FINAL

2000 AIR EMISSIONS INVENTORY

BADLANDS NATIONAL PARK
SOUTH DAKOTA

U.S. NATIONAL PARK SERVICE

FEBRUARY 2003

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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. Development of an in-park air emissions inventory for Badlands National Park (NP) serves three functions in this regard. 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 prescribed woodstoves and fireplaces, campfires, and prescribed burning and wild fires. Mobile sources include vehicles operated by visitors and NPS employees and nonroard vehicles and equipment.

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 June 2002, interviews with Badlands NP personnel[1], review of applicable park records, emission calculations, review of applicable state 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 tools to calculate emissions. Computational tools included U.S. Environmental Protection

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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* and *PART5* mobile source emissions model. The year 2000 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 wildland fires, and other activities. Additional information on emission estimation methodology, including emission factors, are provided in Appendices A and B.

1.4 PARK DESCRIPTION

Located in southwestern South Dakota, Badlands NP consists of 244,000 acres of sharply eroded buttes, pinnacles and spires blended with the largest, protected mixed grass prairie in the U.S. The Badlands Wilderness Area covers 64,000 acres and is the site of the reintroduction of the black-footed ferret, the most endangered land mammal in North America. The Stronghold Unit is co-managed with the Oglala Sioux Tribe and includes sites of 1890s Ghost Dances. Established as Badlands National Monument in 1939, the area was redesignated a National Park in 1978. Badlands NP contains the world's richest Oligocene epoch fossil beds, dating 23 to 35 million years old. The evolution of mammal species such as the horse, sheep, rhinoceros, and pig can be studied in the Badlands formations.

Badlands NP is located approximately 70 miles east of Rapid City, SD. Figure 1 depicts the vicinity of the park, and a map of the park is provided in Figure 2. Developed facilities include the Visitor Center, Headquarters, and the Park-owned but concessionaire-operated Cedar Pass Lodge in the east end of the park (Figure 3). The principal roadway is a 27-mile paved Badlands Loop Road that extends from the northeast entrance to the western Pinnacles entrance station. Sage Creek and Sheep Mountain Roads are unpaved and are open from May to September. Table I summarizes the facilities in the Park.

TABLE 1: BADLANDS NATIONAL PARK DEVELOPED AREAS

Location	**Function/Facilities**
Cedar Pass	Visitor Center, Headquarters, Employee Housing. Maintenance Shop, Refueling Facili , Cedar Pass Lode, Entrance Station
Pinnacles En rance	Pinnacles Ranger Station, Park Entrance
South Unit	White River Visitor Center, South Unit Ranger Station, Park Entrance

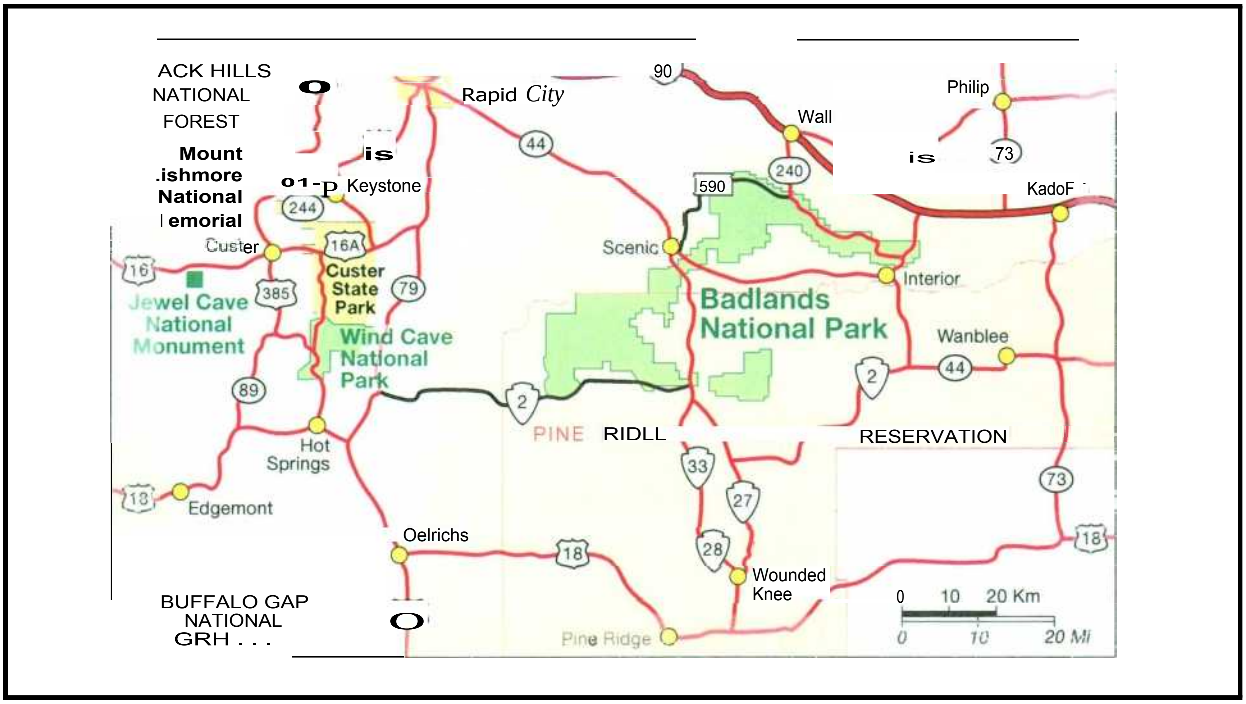

FIGURE 1. BADLANDS NATIONAL PARK LOCATION

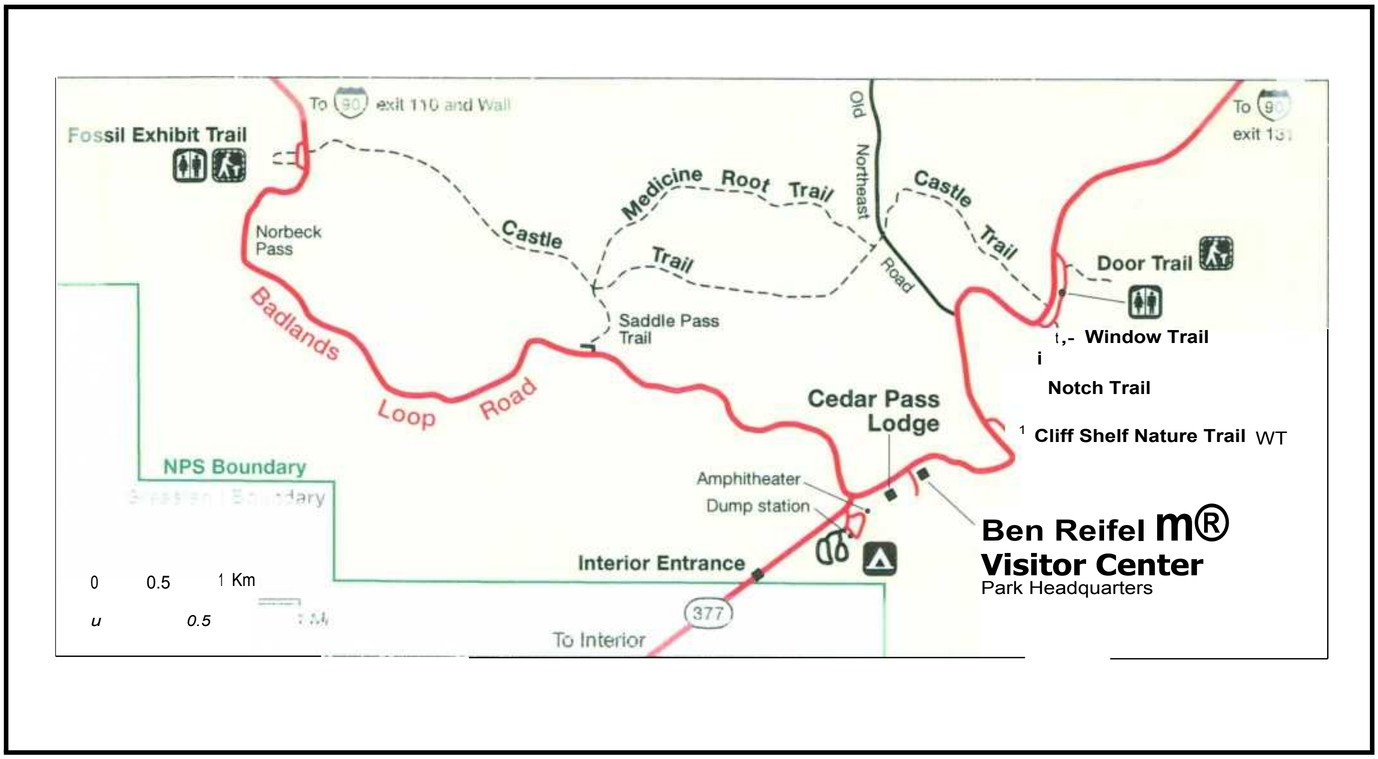

FIGURE 2. CEDAR PASS AREA

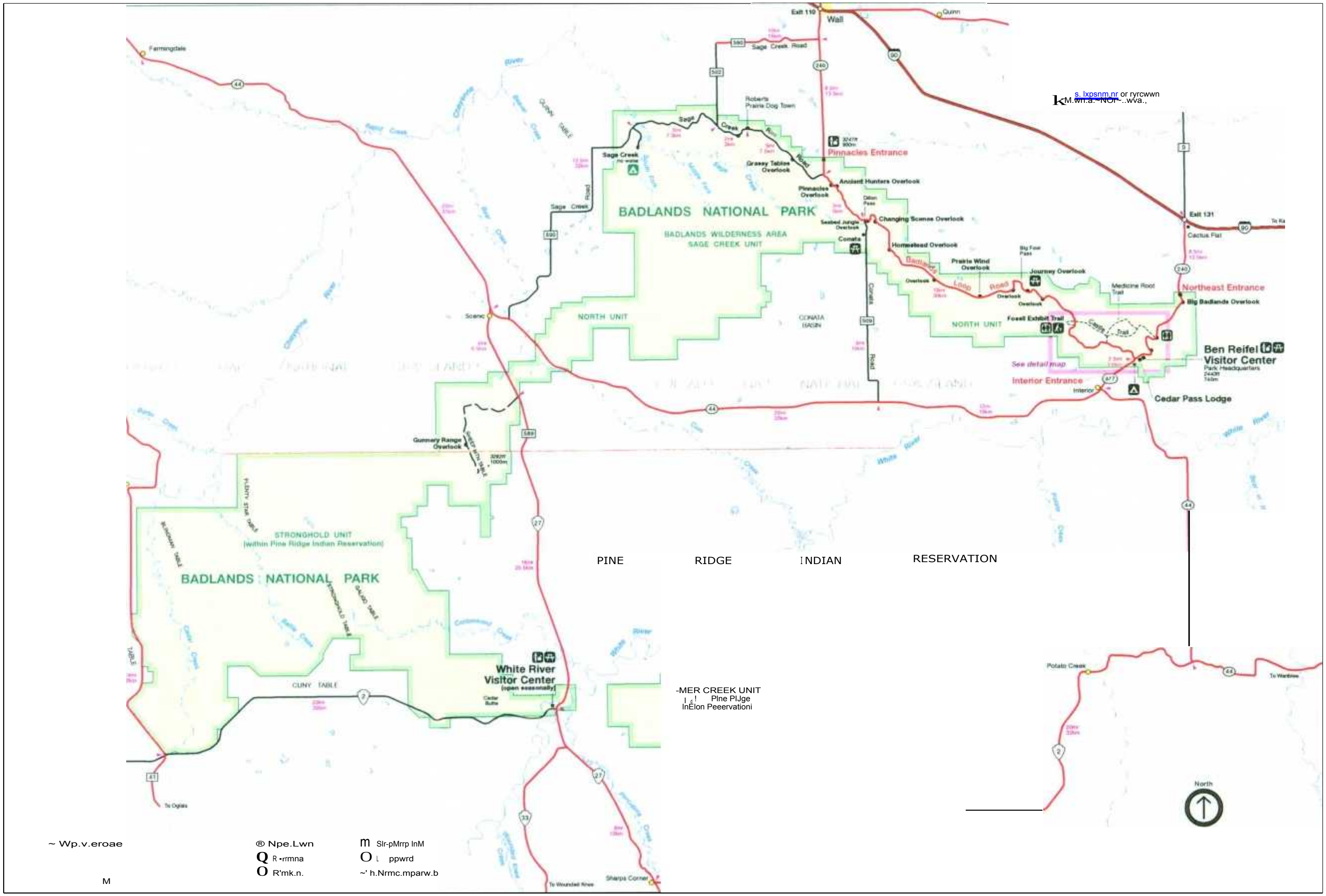

FIGURE 2. BADLANDS NATIONAL PARK

1.5 AIR QUALITY STATUS

The South Dakota Department of Environment and Natural Resources administers the state's air pollution program. The park is located in Pennington, Jackson, and Shannon Counties, which are classified as attainment for all state and national ambient air quality standards. The Park has hosted an IMPROVE visibility monitoring site since 1988 and operates two ozone monitors. One is located on the roadside between Park Headquarters and the maintenance shop in Cedar Pass, and the other is on the Old Northeast Road. The state Department of Environment and Natural Resources recently co-located its own ozone monitor at the Park's Cedar Pass monitoring station in order to correlate data collected using two different monitoring systems.

2. STATIONARY AND AREA SOURCE EMISSIONS

This section summarizes emissions from stationary sources at the Park for the year 2000. The discussion is divided into sections covering emissions from combustion sources, fuel storage sources, and area sources. The following emissions were calculated for each source: particulate matter (PM10), sulfur dioxide (SO2), nitrogen oxides (NO_X), carbon monoxide (CO), and volatile organic compounds (VOCs).

2.1 STATIONARY SOURCES

2.1.1 Space And Water Heating Equipment

There are approximately 55 propane space and water heating units in the Park, and criteria emissions were calculated using the appropriate residential emission factors. For example, NOx emissions from the propane furnace in the Headquarters building was calculated as follows:

$$1{,}144 \text{ gallons/yr} \times \frac{14 \text{ lb NOx}}{1{,}000 \text{ gallons}} = 161\text{bPM10/yr}$$

Actual criteria pollutant emissions from the heating equipment are summarized in Table 2. Potential emissions for the propane heating equipment also were calculated by assuming that the heating units were operated continuously during the year, and these emissions are noted in Table 3.

2.1.2 Generators

There is one stationary generator at the maintenance shop that is owned by West River Lyman Jones, a water utility company. Emissions were calculated by multiplying the unit rating (kW) of the generator by an estimated annual run time (hr/yr) to get the kW-hr/yr, and the appropriate emission factors were then applied.

$$100 \text{ kW} \times \frac{13 \text{ hours}}{\text{year}} \times \frac{1.34 \text{ hp}}{\text{kW}} \times \frac{0.00220 \text{ lb PM}}{\text{hp - hr}} = 4 \text{ lb PM/yr}$$

TABLE 2. 2000 ACTUAL AIR EMISSIONS FROM BADLANDS NATIONAL PARK HEATING EQUIPMENT

Location	No.	Fuel	Fuel Consumption (gal/yr)	PM10 (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Headquarters	2	Propane	1,144	0	0	16	2	14,297	0
Conference Building	1	Propane	238	0	0	3	0	2,978	0
Ranger Office	1	Propane	238	0	0	3	0	2,978	0
Resource Management	1	Propane	286	0	0	4	1	3,574	0
Ben Reifel Visitor Center	1	Propane	1,668		0	23	3	20,849	1
Wellness Center	1	Propane	191	0	0	3	0	2,383	0
Museum	1	Propane	83	0	0	1	0	1,042	0
Cedar Pass Residences	6	Propane	1,430	1	0	20	3	17,871	0
Cedar Pass Residences	1	Propane	179	0	0	3	0	2,234	0
Cedar Pass Apartment	2	Propane	953	0	0	13	2	11,914	0
Cedar Pass Apartment	2	Propane	953	0	0	13	2	11,914	0
Cedar Pass Apartment	2	Propane	953	0	0	13	2	11,914	0
Cedar Pass Apartment	2	Propane	953	0	0	13	2	11,914	0
Cedar Pass Lodge Office	1	Propane	219	0	0	3	0	2,740	0
Cedar Pass Lodge	1	Propane	476	0	0	7	1	5,954	0
Cedar Pass Cottage	1	Propane	286	0	0	4	1	3,574	0
Cedar Pass Lodge	9	Propane	1,930	1	0	27	4	24,125	
Cedar Pass Cottage	1	Propane	286	0	0	4	1	3,574	0
Cedar Pass Laundry	I	Propane	95	0	0	1	0	1,191	0
Pinnacles Fire Cache	1	Propane	477	0	0	7	1	5,957	0
Pinnacles Fee Office	1	Propane	58	0	0	1	0	730	0
Pinnacles Tack room	1	Propane	60	0	0	1	0	745	0
Pinnacles Residence	1	Propane	238	0	0	3	0	2,978	0
Northeast Support Building	1	Propane	105	0	0	1	0	1,311	0
South Unit Visitor Center	1	Propane	179	0	0	3	0	2,234	0
South Unit Fire Cache	1	Propane	238	0	0	3		2,978	0
South Unit Residence	1	Propane	226	0	0	3	0	2,830	0
Residences	11	Propane	1,048	0	0	15	2	13,105	0
		Totals	15,191		0	213	30	189,888	5

TABLE 3. 2000 POTENTIAL AIR EMISSIONS FROM
BADLANDS NATIONAL PARK HEATING EQUIPMENT

Location	**No.**	**Fuel**	**Fuel Consumption (gal/yr)**	PM_{10} **(Ibs/yr)**	SO_2 **(Ibs/yr)**	NO_X **(lbs/yr)**	**CO (Ibs/yr)**	**CO2 (Ibs/yr)**	**VOC (Ibs/yr)**
Headquarters	2	Propane	45,954	18	1	643	92	574,426	14
Conference Building	1	Propane	9,574	4	0	134	19	119,672	3
Ranger Office	1	Propane	9,574	4	0	134	19	119,672	3
Resource Management	1	Propane	11,489	5	0	161	23	143,607	3
Ben Reifel Visitor Center	1	Propane	67,016	27	1	938	134	837,705	20
Wellness Center	I	Propane	7,659	3	0	107	15	95,738	2
Museum	1	Propane	3,351	1	0	47	7	41,885	1
Cedar Pass Residences	6	Propane	57,443	23	1	804	115	718,033	17
Cedar Pass Residences	1	Propane	7,180	3	0	101	14	89,754	2
Cedar Pass Apa ment	2	Propane	38,295	15	1	536	77	478,689	11
Cedar Pass Apartment	2	Propane	38,295	15	1	536	77	478,689	11
Cedar Pass Apa ent	2	Propane	38,295	15	1	536	77	478,689	11
Cedar Pass Apartment	2	Propane	38,295	15	1	536	77	478,689	11
Cedar Pass Lodge Office	1	Propane	8,808	4	0	123	18	110,098	3
Cedar Pass Lodge	1	Propane	19,138	8	0	268	38	239,225	6
Cedar Pass Cottage	1	Propane	11,489	5	0	161	23	143,607	3
Cedar Pass Lodge	9	Propane	77,548	31	1	1,086	155	969,344	23
Cedar Pass Cottage	1	Propane	11,489	5	0	161	23	143,607	3
Cedar Pass Laundry	1	Propane	3,830	2	0	54	8	47,869	1
Pinnacles Fire Cache	1	Propane	19,148	8	0	268	38	239,344	6
Pinnacles Fee Office	1	Propane	2,346	1	0	33	5	29,320	1
Pinnacles Tack room	I	Propane	2,393	1	0	34	5	29,918	1
Pinnacles Residence	1	Propane	9,574	4	0	134	19	119,672	3
Northeast Support Building		Propane	4,212	2	0	59	8	52,656	1
South Unit Visitor Center	1	Propane	7,180	3	0	101	14	89,754	2
South Unit Fire Cache	I	Propane	9,574	4	0	134	19	119,672	3
South Unit Residence	1	Propane	9,095	4	0	127	18	113,689	3
Residences	11	Propane	42,125	17	1	590	84	526,557	13
		Totals	610,366	244	11	8,545	1,221	7,629,577	183

Potential emissions also were calculated for the generators. According to EPA guidance on calculating potential emissions from generators, 500 hours is an appropriate default assumption for estimating the number of hours that an emergency generator could be expected to operate. 1 Actual and potential generator emissions are summarized in Table 4.

[1] *Calculating Potential to Emit (PTE) for Emergency Generators,* Office of Air Quality Planning and Standards (MD-10) U.S. Environmental Protection Agency, September 6, 1995.

TABLE 4. 2000 ACTUAL AND POTENTIAL AIR EMISSIONS FROM BADLANDS NP GENERATORS

Location	Rating (kW)	Run Time (hrs/yr)	PM10 (Ibs/yr)	SO2 (lbs/yr)	NO_x (Ibs/yr)	CO (Ibs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Actual Emissions								
Maintenance S lop	l 00	13	4				2, 03	
Potential Emissions								
Maintenance Shop	**100**	**500**	147	137	2,077	448	77.050	168
Em ssion Factors from AP-42, Chapter 3.4-1 for generators rated less than 448 kW, S = 0.05 Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)								

2.1.3 Fuel Storage Tanks

Badlands NP has three gasoline and three diesel fuel aboveground storage tanks that service NPS vehicles and other motorized equipment. There are no public automotive service stations in the park.

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 turnovers. Emissions from diesel tanks are extremely small since the volatility of diesel fuel is extremely low compared to gasoline. VOC emissions from the NPS fuel storage tanks were calculated using the USEPA *TANKS* software program. *TANKS* 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. Table 5 summarizes the calculated emissions from the gasoline tanks.

TABLE 5: 2000 BADLANDS NP FUEL TANK EMISSIONS

Location	**Product**	Tank Type	**Volume (gal)**	**Throughput (gal/yr)**	**VOC** (lbs/yr)
Cedar Pass Maintenance	Gasoline	AST	1,600	28,000	531
Pinnacles Ranger Station	Gasoline	AST	1,000	1,000	240
South Unit Ranger Station	Gasoline	AST	1,000	1,000	240
			Total	30,000	1,011

2.2 AREA SOURCES

2.2.1 Woodstoves

Park officials estimated that about 10 employee housing units equipped with woodstoves, but that only two use them. However, there were no data on the quantity of wood consumed.

2.2.2 Campfires

Campfires are not permitted due to the extreme danger of prairie wildfire.

2.2.3 Wildland Fires and Prescribed Burning

Wildland fires are ignited naturally, usually by lightening and are typically suppressed, while prescribed fires are ignited intentionally in order to achieve fire management objectives. Prescribed burning is 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. Only prescribed burning emissions are considered as anthropogenic emissions.

In 2001, there were three prescribed burns of prairie grassland that covered almost 4,000 acres, but only one wildland fire that was less than an acre in size. 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 CO, PM_{10}, and $PM_{2.5}$, which are summarized in Table 6.

TABLE 6: PRESCRIBED BURNING AIR EMISSIONS FROM BADLANDS NP

Type	Acres	PM_{10} tons/ r)	PM2.5 tons/ r	Co (tons/ r)	CO_2 (tons/ r)	VOC[1] (tons/ r)
Grassland	3,874	5.81	5.81	13.56	3,907	1.94

As methane

2.2.4 Miscellaneous Area Sources

Miscellaneous area sources include food preparation, degreasers, paints and other surface coatings, lighter fluid consumption, consumer solvents, and propane use by visitors in recreational vehicles. However, there are no data on the consumption of these materials.

2.3 SUMMARY OF STATIONARY AND AREA SOURCE EMISSIONS

Table 7 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 7: SUMMARY OF 2000 STATIONARY AND AREA SOURCE EMISSIONS AT BADLANDS NP

Activity	Particulates		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		Carbon Dioxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Stationary Sources												
Heating Equipment	6	<0.01	<1	<0.01	213	0.11	30	0.02	189,888	95	5	<0.01
Generator	4	<0.01	<1	<0.01	54	0.03	12	0.01	2,003	1.00	4	<0.01
Gasoline Storage Tanks	--	--	--	--	--	--	--	--	--	--	1,011	0.51
Stationary Sources Subtotal	10	<0.01	<1	<0.01	267	0.13	42	0.02	191,891	96	1,020	0.51
Area Sources												
Prescribed Fires	*11,622*	5.81	--	--	--	--	*27,118*	13.56	*7,813,858*	3,907	3,874	1.94
Totals -												
	Particulates		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		Carbon Dioxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Totals without Prescribed Fires	10	<0.01	<1	<0.01	267	0.13	42	0.02	191,891	96	1,020	0.51
Totals with Prescribed Fires	11,632	5.82		<0.01	267	0.13	*27,160*	13.58	*8,005,750*	4,003	4,894	2.45

3. MOBILE SOURCE EMISSIONS

This section summarizes emissions from mobile sources at Badlands NP for 2000. Mobile emission sources include highway and nonroad vehicles. The following emissions were calculated for each source: particulate matter (PM_{10}), nitrogen oxides (NO,,), carbon monoxide (CO), and volatile organic compounds (VOCs).

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

The only paved road through the park is the Badlands Loop Road, which is a 27-mile segment of Route 240. The number of visitor vehicles operating in NPS units is often correlated to the number of annual visitors to the park unit. The number of visitors to Badlands NP as estimated by the NPS was approximately 974,333 in 2001. Using a people per vehicle factor of 2.4, the number of visitor vehicles is estimated to be approximately 405,975. Assuming that these vehicles entered the park at the Northeast or Northwest (Pinnacles) entrance stations and traveled the paved road once and exited at the other entrance, then the estimated vehicle-miles-traveled (VMT) by visitor vehicles was approximately 10,962,000 miles in 2001.

There are also two unpaved roads that are traveled by a small portion of visitor vehicles during May-September. NPS officials estimated that the seasonal VMT for these unpaved roads, which would generate considerably more fugitive dust than vehicles operating on paved roads, is approximately 444,000 miles a year.

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 PM10. 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, PM10 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 MOBILE6.2 model were used in conjunction with vehicle miles traveled (VMT) data in order to estimate mobile source emissions for VOC (both exhaust and evaporative), NOx, and CO. Similarly, emission factors produced by the PARTS model were used in conjunction with VMT data to estimate PM10 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 class 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 class 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 than the overall model default vehicle age distribution.

In addition to VMT mix and age distribution, CE-CERT also established park-specific modeling inputs for driving pattern characterization. CE-CERT found that park driving patterns differ significantly from the default driving patterns typically used in mobile modeling, such as the Federal Test Procedure (FTP). In particularly, they found that the FTP reflects both higher speeds and a wider range of speeds than observed in the parks. However, since the MOBILE5b 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 UM program parameters. The average speed input to the mobile models was assumed to be 35 mph. The fuel volatility was assumed to be RVP 13.4 (winter) and 8.3 (summer), and reformulated gasoline was not assumed to be present. Finally, inspection/maintenance (UM) program inputs were not included since there are no UM programs in South Dakota.

In order to account for seasonal differences in mobile emissions, separate MOBILE5b runs were performed to produce emission factors for winter and summer. A composite emission factor for each season, reflecting a park specific VMT mix adapted from the CE-CERT data, served as the basis for mobile source emission estimates. Additional particulate emissions (or entrained road dust) from vehicles operating in Badlands NP also were calculated based on VMT. A summary of visitor vehicle emissions is provided in Table 10.

3.1.2 NPS- Vehicles

Badlands NP operates a fleet of highway vehicles that are owned by the NPS. A summary of NPS vehicles and their estimated annual mileage is provided in Table 8, and emissions are provided in Table 10.

TABLE 8: NPS ROAD VEHICLES AT BADLANDS NP

Vehicle Type	Number	Annual Usage (mi/yr)
Light-Duty Gasoline Vehicles	34	394,762
Medium-Duty Gasoline Vehicles/Trucks	10	102,200
Heavy Duty Diesel Trucks	5	36,710
Total	49	533,672

3.2 NONROAD VEHICLES

3.2.1 NPS Nonroad Vehicles

The NPS also owns and operates nonroad motorized equipment that is used to maintain roads and grounds and for other purposes. Although no records on these nonroad vehicles were immediately available, a list of vehicle types and numbers was developed based on observations made during the June 2002 site survey, and these are listed in Table 9. Annual emissions were calculated using USEPA nonroad emission factors and default values for horsepower ratings, engine loads, and hours of operation, and these are summarized in Table 10.

TABLE 9: NPS NONROAD VEHICLES AT BADLANDS NP

Vehicle Type	**Number**
Tractor	1
Grader	1
Case LoaderBackhoe	2
Road Roller	1
Road Broom	1
Bobcat Loader	1
Mower	2

3.2.2 **Tour Helicopters**

A tour helicopter company is located immediately outside the northeast entrance to the park. Due to its close proximity to the park's boundary, emissions associated with takeoffs and landings were calculated using the Federal Aviation Administration's *Emissions and Dispersion Modeling System*. Emissions from the Bell Model 47 were calculated assuming that approximately 1,984 flights were made per tourist season (Foch Associates, 2000), and these are provided in Table 10.

3.4 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 10 summarizes the mobile source emissions for road and nonroad vehicles and equipment operating in Badlands NP in 2000.

TABLE 10: SUMMARY OF 2000 MOBILE SOURCE EMISSIONS AT BADLANDS NP

Activity	Particulates		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	287,584'	143.79	--	--	117,194	58.60	386,236	193.12	21,970	10.99
Visitor Buses	70'	0.03	--	--	288	0.14	1,952	0.98	70	0.03
NPS Road Vehicles	1,038'	0.52		--	2,141	1.07	18,781	9.39	969	0.48
Vehicle Emission Subtotal	288,692	144.35		--	119,623	59.81	406,969	203.48	23,009	11.51
Nonroad Vehicles/Helicopter										
NPS Nonroad Vehicles	104	0.05	--	--	817	0.41	364	0.19	1,201	0.60
Tour Helicopter	--	--	168	0.08	1,895	0.95	3,668	1.83	396	0.20
Nonroad Totals	104	0.05	168	0.08	2,712	1.36	4,032	2.02	1,597	0.80
Totals										
Totals	Particulates'		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/ r	•	mMU411							tons/ r
	288,796	144.40	168	0.08	122,335	61.17	411,001	205.50	24,606	12.30

' Includes exhaust PM10 and road dust

4. BADLANDS NP AND REGIONAL AIR EMISSIONS

4.1 BADLANDS NP SUMMARY

A summary of Badlands NP emissions is provided in Table 11.

TABLE 11: ESTIMATED ANNUAL EMISSIONS FROM BADLANDS NP

Source	PM_{10} (tons)	SO_2 (tons)	NO_x (tons)	CO (tons)	VOCs (tons)
Point Sources					
Heating Equipment	<0.01	<0.01	0.11	0.02	<0.01
Generators	<0.01	<0.01	0.03	0.01	<0.01
Gasoline Storage Tanks					0.51
Subtotal	<0.01	<0.01	0.13	0.02	0.51
Area Sources					
Prescribed Burning	5.81			13.56	1.94'
Subtotal	5.81			13.56	1.94'
Mobile'Sources					
Road Vehicles	144.35		59.81	203.48	11.51
Nonroad Vehicles	0.05	0.08	1.36	2.02	0.80
Subtotal	144.4	0.08	61.17	205.50	12.30
Totals					
Totals	5.86	<0.01	61.30	219.08	14.75

[1] As methane

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Pennington, Jackson, and Shannon Counties and the state of South Dakota were obtained from the 1999 National Emission Inventory (NEI) maintained by USEPA. However, no data were included in the statewide totals for stationary sources in Jackson and Shannon Counties. It is important to note that differences may exist between the methodologies used to generate the preserve emission inventory and those used to generate the NEI. For example, gasoline storage tanks have been included as stationary sources for the Park, while the NEI treats them as area sources. The majority of the emissions generated by point sources in Pennington County are attributable to other industrial processes. Table 12 provides a comparison of the Park emissions with those from the surrounding counties and the State of South Dakota.

TABLE 12: ESTIMATED ANNUAL EMISSIONS FROM BADLANDS NP, SURROUNDING COUNTIES, AND THE STATE OF SOUTH DAKOTA

Area	PM_{10} (tons/yr)	SO_2 (tons/yr)	**NO_Y (tons/yr)**	**CO** (tons/yr)	**VOC (tons/yr)**
Poin Sources					
Badlands NP	5.81	--	--	13.56	1.94'
Pennington County			4,145	30	440
Jackson County	No Data				
Shannon County	No Data				
Surrounding Counties	466	1,253	4,145	30	440
South Dakota	990	27,596	28,770	640	1,481
Area Sources					
Badlands NP	5.81	--	--	13.56	1.94'
Pennington County	4,917	2,328	1,009	11,572	3,270
Jackson County	2,968	6	7	119	253
Shannon County	2,921	9	23	494	246
Surrounding Counties	10,806	2,343	1,039	12,185	3,769
South Dakota	245,528	19,210	7,220	53,727	40,687
Mobile Sources					
Badlands NP	144.4	0.08	61.17	205.50	12.30
Pennington County	3,861	294	4,223	27,732	2,841
Jackson County	51	91	1,357	4,075	408
Shannon County	28	48	607	2,171	248
Surrounding Counties	3,940	433	6,187	33,978	3,497
South Dakota	79,393	8,804	81,386	267,604	32,263

5. COMPLIANCE AND RECOMMENDATIONS

5.1 COMPLIANCE

The park is located in Pennington, Jackson, and Shannon Counties, which are classified as attainment for all state and national ambient air quality standards. The South Dakota Department of Environment and Natural Resources administers the state's air pollution program. Park personnel should coordinate with the agency on permit issues relating to stationary sources, as well as prescribed burning activities. The South Dakota regulations do not address very many specific issues. For example, although they address major stationary sources, they do not set thresholds for triggering the need for a permit. With respect to open burning, the state regulations do not identify what is permissible to open burn; however, Pennington County has developed open burning regulations for the City of Rapid City and the area immediately surrounding the city limits.

With respect to wildland and prescribed fires, the state is working with the National Park Service, National Forest Service, Bureau of Land Management, and State Forest Service to develop Smoke Management Plans for the Black Hills region. The plans will follow EPA issued policy on wildland and prescribed fires to minimize air quality impacts.

5.2 RECOMMENDATIONS

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.

The park currently is investigating a visitor shuttle system to serve the needs of visitors to the Castle Trail Complex during the peak and shoulder seasons. The system would serve hiking trails in the North Unit of the park as well as visitor parking areas near Cedar Pass and along the eastern end of the 27-mile Badlands Loop Road. Alternative fuels may also be investigated.

Emissions from the Park are minor, both in comparison to State totals and to other NPS units. The principal air emission issues relate to planned energy production facilities in the Powder

River Basin in northeast Wyoming. These facilities include three low sulfur coal power plants that are in the planning stages and approximately 40,000 coal seam methane extraction wells. Although each well does not constitute a significant air emission source, collectively, they can impact the Park's air quality resources. Park officials are well aware of these developments and are monitoring their permitting status.

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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^3	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]	SOP)	NO,( )	CO	VOCP
Residential Furnace[e]	0.4	142S	18	5	0.713
Boilers < 100 Million Btu/hr (Commercial/Institutional Combust.( )	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)				
	PMO)	SO_2	NO,,[c]	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)l 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 al fuel burned)				
	PM(a)	S02 (b)	NO,(c)	CO	VOC d,
Commercial Boilers(f)	0.4	0.10S	14	1.9	0.3
Industrial Boilers(s)	0.6	0.10S	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):

Fuel Type	Emission Factor (lb/hp-hr)				
	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	SO_X(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°)	SO,,	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)				
	PM°)	SO_X	NO,, [c]	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_2.

(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.

(I) 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

2000 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT BADLANDS NATIONAL PARK

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO, (lbs/yr)	CO (lbs/yr)	CO, (lbs/yr)	VOC (lbs/yr)
Furnace	Headquarters	Propane	2	240,000	480,000	1,144	0	0	16	2	14,297	0
Furnace	Conference Building	Propane	1	100,000	100,000	238	0	0	3	0	2,978	0
Furnace	Ranger Office	Propane	1	100,000	100,000	238	0	0	3	0	2,978	0
Furnace	Resource Management	Propane	1	120,000	120,000	286	0	0	4	1	3,574	0
Furnace	Ben Reifel Visitor Cent	Propane	1	700,000	700,000	1,668	1	0	23	3	20,849	1
Furnace	Wellness Center	Propane	1	80,000	80,000	191	0	0	3	0	2,383	0
Furnace	Museum	Propane	1	35,000	35,000	83	0	0	1	0	1,042	0
Furnace	Cedar Pass Residences	Propane	6	100,000	600,000	1,430	1	0	20	3	17,871	0
Furnace	Cedar Pass Residences	Propane	1	75,000	75,000	179	0	0	3	0	2,234	0
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	953	0	0	13	2	11,914	0
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	953	0	0	13	2	11,914	0
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	953	0	0	13	2	11,914	0
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	953	0	0	13	2	11,914	0
Furnace	Cedar Pass Lodge Offic	Propane	1	92,000	92,000	219	0	0	3	0	2,740	0
Water Heater	Cedar Pass Lodge	Propane	1	199,900	199,900	476	0	0	7	1	5,954	0
Furnace	Cedar Pass Cottage	Propane	1	120,000	120,000	286	0	0	4	1	3,574	0
Furnace	Cedar Pass Lodge	Propane	9	90,000	810,000	1,930	1	0	27	4	24,125	1
Furnace	Cedar Pass Cottage	Propane	1	120,000	120,000	286	0	0	4	1	3,574	0
Water Heater	Cedar Pass Laundry	Propane	1	40,000	40,000	95	0	0	1	0	1,191	0
Furnace	Pinnacles Fire Cache	Propane	1	200,000	200,000	477	0	0	7	1	5,957	0
Furnace	Pinnacles Fee Office	Propane	1	24,500	24,500	58	0	0	1	0	730	0
Furnace	Pinnacles Tack room	Propane	1	25,000	25,000	60	0	0	1	0	745	0
Furnace	Pinnacles Residence	Propane	1	100,000	100,000	238	0	0	3	0	2,978	0
Furnace	Northeast Support Buih	Propane	1	44,000	44,000	105	0	0	1	0	1,311	0
Furnace	South Unit Visitor Cent	Propane	1	75,000	75,000	179	0	0	3	0	2,234	0
Furnace	South Unit Fire Cache	Propane	1	100,000	100,000	238	0	0	3	0	2,978	0
Furnace	South Unit Residence	Propane	1	95,000	95,000	226	0	0	3	0	2,830	0
Water Heater	Residences	Propane	11	40,000	440,000	1,048	0	0	15	2	13,105	0
			56		6,375,400	15,191	6	0	213	30	189,888	5

Emission Factors (lbs/1,000 gal)

	PM_{10}	SO_2	NO,	CO	CO,	VOC
Propane	0.4	0.005	14	1.9	12,500	0.3

2000 POTENTIAL CRITERIA EMISSIONS FROM HEATING UNITS AT BADLANDS NATIONAL PARK

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Furnace	Headquarters	Propane	2	240,000	480,000	45,954	18	0	643	92	574,426	14
Furnace	Conference Building	Propane	1	100,000	100,000	9,574	4	0	134	19	119,672	3
Furnace	Ranger Office	Propane	1	100,000	100,000	9,574	4	0	134	19	119,672	3
Furnace	Resource Management	Propane	1	120,000	120,000	11,489	5	0	161	23	143,607	3
Furnace	Ben Reifel Visitor Center	Propane	1	700,000	700,000	67,016	27	0	938	134	837,705	20
Furnace	Wellness Center	Propane	1	80,000	80,000	7,659	3	0	107	15	95,738	2
Furnace	Museum	Propane	1	35,000	35,000	3,351	1	0	47	7	41,885	1
Furnace	Cedar Pass Residences	Propane	6	100,000	600,000	57,443	23	0	804	115	718,033	17
Furnace	Cedar Pass Residences	Propane	1	75,000	75,000	7,180	3	0	101	14	89,754	2
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	38,295	15	0	536	77	478,689	11
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	38,295	15	0	536	77	478,689	11
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	38,295	15	0	536	77	478,689	11
Furnace	Cedar Pass Apartment	Propane	2	200,000	400,000	38,295	15	0	536	77	478,689	11
Furnace	Cedar Pass Lodge Office	Propane	1	92,000	92,000	8,808	4	0	123	18	110,098	3
Water Heater	Cedar Pass Lodge	Propane	1	199,900	199,900	19,138	8	0	268	38	239,225	6
Furnace	Cedar Pass Cottage	Propane	1	120,000	120,000	11,489	5	0	161	23	143,607	3
Furnace	Cedar Pass Lodge	Propane	9	90,000	810,000	77,548	31	0	1,086	155	969,344	23
Furnace	Cedar Pass Cottage	Propane	1	120,000	120,000	11,489	5	0	161	23	143,607	3
Water Heater	Cedar Pass Laundry	Propane	1	40,000	40,000	3,830	2	0	54	8	47,869	1
Furnace	Pinnacles Fire Cache	Propane	1	200,000	200,000	19,148	8	0	268	38	239,344	6
Furnace	Pinnacles Fee Office	Propane	1	24,500	24,500	2,346	1	0	33	5	29,320	1
Furnace	Pinnacles Tack room	Propane	1	25,000	25,000	2,393	1	0	34	5	29,918	1
Furnace	Pinnacles Residence	Propane	1	100,000	100,000	9,574	4	0	134	19	119,672	3
Furnace	Northeast Support Building	Propane	1	44,000	44,000	4,212	2	0	59	8	52,656	1
Furnace	South Unit Visitor Center	Propane	1	75,000	75,000	7,180	3	0	101	14	89,754	2
Furnace	South Unit Fire Cache	Propane	1	100,000	100,000	9,574	4	0	134	19	119,672	3
Furnace	South Unit Residence	Propane	1	95,000	95,000	9,095	4	0	127	18	113,689	3
Water Heater	Residences	Propane	11	40,000	440,000	42,125	17	0	590	84	526,557	13
			56		6,375,400	610,366	244	3	8,545	1,221	7,629,577	183

Emission Factors (lbs/1,000 gal)						
Propane	0.4	0.005	14	1.9	12,500	0.3

2000 ACTUAL CRITERIA EMISSIONS FROM GENERATORS AT BADLANDS NATIONAL PARK

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM'' (Ibs/yr)	SO, (lbs/yr)	NO, (lbs/yr)	CO (Ibs/yr)	CO, (Ibs/yr)	VOC (Ibs/yr)
Generator	Maintenance Shop	Diesel	1	100	13	1,300	4	0	54	12	2,003	4
Emission Factors from AP-42, Chapter 3.4-1 for generators rated less than 448 kW, 5=.05							2.20E-03	0.00205*S	3.10E-02	6.68E-03	1.15E+00	2.51E-03

Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)

2000 POTENTIAL CRITERIA EMISSIONS FROM GENERATORS AT **BADLANDS NATIONAL PARK**

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM'' (lbs/yr)	SO, (lbs/yr)	NO, (Ibs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Generator	Maintenance Shop	Diesel	1	100	500	50,000	147	7	2,077	448	77,050	168

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

Identification

User Identification:	Badlands Cedar Pass
City:	Rapid City
State:	South Dakota
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	Sandstone AST

Tank Dimensions

Shell Length (ft):	9.00
Diameter (ft):	5.25
Volume (gallons):	1,600.00
Turnovers:	0.00
Net Throughput (gal/yr):	28,000.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

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

Breather Vent Settings

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

Meteorological Data used in Emissions Calculations: Rapid City, South Dakota (Avg Atmospheric Pressure = 13.11 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 9)	All	53.53	43.82	63.25	48.77	4.0537	3.3197	4.9134	67.0000			92.00	Option 4: RVP=9, 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 9)	181.06	350.04	531.10

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

Identification

User Identification:	Badlands Pinnacles
City:	Rapid City
State:	South Dakota
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	AST

Tank Dimensions

Shell Length (ft):	6.00
Diameter (ft):	5.25
Volume (gallons):	1,000.00
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/Light
Shell Condition:	Good

Breather Vent Settings

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

Meteorological Data used in Emissions Calculations: Rapid City, South Dakota (Avg Atmospheric Pressure = 13.11 psia)

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

Mixture/Com onent	Month	Daily Liquid Surf. Temperatures (deg F)			Liquid Bulk Temp. de F	Vapor Pressures (psia)			Vapor Mot. Wei t	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Wei ht	Basis for Vapor Pressure Calculations
		A	Min.	Max.		Av	Min.	Max					
Gasoline (RVP 9)	All	53.53	43.82	63.25	48.77	4.0537	3.3197	4.9134	67.0000			92.00	Option 4: RVP=9, 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 9)	6.47	233.36	239.83

TITLE: Results of FOFEM model execution on date: 1/31/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 607 - Wheatgrass - Needlegrass
Fuel Type: Natural
Fuel Reference: FOFEM 271

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (0)	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	0.63	0.57	0.06	90.0	221	
Shrubs	0.00	0.00	0.00	0.0	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	0.63	0.57	0.06	90.0		

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 (U	.0	21.9	21.9	21.9	10

Emissions -- lbs/acre

	flaming	smoldering	total
PM 10	3	0	
PM 2.5	3	0	
CH 4	1	0	1
CO	7	0	7
CO 2	2017	0	2017

	Consumption tons/acre	Duration hour: min: sec
Flaming:	0.57	00:01:00
Smoldering:	0.00	00:00:00
Total:	0.57	

2001 PRESCRIBED BURNING EMISSIONS AT BADLANDS NATIONAL PARK

Fire Type	Acres	PM_{10} (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CH_4 (lbs/yr)	CO_2	CO (lbs/yr)	PM10 (tons/yr)	$PM_{2.5}$ (tons/yr)	CH_4 (tons/yr)	CO_2	CO (tons/yr)
Grassland	3,874	11,622	11,622	3,874	7,813,858	27,118	5.81	5.81	1.94	3,906.93	13.56
Emission Facors (lbs/acre)		3	3	1	2,017	7					

- ##########################
- Badlands NP Winter Conditions.
- File 1, Run 1, Scenario 5.
- #

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:	10.0 (F)
Maximum Temperature:	40.0 (F)
Absolute Humidity:	75. grains/lb

Nominal Fuel RVP: 13.4 psi
Weathered RVP: 13.4 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:	0.1339	0.3439	0.1596		0.1033	0.0001	0.0035	0.2567	0.0000	1.0000

Compooite Emission Factors (g/mi):

	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Composite VOC `	0.823	1.150	1.039	1.115	0.984	0.410	0.466	0.810	0.00	0.982
Composite CO ~	20.08	36.58	23.74	25.68	29.05	1.278	1.006	4.431	0.00	19.757
Composite NOX ~	0.878	1.282	1.493	1.349	3.980	1.254	1.231	14.858	0.08	5.026

vah. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0790	0.2649	0.1094	0.0502	0.0001	0.0024

Compooite Emission Factors (g/mi):

	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
Composite VOC	1.076	1.172	1.010	1.101	2.424	0.390
Composite CO ~	25.85	26.80	23.62	24.02	6.522	0.792
Composite NOX ~	1.007	1.364	1.347	1.812	2.555	1.179

Veh. Type:	HDGV2B	HDGV3	HDGV4	BoGv5	HDGV6	HDGV7	HDGV8A	aDGV8B
VMT Mix:	0.0871	0.0028	0.0003	0.0032	0.0063	0.0026	0.0000	0.0000

Compoaite Emission Factors (g/mi):

	HDGV2B	HDGV3	HDGV4	BoGv5	HDGV6	HDGV7	HDGV8A	aDGV8B
Composite VOC ~	0.959	0.976	1.007	1.140	1.131	1.241	1.354	0.000
Composite CO ~	28.18	29.09	29.80	34.22	33.97	37.43	40.56	0.00
Composite NOX ~	3.920	4.076	3.727	4.285	4.258	4.692	5.086	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
nnMT Mix:	0.0299	0.0092	0.0081	0.0038	0.0187	0.0274	0.0330	0.1190

Composite Emission Factors (g/mi):

Composite VOC :	0.378	0.430	0.502	0.538	0.776	0.963	0.827	0.932
Composite CO	1.941	2.258	2.634	2.859	2.832	3.515	4.997	5.670
Composite NOX :	4.149	4.695	5.517	5.943	9.043	11.209	17.871	20.215

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* #
* Badlands NP Summer Conditions.
* File 1, Run 1, Scenario 6.
* #

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:	July
Altitude:	High
Minimum Temperature:	62.0 (F)
Maximum Temperature:	92.0 (F)
Absolute Humidity:	75. grains/lb
Nominal Fuel RVP:	8.3 psi
Weathered RVP:	8.0 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:	0.1339	0.3439	0.1596		0.1034	0.0001	0.0025	0.2566	0.0000	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.730	0.887	0.874	0.883	0.865	0.384	0.484	0.806	0.00	0.840
Composite CO	11.73	14.44	14.15	14.35	22.71	1.249	1.012	4.397	0.00	12.274
Composite NOX :	0.752	1.016	1.287	1.102	3.666	1.157	1.255	14.245	0.00	4.693

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0790	0.2649	0.1094	0.0502	0.0001	0.0024
Composite Emission Factors (g/mi):						
Composite VOC :	0.848	0.898	0.856	0.912	2.512	0.417
Composite CO	14.05	14.55	14.06	14.34	6.775	0.821
Composite NOX :	0.805	1.079	1.159	1.567	2.574	1.211

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0874	0.0028	0.0009	0.0031	0.0062	0.0026	0.0000	0.0000
Composite Emission Factors (g/mi):								
Composite VOC :	0.841	0.843	0.924	1.011	1.005	1.089	1.192	0.000
Composite CO	22.05	22.79	23.23	26.73	26.53	29.24	31.63	0.00
Composite NOX :	3.618	3.765	3.390	3.905	3.879	4.276	4.628	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8E
VMT Mix:	0.0296	0.0092	0.0081	0.0039	0.0188	0.0274	0.0330	0.1190
Composite Emission Factors (g/mi):								
Composite VOC :	0.374	0.426	0.498	0.534	0.773	0.959	0.822	0.926
Composite CO	1.956	2.270	2.648	2.871	2.810	3.487	4.951	5.612
Composite NOX :	4.077	4.617	5.427	5.847	8.744	10.841	17.060	19.274

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* ########################
* Badlands NP Winter Conditions.
* File 1, Run 1, Scenario 5..
* # # # # # # # # # # # # # # # # # # # # # # # #

                              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
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GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.1339	0.3439	0.1596		0.1033	0.0001	0.0025	0.2567	0.0000	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	0.0520	------	------	------	0.0205	0.0083
ECARBON:	------	------	------	------	------	0.1198	0.0502	0.1268	------	0.0327
OCARBON:	------	------	------	------	------	0.0338	0.0722	0.0657	------	0.0170
S04:	0.0028	0.0049	0.0047	0.0049	0.0109	0.0049	0.0105	0.0306	0.0000	0.0118
Total Exhaust PM:	0.0071	0.0096	0.0091	0.0095	0.0629	0.1584	0.1330	0.2231	0.0205	0.0699
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0000	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0086	0.0080	0.0080	0.0257	0.0000	0.0126
Total PM:	0.0276	0.0302	0.0296	0.0300	0.0841	0.1790	0.1535	0.2614	0.0205	0.0950
S02:	0.0684	0.0804	0.1134	0.0908	0.1666	0.0934	0.2017	0.4376	0.0000	0.1849
NH3:	0.1016	0.1005	0.1015	0.1008	0.0451	0.0068	0.0068	0.0270	0.0000	0.0760
Idle Emissions (g/hr)										
PM Idle:	------	------	------	------	------	------	------	1.0438	------	0.2680

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0790	0.2649	0.1094	0.0502	0.0001	0.0024
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	0.0463
OCARBON:	------	------	------	------	0.2156	0.0667
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	0.1237
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	0.0296	0.0296	0.3922	0.1443
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	HDGVS	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0871	0.0028	0.0009	0.0032	0.0063	0.0026	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	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
ECARBON:								
0CARBON:				------	------	------	------	------
S04:	0.0118	0.0118	0.0049	0.0050	0.0050	0.0049	0.0048	0.0000
Total Exhaust PM:	0.0640	0.0641	0.0553	0.0554	0.0553	0.0553	0.0551	0.0000
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0000
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0000
Total PM:	0.0846	0.0887	0.0798	0.0799	0.0799	0.0798	0.1036	0.0000
S02:	0.1603	0.1730	0.1764	0.2054	0.2026	0.2213	0.2339	0.0000
NH3:	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0000
Idle Emissions (g/hr)								
PM Idle:								

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDVS	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0299	0.0092	0.0081	0.0038	0.0187	0.0274	0.0330	0.1190

Composite Emission Factors (g/mi):

Lead:								
GAS PM:								
ECARBON:	0.0513	0.0486	0.0476	0.0466	0.1058	0.1043	0.1234	0.1676
OCARBON:	0.0534	0.0506	0.0495	0.0485	0.0831	0.0819	0.0970	0.0529
S04:	0.0172	0.0190	0.0217	0.0224	0.0254	0.0294	0.0337	0.0353
Total Exhaust PM:	0.1219	0.1182	0.1189	0.1175	0.2143	0.2156	0.2540	0.2558
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0360
Total PM:	0.1424	0.1427	0.1434	0.1420	0.2389	0.2401	0.3026	0.3043
S02:	0 2452	0.2722	0.3107	0.3208	0.3637	0.4200	0.4813	0.5043
NH3:	0 0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270
Idle Emissions (g/hr)								
PM Idle:	1.0607	1.0424	1.0459	1.0391	1.0381	1.0402	1.0381	1.0417

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* # # # # # # # # # # # # # # # # # # # # # # # # #
* Badlands NP Summer Conditions.
* File 1, Run 1, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                         Calendar Year:   2001
                                Month:   July
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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:	0.1339	0.3439	0.1596		0.1034	0.0001	0.0025	0.2566	0.0000	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	0.0046	0.0520	------	------	------	0.0205	0.0082
ECARBON:	------	------	------	------	------	0.1150	0.0496	0.1241		0.0320
OCARBON:	------	------	------	------	------	0.0324	0.0714	0.0641		0.0166
S04:	0.0028	0.0049	0.0047	0.0048	0.0113	0.0048	0.0106	0.0306	0.0000	0.0118
Total Exhaust PM:	0.0070	0.0095	0.0091	0.0094	0.0633	0.1522	0.1316	0.2187	0.0205	0.0687
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0000	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0086	0.0080	0.0080	0.0258	0.0000	0.0126
Total PM:	0.0276	0.0300	0.0297	0.0299	0.0845	0.1728	0.1522	0.2570	0.0205	0.0938
S02:	0.0684	0.0804	0.1134	0.0908	0.1663	0.0924	0.2022	0.4374	0.0000	0.1848
NH3:	0.1016	0.1007	0.1015	0.1009	0.0451	0.0068	0.0068	0.0270	0.0000	0.0760
Idle Emissions (g/hr)										
PM Idle:								1.0356	------	0.2657

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0790	0.2649	0.1094	0.0502	0.0001	0.0024
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	0.0463
OCARBON:	------	------	------	------	0.2156	0.0667
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	0.1237
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	0.1443
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:	0.0874	0.0028	0.0009	0.0031	0.0062	0.0026	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	0.0121	0.0061	0.0062	0.0062	0.0062	0.0060	0.0000
Total Exhaust PM:	0.0643	0.0644	0.0567	0.0568	0.0568	0.0568	0.0565	0.0000
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0000
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0000
Total PM:	0.0848	0.0889	0.0813	0.0814	0.0814	0.0813	0.1051	0.0000
S02:	0.1601	0.1728	0.1758	0.2049	0.2021	0.2208	0.2332	0.0000
NH3:	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0000
Idle Emissions (g/hr)								
PM Idle:								

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0296	0.0092	0.0081	0.0039	0.0188	0.0274	0.0330	0.1190
Composite Emission Factors (g/mi):								
Lead:								
GASPM:	------	------	------	------				
ECARBON:	0.0502	0.0478	0.0468	0.0459	0.1020	0.1004	0.1214	0.1647
OCARBON:	0.0523	0.0497	0.0487	0.0477	0.0802	0.0789	0.0954	0.0520
S04:	0.0171	0.0190	0.0217	0.0224	0.0254	0.0294	0.0337	0.0352
Total Exhaust PM:	0.1196	0.1165	0.1172	0.1161	0.2076	0.2087	0.2504	0.2519
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0360
Total PM:	0.1402	0.1410	0.1417	0.1406	0.2322	0.2332	0.2990	0.3005
S02:	0.2449	0.2719	0.3106	0.3207	0.3635	0.4199	0.4810	0.5038
NH3:	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270
Idle Emissions (g/hr)								
PM Idle:	1.0495	1.0341	1.0377	1.0321	1.0309	1.0326	1.0307	1.0338

* #

BADLANDS NATIONAL PARK VISITOR VEHICLE EMISSIONS

Paved Road Annual VMT	Unpaved Road Annual VMT
10,962,000	444,000

Emission Factors (g/mi) -All Vehicles

				PM 10 (Paved)			PM10 (Unpaved)		
	NO_x	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total	Exhaust, Brake, and Tire	Fugitive	Total
Summer	4.693	12.274	0.840	0.0938	0.84	0.9338	0.0938	271.25	271.34
Winter	5.026	19.757	0.982	0.0950	0.84	0.9350	0.0950	271.25	271.35
Average	4.860	16.016	0.911			0.934			271.34

Emissions (tonslyr) - All Vehicles

NO_x	CO	VOC	Paved PM_{10}	Unpaved PM_{10}	Total PM"
58.60	193.12	10.99	11.27	132.52	143.79

Emissions (Ibs/yr) - All Vehicles

NO_x	CO	VOC	Paved PM_{10}	Unpaved PM_{10}	Total PM,
117,194	386,236	21,970	22,534	265,049	287,584

Bus Annual VMT
34,290

Emission Factors (g/mi) - Buses

				PM_{10} (Paved)		
	NO_x	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	3.666	22.710	0.865	0.0845	0.84	0.9245
Winter	3.980	29.050	0.984	0.0841	0.84	0.9241
Average	3.823	25.880	0.925			0.924

Emissions (tonslyr) - Buses

NO_x	CO	VOC	Paved PM"
0.14	0.98	0.03	0.03

Emissions (Ibs/yr) - Buses

NO_x	CO	VOC	Paved PM"
288	1,952	70	70

BADLANDS NATIONAL PARK NPS AND GSA VEHICLES

	LDGV	LDGT	HDGV	HDDV	Total
Total Miles	394,762	102,200	0	36,710	533,672

Emission Factors (9/mi) - LDGV

	NO_x	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	0.7520	11.7300	0.7300	0.0276	0.8400	0.8676
Winter	0.8780	20.0800	0.8230	0.0276	0.8400	0.8676
Average	0.8150	15.9050	0.7765			0.8676

Emissions (tons/yr) - LDGV

NOx	CO	VOC	PM_{10}
0.35	6.91	0.34	0.38

Emission Factors (g/mi) - LDGT

	NO_x	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	1.016	14.440	0.887	0.030	0.840	0.870
Winter	1.282	26.580	1.150	0.030	0.840	0.870
Average	1.149	20.510	1.019			0.870

Emissions (tons/yr) - LDGT

NO_x	CO	VOC	PM_{10}
0.13	2.31	0.11	0.10

Emission Factors (9/mi) - HDGV

	NO_x	CO	VOC	PM, Exhaust, Brake, and Tire	PM, Fugitive	PM, Total
Summer	3.634	23.630	0.891	0.085	0.840	0.925
Winter	3.844	26.110	0.849	0.084	0.840	0.924
Average	3.739	24.870	0.870			0.924

Emissions (tonslyr) - HDGV

NOx	CO	VOC	PM_{10}
0.00	0.00	0.00	0.00

Emission Factors (g/mi) - HDDV

	NO_x	CO	VOC	PM_{70} Exhaust, Brake, and Tire	PM_{70} Fugitive	PM_{70} Total
Summer	14.245	4.397	0.806	0.261	0.840	1.101
Winter	14.858	4.431	0.810	0.261	0.840	1.101
Average	14.552	4.414	0.808			1.101

Emissions (tons/yr) - HDDV

NO_x	CO	VOC	PM_{10}
0.59	0.18	0.03	0.04

Emissions (tonslyr) - Total

NO_x	CO	VOC	PM_{10}
1.07	9.39	0.48	0.52

Emissions (lbs/vr) - Total

NO_x	CO	VOC	PM_{10}
2,141	18,781	969	1,038

2000 BADLANDS NP NONROAD VEHICLE EMISSIONS

Vehicle	No.	Emission Factors (gm/hp-hr) PM	Nox	CO	VOC	hp	load	hrs/yr	Emissions (lbs/yr) PM	Nox	CO	VOC
Daihaitsu	0	2.04	1.03	2.31	2.19	30	0.55	200	0.0	0.0	0.0	0.0
Honda ATV	0	2.04	1.03	2.31	2.19	18	0.55	100	0.0	0.0	0.0	0.0
								100				
Gator	0	2.04	1.03	2.31	2.19	18	0.55	200	0.0	0.0	0.0	0.0
Tractors	0	2.04	1.03	2.31	2.19	40	0.68	120	0.0	0.0	0.0	0.0
Tractors	0	2.04	1.03	2.31	2.19	65	0.68	120	0.0	0.0	0.0	0.0
										0.0	0.0	
Backhoe	0	2.04	1.03	2.31	2.19	70	0.55	250	0.0	0.0	0.0	0.0
Riding Mower	2	1.11	10.3	4.8	1.3	18	0.55	110	5.3	49.4	23.0	6.2
Riding Mower	0	1.11	10.3	4.8	1.3	20	0.55	90	0.0	0.0	0.0	0.0
Brush Mower	0	1.11	10.3	4.8	1.3	15	0.55	40	0.0	0.0	0.0	0.0
Bobcat	1	2.04	1.03	2.31	2.19	70	0.55	80	13.8	7.0	15.7	14.8
Dozer	0	2.04	1.03	2.31	2.19	77	0.55	300	0.0	0.0	0.0	0.0
Grader	1	1.06	9.6	3.8	1.43	200	0.61	60	17.1	154.6	61.2	23.0
Power Pruner	0	3.99	0.9	4.8	1.3	5	0.55	600	0.0	0.0	0.0	0
Stihl Brushcutters	0	3.99	0.9	4.8	1.3	5	0.55	600	0.0	0.0	0.0	0.0
Stihl 14 Quick Cut Saw	0	3.99	0.9	4.8	1.3	5	0.55	100	0.0	0.0	0.0	0.0
Post Hole Digger	0	3.99	0.9	4.8	1.3	5	0.55	400	0.0	0.0	0.0	0.0
Case Plate Tamper	0	3.99	0.9	4.8	1.3	5	0.55	300	0.0	0.0	0.0	0.0
Tamper Rammer	0	3.99	0.9	4.8	1.3	5	0.55	100	0.0	0.0	0.0	0.0
Pionjar	0	3.99	0.9	4.8	1.3	5	0.55	600	0.0	0.0	0.0	0.0
Wacker Trash Pump	0	3.99	0.9	4.8	1.3	5	0.55	100	0.0	0.0	0.0	0.0
Generators	0	3.99	0.9	4.8	1.3	5	0.55	165	0.0	0.0	0.0	0.0
Welder-Arc-Generator	0	3.99	0.9	4.8	1.3	5	0.55	100	0.0	0.0	0.0	0.0
Emglo Air Compressor	0	3.99	0.9	4.8	1.3	32	0.55	400	0.0	0.0	0.0	0.0
Sweeper	0	1.7	14	6.06	1.46	15	0.68	120	0.0	0.0	0.0	0.0
Road Broom	0	1.7	14	6.06	1.46	23	0.68	40	0.0	0.0	0.0	0.0
Leaf Blowers	0	3.99	0.9	4.8	1.3	1.2	0.55	15	0.0	0.0	0.0	0.0
Chainsaws	0	3.6	0.96	4.8	1.3	3	0.55	1600	0.0	0.0	0.0	0.0
Trimmer	0	3.99	0.9	4.8	1.3	1.2	0.55	300	0.0	0.0	0.0	0
Weed Wacker	0	3.99	0.9	4.8	1.3	1.2	0.55	0	0.0	0.0	0.0	0
50 gallon Sprayer	0	1.7	14	6.06	1.46	9	0.55	1000	0.0	0.0	0.0	0
Forklift	0	1.06	9.6	3.8	1.43	172	0.61	175	0.0	0.0	0.0	0.0
Front End Loader	1	1.11	10.3	4.8	1.3	77	0.55	630	65.2	604.6	281.7	76
Roller/Compactor	1	2.04	1.03	2.31	2.19	39	0.55	25	2.4	1.2	2.7	3
Skid Loader	0	1.11	10.3	4.8	1.3	77	0.55	80	0.0	0.0	0.0	0.0
Chipper	0	3.99	0.9	1372	495	30	0.55	60	0.0	0.0	0.0	1078
Crane	0	1.06	9.6	3.8	1.43	172	0.61	175	0.0	0.0	0.0	0.0
Snowplow	0	1	8	5	1.22	210	0.65	130	0.0	0.0	0.0	0.0
							Totals:	(lbs/yr)	104	817	384	1,201
								(tons/yr)	0.05	0.41	0.19	0.60

EDMS 3.23 Emissions Inventory Report

Study Name: mystudy

Airport: Your Airport

Report Date: 07/12/02

SUMMARY

(Tons/Year)

NAME	CO	HC	NOx	SOX	PM10
Aircraft	3.668	.396	1.895	.168	.000
GSE/AGE/APU	20.384	1.278	.406	.010	.036
Total	24.052	1.674	2.301	.178	.036

AIRCRAFT EMISSIONS

(Tons/Year)

Aircraft	Engine	Mode	CO	HC	NOx	SOX	PM10
SH-3E	T58-GE-5	TAXI	.000	.000	.000	.000	.000
SH-3E	T58-GE-5	TKOF	.000	.000	.000	.000	.000
SH-3E	T58-GE-5	CLMB	1.724	.238	1.091	.092	.000
SH-3E	T58-GE-5	APCH	1.944	.158	.804	.076	.000
SH-3E	T58-GE-5	APU	.000	.000	.000	.000	.000
SH-3E	T58-GE-5	GSE	20.384	1.278	.406	.010	.036

** Denotes User Created Aircraft

APPENDIX C

PUBLIC USE DATA

Form 10-157 U.S. DEPARTMENT OF INTERIOR
!Rev. 3/77)

MONTHLY PUBLIC USE REPORT

'ARK	MONTH YEAR	UPDATE CODE	PARK CODE	MONTH	YEAR	CATE-GORY	R/U
BADLANDS NATIONAL PARK	12/2001		13001				

	CURRENT-MONTH Recreational	Nonrecreational	Total	YEAR-TO-DATE
1 ISITS	62111	15721	77831	974333
'ISITOR HOURS	247861	7861	255721	4306565

	CURRENT MONTH	YEAR-TO-DATE
ECREATION O/N STAYS		
CONCESSIONER LODGING	01	8019
cONCESSIONER CAMPGROUNDS	0	0
NPS CAMPGROUNDS	411	38853
NPS BACKCOUNTRY	51	692
NPS MISCELLANEOUS	0	0
NON RECREATION O/N STAYS 1	0	0
TOTAL OVERNIGHT STAYS	46	47564

NPS CAMPGROUNDS

TENTS	30
R/VS	11
TOTAL	41

VISITOR-HOUR APPENDIX

SEE WORKSHEET

'PECIAL USE DATA	THIS MONTH	YEAR-TO DATE		THIS MONTH	YEAR-TO DATE
x4ORTHEAST	28461	475634	CEDAR PASS VIS CNTR	3981	226621
INNACLES	16971	22646711	WHITE RIVER VIS CTRI	01	8026
INTERIOR	16681	23369811	BUS PASSENGERS	01	19670
ORSES AT SAGE CREEK	01	34111	n. BUSES	01	634

	THIS MONTH		SAME MONTH LAST YEAR		
TOTAL VISITS	7783	TOTAL VISITS	81211	o CHG	-4.21
YTD VISITS	9743331	YTD VISITS	11246881	% CHG 1	-13.4

IGNATURE SCOTT W. LOPEZ

TITLE CHIEF RANGER

DATE 01/02/02