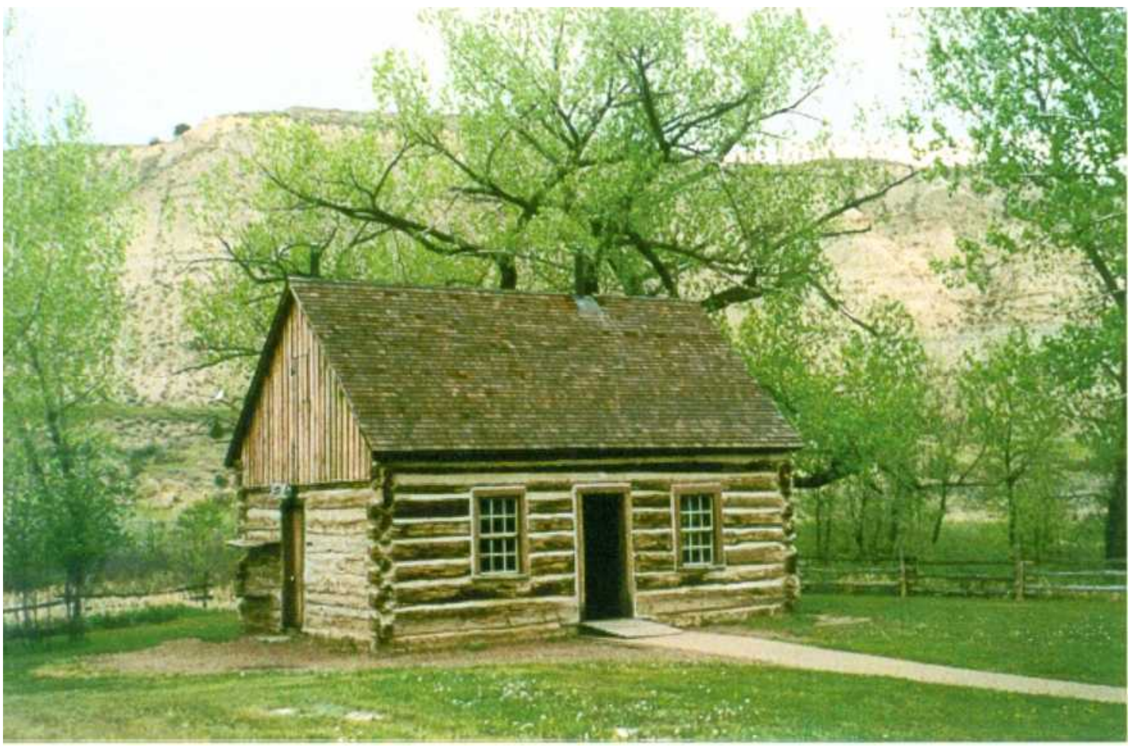
REVISED FINAL

2000 AIR EMISSIONS INVENTORY

THEODORE ROOSEVELT NATIONAL PARK
NORTH DAKOTA



U.S. NATIONAL PARK SERVICE

JANUARY 2003

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THEODORE ROOSEVELT NATIONAL PARK
NORTH DAKOTA

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JANUARY 20©3

Cover Photo: Theodore Roosevelt's Maltese Cross Cabin located behind the Medora Visitor Center

CONTENTS

		Page
FIGURES		iv
TABLES		iv
1.	INTRODUCTION	I
1.1	Background	1
1.2	Typical Air Emission Sources	I
1.3	Inventory Methodology	1
1.4	Park Description	2
1.5	Air Quality Status	5
2.	STATIONARY AND AREA SOURCE EMISSIONS	6
2_1	Stationary Sources	6
2.l .I	Space and Water Heating Equipment	6
2.1.2	Generators	8
2.1.3	Fuel Storage Tanks	9
2.2	Area Sources	10
2.2.1	Woodstoves	10
2.2.2	Campfires	10
2.2.3	Wildland Fires and Prescribed Burning	11
2.2.4	Miscellaneous Area Sources	11
2.3	Summary of Stationary and Area Source Emissions	11
3.	MOBILE SOURCE EMISSIONS	13
3.1	Highway Vehicles	13
3.1.1	Visitor Vehicles	13
3.1.2	NPS Vehicles	16
3.2	Nonroad Vehicles	16
3.3	Summary of Mobile Source Emissions	16

CONTENTS (Continued)

Pave

4. THEODORE ROOSEVELT NP AND REGIONAL AIR EMISSIONS 18

4.1 Theodore Roosevelt NP Summary 18

4.2 Regional Air Emissions 18

5. COMPLIANCE AND RECOMMENDATIONS 20

5.1 Compliance 20

5.2 Recommendations 20

6. REFERENCES 22

APPENDIX A - FUEL DATA AND EMISSION FACTORS
APPENDIX B - EMISSION CALCULATIONS
APPENDIX C - PUBLIC USE DATA
APPENDIX D - SELECTED NORTH DAKOTA AIR QUALITY REGULATIONS

FIGURES

Number	Title	Page
1	Theodore Roosevelt National Park Location	3
2	Theodore Roosevelt NP North and South Units	4
3	Theodore Roosevelt National Park South Unit	
4	Theodore Roosevelt National Park North Unit	

TABLES

Number	Title	Page
1	Theodore Roosevelt National Park Developed Areas	3
2	2000 Actual Air Emissions from Theodore Roosevelt National Park Heating Equipment	7
3	2000 Potential Air Emissions from Theodore Roosevelt National Park Heating Equipment	8
4	2000 Actual and Potential Air Emissions from Theodore Roosevelt NP Generators	9
5	2000 Theodore Roosevelt NP Fuel Tank Emissions	10
6	Woodstove Air Emissions from Theodore Roosevelt NP	10
7	2000 Theodore Roosevelt NP Campfire Emissions	10
8	Wildfire Air Emissions from Theodore Roosevelt NP	11
9	Summary of 2000 Stationary and Area Source Emissions at Theodore Roosevelt NP	12
10	Theodore Roosevelt NP Annual Visitor Vehicle Summary	13
11	Theodore Roosevelt NP Visitor Vehicle Mix and Seasonal VMT	15
12	NPS Road Vehicles at Theodore Roosevelt NP	16
13	NPS Nonroad Vehicles at Theodore Roosevelt NP	16
14	Summary of 2000 Mobile Source Emissions at the Theodore Roosevelt NP	17
15	Estimated Annual Emissions from Theodore Roosevelt NP	18
16	Estimated Annual Emissions from Theodore Roosevelt NP, Surrounding Counties, and the State of North Dakota	19

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 Theodore Roosevelt 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 woodstoves, fireplaces, campfires, and prescribed burning and wild fires. Mobile sources may 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 Theodore Roosevelt NP 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 tools to calculate emissions. Computational tools included U.S. Environmental

[1] Russ Runge, Theodore Roosevelt National Park, Chief of Resource Management (701) 623-4466

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 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

The 70,448-acre Theodore Roosevelt NP is located in the badlands of western North Dakota and consists of three units located approximately 50 miles apart. The South Unit of the park is located in Billings County, the North Unit in McKenzie County approximately 50 miles north of the South Unit, and the undeveloped Elkhorn Ranch that is located in Billings County approximately equidistant between the South and North Units. Figure I is a map noting the locations of the three units relative to Bismarck, ND, and Figure 2 illustrates the features of the North and South Units.

The Theodore Roosevelt National Memorial Park was created in 1947 and included lands that roughly make up the South Unit and the Elkhorn Ranch site today. The North Unit was added to the memorial park in June 1948, and additional boundary revisions were made in later years. In 1978, the memorial park became the Theodore Roosevelt National Park. In April 2002, the Park Superintendent announced a proposal that would establish a Theodore Roosevelt National Preserve. The 5,150-acre property is on the east side of the Little Missouri River, adjacent to the park's Elkhorn Ranch Unit. Roosevelt grazed his cattle, hunted wildlife, and wrote profusely about his experiences on this land.

The South Unit is 130 miles west of Bismarck, ND and 24 miles east of the Montana state line. The entrance to this unit is located in Medora. The Medora Visitor Center, park headquarters, employee housing, and maintenance shops are located here. A major feature of the South Unit is a paved, 36-mile, scenic loop road with interpretive signs that explain some of the park's historical and natural features. Seven miles east of the Medora entrance is the Painted Canyon Overlook, which has a visitor center and rest stop that are open seasonally.

The North Unit is located near Watford City. The North Unit Visitor Center is at the park entrance, and a maintenance shop and employee housing are located nearby. This unit also has a

14-mile Scenic Drive that goes from the entrance station to the Oxbow Overlook, with turnouts and interpretive signs along the way. The Elkhorn Ranch Site, which was the location of Roosevelt's principal home in the badlands, is located 35 miles north of the Medora Visitor Center. The ranch buildings no longer exist but interpretive signs illustrate the locations of the house and outbuildings.

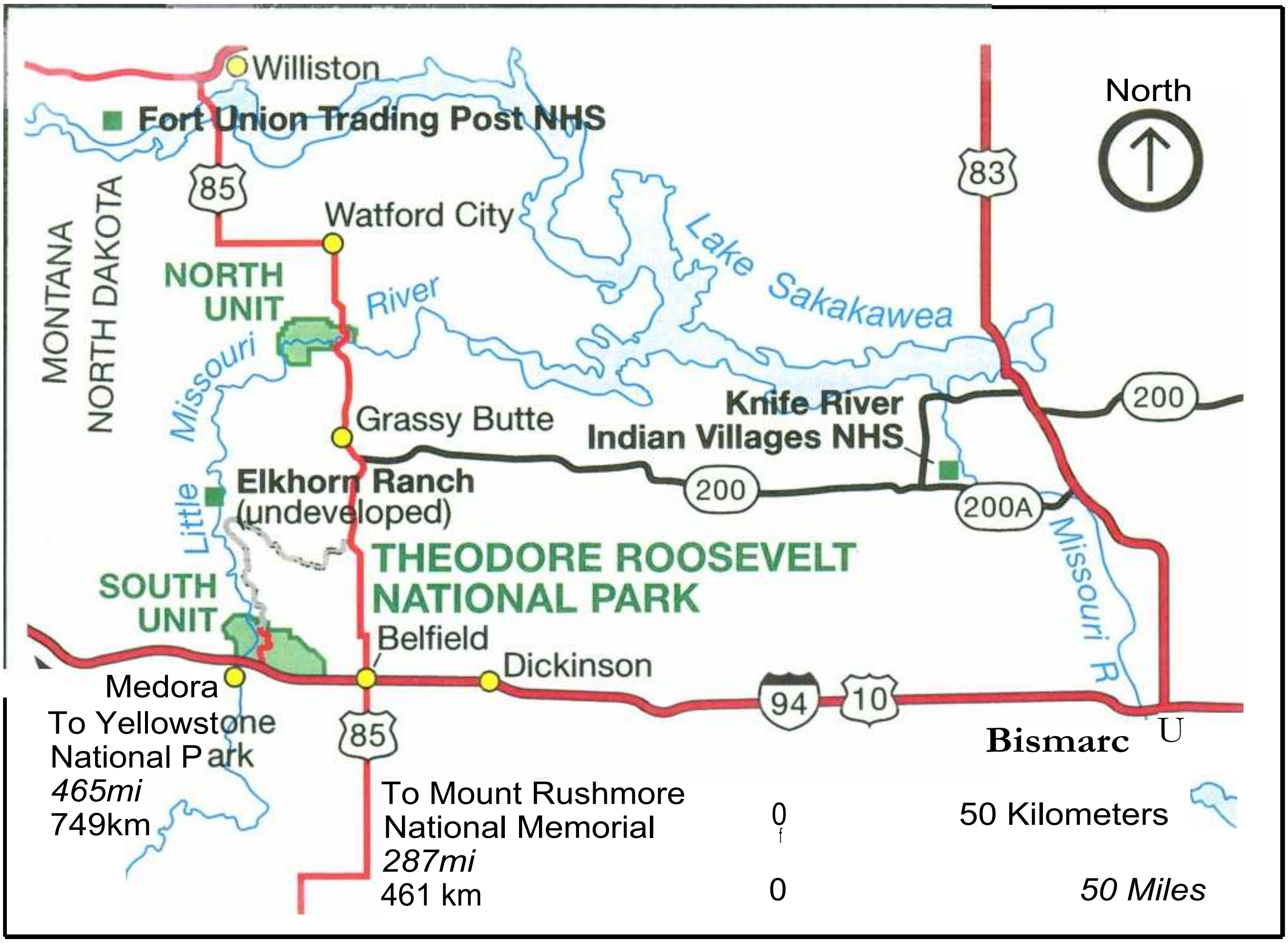

FIGURE 1. THEODORE ROOSEVELT NATIONAL PARK LOCATION

Figures 3 and 4 illustrate the developed areas, and Table 1 summarizes the facilities that are located at each developed area.

TABLE 1: THEODORE ROOSEVELT NATIONAL PARK DEVELOPED AREAS

Unit	Function/Facilities
South Unit	Medora Visitor Center, Maltese Cross Cabin, Park Headquarters, Employee Residences, Maintenance Shop, NPS Fueling Station, Seasonal Quarters, Cottonwood Camptender Residence, Painted Canyon Visitor Center
North Unit	Visitor Center, Maintenance Shop, NPS Fueling Station, , Employee Residences
Elkhorn Ranch	None

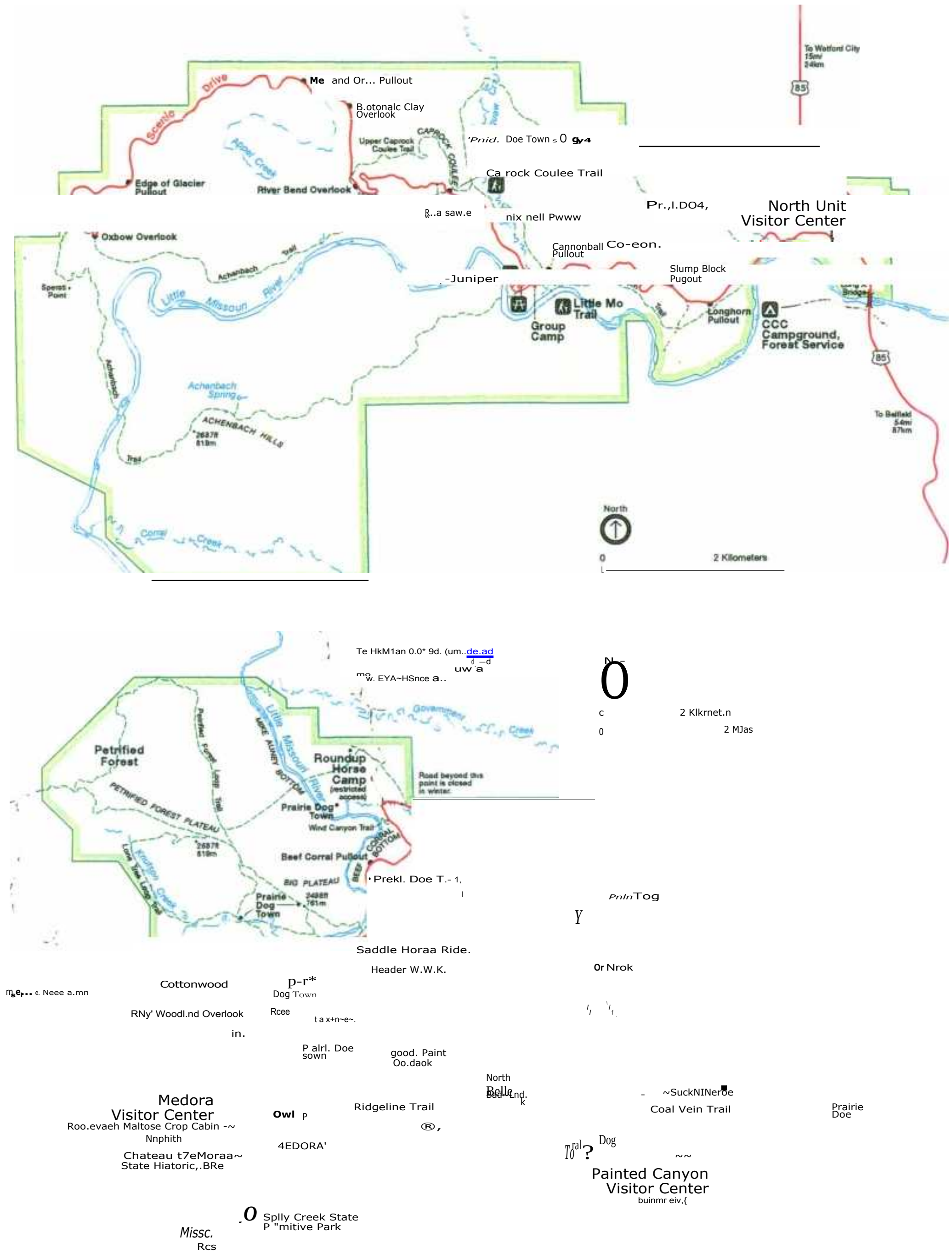

FIGURE 2. THEODORE ROOSEVELT NP NORTH AND SOUTH UNITS

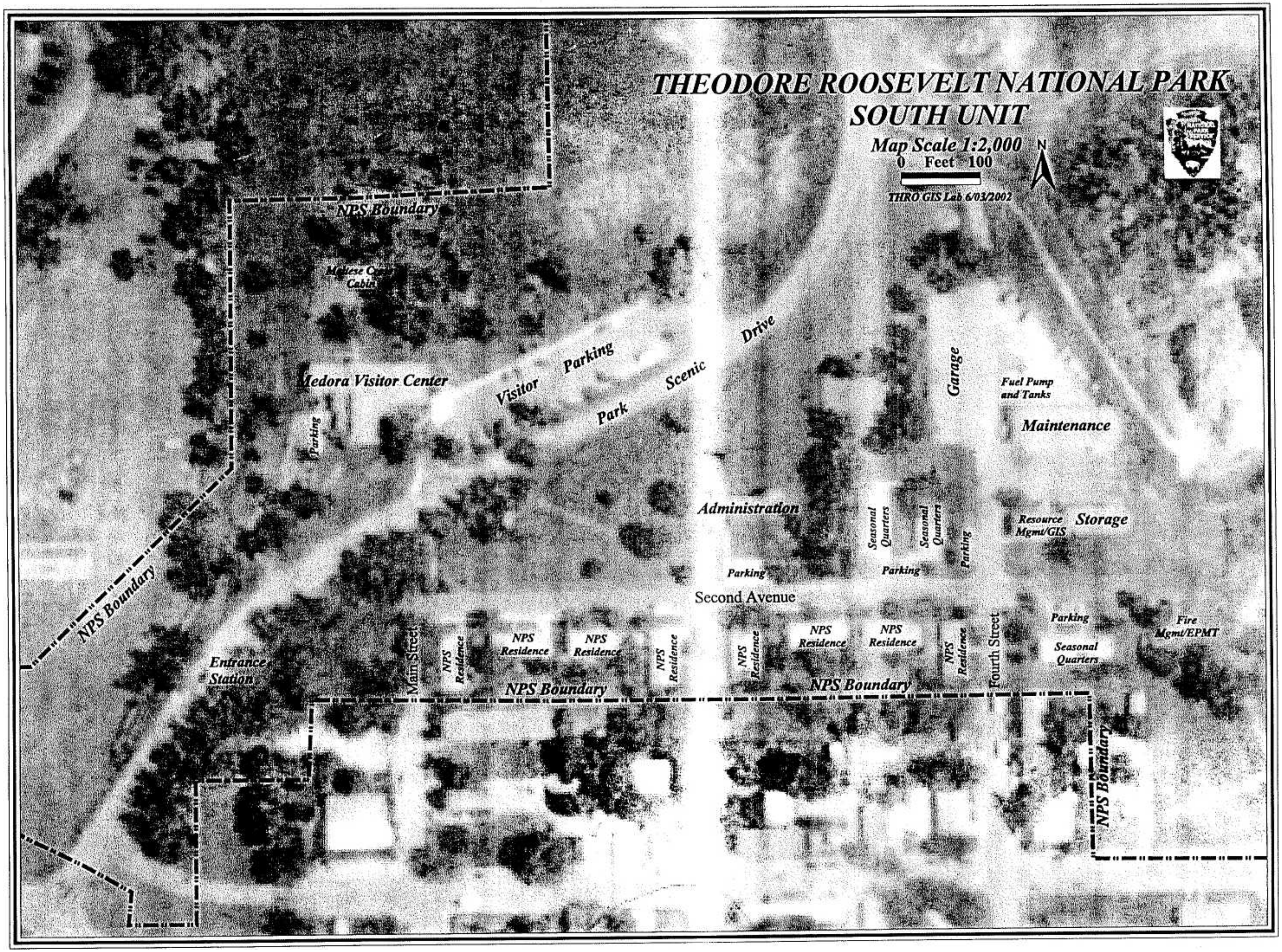
THEODORE ROOSEVELT NATIONAL PARK
SOUTH UNIT
Map Scale 1:2,000
0 Feet 100
N
THRO GIS Lab 6/03/2002
NPS Boundary
Medora Visitor Center
Parking
Visitor Parking
Park Scenic Drive
Garage
Fuel Pump
and Tanks
Maintenance
Administration
Seasonal Quarters
Seasonal Quarters
Parking
Resource Mgmt/GIS
Storage
Parking
Parking
Second Avenue
Main Street
NPS Residence
NPS Residence
NPS Residence
NPS Residence
NPS Residence
NPS Residence
NPS Residence
NPS Residence
Fourth Street
Parking
Seasonal Quarters
Fire
Mgmt/EPMT
Entrance
Station
NPS Boundary
NPS Boundary
NPS Boundary
NPS Boundary

FIGURE 3

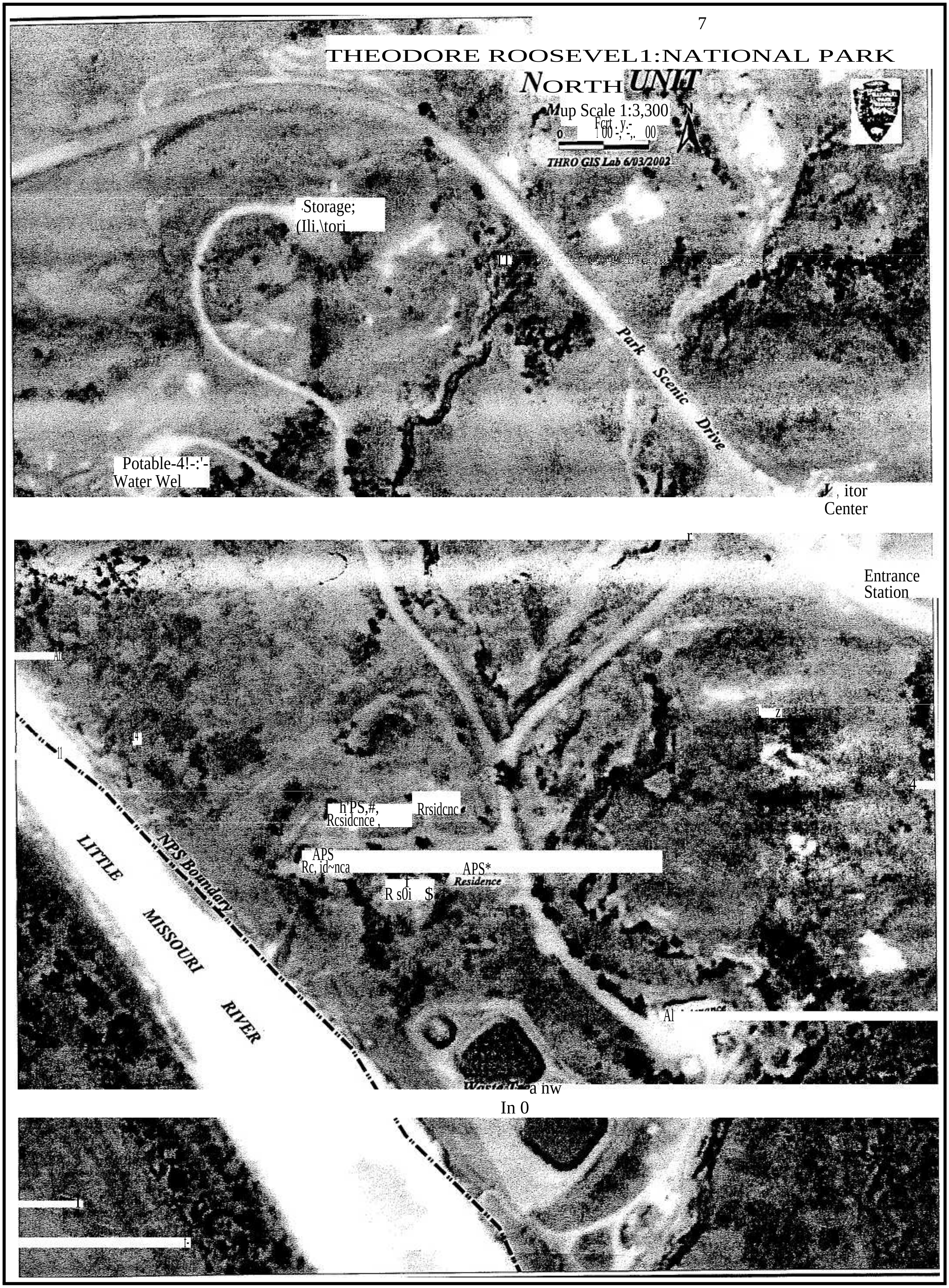
THEODORE ROOSEVELT NATIONAL PARK
NORTH UNIT
Map Scale 1:3,300
THRO GIS Lab 6/03/2002
Storage
Park Scenic Drive
Potable
Water Wel
Center
Entrance
Station
Residence
APS
Residence
NPS Boundary
LITTLE
MISSOURI
RIVER

FIGURE 4

1.5 AIR QUALITY STATUS

The North Dakota State Department of Health,' Division of Air Quality administers the state's air pollution program. The park units are located in Billings (South Unit and Elkhorn Ranch) and McKenzie Counties (North Unit) that are classified as attainment for all state and national ambient air quality standards. The park has an ambient air monitoring station adjacent to the Painted Canyon Visitor Center. It includes an IMPROVE sampler and North Dakota Department of Health ozone and sulfur dioxide samplers.

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 (PM_{IO}), 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 36 propane and one No. 2 fuel oil space and heating units in the Park. Criteria emissions were calculated using the appropriate residential emission factors for the fuel types. For example, NOx emissions from the propane furnace in the Medora Visitor Center was calculated as follows:

$$1{,}720 \text{ gallons/yr} \times \frac{14 \text{ lb PM}}{000 \text{ gallons}} \; 1= 24 \text{lbNOx/yr}$$

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

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

Location	No.	Fuel	Fuel Consumption	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	Co (lbs/yr)	CO_2 (lbs/yr)	VOC (Ibs/yr)
South Unit									
Medora Visitor Center	1	Propane	1,720	1	0	24	3	21,502	1
Painted Canyon Visitor Center	1	Propane	326	0	0	5	1	4,072	0
	2	Propane	869	0	0	12	2	10,859	0
Vehicle Maintenance	1	Propane	6,889	3	0	96	14	86,116	2
	1	Propane	669	0	0	9	1	8,362	0
Cottonwood Residence	1	Propane	369	0	0	5	1	4,615	0
Employee Housing	3	Propane	1,108	0	0	16	2	13,846	0
Employee Apartment	1	Prong	369	0	0			4,615	0
	3	Propane	261	0	0	4	1	3,258	0
Employee Apartment	1	Propane	369	0	0	5	1	4,615	0
	3	Propane	261	0	0	4	1	3,258	0
Employee Apartment	I	Propane	369	0	0	5	1	4,615	0
Employee Housing	1	No. 2 fuel oil	190	0	14	4	1	4,085	0
North Unit									
Maintenance Shop	1	Propane	469	0	0	7	1	5,864	0
	1	Prona~ne_	434	0	0	6	1	5,430	0
Visitor Center	1	Pro n	326	0	0	5		4,072	0
	1	Propa ne	295	0	0	4	1	*3,692*	*0*
Employee Housing	6	Propane	1,955	1	0	27	4	24,434	1
Employee Housing	1	Propane	391	0	0	5	1	4,887	o
Campground Housing	1	Propane	261	0	0	4	1	3,258	o
Employee Housing	5	Propane	434	0	0	6	1	5,430	0
			Total	7	14	257	35	230,885	6

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

Location	No.	Fuel	Fuel Consumption	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
South Unit									
Medora Visitor Center	I	Propane	37,912	15	0	531	72	473,902	11
Painted Canyon Visitor Center	1	Propane	7,180	3	0	101	14	89,754	2
	2	Propane	19,148	8	0	268	36	239,344	6
Vehicle Maintenance	1	Propane	151,840	61	1	2,126	288	1,898,000	46
	I	Propane	14,744	6	0	206	28	184,295	
Cottonwood Residence	1	Propane	8,138	3	0	114	15	101,721	2
Employee Housing	3	Propane	24,413	10	0	342	46	305,164	7
Employee Apartment	1	Propane	8,138	3	0	114	15	101,721	2
	3	Propane	5,744	2	0	80	11	71,803	2
Employee Apartment	1	Propane	8,138	3	0	114	15	101,721	2
	3	Propane	5,744	2	0	80	11	71,803	2
Employee Apartment	1	Propane	8,138	3	0	114	15	101,721	2
Employee Housing	1	No. 2 fuel oil	5,319	2	378	96	27	114,349	4
North Unit									
Maintenance Shop	1	Propane	10,340	4	0	145	20	129,246	3
	I	Propane	9,574	4	0	134	18	119,672	3
Visitor Center	1	Propane	7,180	3	0	101	14	89,754	2
	1	Propane	6,510	3	0	91	12	81,377	2
Employee Housing	6	Propane	43,082	17	0	603	82	538,525	13
Employee Housing	I	Propane	8,616	3	0	121	16	107,705	3
Campground Housing	1	Propane	5,744	2	0	80	11	71,803	2
Employee Housing	5	Propane	9,574	4		134	18	119,672	3
			Total	162	385	5,694	786	5,113,054	124

2.1.2 Generators

There is one stationary NPS-owned generator at the Maintenance Warehouse. 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.

$$55\ kW \times \frac{12\ hours}{year} \times \frac{1.34\ hp}{kW} \times \frac{0.00220\ lb\ PM}{hp\text{-}hr} = 2\ lb\ PM/yr$$

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.

TABLE **4. 2000** ACTUAL AND POTENTIAL AIR EMISSIONS FROM THEODORE ROOSEVELT NP GENERATORS

Location	**Rating (k)V)**	**Run Time (hrs/yr)**	**PM_{10}** (lbs/yr)	SO_2 (Ibs/yr)	NO_x **(lbs/yr)**	**CO** (lbs/yr)	CO_2 (Ibs/yr)	**VOC** (Ibs/yr)
Actual Emissions								
Ma ntenance Warehouse	55	12	2		27		,017	
Potential'**Emissions**								
Maintenance Warehouse	55	500	81	76	1,142	246	42,378	92

2.1.3 Fuel Storage Tanks

Theodore Roosevelt NP has a gasoline and diesel fuel aboveground storage tanks at both the South and North Units 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.

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 5: 2000 THEODORE ROOSEVELT NP FUEL TANK EMISSIONS

South Unit	Gasoline	AST	2,000	9,733	251
North Unit	Gasoline	AST	1,000	4,867	138
				Total	389

2.2 AREA SOURCES

2.2.1 Woodstoves

Six employee housing units are equipped with woodstoves, and park officials estimated that the average wood consumption was one cord a year. Emissions from these woodstoves are summarized in Table 6.

TABLE 6: WOODSTOVE AIR EMISSIONS FROM THEODORE ROOSEVELT NP

Location	Number	Fuel Consumption	PM (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Woodstoves							
Employee Residences	8	8 cords/yr	486		37	3,547	3,215

2.2.2 Campfires

There is one campground in the South Unit and one in the North Unit; however, campfires are not allowed. There is an additional camping area at the Roundup Horse Camp in the northern area of the South Unit that is occupied daily for approximately six months. Assuming that each campfire site consumes approximately 15 lbs of wood, air emissions from campsites in 2000 were calculated and are summarized in Table 7.

TABLE 7: 2000 THEODORE ROOSEVELT NP CAMPFIRE EMISSIONS

Location	Campfires	Fuel (tons/ r	PM_{10} (lbs/ r)	SO_Z (lbs/ r)	NO, (lbs/ r)	CO (lbs/ r)	VOC (lbs/ r)
Roundup Horse Camp	180	1.35	47			341	309

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 burnings for ecological restoration are considered as anthropogenic emissions.

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, C02, and CH4 which are summarized in Table 8.

TABLE 8: WILDFIRE AIR EMISSIONS FROM THEODORE ROOSEVELT NP

Type	Acres	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)	**CO** (tons/yr)	CO_2 (tons/yr)	**VOC'** (tons/yr)
Wildland Fires	750	2,250	2,250	5,250	1,512,750	750
Prescribed Burns	1,500	4,500	4,500	10,500	3,025,500	1,500
Total	2,250	6,750	6,750	15,750	4,538,250	2,250

[1] 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 9 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 9: SUMMARY OF 2000 STATIONARY AND AREA SOURCE EMISSIONS AT THEODORE ROOSEVELT 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 Equiament		<0.01	14	0.01	257	0.13	35	0.02	230,885	115.44		<0.01
Generator	2	<0.01		<0.01	27	0.01	6	<0.01	1,017	0.51	2	<0.01
Gasoline Storage Tanks	--	--	--	--		--	--	--	--	--	389	0.20
Stationary Sources Subtotal	9	<0.01		0.01	284	0.14	41	0.02	231,900	116	397	0.20
Area Sources												
Woodstoves	486	0.24		<0.01	37	0.02	3,547	1.77	--	--	3,215	1.61
Campfires	47	0.02	1	<0.01	4	<0.01	341	0.17	--	--	309	0.16
Wildfires and Prescribed Fires	6,750	3.38	--	--	--		15,750	7.88	4,538,250	2,269	2,250	1.13
Area Sources Total	7,283	3.64	7	<0.01	41	0.02	19,638	9.82	4,538,250	2,269	5,774	2.89
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 and Wild Fires	542	0.27	21	0.01	325	0.16	3,930	1.96	231,900	116	3,921	1.96
Totals with Prescribed and Wildfires	7,292	3.65	21	0.01	325	0.16	19,680	9.84	4,770,150	2,385	6,171	3.09

[1] As methane

3. MOBILE SOURCE EMISSIONS

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

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

As auto touring is one of the principal activities enjoyed by visitors to Theodore Roosevelt NP, mobile source emissions are of particular interest in assessing park emissions. The South Unit has a 36-mile scenic loop road with interpretive signs that explain some of the park's historical and natural phenomena. The North Unit has a 14-mile scenic drive that goes from the entrance station on the east to Oxbow Overlook in the northwest comer of the park.

The number of visitor vehicles operating in NPS units is often correlated to the number of annual visitors to the park unit, and estimated visitors to Theodore Roosevelt NP in 2000 were estimated to be 438,391. However, approximately 65 percent of the recorded visits were to the Painted Canyon Overlook and Visitor Center, and this destination point is only several hundred yards north of Interstate 94 in the South Unit. Table 10 summarizes the approximate number of vehicles entering the park's North and South Units and estimated roundtrip distances traveled by these vehicles. An approximate 4-mile segment of Interstate 94 transverses the southwest corner of the South Unit; however, these vehicles were not considered in estimating park mobile source emissions since they are through-traffic only.

TABLE 10: THEODORE ROOSEVELT NP ANNUAL VISITOR VEHICLE SUMMARY

Entry Point	**Visitation**	No. **Vehicles**[1]	**Miles/Vehicle**[2]	**Vehicle Miles Traveled**	
				Summer	**Winter**
Medora South Unit	109,134	39,169	36	1,338,866	71,203
North Unit	46,430	16,582	14	570,857	26,126
Total	1 55,564	55,751		1,909,723	97,329

[1] Assumes 2.8 visitors per vehicle
[2] Scenic Loop Drive distances

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 PM_{10}. 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 MOBILE6.2 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 PM_{10} 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 (I/M) 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. Using the VMT data noted earlier in Table 10, the VMT by vehicle class for summer and winter travel also are provided in Table 11.

TABLE 11: THEODORE ROOSEVELT NP VISITOR VEHICLE MIX AND SEASONAL VMT

Vehicle Type	Vehicle Distribution	South Unit		North Unit	
		Summer VMT	**Winter VMT**	**Summer VMT**	**Winter VMT**
LDGV (<6000 GVW)	0.742	993,438	52,833	423,576	19,385
LDGTI (<6000 GVW)	0.156	208,863	11,108	89,054	4,076
LDGT2 (6000-8500 GVW)	0.002	2,678	42	1,142	52
HDGV (>6000 GVW)	0.044	58,910	3,133	25,118	1,150
LDDV (<6000 GVW)	0.000	0	0	0	0
LDDT (<8500 GVW)	0.003	4,017	214	1,713	78
HDDT (>8501 GVW)	0.009	2,050	641	5,138	235
Motorcycles	0.044	58,910	3,133	25,118	1,150
Total	1.000	1,338,866	71,203	570,857	26,126

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 I/M program parameters. The average speed input to the mobile models was assumed to be 35 mph. The fuel volatility was assumed to be RVP 9, and reformulated gasoline was not assumed to be present. Finally, inspection/maintenance (I/M) program inputs were not included since there are no I/M programs in North 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 on paved roads in Theodore Roosevelt NP also were calculated based on VMT. A summary of visitor vehicle emissions is provided in Table 14.

3.1.2 NPS Vehicles

Theodore Roosevelt 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 12, and emissions are provided in Table 14.

TABLE 12: NPS ROAD VEHICLES AT THEODORE ROOSEVELT NP

Vehicle Type	**Number**	**Annual** Usage **(mi/yr)**
Light-Duty Gasoline Vehicles/Trucks	51	316,382
Heavy Duty Diesel Trucks	6	11,272
Total	57	327,654

3.2 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 Theodore Roosevelt NP equipment inventory, and the larger pieces of equipment are noted in Table 13. Since there are no data regarding its usage, default values for emission factors and annual usage were derived from the USEPA Nonroad emission database (EPA, 1991) and used to calculate annual emissions that are summarized in table 14.

TABLE 13: NPS NONROAD VEHICLES AT THEODORE ROOSEVELT NP

Vehicle Type	**Number**	**Annual Usage (hrs/yr each)**
Mowers	4	75
Backhoe	1	660
Front End Loader	2	630
Grader	2	100
Tractor	5	50
ATVs	5	75
Total	19	

[1] Estimated

3.3 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 14 summarizes the mobile source emissions for road and nonroad vehicles and equipment operating in Theodore Roosevelt NP in 2000.

TABLE 14: SUMMARY OF 2000 MOBILE SOURCE EMISSIONS AT THEODORE ROOSEVELT 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	3,859	1.93			5,612	2.81	83,533	41.77	4,151	2.08
NPS Road Vehicles	628'	0.31			843	0.42	14,557	7.28	598	0.30
Vehicle Emission Subtotal	4,487'	2.24,			6,455	3.23	98,090	49.05	4,749	2.37
Nonroad Vehicles										
NPS Nonroad Vehicles	297	0.15			1,197	0.60	685	0.34	1,4 0	0.71
Totals										

Totals	Particulates'		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/ r	tons/	lbs/	tons/ r	lbs/	tons/ r	lbs/ r	tons/ r	lbs/	tons/ r
	4,784	2.39			7,652	3.83	98,775	49.39	6,169	3.08

' Includes exhaust, brake, and tire PM19 and road dust

4. THEODORE ROOSEVELT NP AND REGIONAL AIR EMISSIONS

4.1 THEODORE ROOSEVELT NP SUMMARY

A summary of Theodore Roosevelt NP emissions is provided in Table 15.

TABLE 15: ESTIMATED ANNUAL EMISSIONS FROM THEODORE ROOSEVELT NP

Source	**PM_{10} (tons)**	**SO_2 (tons)**	NO_x **(tons)**	**CO (tons)**	**VOCs (tons)**
Point Sources					
Heating Equipment	<0.01	0.01	0.13	0.02	<0.01
Generators	<0.01	<0.01	0.01	<0.01	<0.01
Gasoline Storage Tanks		--	--	--	0.20
Subtotal	<0.01	0.01	0.14	0.02	0.20
Area Sources					
Woodstoves	0.24	<0.01	0.02	1.77	1.61
Campfires	0.02	<0.01	<0.01	0.17	0.16
Prescribed Burning	3.38	--	--	7.88	1.13'
Subtotal	3.64	<0.01	0.02	9.82	2.9
Mobile Sources					
Road Vehicles	2.38	--	11.23	46.62	2.48
Nonroad Vehicles	0.15	--	0.60	0.34	0.71
Subtotal	2.53	--	11.83	46.96	3.19
Totals					
Totals	6.17 1	0.01	11.99	56.80	6.29

' As methane

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Billings and McKenzie Counties and the state of North Dakota were obtained from the 1999 National Emission Inventory (NEI) maintained by USEPA. 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 NOx and SO_2 emissions generated by point sources in Billings and McKenzie Counties are attributable to industrial fuel burning and petroleum and related industries. Table 16 provides a comparison of the Park emissions with those from the surrounding counties and the State of North Dakota.

TABLE 16: ESTIMATED ANNUAL EMISSIONS FROM THEODORE ROOSEVELT NP, SURROUNDING COUNTIES, AND THE STATE OF NORTH DAKOTA

Area	**PM"** (tons/yr)	SO_2 (tons/yr)	NO_x (tons/yr)	**CO** (tons/yr)	**VOC** (tons/yr)
Point Sources					
Theodore Roosevelt NP Totals	<0.01	0.01	0.13	0.02	<0.01
Billings County	2	368	96	127	4
McKenzie County	12	558	950	408	32
Surrounding County Totals	15	925	1,046	527	36
North Dakota Totals	4,976	252,900	87,167	10,762	1,047
Area Sources					
Theodore Roosevelt NP Totals	3.64	<0.01	0.02	9.82	2.9
Billings County	5	14	5	34	92
McKenzie County	5,159	265	93	166	658
Surrounding County Totals	5,164	279	98	200	750
North Dakota Totals	309,571	54,195	19,175	71,569	64,660
Mobile' Sources					
Theodore Roosevelt NP Totals	2.53	--	11.83	46.96	3.19
Billings County	22	42	525	1,464	149
McKenzie County	1,910	187	1,537	4,134	804
Surrounding County Totals	1,932	*229*	*2,062*	5,598	953
North Dakota Totals	93,709	12,905	109,324	278,028	35,200

5. COMPLIANCE AND RECOMMENDATIONS

This section discusses air emission related issues relating to the park and associated recommendations that may be considered to mitigate those issues.

5.1 COMPLIANCE

The South Unit and Elkhorn Ranch are located in Billings County, ND, and the North Unit is in McKenzie County. Both counties are in attainment for all national and state ambient air quality standards (AAQS). The North Dakota Department of Health, Division of Air Quality 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. According to Chapter 33-15-04 of the state's air quality regulations, which are provided in Appendix D, open burning, under certain conditions, is allowed for:

- Campfires and other fires used solely for recreational purposes, ceremonial occasions, or for outdoor preparation of food
- Fires purposely set to forest or rangelands for a specific reason in the management of forest, rangeland, or game
- Firefighting training

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 has undertaken a number of energy conservation and substitution initiatives. These include:

- photovoltaic systems at the Roundup Horse Complex for water pumping and battery charging
- solar space heating system with rock storage at the Administration Building
- solar-powered street and parking lights at the Painted Canyon Visitor Center

The few woodstoves in employee residences are estimated to be the largest non-mobile sources of emissions in the park. If these are replaced, they should be replaced with units that meet the USEPA New Source Performance Standards for residential woodstoves. The park has phased out its No. 2 fuel oil heaters and has only one remaining unit that is planned for replacement with a cleaner burning propane heater.

The principal air emission sources in the vicinity of the Park are numerous active and inactive oil and gas wells. These wells surround all three Park units and utilize diesel generators to produce on-site electricity and flares to combust excess gas. Although each well does not constitute a significant air emission sources collectively, they can impact the Park's air quality resources. Park officials are well aware of these developments and are monitoring their activation status as the economics of petroleum and gas production improves.

6. REFERENCES

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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(b)	NO_X[1`)]	CO	VOC[Id)]
Residential Furnace[(e)]	0.4	142S	18	5	0.713
Boilers < 100 Million Btu/hr (Commercial/Institutional Combust.'[0])	2	142S	20	5	0.34
Boilers < 100 Million Btu/hr (Industrial Boilers[(`)])	2	142S	20	5	0.2
Boilers > 100 Million Btu/hr (Utility Boilers[(")])	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)				
	PM[0)]	SO,	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)[(kl]	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.

PROPANE (LPG) - CRITERIA POLLUTANTS					
Combustor Type	Emission Factor (lb/1,000			al fuel burned)	
	PM[a]	SO_2[b]	NO_X[c]	CO	VOC[d]
Commercial Boilers[f]	0.4	0.105	14	1.9	0.3
Industrial Boilers[g]	0.6	0.10S	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_X	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[a]	SO_X	NO,[c]	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)				
	PMO)	SO,,	NO_X (°)	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 2300,000 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

2000 ACTUAL CRITERIA EMISSIONS FROM GENERATORS AT THEODORE ROOSEVELT NATIONAL PARK

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM , 0 (lbs/yr)	SO, (lbs/yr)	NO, (lbs/yr)	CO (lbs/yr)	CO, (Ibs/yr)	VOC (Ibs/yr)
Generator	Maintenance Warehouse	Diesel	1	55	12	660	2	2	27	6	1,017	2

Emission Factors from AP-42, Chapter 3.4-1 for generators rated less than 448 kW		2.20E-03	0.00205	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 THEODORE ROOSEVELT 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, (lbs/yr)	CO (lbs/yr)	CO, (Ibs/yr)	VOC (lbs/yr)
Generator	Maintenance Warehouse	Diesel	1	55	500	27,500	81	76	1,142	246	42,378	92

Emission Factors from AP-42, Chapter 3.4-1 for generators rated less than 448 kW		2.20E-03	0.00205	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 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT THEODORE ROOSEVELT NATIONAL PARK

Building Nuntbe	Emission Source	Location	Fuel	Numb rof Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM" (Ibs,/yr)	SO, (lbs/yr)	NO (Ibs/yr)	CO (Ibs/yr)	CO, (Ibs/yr)	VOC (lbs/yr)
					South Unit								
115	Furnace	Medom Visi or Center	Propane		396.000	396,000	1,720			24		21,502	
147	Furnace	Painted Canyon Visitor Center	Propane	1	75,000	75,000	326	0	O	5	1	4,072	0
	Furnace		Propane	2	100,000	200,000	869	0	O	12	2	10,859	0
121	Furnace	Vehicle Maintenance	Propane	1	1,586.000	1,586,000	6,889	3	O	96	13	86,116	2
	Water Heater		Propane	1	154,000	154,000	669	0	O	9	1	8,362	0
135	Furnace	Cottonwood Residence	Propane	1	85,000	85,000	369	0	O	5	1	4,615	0
101-112	Furnace	Employee Housing	Propane	3	85,000	255,000	1,108	0	O	16	2	13.846	0
118	Furnace	Employee Apartment	Propane	1	85,000	85,000	369	0	O	5	1	4,615	0
	Space Heaters		Propane	3	20,000	60,000	261	0	0	4	0	3,258	0
129	Furnace	Employee Apartment	Propane	I	85,000	85,000	369	0	O	5	1	4,615	0
	Space Heaters		Propane	3	20,000	60,000	261	0	O	4	0	3,258	0
119	Furnace	Employee Apartment	Propane	1	85,000	85.000	369					4,615	
					N(Unit								
	Space Hen er	Maintenance Shop	Propane	I	108,000	108,000	469					5,864	
	Space Heater		Propane	1	100,000	100,000	434	0	0	6	1	5,430	0
	Space Heater	Visitor Center	Propane	1	75,000	75,000	326	0	0	5	1	4,072	0
	Space Heater		Propane	1	68,000	68,000	295	0	0	4	1	3,692	0
	Space Heater	Employee Housing	Propane	6	75,000	450,000	1,955	1	0	27	4	24,434	1
	Space Heater	Employee Housing	Propane	1	90,000	90,000	391	0	0	5	1	4,887	0
	Space Heater	Campground Housing	Propane	1	60,000	60,000	261	0	0	4	0	3,258	0
	Water Heater	Employee Housing	Propane	5	20,000	100,000	434	0	0	6		5,430	0
			Subtotal	36		177,000	18,144	7	0	254	34	226,800	5
	Furnace	Employee Housing	No 2 Fuel Oil	1	85 000	85 000	190	0	13	3	1	4,085	0
			To als	37					14	257	35	230,885	

	Emission Factors (Ibs/1,000 gal)					
Emission Factors from AP-42, Tables 1.5-1 for commercial boilers, S = 0.18 grains/100 cult	0.4	0.1 *S	14	1.9	12,500	0.3
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	5	21,500	0.713

2000 POTENTIAL CRITERIA EMISSIONS FROM HEATING UNITS AT **THEODORE ROOSEVELT** NATIONAL PARK

Building Number	Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM'' (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
					South unit'								
115	Furnace	Mcdora Visitor Center	Propane	1	396,000	396,000	37,912	15	1	531	72	473,902	11
147	Furnace	Painted Canyon Visitor C	Propane	1	75,000	75,000	7,180	3	0	101	14	89,754	2
	Furnace		Propane	2	100,000	200,000	19,148	8	0	268	36	239,344	6
121	Furnace	Vehicle Maintenance	Propane	1	1,586,000	1,586,000	151,840	61	3	2,126	288	1,898,000	46
	Water Heater		Propane	1	154,000	154,000	14,744	6	0	206	28	184,295	4
135	Furnace	Cottonwood Residence	Propane	1	85,000	85,000	8,138	3	0	114	15	101,721	2
101-112	Furnace	Employee Housing	Propane	3	85,000	255,000	24,413	10	0	342	46	305,164	7
118	Furnace	Employee Apartment	Propane	1	85,000	85,000	8,138	3	0	114	15	101,721	2
	Space Heaters		Propane	3	20,000	60,000	5,744	2	0	80	11	71,803	2
129	Furnace	Employee Apartment	Propane	1	85,000	85,000	8,138	3	0	114	15	101,721	2
	Space Heaters		Propane	3	20,000	60,000	5,744	2	0	80	11	71,803	2
119	Furnace	Employee Apartment	Propane	1	85,000	85,000	8,138	3	0	114	15	101.721	2
					North Unit								
	Space Heater	Maintenance Shop	Propane	1	108,000	108,000	10,340	4	0	145	20	129,246	3
	Space Heater		Propane	1	100,000	100,000	9,574	4	0	134	18	119,672	3
	Space Heater	Visitor Center	Propane	1	75,000	75,000	7,180	3	0	101	14	89,754	2
	Space Heater		Propane	1	68,000	68,000	6,510	3	0	91	12	81,377	2
	Space Heater	Employee Housing	Propane	6	75,000	450,000	43,082	17	1	603	82	538,525	13
	Space Heater	Employee Housing	Propane	1	90,000	90,000	8,616	3	0	121	16	107,705	3
	Space Heater	Campground Housing	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
	Water Heater	Employee Housing	Propane	5	20,000	100,000	9,574	4		134	18	119,672	3
			Subtotal	36		4,177,000	399,896	160	7	5,599	760	4,998,705	120
	Furnace	Employee Housing	No. 2 Fuel Oil		85,000	85,000	5,319	2	378	96	27	114,349	4
			Totals	37				162	385	5,694	786	5,113,054	124

	Emission Factors (lbs/1,000 gal)					
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	1.9	12,500	0.3
Emission Factors from AP-42, Tables 1.3-I and 1.3-3 for residential furnaces (<300,000 Btu/hr) S = 0.5 percent	0.4	142S	18	5	21,500	0.713

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

Identification

User Identification:	THRO South
City:	Bismarck
State:	North Dakota
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	White AST

Tank Dimensions

Shell Length (ft):	12.00
Diameter (ft):	5.25
Volume (gallons):	2,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	9,733.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good

Breather Vent Settings

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

Meteorological Data used in Emissions Calculations: Bismarck, North Dakota (Avg Atmospheric Pressure = 13.86 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	43.32	37.42	49.22	41.62	3.2849	2.8975	3.7133	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)	51.00	200.11	251.11

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

Identification

User Identification:	THRO North
City:	Bismarck
State:	North Dakota
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	White AST

Tank Dimensions

Shell Length (ft):	10.75
Diameter (ft):	4.00
Volume (gallons):	1,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	4,867.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good

Breather Vent Settings

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

Meteorological Data used in Emissions Calculations: Bismarck, North Dakota (Avg Atmospheric Pressure = 13.86 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 Mot, Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mot. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 9)	All	43.32	37.42	49.22	41.62	3.2849	2.8975	3.7133	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	Brea hing Loss	Total Emissions
Gasoline (RVP 9)	25.50	112.46	137.96

2000 ACTUAL EMISSIONS FROM WOODSTOVES AT THEODORE ROOSEVELT NATIONAL PARK

Woodstoves

Location	Number	Cords	tons/yr	PM (lbs/yr)	S02 (lbs/yr)	NOx (lbs/yr)	Co (lbs/yr)	VOC (lbs/yr)
Emplyee Residences	8	1	14.04	486	6	37	3,547	3,215
				(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
				0.24	0.00	0.02	1.77	1.61

2000 ACTUAL EMISSIONS FROM CAMPFIRES AT THEODORE ROOSEVELT NATIONAL PARK

Location	Camps	Fires/Yr	Tons/Yr	PM (lbs/yr)	SO, (lbs/yr)	NO, (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Roundup Horse Camp	1	180	1.35	47	1	4	341	309
	1	180	1	47	1	4	341	309
				0.02	0.00	0.00	0.17	0.15

TITLE: Results of FOFEM model execution on date: 6/13/2002

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 611 - Blue Grama - Buffalograss
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 (%)	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	15.0
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	15.0
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	15.0
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	75.0
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 (%)	.0	31.0	31.0	31.0	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	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 WILDFIRE EMISSIONS AT THEODORE ROOSEVELT NATIONAL PARK

Fire Type	Acres	PM 10 (Ibs/yr)	PM2.5 (lbs/yr)	CH4 (Ibs/yr)	Co (Ibs/yr)	CO_2 (lbs/yr)	PM 10 (tons/yr)	PM2.5 (tons/yr)	CH4 (tons/yr)	CO (tons/yr)	CO_2 (Ibs/yr)
Wildland	750	2,250	2,250	750	5,250	1,512,750	1.13	1.13	0.38	2.63	756.38
Prescribed	1,500	4,500	4,500	1,500	10,500	3,025,500	2.25	2.25	0.75	5.25	1,512.75
Totals	2,250	6,750	6,750	2,250	15,750	4,538,250	3.38	3.38	1.13	7.88	2,269.13
Emission Factors (lbs/acre)		3	3	1	7	2,017					

```
***************************************************************************
• MOBILE6.2 Draft (21-Mar-2002)                                           *
• Input file: PARKS.IN (file 1, run 1).                                   *
***************************************************************************
  M601 Comment:
              User has enabled STAGE II REFUELING.


• Reading Registration Distributions from the following external
• data file: REGDATA.D
  M615 Comment:
              User supplied VMT mix.

• # # # # # # # # # # # # # # # # # # # # # # # # #
• Theodore Roosevelt NP Winter Conditions.
• File 1, Run 1, Scenario 1.
• # # # # # # # # # # # # # # # # # # # # # # # # #
  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

- Reading Ammonia (NH3) Basic Emissiion Rates
- from the external data file PMNH3BER.D

- Reading Ammonia (NH3) Sulfur Deterioration Rates
- from the external data file PMNH3SDR.D

Calendar Year: 2001
Month: Jan.
Altitude: High
Minimum Temperature: 1.2 (F)
Maximum Temperature: 26.9 (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:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.943	1.323	1.183	1.263	1.026	0.433	0.439	0.509	2.72	1.063
Composite CO	23.61	31.18	27.85	29.76	30.16	1.308	0.931	6.582	29.57	24.965
Composite NOX :	0.944	1.382	1.610	1.479	4.009	1.267	1.212	16.834	1.33	1.392

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 :	1.238	1.349	1.150	1.256	2.424	0.391
Composite CO	30.40	31.42	27.71	28.15	6.522	0.795
Composite NOX :	1.088	1.472	1.453	1.955	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 :	1.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	30.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	4.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDVS	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

- #
- Theodore Roosevelt NP Summer Conditions.
- File 1, Run 1, Scenario 2.
- #

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:	54.4 (F)
Maximum Temperature:	87.1 (F)
Absolute Humidity:	75. grains/lb
Nominal Fuel RVP:	8.3 psi
Weathered RVP:	8.1 psi
Fuel Sulfur Content:	299. ppm
Exhaust I/M Program:	No
Evap I/M Program:	No
ATP Program:	No
Reformulated Gas:	No

Vehicle Type: GVWR:	LDGV	LDGT12 <6000	LDGT34 >6000	LDGT (All)	HDGV	LDDV	LDDT	HDDV	MC	All Veh
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 :	0.711	0.872	0.867	0.870	0.814	0.405	0.461	0.490	3.24	0.817
Composite CO	11.94	14.78	14.42	14.63	22.01	1.277	0.945	6.500	24.03	12.871
Composite NOX :	0.746	1.018	1.289	1.133	3.624	1.170	1.239	16.586	0.94	1.150

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 :	0.832	0.885	0.849	0.907	2.512	0.418
Composite CO	14.39	14.90	14.33	14.61	6.775	0.824
Composite NOX :	0.807	1.082	1.161	1.571	2.574	1.212

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 :	0.814	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	22.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.624	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDVS	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

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******************************************************************************
* MOBILE6.2 Draft (21-Mar-2002)
* Input file:  PARKS.IN (file 1, run 1).
******************************************************************************
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* # # # # # # # # # # # # # # # # # # # # # # # # # # 
* Theodore Roosevelt NP Winter Conditions.
* File 1, Run 1,  Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # 
```

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
SO4:	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
SO2:	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:								
OCARBON:								
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

- #
- Theodore Roosevelt NP Summer Conditions.
- File 1, Run 1, Scenario 2
- #

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		
GAS PM:	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	0.0000
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:	------	------	------	------	------	------	------	------
GASPM:	------	------	------	------	------	------	------	------
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

THEODORE ROOSEVELT NATIONAL PARK VISITOR VEHICLE EMISSIONS

Paved Road
Annual VMT
2,007,052

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	1.150	12.871	0.817	0.0338	0.84	0.8738
Winter	1.392	24.965	1.063	0.0341	0.84	0.8741
Average	1.271	18.918	0.940			0.874

Emissions (tons/yr) -All Vehicles

NO_X	CO	VOC	Paved PM_{10}
2.81	41.77	2.08	1.93

Emissions (lbs/yr) - All Vehicles

NO_X	CO	VOC	Paved PM_{10}
5,612	83,533	4,151	3,859

THEODORE ROOSEVELT NATIONAL PARK NPS AND GSA VEHICLES

	LDGV/LDGT	HDGV	HDDV	Total
Total Miles	316,382	11,272		327,654

Emission Factors **(g/mi) - LDGV**

					PM10		
		NO,	**CO**	**VOC**	**Exhaust, Brake, and Tire**	**Fugitive**	**Total**
Summer	**LDGV**	0.7460	11.9400	0.7110	0.0276		
	LDGT	1.1330	14.6300	0.8700	0.0299		
	Avg	0.9395	13.2850	0.7905	0.0288	0.8400	0.8688
Winter	**LDGV**	0.9440	23.6100	0.9430	0.0276		
	LDGT	1.4790	29.7600	1.2630	0.0300		
	Avg	1.2115	26.6850	1.1030	0.0288	0.8400	0.8688
Average		1.0755	19.9850	0.8270			0.8688

Emissions (tons/yr) - **LDGV**

NO_x	**CO**	**VOC**	PM1p
0.37	6.96	0.29	0.30

Emissions (lbs/yr) - **LDGV**

NO_x	**CO**	**VOC**	PM1p
749	13,910	576	605

Emission Factors (g/mi) - HDGV

				PM10		
	NO_x	**CO**	**VOC**	**Exhaust, Brake, and Tire**	**Fugitive**	**Total**
Summer	3.624	22.010	0.814	0.085	0.840	0.925
Winter	4.009	30.160	1.026	0.085	0.840	0.925
Average	3.817	26.085	0.920			0.925

Emissions (tons/yr) - HDGV

NO_x	CO	VOC	PM1p
0.05	0.32	0.01	0.01

Emissions (lbs/yr) - **HDGV**

NO_x	**CO**	**VOC**	PM10
95	647	23	23

Emissions (tons/yr) - Total

NO_x	**CO**	**VOC**	PM1p
0.42	7.28	0.30	0.31

Emissions (lbs/yr) - Total

NO_x	**CO**	**VOC**	PM10
843	14,557	598	628

2000 THEODORE ROOSEVELT NP NONROAD VEHICLE EMISSIONS

		Emission Factors (gm/hp-hr)							Emissions (lbs/yr)			
Vehicle	No.	PM	**Nox**	CO	VOC	hp	load	hrs/yr	PM	Nox	CO	VOC
Utility Cart	5	2.04	1.03	2.31	2.19	20	0.55	75	18.5	9.3	21.0	19.9
Tractors	5	2.04	1.03	2.31	2.19	42.35	0.68	50	32.3	16.3	36.6	34.7
										0.0	0.0	
Backhoe	1	2.04	1.03	2.31	2.19	77	0.55	660	125.4	63.3	142.0	134.7
Riding Mower	4	1.11	10.3	4.8	1.3	20	0.55	60	6.4	59.8	27.9	7.6
Brush Mower	0	1.11	10.3	4.8	1.3	15	0.55	40	0.0	0.0	0.0	0.0
Bobcat	0	2.04	1.03	2.31	2.19	15	0.55	300	0.0	0.0	0.0	0.0
Dozer	0	2.04	1.03	2.31	2.19	77	0.55	300	0.0	0.0	0.0	0.0
Grader	2	1.06	9.6	3.8	1.43	172	0.61	100	48.9	443.2	175.4	66.0
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	5	0.55	400	0.0	0.0	0.0	0.0
Sweeper	0	1.7	14	6.06	1.46	30	0.68	120	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	0	2.04	1.03	2.31	2.19	30	0.55	17	0.0	0.0	0.0	1
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)	297	1,197	685	1,419
								(tons/yr)	0.15	0.60	0.34	0.71

APPENDIX C

PUBLIC USE DATA

O Visitation Stats

January	1994	1995	1996	1997	1998	1999	2000	2001
Medora Entrance	672	573	481	524	693	849	674	593
Painted Canyon	0	0	0	0	0	0	0	0
North Unit	329	486	231	290	2518	318	365	32
Walk-in/Misc.	0	0	0	0	0	0	0	0
Nonrecreational Use	310	417	417	417	417	417	472	472
Total	1,311	1,476	1,129	1,231	3628	1584	1511	1097
February								
Medora Entrance	656	1,474	733	706	947	1144	1037	527
Painted Canyon.	0	0	0	0	0	0	0	0
North Unit	384	214	2,333	970	2275	320	470	56
Walk-in/Misc.	0	0	0	0	0	0	0	0
Nonrecreational Use	310	417	417	417	417	417	472	472
Total	1,350	2,105	3,483	2,093	3639	1881	1509	1055
March								
Medora Entrance	2,279	1,352	1,451	1,852	790	1597	1566	
Painted Canyon	0	0	0	115	136	518	1341	
North Unit	712	668	1,371	552	1299	806	1166	
Walk-in/Misc.	0	0	0	0	0	0	0	
Nonrecreational Use	365	472	472	472	472	472	472	
Total	3,356	2,492	3,294	2,991	2697	3393	4545	
April								
Medora Entrance	3,201	2,244	1,835	1,618	3645	3736	2718	
Painted Canyon	10,715	8,865	8,415	7,342	11093	11308	11393	
North Unit	2,953	1,328	6,690	1,166	2700	5150	2153	
Walk-in/Misc.	0	0	0	0	0	0	0	
Nonrecreational Use	635	622	622	622	622	622	622	
Total	17,504	13,059	17,562	10,749	18060	20816	16886	
May								
Medora Entrance	13,396	10,697	6,553	7,578	7758	6432	8642	
Painted Canyon	20,090	21,859	16,303	17,239	18665	16906	27396	
North Unit	7,946	4,584	20,568	4,444	14220	7252	5356	
Walk-in/Misc.	0	0	0	0	0	0	0	
Nonrecreational Use	623	623	623	623	623	623	623	
Total	42,055	37,763	44,047	29,884	41266	31213	42017	
June								
Medora Entrance	28,493	15,072	16,137	16,370	16354	17238	16651	

Painted Canyon	40,704	32,933	31,882	36,617	35321	38762	33408
North Unit	15,256	12,807	91,33	7,366	23967	14175	13137
Walk-in/Misc.	1,200	1,200	1,200	1,200	1200	1200	1200
Nonrecreational Use	623	623	623	623	623	623	623
Total	86,276	62,635	58,975	62,176	77465	71998	65019
July							
Medora Entrance	55,267	50,697	27,702	24,768	27729	27822	30170
Painted Canyon	72,631	60,221	60,381	59,398	62826	61013	74136
North Unit	12,277	13,990	10,467	8,321	14633	12531	11063
Walk-in/Misc.	1,200	1,200	1,200	1,200	1200	1200	1200
Nonrecreational Use	622	622	622	622	622	622	622
Total	141,997	126,730	100,372	94,309	107010	103188	117191
August							
Medora Entrance	52.082	34.901	33.330	31.352	30899	31414	27818
Painted Canyon	66,794	78,739	76,614	68,573	68883	67872	64995
North Unit	10,310	10,492	11,422	7,376	10693	10181	7693
Walk-in/Misc.	1,200	1,200	1,200	1,200	1200	1200	1200
Nonrecreational Use	621	621	621	621	621	621	621
Total	131,007	125,953	123,187	109,122	112296	111288	102327
September							
Medora Entrance	16,521	13,594	11,901	12,014	13588	13021	13414
Painted Canyon	27,761	35,122	27,862	32,131	32244	30600	36295
North Unit	10,889	9,851	12,445	7,390	8159	7006	4753
Walk-in/Misc.	900	900	900	900	900	900	900
Nonrecreational Use	624	624	624	624	624	624	624
Total	56,695	60,091	53,732	53,059	55515	52151	55986
October							
Medora Entrance	4,767	4,447	4,234	5,126	4770	6247	4721
Painted Canyon	15,033	16,797	13,910	17,232	16270	16072	17133
North Unit	2,376	3,821	9,189	2,252	2712	5376	243

Walk-in/Misc.	0	0	0	0	0	0	0
Nonrecreational Use	482	482	482	482	482	483	483
Total	22,658	25,547	27,815	25,092	24534	28178	22580
November							
Medora Entrance	1,538	1,480	1,630	1,271	1554	1350	1528
Painted Canyon	3,284	4,170	4,470	3,488	4488	6252	5584
North Unit	845	2,169	2,428	753	843	2015	26
Walk-in/Misc.	0	0	0	0	0	0	0
Nonrecreational Use	472	472	472	472	472	472	472
Total	6,139	8,291	9,000	5,984	7357	10089	7610
December							
Medora Entrance	730	434	567	834	845	1059	733
Painted Canyon	0	0	0	0	0	0	0
North Unit	434	119	227	1,736	269	469	5
Walk-in/Misc.	0	0	0	0	0	0	0
Nonrecreational Use	417	417	417	417	417	472	472
Total	1.581	970	1.211	2,987	1 531	2000	1 210
TOTALS							
Medora Entrance	179,602	136,965	106,554	104,013	109,572	111,909	109,202
Painted Canyon	257,012	258,706	239,837	242,135	249,926	249,303	271,681
North Unit	64,711	60,529	86,504	42,617	84,288	65,599	46,430
Walk-in/Misc.	4,500	4,500	4,500	4,500	4,500	4500	4500
Nonrecreational Use	6,104	6,412	6,412	6,412	6,412	6412	6412
Total	511,929	467,112	443,807	399,677	454,698	437,889	438,391

APPENDIX D

SELECTED NORTH DAKOTA AIR QUALITY REGULATIONS

CHAPTER 33-15-04
OPEN BURNING RESTRICTIONS

Section
33-15-04-01 Refuse Burning Restrictions
33-15-04-02 Permissible Open Burning

33-15-04-01. Refuse burning restrictions. No person may dispose of refuse and other combustible material by open burning, or cause, allow, or permit open burning of refuse and other combustible material, except as provided for in section 33-15-04-02 or 33-15-10-02, and no person may conduct, cause, or permit the conduct of a salvage operation by open burning.

History: Amended effective October 1, 1987; January 1, 1989; January 1, 1996.
General Authority: NDCC 23-25-03, 28-32-02
Law Implemented: NDCC 23-25-03

33-15-04-02. Permissible open burning. The open burning of refuse and other combustible material may be conducted as specified in this section if the burning is not prohibited by, and is conducted in compliance with, other applicable laws, ordinances, and regulations. All open burning must comply with the rural fire mitigation action guide included in the North Dakota rural fire contingency plan and with provisions of the state fire code. The authority to conduct open burning under this section does not exempt or excuse a person from the consequences, damages, or injuries that may result therefrom.

1. The following types of burning are specifically authorized but are subject to the conditions listed in subsection 2 as well as any condition included as part of this subsection:

   a. Fires purposely set for the instruction and training of public and industrial firefighting personnel.

   b. Fires set for the elimination of a fire hazard that cannot be abated by any other means when authorized by the appropriate governmental entity, including the local fire department.

   c. Fires set for the removal of dangerous or hazardous material, where there is no other practical or lawful method of disposal and burning is approved in advance by the department. Where there is imminent danger to human health or safety and where there is no other practical or lawful method of disposal, burning may be initiated without prior notice to the department, provided notice is furnished as soon as practical.

d. Campfires and other fires used solely for recreational purposes, for ceremonial occasions, or for outdoor preparation of food.

e. Fires purposely set to forest or rangelands for a specific reason in the management of forest, rangeland, or game in accordance with practices recommended by state or federal agencies, as appropriate, and the burning is approved in advance by the department.

f. The burning of trees, brush, grass, wood, and other vegetable matter in the' clearing of land, right-of-way maintenance operations, and agricultural crop burning.

The burning of refuse and other combustible materials generated in the operation of a domestic household if the following conditions are met:

(1) No collection and disposal service is required or directed by a municipality or other government entity.

(2) The material to be burned must be from a building accommodating no more than one family.

(3) The burning must be conducted on the property on which the waste is generated.

h. The burning of liquid hydrocarbons that are spilled or lost as a result of pipeline breaks or other accidents involving the transportation of such materials or which are generated as wastes as the result of oil exploration, development, production, refining, or processing operations if the following conditions are met:

(1) The material cannot be practicably recovered or otherwise lawfully disposed of in some other manner.

(2) The burning must be approved in advance by the department, except as provided in subdivision

C.

2. The following conditions apply to all types permissible burning listed in subsection 1.

a. No public nuisance is or will be created.

b. The burning must not be conducted upwind of, or in proximity to, an occupied building such that the ambient air of such occupied building may be adversely affected by the air contaminants being emitted.

c. Care must be used to minimize the amount of dirt on the material being burned and the material must be dry enough to burn cleanly.

d. Oils, rubber, and other materials that produce unreasonable amounts of air contaminants may not be burned.

e. The burning may be conducted only when meteorological conditions favor smoke dispersion and air mixing.

f. The burning must not be conducted adjacent to any highway or public road so as to create a traffic hazard.

g The burning must not be conducted adjacent to any operational military, commercial, county, municipal, or private airport or landing strip in such a manner as to create a hazard.

h. Except in an emergency, burning may not be conducted in such proximity of any class I area, as defined in chapter 33-15-15, that the ambient air of such area is adversely impacted.

i. Except in an emergency, the visibility of any class I area cannot be adversely impacted as defined in chapter 33-15-19.

J · Burning activities must be attended and supervised at all times burning is in progress.

k. Burning is prohibited if the fire index is in the "extreme" category as issued by the national weather service. Notification to the department is required prior to starting the burn if the fire index is in the "very high" category.

1. If state or local fire officials determine

conditions to be unsafe for open burning, such burning must cease until conditions are deemed safe by such officials.

History: Amended effective October 1, 1987; January 1, 1989; January 1, 1996.
General Authority: NDCC 23-25-03, 28-32-02
Law Implemented: NDCC 23-25-03