Notice of Intent (NOI). February 1985

Exxon Minerals Company
Rhinelander, Wisconsin: Exxon Minerals Company, February 1985

CRANDON PROJECT

REVISED
AIR QUALITY PERMIT APPLICATION REPORT
NOTICE OF INTENT
(NOI)

EXXON MINERALS COMPANY
RHINELANDER, WISCONSIN

FEBRUARY 1985

REVISED AIR QUALITY PERMIT APPLICATION REPORT

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1.0 REGULATORY REQUIREMENTS

The Wisconsin Air Quality Program requires owners of all non-exempt stationary sources of potential air pollution to apply for a permit to construct from the Wisconsin Department of Natural Resources (DNR, 1982a). Several factors must be considered in determining what must be addressed in the permit application including: source type (major or minor); source location (attainment or non-attainment area); and whether the source is new or existing.

The implementing portion of Wisconsin law is statute section 144.391. This section provides for major source (ss. 144.391(2)) and minor source (ss. 144.391(3)) permits. Under Wisconsin air law, the proposed Crandon Project (Project) will be classified as a new minor stationary source. An application is required for a construction or new operation permit under this category. Within 20 days of receipt of the application, the DNR must inform the applicant of "...the plan, specifications and any other information necessary to determine if the proposed construction or operation will meet the requirements of ss. 144.30 to 144.426 and 144.96 and rules promulgated under these sections." (ss. 144.392(2)). In addition, the DNR will review the permit application for consistency with Federal regulations, such as the February 21, 1984 promulgated, New Source Performance Standards (NSPS) for metallic mineral processing plants (40 CFR Part 60, Subpart LL).

The DNR must also prepare an analysis of the submitted information and present a preliminary determination of approvability of the permit application within 30 days after receipt of the requested information (ss. 144.392(3)). The notice, comment and hearing requirements for an air permit for a mining applicant are governed by the mining permit master hearing process (ss. 144.392(9)).

1.1 Wisconsin Administrative Code, Chapter NR 154

The governing regulations supporting Wisconsin statute 144.391 are found in Chapter NR 154 of the Wisconsin Administrative Code. These rules required the submittal of a Notice of Intent (NOI) prior to permitting the construction of a new stationary source (DNR, 1982a). As required by NR 154.04(3), the submitted written NOI for stationary sources must contain: the applicant's name and address; a listing of all stationary sources; a map showing the location and layout; dates of construction and operation; and the estimated cost of the project. Additional information is required for direct sources in section NR 154.04(3).

Section NR 154.04 was amended in July 1983 to include a larger number of exempt air pollution sources. The Project is not one of these sources. It also requires permit applicants to use DNR supplied forms. The original air permit application for the Project was submitted to the DNR in December 1982 when the NOI requirement was still in effect. The Bureau of Air Management considers the 1982 submittal as the original application and this revised application as the submission of additional information to supplement the December 1982 air permit application.

1.2 Crandon Project Requirements

The Project will be a new minor stationary source since each of its potential air emissions will be less than 250 tons per year. A stationary source may consist of one or more pieces of process equipment, each of which is capable of emitting an air contaminant. According to statute section 144.30(23), stationary sources do not include motor vehicles or equipment capable of emitting an air contaminant while moving.

The following is the air quality permit application for the proposed Crandon Project:

Person Submitting: Exxon Corporation
c/o Exxon Minerals Company
P. O. Box 813
Rhinelander, Wisconsin 54501
(715) 369-2800

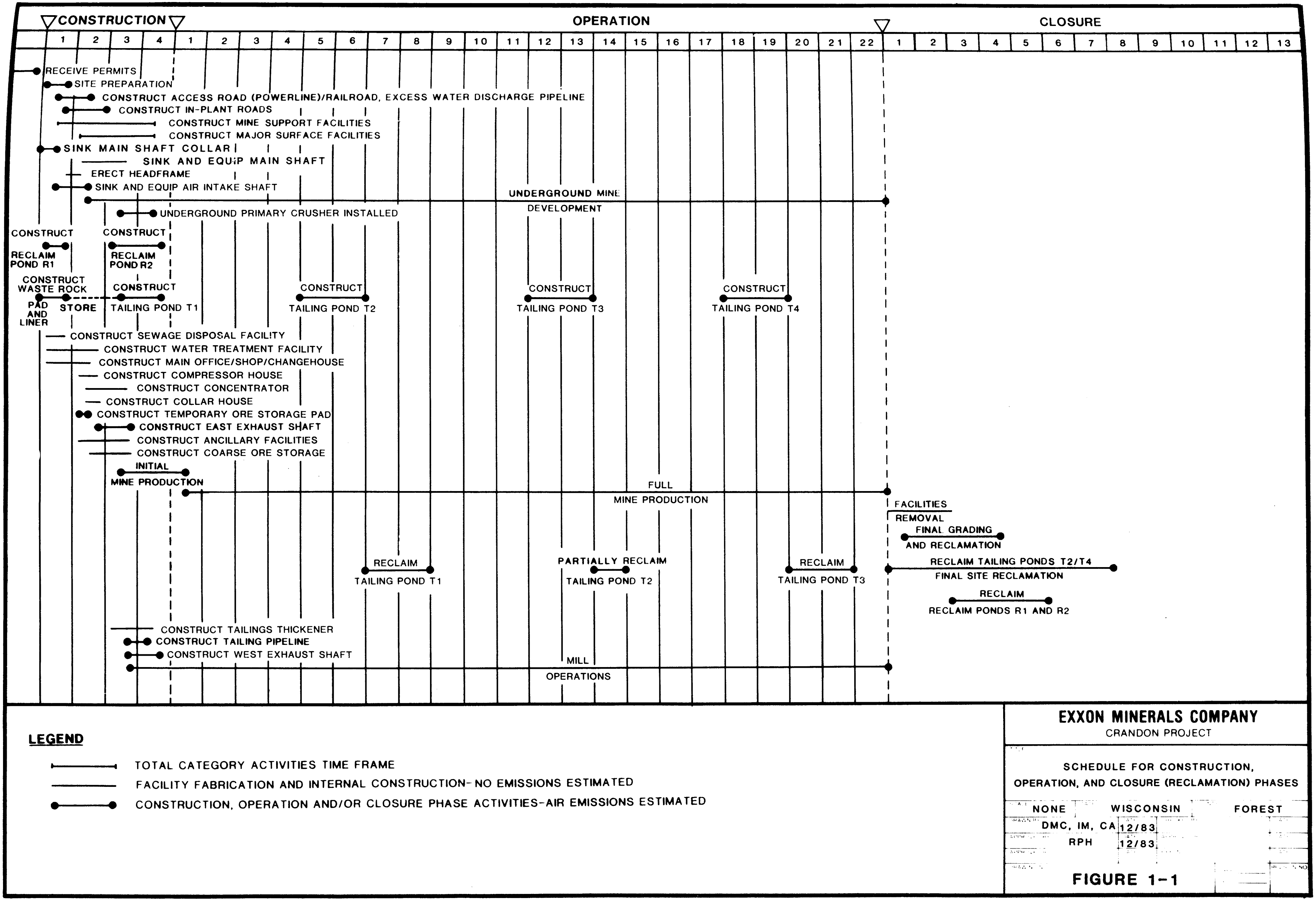
Information Contact: Barry J. Hansen, Permitting Manager

Company Officer: (Attorney-in-fact for Exxon Corporation)
Donald B. Achttien
General Manager, Crandon Project
Exxon Minerals Company, A Division of Exxon Corporation
P. O. Box 813
Rhinelander, Wisconsin 54501
(715) 369-2800

Dates of Construction and Operation: See Figure 1-1

Estimated Cost of the Project: $535 Million in 1983 dollars

EXXON MINERALS COMPANY
CRANDON PROJECT
SCHEDULE



383-2-18M1

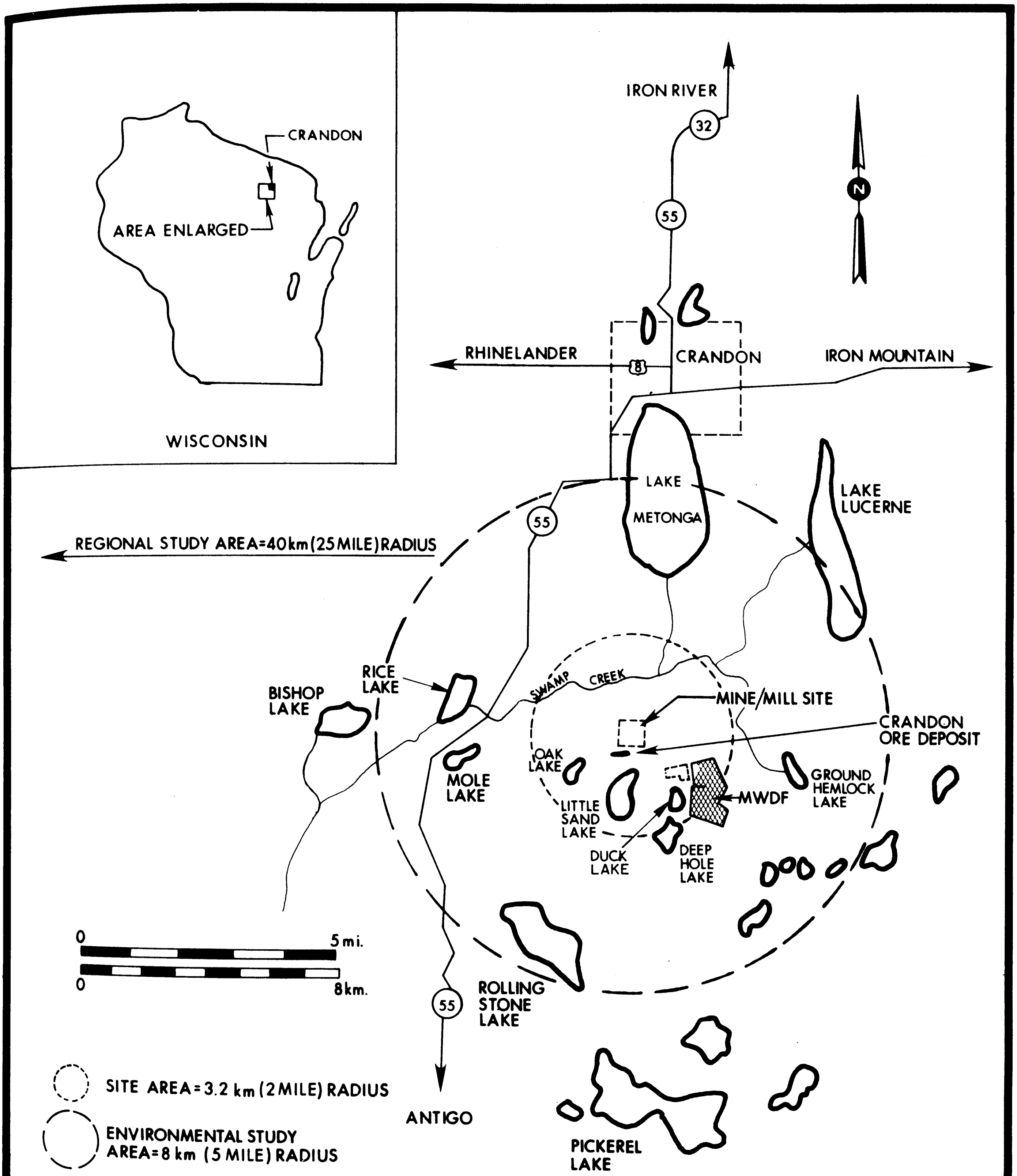
2.0 PROJECT FACILITY DESCRIPTION

Exxon Minerals Company (Exxon) is proposing development of a zinc(Zn)/copper(Cu)/lead(Pb) mine, mill and associated facilities (Crandon Project or Project) in Forest County, Wisconsin, approximately 8 km (5 miles) south of the city of Crandon, Wisconsin. Figure 2-1 shows the location of the ore deposit and the Crandon Project. The ore deposit contains two types of ore and its recovery involves different concentrate processes with separate handling and storage. Components of the proposed Crandon Project include: mine operations, mill activities (i.e., ore handling, ore storage, ore crushing and the concentrator operation), ancillary units (e.g. offices, shops, warehouses, emergency generators), and the mine waste disposal facility (MWDF) operation.

The mill is designed to have a maximum ore processing capacity of 9,580 t (10,540 short tons) per day. While the mine will operate five days a week, mill operations will maintain a 24-hour, 7 day schedule. The mine waste disposal facility will be constructed as required to correspond with tailings production in the mill.

2.1 Description of Existing Air Emission Sources

There are no major air emission sources located in or near the Project environmental study area (Figure 2-1). The city of Crandon has several minor



EXXON MINERALS COMPANY

CRANDON PROJECT

TITLE

GEOGRAPHIC LOCATION OF THE CRANDON PROJECT

SCALE	STATE	COUNTY
AS SHOWN	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
DMC	7/82		
APPROVED BY	DATE	APPROVED BY R P Herbst	DATE 11-'82
APPROVED BY	DATE	EXXON	DATE

DRAWING NO **FIGURE 2-1** SHEET ___ OF ___ REVISION NO sources, none of which are close enough to the site area to influence its current ambient air quality.

2.2 Description of Project Air Emission Sources

The Crandon Project will generate air emissions from three basic types of facilities and their construction, operation, and reclamation activities: the underground mine, the mine/mill surface facilities and the mine waste disposal facility. These emissions are expected to occur during three phases of the Project. The first phase will occur during construction of these facilities, the second during the operation of them, and the third when the facilities are reclaimed as part of the closure activities.

Stationary sources for the construction and operation of the mine, mill and ancillary facilities, and the MWDF will include processes which emit one or more of the following: total suspended particulates (TSP), sulfur dioxide (SO_2), nitrogen oxides (NO_x), hydrocarbons (HC), carbon monoxide (CO), and lead (Pb). The component air emissions from these sources will be emitted during mining and milling activities such as rock breakage (blasting), transport (hoisting, conveying), size reduction (grinding), and mineral separation (flotation and concentrating).

To control the air emissions, technology will be employed to achieve reliable and effective control for compliance with the national (federal) and state standards. The paragraphs below provide a more detailed description of the specific type of sources (i.e., stationary, mobile or fugitive) and quantities of emissions, and the pollution control equipment or techniques for these sources, which are estimated to occur during the three phases of the Project.

2.2.1 Mine - Construction and Operation

Initial development of the underground mine facilities will include the activities associated with opening (sinking) of the entrance shafts (main and air intake) and tunnel construction (drift driving). The air emissions generated in performing these tasks will originate from construction blasting, mine air heating (i.e., mainly seasonal), and mobile diesel vehicles. Release of initial air emissions will occur from the construction activities during development of the two entrance shafts and later the mine ventilation exhaust shafts (2) located at the eastern and western ends of the ore deposit. Maximum estimated source air emission rates at the generation location for mine construction are presented in Table 2.1.

Drilling and blasting will be the primary method used to loosen and reduce the size of rock for removal during mine development. Drilling activities will be conducted using water injection to the drill bit and will be virtually 100 percent effective in controlling total suspended particle (dust) emissions. The drilled holes will be charged with ammonium nitrate and fuel oil (ANFO). Blasting dust emissions will be reduced because of particle settling during it transport time in the mine, the humid underground environment, and the waterin

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION OF THE MINE

CONSTRUCTION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	MINE CONSTRUCTION								
	Stationary Sources								
1 - 4	Drilling and Blasting	TSP	Particle settling and humid underground environment	1.4	3.0	11.8	(13.0)[c]	179,740 st/hr; 179,740 st/day; 2,846,000 st/yr	I.1.a & I.1.b
		SO_2		0.12	(0.13)	2.8	(3.1)		
		NO_x		N/A		22.6	(24.9)		
		CO		N/A		118.5	(130.3)		
		Pb		0.0003	(0.0006)	0.003	(0.003)		
1 - 2	Power Generation	TSP	Diesel generator - 2500 kw	1.0	(2.1)	3.8	(4.2)	161 gal/hr; 3,846 gal/day; 108,192 gal/yr	I.2
		SO_2		10.2	(22.5)	41.3	(45.4)		
		NO_x		27.1	(59.6)	109.1	(120.0)		
		CO		16.5	(36.2)	66.4	(73.0)		
		HC		2.7	(6.0)	10.9	(12.0)		
1 - 4	Mine Air Heating	TSP	Use of clean burning natural gas	0.38	(0.84)	0.35	(0.38)	$84.4x10^3$ ft^3/hr; $7.6x10^7$ ft^3/yr	I.3
		SO_2		0.02	(0.05)	0.02	(0.02)		
		NO_x		4.6	(10.1)	4.2	(4.6)		
		CO		0.77	(1.69)	0.7	(0.8)		
		HC		0.31	(0.68)	0.3	(0.3)		
	Mobile Sources								
1 - 4	Mine Vehicles	TSP	Clean burning Deutz engines with catalytic scrubbers	0.79	(1.73)[e]	4.6	(5.1)	157.8 gal/hr; 926,398 gal/yr	I.4
		SO_2		2.22	(4.89)	13.1	(14.4)		
		NO_x		7.77	(17.1)	45.7	(50.3)		
		CO		0.07	(0.16)	0.5	(0.5)		
		HC		0.14	(0.31)	0.8	(0.9)		

a. st/yr = short ton per year
b. Air emission calculations for one or more of the components are presented in Appendix B.
c. The total estimate provided is for the sum of the different activities included for the various tasks and uses the highest annual calculation for each one as presented in Appendix B even though they may occur in different years.
d. N/A = not applicable
e. These values do not occur at the same time as blasting and should not be included in hourly totals.

of loosened rock (muck) piles prior to handling. Muck pile wetting will be a standard operating procedure.

Power generation may require the use of temporary diesel generators during the first six months of the construction phase if transmission line electrical power is not available at the site. One 2500-kw unit will be required during these months to supply electrical power for mine shaft and mine/mill surface facilities construction.

The use of 3 emergency diesel generators is required to supply electrical power in the event transmission line service is interrupted to the Project facilities during the operation phase. For this purpose, two 2500- and one 1000-kw units will supply emergency power for the mine and for the mill facilities, respectively. Although these units are intended for use only in emergencies, weekly operation of each unit is necessary for a maximum of 1 hour to assure their ability to perform when needed. Actual emergency use during the operation phase was estimated to be 2.5 hours per year.

Mine air heating will be accomplished by directly burning natural gas (i.e., direct-fired air heaters) in the intake air system as needed during freezing weather. Natural gas will be used because of its relative low cost, inherent clean burning properties and high heating efficiency. Control system to detect natural gas leakage and prevent explosions will be installed to insure maximum protection to personnel.

Diesel vehicles will be used for handling of rock and transporting personnel, equipment, and materials. Each diesel engine will employ a catalytic scrubber to reduce air emissions of NO_x CO and HC. A water/oil emulsion also controls TSP and NO_x air emissions. The emission factor used for the estimated emission rates in Tables 2.1 and 2.2 assumed use of diesel fuel with less than a 0.4 percent sulfur content (see also Appendix B).

During mine operations, the major air emission sources will be drilling and blasting, heating of the mine air during periods of freezing temperatures, and operation of diesel vehicles. Estimated source air contaminant emission rates at the generation location during full production mine operations are presented in Table 2.2.

Operation of the underground mine will include, drilling and blasting of rock to access (drift development) the ore and allow subsequent removal (stope production). Generation of dust during drilling will be virtually 100 percent controlled with water injection to the drill bit. Blasting will release dust (TSP) from the fracturing of the rock and components of SO_2, NO_x, CO, and HC from detonation of ANFO (i.e., the blasting agent). Dust from blasting is expected to be controlled at a minimum efficiency of 95 percent by the residence (local) gravity settling of particles because of the low air velocities in many areas of the mine, and the humid underground environment.

Mine air heating will also generate component emissions of TSP, SO_2, NO_x, CO, and HC during the controlled combustion of natural gas to increase the temperature of the intake air streams. Operation of this source will be

TABLE 2.2

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING OPERATION OF THE MINE

OPERATION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	MINE OPERATION								
	Stationary Sources								
1 - 22	Drilling and Blasting	TSP	Particle settling and humid underground environment	2.3	(5.0)	19.6	(21.5)[c]	179,740 st/hr; 179,740 st/day; 3,991,900 st/yr	II.1
		SO_2		0.2	(0.5)	2.1	(2.3)		
		NO_x		1.8	(3.9)	16.9	(18.6)		
		CO		7.6	(16.6)	71.8	(79.0)		
		Pb		0.0002	(0.0004)	0.002	(0.002)		
1 - 22	Mine Air Heating	TSP	Use of clean burning natural gas	0.4	(0.9)	0.5	(0.6)	91,800 SCF/hr 110,600,000 SCF/yr	II.2
		SO_2		0.03	(0.07)	0.03	(0.03)		
		NO_x		5.0	(11.0)	6.0	(6.6)		
		CO		0.8	(1.8)	1.0	(1.1)		
		HC		0.33	(0.73)	0.4	(0.4)		
	Mobile Sources								
1 - 22	Mine Vehicles	TSP	Clean burning Deutz engines with catalytic scrubbers	1.2	(2.6)[d]	5.0	(5.5)	879 l/hr; 3,654,000 l/yr	II.3
		SO_2		3.4	(7.4)	14.0	(15.4)		
		NO_x		11.8	(26.0)	49.1	(54.0)		
		CO		0.2	(0.5)	0.9	(1.0)		
		HC		0.2	(0.5)	0.9	(1.0)		

a. st/yr = short ton per year

b. Air emission calculations for one or more of the components are presented in Appendix B.

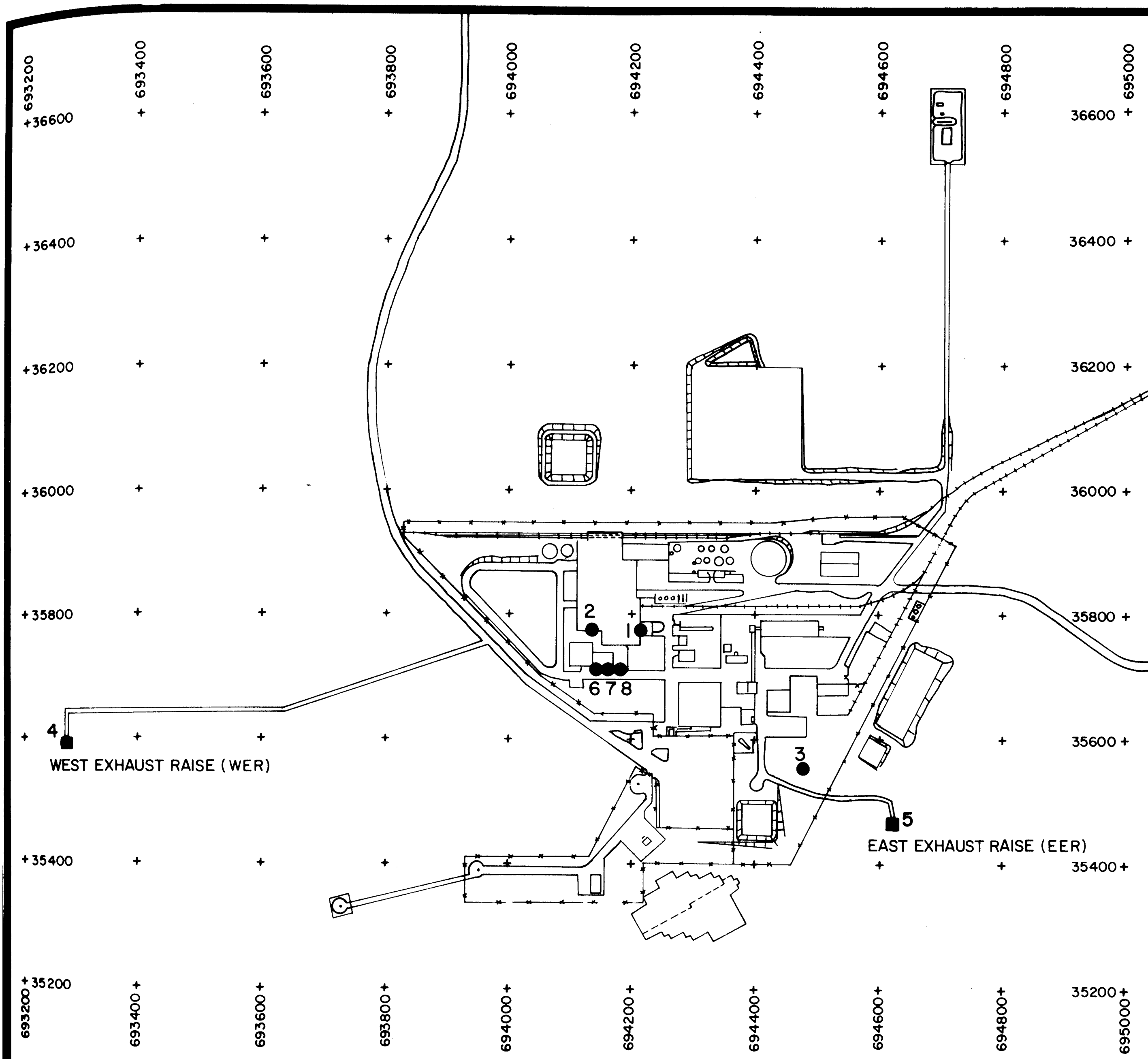
c. The total estimate provided is for the sum of the different activities included for the various tasks and uses the highest annual calculation for each one as presented in Appendix B even though they may occur in different years.

d. These values do not occur at the same time as blasting and should not be included in hourly totals.

necessary during periods in which heating of mine air is necessary to prevent freezing of water and service pipelines in the intake shafts. Natural gas will be used because it is cost-effective, clean burning and highly efficient.

Another source of air emissions underground is operation of the diesel vehicles. These vehicles will be used for drilling, loading, and hauling of ore and waste rock. Other support vehicles will also be used as required to transport personnel and equipment. The primary tailpipe exhaust components of the mobile equipment will be TSP, SO_2, NO_x, CO, and HC. The source related emission rates for these components are also presented in Table 2.2. These rates are estimated source emissions as discharged from clean burning engines with catalytic scrubbers. The emission rates listed do not include the control inherent in the humid mine atmosphere and the thousands of square feet of rock surface available for air contaminant capture and retention.

Underground air emissions listed in Table 2.2 will be emitted from two fixed locations at the ground surface; the east exhaust raise (EER) and the west exhaust raise (WER) (Figure 2-2). Releases at the EER and WER will be approximately equal. The control effects of the humid mine environment and the large areas of moist exposed rock surface were not utilized in these calculations, because of their undocumented efficiencies. However, the effects of particle gravity settling were used for estimating TSP emissions. Therefore, the air emission rates presented in Table 2.2 were estimated at the point of origin, and with the exception of TSP and Pb, do not include control provided by the mine environment.



NUMBER	SOURCE	COORDINATES X	Y
1	SECONDARY AND TERTIARY CRUSHING AND SCREENING	694215	35770
2	FINE ORE BIN LOADING AND UNLOADING	694140	35770
3	CONCRETE BATCH PLANT	694470	35550
4	WER	693285	35590
5	EER	694625	35460
6	DIESEL GENERATOR/A	694155	35710
7	DIESEL GENERATOR/B	694160	35710
8	DIESEL GENERATOR/C	694165	35710

0 200 400
METERS
N

EXXON MINERALS COMPANY
CRANDON PROJECT

MINE/MILL STACK EMISSION SOURCES

WISCONSIN FOREST

B.W. MEDLIN 06/84

FIGURE 2-2

384-1-138MB1

2.2.2 Mill and Other Surface Facilities - Construction and Operation

Earth moving and transport activities are the major sources of air emissions during construction of the mill and other surface facilities. Minor air emissions result from vehicle travel, fuel transfer and storage, and concrete batch plant operation (Table 2.3).

Wetting and chemical stabilization, where necessary, of unpaved in-plant roadways and excavation areas will be performed as required to control fugitive dust. A truck will be available at the mine/mill site for water spraying. Application of chemical stabilizers, such as calcium chloride and COHEREX, will also be used if necessary. Frequently traveled in-plant roads will be paved early in construction to minimize fugitive dust generation. In addition, trucks carrying crushed rock or fine particles will be covered or water sprayed as required when long distance transport is necessary.

Areas subject to cut and fill operations will be temporarily revegetated after final grading for soil stabilization and dust control. This activity will start during the first year and continue through completion of construction.

A batch plant may be located on-site to support concrete needs during the mine/mill construction and operation phases (Figure 2-2). Control of dust emissions from this facility will include insertable collectors on the cement storage silo, and cement weigh hopper. Aggregate used in the facility will be pre-washed and loading and discharge points will be vented to a baghouse type collector with a 99% efficiency.

TABLE 2.3

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION OF THE MINE/MILL SURFACE FACILITIES

CONSTRUCTION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	MINE/MILL SURFACE FACILITIES CONSTRUCTION								
	Stationary Source								
1 - 4	Concrete Batch Plant	TSP	Baghouse on mix truck-99%; loading hopper and silo filter vents - 90%	0.06	(0.13)	0.4	(0.4)	38.3 m^3/shift 1 shift/day, 5 days/wk, 52 wks/year	III.1
	Fugitive Sources								
	Site Preparation								
1	Mine Shafts	TSP	Watering, if necessary	N/A[c]		16.0	(17.6)	14.7 acres/yr	III.2.a
1	Mine/Mill Site[d]	TSP	Watering, if necessary	N/A		74.0	(81.4)	104 acres/yr	III.2.b
2	MWDF Area	TSP	Watering, if necessary	15.8	(34.8)	102.6	(112.8)	94 acres/yr	III.2.c
2	Access Road/Powerline[d]	TSP	Watering, if necessary	N/A		2.5	(2.7)	37 acres/yr	III.2.d
1	Railroad Spur	TSP	Watering, if necessary	N/A		3.8	(4.2)	45 acres/yr	III.2.e
1	Haul Road	TSP	Chemical stabilization-85%	N/A		3.7	(4.1)	96,396 yd^3/yr	III.2.f
1	Water Discharge Pipeline	TSP	Watering, if necessary	N/A		9.4	(10.3)	15 acres/yr	III.2.g
2	In-plant Roads	TSP	Paving; watering, if necessary	N/A		44.6	(49.12)	186 mi/day	III.2.h
	Construct Major Surface Facilities								
	Temporary Sources								
1 - 4	Fuel Transfer and Storage	HC		N/A		0.42	(0.5)	Diesel: 32,850 l/d Gasoline: 660 l/d	III.3.a
1 - 4	Reclaim Pond R1	TSP		N/A		53.9	(59.3)	49.4 acres/yr	III.3.b
	Reclaim Pond R2	TSP				16.4	(18.0)	29.6 acres/yr	
	Mobile Sources								
1	Tailpipe Emissions, Diesel Vehicles	TSP		0.3	(0.7)	0.6	(0.7)	230 gals/day	III.3.c
		SO_2		0.2	(0.5)	0.5	(0.5)		
		NO_x		2.9	(6.4)	5.9	(6.5)		
		CO		0.9	(1.9)	1.7	(1.9)		
		HC		0.5	(1.0)	0.9	(1.0)		

Potential air emissions will be controlled during operations by use of properly sized air cleaning equipment and a process facility design that incorporates minimum component emission rates (Table 2.4). The selection of insertable collectors or scrubbers to control TSP and Pb emissions from the mill and other surface operations was based upon the physical characteristics of the particulates. Insertable collectors were specified where the captured material was fine and could be returned directly to the process. Scrubbers will be employed where the product will be recycled indirectly to the wet process. The insertable collectors will vent inside the buildings and the wet scrubbers although located inside the buildings will vent to the atmosphere through stacks.

Ore handling and crushing, vehicle travel, and fuel transfer and storage constitute the major emission sources from surface facility operations (Table 2.4). A temporary crusher with baghouse control for TSP will be used during the first year of the operation phase to process the preproduction ore from the storage pad. Other air emissions will originate from facility heating and concentrate handling. The air emission sources will have reliable and effective controls for TSP, SO_2, NO_x, CO and HC, as applicable (Table 2.4).

To contain dust, belt conveyors used to transport ore and waste rock will operate inside covered galleries, or will be housed within a building. Material transfer points will be completely enclosed and exhausted to the belt conveyor through appropriately-sized insertable collectors. All of the insertable collectors will vent inside the covered galleries or within a building.

TABLE 2.4

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING OPERATION OF THE MINE/MILL SURFACE FACILITIES

OPERATION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	MILL/CONCENTRATOR OPERATIONS								
	Stationary Sources								
1 - 5[c]	Coarse Ore Transport and Crushing	TSP	Watering; chemical stabilization; baghouse - 99%	N/A[d]		9.1	(10.0)	898,000 st/yr	IV.1.a
1 - 22	Fine Ore Secondary & Tertiary Crushing & Screening	TSP	Conveyor enclosures and wet scrubber - 97.9%	N/A		8.1	(8.9)	3,629,000 t/yr	IV.1.b
		Pb				0.09	(0.1)		
1 - 22	Zn-Pb-Cu and Cu-Zn Fine Ores Bin Loading and Unloading	TSP	Conveyor enclosures and wet scrubber - 97.9%	N/A		5.3	(5.8)	3,629,000 t/yr	IV.1.c
		TSP				5.3	(5.8)		
1 - 22	Concrete Batch Plant	TSP	Baghouse with ducting and insertable collector - 99%; silo filter vents - 90%	0.06	(0.13)	0.4	(0.4)	23,900 t/y	IV.1.d
1 - 22	Facility Heating	TSP	Use of clean burning natural gas	0.15	(0.33)	0.8	(0.9)	33.9×10^6 SCF/yr	IV.1.e
		SO_2		0.01	(0.02)	0.05	(0.05)	9.1×10^6 SCF/yr;	
		NO_x		1.8	(3.96)	9.3	(10.26)		
		CO		0.26	(0.56)	1.33	(1.46)	127.9×10^6 SCF/yr	
		HC		0.04	(0.09)	0.23	(0.25)		
1 - 22	Fuel Transfer & Storage (Bulk Storage Facility & Service Station)	HC	Vapor balance on loading systems - 95%	N/A		4.6	(5.1)	6,000 gal/day	IV.1.f
				N/A					

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING OPERATION OF THE MINE/MILL SURFACE FACILITIES

OPERATION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
1 - 25	Emergency Diesel Generators	TSP	Emergency use only	1.1	(2.5)	0.2	(0.2)	25,125 gal/yr	IV.1.g
		SO_2		12.2	(26.9)	1.6	(1.8)		
		NO_x		32.3	(71.0)	4.3	(4.7)		
		CO		19.6	(43.2)	2.6	(2.8)		
		HC		3.2	(7.1)	0.5	(0.5)		
	Fugitive Sources								
1 - 22	Total Road Dust Emissions	TSP	Paving; watering, if necessary	N/A		44.6	(49.1)	182 mi/day for 350 days/yr	III.2.h & III.2.d
		TSP				2.9	(3.2)		
	Mobile Sources								
1 - 22	Vehicular Travel, Plant Vehicles Exhaust	TSP	Federal vehicular emission standards	N/A		0.02	(0.02)	182 mi/day for 350 days/yr	IV.1.h
		SO_2		N/A		0.04	(0.04)		
		NO_x		N/A		0.36	(0.39)		
		CO		N/A		1.66	(1.82)		
		HC		N/A		0.14	(0.15)		
1 - 25	Vehicular Travel, Employee Vehicles	TSP	Federal vehicular emission standards	N/A		0.04	(0.04)	2200 mi/day for 350 days/yr	IV.1.i
		SO_2		N/A		0.09	(0.1)		
		NO_x		N/A		0.3	(0.3)		
		CO		N/A		2.6	(2.8)		
		HC		N/A		0.3	(0.3)		
1 - 25	Locomotive Exhaust Emissions	TSP		0.06	(0.13)	0.13	(0.14)	10,800 gal/yr	III.2.e
		SO_2		0.13	(0.29)	0.3	(0.3)		
		NO_x		0.84	(1.85)	1.8	(2.0)		
		CO		0.3	(0.65)	0.6	(0.7)		
		HC		0.2	(0.45)	0.5	(0.5)		

a. st/yr = short ton per year
b. Air emission calculations for one or more of the components are presented in Appendix B.
c. First four years of coarse ore transport are during the construction phase, and only one year (i.e., the first year) of crushing actually occurs during the operation phase years as designated.
d. N/A = Not Applicable

Insertable collectors will be used to control dust emissions from coarse ore transport and the coarse (waste rock) and fine ore transfer towers. The dust collection efficiencies of these insertable collectors will exceed 99 percent. Collected dust will be recycled to the appropriate process. An insertable collector will also be used to control dust emissions from the backfill cement storage tank.

In addition, wet scrubbers will be used to control dust emissions in the fine ore storage bin loading and unloading areas, and the fine ore crushing and screening area. These systems will have wet scrubbers with dust collection efficiencies exceeding 97 percent. Collected dust will be slurried and returned to the processing circuit. Flotation is a wet process and will not emit dust.

To minimize potential dust emissions from concentrate (zinc, copper, and lead) handling, wetting will be used for each concentrate to assure a maintained moisture content of approximately 10%. A telescopic spout will be used to minimize material freefall distance during concentrate loading to the railcars.

Burnt pebble lime will be stored and processed within a separate facility To minimize potential dust emissions from this facility, dust collection hoods and ducting will be used to exhaust the storage bin through an insertable collector which will vent within the building. This insertable collector will have a collection efficiency exceeding 99 percent. Collected material will be returned to the process.

Filtered vents and an insertable collector will also be used to control dust from the reagent mixing area (i.e., soda ash storage bin). Material from the insertable collector will be returned to the appropriate reagent preparation process system, and the collector will vent within the building. The filtered vents will exhaust through ducts to the outside of the building.

Transfer and storage of fuels will occur primarily at the 113,550 l (30,000 gallon) bulk diesel storage tanks and at the fueling station. A vapor balance system will be used during storage tank loading to minimize hydrocarbon emissions. This will consist of a product line and ventilation line connected between tankcar or tanktruck and the storage tanks. The ventilation lines will exhaust the hydrocarbon vapors from the tank vents to the tankcar or tanktruck.

Emissions during vehicle operation at the facility will occur primarily from road dust, vehicle tires from road friction and exhaust gases (Table 2.4). There will be four types of vehicles capable of producing emissions. They are light-duty gasoline powered automobiles (employee vehicles), light-duty gasoline powered trucks (plant vehicles), heavy-duty gasoline powered vehicles, and heavy-duty diesel powered vehicles. Applicant owned vehicles used at the mine/mill site will meet all local, state and federal exhaust and evaporative emission regulations.

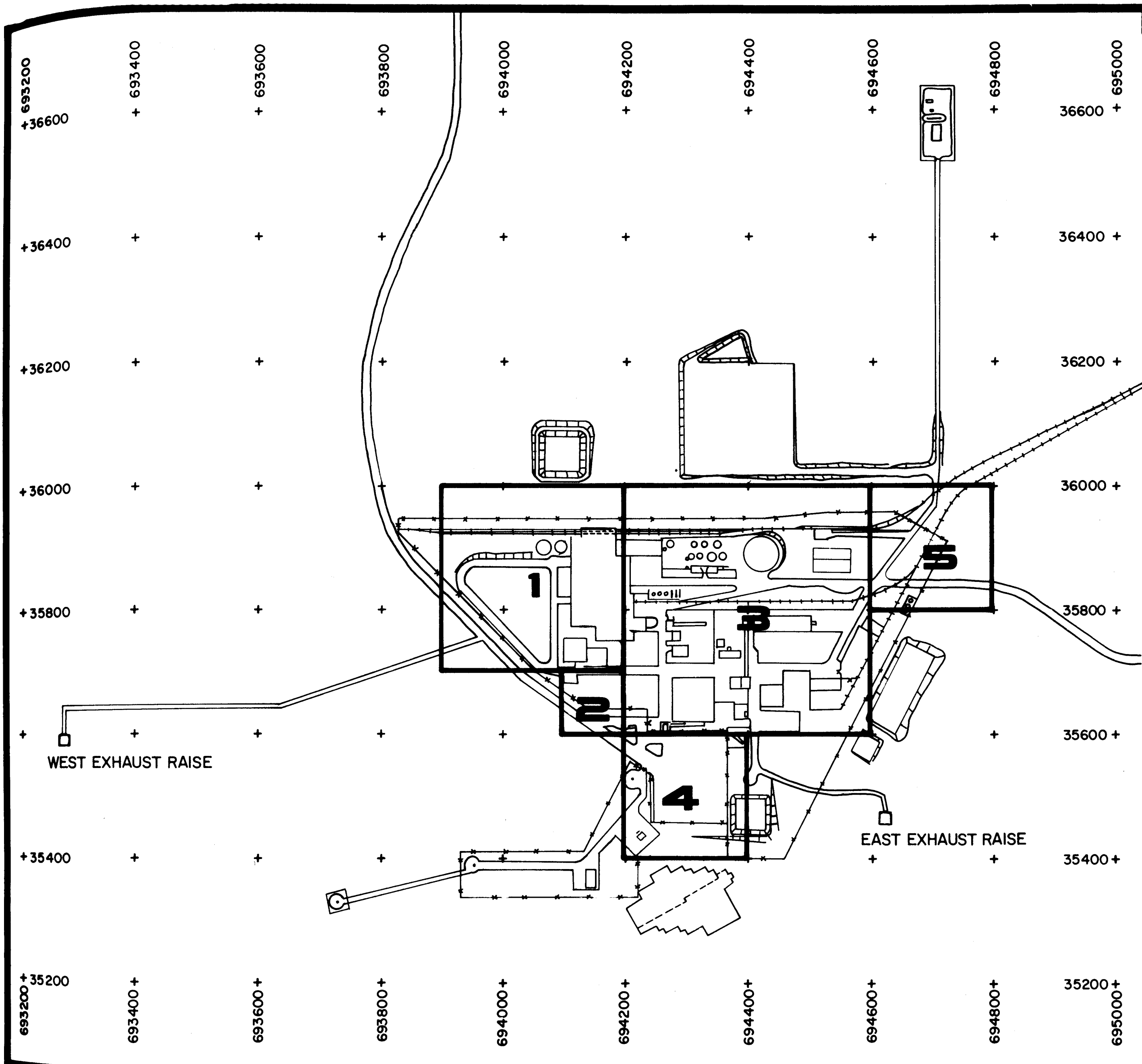
Estimated emissions for sources other than stack sources (i.e., fugitive and mobile sources) were modelled as if they are emitted from the general area of the activity. Five such areas were delimited for the mine/mill site (Figure 2-3). The emissions from these general locations were identified as area sources since the estimated emission rates are distributed throughout the delimited area by the modelling technique (see Section 4 for a further description of the model).

2.2.3 Mine Waste Disposal Facility - Construction and Operation

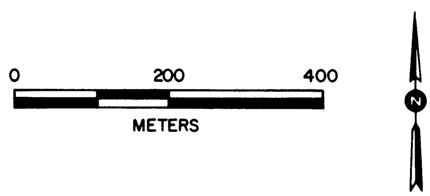
The primary air emission sources during development of the mine waste disposal facility are the vehicles used for excavation of the ponds and the transportation and handling of till and other materials used in pond construction. Minor stationary sources include the liner batch plant and soil processing plant operations (Figure 2-4). Most of the emissions from the MWDF will occur from the general area of each pond as it is being constructed, operated and reclaimed. The modelling technique for the MWDF will distribute the estimated emissions individually for each pond as an area source. Therefore, the area source limits are essentially the outer edges of the individual ponds (Figure 2-4).

Particulate emissions constitute the major air contaminant generated during MWDF construction (Table 2.5). Fugitive dust represents 96 percent of total particulate emissions.

The ponds will be excavated with scrapers and the normal compliment of support equipment (e.g. dozers, trucks). To reduce particulate emissions, disturbed areas will be sprinkled with water as required. After final grading



NUMBER	SOURCE	COORDINATES X	Y
1	INPLANT ROADS, BUILDING HEATING, LOCOMOTIVE	693900	35600
2	INPLANT ROADS	694100	35600
3	INPLANT ROADS, BUILDING HEATING, LOCOMOTIVE	694200	35600
4	INPLANT ROADS	694200	35400
5	INPLANT ROADS, LOCOMOTIVE	694600	35800



EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
MINE/MILL SITE EMISSIONS AREA SOURCES

SCALE | STATE WISCONSIN | COUNTY FOREST
DRAWN BY B.W.MEDLIN | DATE 06/84 | CHECKED BY | DATE
APPROVED BY | DATE | APPROVED BY | DATE
APPROVED BY | DATE | EXXON | DATE
DRAWING NO. **FIGURE 2-3** | SHEET ___ OF ___ | REVISION NO.

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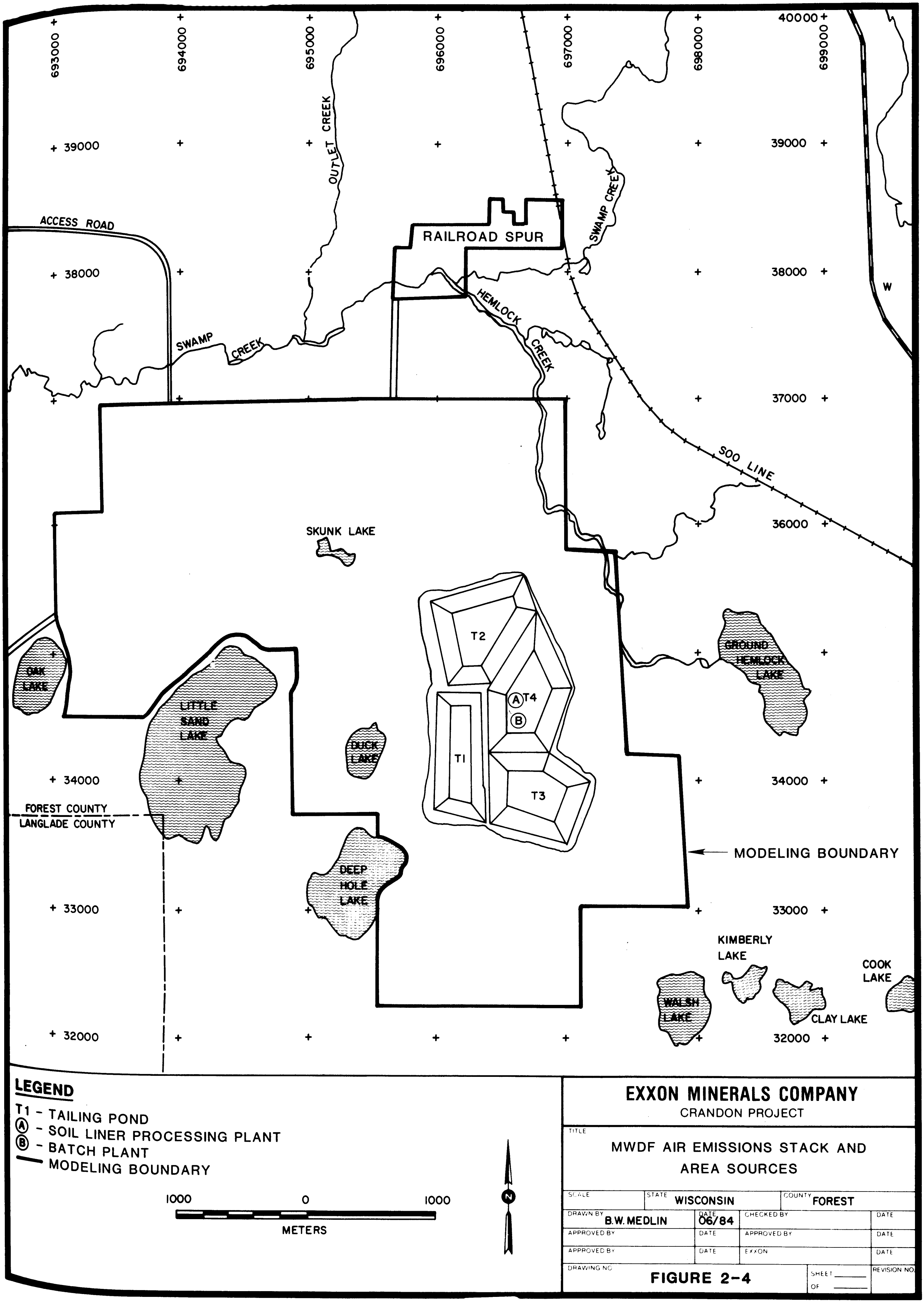
693000
694000
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40000
39000
38000
37000
36000
34000
33000
32000
OUTLET CREEK
ACCESS ROAD
RAILROAD SPUR
SWAMP CREEK
HEMLOCK CREEK
SOO LINE
W
SKUNK LAKE
T2
T4
T1
T3
GROUND HEMLOCK LAKE
OAK LAKE
LITTLE SAND LAKE
DUCK LAKE
DEEP HOLE LAKE
FOREST COUNTY
LANGLADE COUNTY
MODELING BOUNDARY
KIMBERLY LAKE
COOK LAKE
WALSH LAKE
CLAY LAKE
LEGEND
T1 - TAILING POND
Ⓐ - SOIL LINER PROCESSING PLANT
Ⓑ - BATCH PLANT
MODELING BOUNDARY
1000 0 1000
METERS
N
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
MWDF AIR EMISSIONS STACK AND AREA SOURCES
SCALE
STATE WISCONSIN
COUNTY FOREST
DRAWN BY B.W. MEDLIN
DATE 06/84
CHECKED BY
DATE
APPROVED BY
DATE
APPROVED BY
DATE
APPROVED BY
DATE
EXXON
DATE
DRAWING NO.
FIGURE 2-4
SHEET
OF
REVISION NO.

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TABLE 2.5

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION AND OPERATION OF THE MINE WASTE DISPOSAL FACILITY

CONSTRUCTION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED kg/h (lb/hr)	COMPONENT EMISSION RATES t/y (st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	MINE WASTE DISPOSAL FACILITY CONSTRUCTION						
	Fugitive Sources						
2	Site Preparation MWDF Area	TSP	Watering, if necessary	N/A[c]	102.55 (112.8)	Approximately 94 acres/each pond	V.1
3	Construct MWDF Facilities Waste Rock Handling (Loading and Dumping)	TSP	None	N/A	0.09 (0.1)	1,144,000 st/yr	V.2.a
	Hauling	TSP	Watering and chemical stabilization - 85%	N/A	32.36 (35.6)	1,144,000 st/yr	V.2.b
3 - 4	Construct Tailing Pipeline	TSP	Watering, if necessary	N/A	5.5 (6.0)	5 acres/yr	V.3
DURING OPERATION PHASE							
17 - 18	Construct Tailing Pond T4 (See also Table 4.1 and Appendix B)	TSP	Watering, as necessary	N/A	76.3 (83.9)[d]	6.07×10^6 cu yds/yr	V.4.d
	Hauling						
19	Excavated Till Within Pond	TSP	Watering, as necessary - 50%	N/A	61.2 (67.3)	1,913,000 cu yds/yr	V.4.a
19	Till/Bentonite Mixture from Batch Plant to Pond	TSP	Watering and chemical stabilization - 85%	N/A	0.77 (0.85)	90,000 cu yds/yr	V.4.a
19	Underdrain Material from Support Area to Pond	TSP	Watering and chemical stabilization - 85%	N/A	1.92 (2.11)	264,000 cu yds/yr	V.4.a
19	Filter Material from Support Area to Pond	TSP	Watering and chemical stabilization - 85%	N/A	3.23 (3.55)	383,000 cu yds/yr	V.4.a
19	Rip-Rap from Support Area to Pond	TSP	Watering and chemical stabilization - 85%	N/A	1.72 (1.89)	237,000 cu yds/yr	V.4.a

TABLE 2.5 (continued)

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION AND OPERATION OF THE MINE WASTE DISPOSAL FACILITY

CONSTRUCTION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED kg/h	(lb/hr)	COMPONENT EMISSION RATES t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	MINE WASTE DISPOSAL FACILITY CONSTRUCTION								
19	Loading								
	Till into Batch Plant	TSP	Minimize drop height	N/A		0.21	(0.23)	122,000 st/yr	V.4.b
	Underdrain Material	TSP	Minimize drop height	N/A		0.016	(0.017)	330,000 st/yr	V.4.b
	Filter	TSP	Minimize drop height	N/A		0.96	(1.05)	569,000 st/yr	V.4.b
	Rip-Rap	TSP	Minimize drop height	N/A		0.014	(0.015)	296,000 st/yr	V.4.b
19	Dumping								
	Till and Bentonite Mixture in Pond	TSP		N/A		0.17	(0.19)	122,000 st/yr	V.4.b
	Underdrain Material	TSP		N/A		0.012	(0.013)	330,000 st/yr	V.4.b
	Filter	TSP		N/A		0.8	(0.88)	569,000 st/yr	V.4.b
	Rip-Rap	TSP		N/A		0.011	(0.012)	296,000 st/yr	V.4.b
18 - 19	Wind-blown								
	Haul Road	TSP	Watering and chemical stabilization - 85%	N/A		0.07	(0.08)	16 acres	V.4.c
	Storage Area	TSP	Watering and chemical stabilization - 85%	N/A		0.13	(0.14)	20 acres	V.4.c
	Ponds	TSP		N/A		5.07	(5.58)	119 acres	V.4.c
18 - 19	Mobile Sources								
	Tailpipe Emissions, Diesel	TSP	Federal emission standards	N/A		0.02	(0.02)	17,217 miles/yr	V.5.a
		SO_2		N/A		0.04	(0.04)		
		NO_x		N/A		0.26	(0.28)		
		CO		N/A		0.41	(0.45)		
		HC		N/A		0.06	(0.07)		

TABLE 2.5 (continued)

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION AND OPERATION OF THE MINE WASTE DISPOSAL FACILITY

OPERATION YEAR(S)	EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	t/y	(st/yr)[a]	PROCESS FLOW RATES	APPENDIX B REFERENCE[b]
	Gasoline								
		TSP	Catalytic converter (on trucks)	N/A		0.002	(0.002)	49,322 miles/yr	V.5.b
		SO_2		N/A		0.007	(0.008)		
		NO_x		N/A		0.09	(0.103)		
		CO		N/A		0.4	(0.439)		
		HC		N/A		0.04	(0.045)		
	MINE WASTE DISPOSAL FACILITY OPERATION								
	Stationary Sources								
18 - 19	Batch Plant	TSP	Enclose dumping areas and vent to filers - 90%	N/A		0.93	(1.02)	102,020 yd^3/yr	V.6.a
18 - 19	Soil Processing Plant	TSP	Emissions vented to baghouse - 99%	N/A		0.026	(0.028)	139,380 st/yr	V.6.b
	Fugitive Source								
18 - 19	Hauling of Bentonite to MWDF	TSP	Watering and chemical stabilization - 85%	N/A		0.82	(0.9)	4,995 miles/yr	V.6.c

a. st/yr = short ton per year
b. Air emission calculations for one or more of the components are presented in Appendix B.
c. N/A = Not Applicable
d. Highest estimated annual quantity for any pond.

of embankment slopes, temporary or permanent vegetation will be planted for soil stabilization and to reduce wind blown dust. Soil additives will be applied to haul roads, as necessary, to reduce generation of dust by vehicle tires. During construction, the outside embankments will also be vegetated to reduce wind erosion.

Emission controls for the liner batch plant and soil processing plant will be similar to those used at the concrete batch plant at the mill. Where possible, unloading systems will be enclosed and emissions will be vented through filters to remove suspended particulates.

The primary source of air emissions from operation of the mine waste disposal facility will be wind erosion of the access road and pond embankments, as well as dust and vehicle exhaust emissions from maintenance and inspection vehicles traveling from the mill to the MWDF (Table 2.5). The access road will be treated with a chemical stabilizer, as necessary, which will reduce the generation of fine particles by vehicular traffic. The interior of the ponds will be water saturated from the discharge of the tailings from the mill. Water spraying will be used to prevent drying. If a long-term inactive disposal period of the tailing ponds occurs (i.e., longer than one month), water spraying will be a standard operating procedure to prevent drying of the tailings, and chemical stabilizers will be considered, if necessary. The specific details of the tailing ponds dust control programs will be provided in the MWDF - Plan of Operation (i.e., NR 182.09).

Reclamation activities will occur periodically during the operation phase of the Project (see Figure 1.1 and Table 4.1). The major estimated air contaminant emitted from these activities will be TSP generated during earthwork. The main earthwork activities will be associated with filling, grading and development of the reclamation cap for the tailing ponds. Reclamation activities will also be the main generators of TSP during the initial 7 years of the closure phase (see Table 4.2). In addition to the reclamation of the final tailing pond, major earthwork activities will include removal, filling, and grading of the mine/mill site and associated facilities such as the reclaim ponds, railroad spur, and access road.

Although the actual soil materials moved during reclamation activities will be much less than for the construction of the tailing ponds (i.e., 10 ft. reclamation cap vs. 40 ft. pond depths), the conservative assumption that the identical vehicle mileage for pond construction would be required for the reclamation activities was used to estimate mobile source air emissions (see Tables 4.1, 4.2 and Appendix B, section VI.j). Similarly, identical control methodogies such as watering and/or chemical stabilization would be used, if necessary, to reduce the TSP quantities emitted during reclamation activities.

2.3 Source Air Pollution Control Equipment Specifications

As indicated previously, the air pollution control equipment for the Crandon Project will generally consist of two types; insertable particle (dust) collectors or wet scrubbers. Table 2.6 is a listing of the pollution control equipment for the various facilities currently being considered for the Crandon Project. Although manufacturer or model numbers of the equipment may change in

TABLE 2.6

MANUFACTURER AND MODEL NUMBERS OF POLLUTION CONTROL EQUIPMENT

Process	Pollution Control Equipment	System
MINE		
Primary (Coarse) Crusher	Insertable Collector, Similar to a DCE-Vokes Model DLM-V 45/15 Fl	Pick-ups to duct with return to product convey
Crusher Discharge to Picking Belt	Insertable Collector, Similar to a DCE-Vokes Model DLM-V 45/15 Fl	"
Picking Belt to Loading Belt	Insertable Collector, Similar to a DCE-Vokes Model DLM-V 45/15 Fl	"
Loading Belt to Hoisting Pocket	Insertable Collector, Similar to a DCE-Vokes Model DLM-V 45/15 Fl	"
Hoisting Pocket into Skip	Insertable Collector, Similar to a DCE-Vokes Model DLM-V 45/15 Fl	"
MINE/MILL SURFACE FACILITIES		
Course Ore Transport to Headframe	Insertable Collector, Similar to a DCE-Vokes Model DLM-V Type F or equivalent	Pick-ups to duct with return to product convey
Coarse Ore Storage Building	Insertable Collector, Similar to a DCE-Vokes Model DLM-V Type F or equivalent	"
Surge Bins to Secondary and Tertiary Crushing and Screening	Passive Bin Filter, with 4.5 m^2 (48.4 ft^2) cloth area	Directly Connecte to Bin
Secondary and Tertiary Crushing and Screening	Wet Scrubber, Similar to Ducon - Type UW-4, Model IV	Pick-ups, Ductin and Fan*
Fine Ore Crushing Transfer Tower	Insertable Collector, Similar to a DCE-Vokes Model DLM-V Type F or equivalent	Pick-ups to duct with return to product convey
Zn-Cu-Pb and Cu-Zn Fine Ore Bins Loading	Wet Scrubber, Similar to Ducon - Type UW-4, Model IV	Pick-ups, Ductin and Fan*

TABLE 2.6 (continued)

Process	Pollution Control Equipment	System
MINE/MILL SURFACE FACILITIES		
Zn-Cu-Pb and Cu-Zn Fine Ore Bins Unloading	Wet Scrubber, Similar to Ducon - Type UW-4, Model IV	Pick-ups Ducting and Fan*.
Milk of Lime Facilities	Insertable Collector, Similar to a DCE-Vokes Model DLM-V Type F or equivalent	Pick-ups to ducting with return to the product conveyors.*
Backfill System	Insertable Collector, Similar to a DCE-Vokes Model DLM-V Type F or equivalent	Pick-ups, Ducting and Fan*. Filter Directly Connected to Bin.
Temporary Coarse (Preproduction) Ore Crusher	Baghouse, Similar to a DCE-Vokes Model DLM 1/3/10 Type W or equivalent.	"
Cement Batch Plant	Baghouse, Similar to a DCE-Vokes Model DLM 1/3/10 Type W or equivalent.	"

* All Design of Pick-ups and Ducting, will be in Accordance with Industrial Ventilation Guidelines of the American Conference of Governmental Industrial Hygienists (1976).

final engineering, the control type and efficiency will be equal to or better than that estimated (see Appendix B).

A general description of the pollution control equipment, largely excerpted from the manufacturer's brochures, is presented below. Although the information is a synopsis of the equipment specifications, it does provide sufficient background for understanding how the equipment functions. Most importantly, the information provides an indication that the control efficiencies estimated are achievable and that the equipment has a performance history which has been evaluated by the manufacturers.

The insertable particle collectors currently included in the design of the Project facilities are manufactured by DCE Vokes, Inc. of Jeffersontown, Kentucky. The product line planned for the Project is the DCE Dalamatic Insertable Filters. The Dalamatic filters are designed for continuous operation for applications, where product or nuisance dusts are involved, and where high collection efficiencies are required. They are capable of filtering heavy dust burdens at a high air velocity and constant level of resistance. Collection efficiency often exceeds 99.99%.

The manufacturer also indicates that the Dalamatics have been used for many years with a record of successful performance in some of the world's most demanding markets. The Dalamatics have been reliable in thousands of installations, cleaning millions of cubic feet per minute of air. The principle of operation is that dust laden air is drawn onto the filter envelope where the particles are retained on the outer surface of the fabric. Continuous operation is maintained by periodic reverse jet air pulses which dislodge the dust from the fabric surface. The dislodged dust is collected and returned to the process stream being cleaned.

Felted fabrics with a high efficiency and low resistance compared to woven materials are used for filtering. Generally these filter fabrics are nylon, orlon, or dacron. The current designs for the filter areas of a module in the insertable collectors to be used in the Project will range from 215 to 323 sq.ft. of 16-oz. Dacron filter material, and have an air to cloth ratio range of 6.6 to 10 (cfm) per 1.0 $ft.^2$. No filter will have a greater air to cloth ratio than the 10 to 1. The supply of clean air for filter cleaning will be at a pressure of 90 psig (7 atmospheres), pulsed every 12 seconds. Design pulsed air volumes range from 8-16 cfm (cubic feet per minute).

The wet dust collection systems (scrubbers) currently designed for the Project are manufactured by The Ducon Company, Inc. of Mineola, New York. The Ducon Type UW-4, Model IV wet scrubber is a three-stage, non-plugging system, ideally suited for product recovery and pollution control. This unit is the result of over 25 years of design and application experience in the mining industry. It has a collection efficiency of greater than 99% even for particles in the 1 to 2 micron range.

It's principle of operation involves use of a wet fan to mix gas, dust and water in high turbulance to force the dust particles into the scrubbing liquid. This allows for continuous equipment performance at maximum collection efficiencies. The constant speed of the fan assures peak performance even when gas flows are 60 - 70% of design capacity. Minimum water usage is required because the scrubbing liquid is recycled. The Ducon wet scrubbers have a performance record of maintenance free and highly efficient operation, even under severe or adverse operating conditions. The water flow rates necessary to operate (i.e., recirculation) the wet scrubbers currently designed for the Project range from 96 to 134 gpm (gallons per minute) with a water pressure drop of 5 inches. All of these parameters will be monitored along with the water pressure drop as per NSPS requirements.

2.4 Summary of Air Emission Sources for Proposed Crandon Project

A summary of the estimated air emission rates from the construction and operation sources of the mine are presented in Tables 2.1 and 2.2. The majority of the air emissions resulting from the activities of mine development and ore production are associated with blasting and operation of diesel vehicles. Blasting will occur predominately at the end of a normal mining shift, and emissions will be of short duration. Ore and waste rock hoisting will occur primarily during 2 daily shifts and mine vehicle use will be throughout the day for a normal 5 day week. Major air emission components will be carbon monoxide from blasting and nitrogen oxides from diesel vehicle operation.

A summary of the estimated air emission rates from the construction and operation sources associated with the mine/mill surface facilities are presented in Tables 2.3 and 2.4. The construction phase will predominately generate TSP as fugitive dust and products of diesel combustion from mobile construction vehicles. The primary type of control will consist of watering areas undergoing construction activities. Operation of the mine/mill surface facilities will generate air emissions almost exclusively from stationary sources. The largest air emissions will occur from building heating during winter and from secondary and tertiary crushing and screening. Building heating will be accomplished with clean burning natural gas. Secondary and tertiary crushing and screening will utilize a wet scrubber which operates above a 99 percent collection efficiency to control emissions of TSP.

Construction and operation of the MWDF will produce emissions similar to those encountered in any construction activity of this type and magnitude. Construction activity at the MWDF is estimated to generate air emissions as represented in Table 2.5. The principal component air emission will be fugitive dust (TSP). Escape of fugitive dust from the MWDF is minimized by its design configuration (i.e., the 15 m (50 feet) perimeter embankment). This embankment will offer maximum attenuation to wind dispersal and allow gravity settling of dust particles within the facility. Any dust blown beyond the embankments will also be rapidly attenuated by the surrounding vegetation.

Operating the MWDF is estimated to produce very minor emissions of TSP. During construction of the individual ponds of the MWDF, the liner batch plant will be the main stationary source emitting TSP (Table 2.5). This emission source will be very small because of its size and type of controls. Therefore, estimated emissions from the liner batch plant will also be a very minor source of TSP during the operation phase of the Project when the other tailing ponds are constructed.

3.0 ENVIRONMENTAL STUDY AREA CHARACTERISTICS

The proposed Crandon Project will be developed approximately 8 km (5 miles) south of the city of Crandon in Forest County, Wisconsin. Figure 3-1 shows the location of the ore deposit, the mine/mill site, the mine waste disposal facility, and their relation to the air quality modeling boundary.

3.1 Topography

The environmental study area is located within the Northern Highlands physiographic province (Martin, 1965), a region of rolling terrain that reflects its glacial origins. Ground surface elevation in the environmental study area is from less than 472 m (1,550 feet) MSL near Rolling Stone Lake, approximately 5 km (3 miles) southwest, to more than 533 m (1,750 feet) MSL, approximately 8 km (5 miles) northwest of the ore deposit.

Topography in the environmental study area is characterized by a general southwest trend of the ridges and intervening valleys. This trend reflects the southwesterly advance of the most recent glacier, which reshaped the pre-existing topography. This southwest trend is especially apparent in the upland areas of the regional study area 8 to 16 km (5 to 10 miles) northwest of the ore deposit where elongated eliptical ridges or drumlins exhibit approximately 30 m (100 feet) of vertical elevation. The southwest trend is also apparent in the Swamp Creek valley and in the orien-

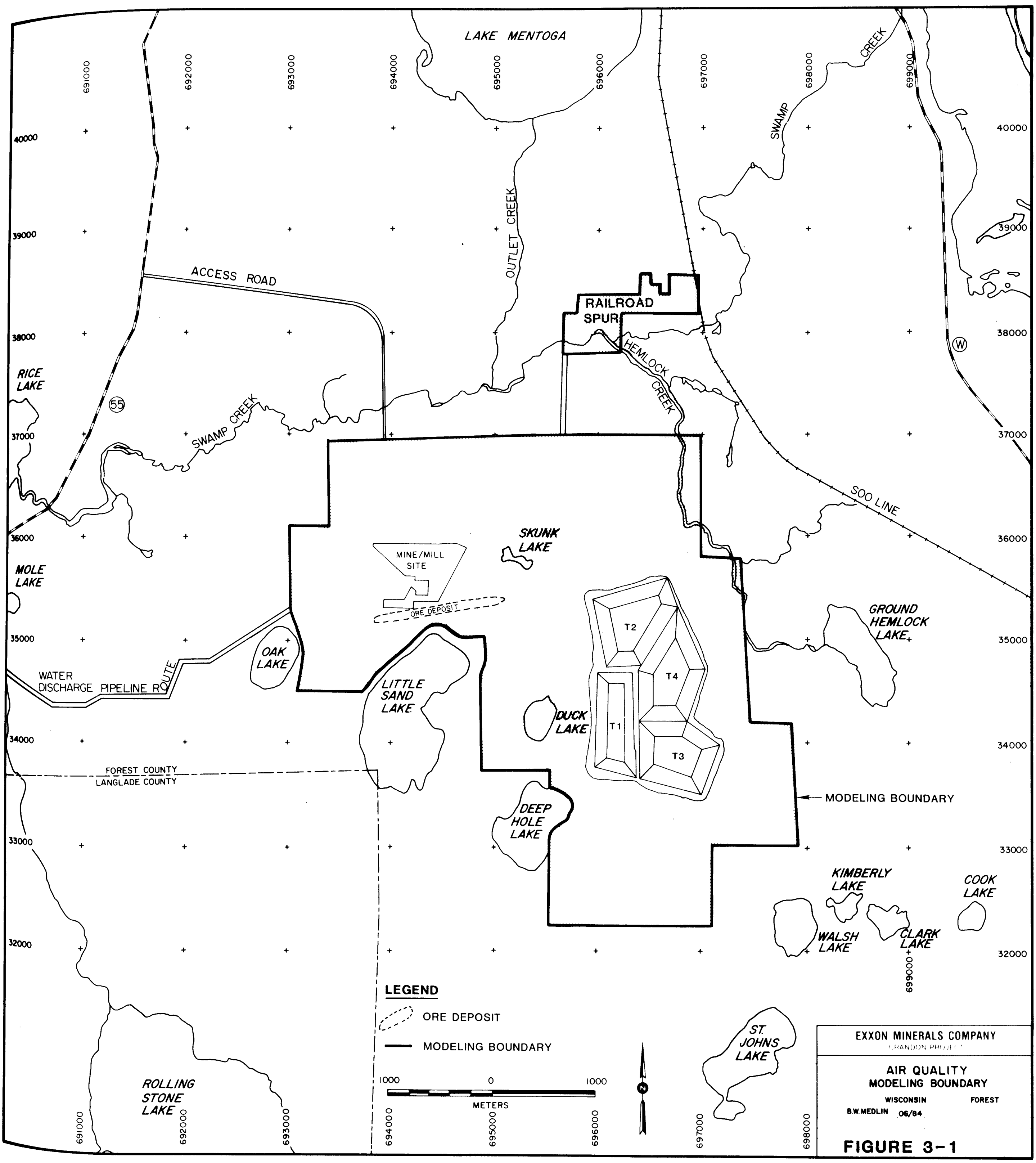

FIGURE 3-1

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tation of the ridges south of Mole Lake and immediately to the east and west of the mine/mill site.

Figure 3-2 illustrates the topography of the site area. The ground surface in the site area is gently rolling, ranging in elevation from approximately 500 to 515 m (1,650 to 1,700 feet) MSL (Figure 3-2). Two upland areas are on the east and west. To the east, the ridge reaches a maximum elevation of 539 m (1,779 feet) MSL, while on the west, the elevation is approximately 530 m (1,750 feet) MSL (Figure 3-2). The eastern ridge forms a distinguishing feature because its elevation as well as the vegetation are effective barriers to air movement from the west and southwest. This is also an important feature since westerly winds predominate in the site area and the ridge is likely an effective barrier to the air currents with associated wind-borne contaminants from the MWDF.

3.2 Meteorology

The climate of the environmental study area is continental. During most of the year, the environmental study area is in the path of eastwardly moving pressure systems of the prevailing westerly air movements. Terrain in the vicinity of the site area is rolling but does not greatly inhibit pressure system air movement (Figure 3-2).

Temperatures are mild to warm during the summer and cold during the winter. Summer nights are generally cool, with temperatures of 10 to 16°C

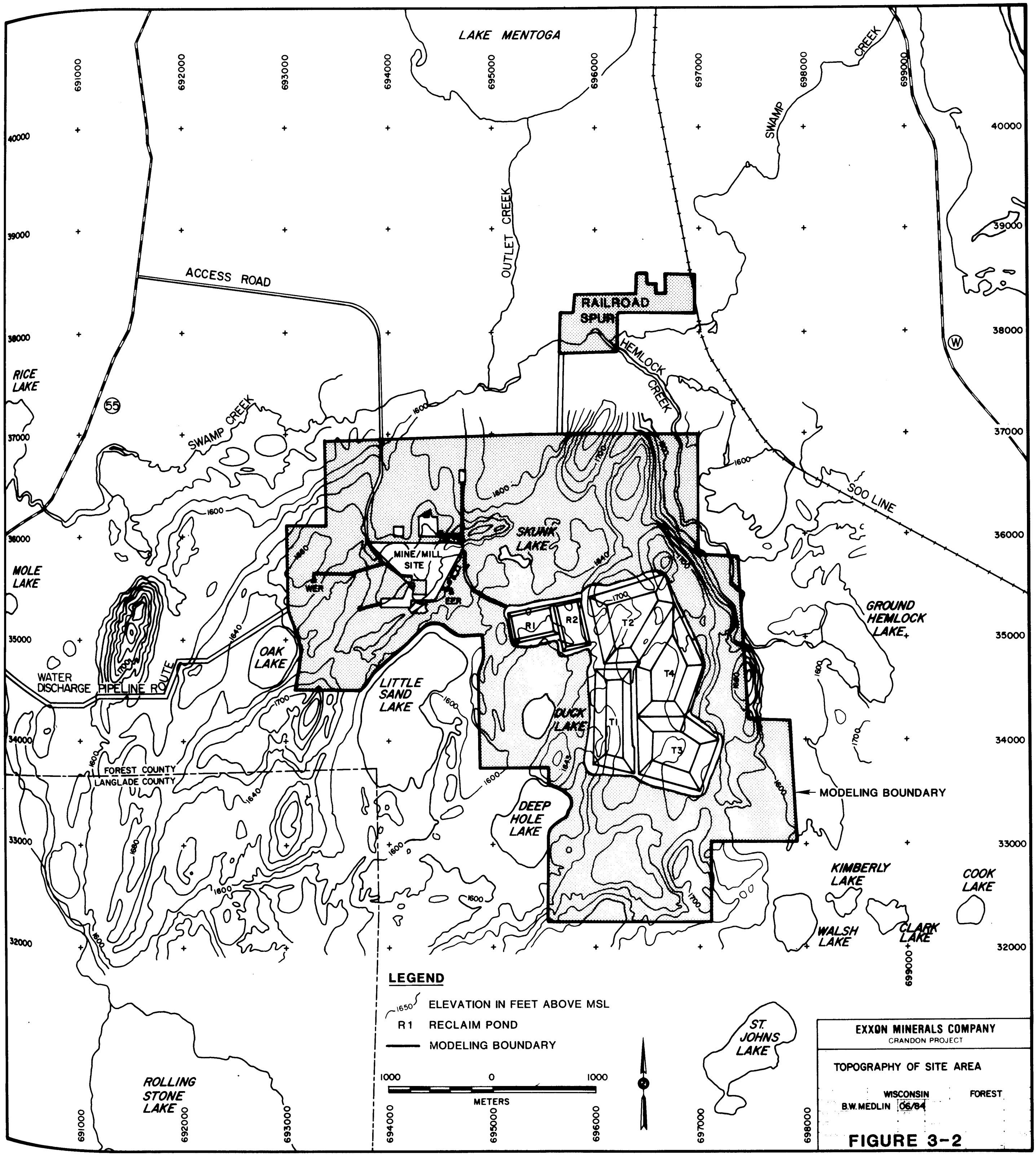

FIGURE 3-2

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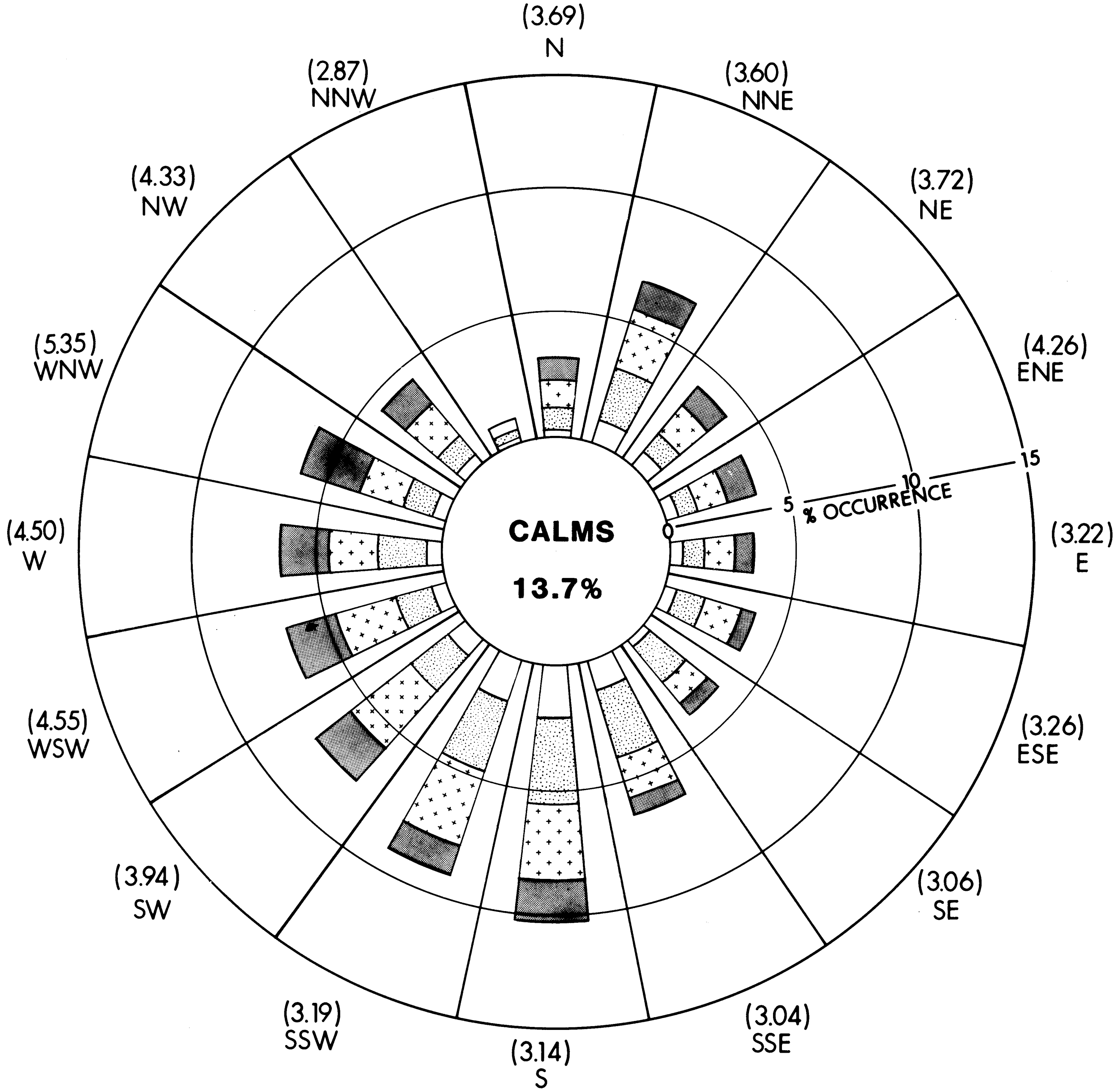
(50 to 60°F). Winter temperatures generally range from -18 to -4°C (0 to 25°F) and occasionally will be below -34°C (-30°F) (National Oceanic and Atmospheric Administration, 1974).

Moisture content of the air is generally moderate during the summer and low during the winter. The heaviest precipitation occurs during early summer and the least during mid-winter, averaging 781.6 mm (30.77 inches) per year (Black, 1978). Precipitation is caused by both localized thunderstorms and frontal pressure systems during summer. During winter, precipitation, mostly in the form of snow, is caused exclusively by passing weather systems. The snow is usually quite light because of the lack of atmospheric moisture. Snowfall averages between 1016 and 1524 mm (40 and 60 inches) per year (Environmental Science Services Administration, 1968).

Wind roses from the data of the air monitoring program conducted in 1978 were used to depict the frequency of occurrence of wind direction and speed in each of 16 compass directions (Dames & Moore, 1981a). An annual wind rose for January through December 1978 is presented on Figure 3-3. The annual wind rose for 1978 indicates the predominant wind direction was from the south (10.3 percent of the time). South-southwest, southwest, and north-northeast were the next most frequently observed directions (9.0, 7.5, and 7.0 percent, respectively). West and west-northwest winds were almost equal in frequency (i.e., approximately 6.0 percent) to those from the north-northeast (Figure 3-3).



LEGEND

(0.00) MEAN WIND SPEED (m/s) FOR SECTOR

WIND SPEED (m/s)	mph
> 5.0	> 11.2
3.0 - 5.0	6.7 - 11.2
1.5 - 3.0	3.4 - 6.7
0.0 - 1.5	0.0 - 3.4

MEAN WIND SPEED FOR ALL SECTORS: 3.24 m/s

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
ENVIRONMENTAL STUDY AREA WIND ROSE (ANNUAL, 1978)

SCALE	STATE WISCONSIN		COUNTY FOREST	
DRAWN BY BWM	DATE 07/21/82	CHECKED BY		DATE
APPROVED BY	DATE	APPROVED BY		DATE
APPROVED BY	DATE	EXXON		DATE
DRAWING NO	**FIGURE 3-3**		SHEET ___ OF ___	REVISION NO. 1

Mean wind speed ranged from 2.24 to 3.66 m/s (5.0 to 8.2 miles per hour) and averaged 3.24 m/s (7.3 miles per hour) for the 1978 calendar year. Calm wind (less than 0.45 m/s [1.0 mile per hour]) occurred 13.7 percent of the time in 1978, and was almost exclusively observed at night.

Precipitation at Nicolet College (Rhinelander, Wisconsin) during the 1978 calendar year totaled 747.7 mm (29.44 inches), which approximates the long-term (1908-1977 annual average of 781.6 mm (30.77 inches) (Black, 1978). The winter season (December 1977 through March 1978) was one of the driest on record, with the total precipitation in March (2.5 mm [0.10 inch] at Nicolet College) being the lowest recorded total since 1908. During this month, the environmental study area received only 0.2 mm (0.01 inch) of precipitation. Precipitation totals during July and August 1978 were 60 to 80 percent above normal, and the remaining months were near normal.

3.3 Environmental Description

The vegetation of the site area is a result of various factors such as water availability, soil type, topography, and seed dispersal. Agriculture and lumbering have also affected the vegetational pattern. The vegetation types of the site area were mapped using April 1976 and June 1978 aerial photographs according to the classifications of Curtis (1959) for native Wisconsin vegetation communities (Dames & Moore, 1981b). The site area generally consists of heavily forested upland areas interspersed with forested lowlands and is typical of this region of Wisconsin (Figure 3-4). The approximate acreage covered by the various vegetation types in the site area is presented in Table 3.1.

Approximately 59 percent of the site area is Upland Forest and 20 percent is Swamp Conifer. The upland forest type is composed primarily of Northern Hardwood and Aspen/Birch communities. Nonforested wetland (marsh, shrub swamp and bog) comprises approximately 6 percent of the site area. These small wetland areas are classified as either Palustrine scrub/shrub or Palustrine emergent wetland (Sather, 1977). The remaining area is primarily disturbed land, agriculture, or water.

3.4 Current Air Quality Status

Total suspended particulate (TSP) concentrations were monitored at three stations during 1977 and 1978 (Dames & Moore, 1981a). At each station the sampler was operated for a 24-hour period every third calendar day in phas with the state-wide sampling schedule (every sixth day) established by the DNR.

The data from this sampling program are summarized in Table 3.2 for comparison to the Wisconsin Ambient Air Quality Standards. The highest 24-hour TSP concentrations at the three stations ranged from 65 to 99 ug/m^3, and the second highest 24-hour concentrations ranged from 61 to 77 ug/m^3. These concentrations are far below the Wisconsin primary and

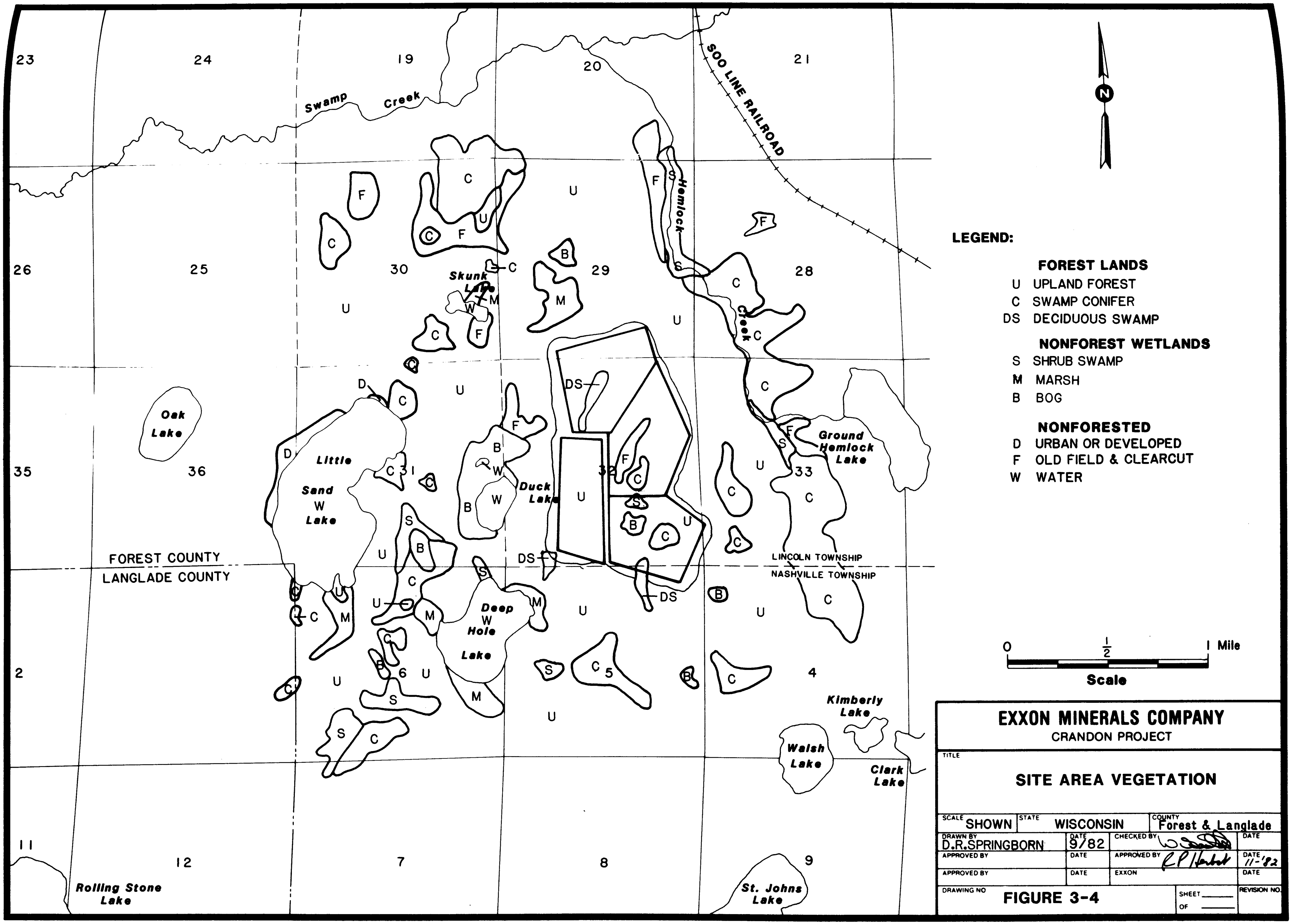

LEGEND:
FOREST LANDS
U UPLAND FOREST
C SWAMP CONIFER
DS DECIDUOUS SWAMP
NONFOREST WETLANDS
S SHRUB SWAMP
M MARSH
B BOG
NONFORESTED
D URBAN OR DEVELOPED
F OLD FIELD & CLEARCUT
W WATER
0 1/2 1 Mile
Scale
Swamp Creek
SOO LINE RAILROAD
Hemlock Creek
Skunk Lake
Oak Lake
Little Sand Lake
Duck Lake
Deep Hole Lake
Ground Hemlock Lake
Kimberly Lake
Walsh Lake
Clark Lake
St. Johns Lake
Rolling Stone Lake
FOREST COUNTY
LANGLADE COUNTY
LINCOLN TOWNSHIP
NASHVILLE TOWNSHIP
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
SITE AREA VEGETATION
SCALE SHOWN
STATE WISCONSIN
COUNTY Forest & Langlade
DRAWN BY D.R.SPRINGBORN
DATE 9/82
CHECKED BY
APPROVED BY
DATE 11-'82
EXXON
DRAWING NO
FIGURE 3-4
SHEET
OF
REVISION NO.

TABLE 3.1

VEGETATION TYPES OF THE SITE AREA

TYPE	CLASSIFICATION SYMBOL	APPROXIMATE AREA HECTARES	ACRES	PERCENT OF TOTAL
Upland Forest	U	4,654	11,490	59
Swamp Conifer	C	1,565	3,865	20
Marsh	M	155	383	2
Shrub Swamp	S	220	544	3
Bog	B	85	211	1
Urban or Developed	D	50	98	<0.5
Old Field and Clearcut	F	340	839	4
Agriculture	A	333	823	4
Water	W	546	1,347	7
TOTALS	-	7,938	19,600	100

TABLE 3.2

TOTAL SUSPENDED PARTICULATE GEOMETRIC MEAN CONCENTRATIONS AT STATIONS 1, 2, and 3 (ug/m^3) (APRIL 1977 - DECEMBER 1978)

CALENDAR QUARTER	STATION 1	STATION 2	STATION 3
Apr. - June. 1977	20.6	–[a]	–[a]
Jul. - Sep. 1977	18.6	–	–
Oct. - Dec. 1977	13.2	–	–
Jan. - Mar. 1978	11.5	11.1	11.6
Apr. - Jun. 1978	20.0	17.5	21.8
Jul. - Sep. 1978	18.8	19.1	20.9
Oct. - Dec. 1978	17.2	15.9	16.8

CONCENTRATIONS	STATION 1	STATION 2	STATION 3
Highest 24-Hour	99	65	74
Second Highest 24-Hour	77	61	73
Annual Geometric Mean[b]	16.6	15.9	17.9

WISCONSIN AMBIENT AIRQUALITY STANDARDS (WISCONSIN ADMINISTRATIVE CODE, 1975)	24-HOUR AVERAGE[c]	ANNUAL GEOMETRIC MEAN
Primary	260	75
Secondary	150	60

a. No data collected.
b. Calendar year 1978.
c. Not to be exceeded more than once per year.

secondary standards of 260 and 150 ug/m^3, respectively. The geometric mean TSP concentrations ranged from 15.9 to 17.9 ug/m^3 at the three monitoring stations during the 12 months of concurrent monitoring in 1978. An additional 9 months of monitoring were performed at Station 1 in 1977 (Dames & Moore, 1981a). The TSP geometric mean for Station 1 was 16.6 ug/m^3. Geometric means at the stations are less than 24 percent of the primary annual standard of 75 ug/m^3.

The highest TSP concentrations occurred during spring and summer when agricultural operations are most active. Total suspended particulate levels were lowest during periods of snow cover, when 24-hour concentrations were as low as 2 ug/m^3 (Dames & Moore, 1981a). Concentrations were similar at all three monitoring locations, with concurrent 24-hour concentrations often within 5 ug/m^3.

Background levels of atmospheric SO_2 were also monitored at Station 1 (Dames & Moore, 1981a). None of the SO_2 samples indicated that ambient 24-hour SO_2 concentrations exceeded the lower limit of detection (25 ug/m^3). For consistency with the DNR data reporting procedures, all 24-hour SO_2 concentrations were reported as 0.5 of the lower limit of detection. All concentrations were far below the Wisconsin ambient 24-hour and annual SO_2 standards of 365 and 80 ug/m^3 (see Table 4.7), respectively (Wisconsin Administrative Code, 1975).

No measurements of other criteria pollutants were obtained for the environmental study area. Background concentrations of TSP and SO_2 indicate air quality of the environmental study area for these parameters is well belo federal and state standards.

4.0 AIR QUALITY ASSESSMENT OF PROPOSED CRANDON PROJECT

Calculation of TSP emission rates for the Project includes all stationary, fugitive, and mobile source air emissions from the construction, operation, and reclamation of the mine, mill, and mine waste disposal facility (Tables 4.1 and 4.2). As indicated by the estimated annual total emission rates for TSP, which is the predominant Project generated air contaminant (Table 4.1), the Crandon Project is a minor source (i.e., does not emit 250 st/yr of TSP). Similarly, the closure (reclamation) phase estimated air emissions for TSP are much less than 250 st/yr (Table 4.2).

The Project stationary source air contaminant emission rates for TSP, SO_2, NO_x, CO, HC, and Pb are 50.7, 19.6, 94.2, 85.4, 7.3, and 0.102 tons per year, respectively (see Tables 2.2, 2.4, and 2.5). Since these air contaminant emission rates are below the 250 ton per year limit, the Project is exempt from the requirement to obtain a Prevention of Significant Deterioration (PSD) permit.

The ambient air quality impact of the Project operations was assessed by performing a dispersion modeling analysis. The objective of the modeling analysis was to demonstrate compliance with federal (National Ambient Air Quality Standards [NAAQS]) and state standards. Data bases and technical assumptions for the modeling analysis are discussed below.

TABLE 4.1 Schedule Associated With Project Activities During the Construction and Operation Phases and the Estimated TSP Air Emissions from the Proposed Sources (st/yr).

	CONSTRUCTION				OPERATION																	
Project Activities	1	2	3	4	1	2-3	4	5	6	7	8	9-11	12	13	14	15	16-17	18	19	20	21	22
Site Preparation (trees & brush)																						
1. Mine Shafts	17.6																					
2. Mine/Mill Site	81.4																					
3. MWDF Area		112.8					112.8					112.8[a]					112.8[b]					
4. Access Road/Powerline	2.7	3.24	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5. Railroad Spur	4.2	0.14	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6. Haul Road	4.1																					
7. Water Discharge Pipeline	10.3																					
8. In-Plant Roads	4.5	49.12	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9. Concrete Batch Plant	0.4	*	*	*																		
Construct Mine Support Facilities																						
1. Sink Main Shaft	6.1	2.5																				
2. Sink and Equip Air Intake Shaft	2.6	2.1																				
3. Construct East Exhaust Shaft			0.3																			
4. Construct West Exhaust Shaft				0.3																		
5. Power Generation	4.2	0.2	*	*																		
Underground Mine Development																						
1. Develop Drifts and Stopes	0.01	0.09	1.7	3.7																		
2. Mine Air Heating		0.38	*	*																		
3. Mine Vehicles		5.1	*	*																		

TABLE 4.1 (continued)

Project Activities	CONSTRUCTION 1	2	3	4	OPERATION 1	2-3	4	5	6	7	8	9-11	12	13	14	15	16-17	18	19	20	21	22
<u>Construct Major Surface Facilities</u>																						
1. Construct Reclaim Pond R1	59.3																					
2. Construct Reclaim Pond R2		18.0	18.0																			
3. Mobile Sources	0.7																					
4. Construct Temporary Ore Storage Pad	Included in Mine Shafts																					
<u>Construct MWDF Facilities (Operation)</u>																						
1. Waste Rock Handling																						
a. Loading and Dumping		0.01	0.07	0.1	0.03	*	*	0.01	*	*	*	*	*	*	*	*	*	*	*	*	*	*
b. Hauling	0.35	2.1	23.7	35.6	9.23	*	*	4.23	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2. Construct Tailing Pipeline			6.0	6.0																		
3. Construct Tailing Pond T1			46.8	57.2																		
4. Construct Tailing Pond T2								66.8	79.6													
5. Reclaim Tailing Pond T1										49.0	49.0											
6. Construct Tailing Pond T3													55.8	65.6								
7. Reclaim Tailing Pond T2															64.8							
8. Construct Tailing Pond T4																		73.1	83.9			
9. Reclaim Tailing Pond T3																				60.5	60.5	
10. Mobile Sources			0.02	*				*	*	*	*		*	*	*			*	*	*	*	
11. Install Liner	1.05		*	*				*	*	*	*		*	*	*			*	*	*	*	
a. Hauling of Bentonite to MWDF			0.9	*				*	*	*	*		*	*	*			*	*	*	*	

TABLE 4.1 (continued)

Project Activities	CONSTRUCTION				OPERATION																	
	1	2	3	4	1	2–3	4	5	6	7	8	9–11	12	13	14	15	16–17	18	19	20	21	22
Mine Operation (Production)																						
1. Initial					4.2																	
2. Full (Total Estimated Underground Emissions)																						
a. Drilling & Blasting (Rock Handling)					21.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
b. Mine Air Heating					0.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
c. Mobile Equipment					5.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Mill/Concentrator Operations																						
1. Coarse Ore Transport		0.3	4.7	3.3	10.0																	
2. Crushing and Screening					8.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3. Fine Ore Loading					5.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4. Fine Ore Unloading					5.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5. Concrete Batch Plant					0.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6. Facility Heating					0.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
7. Emergency Diesel Generators					0.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
TOTAL	199.5	196.5	161.8	166.8	125.6	111.4	224.2	175.1	187.9	157.4	157.4	219.1	164.1	173.9	173.2	106.3	219.1	181.4	192.2	168.8	168.8	106.3

* Means previous annual estimate is used for this year.

[a]In year 11 only.

[b]In year 17 only.

Table 4.2

Schedule Associated With Project Activities During Closure (Reclamation Phase) and the Estimated TSP Air Emissions from the Proposed Sources (st/yr).

Project Activities	CLOSURE						
	1	2	3	4	5	6	7
Reclamation Phase							
1. Remove Surface Facilities							
2. Reclaim Tailing Pond T4					42.3[a]	42.3[a]	42.3[a]
3. Reclaim Reclaim Ponds R1 and R2			30.2	30.2	30.2		
4. Reclaim Tailing Pond T2 (remainder)	45.2[a]	45.2[a]					
5. Final Site Reclamation	20.9	41.8	41.8	20.9			
a. Reclaim Railroad Spur					24.5	24.5	
b. Reclaim Access Road						21.6	21.6
6. Mobile Sources	0.022	*	*	*	*	*	*
TOTAL	66.12	87.02	72.02	51.12	97.02	88.42	63.92

* Means previous annual estimate is used for this year.

a. Includes installation of reclamation cap seal (liner) and hauling of bentonite to MWDF (see Tables 2.5, 4.1 and Appendix B).

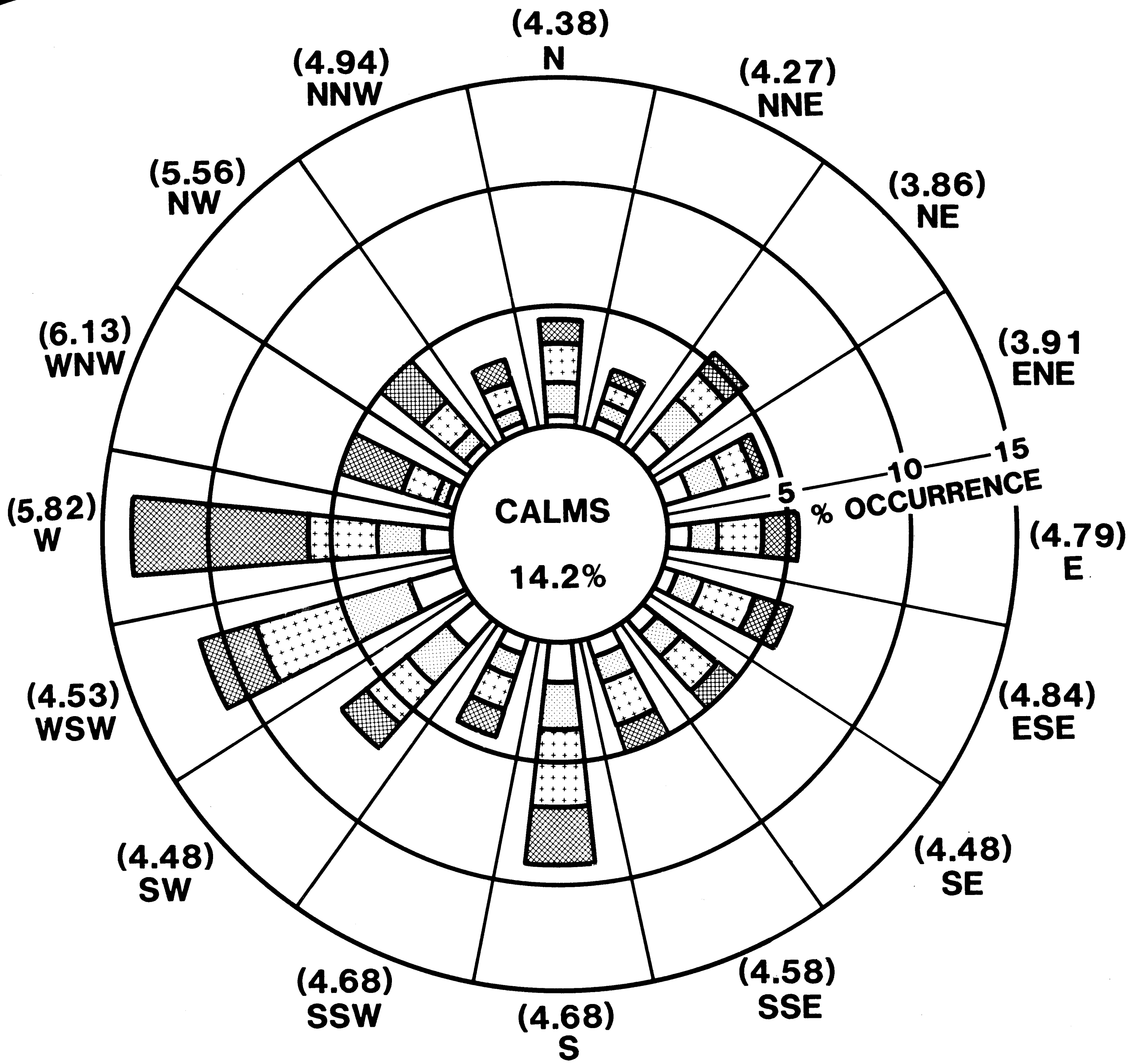
4.1 Data Bases for Air Quality Evaluation

In an effort to predict the ambient air quality impact of the Project operations, a dispersion modeling analysis was performed. Data bases in the following areas were used: meteorology, existing air quality, the emission inventory, the emission factors, and calculated air emissions for the Project. In all cases the data used was the most currently accepted and available.

4.1.1 Meteorology and Air Quality

The data base used for the meteorological information consisted of the 1977 hourly surface observations from a National Weather Service (NWS) monitoring location at Eau Claire, Wisconsin, and the NWS upper air data from St. Cloud, Minnesota (Appendix A). This data, as well as that for the earlier analysis (see the December 1982 Air Permit Application, Exxon Minerals Company 1982), which used the 1979 Quinnesec, Michigan and Green Bay, Wisconsin meteorological data, was at the request of the DNR (DNR, 1982b and 1983).

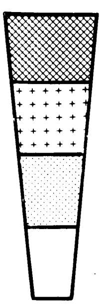
An annual wind rose (velocity/direction plot) was drawn of the Eau Claire, Wisconsin meteorological data (Figure 4-1). The wind rose indicates predominant wind directions from the west, south and southwest quadrants for Eau Claire. Comparison of this wind rose with that in Section 3.2 (collected at the Project site area) indicates a similarity in predominant wind direction and frequency (see Figures 3-3 and 4-1). The site area data does not have as strong a westerly wind velocity as found in the Eau Claire wind rose, nor as



LEGEND

(0.00) MEAN WIND SPEED (m/s) FOR SECTOR

MEAN WIND SPEED FOR ALL SECTORS: 4.17 m/s



WIND SPEED (m/s)	mph
> 5.0	> 11.2
3.0 - 5.0	6.7 - 11.2
1.5 - 3.0	3.4 - 6.7
0.0 - 1.5	0.0 - 3.4

EXXON MINERALS COMPANY
CRANDON PROJECT

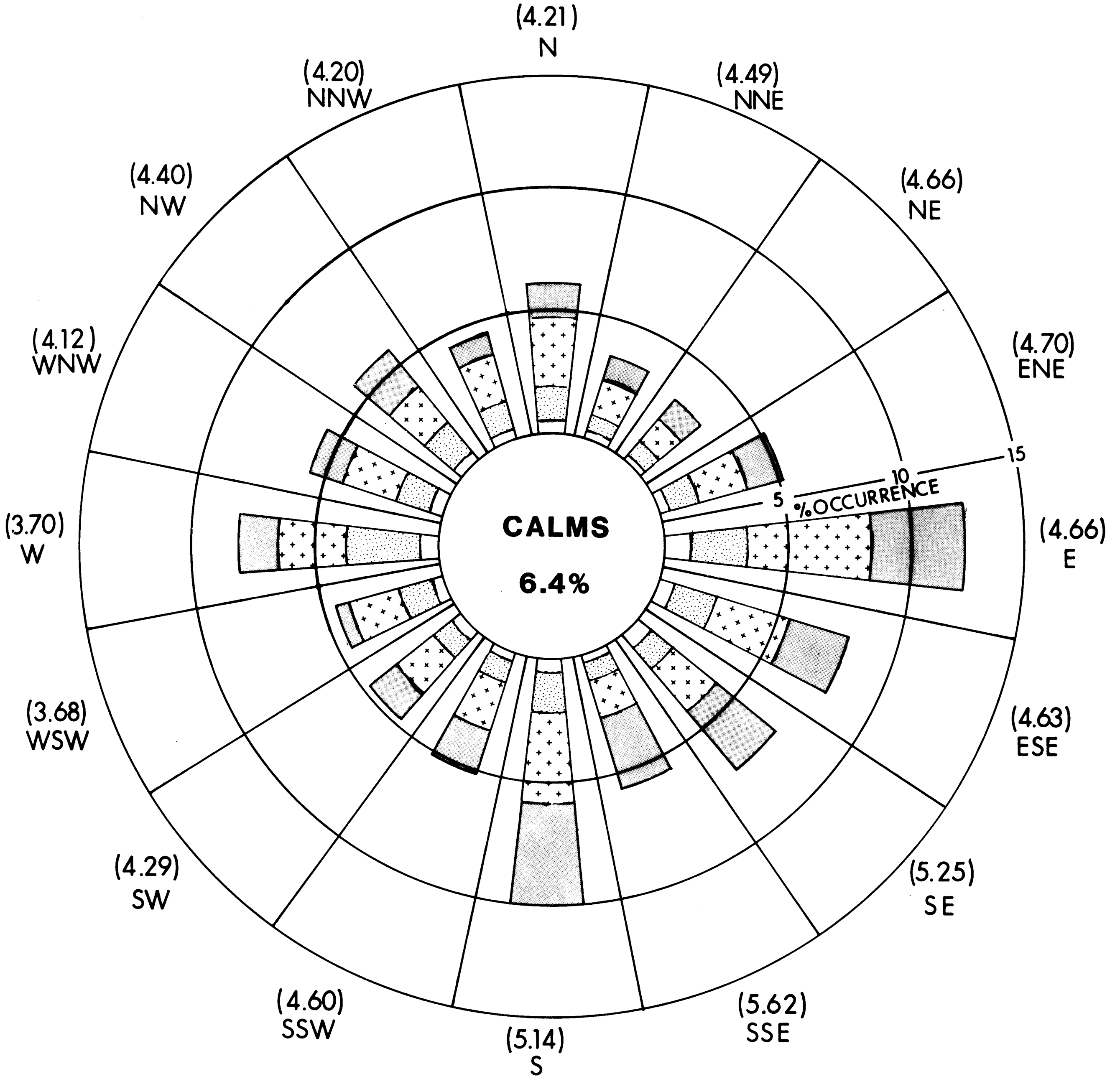
TITLE
EAU CLAIRE, WISCONSIN
ANNUAL WIND ROSE (1977)

SCALE NONE | STATE WISCONSIN | COUNTY FOREST
DRAWN BY IM | DATE 2/84 | CHECKED BY | DATE
APPROVED BY | DATE | APPROVED BY | DATE
APPROVED BY | DATE | EXXON | DATE
DRAWING NO. FIGURE 4-1 | SHEET ___ OF ___ | REVISION NO.

184-3-38M1

consistent a west, southwest orientation. The site area data are quite similar to Eau Claire meteorological parameter measurements for the easterly wind directions with the Eau Claire wind velocities generally higher than those for the site area. Therefore, utilization of the Eau Claire meteorological data leads to conservative estimates (i.e., higher) of predicted ambient air quality concentrations (i.e., TSP) and resulting increment consumption. The modeling results also reflect a conservative bias because no adjustments were included for the MWDF embankment heights or higher terrain elevations surrounding the Project facilities.

With the exception of the stronger wind velocity from the east for the Quinnesec meteorological data (Figure 4-2); it, Eau Claire and the site area data are quite similar for the easterly components of wind direction. Therefore, predicted ambient air quality concentrations for SO_2 and NO_x as presented previously (see the December 1982 Air Permit Application, Exxon Minerals Company, 1982) are a conservative estimate for Project conditions. The only modification for application of the EPA Industrial Source Complex (ISC) model for the SO_2 and NO_x calculations involved adjusted wind speed from 0.0 to 1.0 m/s (0.0 to 2.2 mph) as provided by EPA guidelines (EPA, 1980).



LEGEND

(0.00) MEAN WIND SPEED (m/s) FOR SECTOR

WIND SPEED (m/s)	mph
> 5.0	> 11.2
3.0 - 5.0	6.7 - 11.2
1.5 - 3.0	3.4 - 6.7
0.0 - 1.5	0.0 - 3.4

MEAN WIND SPEED FOR ALL SECTORS: 4.57 m/s

EXXON MINERALS COMPANY
CRANDON PROJECT

QUINNESEC, MICHIGAN
ANNUAL WIND ROSE (1979)

MICHIGAN
DMC 09/6/82

FIGURE 4-2

1

484-2C-204MB

Ambient air quality monitoring data were used to estimate the background concentration of TSP, SO_2, and NO_x in the site area. These extrapolated values were then added to the ambient air quality concentrations estimated by the modeling.

In 1978, Dames & Moore conducted an ambient air quality monitoring program in the Project site area which included three separate installations for the collection of total suspended particulates (TSP) and one installation for sampling SO_2. In applying this data, the highest, second highest 24-hour TSP concentration at the three locations was 77 ug/m^3 and the highest of the annual geometric means from the three sampling locations was 17.9 ug/m^3. During this particular year of sampling, ambient SO_2 concentrations did not exceed the minimum detectable limit of (25 ug/m^3) of the SO_2 analyzer (Dames & Moore, 1981a). As a result, a conservative background concentration of 25 ug/m^3 for all averaging periods in which an NAAQS exists (3-hour, 24-hour, and annual average) was used for ambient air quality for SO_2. Since this monitoring program did not include sampling for ambient NO_2 concentrations, a DNR estimated annual average of 19.4 ug/m^3 was used from data obtained at a NO_2 monitoring location in Sheboygan County, Wisconsin (DNR, 1982c).

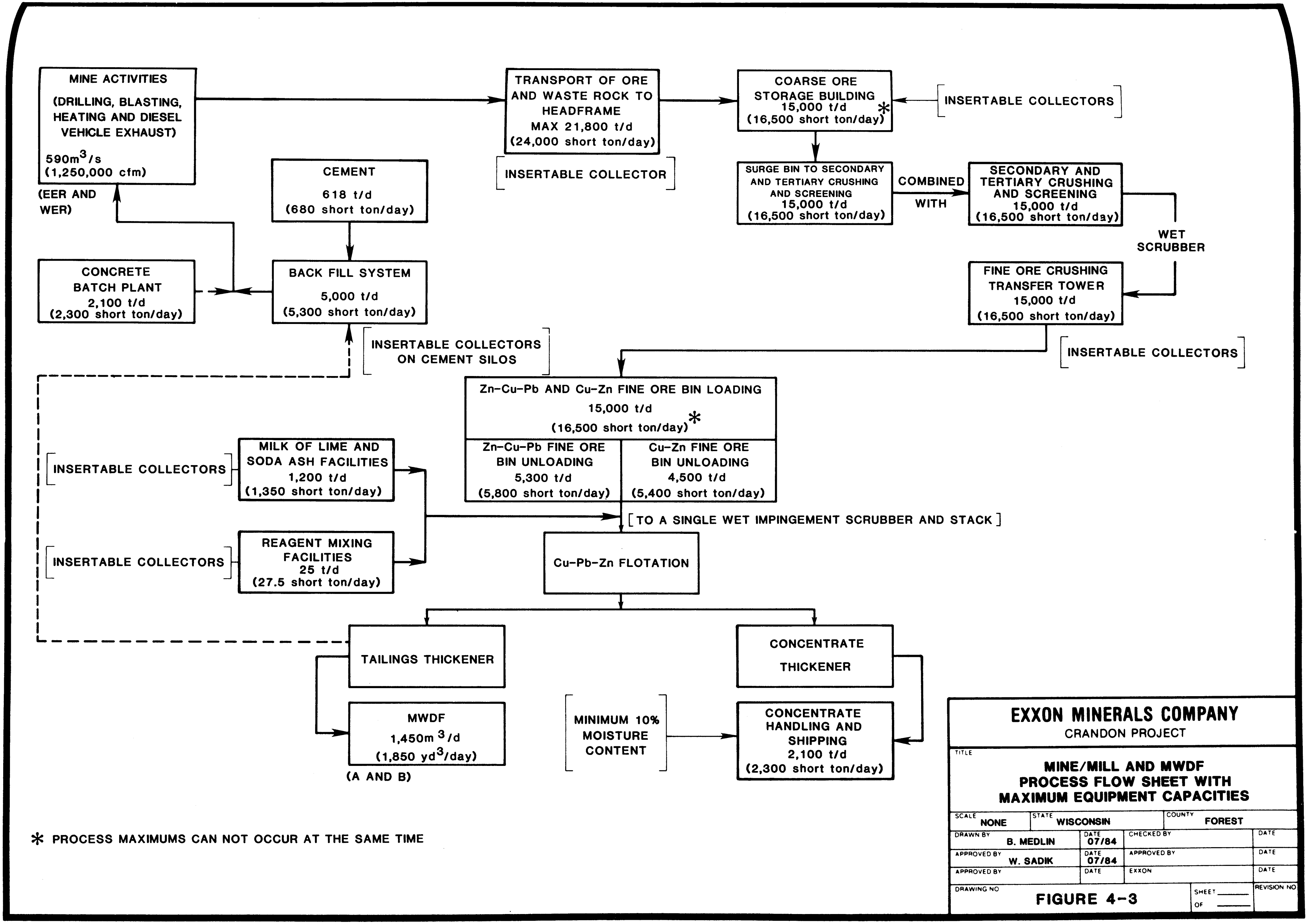
4.1.2 Emission Factors and Inventory

Air emission rate estimates were calculated for each source of the Project (see Appendix B). Air emission sources, control measures and estimated rates can be found in Tables 2.1, 2.2, 2.3, 2.4 and 2.5. Tables 4.1 and 4.2 present the summed estimated TSP emission rates for each source on an annual basis, as well as the Project annual total. The estimates represent the anticipated production mode controlled (where applicable) air emission rates. The air emissions for all sources were estimated on an hourly, and yearly basis, whenever possible. The tables include construction, operation, and closure (reclamation) phase activities for the mine, mine/mill surface facilities, and the MWDF.

4.1.3 Calculated Air Emissions for Proposed Crandon Project

Calculation procedures for all the air emission rates presented in Tables 2.1, 2.2, 2.3, 2.4, 2.5, 4.1 and 4.2, are provided in Appendix B. Figure 4-3 is a schematic flow diagram of the processes occurring during operations and associated air pollution control equipment.

The control equipment for the processes in Figure 4.3 are listed in Table 2.6 and will provide control efficiencies as good or better than those indicated in Tables 2.1, 2.2, 2.3, 2.4, 2.5 and Appendix B. The installed equipment will be similar to the manufacturer and model number of those identified in Table 2.6.



MINE ACTIVITIES
(DRILLING, BLASTING, HEATING AND DIESEL VEHICLE EXHAUST)
590m³/s
(1,250,000 cfm)
(EER AND WER)
TRANSPORT OF ORE AND WASTE ROCK TO HEADFRAME
MAX 21,800 t/d
(24,000 short ton/day)
INSERTABLE COLLECTOR
COARSE ORE STORAGE BUILDING
15,000 t/d
(16,500 short ton/day) *
INSERTABLE COLLECTORS
SURGE BIN TO SECONDARY AND TERTIARY CRUSHING AND SCREENING
15,000 t/d
(16,500 short ton/day)
COMBINED WITH
SECONDARY AND TERTIARY CRUSHING AND SCREENING
15,000 t/d
(16,500 short ton/day)
WET SCRUBBER
CEMENT
618 t/d
(680 short ton/day)
CONCRETE BATCH PLANT
2,100 t/d
(2,300 short ton/day)
BACK FILL SYSTEM
5,000 t/d
(5,300 short ton/day)
INSERTABLE COLLECTORS ON CEMENT SILOS
FINE ORE CRUSHING TRANSFER TOWER
15,000 t/d
(16,500 short ton/day)
INSERTABLE COLLECTORS
Zn-Cu-Pb AND Cu-Zn FINE ORE BIN LOADING
15,000 t/d
(16,500 short ton/day) *
Zn-Cu-Pb FINE ORE BIN UNLOADING
5,300 t/d
(5,800 short ton/day)
Cu-Zn FINE ORE BIN UNLOADING
4,500 t/d
(5,400 short ton/day)
INSERTABLE COLLECTORS
MILK OF LIME AND SODA ASH FACILITIES
1,200 t/d
(1,350 short ton/day)
[TO A SINGLE WET IMPINGEMENT SCRUBBER AND STACK]
INSERTABLE COLLECTORS
REAGENT MIXING FACILITIES
25 t/d
(27.5 short ton/day)
Cu-Pb-Zn FLOTATION
TAILINGS THICKENER
CONCENTRATE THICKENER
MWDF
1,450m³/d
(1,850 yd³/day)
(A AND B)
MINIMUM 10% MOISTURE CONTENT
CONCENTRATE HANDLING AND SHIPPING
2,100 t/d
(2,300 short ton/day)
* PROCESS MAXIMUMS CAN NOT OCCUR AT THE SAME TIME
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
MINE/MILL AND MWDF PROCESS FLOW SHEET WITH MAXIMUM EQUIPMENT CAPACITIES
SCALE NONE
STATE WISCONSIN
COUNTY FOREST
DRAWN BY B. MEDLIN
DATE 07/84
CHECKED BY
DATE
APPROVED BY W. SADIK
DATE 07/84
APPROVED BY
DATE
APPROVED BY
DATE
EXXON
DATE
DRAWING NO
FIGURE 4-3
SHEET
OF
REVISION NO

384-1-143MB2

4.2 Air Quality Modeling

4.2.1 Methodology

The EPA Industrial Source Complex (ISC) model was used to predict the potential air quality effects of the Project. The model calculation procedure is based on the steady state Gaussian Plume concept (Bowers, Bjorklund, and Chenev, 1979). This model is recommended by the EPA for assessing the impact of fugitive particulate emissions and aerodynamic downwash effects.

The main ISC model consists of two computer programs: a short-term model (ISCST) and a long-term model (ISCLT). The ISCST program uses an hourly meteorological data base, while the ISCLT incorporates a sector-averaged program using a frequency of occurrence based on categories of wind speed, wind direction and atmospheric stability. The ISCLT model was used only to assess NO_2 impacts, since only annual average standards exist for this air contaminant. Estimation of ambient CO concentrations was determined by a direct ratio to SO_2 concentration results. Both the ISCST and ISCLT programs were used to:

1) estimate effects of plume rise from momentum and buoyancy as a function of downwind distance for stack emissions (Briggs, 1971; 1975);
2) estimate effects created by building wakes (Huber and Synder, 1976; Huber, 1977);

3) maintain separation of individual stationary point and area sources for input and output; and

4) estimate concentrations for 1-hour to annual averages.

The assumptions and calculations utilized were as follows:

1) horizontal wind field - assumed to be steady-state (constant and uniform) within each hour;

2) vertical wind field - assumed to equal zero;

3) horizontal dispersion - was based on the semi-empirical Gaussian Plume Hourly stability classes were determined internally by the Turner procedure. Turner's rural dispersion coefficients were used;

4) vertical dispersion - was based on the semi-empirical Gaussian Plume. Hourly stability classes were determined internally and Turner's rural dispersion coefficients were used; and

5) no adjustments were made for terrain topography because of the gradual changes present in the Project site area.

The ISCST and ISCLT models used the following formula for estimation of the respective air component ambient air concentrations.

ISCST MODEL
INDUSTRIAL SOURCE COMPLEX SHORT TERM
GROUND-LEVEL CONCENTRATION FOR STACK AND AREA SOURCES

$$X\{x,y\} = \frac{K Q_A x_o}{\sqrt{2\pi}\,\bar{u}\,\{h\}\,\sigma_z}\{\text{Vertical Term}\}\left\{\mathrm{erf}\left(\frac{x_o'/2+y}{\sqrt{2}\,\sigma_y}\right)\right.$$

$$\left.+\,\mathrm{erf}\left(\frac{x_o'/2-y}{\sqrt{2}\,\sigma_y}\right)\right\}\{\text{Decay Term}\}$$

x = HOURLY DOWNWIND DISTANCE CO-ORDINATE

y = HOURLY CROSSWIND DISTANCE CO-ORDINATE

x_o = LENGTH OF ONE SIDE OF SQUARE AREA

K = CONSTANT ≈ 7　　　　Q = EMISSION RATE

$\bar{u}$ = MEAN WIND SPEED

h = EFFECTIVE STACK HEIGHT OF SOURCE

$\sigma_{z,k}$ = STANDARD DEVIATION OF THE VERTICAL CONCENTRATION (m) FOR THE K^{th} STABILITY CATEGORY

The model calculations for annual mean and short-term (3-hour and 24-hour ground level air pollutant concentrations were performed with the ISC dispersion models using one year of meteorological data (the Quinnesec, MI and Green Bay, WI meteorological data (1979) was previously described in the Decemb 1982 Air Permit Application, Exxon Minerals Company, 1982). For TSP, the meteorological data (1977) consisted of surface observations from Eau Claire, Wisconsin and upper air data from St. Cloud, Minnesota. The stationary (point) source air emission rates used in the modelling are found in Table 4.3. Actual input of emission rates for TSP in this table used the ton (st)/yr (annual) and 24-hour estimates (when available). The December 1982 Air Permit Application (Exxon Minerals Company, 1982), used the lb/hr estimates for SO_2, and NO_2 (NO_x) (when available).

Stationary (point) source stack emissions were modeled with horizontal discharge from structure walls, exceptions were: vertical discharge from the m exhausts (east exhaust raise [EER] and west exhaust raise [WER]), and secondary tertiary crushing and screening. All stack parameters are presented in Table 4

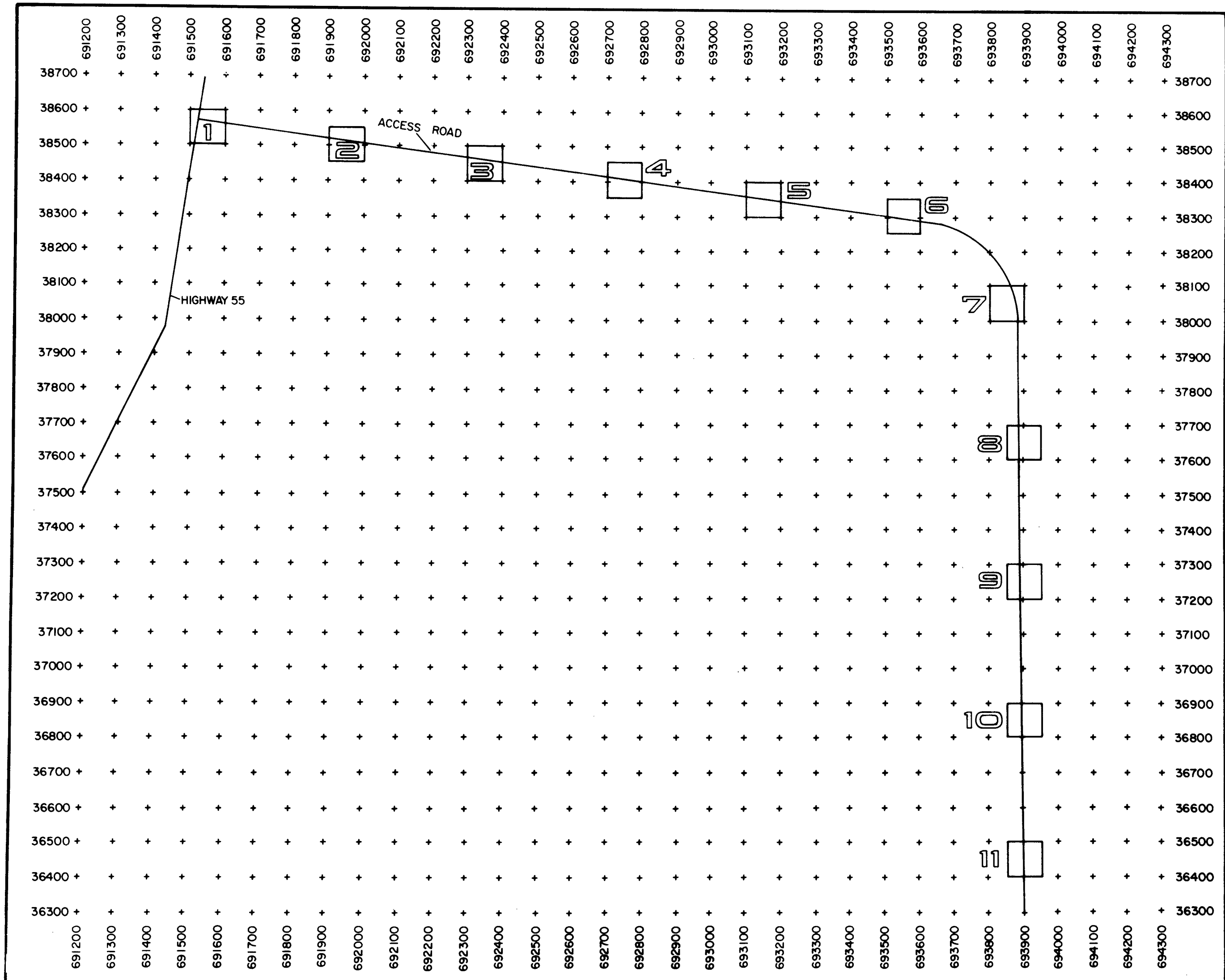
Area source inputs were used to represent emissions from: the mine/mill surface structure heating (1 square area = 400 m [1310 feet] per side), MWDF construction (2 square areas = 800 m [2625 feet] per side), the access road to mine/mill site (1 square area = 100 m [330 feet] per side) (Figure 4-4), and the haul road from the mine/mill site to the MWDF (1 square area = 100 m [330 feet] side) (Figure 4-5). These areas were assumed to have an effective plume height 1.0 m (3.3 feet) except the mine/mill surface structure heating which was assume

TABLE 4.3 TSP EMISSION RATES AS SPECIFIED FOR THE ANNUAL AND 24-HOUR CALCULATIONS OF THE ISC MODEL

No.	Sources	Coordinates X	Coordinates Y	Stk. Hgt. (m)	Stk. Dia. (m)	Exit Vel. (m/s)	Exit Temp. (K)	Building Hgt. (m)	Building Lgth. (m)	Building Width (m)	Emission Rate (g/s) Annual	Emission Rate (g/s) 24-Hour
Stack Sources												
1	Secondary and tertiary crushing and screening	94215	35770	26.0	1.0	0.01	294	35.0	21.0	22.0	0.242	0.789
2	Fine ore bin loading and unloading	94140	35770	38.0	0.84	20.4	294	35.0	15.0	30.0	0.168	0.565
3	Concrete batch plant	94470	35550	8.0	0.43	0.01	294	20.0	50.0	25.0	0.016	0.341
4	EER	93285	35590	3.7	6.71	8.33	294	0.0	0.0	0.0	0.397	3.45
5	WER	94625	354670	3.7	6.71	8.33	294	0.0	0.0	0.0	0.397	3.45
6	Diesel generator(A)	94155	35710	13.0	0.6	0.01	623	10.0	23.5	30.0	0.00231	0.116
7	Diesel generator(B)	94160	35710	13.0	0.6	0.01	623	10.0	23.5	30.0	0.00231	0.116
8	Diesel generator(C)	94165	35710	13.0	0.5	0.01	623	10.0	23.5	30.0	0.00138	0.0697
Area Sources						Length of Side (m)					$g/s\text{-}m^2$ $\times 10^{-7}$	$\times 10^{-7}$
9	Access road (road and tailpipe)	91500	38500	1.0	0.0	100.0					8.45	8.45
10	"	91900	38450	1.0	0.0	100.0					8.45	8.45
11	"	92300	38400	1.0	0.0	100.0					8.45	8.45
12	"	92700	38350	1.0	0.0	100.0					8.45	8.45
13	"	93100	38300	1.0	0.0	100.0					8.45	8.45
14	"	93500	38250	1.0	0.0	100.0					8.45	8.45
15	"	93800	38000	1.0	0.0	100.0					8.45	8.45

TABLE 4.3 (continued)

No.	Sources	Coordinates X	Coordinates Y	Stk. Hgt. (m)	Stk. Dia. (m)	Exit Vel. (m/s)	Exit Temp. (K)	Building Hgt. (m)	Building Lgth. (m)	Building Width (m)	Emission Rate (g/s)	
	Area Sources					Length of Side (m)					Annual x 10^{-7}	24-Hour x 10^{-7}
16	Access road (road and tailpipe	93850	37600	1.0	0.0	100.0					8.45	8.45
17	"	93850	37200	1.0	0.0	100.0					8.45	8.45
18	"	93850	36800	1.0	0.0	100.0					8.45	8.45
19	"	93850	36400	1.0	0.0	100.0					8.45	8.45
											x 10^{-6}	x 10^{-6}
20	Mine/mill site	93900	35700	1.0	0.0	300.0					4.27	4.33
21	"	94100	35600	1.0	0.0	100.0					4.16	4.16
22	"	94200	35600	15.0	0.0	400.0					4.27	4.33
23	"	94200	35400	1.0	0.0	200.0					4.16	4.16
24	"	94600	35800	1.0	0.0	200.0					4.17	4.17
25	Haul road	94700	35600	1.0	0.0	100.0					3.83	29.0
26	"	94700	35450	1.0	0.0	100.0					3.83	29.0
27	"	94900	35350	1.0	0.0	100.0					3.83	29.0
28	"	95100	35250	1.0	0.0	100.0					3.83	29.0
29	"	95250	3520	1.0	0.0	100.0					3.83	29.0
30	"	95450	35250	1.0	0.0	100.0					3.83	29.0
31	"	96650	35300	1.0	0.0	100.0					3.83	29.0
32	MWDF	95850	34700	1.0	0.0	800.0					5.07	6.85



NO.	SOURCES	COORDINATES X	COORDINATES Y
1	ACCESS ROAD	691500	38500
2	ACCESS ROAD	691900	38450
3	ACCESS ROAD	692300	38400
4	ACCESS ROAD	692700	38350
5	ACCESS ROAD	693100	38300
6	ACCESS ROAD	693500	38250
7	ACCESS ROAD	693800	38000
8	ACCESS ROAD	693850	37600
9	ACCESS ROAD	693850	37200
10	ACCESS ROAD	693850	36800
11	ACCESS ROAD	693850	36400

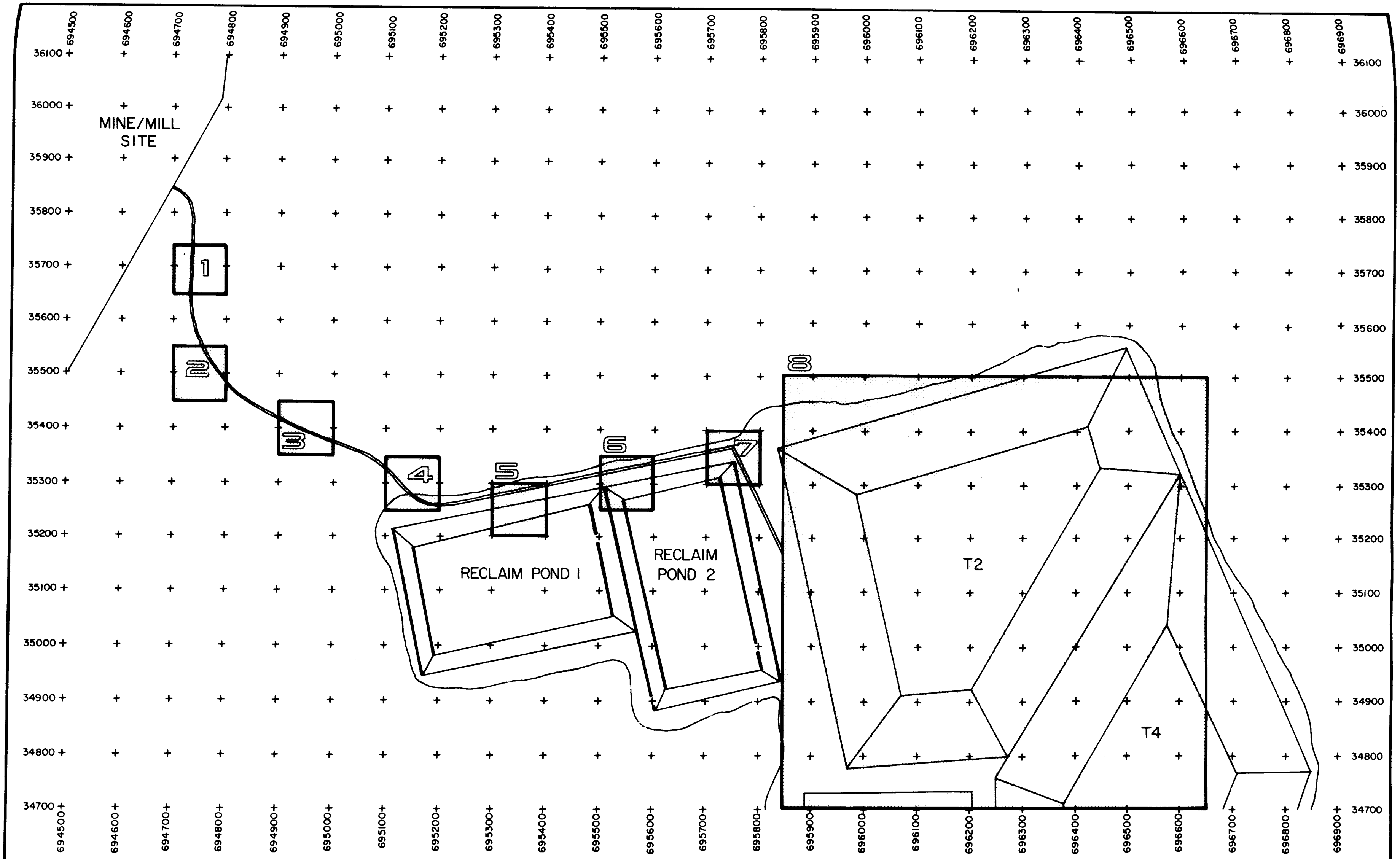
EXXON MINERALS COMPANY
CRANDON PROJECT

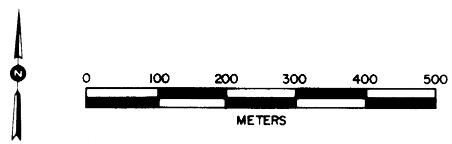
ACCESS ROAD EMISSIONS
AREA SOURCES

STATE WISCONSIN COUNTY FOREST
DRAWN BY B. MEDLIN DATE 07/84

FIGURE 4-4

384-1-142MB





NUMBER	SOURCE	COORDINATES X	Y
1	HAUL ROAD AREA	694700	35650
2	HAUL ROAD AREA	694700	35450
3	HAUL ROAD AREA	694900	35350
4	HAUL ROAD AREA	695100	35250
5	HAUL ROAD AREA	695300	35200
6	HAUL ROAD AREA	695500	35250
7	HAUL ROAD AREA	695700	35300
8	MWDF	695850	34700

EXXON MINERALS COMPANY
CRANDON PROJECT

HAUL ROAD EMISSIONS
AREA SOURCES

STATE: WISCONSIN
COUNTY: FOREST
DRAWN BY: B. MEDLIN DATE: 07/84
APPROVED BY: W. SADIK DATE: 07/84

FIGURE 4-5

384-1-140MB

to emit from a height of 15.0 m (50 feet) (Table 4.3). Area sources also included particle gravity settling parameters to estimate the rate at which these particles would actually settle after release from the sources. The particle gravity settling parameters are provided in Table 4.4

The meteorological data as input contained many conservative features such as the unrealistic occurrences of constant wind speeds, temperatures and/or wind directions. The data base also had occurrences of stability Classes E and F during the day and unstable Classes A through C at night. Therefore, use of the meteorological data containing these conditions would predict conservatively high ambient air contaminant concentrations.

The air emissions data used, also had the conservative assumption that all annual air emission rates were occurring for 24-hours per day, 365 days per year. This is obviously not the case for construction activities occurring only during daylight hours and as weather allows (i.e., precipitation and winter conditions). The mine and mill heating will also occur only during the winter (i.e., freezing temperatures) when needed.

4.2.2 Dispersion Model Description

The use of the ISC model for determining ambient air concentrations as a result of the Project emissions was conservative because of the inability of the model to predict effects from sources that emit from a location below surrounding grade elevations (i.e., such as the actual conditions present during construction of the MWDF 15 m (50 feet) embankments). The embankments will

Table 4.4

PARTICLE SIZE DISTRIBUTION AND GRAVITY SETTLING PARAMETERS FOR THE MODELLING CONDITIONS

p = 2.5 g/cm^3

Mean Diameter of Range (um)	Mass Fraction of Particles %		Settling Velocity (m/s)	Reflection Coefficient %
5	0.017	(0.127)*	0.003	0.87
15	0.043	(0.321)*	0.020	0.71
25	0.074	(0.552)*	0.048	0.63
		1.000 *		
35	0.084		0.096	0.51
45	0.108		0.155	0.36
55	0.094		0.230	0.17
65	0.104		0.322	0.0
75	0.099		0.430	0.0
85	0.087		0.550	0.0
95	0.094		0.690	0.0
105	0.092		0.830	0.0
115	0.072		1.010	0.0
125	0.030		1.230	0.0

*Used only for the access road, mine/mill site and haul road area sources estimated emission rates for which the emission factor had already partially adjusted for particle settling. Therefore, particles less than 30 microns diameter are totally accounted for in this range and none of the settling parameters for particles larger than 30 microns are used in the model calculations.

also reduce the air emission concentrations leaving the MWDF by shielding the dispersing winds as well as providing a retention barrier for gravitational settling of the particles. A similar barrier is provided by a north-south trending ridge located immediately to the east of the MWDF. Also, the attenuation effects provided by the vegetation surrounding the MWDF will reduce the transport of particles during the construction and operational activities at the facility. All of these mitigating factors are beneficial aspects reducing air emission concentrations which are not accounted for by the ISC model.

Air emission rates modeled for the MWDF did include the effects from gravity settling of particulate matter resulting from earthwork activities within the embankments. Size distributions for gravitational settling rates for the model calculations are provided in Table 4.4.

A dense receptor grid containing 123 locations was selected and used to identify the maximum predicted air quality effects from the Project. Receptors were located along the air emissions modelling (modelling) boundary, approximately 500 m (1,650 feet) beyond the modelling boundary, at the locations of the ambient air quality monitors, and to distances from the modelling boundary which were predicted to have TSP concentration changes of 1 (annual) and 5 (24-hour) ug/m^3 because of Project air emissions. Project air emission stationary sources have short stacks with release heights below building roof levels and the area sources for fugitive dust emissions are from near ground surface. For these reasons, maximum air emission concentrations from the Project sources will occur in close proximity to their point of origin with minimal effects beyond the modelling boundary. The actual receptor grid is presented on Figure 4.6.

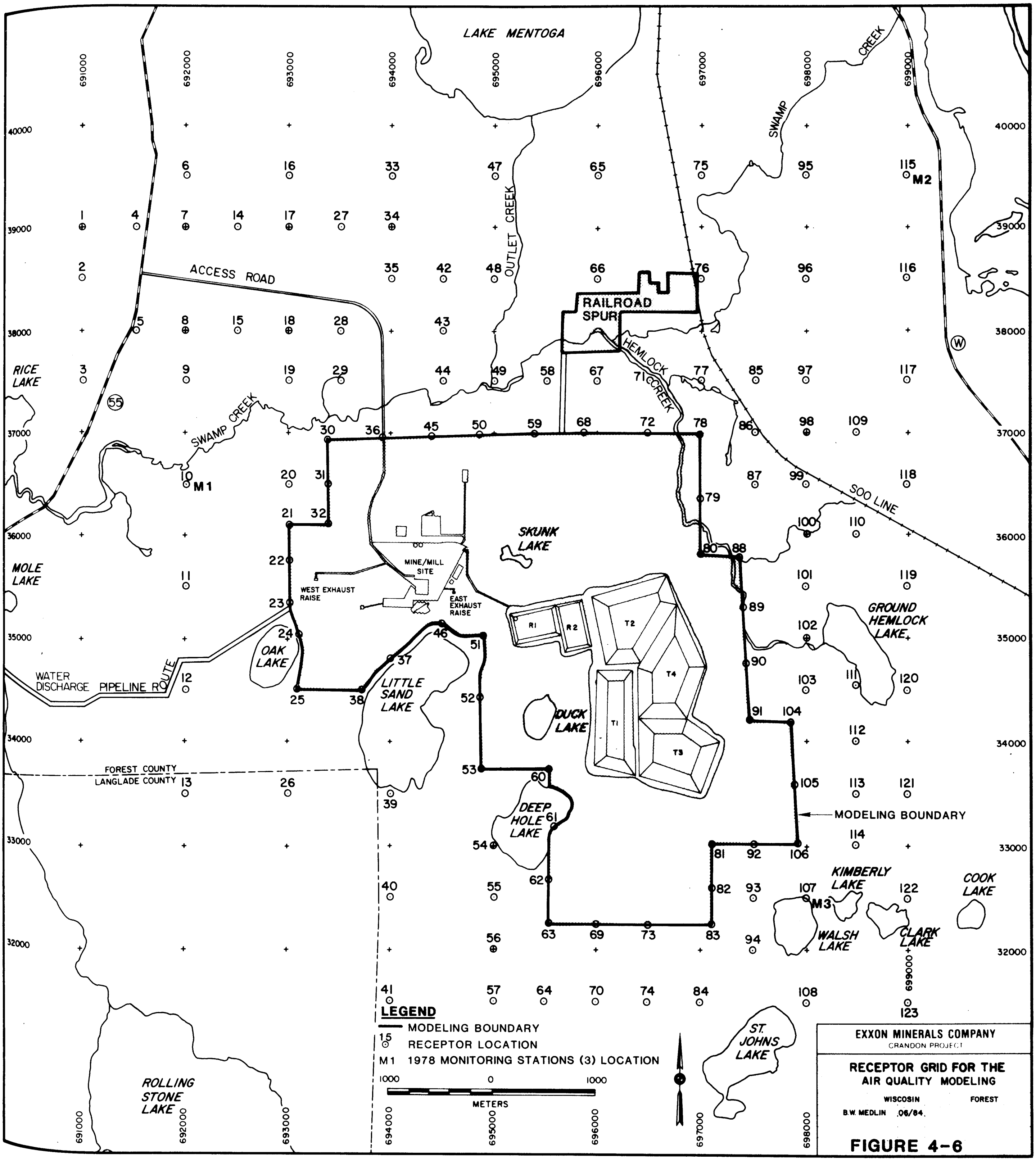


FIGURE 4-6

384-1-137MB2

4.2.3 Background Air Quality Concentrations

Ambient air quality monitoring data were used to estimate background concentrations of TSP, SO_2, and NO_2 from existing air emission sources. The background concentrations used for TSP and SO_2 were obtained from an ambient air monitoring program conducted in the site area (Dames and Moore, 1981a). This program included 3 TSP and 1 SO_2 sampler monitoring locations. Data at these locations was collected over a one year sampling period and represented upwind and downwind monitoring related to the Project site area.

The monitoring program data was used as a conservative estimate for ambient TSP background concentrations. The highest, second highest 24-hour TSP concentration of 77 ug/m^3 obtained from the three monitoring locations was used to represent background TSP concentrations. Background TSP concentrations for an annual average was obtained from the highest of the annual geometric means observed at the three TSP sampling locations (17.9 ug/m^3).

During this monitoring period, measured ambient concentrations of SO_2 did not exceed the 25 ug/m^3 minimum detectable limit of the analyzer. Therefore, background SO_2 concentrations for all averaging periods having an NAAQS (3-hour, 24-hour, and annual average) will use 25 ug/m^3. This value is a conservative estimate of the maximum SO_2 concentration in the site area.

This monitoring program did not measure ambient NO_2 concentrations. Therefore, the DNR recommended the use of 19.4 ug/m^3 as an annual average NO_2 concentration. This value was obtained from the nearest NO_2 monitoring site located in Sheboygan County, Wisconsin.

4.2.4 Project Related Air Quality Concentrations

The three primary air emissions modeled were TSP, SO_2, and NO_2. Results obtained from the modeling conservatively predicted the ambient concentrations produced by Project sources for areas adjacent to the modelling boundary. The actual input conditions for the TSP modelling are presented in Table 4.5.

Air emissions of TSP leaving the modelling boundary were initially calculated for all sources with the ISC model using the annual emission rates (Table 4.3), to obtain the predicted annual average and 50 maximum 24-hour concentrations (see Appendix C, Tables C-1, C-2, and C-3). The highest 10 days of the 50 maximum 24-hour concentrations from the annual emission rate calculations were then modified by remodelling them using the CALMPRO adjustment procedure (see Appendix C, Table C-4).

CALMPRO is an United States Environmental Protection Agency (EPA) computer program used with the ISC model to adjust the calculations of predicted concentrations for calm periods in the meteorological data (EPA, 1984). The basic mechanism of the CALMPRO adjustment procedure is to average the predicted

Table 4.5

THE INPUTS ACTUALLY USED IN THE ISC MODEL - ANNUAL

		Code
1.	Calculate concentrations	1
2.	Receptor grid system - rectangular	1
3.	Discrete receptor system - rectangular	1
4.	Terrain elevations - (operational	0
5.	Calculations to tape - yes	1
6.	List all input data with met data - yes	2
7.	Calculate annual conc. and produce N-day table	1
8.	Print highest and 2nd highest tables	1
9.	Meteorological data input - preprocessed Eau Claire-St. Cloud	1
10.	Rural option	0
11.	Wind profile exponent - default	1
12.	Vertical potential temperature gradient - default	1
13.	Scale emission rates for all sources - no	0
14.	Calculate final plume rise - program	1
15.	Stack heights adjusted for downwash - no	1
16.	Number of input sources	32
17.	Number of source groups	11
18.	Time interval - default	0
19.	No. of x-grid values	0
20.	No. of y-grid values	0
21.	Number of discrete receptors - minimum	100
22.	Source emission rate conversion factor - default	0
23.	Entrainment coefficient, unstable atmosphere - default	0
24.	Entrainment coefficient stable atmosphere - default	0
25.	Wind speed reference height	10
26.	K-coefficient - default	0
27.	Surface station number	14991
28.	Yr. of surface data	77
29.	Upper air station number	14926
30.	Yr. of upper air data	77
31.	Julian day input	365
32.	Sources (see Table 4.3)	
33.	Gravity settling (see Table 4.4)	

Table 4.5 (continued)

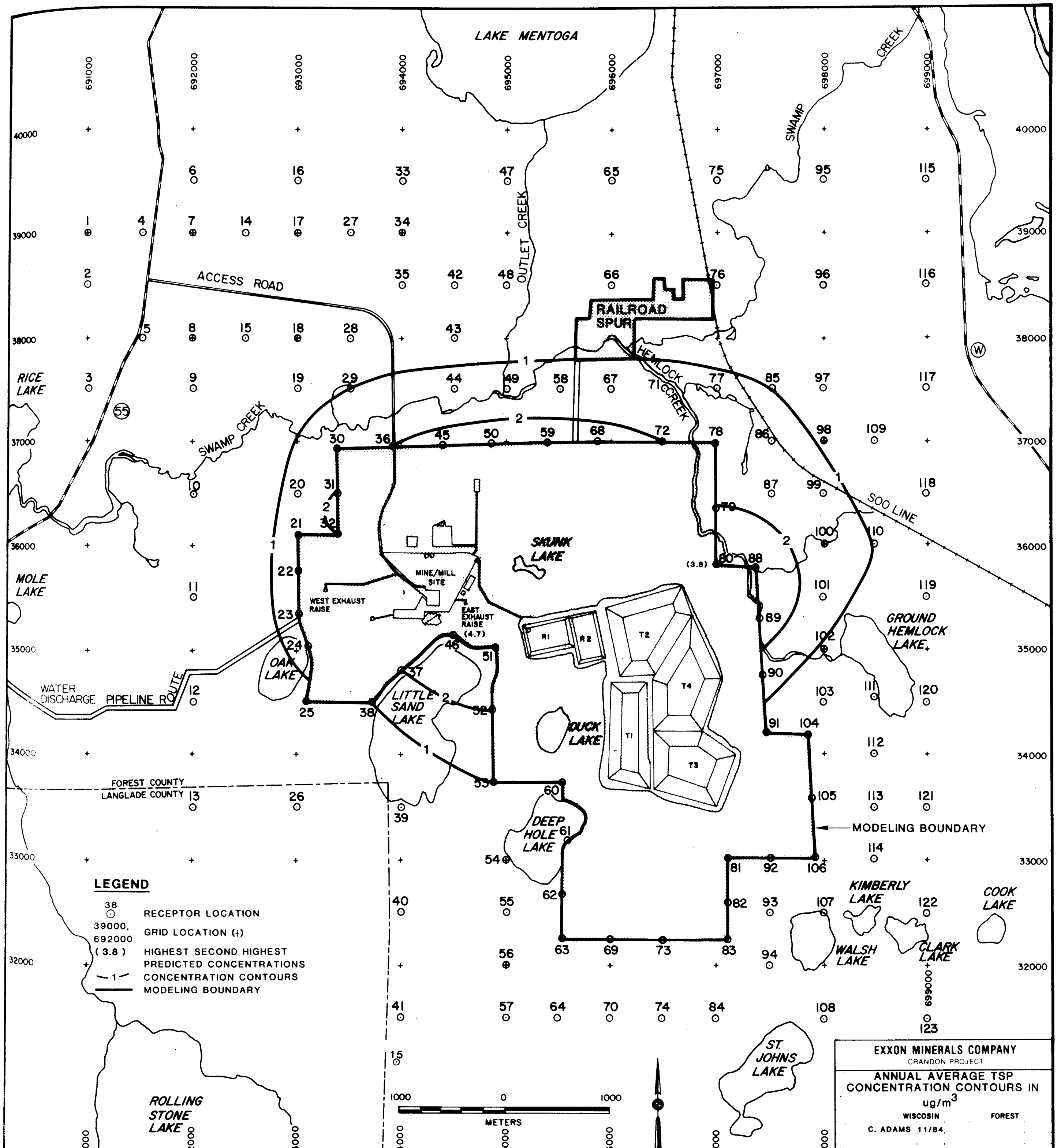
THE INPUTS ACTUALLY USED IN THE ISC MODEL - 24-HOUR

		Code
1.	Calculate concentrations	1
2.	Receptor grid system - rectangular	1
3.	Discrete receptor system - rectangular	1
4.	Terrain elevations - (operational	0
5.	Calculations to tape - yes	1
6.	List all input data with met data - yes	2
7.	Calculate annual conc. and produce N-day table	1
8.	Print highest and 2nd highest tables	1
9.	Meteorological data input - preprocessed Eau Claire-St. Cloud	1
10.	Rural option	0
11.	Wind profile exponent - default	1
12.	Vertical potential temperature gradient - default	1
13.	Scale emission rates for all sources - no	0
14.	Calculate final plume rise - program	1
15.	Stack heights adjusted for downwash - no	1
16.	Number of input sources	32
17.	Number of source groups	11
18.	Time interval - default	0
19.	No. of x-grid values	0
20.	No. of y-grid values	0
21.	Number of discrete receptors - minimum	100
22.	Source emission rate conversion factor - default	0
23.	Entrainment coefficient, unstable atmosphere - default	0
24.	Entrainment coefficient stable atmosphere - default	0
25.	Wind speed reference height	10
26.	K-coefficient - default	0
27.	Surface station number	14991
28.	Yr. of surface data	77
29.	Upper air station number	14926
30.	Yr. of upper air data	77
31.	Julian day input	Top 10 with CALMPRO
32.	Sources (see Table 4.3)	
33.	Gravity settling (see Table 4.4)	

concentrations for those hourly measurements of wind speeds which are less than 1 m/s (2.2 mph). The total number of calm hours and a general indication of the days which would be adjusted by the CALMPRO procedure is indicated by the data in Appendix C, Table C-5.

The maximum annual average TSP concentration predicted from all sources was 4.7 ug/m^3 at receptor 46 (Figure 4.7; Table C-2). The second highest annual average TSP concentration predicted from all sources was 3.8 ug/m^3 at receptor 80 (Figure 4.7; Table C-2). These predicted concentrations are an overestimate, because they have not been adjusted using the CALMPRO procedure (see Appendix C, Table C-6). The CALMPRO adjusted concentrations at receptors 46 and 80 are 1.9 (4.7-2.8) and 3.2 (3.8-0.6) ug/m^3, respectively (see Table C-6). These predicted TSP concentrations, either unadjusted or CALMPRO adjusted, are less than 7 percent of the primary federal and state standard of 75 ug/m^3. The predicted TSP concentrations beyond the modelling boundary are even lower (i.e., <2% of the standard), generally less than 1 ug/m^3 (Figure 4.7; Table C-2).

The 10 highest days from the predicted 50 maximum (MAX) annual average TSP concentrations were then modelled using the estimated 24-hour emission rates (see Tables 4.5 and C-7). Since there was one day (i.e., 248), which was listed twice in the ten highest, the eleventh listed day (i.e., 308) was included in the 24-hour emission rate calculations (Tables C-3 and C-7). The 10 highest days were also compared against the predicted highest 24-hour concentrations with the annual emission rates (Table C-4). This assured that those days likely to have the highest 24-hour concentrations were included in the model calculations with the

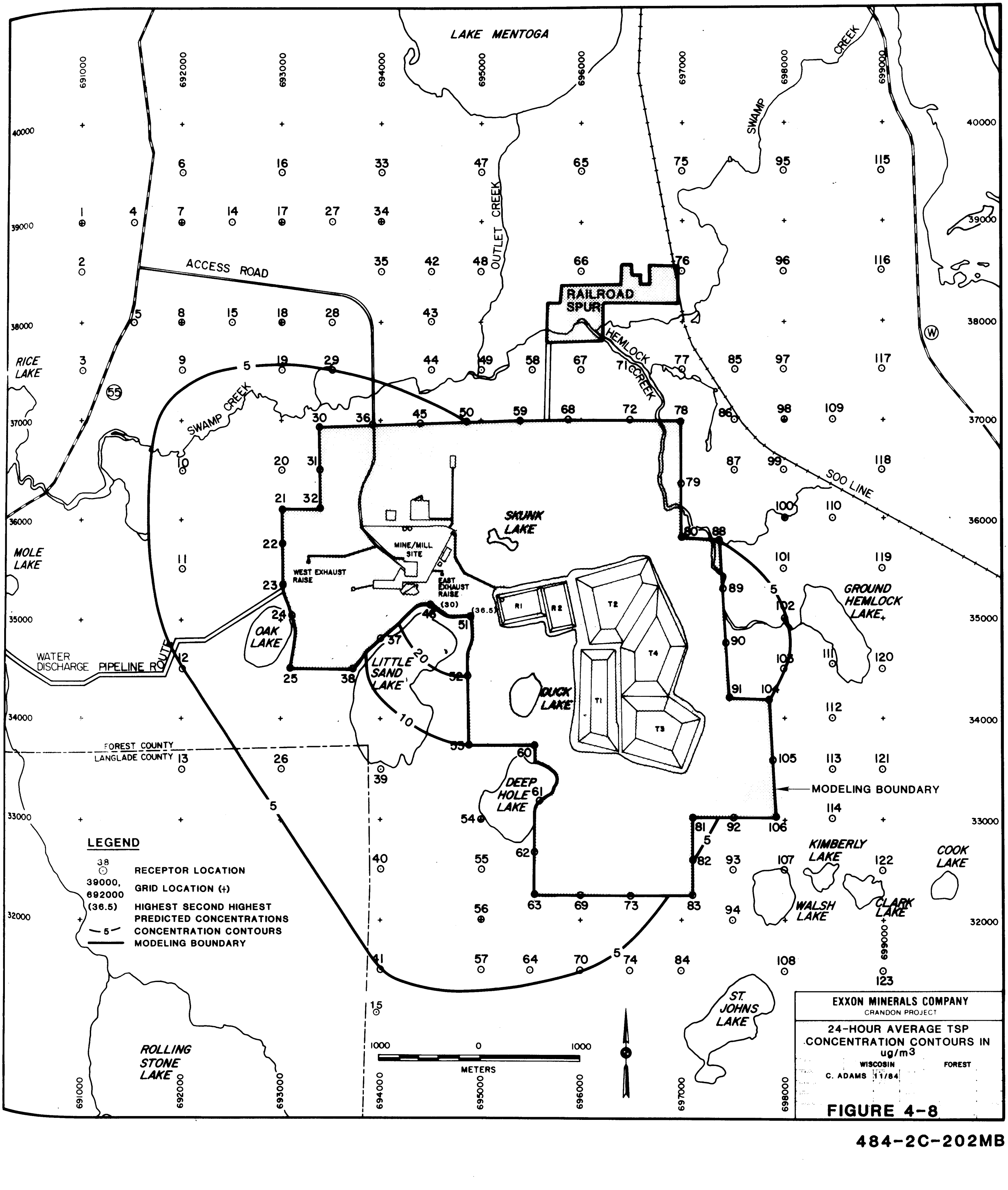

LAKE MENTOGA
SWAMP CREEK
OUTLET CREEK
ACCESS ROAD
RAILROAD SPUR
HEMLOCK CREEK
SOO LINE
RICE LAKE
MOLE LAKE
SKUNK LAKE
MINE/MILL SITE
WEST EXHAUST RAISE
EAST EXHAUST RAISE (4.7)
(3.8)
GROUND HEMLOCK LAKE
OAK LAKE
WATER DISCHARGE PIPELINE ROUTE
LITTLE SAND LAKE
DUCK LAKE
DEEP HOLE LAKE
MODELING BOUNDARY
FOREST COUNTY
LANGLADE COUNTY
KIMBERLY LAKE
COOK LAKE
WALSH LAKE
CLARK LAKE
ST. JOHNS LAKE
ROLLING STONE LAKE
LEGEND
RECEPTOR LOCATION
39000, 692000 GRID LOCATION (+)
(3.8) HIGHEST SECOND HIGHEST PREDICTED CONCENTRATIONS
CONCENTRATION CONTOURS
MODELING BOUNDARY
METERS
EXXON MINERALS COMPANY
CRANDON PROJECT
ANNUAL AVERAGE TSP CONCENTRATION CONTOURS IN ug/m3
WISCOSIN
FOREST
C. ADAMS 11/84
FIGURE 4-7

484-2C-200MB

24-hour emission rates. No differences were found, indicating that the 10 highest days from the predicted 50 maximum, did incorporate the days likely to have the meteorological conditions which would distribute air contaminants from Project facilities the farthest. The 24-hour emission rate model calculations included the CALMPRO adjustment procedure in obtaining the predicted 24-hour TSP concentrations.

The second highest 24-hour TSP concentration predicted for these 10 days with the 24-hour emission rates was 36.5 ug/m^3 at receptor 51 (Figure 4.8; Table C-8). The next highest predicted TSP concentration for these ten days was 29.7 ug/m^3 at receptor 46 (Table C-8). Receptors 46 and 51 are in a downwind direction of easterly winds (i.e., west of the MWDF). These predicted TSP concentrations occurred on days 256 (29.7 mg/m^3) and 275 (36.5 mg/m^3), and were a result of construction activities at the MWDF.

These predicted TSP concentations are conservatively high since they are a result of an easterly wind direction and velocity (i.e., 5.6 and 6.7 m/s [12.3 and 14.7 miles per hour]; see Appendix A), which is not predominant or usual for the MWDF area. The Eau Claire meteorological data has a strong easterly component wind speed not likely to be found at the MWDF. In comparing the annual wind roses for the Eau Claire and site area monitoring data, the ENE, E, and ESE component wind directions are measured less than 5% of the year for the site area and generally 5% for the Eau Claire meteorological data (see Figures 3-3 and 4-1). Further, the average wind speed for the NE, E and ESE sectors is approximately 25% lower for the site area than the Eau Claire data (see Figures 3-3 and 4-1). Therefore, the wind direction and speed conditions which were modelled are likely a rare occurrence for


LAKE MENTOGA
RAILROAD SPUR
ACCESS ROAD
HEMLOCK CREEK
OUTLET CREEK
SWAMP CREEK
SOO LINE
RICE LAKE
MOLE LAKE
SKUNK LAKE
MINE/MILL SITE
WEST EXHAUST RAISE
EAST EXHAUST RAISE
OAK LAKE
LITTLE SAND LAKE
DUCK LAKE
DEEP HOLE LAKE
GROUND HEMLOCK LAKE
KIMBERLY LAKE
COOK LAKE
WALSH LAKE
CLARK LAKE
ST. JOHNS LAKE
ROLLING STONE LAKE
WATER DISCHARGE PIPELINE ROUTE
FOREST COUNTY
LANGLADE COUNTY
MODELING BOUNDARY
LEGEND
RECEPTOR LOCATION
GRID LOCATION (+)
(36.5) HIGHEST SECOND HIGHEST PREDICTED CONCENTRATIONS
CONCENTRATION CONTOURS
MODELING BOUNDARY
METERS
EXXON MINERALS COMPANY
CRANDON PROJECT
24-HOUR AVERAGE TSP CONCENTRATION CONTOURS IN ug/m3
WISCONSIN FOREST
C. ADAMS 11/84
FIGURE 4-8
484-2C-202MB

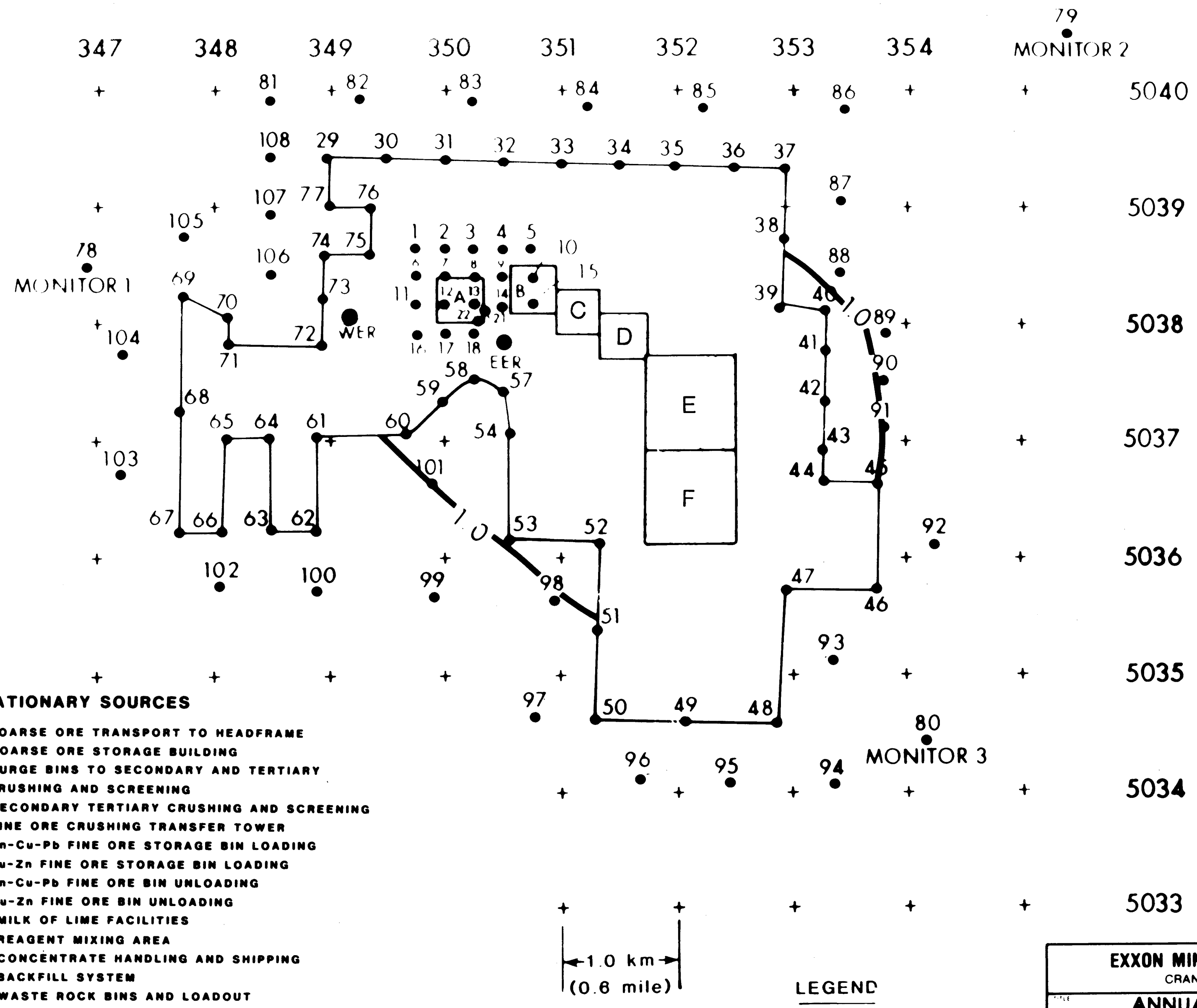
the site area. In addition, the modelling of the fugitive sources air emissions did not include reducing effects to local wind velocities of the higher elevations east and northeast of the MWDF or its 15.2 m (50 feet) embankments.

As a final assurance that the likely "worst case" meteorological conditions and resulting predicted TSP concentrations were included in the analysis, the highest 5 and 10 days of the predicted high and second high 24-hour TSP concentrations, respectively, from the annual emission rate calculations, were also modelled with the 24-hour emission rates (Table C-9, C-10 and C-11). In effect, this resulted in the highest 25 days of predicted 24-hour TSP concentrations with the annual emission rates being modelled with the 24-hour emission rates. The range of the predicted TSP concentrations was from 9.2 to 28.9 ug/m^3 (Tables C-12, C-13 and C-14). This confirmed that the highest predicted ambient TSP concentration was obtained by modelling the 10 maximum days of the annual emission rate calculations. It also indicated that the highest predicted TSP concentrations from these days with the 24-hour emission rates did not exceed the second highest value of 29.7 ug/m^3 for day 256. Thus, the predicted 36.5 ug/m^3 TSP concentration is very conservative.

The highest 24-hour average TSP concentration from stationary sources (excluding the access and haul roads, and the MWDF) was 18.8 ug/m^3 (Table C-15) at receptor No. 46, which has no additive effect on any other receptors. This concentration was attributable to the secondary and tertiary crushing and screening, and the EER, which have their release locations immediately northwest and north of this receptor. This maximum predicted 24-hour average TSP concentration for the stationary sources is less than 8 and 13 percent of the secondary standards (260 and 150 ug/m^3, respectively; see Table 4.7).

Air emissions of SO_2 from Project sources were predicted using the Quinnesec meteorological data for a 365-day annual, 24-hour second highest, and 3-hour second highest occurrence (see the December 1982 Air Permit Application, Appendix C - Tables C-6, C-7 and C-8 [Exxon Minerals Company, 1982]). The predicted maximum annual SO_2 concentration was 2.0 ug/m^3 which occurred at receptor No. 52 (60) (Figures 4-9 and 4.10). The second highest, 24-hour and 3-hour predicted concentrations were 24.9 and 186.0 ug/m^3, respectively, which also occurred at receptor No. 52 (60) (see the December 1982 Air Permit Application, Appendix C - Tables C-7 and C-8 [Exxon Minerals Company, 1982]). Annual average SO_2 concentrations predicted beyond the modelling boundary are also presented on Figures 4-9 and 4-10. Figure 4-10 is simply the presentation of the data from Figure 4-9 on the new receptor grid developed for the TSP calculations of this report. Therefore, it also provides a compatible comparison with the predicted SO_2 (see Figure 4-9) and TSP (see Figure 4-7) concentrations.

These predicted SO_2 concentrations resulted from mobile source air emissions during construction activities being conducted at the MWDF. However, because the model assumed such activities were being performed for a full day, and the 3-hour second highest concentration occurred during Period 8 (9:00 pm to 12:00 am), a time period during which no actual MWDF construction activity will be conducted, this predicted value represents an unrealistic condition. Similarly, it represents a strong easterly component to the wind direction, which as mentioned above (see subsections 4.1.1 and 4.2.2), is a conservative prediction.



STATIONARY SOURCES

1. COARSE ORE TRANSPORT TO HEADFRAME
2. COARSE ORE STORAGE BUILDING
3. SURGE BINS TO SECONDARY AND TERTIARY CRUSHING AND SCREENING
4. SECONDARY TERTIARY CRUSHING AND SCREENING
5. FINE ORE CRUSHING TRANSFER TOWER
6. Zn-Cu-Pb FINE ORE STORAGE BIN LOADING
7. Cu-Zn FINE ORE STORAGE BIN LOADING
8. Zn-Cu-Pb FINE ORE BIN UNLOADING
9. Cu-Zn FINE ORE BIN UNLOADING
10. MILK OF LIME FACILITIES
11. REAGENT MIXING AREA
12. CONCENTRATE HANDLING AND SHIPPING
13. BACKFILL SYSTEM
14. WASTE ROCK BINS AND LOADOUT
15. WASTE ROCK CRUSHING PLANT
16. CONCRETE BATCH PLANT
17. MINE EXHAUST-EER
18. MINE EXHAUST-WER

AREA SOURCES

A	MINE/MILL SURFACE FACILITIES HEATING
B,C,D	HAUL ROAD
E,F	MWDF

LEGEND

-1.0 - CONCENTRATION CONTOURS

29-108 = RECEPTORS

347, 5040 = GRID LOCATION (+)

EXXON MINERALS COMPANY
CRANDON PROJECT

ANNUAL AVERAGE
SO_2 CONCENTRATION CONTOURS
IN $\mu g/m^3$

SCALE AS SHOWN
DRAWN BY IM

FIGURE 4-9

484-2C-207M

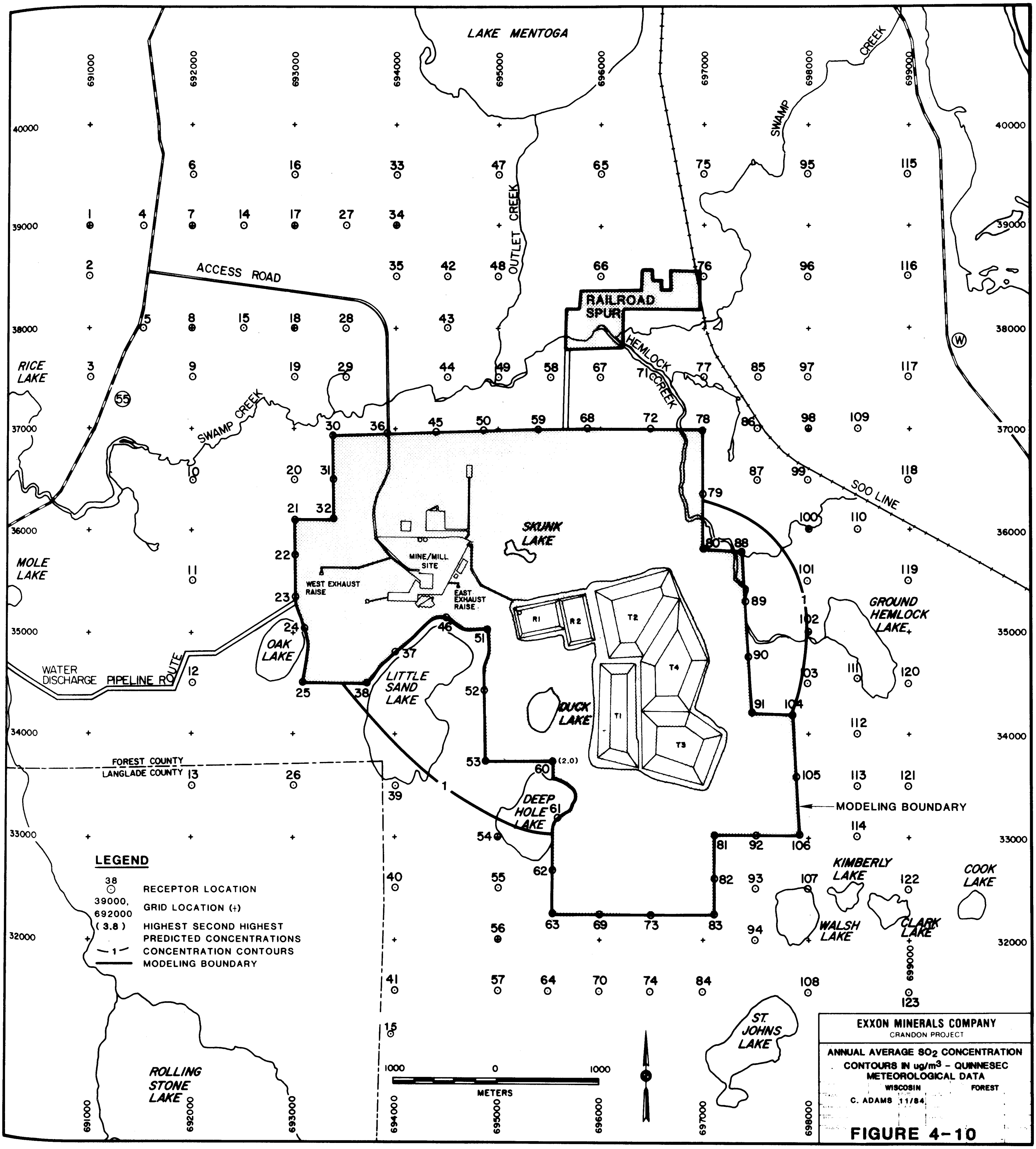
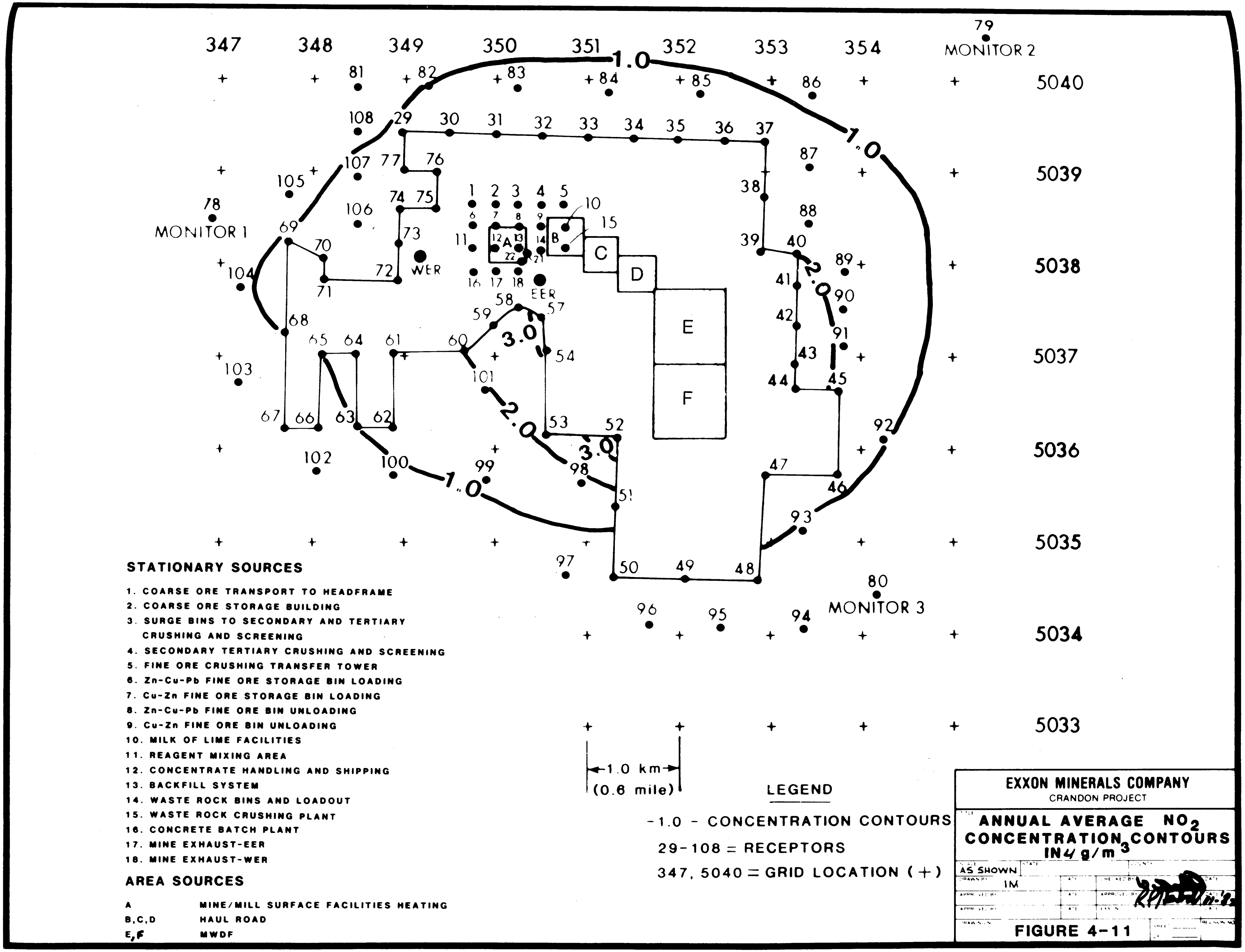


FIGURE 4-10

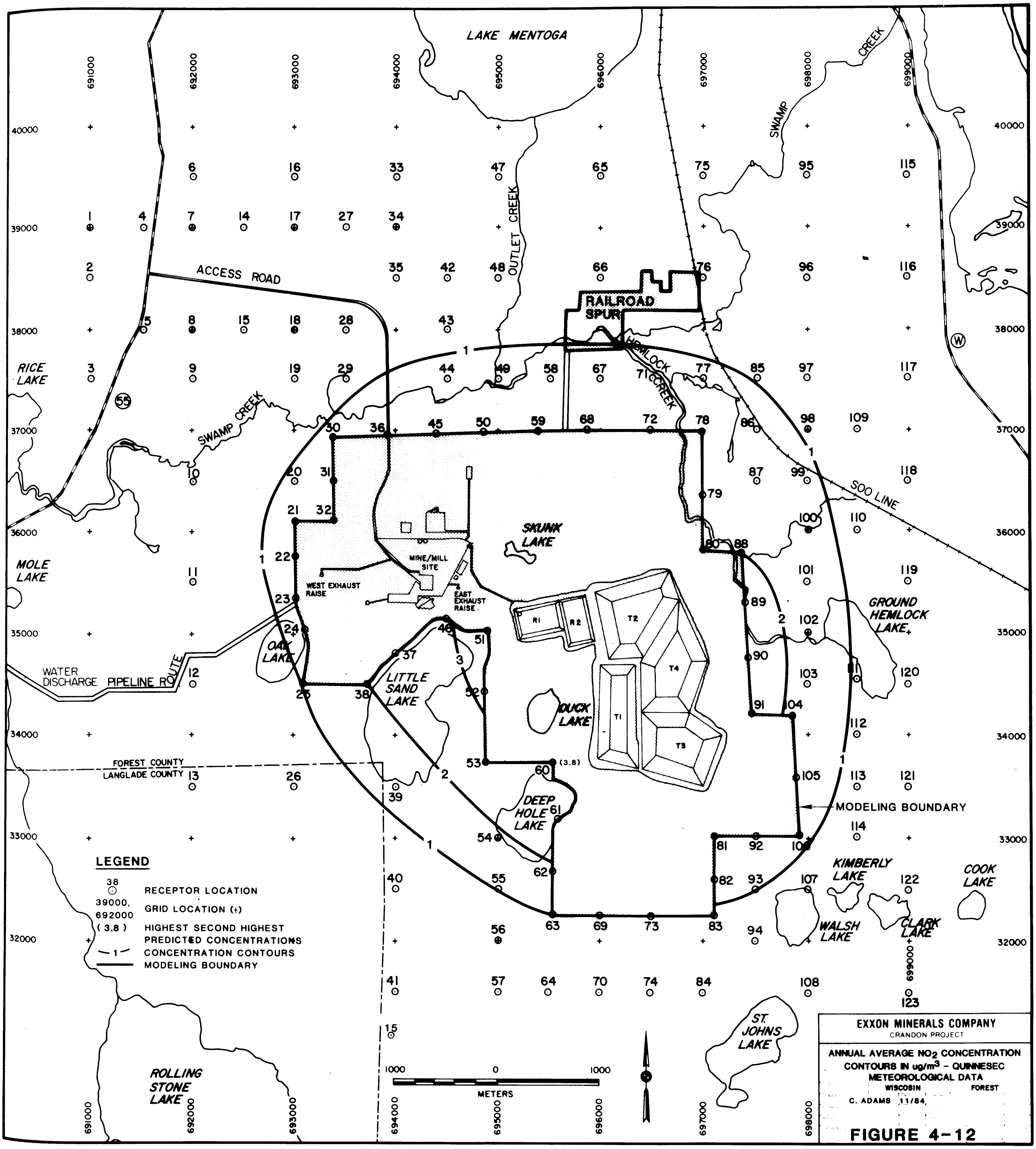
484-2C-203MB

The highest predicted annual NO_2 ground level concentration was 3.8 ug/m^3 at receptor No. 52 (60) (Figures 4-11 and 4-12) using the Quinnesec meteorological data (see the December 1982, Air Permit Application, Appendix C - Table C-9 [Exxon Minerals Company, 1982]). The principle source of this low concentration appears to be mobile vehicles at the MWDF. All 365 days of meteorology data were used in the model thus providing an extremely conservative set of predicted values. Predicted concentrations for NO_2 leaving the modelling boundary are also presented on Figures 4-11 and 4-12. Figure 4-12 is again just the presentation of the data from Figure 4-11 on the new receptor grid developed for the TSP calculations of this report.

Carbon monoxide (CO) concentrations were not modelled for the Crandon Project sources, but were estimated by interpolation from the SO_2 results. Initially, the estimated SO_2 and CO air emissions (see also the December 1982 Air Permit Application, Exxon Minerals Company, 1982) for the various sources during facility operations were grouped and compared for their total emission rate quantities (Table 4-6). The estimates of SO_2 and CO emissions provided in this report (see Appendices B and D) are actually much lower than those of the December 1982 Air Permit Application (Exxon Minerals Company, 1982). However, since the SO_2 model calculations performed in 1982 used higher estimated emission rates, the analysis presented here maintains the continuity with the earlier data and represents a conservative (i.e., higher) comparison with the standards (see Table 4.7). The maximum estimated SO_2 emission rate was from the MWDF sources at 1.95 g/s (Table 4.6; see also Table 2.6 of the December 1982 Air Permit Application, Exxon Minerals Company, 1982). The maximum estimated CO emission rate from the same sources was


347
348
349
350
351
352
353
354
5040
5039
5038
5037
5036
5035
5034
5033
MONITOR 1
MONITOR 2
MONITOR 3
WER
EER
A
B
C
D
E
F
1.0
2.0
3.0
STATIONARY SOURCES
1. COARSE ORE TRANSPORT TO HEADFRAME
2. COARSE ORE STORAGE BUILDING
3. SURGE BINS TO SECONDARY AND TERTIARY CRUSHING AND SCREENING
4. SECONDARY TERTIARY CRUSHING AND SCREENING
5. FINE ORE CRUSHING TRANSFER TOWER
6. Zn-Cu-Pb FINE ORE STORAGE BIN LOADING
7. Cu-Zn FINE ORE STORAGE BIN LOADING
8. Zn-Cu-Pb FINE ORE BIN UNLOADING
9. Cu-Zn FINE ORE BIN UNLOADING
10. MILK OF LIME FACILITIES
11. REAGENT MIXING AREA
12. CONCENTRATE HANDLING AND SHIPPING
13. BACKFILL SYSTEM
14. WASTE ROCK BINS AND LOADOUT
15. WASTE ROCK CRUSHING PLANT
16. CONCRETE BATCH PLANT
17. MINE EXHAUST-EER
18. MINE EXHAUST-WER
AREA SOURCES
A MINE/MILL SURFACE FACILITIES HEATING
B,C,D HAUL ROAD
E,F MWDF
1.0 km
(0.6 mile)
LEGEND
-1.0 - CONCENTRATION CONTOURS
29-108 = RECEPTORS
347, 5040 = GRID LOCATION (+)
EXXON MINERALS COMPANY
CRANDON PROJECT
ANNUAL AVERAGE NO2 CONCENTRATION CONTOURS IN µg/m3
AS SHOWN
IM
FIGURE 4-11

484-2C-206M


LAKE MENTOGA
RICE LAKE
MOLE LAKE
SKUNK LAKE
OAK LAKE
LITTLE SAND LAKE
DUCK LAKE
DEEP HOLE LAKE
GROUND HEMLOCK LAKE
KIMBERLY LAKE
WALSH LAKE
CLARK LAKE
COOK LAKE
ST. JOHNS LAKE
ROLLING STONE LAKE
ACCESS ROAD
RAILROAD SPUR
HEMLOCK CREEK
OUTLET CREEK
SWAMP CREEK
SOO LINE
WATER DISCHARGE PIPELINE ROUTE
FOREST COUNTY
LANGLADE COUNTY
MINE/MILL SITE
WEST EXHAUST RAISE
EAST EXHAUST RAISE
MODELING BOUNDARY
LEGEND
RECEPTOR LOCATION
39000, 692000 GRID LOCATION (+)
(3.8) HIGHEST SECOND HIGHEST PREDICTED CONCENTRATIONS
CONCENTRATION CONTOURS
MODELING BOUNDARY
METERS
EXXON MINERALS COMPANY
CRANDON PROJECT
ANNUAL AVERAGE NO2 CONCENTRATION CONTOURS IN ug/m3 - QUINNESEC METEOROLOGICAL DATA
WISCOSIN
FOREST
C. ADAMS 11/84
FIGURE 4-12

484-2C-201MB

TABLE 4.6

INTERPOLATED CO CONCENTRATIONS FROM THE MODELLED SO_2 CONCENTRATIONS OF THE PROJECT SOURCES

Source Group		Air Emissions Rate (g/s) SO_2	Air Emissions Rate (g/s) CO	Conversion Factor
Mine Shafts		1.33[a]	40.08[a]	30.14
Mine/Mill Heating		0.008[b]	0.23[b]	28.75
MWDF		1.95[b]	7.08[b]	3.63
Haul Road		0.003[b]	0.23[b]	76.67
		Concentrations (ug/m^3)		
		SO_2[c]	CO	
Mine Shafts and Mine/Mill Heating	(3-hour)	7.05	212.5	
	(24-hour)	1.77	53.4	
MWDF	(3-hour)	185.99	675.1	
	(24-hour)	24.95	90.6	
Haul Road	(3-hour)	0.67	51.4	
	(24-hour)	0.06	4.6	

a. See the December 1982 Air Permit Application, Appendix C - Table C-1 (Exxon Minerals Company, 1982).

b. See the December, 1982 Air Permit Application, Tables 2.4 and 2.6 (Exxon Minerals Company, 1982)

c. High-second high value calculated by the ISC model (see the December 1982 Air Permit Application, Appendix C - Tables C-7, C-8, C-11 and C-12 [Exxon Minerals Company, 1982]).

7.08 g/s which provides a conversion factor of 3.63. However, comparisons for other source groups with generally lower emission rates, had higher conversion factors of 30.14, 28.75 and 76.67 (Table 4.6).

If the MWDF source group, which had the highest modelled SO_2 concentrations, is used to convert the predicted SO_2 concentration to an equivalent CO concentration, the values are 675.1 (3-hour) and 90.6 (24-hour) ug/m^3 (Table 4.6). Estimates for the mine shafts and mine/mill heating, and the haul road sources, with conversion factors of 30.14 and 76.67, respectively, have an equivalent CO concentration of 212.5 and 51.4 (3-hour), and 53.4 and 4.6 (24-hour) ug/m^3, respectively (Table 4.6).

The standards for CO are established for 1-hour and 8-hour concentrations. conservative (i.e., higher) estimate for these periods was developed by using the 3-hour concentration. These estimates are conservative because their calculation assumes the CO concentration for 3-hours is emitted at that concentration for each and every hour, which is unrealistic. The estimates for 1-hour and 8-hour CO concentrations assuming this 3-hour concentration are 2025.3 (675.1/hr x 3 hrs) and 1802.5 (675.1 x 2 + 675.1 x 0.67) ug/m^3, respectively. These concentrations are well within the concentration limits of CO for exceedance of the standards (see Table 4.7).

Similarly, hydrocarbon (HC) and lead (Pb) concentrations were not modelled for the Project sources, but were estimated by interpolation from the NO_x and TSP results, respectively. These estimates are conservatively biased because of the assumptions that the relationships are linear (i.e., there is actually less HC and

Pb emitted than directly proportional to the respective NO_x and TSP concentrations), that there is no reactive mechanisms for these air contaminants, and the use of the highest emission rates and modeled concentrations for NO_x and TSP.

Hydrocarbon (HC) emissions from the Project will be released from heating the mine and mine/mill surface facilities, operation of diesel and gasoline vehicles, and from the handling and storage of liquid fuels for these vehicles. The estimated ambient concentrations can be conservatively compared with modeled SO_2 (3-hour) and annual SO_2 and NO_x quantities, and their relation with emission rates from NO_x sources. This estimating procedure was used because HC emission rates are more accurately related to those of NO_x than to SO_2, but the model calculations do not derive a 3-hour NO_x concentration. The NO_x and SO_2 modeled concentrations can be compared from their emission rates. In addition to the previously mentioned reasons, this estimate is also conservative because it assumes that all NO_x emission sources have an HC component (i.e., which is unrealistic).

The maximum annual NO_x stationary and mobile source emissions from operation of the mine, mine/mill surface facilities, and construction of the MWDF are 79.2 (Table 2.2), 17.7 (Table 2.4), and 0.4 (Table 2.5) short tons per year, respectively. Annual HC emissions from these sources are 1.4, 6.8, and 0.1 short tons per year, respectively. Therefore, estimated total annual air emissions are 97.3 and 8.3 short tons per year for NO_x and HC, respectively. Estimated annual HC emissions are approximately 9 percent of NO_x concentrations.

The standard for HC (160 ug/m^3) is established for a 3-hour maximum concentration. The modeled calculations for NO_x do not include a 3-hour prediction so that comparison between SO_2 and NO_x concentrations were also required prior to interpolation for estimated HC concentrations. With the Quinnesec meteorological data and the higher estimates (i.e., than presented in this report) for the SO_2 and NO_x emission rates, the modeled maximum annual average SO_2 and NO_x concentrations were 2.0 and 3.8 ug/m^3 (see the December 1982 Air Permit Application, Appendix C - Tables C-6 and C-9 [Exxon Minerals Company, 1982]), respectively, at receptor No. 52 (60) (see Figures 4-9, 4-10, 4-11, and 4-12). Therefore, the estimated annual average NO_x concentrations are 190 percent higher than SO_2. The modeled highest maximum average 3-hour SO_2 concentration is 186.0 ug/m^3. The estimated highest maximum average 3-hour NO_x concentration would be 353.4 ug/m^3. Estimated HC emissions are approximately 9 percent of NO_x concentrations, indicating a calculated maximum average 3-hour HC concentration of 31.8 ug/m^3.

Lead emissions from the Project will be released as small particles and as a result the estimated ambient concentrations can be conservatively compared with modeled TSP quantities. This estimate is conservative because of the above reasons (see subsections 4.1.1 and 4.2.2), as well as the assumption that all TSP emission sources have a lead component (which is unrealistic), and that these ambient concentrations are at maximum for the complete time period.

The maximum annual TSP stationary source emissions during operation are from the mine and mine/mill surface facilities. The values are 27.6 and 32.0 short tons per year for the mine (Table 2.2) and mine/mill surface facilities (Table

2.4), respectively. Lead emissions from these sources are 0.002 and 0.1 short tons per year, respectively. Therefore, total estimated air emissions are 0.102 and 59.6 short tons per year for Pb and TSP, respectively. Estimated Pb emissions are approximately 0.2 percent of TSP concentrations. The modeled stationary source maximum 24-hour average TSP concentration was 18.8 ug/m^3 at receptor No. 46 (see Figure 4-8 and Table C-15). The estimated maximum 24-hour average lead concentration would be 0.04 ug/m^3 (18.8 x 0.002) at this receptor.

The primary and secondary standard for lead is 1.5 ug/m^3 for a 3-month (90 day) average concentration. Therefore, the estimated maximum 3-month average lead concentration at receptor No. 46 (see Figure 4-8) would be 0.04 ug/m^3. This conservatively estimated concentration is less than 3 percent of the standard (see Table 4.7).

Similarly, extremely low concentrations can be predicted for other metals which might be hypothesized as associated with the particles having an origin from Project activities. For example, the highest 24-hour average TSP concentration predicted by the ISC model at the property boundary for all sources is approximately 37 ug/m^3 (see Tables 4.7 and C-8). Since most of these particles will originate from the soil because of construction activities (i.e., excavation and embankment development), approximately 8 percent (5.8 wind-blown tailings ÷ 78.1 excavation [hauling] loading and dumping; see Table 2.5 and Appendix B - V.4) of the particles from the predicted 37 ug/m^3 might actually be wind-blown tailings from the disposal pond then currently in operation (see Table 2.5). Therefore, only a small percentage of the particles will have metal concentrations similar to that of the impounded tailings (see Table 3.9 of the MWDF - Feasibility Report, Exxon Minerals Company, 1984).

For the following metals, the concentrations in ppm (parts per million) estimated for the tailings are: aluminum (Al) - 45,000; arsenic (As) - 900; cadmium (Cd) - 16; copper (Cu) - 1,690; mercury (Hg) - 2.2; and zinc (Zn) - 5,410. This represents the following percent of these metals for each particle; Al - 4.5, As - 0.09, Cd - 0.0016, Cu - 0.169, Hg - 0.00022, and Zn - 0.541. The concentrations in ug/m^3 of these metals, which can then be conservatively (i.e., higher) predicted at the location calculated from the ISC model to have the highest 24-hour average TSP concentration (37 ug/m^3), are: Al - 0.01 (i.e., 37 x 0.045 x 0.008), As - 0.0003, Cd - 0.000005, Cu - 0.0005, Hg-0.0000006, and Zn - 0.002. Even a "worst case" assumption that all of the particles were wind-blown tailings would only predict metal concentrations of the TSP particles as Al - 1.67 (i.e., 37 x 0.045), As - 0.03, Cd - 0.0005, Cu - 0.06, Hg - 0.00008, and Zn - 0.2 ug/m^3, respectively.

These concentrations can be compared with the Threshold Limit Values (TLV) recommended as guidelines for worker exposures by the American Conference of Governmental Industrial Hygienists (ACGIH). Threshold limit values generally refer to airborne concentrations of substances to which "...it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect." (ACGIH, 1982). The recommended TLV concentrations for the above metals in ug/m^3 are: Al - 10000.0, As - 200.0 (soluble), Cd - 50.0, Cu - 1000.0, Hg - 50.0, and Zn - 5000.0. As indicated by the conservatively extrapolated property boundary values (see subsections 4.1.1 and 4.2.2) and the TLV concentrations recommended for repeated exposures (i.e., not a conservatively estimated maximum single event), dispersed particles from Project facilities at the property boundary will be below the guidelines of the ACGIH for worker health (ACGIH, 1982). These predicted metal concentrations of TSP from Project activities at the modelling boundary are 0.02 percent of the ACGIH guidelines.

4.2.5 Comparison with Applicable Ambient Air Quality Standards

The predicted ambient air quality parameter concentrations presented in subsection 4.2.4 are added to the previously discussed background concentrations to provide the estimated Project impact on ambient air quality standards. Comparisons with the National Ambient Air Quality Primary and Secondary Standards are presented in Table 4.7. As indicated in Table 4.7, the combined background and estimated Project air emissions maintain all state and federal ambient air quality standards during the construction, operation, and closure (reclamation) phases.

Two programs will be conducted during these phases to assure protection and maintenance of all state and federal ambient air quality standards. These programs are for air quality monitoring and pollution equipment operation and maintenance. These programs will ultimately be part of the Mine Permit (NR 132) - Monitoring and Quality Assurance Plan, and the Air Permit (NR 154) - Malfunction Prevention and Abatement Plan. The Malfunction Prevention and Abatement Plan will also include programs to assure consistency with federal regulations such as the NSPS for metallic mineral processing plants. Final design of the programs will be completed with the DNR before their initiation.

4.2.6 Net Air Quality Effects

The net air quality effects predicted for the construction, operation, and reclamation phases of the Project will be minimal. Areas of interest related to

TABLE 4.7

COMPARISON OF STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS[a]
WITH ISC MODEL PREDICTED CONCENTRATIONS FOR THE PROJECT
AT THE MODELLING BOUNDARY
(All Concentrations in ug/m3)

	PREDICTED CONCENTRATION FROM CRANDON PROJECT	BACKGROUND CONCENTRATION	SUMMED CONCENTRATION	PRIMARY NAAQS	SECONDARY NAAQS
SULFUR DIOXIDE					
Annual	0.1[b](2.1)[c]	25.0	25.1 (27.1)	80	--
24-Hour	1.8 (24.9)	25.0	26.8 (49.9)	365	--
3-Hour	7.1 (186.0)	25.0	32.1 (211.0)	--	1,300
PARTICULATE MATTER (TSP)					
Annual	3.8	17.9	21.7	75	60
24-Hour	36.5	77.0	113.5	260	150
NITROGEN DIOXIDE					
Annual	3.8	19.4	23.2	100	100
CARBON MONOXIDE					
8-Hour	1802.5	N/A[d]	1802.5	10,000	10,000
1-Hour	2025.3	N/A	2025.3	40,000	40,000
HYDROCARBONS (HC)					
3-Hour	31.8	N/A	31.8	160	160
LEAD (Pb)					
3-Month Average	0.04	N/A	0.04	1.5	1.5

a. All short-term limits (24-hour and less) can be exceeded once a year.

b. Stationary sources only (see the December 1982 Air Permit Application, Appendix C - Tables C.10, C.11 and C.12 [Exxon Minerals Company, 1982]).

c. Includes temporary mobile source emissions and are the highest, second-highest predicted concentrations (see the December 1982 Air Permit Application, Appendix C - Table C-9 [Exxon Minerals Company, 1982]).

d. N/A = Not applicable.

the predicted ambient air quality discussed in this report include: vegetation and soils, animals, environmental health and safety, and visibility.

4.2.6.1 Vegetation and Soils

The predicted ambient air quality around the Project will meet all state and federal standards. As a result, no deleterious effects are projected to occur to either the vegetation or soils of the site area. Some dusting will occur to vegetation species nearest the major construction, operation, and reclamation activities of the Project. However, since the vegetation acts as a filter, no harmful effects are expected and precipitation events will wash the vegetation regularly. Air emissions other than dust are of such minor concentrations that no effects on the vegetation or soils is predicted.

4.2.6.2 Animals

Animal populations such as large mammals (i.e., deer, bear), with the exception of birds, will be largely restricted from the property by fencing. As a consequence, their exposure to ambient air quality will be that which is predicted to meet all of the federal and state standards for public health and welfare. Therefore, animal species will not be exposed to ambient air emission concentrations considered to be harmful.

Since the vegetation and soils are also expected to be unaffected by the Project air emissions, no animal food sources or habitats should be altered. Therefore, no deleterious effects are projected to occur to animal populations of the site area because of Project related air emissions.

4.2.6.3 Environmental Health and Safety

As presented in subsection 4.2.5, federal and state standards will not be exceeded by air emissions from the Project. To assure maximum protection to the health and safety of employees, all applicable regulations of the state and federal regulatory agencies will be attained by the Project.

4.2.6.4 Visibility

Some activities performed as part of the Project construction and operation will be visible from off-site locations. The emissions visible from the Project are expected to be in the air vented from the mine exhaust shafts (EER and WER), especially immediately following explosive detonations. These occurrences (blasting) will be of short duration (15 minutes) and on an infrequent basis.

The mine air exhausted during periods of extemely cold weather will also be visible beyond the property boundary. The primary visible component will be water vapor resulting from the saturated air leaving the mine. In all cases, the vented air should not have an objectionable color or odor, and its visibility will be restricted to the immediate areas surrounding the property boundary.

5.0 SUMMARY AND CONCLUSIONS

Exxon Minerals Company is proposing development of the Crandon Project approximately 8 km (5 miles) south of the city of Crandon, Forest County, Wisconsin. Components of the Project include: mine operations, mill activities, ancillary units (i.e., offices, warehouses) and the mine waste disposal facility. While the mine would operate five days a week, mill operations would maintain a 24-hour, 7 day a week schedule.

There are no major air emission sources located within 25 miles of the Project facilities. Project air emissions will include TSP, SO_2, NO_x, CO, HC, and Pb. Calculated air emission rates for these parameters from Project stationary sources are 50.7, 19.6, 94.2, 85.4, 7.3, and 0.102 tons (st) per year, respectively (see Tables 2.2, 2.4 and 2.5). Since the total for each of the estimated air component emission rates is below the 250 ton (st) per year limit, the Project is exempt from the requirement to obtain a PSD permit. The Crandon Project will be a new minor stationary source.

Total suspended particulate (TSP) and SO_2 concentrations were monitored for the Project during 1978. The highest 24-hour TSP concentrations ranged from 65 to 99 ug/m^3 and the second highest 24-hour concentrations ranged from 61 to 77 ug/m^3 (see Table 3.2). The geometric mean TSP concentrations ranged from 15.9 to 17.9 ug/m^3. None of the SO_2 samples collected during the monitoring program indicated that ambient 24-hour SO_2 concentrations exceeded the lower limit of detection (25 ug/m^3) of the measuring instrument (i.e., analyzer). Background concentrations of TSP and SO_2 indicate air quality for the Project site area is within state and federal standards.

The ambient air quality impact of the Project operations was assessed by performing a dispersion modelling analysis for TSP, SO_2 and NO_x concentrations. The objective of the modelling analysis was to demonstrate compliance with the federal and state ambient air quality standards. The EPA Industrial Source Complex (ISC) model was used to predict the potential air quality effects. The model calculation procedure is based on the steady state Gaussian Plume concept and is recommended by the EPA for assessing fugitive particulate emissions.

The model calculations for annual mean and short-term (3-hour and 24-hour) ground level air pollutant concentrations were performed with the ISC model using one year of meteorological data. This data consisted of surface observations from Eau Claire, Wisconsin (1977) and upper air data from St. Cloud, Minnesota (1977) for the TSP modelling. The model calculations for prediction of ambient SO_2 and NO_2 concentrations used the meteorological data for surface observations from Quinnesec, Michigan (1979) and the upper air data from Green Bay, Wisconsin (1979). Both of these meteorological data sets are conservative for the site area because of stronger easterly wind direction and speed components than measured by the monitoring program. As a result, the predicted ambient concentrations for all the air quality parameters are higher than expected (i.e., conservative). Actual input of Crandon Project air emission rates (ton [st]/yr) used the annual and 24-hour estimates (g/s) for TSP and lb/hr estimates for SO_2 and NO_2.

The Eau Claire meteorology data required adjustment with the CALMPRO program for its use after modeling with ISC. Application of this data for predicting ambient air quality concentrations is conservative because the data contains unusual meteorological conditions which cannot or are very unlikely to occur. They include periods of constant wind speed, temperature, and/or wind direction; wind speed values less than 1.0 m/s (2.2 miles per hour); and abrupt, unstable and/or continuous atmospheric conditions for adjacent hours which are unlikely. The annual wind rose for Eau Claire indicated a predominant wind direction from the west, just as the Project site area monitoring data shows a westerly direction. However, the Eau Claire meteorology data base has a higher average wind velocity from the easterly and westerly sectors than the site area monitoring data. It also has a slightly higher proportion of calms and prevailing wind directions from the easterly sectors than the site area. Therefore, utilization of the Eau Claire meteorological data leads to a conservative estimate of predicted ambient air quality concentrations.

A dense receptor grid containing 123 locations was selected and used to identify the maximum predicted air quality impact from the Project. These receptors were located along the modelling property boundary, approximately 500 m (1,650 feet) beyond this boundary, at the locations of the air quality monitors used for the Project in 1978, and to incorporate the 1 (annual) and 5 (24-hour) ug/m^3 changes in ambient concentrations predicted by the model. The estimated air emissions are from sources that have short stacks with release heights below building roof levels, and area sources of fugitive dust emissions are from near ground surface. For these reasons, maximum air emission concentrations from the Project sources will occur in close proximity to their point of origin with minimal concentrations beyond the modelling boundary.

Air emissions of TSP leaving the modeling property boundary were estimated for an annual and 24-hour second highest occurrence. The maximum annual average TSP concentration from all sources was 4.7 ug/m^3 at receptor 46 (see Table C-2). The second highest annual average TSP concentration for these days was 3.8 ug/m^3 at receptor 80 (see Table C-2). The CALMPRO adjusted TSP concentrations at receptors 46 and 80 were 1.9 and 3.2 ug/m^3, respectively (see Table C-6). The second highest 24-hour TSP concentration predicted for the Project with the 24-hour emission rates was 36.5 ug/m^3 at receptor 51 (see Table C-8). The predicted TSP concentrations at receptors 46 and 51 are downwind of easterly winds to the MWDF. Therefore, these values are conservative since they are a result of a prevailing easterly wind direction and average velocity higher than that measured during the monitoring program.

Air emissions of SO_2 from the Project sources were predicted for the annual, 24-hour and 3-hour second highest occurrence. The predicted maximum SO_2 annual, 24-hour and 3-hour concentrations were 2.0, 24.9, and 186.0 ug/m^3, respectively, at receptor 52(60) (see the December 1982 Air Permit Application, Appendix C - Tables C-7 and C-8 [Exxon Minerals Company, 1982]).

The highest predicted annual NO_2 ground level concentration was 3.8 ug/m^3 (see the December 1982 Air Permit Application, Appendix C - Table C-9 [Exxon Minerals Company, 1982]). The primary sources of this low concentration were mobile vehicles.

Carbon monoxide (CO) concentrations were interpolated from the SO_2 modelling results with appropriate conversion factors. The highest estimated CO concentrations were 675.1 and 90.6 ug/m^3 for 3-hour and 24-hour calculations, respectively (see Table 4.6). These values converted to 2025.3 and 1802.5 ug/m^3 on a 1-hour and 8-hour basis, respectively.

Similarly, hydrocarbon (HC) and lead (Pb) concentrations were not modelled for the Project sources, but were estimated by interpolation from the NO_x and TSP results, respectively. Estimated annual HC emissions are approximately 9 percent of NO_x concentrations. The calculated maximum average 3-hour HC concentration is 31.8 ug/m^3 (see Table 4.7).

Lead emissions from the Project will be released as small particles and as a result the estimated ambient concentrations can be conservatively compared with modelled TSP quantities. Estimated Pb emissions are approximately 0.2 percent of TSP concentrations. The estimated maximum 3-month average lead concentration is 0.04 ug/m^3 (see Table 4.7).

Similarly, extremely low concentrations can be predicted for other metals which might be hypothesized as associated with the particles having an origin from Project activities. Approximately 8 percent of the estimated particles reaching a modelling boundary receptor might actually be wind-blown tailings from the disposal pond then currently in operation. The concentrations in ug/m^3 which can be conservatively (i.e., higher) predicted for the following metals, which might be associated with the tailing particles, are: Al - 0.01, As - 0.0003, Cd - 0.000005, Cu - 0.0005, Hg - 0.0000006, and Zn - 0.002. When compared with Threshold Limit Values (TLV) recommended as guidelines for worker exposures (ACGIH, 1982), the predicted metal concentrations of TSP from Project activities at the modelling boundary are 0.02 percent of the guidelines for worker health.

The predicted ambient air quality around the Project will meet all state and federal standards. The net air quality effects predicted for the construction, operation and reclamation phases of the Project are minimal. As a result, no deleterious effects are projected to occur to either the soil, vegetation, or animals. Because state and federal standards will be attained, the Project will maintain the air quality for the area.

6.0 REFERENCES CITED

American Conference of Government Industrial Hygienists. 1976. Industrial Ventilation. A Manual of Recommended Practice. 14th Edition. Edwards Brothers, Inc. Ann Arbor, Michigan.

______. 1982. Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment with Intended Changes for 1982, ACGIH. Cincinnati, Ohio.

Black, C. 1978. Personal communication. Professor, Nicolet College and Technical Institute. January. Rhinelander, Wisconsin.

Bowers, J.F., J.R. Bjorklund and C.S. Chenev. 1979. Industrial Source Complex (ISC) Dispersion Model. Users Guide. Volume 1. December. Office of Air Quality Planning and Standards. United States Environmental Protection Agency. Research Triangle Park, North Carolina. EPA-450/4-79-030.

Briggs, G.A. 1971. Some Recent Analyses of Plume Rise Observations. Proceedings of the Second International Clean Air Congress. Ed.: Englund, H.M. and W.T. Berry. Academic Press, New York.

Briggs, G.A. 1975. Plume Rise Predictions. Lectures on Air Pollution and Environmental Impact Analysis. American Meteorological Society. Boston, Massachusetts.

Curtis., J.T. 1959. The vegetation of Wisconsin. The University of Wisconsin Press. Madison, Wisconsin.

Dames & Moore. 1981a. Draft. Air quality study, baseline conditions and study methodology. Crandon Project. Exxon Minerals Company. Rhinelander, Wisconsin.

_______. 1981b. Draft. Terrestrial ecology study, baseline conditions and study methodology. Crandon Project. Exxon Minerals Company. Rhinelander, Wisconsin.

Environmental Protection Agency. 1980. Guidelines on Air Quality Models - Proposed Revisions. October. Office of Air Quality Planning and Standards. United States Environmental Protection Agency. Research Triangle Park, North Carolina.

______. 1984. CALMS Processor (CALMPRO) User's Guide. Air Management Division. United States Environmental Protection Agency. Boston, Massachusetts. June 1984. EPA-901/9-84-001.

Environmental Science Services Administration. 1968. Climatic Atlas of the United States: United States Department of Commerce. Washington, D.C.

Exxon Minerals Company. 1982. Air Permit Application. Appendices. December, 1982 Exxon Minerals Company. Rhinelander, Wisconsin.

Exxon Minerals Company. 1984. Mine Waste Disposal Facility - Feasibility Report (NR182.08). October, 1984. Exxon Minerals Company. Rhinelander, Wisconsin.

Huber, A. 1977. Incorporating Building/Terrain Wake Effects on Stack Effluents. Preprints of the American Meteorological Society. November. Air Pollution Control Association Joint Conference on Applications of Air Pollution Meteorology. Salt Lake City, Utah.

Huber, A. and A. Snyder. 1976. Building Wake Effects on Short Stack Effluents. Preprints of the American meteorological Society. Third Symposium on Atmospheric Turbulence, Diffusion, and Air Quality. Raleigh, North Carolina.

Martin, L. 1965. The physical geography of Wisconsin. Wisconsin Geological Bulletin No. 36. Madison, Wisconsin.

National Oceanic and Atmospheric Administration. 1974. Climates of the States: Volume 1. United States Department of Commerce. Washington, D.C.

Sather, H.J. 1977. Classification of wetland and deep-water habitats of the United States. Fish and Wildlife Service. United States Department of Interior, Washington, D.C.

Wisconsin Administrative Code. 1975. Ambient air quality. Chapter NR 155, amended July 1, 1984. Register, August, 1981, No. 308. Environmental Protection. Madison, Wisconsin.

Wisconsin Department of Natural Resources. 1982a. Guide to Preparation of an Air Permit Application. Mimeo. Madison, Wisconsin.

_____. 1982b. Personal communication. Steve Klafka. Bureau of Air Management. August 25, 1982. Madison, Wisconsin.

_____. 1982c. Personal communication. Ralph Patterson. Bureau of Air Management. September 15, 1982. Madison, Wisconsin.

_____. 1983. Personal communication. Paul Koziar. Bureau of Air Management. February 24, 1983. Madison, Wisconsin.