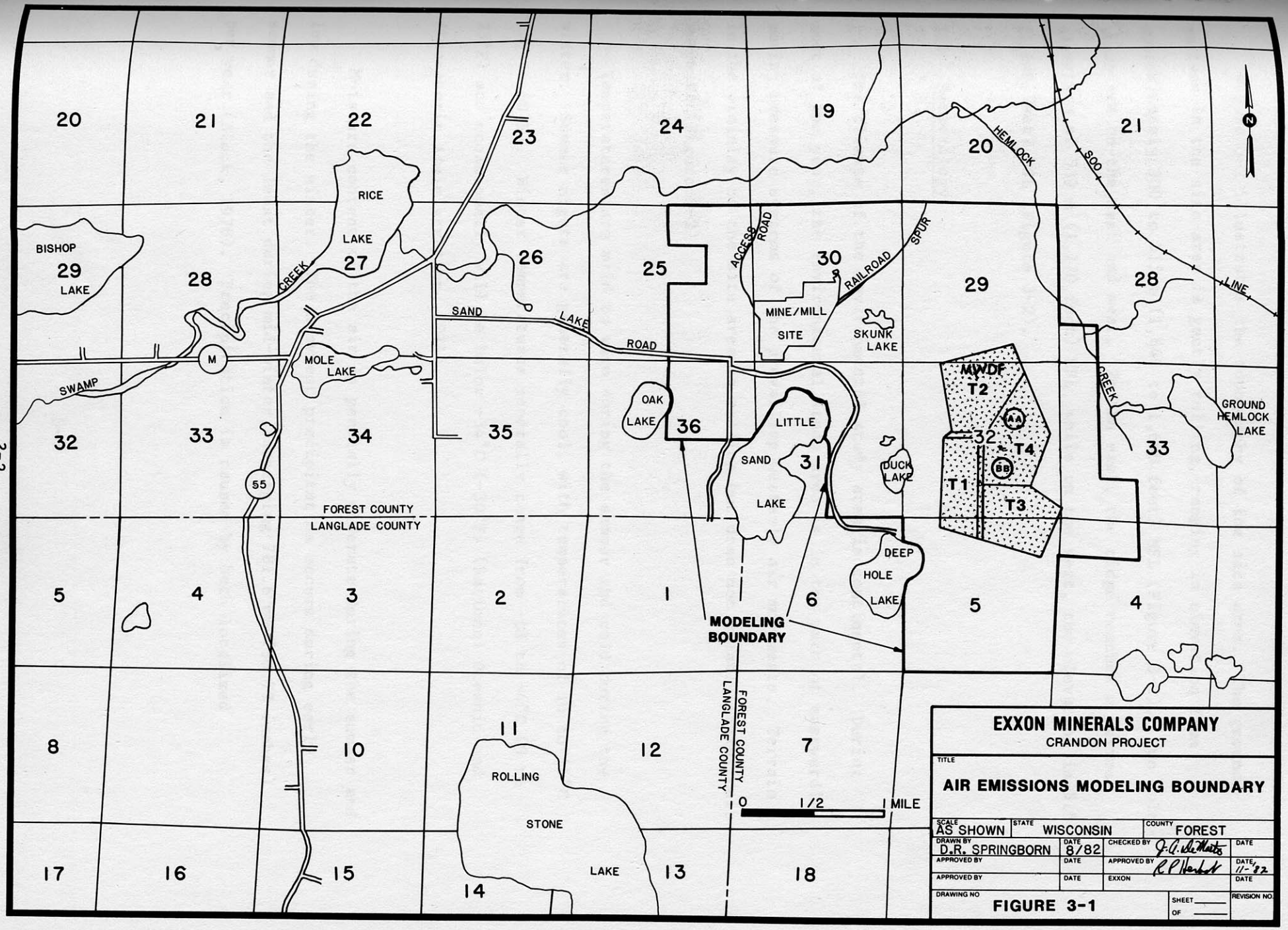
# 3.0 ENVIRONMENTAL STUDY AREA CHARACTERISTICS

The proposed Crandon Project will be developed approximately 5 miles south 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 orientation of the ridges south of Mole Lake and immediately to the east and west of the mine/mill site.




3-2

**EXXON MINERALS COMPANY**
CRANDON PROJECT

TITLE
**AIR EMISSIONS MODELING BOUNDARY**

| | | | | | |
|---|---|---|---|---|---|
| SCALE AS SHOWN | STATE WISCONSIN | | COUNTY FOREST | | |
| DRAWN BY D.R. SPRINGBORN | DATE 8/82 | CHECKED BY J.C. DeMatteo | DATE | | |
| APPROVED BY | DATE | APPROVED BY R.P. Hewlett | DATE 11-82 | | |
| APPROVED BY | DATE | EXXON | DATE | | |
| DRAWING NO **FIGURE 3-1** | | SHEET ___ OF ___ | REVISION NO. | | |

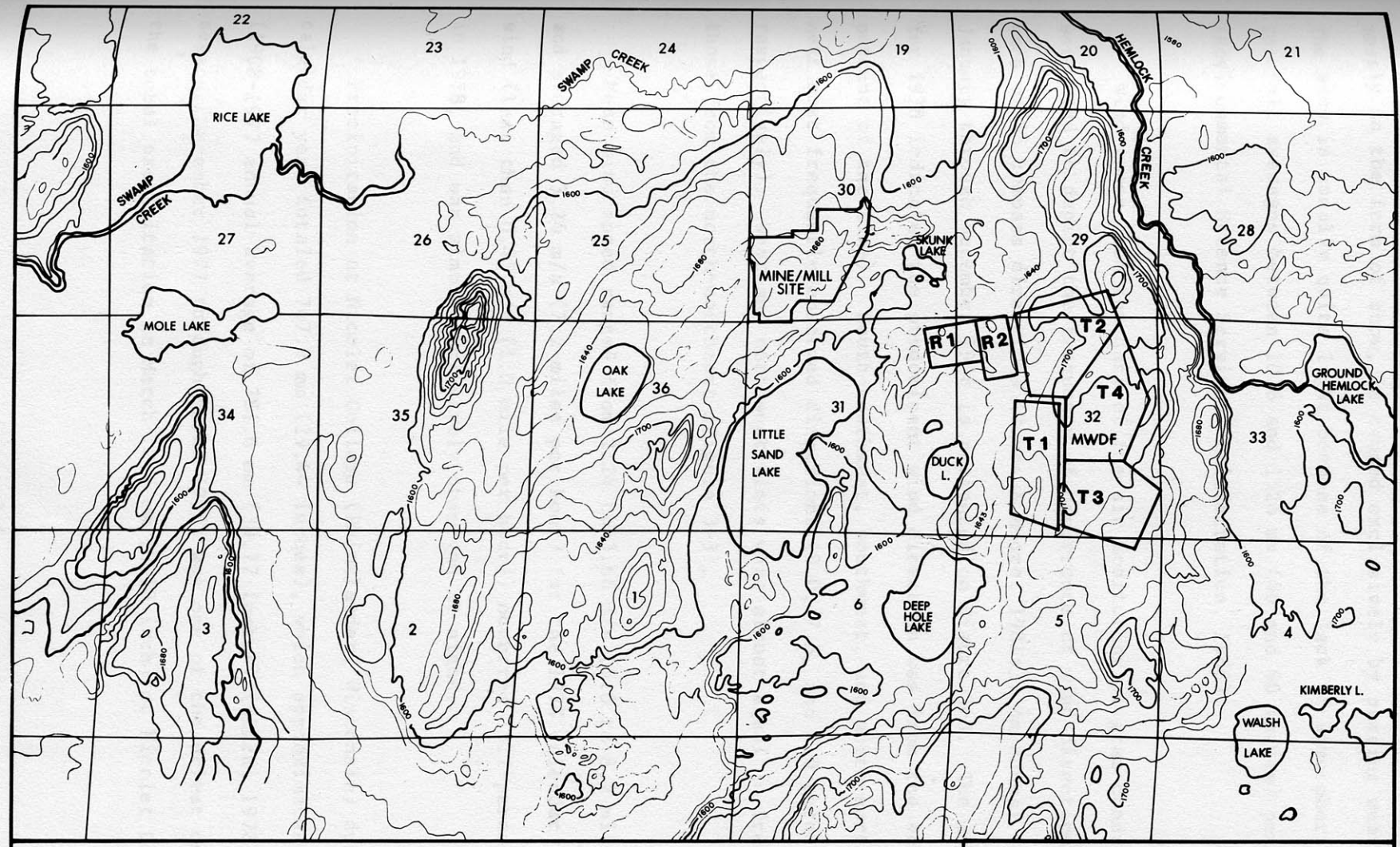
Figure 3-2 illustrates the topography of the site area. The ground surface in the site area is gently rolling, ranging in elevation from approximately 500 to 515 m (1,640 to 1,690 feet) MSL (Figure 3-2). Two upland areas are on the east and west. To the east, the ridge reaches a maximum elevation of 539 m (1,770 feet) MSL, while on the west, the elevation is 515 m (1,690 feet) MSL (Figure 3-2).

## 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 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 (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




**LEGEND**

**1650-ELEVATION IN FEET ABOVE MSL**

MILE
0 .5 1

0 .5 1
KILOMETER

N

**EXXON MINERALS COMPANY**
CRANDON PROJECT

TITLE
**TOPOGRAPHY OF SITE AREA**

| SCALE | STATE | COUNTY |
|---|---|---|
| SHOWN | WISCONSIN | FOREST |

| | | | |
|---|---|---|---|
| DRAWN BY BWM | DATE | CHECKED BY | DATE |
| APPROVED BY | DATE | APPROVED BY | DATE 11-82 |
| APPROVED BY | DATE | EXXON | DATE |
| DRAWING NO | | SHEET ___ OF ___ | REVISION NO |

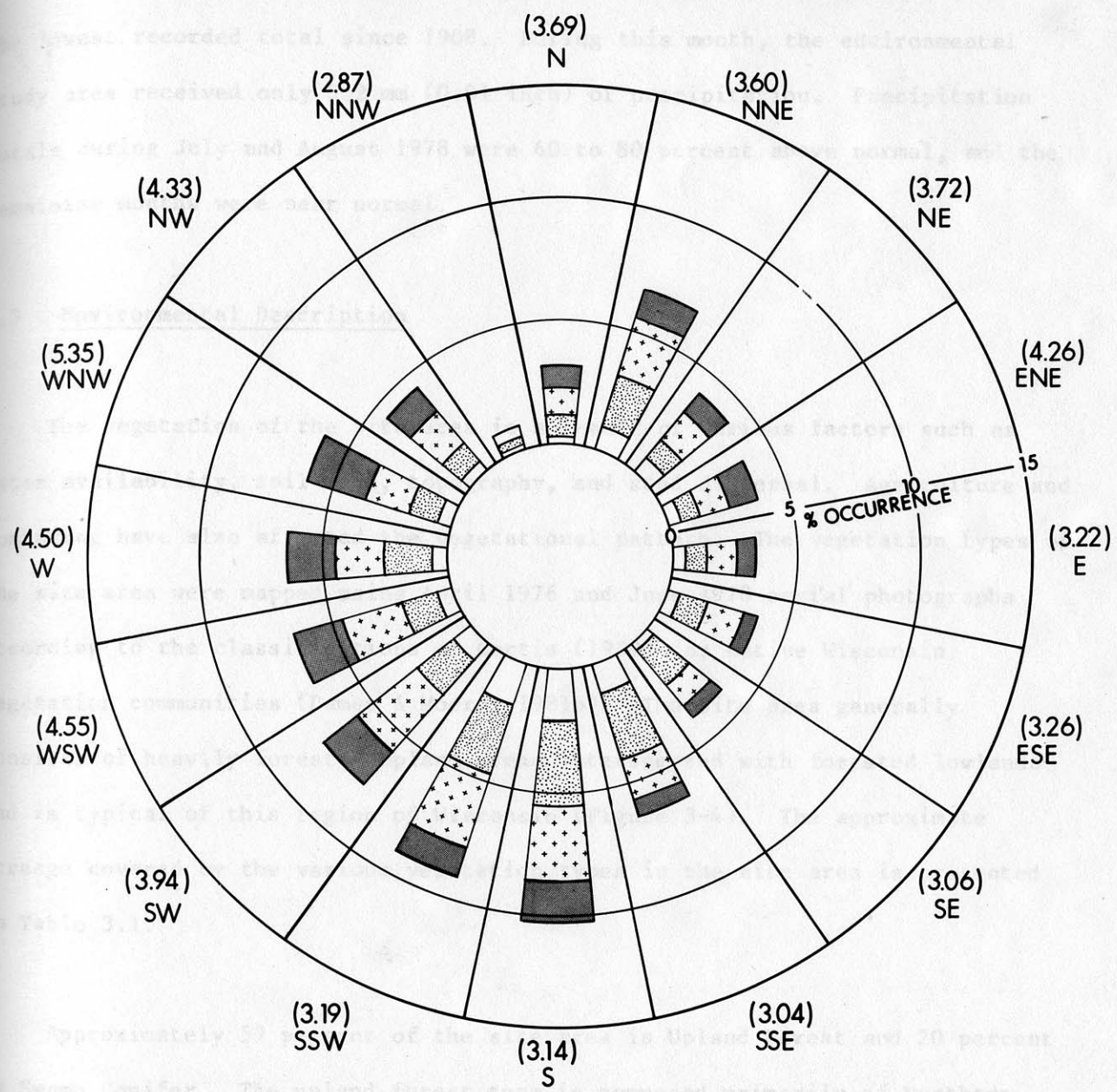
**FIGURE 3-2**

thunderstorms and frontal 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 northwest winds were almost equal in frequency to those from the north-northeast (Figure 3-3).

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 (7.2 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




LEGEND

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

WIND SPEED (m/s)

> 5.0

3.0 - 5.0

1.5 - 3.0

0.0 - 1.5

MEAN WIND SPEED FOR ALL SECTORS: 3.24 m/s

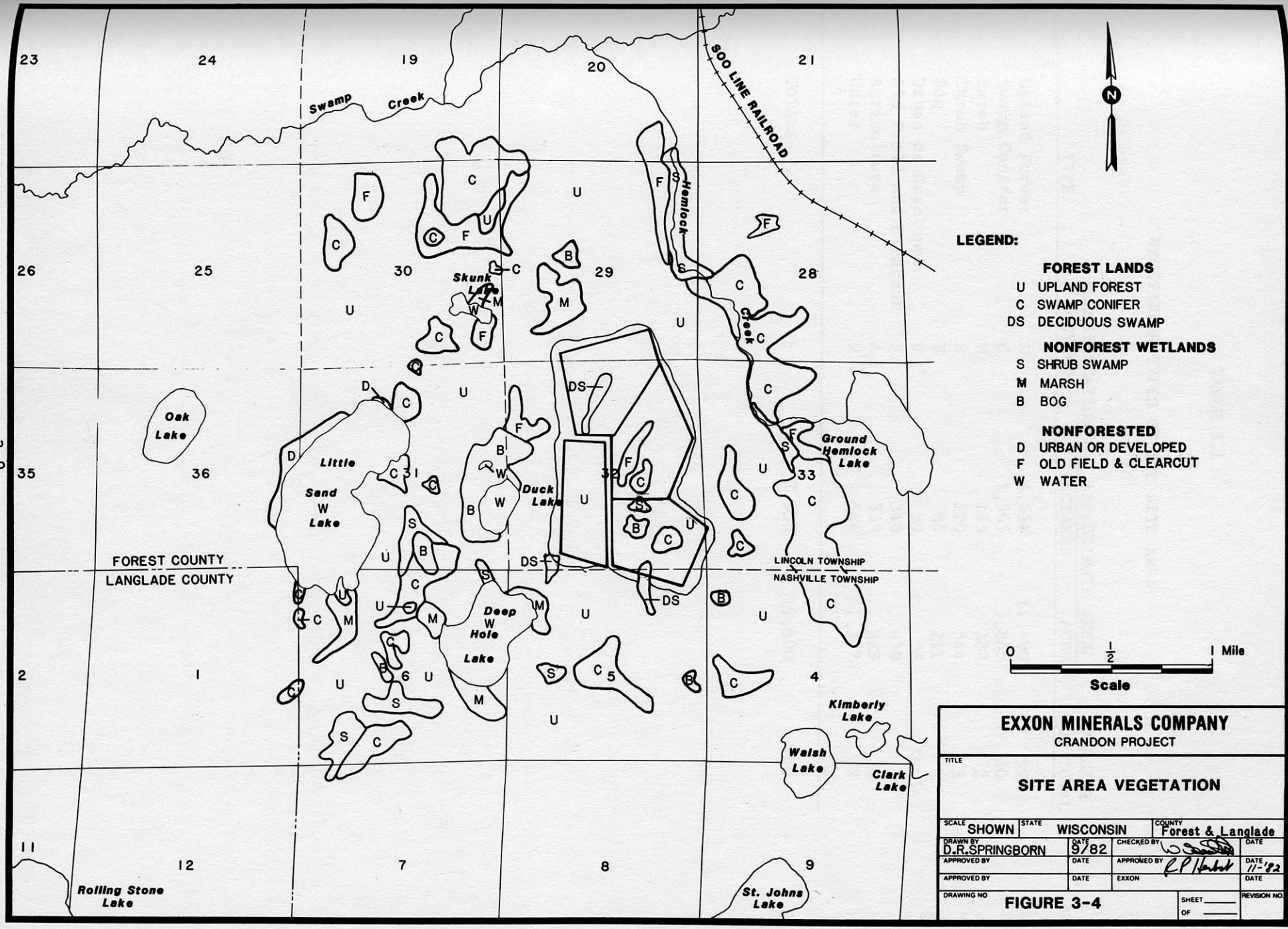
| EXXON MINERALS COMPANY | | | |
|---|---|---|---|
| CRANDON PROJECT | | | |
| TITLE: ENVIRONMENTAL STUDY AREA WIND ROSE (ANNUAL, 1978) | | | |
| SCALE: NONE | STATE: WISCONSIN | COUNTY: FOREST | |
| DRAWN BY: BWM | DATE: 07/21/82 | CHECKED BY: | DATE |
| APPROVED BY | DATE | APPROVED BY: R P Herbst | DATE: 11-82 |
| APPROVED BY | DATE | EXXON | DATE |
| DRAWING NO. FIGURE 3-3 | | SHEET ___ OF ___ | REVISION NO. |

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.




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 | DATE |
| APPROVED BY | DATE | APPROVED BY | DATE 11-'82 |
| APPROVED BY | DATE | EXXON | DATE |
| DRAWING NO FIGURE 3-4 | | SHEET OF | REVISION NO. |

TABLE 3.1

VEGETATION TYPES OF THE SITE AREA

| TYPE | CLASSIFICATION SYMBOL | APPROXIMATE AREA HECTARES | APPROXIMATE AREA 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 |

## 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 phase 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 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 (see section 4.2.3) in 1977. 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 were greatest. 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 $ug/m^3$.

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. - Jun. 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 AIR QUALITY 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.

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 4.11), 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 below state and federal standards.