/hr Heat Input)	Emission Factor (lb/10^6 ft^3 fuel burned)				
	PMU[j]	SO2	NO_X[e]	CO	VOC
Residential Furnaces (<0.3)					
-Uncontrolled	7.6	0.6	94	40	5.5
Tangential-Fired Boilers (All Sizes)					
-Uncontrolled	7.6	0.6	170	24	5.5
-Controlled-Flue gas recirculation	7.6	0.6	76	98	5.5
Small Boilers (<100)					
-Uncontrolled	7.6	0.6	100	84	5.5
-Controlled-Low NO, burners	7.6	0.6	50	84	5.5
-Controlled-Low NO,, burners/Flue gas recirculation	7.6	0.6	32	84	5.5
Large Wall-Fired Boilers (>100)					
-Uncontrolled (Pre-NSPS)[k]	7.6	0.6	280	84	5.5
-Uncontrolled (Post-NSPS)[k]	7.6	0.6	190	84	5.5
-Controlled-Low NO,, burners	7.6	0.6	140	84	5.5
-Controlled-Flue gas recirculation	7.6	0.6	100	84	5.5

Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Tables 1.4-1 and 1.4-2.

STATIONARY SOURCE EMISSION FACTORS - BOILERS/HEATING UNITS (Continued)

PROPANE (LPG) - CRITERIA POLLUTANTS					
Combustor Type	Emission Factor (lb/1,000 gal fuel burned)				
	PM[a]	S02[b]	NO_X[c]	CO	VOC[d]
Commercial Boilers[f]	0.4	0.105	14	1.9	0.3
Industrial Boilers[g]	0.6	0.105	19	3.2	0.3

Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.5-1.

STATIONARY SOURCE EMISSION FACTORS - GENERATORS

For generators rated at less than or equal to 448 kW (600 hp):

	Emission Factor (lb/h -hr)				
Fuel Type	PM	SO,	NO,,	CO	VOC
DF-2	2.20 E-03	2.05 E-03	0.031	6.68 E-03	2.51 E-03
Gasoline	7.21 E-04	5.91 E-04	0.011	0.439	0.022
Natural Gas/Propane	1.54 E-04	7.52 E-03(S)	3.53 E-03	8.6 E-04	1.92 E-04
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 3.3-1 and 3.1-1					

For generators rated at greater than 448 kW (600 hp):

Fuel Type	Emission Factor (lb/hp-hr)				
	PM	SOX(b)	NO,,	CO	VOC
DF-2	0.0007	(8.09 E-03)S	0.024	5.5 E-03	6.4 E-04
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 3.4-1.					

FIREPLACE EMISSION FACTORS

Fuel Type	Emission Factor (lb/ton)				
	PM[c]	SO_X	NO,,(`)	CO	VOC
Wood	34.6	0.4	2.6	252.6	229.0
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.9-1.					

WOODSTOVE EMISSION FACTORS

Stove Type	Emission Factor (lb/ton)				
	PMU)	SO,,	NO,I`)	CO	VOC
Conventional	30.6	0.4	2.8	230.8	53
Noncatalytic	19.6	0.4	--	140.8	12
Catalytic	20.4	0.4	2.0	104.4	15

Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.10-1.

STATIONARY SOURCE EMISSION FACTORS - SURFACE COATING OPERATIONS

Surface Coating Type	VOC Emission Factor (lb/gal)
Paint: Solvent Base	5.6
Paint: Water Base	1.3
Enamel: General	3.5
Lacquer: General	6.1
Primer: General	6.6
Varnish/Shellac: General	3.3
Thinner: General	7.36
Adhesive: General	4.4

Source: *Calculation Methods for Criteria Air Pollutant Emission Inventories,* AL/OE-TR-1994-0049, July 1994. Armstrong Laboratory.

(a) PM = Filterable Particulate Matter.
(b) These factors must be multiplied by the fuel sulfur content (for example, if the sulfur content is 0.05%, then S equals 0.05).
(c) Expressed as NO,.
(d) Emission factors given in AP-42 are actually for non-methane total organic compounds (NMTOC) which includes all VOCs and all exempted organic compounds (such as ethane, toxics and HAPs, aldehydes and semivolatile compounds) as measured by EPA reference methods.
(e) Unit Rating <300,000 Btu/hr.
(f) Unit Rating 3300,000 Btu/hr, but <10,000,000 Btu/hr.
(g) Unit Rating 310,000,000 Btu/hr, but <100,000,000 Btu/hr.
(h) Unit Rating 3100,000,000 Btu/hr.
(i) POM = Particulate POM only.
(j) PM = Filterable Particulate Matter + Condensible Particulate Matter.
(k) NSPS = New Source Performance Standard as defined in 40 CFR 60 Subparts D and Db. Post-NSPS units are boilers with greater than 250 MMBtu/hr of heat input that commenced construction, modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction, modification, or reconstruction after June 19, 1984.
(1) Emission factors are given on a fuel input basis (lb/MMBtu). To convert to a power output basis (lb/hp-hr), use an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr.

APPENDIX B

EMISSION CALCULATIONS

2002 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT DENALI NATIONAL PARK AND PRESERVE

Emission Source	Facilities	Fuel	Number of Sources	Capacity (Btu/hr) N bowl P*si e		Consumption (e U.)	PM_{10} (lbs/)	SO_x (Ihs/vrl	NO_x (Ihs/vrl	CO (lbs/yr)	CO_2 (lbs/vr)	VOC (Ibs/.)
Boiler	Boiler Plant	No. 1 Fuel Oil		8,369,000	16,738,000	61,865	124	4,392	1,231	309	1,330,098	21
Boiler	Auto Shop	No. I Fuel Oil	2	115,000	230,000	13,241	5	940	238	66	284,682	9
Boiler	P-251 Residence	No. 1 Fuel Oil	1	114,000	114,000	1,351	1	96	24	7	29,047	1
Boiler	P51 6 Plex Apartments	No. 1 Fuel Oil	2	1,358,000	2,716,000	1,674	3	119	33	8	35,991	1
Boiler	P I I I Residence	No. I Fuel Oil	1	125,000	125,000	929	0	66	17	5	19,974	1
Boiler	B 106 Bam	No. 1 Fuel Oil	1	117,000	117,000	386	0	27	7	2	8,299	0
Boiler	Butler Building	No. 1 Fuel Oil	2	299,000	598,000	5,277	2	375	95	26	113,456	4
Boiler	Resorce Management	No. I Fuel Oil	1	175,000	175,000	451	0	32	8	2	9,697	0
urnace	C Camp Dorm B-121	No. I Fuel Oil	1	105,000	105,000	1,330	1	94	24	7	28,595	1
Boiler	Visitor Access Center	No. 1 Fuel Oil	2	408,000	816,000	6,334	13	450	127	32	136,181	2
umace	Dispatch B-141	No. I Fuel Oil	1	105,000	105,000	1,390	1	99	25	7	29,885	1
umace	Atco 1	No. 1 Fuel Oil	1	68,000	68,000	1,470	1	104	26	7	31,605	1
umace	Atco 3 (at Visitor Access Center)	No. I Fuel Oil	1	68,000	68,000	1,104	0	78	20	6	23,736	1
urnace	Superintendent's Residence	No. I Fuel Oil	1	189,000	189,000	359	0	25	6	2	7,719	0
urnace	P-26 Residence	No. 1 Fuel Oil	1	105,000	105,000	624	0	44	11	3	13,416	0
umace	P-27 Residence	No. I Fuel Oil	1	68,000	68,000	592	0	42	11	3	12,728	0
umace	P-28 Residence	No. 1 Fuel Oil	1	68,000	68,000	592	0	42	11	3	12,728	0
urnace	P-34 Residence	No.1 Fuel Oil	1	189,000	189,000	777	0	55	14	4	16,706	I
umace	P-169/170 Panabodes	No. 1 Fuel Oil	2	70,000	140,000	469	0	33	8	2	10,084	O
urnace	B-21 Headquarters	No. 1 Fuel Oil	1	140,000	140,000	148	0	11	3	1	3,182	O
urnace	B-l0l Interpretation	No. I Fuel Oil	1	140,000	140,000	106	0	8	2	1	2,279	O
urnace	Eielson Visitor Center	No. I Fuel Oil	1	140,000	140,000	1,865	1	132	34	9	40,098	1
Water Heater	East End Park Road	No. I Fuel Oil	4	150,000	600,000	400	0	28	7	2	8,600	0
		Totals	32			102,734	153	7,294	1,989	514	2,208,781	47
mission Factors from AP-42, Tables 1.3-1 and 1.3-3 for residential furnaces (<300,000 Btu/hr), S = 0.5 percent							0.4	142S	18.0	5.0	21,500	0.7
mission Factors from AP-42. Tables 1.3-1 and 1.3-3 for furnaces (>300,000 Btu/hr), S =0.5 percent							2.0	142S	20.0	5.0	21,500	0.3
ormula = Consumption (gal/yr) * Emission Factor (lb/1,000 gal)												
Boiler	C-Camp Shower	Propane		117,000	117,000	604			8		7,553	
Boiler	Apartments 12 & 13	Propane	4	175,000	700,000	3,615	1	0	51	7	45,188	1
Boiler	P-171 Residence	Propane	1	11,700	11,700	60	0	0	1	0	755	0
Heater	C-Camp Rec Hall B-121	Propane	1	40,000	40.000	207	0	0	3	0	2,582	0
Heater	C-Camp West Row	Propane	11	20,000	220,000	1,136	0	0	16	2	14,202	O
Heater	C-Camp East Row	Propane	17	20,000	340,000	1,756	1	0	25	3	21,948	1
Heater	Igloo Cabin	Propane	1	35,000	35,000	181	0	0	3	0	2,259	O
Heater	East Fork Cabin	Propane	1	35,000	35,000	181	0	0	3	0	2,259	O
Heater	Toklat Ranger Cabin	Propane	1	35,000	35,000	181	0	0	3	0	2,259	O
Heater	Sanctuary Cabin	Propane	1	35,000	35,000	181	0	0	3	0	2,259	0
Heater	Toklat Pumphouse	Propane	1	35,000	35,000	181	0	0	3	O	2,259	0
Monitor	Rock Creek	Propane	1	20,000	20,000	103	0	0	1	O	1,291	0
Monitor	Hotel Treatment Building	Propane	1	20,000	20,000	103	0	0	1	O	1,291	0
Monitor	Duplex North	Propane	2	20,000	40,000	207	0	0	3	0	2,582	0
Monitor	Duplex South	Propane	2	20,000	40,000	207	0	0	3	0	2,582	0
Monitor	Toklat Rec Hall	Propane	1	40,000	40,000	207	0	0	3	O	2,582	0
Monitor	Toklat Cabin #235 & 236	Propane	1	20,000	20,000	103	0	0	1	O	1,291	0
Monitor	Toklat Cabin #242	Propane	1	20,000	20,000	103	0	0	1	0	1,291	0
Monitor	Toklat Cabin #241	Propane	1	20,000	20,000	103	0	0	1	O	1,291	0
Monitor	Toklat Cabin #243	Propane	1	20,000	20,000	103	0	0	1	0	1,291	0
Monitor	Toklat New Duplex	Propane	2	20,000	40,000	207	0	0	3	. 0	2,582	0
Heater	West End Park Road	Propane	2	150,000	300,000	1,549	1	0	22	3	19,366	0
Heater	West End Park Road	Propane	1	260,000	260,000	1,343	1	0	19		16,784	0
		Totals	56		2,443,700	12,620			177		157,750	
Emission Factors from AP-42, Tables 1.5-1 for commercial boilers, S = 0.18 grains/100 cu ft							0.4	0.1 •S	14.00	1.90	12,500	0.30
Formula = Consumption (gal/yr) " Emission Factor (Ib/1,000 gal)												
	Total National Park Service Heating Units		88				158	7,294	2,166	514	2366,531	

Emission Source	Facilities	Fuel	Number of Sources	Capacity (Btu/hr) D n,Limi e n Aramark		Consumption (eaUvr)	PM, (lbs/vr)	S0_ (lbs/)	NO (lhs/vr)	CO	CO, (lbs/)	VOC (Ibs/)
Boiler	bus shop	Used Oil		240,000	240,000	1,500	21	510	17		33,000	
Furnace	Bus Shop	Used Oil	1	280,000	280,000	1,500	21	510	17	3	33,000	2
Furnace	Auto Shop	Used Oil	1	500,000	500.000	1,000	255	500	19	5	22,000	1
		Subtotal		1 020,000	1,020.000	4,000	297	1 520	52	10	88,000	
Emission Factors from AP-42, Tables 1.11-I, 1.11-2, and 1.11-3 for space heaters. Ash = 5 percent, S = 3.4 percent							2.8A	1 005	1.0	1.7	22,000	1.0
Emission Factors from AP-42, Tables 1.11-1, 1.11-2, and I.11-3 for small boilers, Ash = 5 Percent, S = 3.4 percent							51 A	1 475	19.0	5.0	22,000	1.0
Formula = Consumption (gal/yr)' Emission Factor (lb/1,000 gal)												
		Park Totals	91			lbs/yr	455	8 814	2,218	524	2,454 531	55
						tons/yr	0 23	4.41	1 11	0.26	1227.27	0.03

2002 POTENTIAL CRITERIA EMISSIONS FROM HEATING UNITS AT DENALI NATIONAL PARK AND PRESERVE

Emission Sour a	Facilities	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (eal/vr)	PM, (lbs/vr)	SO_1 (lbs/vr)	NO_x	CO	CO_2	VOC
				tlonil Perk Servk					lbs/wd			
Boiler	Boiler Plant	No. I Fuel Oil		8,369,000	16,738,000	1,047,321	2,095	74,360	*20,946*	5,237	22,517,392	356
Boiler	Auto Shop	No. I Fuel Oil	2	115,000	230,000	14,391	6	1,022	259	72	309,416	10
Boiler	P-251 Residence	No. 1 Fuel Oil	1	114,000	114,000	7,133	3	506	128	36	153,363	5
Boiler	P51 6 Plex Apartments	No. I Fuel Oil	2	1,358,000	2,716,000	169,944	340	12,066	3,399	850	3,653,796	58
Boiler	P I II Residence	No. 1 Fuel Oil	1	125,000	125,000	7,821	3	555	141	39	168,161	6
Boiler	B 106 Barn	No. I Fuel Oil	1	117,000	117,000	7,321	3	520	132	37	157,398	5
Boiler	Butler Building	No. I Fuel Oil	2	299,000	598,000	37,418	15	2,657	674	187	804,481	27
Boiler	Resorce Management	No. I Fuel Oil	1	175,000	175,000	10,950	4	777	197	55	235,425	8
Furnace	C Camp Dorm B-121	No. I Fuel Oil	1	105,000	105,000	6,570	3	466	118	33	141,255	5
Boiler	Visitor Access Center	No. I Fuel Oil	2	408,000	816,000	51,058	102	3,625	1,021	255	1,097,753	17
Furnace	Dispatch B-141	No. I Fuel Oil	1	105,000	105,000	6,570	3	466	118	33	141,255	5
Furnace	Atco I	No. 1 Fuel Oil	1	68,000	68,000	4,255	2	302	77	21	91,479	3
Furnace	Atco 3 (at Visitor Access Center)	No. I Fuel Oil	1	68,000	68,000	4,255	2	302	77	21	91,479	3
Furnace	Superintendent's Residence	No. I Fuel Oil	1	189,000	189,000	11,826	5	840	213	59	254,259	8
Furnace	P-26 Residence	No. I Fuel Oil	1	105,000	105,000	6,570	3	466	118	33	141,255	5
Furnace	P-27 Residence	No. I Fuel Oil	1	68,000	68,000	4,255	2	302	77	21	91,479	3
Furnace	P-28 Residence	No. I Fuel Oil	1	68,000	68,000	4,255	2	302	77	21	91,479	3
Furnace	P-34 Residence	No. I Fuel Oil	1	189,000	189,000	11,826	5	840	213	59	254,259	8
Furnace	P-169/170 Panabodes	No. I Fuel Oil	2	70,000	140,000	8,760	4	622	158	44	188,340	6
Furnace	B-21 Headquarters	No. 1 Fuel Oil	1	140,000	140,000	8,760	4	622	158	44	188,340	6
Furnace	B-101 Interpretation	No. 1 Fuel Oil	1	140,000	140,000	8,760	4	622	158	44	188,340	6
Furnace	Eielson Visitor Center	No. I Fuel Oil	1	140,000	140,000	8,760	4	622	158	44	188,340	6
Water Hea	East End Park Road	No I Fuel Oil	4	150,000	600.000	37 543	15	2,666	676	188	807,171	27
		To als	32			1,486 322	2,624	105,529	29,290	7,432	31,955,917	587
Emission Factors from AP-42, Tables 1.3-1 and 1.3-3 for residential furnaces *(<300,000* Btu/hr), S = 0.5 percent							0.4	142S	18.0	5.0	21,500	0.7
Emission Factors from AP-42, Tables 1.3-1 and 1.3-3 for furnaces (>300,000 Btu/hr), S = 0.5 percent							2.0	142S	20.0	5.0	21,500	0.3
Formula = Consumption (gallyr) * Emission Factor (lb/1,000 gal)												
Boiler	C-Camp Shower	Propane		117 000	117,000	11,388	5		159	22	142,350	
Boiler	Apartments 12 & 13	Propane	4	175,000	700,000	68,133	27	1	954	129	851,667	20
Boiler	P-171 Residence	Propane	1	11,700	11,700	1,139	0	0	16	2	14,235	0
Heater	C-Camp Rec Hall B-121	Propane	1	40,000	40,000	3,893	2	0	55	7	48,667	1
Heater	C-Camp West Row	Propane	11	20,000	220,000	21,413	9	0	300	41	267,667	6
Heater	C-Camp East Row	Propane	17	20,000	340,000	33,093	13	1	463	63	413,667	10
Heater	Igloo Cabin	Propane	1	35,000	35,000	3,407	1	0	48	6	42,583	1
Heater	East Fork Cabin	Propane	1	35,000	35,000	3,407	1	0	48	6	42,583	1
Heater	Toklat Ranger Cabin	Propane	1	35,000	35,000	3,407	1	0	48	6	42,583	1
Heater	Sanctuary Cabin	Propane	1	35,000	35,000	3,407	1	0	48	6	42,583	1
Heater	Toklat Pumphouse	Propane	1	35,000	35,000	3,407	1	0	48	6	42,583	1
Monitor	Rock Creek	Propane	1	20,000	20,000	1,947	1	0	27	4	24,333	1
Monitor	Hotel Treatment Building	Propane	1	20,000	20,000	1,947	1	0	27	4	24,333	1
Monitor	Duplex North	Propane	2	20,000	40,000	3,893	2	0	55	7	48,667	1
Monitor	Duplex South	Propane	2	20,000	40,000	3,893	2	0	55	7	48,667	1
Monitor	Toklat Rec Hall	Propane	1	40,000	40,000	3,893	2	0	55	7	48,667	1
Monitor	Toklat Cabin #235 & 236	Propane	1	20,000	20,000	1,947	1	0	27	4	24,333	1
Monitor	Toklat Cabin #242	Propane	1	20,000	20,000	1,947	1	0	27	4	24,333	1
Monitor	Toklat Cabin #241	Propane	1	20,000	20,000	1,947	1	0	27	4	24,333	1
Monitor	Toklat Cabin #243	Propane	1	20,000	20,000	1,947	1	0	27	4	24,333	1
Monitor	Toklat New Duplex	Propane	2	20,000	40,000	3,893	2	0	55	7	48,667	1
Heater	West End Park Road	Propane	2	150,000	300,000	29,200	12	1	409	55	365,000	9
Heater	West End Park Road	Propane	1	260,000	260,000	25.307	10	0	354	48	316,333	8
		Totals	56		2.443 700	237 853	95		3 330		2.973 168	71
Emission Factors from AP-42, Tables 1.5-I for commercial boilers, S = 0.18 grains/100 cu ft							0.4	0.1 *S	14.00	1.90	12,500	0.3
Formula = Consumption (gal/yr) * Emission Factor (lb/1,000 gal)												
		Total N tional Park Service Heating Units	88				2 719	105 533	3^1.620	7.432	34,929 085	658

Emission Source	Facilities	uel	Numberof qm	Capacity (Btu/hr)		Consumption all)	PM, (lbs/)	SO, (lbs/)	NOx (lbs/)	CO	CO_2 (lbs/yr)	VOC (lbs/yr)
				Ithy n,	mit	Avarn r						
Boiler	Bus Shop	Used Oil		240,000	240,000	15,017	210	5,106	165	26	330,377	5
Furnace	Bus Shop	Used Oil	1	280,000	280,000	17,520	245	5,957	193	30	385,440	18
Furnace	Auto Shop	Used Oil	1	500.000	500,000	31,286	7,978	15.637	594	156	688,286	31
		Subtotal		1.020 000	1,020.000	63 823	8 433	26 699	952	212	1,404 103	64
Emission Factors from AP-42, Tables 1.11-1, 1.11-2, and 1.1 1-3 for space heaters, Ash = 5 percent, S = 3.4 percent							2.8A	1005	11.0	1.7	22,000	1.0
Emission Factors from AP-42, Tables 1.11-1, 1.11-2, and 1.11-3 for small boilers, Ash = 5 Percent, S = 3.4 percent							51A	1475	19.0	5.0	22,000	1.0
Formula = Consumption (galyr) * Emission Factor (lb/1,000 gal)												
		Park Totals	91			lbs/yr	1 1,152	132.232	33 573	7,643	36,333 188	722
						tons/yr	5.58	66.12	16.79	3.82	18.167	0.36

2002 ACTUAL CRITERIA EMISSIONS FROM GENERATORS AT DENALI NATIONAL PARK AND PRESERVE

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	CO (Ibs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
National Park Service												
Generator	Powerhouse	Diesel	1	600	52	31,200	29	169	1,003	230	48,079	27
Generator	Headquarters	Diesel	1	113	52	5,876	17	16	244	53	9,055	20
Generator	Toklat	Diesel	1	55	8,760	481,800	1,420	1,324	20,014	4,313	742,454	1,620
Generator	Eielson Visitor Center	Diesel	1	32	260	8,320	25	23	346	74	12,821	28
Generator	Wonder Lake	Diesel	1	14	26	374	1	1	16	3	577	1
							1,493	1,533	21,623	4,673	812,986	1,696
						tons/yr	0.75	0.77	10.81	2.34	406.49	0.85
Emission Factors from AP-42, Chapter 3.3 Table 3.3-1 for generators rated less than 448 kW							2.20E-03	0.00205	3.10E-02	6.68E-03	1.15E+00	2.51 E-03
Emission Factors from AP-42, Chapter 3.4 Table 3.4-1 for generators rated greater than 448 kW, S = 0.5 percent							7.00E-04	(8.09E-03)*S	2.40E-02	5.50E-03	1.15E+00	6.40E-04
Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)												

2002 POTENTIAL CRITERIA EMISSIONS FROM GENERATORS AT DENALI NATIONAL PARK AND PRESERVE

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (Ibs/yr)	SO_2 (lbs/yr)	NO. (lbs/yr)	CO (lbs/yr)	CO_2 (Ibs/yr)	VOC (Ibs/yr)
National Park.Service												
Generator	Powerhouse	Diesel	1	600	500	300,000	281	1,626	9,648	2,211	462,300	257
Generator	Headquarters	Diesel	1	113	500	56,500	167	155	2,347	506	87,067	190
Generator	Toklat	Diesel	1	55	8,760	481,800	1,420	1,324	20,014	4,313	742,454	1,620
Generator	Eielson Visitor Center	Diesel	1	32	500	16,000	47	44	665	143	24,656	54
Generator	Wonder Lake	Diesel	1	14	500	7,200	21	20	299	64	11,095	24
							1,937	3,169	32,973	7,237	1,327,572	2,146
						tons/yr	0.97	1.58	16.49	3.62	663.79	1.07
Emission Factors from AP-42, Chapter 3.3 Table 3.3-1 for generators rated less than 448 kW							2.20E-03	0.00205	3.10E-02	6.68E-03	1.15E+00	2.51 E-03
Emission Factors from AP-42, Chapter 3.4 Table 3.4-1 for generators rated greater than 448 kW, S = 0.5 percent							7.00E-04	(8.09E-03)*S	2.40E-02	5.50E-03	1.15E+00	6.40E-04

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	12,000 UST
City:	Fairbanks
State:	Alaska
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	Denali NP & Pres Automotive Shop

Tank Dimensions

Shell Length (ft):	20.60
Diameter (ft):	10.00
Volume (gallons):	12,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	45,072.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	Y

Paint Characteristics

Shell Color/Shade:	
Shell Condition:	

Breather Vent Settings

Vacuum Settings (psig):	0.00
Pressure Settings (psig):	0.00

Meteorological Data used in Emissions Calculations: Fairbanks, Alaska (Avg Atmospheric Pressure = 14.41 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	26.31	26.31	26.31	25.87	1.9672	1.9672	1.9672	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	143.55	0.00	143.55

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Denali Wonder Lake
City:	Fairbanks
State:	Alaska
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	500 AST

Tank Dimensions

Shell Length (ft):	5.50
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	0.00
Net Throughput (gal/yr):	1,172.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Fairbanks, Alaska (Avg Atmospheric Pressure = 14.41 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	32.93	25.63	40.23	29.95	2.2839	1.9365	2.6806	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	4.33	43.97	48.30

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Denali Elelson VC
City:	Fairbanks
State:	Alaska
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	500 AST

Tank Dimensions

Shell Length (ft):	5.50
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	0.00
Net Throughput (gal/yr):	3,017.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Fairbanks, Alaska (Avg Atmospheric Pressure = 14.41 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deq F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract,	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	32.93	25.63	40.23	29.95	2.2839	1.9365	2.6806	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	11.16	43.97	55.12

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Denali Bus Shop
City:	Fairbanks
State:	Alaska
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	500 gallon AST

Tank Dimensions

Shell Length (ft):	5.50
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	0.00
Net Throughput (gal/yr):	1,000.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Fairbanks, Alaska (Avg Atmospheric Pressure = 14.41 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max,	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min,	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	32.93	25.63	40.23	29.95	2.2839	1.9365	2.6806	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	3.70	43.97	47.67

2002 ACTUAL EMISSIONS FROM WOODSTOVES AT DENALI NATIONAL PARK AND PRESERVE

Woodstoves

Location	Number	Cords	tons/yr	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO (Ibs/yr)	VOC (lbs/yr)
Patrol Cabins	8	0.5	0.88	30	0	2	222	201
				(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
				0.02	0.00	0.00	0.11	0.10
		Emission Factors lbs/ton		34.6	0.4	2.6	252.6	229

2002 ACTUAL EMISSIONS FROM CAMPFIRES AT DENALI NATIONAL PARK AND PRESERVE

Campers in 2002	Fires/Yr	Tons/Yr	PM (lbs/yr)	SO_Z (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
12,875	1,300	10	337	4	25	2,463	2,233
		tons/yr	0.17	0.00	0.01	1.23	1.12
Emission Factors (lbs/ton)			34.60	0.40	2.60	252.60	229.00

TITLE: Results of FOFEM model execution on date: 8/27/2003

FUEL CONSUMPTION CALCULATIONS

Region: Pacific West
Cover Type: SAF/SRM - SAF 012 - Black Spruce
Fuel Type: Natural
Fuel Reference: FOFEM 151

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced R)	Equation Reference Number	Moisture
Litter	13.90	13.90	0.00	100.0	999	
Wood (0-1/4 inch)	0.00	0.00	0.00	0.0	999	
Wood (1/4-1 inch)	0.00	0.00	0.00	0.0	999	25.0
Wood (1-3 inch)	0.00	0.00	0.00	0.0	999	
Wood (3+ inch) Sound	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Wood (3+ inch) Rotten	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Duff	50.00	20.55	29.45	41.1	2	100.0
Herbaceous	0.15	0.15	0.00	100.0	22	
Shrubs	0.00	0.00	0.00	0.0	23	
Crown foliage	6.00	0.00	6.00	0.0	37	
Crown branchwood	3.90	0.00	3.90	0.0	38	
Total Fuels	73.95	34.60	39.35	46.8		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	3.8	1.6	2.2	41.8	6
Min Soil Exp (%)	.0	21.9	21.9	21.9	10

Emissions -- lbs/acre

	flaming	smoldering	total
PM 10	86	1098	1184
PM 2.5	73	931	1004
CH 4	22	566	588
CO	183	12404	12587
CO 2	49974	50488	100462

	Consumption tons/acre	Duration hour:min:sec
Flaming:	14.05	00:01:00
Smoldering:	20.55	02:40:00
Total:	34.60	

TITLE: Results of FOFEM model execution on date: 8/27/2003

FUEL CONSUMPTION CALCULATIONS

Region: Pacific West
Cover Type: SAF/SRM - SAF 201 - White Spruce
Fuel Type: Natural
Fuel Reference: FOFEM 161

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number	Moisture
Litter	11.10	11.10	0.00	100.0	999	
Wood (0-1/4 inch)	0.00	0.00	0.00	0.0	999	
Wood (1/4-1 inch)	0.00	0.00	0.00	0.0	999	25.0
Wood (1-3 inch)	0.00	0.00	0.00	0.0	999	
Wood (3+ inch) Sound	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Wood (3+ inch) Rotten	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Duff	35.00	14.38	20.62	41.1	2	100.0
Herbaceous	0.15	0.15	0.00	100.0	22	
Shrubs	0.25	0.15	0.10	60.0	23	
Crown foliage	0.00	0.00	0.00	0.0	37	
Crown branchwood	0.00	0.00	0.00	0.0	38	
Total Fuels	46.50	25.78	20.72	55.5		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	2.3	0.9	1.4	40.5	6
Min Soil Exp (%)	.0	21.9	21.9	21.9	10

	Emissions -- lbs/acre flaming	smoldering	total
PM 10	70	769	839
PM 2.5	59	652	711
CH 4	18	396	414
CO	149	8683	8832
CO 2	40548	35341	75889

	Consumption tons/acre	Duration hour:min:sec
Flaming:	11.40	00:01:00
Smoldering:	14.39	01:52:00
Total:	25.79	

TITLE: Results of FOFEM model execution on date: 8/27/2003

FUEL CONSUMPTION CALCULATIONS

Region: Pacific West
Cover Type: SAF/SRM - SAF 253 - Black Spruce - White Spruce
Fuel Type: Natural
Fuel Reference: PMS-831

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number	Moisture
Litter	6.09	6.09	0.00	100.0	999	
Wood (0-1/4 inch)	0.10	0.10	0.00	100.0	999	
Wood (1/4-1 inch)	0.20	0.20	0.00	100.0	999	25.0
Wood (1-3 inch)	0.10	0.09	0.01	89.7	999	
Wood (3+ inch) Sound	1.08	0.80	0.28	73.7	999	20.0
3->6	0.27	0.26	0.01	1.0		
6->9	0.27	0.26	0.01	1.0		
9->20	0.27	0.19	0.08	0.7		
20->	0.27	0.09	0.18	0.4		
Wood (3+ inch) Rotten	0.12	0.11	0.01	88.3	999	20.0
3->6	0.03	0.03	0.00	1.0		
6->9	0.03	0.03	0.00	1.0		
9->20	0.03	0.03	0.00	1.0		
20->	0.03	0.02	0.01	0.6		
Duff	125.84	51.72	74.12	41.1	2	100.0
Herbaceous	0.33	0.33	0.00	100.0	22	
Shrubs	1.57	0.94	0.63	60.0	23	
Crown foliage	0.00	0.00	0.00	0.0	37	
Crown branchwood	0.00	0.00	0.00	0.0	38	
Total Fuels	135.43	60.37	75.06	44.6		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	9.1	3.9	5.2	43.0	6
Min Soil Exp (%)	.0	21.9	21.9	21.9	10

	Emissions -- lbs/acre flaming	smoldering	total
PM 10	45	2835	2880
PM 2.5	38	2402	2440
CH 4	12	1459	1471
CO	96	32009	32105
CO 2	26117	130289	156406

	Consumption tons/acre	Duration hour :min: sec
Flaming:	7.34	00:01:00
Smoldering:	53.03	06:42:45
Total:	60.37	

TITLE: Results of FOFEM model execution on date: 8/27/2003

FUEL CONSUMPTION CALCULATIONS

Region: Pacific West
Cover Type: SAF/SRM - SRM 916 Sedge - Shrub Tundra
Fuel Type: Natural
Fuel Reference: SMFDB 292

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number	Moisture
Litter	0.00	0.00	0.00	0.0	999	
Wood (0-1/4 inch)	0.00	0.00	0.00	0.0	999	
Wood (1/4-1 inch)	0.00	0.00	0.00	0.0	999	25.0
Wood (1-3 inch)	0.00	0.00	0.00	0.0	999	
Wood (3+ inch) Sound	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Wood (3+ inch) Rotten	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Duff	0.00	0.00	0.00	0.0	2	100.0
Herbaceous	0.14	0.14	0.00	100.0	22	
Shrubs	0.69	0.41	0.28	60.0	23	
Crown foliage	0.00	0.00	0.00	0.0	37	
Crown branchwood	0.00	0.00	0.00	0.0	38	
Total Fuels	0.83	0.55	0.28	66.7		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	0.0	0.0	0.0	0.0	6
Min Soil Exp (%)	.0	21.9	21.9	21.9	10

	Emissions -- lbs/acre flaming	smoldering	total
PM 10	3	0	3
PM 2.5	3	0	3
CH 4	1	0	1
CO	7	0	7
CO 2	1971	0	1971

	Consumption tons/acre	Duration hour:min:sec
Flaming:	0.55	00:01:00
Smoldering:	0.00	00:00:00
Total:	0.55	

2002 WILDFIRES IN DENALI NATIONAL PARK AND PRESERVE

Fuel Type	Acres	PM, (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CH, (lbs/yr)	CO (ibs/yr)	CO_2 (ibs/yr)	PM,p (tons/yr)	$PM_{2.5}$ (tons/yr)	CH_4 (tons/yr)	CO (tons/yr)	CO_2 (tons/yr)
Black Spruce	1,285	1,521,677	1,290,341	755,698	16,176,812	129,113,762	760.8	645.2	377.8	8,088.4	64,556.9
White Spruce	428	359,428	304,592	177,358	3,783,629	32,510,848	179.7	152.3	88.7	1,891.8	16,255.4
Black Spruce - White Spruce	714	2,056,320	1,742,160	1,050,294	22,922,970	111,673,884	1,028.2	871.1	525.1	11,461.5	55,836.9
Sedge Shrub Tundra	428	1,285	1,285	428	2,999	844,376	0.6	0.6	0.2	1.5	422.2
Totals	2,856	3,938,710	3,338,378	1,983,778	42,886,410	274,142,870	1,969.4	1,669.2	991.9	21,443.2	137,071.4

Emission Factors (lbs/acre)					
Black Spruce	1,184	1,004	588	12,587	100,462
White Spruce	839	711	414	8,832	75,889
Black Spruce - White Spruce	2,880	2,440	1,471	32,105	156,406

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· ##########################
• Denali NP Winter Conditions.
• File 1, Run 1, Scenario 23.
• ##########################
  M584 Warning:
            The user supplied area wide average speed of 35.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways,
            freeway ramps, arterial/collector and local roadways
            for all hours of the day and all vehicle types.

• Reading PM Gas Carbon ZML Levels
• from the external data file PMGZML.CSV

• Reading PM Gas Carbon DR1 Levels
• from the external data file PMGDR1.CSV

• Reading PM Gas Carbon DR2 Levels
• from the external data file PMGDR2.CSV

• Reading PM Diesel Zero Mile Levels
• from the external data file PMDZML.CSV

• Reading the First PM Deterioration Rates
• from the external data file PMDDR1.CSV

• Reading the Second PM Deterioration Rates
• from the external data file PMDDR2.CSV

          User supplied gasoline sulfur content = 300.0 ppm.

  M616 Comment:
               User has supplied post-1999 sulfur levels.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                    Calendar Year:   2001
                            Month:   Jan.
                         Altitude:   High
              Minimum Temperature:    0.0 (F)
```

Maximum Temperature: 20.0 (F)
Absolute Humidity: 75. grains/lb
Nominal Fuel RVP: 9.0 psi
Weathered RVP: 9.0 psi
Fuel Sulfur Content: 299. ppm

Exhaust I/M Program: No
Evap I/M Program: No
ATP Program: No
Reformulated Gas: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.981	1.379	1.221	1.312	1.003	0.433	0.439	0.509	2.77	1.103
Composite CO	25.03	33.12	29.57	31.61	30.98	1.308	0.931	6.582	30.43	26.443
Composite NOX :	0.971	1.425	1.659	1.525	4.045	1.267	1.212	16.834	1.36	1.423

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016
Composite Emission Factors (g/mi):						
Composite VOC :	1.289	1.406	1.186	1.297	2.424	0.391
Composite CO	32.31	33.36	29.42	29.89	6.522	0.795
Composite NOX :	1.122	1.518	1.498	2.015	2.555	1.180

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Composite Emission Factors (g/mi):								
Composite VOC :	1.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	30.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite **NOX** :	4.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B

VMT Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.378	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	1.942	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite NOX :	4.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000

- #
- Denali NP Summer Conditions.
- File 1, Run 1, Scenario 24.
- #

M584 Warning:
The user supplied area wide average speed of 35.0
will be used for all hours of the day. 100°s of VMT
has been assigned to a fixed combination of freeways,
freeway ramps, arterial/collector and local roadways
for all hours of the day and all vehicle types.

- Reading PM Gas Carbon ZML Levels
- from the external data file PMGZML.CSV

- Reading PM Gas Carbon DR1 Levels
- from the external data file PMGDR1.CSV

- Reading PM Gas Carbon DR2 Levels
- from the external data file PMGDR2.CSV

- Reading PM Diesel Zero Mile Levels
- from the external data file PMDZML.CSV

- Reading the First PM Deterioration Rates
- from the external data file PMDDR1.CSV

- Reading the Second PM Deterioration Rates
- from the external data file PMDDR2.CSV

User supplied gasoline sulfur content = 300.0 ppm.

M616 Comment:
User has supplied post-1999 sulfur levels.

M 48 Warning:
there are no sales for vehicle class HDGV8b

Calendar Year:	2001
Month:	July
Altitude:	High
Minimum Temperature:	33.0 (F)
Maximum Temperature:	75.0 (F)
Absolute Humidity:	75. grains/lb
Nominal Fuel RVP:	9.0 psi
Weathered RVP:	9.0 psi
Fuel Sulfur Content:	299. ppm
Exhaust I/M Program:	No
Evap I/M Program:	No
ATP Program:	No
Reformulated Gas:	No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.705	0.902	0.902	0.902	0.816	0.405	0.461	0.490	2.86	0.810
Composite CO	13.42	17.17	16.36	16.82	23.37	1.277	0.945	6.500	22.97	14.430
Composite NOX :	0.751	1.062	1.342	1.181	3.669	1.170	1.239	16.586	1.04	1.169

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016
Composite Emission Factors (g/mi):						
Composite VOC :	0.855	0.917	0.881	0.948	2.512	0.418
Composite CO	16.80	17.28	16.26	16.56	6.775	0.824
Composite NOX :	0.842	1.129	1.209	1.637	2.574	1.212

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGVS	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.816	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	23.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.669	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	1.957	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite NOX :	4.078	0.000	0.000	0.000	0.000	0.000	0.000	0.000

• ##########################
• Denali NP Winter Conditions.
• File 1, Run 1, Scenario 23.
• ##########################

Calendar Year: 2001
Month: Jan.
Gasoline Fuel Sulfur Content: 299. ppm
Diesel Fuel Sulfur Content: 500. ppm
Particle Size Cutoff: 10.00 Microns
Reformulated Gas: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0042	0.0047	0.0044	0.0046	0.0523	------	------	------	0.0205	0.0050
ECARBON:	------	------	------	------	------	0.1244	0.0488	0.1250	------	0.0024
OCARBON:	------	------	------	------	------	0.0351	0.0703	0.0997	------	0.0019
S04:	0.0028	0.0049	0.0047	0.0048	0.0118	0.0049	0.0106	0.0540	0.0010	0.0043
Total Exhaust PM:	0.0071	0.0096	0.0091	0.0094	0.0640	0.1644	0.1297	0.2786	0.0215	0.0136
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0115	0.0040	0.0080
Total PM:	0.0276	0.0302	0.0297	0.0300	0.0846	0.1849	0.1503	0.3027	0.0380	0.0341
S02:	0.0684	0.0804	0.1134	0.0944	0.1603	0.0939	0.2028	0.7715	0.0328	0.0872
NH3:	0.1016	0.1005	0.1015	0.1009	0.0451	0.0068	0.0068	0.0270	0.0113	0.0970
Idle Emissions (g/hr)										
PM Idle:	------	------	------	------	------	------	------	1.0557	------	0.0190

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016
Composite Emission Factors (g/mi):						
Lead:	0.0000	0.0000	0.0000	0.0000		
GASPM:	0.0047	0.0047	0.0044	0.0044	------	------
ECARBON:					0.1498	0.0464
OCARBON:					0.2156	0.0668

S04:	0.0049	0.0049	0.0047	0.0047	0.0062	0.0107
Total Exhaust PM:	0.0096	0.0096	0.0091	0.0091	0.3717	0.1238
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Total PM:	0.0302	0.0302	0.0297	0.0297	0.3922	0.1444
S02:	0.0804	0.0804	0.1134	0.1134	0.1196	0.2049
NH3:	0.1005	0.1005	0.1015	0.1015	0.0068	0.0068

Idle Emissions (g/hr)

PM Idle:

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GAS PM:	0.0523	0.0523	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
ECARBON:								
0CARBON:								
S04:	0.0118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.0640	0.0523	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total PM:	0.0846	0.0523	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
S02:	0.1603	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0451	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Idle Emissions (g/hr)

PM Idle:

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Lead:								
GASPM:								
ECARBON:	0.0514	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OCARBON:	0.0535	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
S04:	0.0172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.1221	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Total PM:	0.1426	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
S02:	0.2452	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	1.0617	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

- #
- Denali NP Summer Conditions.
- File 1, Run 1, Scenario 24.
- #

Calendar Year: 2001
Month: July
Gasoline Fuel Sulfur Content: 299. ppm
Diesel Fuel Sulfur Content: 500. ppm
Particle Size Cutoff: 10.00 Microns
Reformulated Gas: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0042	0.0046	0.0044	0.0045	0.0523	------	------	------	0.0205	0.0050
ECARBON:	------	------	------	------	------	0.1192	0.0485	0.1160	------	0.0023
OCARBON:	------	------	------	------	------	0.0336	0.0698	0.0926	------	0.0018
S04:	0.0028	0.0049	0.0047	0.0048	0.0120	0.0049	0.0106	0.0540	0.0010	0.0042
Total Exhaust PM:	0.0070	0.0095	0.0091	0.0093	0.0643	0.1576	0.1289	0.2626	0.0215	0.0133
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0116	0.0040	0.0080
Total PM:	0.0276	0.0300	0.0297	0.0299	0.0848	0.1782	0.1494	0.2867	0.0380	0.0338
S02:	0.0684	0.0804	0.1134	0.0944	0.1601	0.0929	0.2031	0.7714	0.0328	0.0872
NH3:	0.1016	0.1007	0.1015	0.1010	0.0451	0.0068	0.0068	0.0270	0.0113	0.0970
Idle Emissions (g/hr)										
PM Idle:	------	------	------	------	------	------	------	1.0472	------	0.0189

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016

Composite Emission Factors (g/mi):						
Lead:	0.0000	0.0000	0.0000	0.0000	------	------
GASPM:	0.0046	0.0046	0.0044	0.0044	------	------
ECARBON:	------	------	------	------	0.1498	0.0464
OCARBON:	------	------	------	------	0.2156	0.0668
S04:	0.0049	0.0049	0.0047	0.0047	0.0062	0.0107
Total Exhaust PM:	0.0095	0.0095	0.0091	0.0091	0.3717	0.1238
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Total PM:	0.0300	0.0300	0.0297	0.0297	0.3922	0.1444
S02:	0.0804	0.0804	0.1134	0.1134	0.1196	0.2049
NH3:	0.1007	0.1007	0.1015	0.1015	0.0068	0.0068
Idle Emissions (g/hr)						
PM Idle:	------	------	------	------	------	------

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):								
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0523	0.0523	0.0506	0.0506	0.0506	0.0506	0.0505	0.0000
ECARBON:	------	------	------	------	------	------	------	------
OCARBON:	------	------	------	------	------	------	------	------
S04:	0.0120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.0643	0.0523	0.0506	0.0506	0.0506	0.0506	0.0505	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total PM:	0.0848	0.0523	0.0506	0.0506	0.0506	0.0506	0.0505	10.0000
S02:	0.1601	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0451	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	------	------	------	------	------	------		

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):		
Lead:	------	-
GAS PM:		

ECARBON:	0.0503	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OCARBON:	0.0523	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
S04:	0.0171	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.1198	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total PM:	0.1403	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
S02:	0.2450	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	1.0504	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

2002 DENALI NP & PRES VISITOR VEHICLE EMISSIONS

Annual VMT
1,014,300

Emission Factors (g/mi) - All Vehicles

	NO_x	CO	VOC	PM_{10} (Paved) Exhaust, Brake, and Tire	PM_{10} (Paved) Fugitive	PM_{10} (Paved) Total
Summer	1.169	14.430	0.810	0.0338	0.84	0.8738

Emissions (tons/yr) - All Vehicles

NO_x	**CO**	**VOC**	Paved **PM_{10}**
1.30	16.10	0.90	0.97

Emissions (lbs/yr) - All Vehicles

NO_x	CO	VOC	Paved PM_{10}
2,609	32,200	1,807	1,950

Denali National Park and Preserve
Private Lottery Vehicles

Type	Park Road Length	Treated	% Reduction	PM_{10} Fugitive Emission Factors[1] lbs/mi	gm/mi
Paved	15			0.0018	0.84
Gravel	16	Yes	90	0.0339	13
Gravel	62	No	0	0.3394	127
Total	93				

[1] *Assumptions: silt content 5%, moisture content 10%, and vehicle weight 2 tons*

Miles/Year					
Total	Paved	Unpaved	Unpaved Treated	Unpaved Untreated	
297,600	48,000	249,600	64,413	185,187	
Fugitive Emissions (lbs/yr)					**Total**
65,122	89		2,186	62,847	65,122
Fugitive Emissions (tons/yr)					**Total**
32.56	0.04		1.09	31.42	32.56

DENALI NP AND PRES ARAMARK TOUR AND SHUTTLE BUSES

Tour and Shuttle Buses
(miles/yr)
1,100,000

Emission Factors (g/mi) - Buses

	NO_X	CO	VOC	SO_2
Summer	16.586	6.500	0.490	0.7714

Emissions (tons/yr) - Tour Buses

NO_X	CO	VOC	SO_2
20.07	7.87	0.59	0.93

Emissions (lbs/yr) - Tour Buses

NO_X	CO	VOC	SO_2
40,138	15,730	1,186	1,867

Denali National Park and Preserve
ARAMARK Tour and Shuttle Buses

Type	Park Road Length	Treated	% Reduction	PM_{10} Fugitive Emission Factors' lbs/mi	gm/mi
Paved	15			0.0018	0.84
Gravel	16	Yes	90	0.0718	27
Gravel	62	No	0	0.7175	268
Total	93				

[1] Assumptions: silt content 5%, moisture content 10%, and vehicle weight 13 tons

Miles/Year					
Total	Paved	Unpaved	Unpaved Treated	Unpaved Untreated	
1,100,000	220,000	880,000	227,097	652,903	
Fugitive Emissions (lbs/yr)					Total
485,181	407		16,295	468,480	485,181
Fugitive Emissions (tons/yr)					Total
242.59	0.20		8.15	234.24	242.59

DENALI NP AND PRES COMMERCIAL TOUR BUSES

Commercial Tour Buses
(mileslyr)
19,500

Emission Factors (g/mi) - Buses

	NO_X	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total	SO_2
Summer	16.586	6.500	0.490	0.287	0.840	1.127	0.7714

Emissions (tons/yr) - Tour Buses

NO_X	CO	VOC	Paved PM_{10}	SO_2
0.36	0.14	0.01	0.02	0.02

Emissions (lbs/yr) - Tour Buses

NO_X	CO	VOC	PM_{10}	SO_2
712	279	21	48	33

DENALI NATIONAL PARK AND PRESERVE NPS AND GSA VEHICLES

	LDGV	LDGT	MDGT	MDDT	HDDV	Total
Total Miles	5,250	66,000	558,000	14,4D0	118,400	762,050

Emission Factors (glmi) - LDGV

	NO_x	CO	VOC	$PM_{,,}$ haust, Brake, and Tire	$PM_{,,}$ Fugitive	$PM_{,,}$ Total
Summer	0.7510	13.4200	0.7050	0.0276	0.8400	0.8676
Winter	0.9710	25.0300	0.9810	0.0276	0.8400	0.8676
Average	0.8610	19.2250	0.8430			0.8676

Emissions (tonstyr) - LDGV

NO_x	CO	VOC	$PM_{,o}$
0.00	0.11	0.00	0.01

Emission Factors (glmi) - LDGT

	NOx	CO	VOC	$PM_{,,}$ Exhaust, Brake, and Tire	$PM_{,,}$ Fugitive	$PM_{,,}$ Total
Summer	1.062	17.170	0.902	0.030	0.840	0.870
Winter	1.425	33.120	1.379	0.030	0.840	0.870
Average	1.244	25.145	1.141			0.870

Emissions (tonsyr) - LDGT

NO_x	CO	VOC	$PM_{,,}$
0.09	1.83	0.08	0.06

Emission Factors (glmi) - MDGT

	NOx	CO	VOC	$PM_{,o}$ Exhaust, Brake, and Tire	$PM_{,o}$ Fugitive	$PM_{,o}$ Total
Summer	1.342	16.360	0.902	0.030	0.840	0.870
Winter	1.659	29.570	1.221	0.030	0.840	0.870
Average	1.501	22.965	1.062			0.870

Emissions (tonslyr) - MDGT

NOx	CO	VOC	$PM_{,o}$
0.92	14.10	0.65	0.53

Emission Factors (g/mi) - MDDT

	NOx	CO	VOC	PM" Exhaust, Brake, and Tire	PM" Fugitive	PM" Total
Summer	1.239	0.945	0.461	0.149	0.840	0.989
Winter	1.212	0.931	0.439	0.150	0.840	0.990
Average	1.226	0.938	0.450			0.990

Emissions (tonslyr) - MDDT

NOx	CO	VOC	PM"
0.02	0.01	0.01	0.02

Emission Factors (g/mi) -HDDV

	NO_x	CO	VOC	$PM_{,,}$ xhaust, Brake, and Tire	$PM_{,,}$ Fugitive	$PM_{,,}$ Total
Summer	16.586	6.500	0.490	0.287	0.840	1.127
Winter	16.834	6.582	0.509	0.303	0.840	1.143
Average	16.710	6.541	0.500			1.135

Emissions (tonslyr) - HDDV

NO_x	CO	VOC	$PM_{,,}$
2.18	0.85	0.07	0.15

Emissions (tonslyr) - Total

NOx	CO	VOC	$PM_{,a}$
3.21	16.90	0.81	0.77

Emissions (lbs/yr) - Total

NO_x	CO	VOC	$PM_{,,}$
6,424	33,798	1,623	1,531

DENALI NP AND PRES ARAMARK VEHICLES

	LDGV	LDGT	MDGT	MOOT	HDDV	Total
Total Miles	0	1,000	0	1,500	500	3,000

Emission Factors (glmi) - LDGT

	NO_x	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	1.062	17.170	0.902	0.030	0.840	0.870
Winter	1.425	33.120	1.379	0.030	0.840	0.870
Average	1.244	25.145	1.141			0.870

Emissions (tonslyr) - LDGT

NO_x	CO	VOC	PM_{10}
0.00	0.03	0.00	0.00

Emission Factors (glml) - MOOT

	NO_x	CO	VOC	PM" Exhaust. Brake, and Tire	PM" Fugitive	PM" Total
Summer	1.239	0.945	0.461	0.149	0.840	0.989
Winter	1.212	0.931	0.439	0.150	0.840	0.990
Average	1.226	0.938	0.450			0.990

Emissions (tons/yr) - MOOT

NO_{10}	CO	VOC	PM_{10}
0.00	0.00	0.00	0.00

Emission Factors (glml) - HDDV

	NO_x	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	16.586	6.500	0.490	0.287	0.840	1.127
Winter	16.834	6.582	0.509	0.303	0.840	1.143
Average	16.710	6.541	0.500			1.135

Emissions (tonslyr) - HDDV

NO_x	CO	VOC	PM_{10}
0.01	0.00	0.00	0.00

Emissions (tonslyr) - Total

NOx	CO	VOC	PM_{10}
0.01	0.03	0.00	0.00

Emissions (Ibslyr) - Total

NO_x	CO	VOC	PM_{10}
25	66	5	6

Tour and Shuttle Buses

(mileslyr)
1,100.000

Emission Factors (g/mi) - Buses

	NO_x	CO	VOC	PM_{10} (Paved) Exhaust, Brake, and Tire	SO_2
Summer	16.586	6.500	0.490	0.287	0.7714
Winter	16.834	6.582	0.509	0.303	0.7715
Average	16.710	6.541	0.500	0.295	0.771

Emissions (tons/yr) -ARAMARK Buses

NO_x	CO	VOC	Paved PM_{10}	SO_2
20.22	7.91	0.60	0.07	0.93

Emissions (lbslyr) - ARAMARK Buses

NO_x	CO	VOC	Paved PM_{10}	SO_2
40,438	15,829	1,209	143	1,867

2002 DENALI NP AND PRES NONROAD VEHICLE EMISSIONS

		Emission Factors (gm/hp-hr)							Emissions (lbs/yr)			
Vehicle	No.	PM_{10}	NO_x	Co	VOC	hp	load	hrs/yr	PM_{10}	NO_x	CO	VOC
Tractors	1	2.04	1.03	2.31	2.19	42.35	0.68	750	96.9	48.9	109.8	104.1
										0.0	0.0	
Bobcat	3	2.04	1.03	2.31	2.19	15	0.55	750	83.3	42.1	94.3	89.4
Dozer	3	2.04	1.03	2.31	2.19	77	0.55	750	427.7	215.9	484.3	459.1
Grader	5	1.06	9.6	3.8	1.43	172	0.61	750	917.5	8309.7	3289.2	1237.8
Sweeper	2	1.7	14	6.06	1.46	30	0.68	750	114.4	942.5	408.0	98.3
Forklift	8	1.06	9.6	3.8	1.43	172	0.61	750	1468.0	13295.5	5262.8	1980.5
Roller/Compactor	2	2.04	1.03	2.31	2.19	30	0.55	750	111.1	56.1	125.8	60
Chipper	1	3.99	0.9	1372	495	30	0.55	750	108.6	24.5	37352.7	13476
							Totals:	(lbs/yr)	3,328	22,935	47,127	17,505
								(tons/yr)	1.66	11.47	23.56	8.75

Denali NP and Pres Snowmobile Emissions

Two-Stroke **Miles/Year:** *12,000*

Emission (grams/mile)

CO	PM10	NO_X	HC
230.44	*1.25*	*0.51*	*85.92*

Emission (lbs/yr)

CO	PM_{10}	NO_X	HC
6,084	*33*	*13*	*2,268*

Emission (tons/yr)

CO	PM_{10}	NO_X	HC
3.04	*0.02*	*0.01*	*1.13*

Four-Stroke **Miles/Year:** *2,000*

Emission (grams/mile)

CO	PM_{10}	NO_X	HC
36.50	*0.03*	*4.93*	*2.28*

Emission (lbs/yr)

CO	PM_{10}	NO_X	HC
161	*0*	*22*	*10*

Emission (tons/yr)

CO	PM_{10}	NO_x	HC
0.08	*0.00*	*0.01*	*0.01*

Totals

Emission (lbs/yr)

CO	$PM_{,0}$	NO_X	HC
6,244	*33*	*35*	*2,278*

Emission (tons/yr)

CO	PM_{10}	NO_X	HC
3.12	*0.02*	*0.02*	*1.14*

Source: National Park Service. *Winter Use Plans Final Supplemental Environmental Impact Statement Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway* February *2003*

Alaska Railroad - Passenger Trains

Season	Trips	Miles/Yr'	Gal/Mi	Gal/Yr	Emissions (lbs/yr) PM_{10}	NO_x	CO	VOC
Summer	242	6,861	6.7	45,967	676	27,304	2,689	1,011
Winter	70	1,985	6.7	13,296	195	7,898	778	293
	312	8,845		59,263	871	35,202	3,467	1,304
	Emission Factors (lbs/1,000 gallons)				14.7	594	58.5	22

[1] 28.35 miles one-way in park

Alaska Railroad - Freight Trains

Trips	Miles/Yr'	Gal/Mi	Gal/Yr	Emissions (lbs/yr) PM_{10}	NO_X	CO	VOC
950	26,933	6.7	180,448	2,653	107,186	10,556	3,970
Emission Factors (lbs/1,000 gallons)				14.7	594	58.5	22

28.35 miles one-way in park

Totals

Emissions (lbs/yr) PM_{10}	NO_X	CO	VOC
3,524	142,388	14,023	5,274

Emissions (tons/yr)

1.76	71.19	7.01	2.64

EDMS 3.23 Emissions Inventory Report

Study Name: Denali

Airport: WAINWRIGHT AAF

Report Date: 09/08/03

SUMMARY

(Tons/Year)

NAME	CO	HC	NOx	sox	PM10
Aircraft	1.378	.034	.005	.000	.000
GSE/AGE/APU	.000	.000	.000	.000	.000
Total	1.378	.034	.005	.000	.000

AIRCRAFT EMISSIONS

(Tons/Year)

Aircraft	Engine	Mode	CO	HC	NOx	SOX	PM1C
Cessna 150	0-200	TAXI	.000	.000	.000	.000	.0
Cessna 150	0-200	TKOF	.044	.001	.000	.000	.0(
Cessna 150	0-200	CLMB	.731	.016	.004	.000	.0
Cessna 150	0-200	APCH	.603	.017	.001	.000	.0(
Cessna 150	0-200	APU	.000	.000	.000	.000	
Cessna 150	0-200	GSE	.000	.000	.000	.000	.0c

** Denotes User Created Aircraft

EDMS 3.23 Study Information Denali

Date: Monday, September 08, 2003
Study Created: Monday, September 08, 2003
Study Pathname: P:\DENALI\Denali.EDM

Airport: WAINWRIGHT AAF , AK FBK
Airport Location (lat / lon): 64-50-11.455N 147-37-00.721W
Field elevation: 448
Metric airport layout units selected
Average temperature: 58.
Mixing Height: 3000
Vehicle fleet year: 2003

Hourly Profiles:
DEFAULT

Hour	Fraction of Peak	Hour	Fraction of Peak	Hour	Fraction of Peak
1	1.000	9	1.000	17	1.000
2	1.000	10	1.000	18	1.000
3	1.000	11	1.000	19	1.000
4	1.000	12	1.000	20	1.000
5	1.000	13	1.000	21	1.000
6	1.000	14	1.000	22	1.000
7	1.000	15	1.000	23	1.000
8	1.000	16	1.000	24	1.000

Daily Profiles:
DEFAULT

Day	Fraction of Peak	Day	Fraction of Peak
Monday	1.000	Friday	1.000
Tuesday	1.000	Saturday	1.000
Wednesday	1.000	Sunday	1.000
Thursday	1.000		

Monthly Profiles:
DEFAULT

Month	Fraction of Peak	Month	Fraction of Peak
January	1.000	July	1.000
February	1.000	August	1.000
March	1.000	September	1.000
April	1.000	October	1.000
May	1.000	November	1.000
June	1.000	December	1.000

Aircraft:

Aircraft Name	Engine Type	Aircraft Category	Identification
Cessna 150	0-200	SGPP	#1

AnnualLTO: 000000000400
TGO: 0
Annual Average Taxi Time: 0.00
Annual Average Queue Time: 0.00
Hourly Profile: DEFAULT
Daily Profile: DEFAULT
Monthly Profile: DEFAULT

Assigned Gate:

Aircraft does not use configurations

Assigned Taxiway 1: -NONE-

Assigned Taxiway 2: -NONE-

Assigned Taxiway 3: -NONE-

Assigned Runway:

Assigned GSE/AGE:

GSE	Op Time

Advanced Dispersion Settings

Urban vs. Rural flag set to urban

Aircraft Settings

Aircraft Size:	Small	Large	Heavy
Initial Sigma Y:	6	15	25
Initial Sigma Z:	2	4	7

Stationary Source Settings

Initial Sigma Y: 2

Initial Sigma Z: 2

APPENDIX C

PUBLIC USE DATA

Denali National Park and Preserve				
Month	**Year**	**Recreation Visits**	**Non-Recreational Visits**	**Total Visits**
January	2002	101	12,438	12,539
February	2002	90	10,722	10,812
March	2002	1,858	21,248	23,106
April	2002	2,437	41,552	43,989
May	2002	25,525	130,646	156,171
June	2002	84,916	170,525	255,441
July	2002	105,422	169,833	275,255
August	2002	60,231	172,780	233,011
September	2002	30,383	71,399	101,782
October	2002	254	24,376	24,630
November	2002	91	18,574	18,665
December	2002	27	14,944	14,971
	Totals:	311,335	859,037	1,170,372

APPENDIX D

SELECTED ALASKA AIR QUALITY REGULATIONS

18 AAC 50.025. Visibility and other special protection areas

0 (a) Visibility special protection areas are established to prevent impairment of visibility. The following areas are designated visibility special protection areas:

(1) Mt. Deborah and the Alaska Range East, as viewed from approximately the Savage River Campground area;

(2) Mt. McKinley, Alaska Range, and the Interior Lowlands, as viewed from the vicinity of Wonder Lake; and

(3) geographic areas classified as Class I areas under 18 AAC 50.015(c) .

(b) A wood smoke control area is a geographic location where a wood-burning activity has resulted in two or more discontinuous 24-hour periods when the ambient exposures of PM- 10 solely from this activity have reached or exceeded 150 micrograms per cubic meter of air. The Mendenhall Valley area of Juneau is designated a wood smoke control area.

(c) Special protection areas for sulfur dioxide are established to prevent the violation of the ambient air quality standard and maximum allowable ambient concentration for sulfur dioxide. The following areas are designated as sulfur dioxide special protection areas:

(1) in the Unalaska area, the land and water areas with a 3.4-mile radius of the intersection of 530 *53'4"* N. latitude, 166o 32' 11" W. longitude; and

(2) in the St. Paul Island area, the land and water areas south of UTM Northing 6333.00 kilometers (570 8'29" N. latitude) and within 0.6 kilometers of St. Paul Island.

0 History

0 18 AAC 50.065. Open burning

I' (a) General Requirements. Except when conducting open burning under (g), (h), or (i) of this section, a person conducting open burning shall comply with the limitations of (b) - (f) of this section and shall ensure that

(1) the material is kept as dry as possible through the use of a cover or dry storage;

(2) before igniting the burn, noncombustibles are separated to the greatest extent practicable;

(3) natural or artificially induced draft is present;

(4) to the greatest extent practicable, combustibles are separated from grass or peat layer; and

(5) combustibles are not allowed to smolder.

(b) Black Smoke Prohibited. Except for firefighter training conducted under (h) or (i) of this section, open burning of asphalts, rubber products, plastics, tars, oils, oily wastes, contaminated oil cleanup materials, or other materials in a way that gives off black smoke is prohibited without written depai tinent approval. Depai tinent approval of open burning as an oil spill response countermeasure is subject to the depaiWnent's *In Situ Burning Guidelines for Alaska,* adopted by reference in 18 AAC 50.035. Open burning approved under this subsection is subject to the following limitations:

(1) opening burning of liquid hydrocarbons produced during oil or gas well flow tests may occur only when there are no practical means available to recycle, reuse, or dispose of the fluids in a more environmentally acceptable manner;

(2) the person who conducts open burning shall establish reasonable procedures to minimize adverse environmental effects and limit the amount of smoke generated; and

(3) the department will, in its discretion, as a condition of approval issued under this subsection, require public notice as described in (j) of this section.

(c) Toxic and Acid Gases and Particulate Matter Prohibited. Open burning or incineration of pesticides, halogenated organic compounds, cyanic compounds, or polyurethane products in a way that gives off toxic or acidic gases or particulate matter is prohibited.

(d) Adverse Effects Prohibited. Open burning of putrescible garbage, animal carcasses, or petroleum-based materials, including materials contaminated with petroleum or petroleum derivatives, is prohibited if it causes odor or black smoke that has an adverse effect on nearby persons or property.

(e) Air Quality Advisory. Open burning is prohibited in an area if the depaitinent declares an air quality advisory under 18 AAC 50.245, stating that burning is not permitted in that area for that day. This advisory will be based on a determination that there is or is likely to be inadequate air ventilation to maintain the standards set by 18 AAC 50.010. The depai tinent will make reasonable efforts to ensure that the advisory is broadcast on local radio or television.

(f) Wood Smoke Control Areas. Open burning is prohibited between November 1 and March 31 in a wood smoke control area identified in 18 AAC 50.025(b).

(g) Controlled Burning. Controlled burning to manage forest land, vegetative cover, fisheries, or wildlife habitat, other than burning to combat a natural wildfire, requires written depai hnent approval if the area to be burned exceeds 40 acres yearly. The depattuient will, in its discretion, require public notice as described in (j) of this section.

(h) Firefighter Training: Structures. A fire service may open burn structures for firefighter training without ensuring maximum combustion efficiency under the following circumstances:

(1) before igniting the structure, the fire service shall

(A) obtain depai tinent approval for the location of the proposed firefighter training; approval will be based on whether the proposed open burning is likely to adversely affect public health in the neighborhood of the structure;

(B) visually identify materials in the structure that might contain asbestos, test those materials for asbestos, and remove all materials that contain asbestos;

(C) ensure that the structure does not contain

(i) putrescible garbage;

(ii) electrical batteries;

(iii) stored chemicals such as fertilizers, pesticides, paints, glues, sealers, tars, solvents, household cleaners, or photographic reagents;

(iv) stored linoleum, plastics, rubber, tires, or insulated wire;

(v) hazardous waste;

(vi) lead piping;

(vii) plastic piping with an outside diameter of four inches or more; or

(viii) urethane or another plastic foam insulation;

(D) provide public notice consistent with (j) of this section; and

(E) ensure that a fire-service representative is on-site before igniting the structure;

(2) the fire service shall ignite and conduct training on only one main structure and any number of associated smaller structures at a time; examples of associated smaller structures are garages, sheds, and other outbuildings; and

(3) the fire service shall respond to complaints in accordance with (k) of this section.

(i) Firefighter Training: Fuel Burning. Unless a greater quantity is approved by the department, a fire

service may open burn up to 250 gallons of uncontaminated fuel daily and up to 600 gallons yearly for firefighter training without ensuring maximum combustion efficiency. To conduct this training without prior written depaitment approval, the fire service shall

(1) provide public notice consistent with (j) of this section before burning more than 20 gallons of uncontaminated fuel, unless waived in writing by the department; and

(2) respond to complaints in accordance with (k) of this section.

(j) Public Notice. A person required to provide public notice of open burning shall issue the notice through local news media or by other appropriate means if the area of the open burning does not have local news media. The public notice must be issued as directed by the depaitinent and must

(1) state the name of the person conducting the burn;

(2) provide a list of material to be burned;

(3) provide a telephone number to contact the person conducting the burn before and during the burn;

(4) for a surprise fire drill, state

(A) the address or location of the training; and

(B) the beginning and ending dates of the period during which a surprise fire drill may be conducted (this period may not exceed 30 days); and

(5) for open burning other than a surprise fire drill, state the expected time, date, and location of the open burning.

(k) Complaints. A person required to provide public notice of open burning shall

(1) make a reasonable effort to respond to complaints received about the burn;

(2) keep, for at least 30 days, a record of all complaints received about the burn, including to the extent feasible

(A) the name, address, and telephone number of each person who complained;

(B) a short summary of each complaint; and

(C) any action the person conducting the open burning took to respond to each complaint; and

(3) upon request, provide the depai twent with a copy of the records kept under (2) of this subsection.

I° History: Eff. 1/18/97, Register 141

ID Authority: AS 46.03.020

AS 46.03.7 10

I' 18 AAC 50.300. Construction permits: classifications

0 (a) Facilities and modifications are classified in this section for the purpose of refining the facility types established in AS 46.14.130 (a) and for the purpose of implementing AS 46.14.020 and 46.14.140 as they apply to construction permits. A facility or modification may be classified under more than one subsection of this section.

(b) Ambient Air Quality Facilities. For the purpose of AS 46.14.130 (a)(3)(A), the following facilities are classified as having the potential to violate one or more of the ambient air quality standards:

(1) a facility containing a source that must have an air contaminant control unit or system to comply with an emission standard set by 18 AAC 50.050 - 18 AAC 50.060 and that is

(A) an industrial process with a total rated capacity or design throughput greater than five tons per hour; or

(B) fuel-burning equipment with a rated capacity of 50 million Btu per hour or more;

(2) a facility containing fuel-burning equipment with a rated capacity of 100 million Btu per hour or more, except a portable oil and gas operation that qualifies for and operates in compliance with 18 AAC 50.390:

(3) a facility containing one or more incinerators with a total combined rated capacity of 1,000 pounds per hour or more;

(4) a facility subject to the standards set by 18 AAC 50.055(a) (5), (a)(7), or (d);

(5) a facility containing an incinerator that burns waste containing more than 10 percent sludge from a municipal wastewater treatment plant that serves 10,000 or more persons; and

(6) a facility located in a sulfur dioxide special protection area identified under 18 AAC 50.025(c) that contains a source with a rated capacity of 10 million Btu per hour or more and that

(A) operates at specific multiple locations in the state for temporary periods of time; or

(B) commences construction or operation on or after January 18, 1997.

(c) Prevention of Significant Deterioration Major Facilities. For the purpose of AS 46.14.020 and 46.14.130(a)(1) and (a)(2), a facility is classified as a "major facility" if the facility emits or has the potential to emit

(1) 250 TPY or more of a regulated air contaminant in an area designated attainment or unclassifiable for that air contaminant under 18 AAC 50.015;

(2) 100 TPY or more of a regulated air contaminant in an area designated attainment or unclassifiable for that air contaminant under 18 AAC 50.015 and the facility is a

(A) fossil-fuel-fired steam electric plant of more than 250 million Btu per hour heat input;

(B) coal-cleaning plant with thermal dryers;

(C) kraft pulp mill;

(D) portland cement plant;

(E) primary zinc smelter;

(F) iron and steel mill plant;

(G) primary aluminum ore reduction plant;

(H) primary copper smelter;

(I) municipal incinerator with a rated capacity greater than 250 tons of refuse per day;

(J) hydrofluoric, sulfuric, or nitric acid plant;

(K) petroleum refinery;

(L) lime plant;

(M) phosphate rock processing plant;

(N) coke-oven battery;

(0) sulfur recovery plant;

(P) carbon-black plant (furnace process);

(Q) primary lead smelter;

(R) fuel conversion plant;

(S) sintering plant;

(T) secondary metal production plant;

(U) chemical processing plant;

(V) fossil-fuel boiler or a combination of boilers totaling more than 250 million Btu per hour heat input;

(W) petroleum storage and transfer unit with a total storage capacity exceeding 300,000 barrels;

(X) taconite ore processing plant;

(Y) glass-fiber processing plant; or

(Z) charcoal production plant.

(d) Nonattainment Major Facilities. For the purpose of AS 46.14.020 and 46.14.130(a)(2), a facility is classified as a "nonattainment area major facility" if the facility is located in an area designated nonattainment under 18 AAC 50.015 and the facility emits or has the potential to emit 100 TPY or more of the nonattainment air contaminant.

(e) Major Facility Near a Nonattainment Area. For the purpose of AS 46.14.020 and 46.14.130(a)(2), a facility is classified as a "major facility near a nonattainment area" if the facility

(1) is not classified under (c) or (d) of this section;

(2) is located within 10 kilometers of an area designated as nonattainment in 18 AAC 50.015; and

(3) emits or has the potential to emit 100 TPY or more of the nonattainment air contaminant.

(f) Hazardous Air Contaminant Major Facilities. A facility is classified as a "hazardous air contaminant major facility" if the facility emits or has the potential to emit 10 TPY or more of any single hazardous air contaminant or 25 TPY or more in the aggregate of two or more hazardous air contaminants. For purposes of this subsection and notwithstanding the definition of "potential to emit," emissions from an oil or gas production or exploration well with its associated equipment and emissions from a pipeline compressor or pump station may not be aggregated with emissions from another similar unit.

(g) Port of Anchorage Facilities. For the purpose of AS 46.14.130 (a)(3)(B), the depai tinent has found that public health or air quality effects provide a reasonable basis for regulating facilities located in the Port of Anchorage that contain

(1) a volatile liquid storage tank with a volume of 9,000 barrels or more; or

(2) a volatile liquid loading rack with a design throughput of 15 million gallons per year or more.

(h) Modifications. The following modifications to an existing facility require a construction permit under AS 46.14.130 (a)(5)(A):

(1) a modification that would cause the facility to be classified under (b) of this section;

(2) for a facility described in (b) - (d) of this section, a modification that would increase actual emissions of an air contaminant for which an ambient air quality standard is established in 18 AAC 50.010 beyond the facility's allowable emissions for that contaminant; if no allowable emissions have been established for that contaminant at the facility, a construction permit is required unless the depaitanent determines, or has previously determined, that the increase will not cause the facility to violate an applicable air quality control requirement, including the ambient air quality standards established under 18 AAC 50.010 and the maximum allowable ambient concentrations established under 18 AAC 50.020;

(3) at an existing facility described in (c) of this section, a modification that

(A) was commenced after August 7, 1980 or after issuance of the most recent permit to the facility under 18 AAC 50.315(e) (3) or under 18 AAC 50.400(c) (3) in effect before January 18, 1997; and

(B) would result in an increase of actual emissions of at least

(i) 100 TPY of carbon monoxide;

(ii) 40 TPY of nitrogen oxides;

(iii) 40 TPY of sulfur dioxide;

(iv) 25 TPY of total particulate matter;

(v) 15 TPY of PM-10;

(vi) 40 TPY of volatile organic compounds as an ozone indicator;

(vii) 0.6 TPY of lead;

(viii) three TPY of fluorides;

(ix) seven TPY of sulfuric acid mist;

(x) 10 TPY of total reduced sulfur compounds, including H_2S;

(xi) 10 TPY of H2S;

(xii) 10 TPY of reduced sulfur compounds, including H2S;

(xiii) 0.0000035 TPY of municipal waste combustor organics, measured as total tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans;

(xiv) 15 TPY of municipal waste combustor metals, measured as particulate matter;

(xv) 40 TPY of municipal waste combustor acid gases, measured as sulfur dioxide and hydrogen chloride combined;

(xvi) any increase in actual emissions of a regulated air contaminant not listed in (i) - (xv) of this paragraph, except for hazardous air contaminants, organic vapors, and ammonia;

(xvii) 45 megagrams per year (50 tons per year) of municipal solid waste landfill emissions measured as nonmethane organic compounds; and

(xviii) notwithstanding (i) - (xvii) of this paragraph, if located within 10 kilometers of a Class I area, any increase in actual emissions of a regulated air contaminant that would result in an ambient concentration of that contaminant greater than one microgram per cubic meter (24-hour average) in the Class I area;

(4) at a facility that does not emit or have the potential to emit the quantities described in (c)(1) or (2) of this section, a modification that

(A) commenced after August 7, 1977 or after issuance of the most recent permit to the facility under 18 AAC 50.315(e)(3) or former 18 AAC 50.400; and

(B) would result in an increase of actual emissions of a regulated air contaminant of at least

(i) 250 TPY in an area designated attainment or unclassifiable for that air contaminant under 18 AAC 50.015; or

(ii) 100 TPY in an area designated attainment or unclassifiable for that air contaminant under 18 AAC 50.015 if the facility is a type listed in (c)(2) of this section;

(5) after July 21, 1991, a modification to a facility described in (d) of this section that would result in an increase of actual emissions of at least 100 TPY of carbon monoxide if the facility is in an area designated in 18 AAC 50.015 as nonattainment for carbon monoxide;

(6) after April 23, 1994, a modification to a facility described in (d) of this section that would result in an increase of actual emissions of at least 15 TPY of PM-10 if the facility is in an area designated in 18 AAC 50.015 as nonattainment for PM-10;

(7) after July 21, 1991, a modification to a facility not described in (d) of this section that would result in an increase of actual emissions of at least 100 TPY of carbon monoxide if the facility is located in an area designated in 18 AAC 50.015 as nonattainment for carbon monoxide;

(8) after April 23, 1994, a modification to a facility not described in (d) of this section that would result in an increase of actual emissions of at least 100 TPY of PM-10 if the facility is located in an area designated in 18 AAC 50.015 as nonattainment for PM-10;

(9) at a facility located within 10 kilometers of an area designated nonattainment in 18 AAC 50.015, any modification that would result in an increase of actual emissions of at least 100 TPY of the nonattainment air contaminant if

(A) the existing facility is not classified under (c) or (d) of this section; and

(B) the modification is not classified under any provision of (3) - (8) of this subsection;

(10) a modification that would result in an increase of actual emissions of at least 10 TPY of any single hazardous air contaminant or at least 25 TPY of two or more hazardous air contaminants; or

(11) in the Port of Anchorage, a modification that results in any increase in actual emissions of organic vapors and causes a source to become regulated under 18 AAC 50.085 or 18 AAC 50.090.

I' History: Eff. 1/18/97, Register 141; am 6/21/98, Register 146; am 2/2/2002, Register 161; am 5/3/2002, Register 162

ID Authority: AS 46.03.020

AS 46.14.020

AS 46.14.030

AS 46.14.130

AS 46.14.140

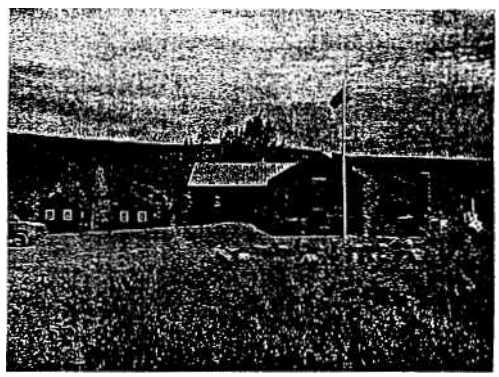
Sec. 30, ch. 74,

APPENDIX E

ALTERNATIVE ENERGY PROJECTS AT DENALI NP & PRES

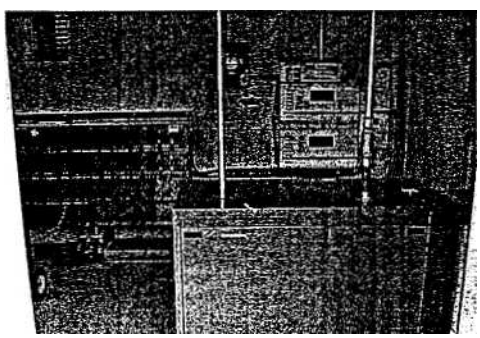
ALTERNATIVE ENERGY PROJECTS AT DENALI

Denali National Park and Preserve is a National Park System Center for Environmental Innovation. The park has committed to showcase new technologies, motivate and educate the public and NPS employees about environmentally-friendly practices, install systems and alter behaviors to reduce energy needs and adverse environmental impacts. Innovation is encouraged as a tool in decision making and problem solving. It is also the park's policy to plan, design, construct and operate facilities in a manner that conserves energy and water, minimizes materials use and waste, and otherwise minimizes adverse environmental impacts. Recent alternative energy projects exemplify some of these goals.



The Civilian Conservation Corps (CCC) built the Wonder Lake Ranger Station in 1939. Its strategic location and historic significance made it a vital part of Denali National Park, but the years had taken their toll on the structure and it was time to upgrade the "classic" old Witte diesel generator. In 1998 the park began a rehabilitation project to restore the historic Ranger Station. The park was also interested in making the Ranger Station and the surrounding buildings more energy efficient and sustainable. The Department of Energy was contacted for assistance.

The Department of Energy provided funding for a SavEnergy audit, which was performed by Integrated Concepts & Research Corporation (ICRC) in 1999. The audit evaluated opportunities for energy efficiency at the Wonder Lake Ranger Station as well as at the Toklat Road Camp and the Eielson Visitor Center, all off-grid locations located in the western end of the park. The park implemented recommendations from the SavEnergy audit throughout the rehabilitation of the Wonder Lake Ranger Station buildings in addition to an upgrade and conversion of the generator system.



The original power generation system consisted of a 35 kw generator that ran 24 hours per day. The generator required weekly oil changes by mechanics stationed at Toklat, a two-hour drive each way. The generator consumed approximately 25 gallons of diesel fuel each day. This fuel had to be hauled from Park Headquarters, 85 miles away.

Once the electrical loads were reduced, a hybrid power generation system was installed during the 2002 summer season. The system consists of a 14.5 kw propane fired generator, an 1850 amp hour, 48-volt battery bank and two 5500-watt sine wave inverters. Two 60-watt photovoltaic panels were added to provide a trickle charge for the batteries through the harsh winter when temperatures can drop to -60F. Additional panels may be added at a later date to further offset generator run time during the summer season.

The new generator runs 8 hours every fifth day, consuming approximately 10 gallons of propane during each charging session. With the reduction of generator run time, oil changes are now an annual rather than weekly event. Operational savings for the 110-day season include 2,750 gallons of diesel fuel, 33 gallons of oil and 60 hours of labor. Reduced run time is also expected to greatly extend the generator's life.

In addition, the natural quiet setting of Wonder Lake has been restored and threats of contamination from fuel oil spills from on-site storage tanks have been eliminated. Exhaust emissions from the generator are not only cleaner, but have also been significantly reduced.

As a spin-off from the ICRC SavEnergy audit, energy management and generation improvements were also made at the Toklat Road Camp and at the Eielson Visitor Center for the 2002 summer season. Both locations saw efforts to reduce base loads that had been added over time to take advantage of excessive generator power. At Toklat, electric heaters were replaced with propane, incandescent bulbs were replaced with compact flourescents and other efficiencies which led to a downsizing of the generator from 135kw to 50kw.

Visitors to Eielson Visitor Center will now notice that the generator no longer runs continuously to provide electric power to this remote location. After reducing electric loads through energy conservation measures, a new diesel hybrid generator system with battery backup, like at the Wonder Lake Ranger Station, has reduced system run time to about 8 - 10 hours every other day. Fuel usage has been reduced by about 60% with the implementation of the audit recommendations. Photovoltaic panels have also been installed at the generator building to further reduce generator run time and to maintain battery condition over the long, subarctic winter at this harsh location.

Beyond the specific benefits at each of these project locations in terms of natural soundscapes, reduced fuel usage and air emissions, there have been other benefits as well. The installation and operation of these alternative and renewable forms of power generation, have generated skills and interest in park staff in such new technologies. The idea of energy management rather than just energy use have led to new ways of thinking about energy.

Along with an established track record of these and other renewable energy systems in use in the park, new facilities that take advantage of these technologies are in the works. Solar water pumping applications are being developed at 3 park campgrounds. The new Denali Visitor Center incorporates building integrated photovoltaics, natural daylighting, and energy sensitive systems and exhibits. Sustainability will be an interpretive thread that weaves through the main exhibit themes. The building and its energy systems will be interpreted for visitors along with park resources. The Denali Visitor Center is expected to open in late 2004.

The new Eielson Visitor Center now in the early planning stages is also looking at renewable energy sources to provide electric power to minimize the hybrid generator use by implementing passive solar design, photovoltaic and micro-hydro electric generation along with energy conservation measures.