Environmental impact report: volume 3: chapter 2.0 sections 2.6 thru 2.9 revised. 1985

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CRANDON PROJECT

REVISED ENVIRONMENTAL IMPACT REPORT (EIR)

VOLUME III
SECTIONS 2.6 THRU 2.9

INSTRUCTIONS

1. The enclosed material replaces information provided in EIR, Volume III, Chapter 2.0, Sections 2.6, 2.7, 2.8 and 2.9.

2. Remove and discard Sections 2.6, 2.7, 2.8 and 2.9 in the three-ring binder labeled EIR Volume III and insert the enclosed material in its place.

3. Retain the original Section 2.10 in the binder.

4. Remove the spine from the three-ring binder and replace it with the enclosed spine which indicates the volume has been revised.

THANK YOU FOR YOUR COOPERATION

EXXON MINERALS COMPANY

RHINELANDER, WISCONSIN
November, 1985

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2.6 TERRESTRIAL ECOLOGY

The terrestrial ecology sampling program was designed to identify and describe the major terrestrial communities in the Crandon Project environmental study area and site area, and to provide a basis for evaluating potential environmental impacts resulting from development. This program included the following:

- Describing the soils in the area;
- Identifying "important" floral and faunal species, including those considered to be threatened and endangered;
- Documenting the distribution and relative abundance of "important" biota;
- Mapping principal plant communities and selected wildlife resources; and
- Describing the regional importance of the site area's flora and faunal populations based on a comparison of site data with regional data.

Species or communities were considered "important" in this study if one or more of the following criteria applied:

1) The species or community is commercially or recreationally valuable;
2) The species is threatened, endangered, or rare;
3) The species or community affects the well-being of some important species within criteria 1 or 2; and
4) The species, population or community is critical to the structure and function of the ecosystem.

Listed in Table 2.6-1 are the major biotic components that were studied and the seasonal sampling schedule during 1977 and 1978.

The environmental study area and the site area are heavily forested. Northern Hardwood, Aspen-Birch, and Swamp Conifer are the most prevalent plant

TABLE 2.6-1

SAMPLING FREQUENCIES FOR TERRESTRIAL ECOLOGY STUDIES

TASK	1977 FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1978 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
GENERAL RECONNAISSANCE	E S		E S	E S	E S		E S		E S				E S		E S	E S	E S	E S	E S
VEGETATION																		E	
Mapping																		S	
Quantitative Sampling					S												S		
Seasonal Collections			E S	E S	E S		E S												
Tissue Analysis							E								S	S	S		S
AMPHIBIANS AND REPTILES																	E		
General Survey				S			S								S	S			S
BIRDS																			
Avian Survey	S			S	S								S			S	S		
Migrating Waterfowl Survey			S						S						S				
Waterfowl Brood Survey																	S		
Grouse Survey			S												S				
MAMMALS																			
Snap Trapping							S												S
Deer Trail Counts				S					S										

NOTE: E = Environmental study area.
S = Site area.

communities. The lands within the site area that will be potentially directly affected by the Project are the waste disposal site, the mine/mill site, and the corridors for the railroad spur and access road (see chapter 1.0 for location and discussion). The prevalent plant communities in these potentially affected areas are also Northern Hardwood, Aspen-Birch and Swamp Conifer.

At the time the ecological baseline surveys were initiated, there were very few existing vegetation or wildlife surveys that pertained to the specific site area. However, the DNR had conducted several regional surveys that were pertinent to the environmental study area. These surveys included deeryard management reports, annual bald eagle (Haliaeetus leucocephalus) and osprey (Pandion haliaetus) nest surveys, game and furbearer harvest reports, and censuses for ruffed grouse (Bonasa umbellus) and American woodcock (Philohela minor). These surveys are mentioned and referenced appropriately in the following text. In addition to the studies reported herein, more recent vegetation and wildlife surveys that have been conducted in the site area are a timber survey by Steigerwaldt and Sons (1982) and a wetlands study by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982). Information from these two surveys is also referenced throughout the following text.

Common names for plants and animals are used throughout the text and the corresponding scientific name is cited when the species is first mentioned. Nomenclature for plants follows that of Gleason and Cronquist (1963). The nomenclature for animals follows three principal sources: Jones et al. (1973) for mammals, the American Ornithologists' Union (1957, 1973, 1976) for birds, and Conant (1975) for reptiles and amphibians.

2.6.1 Field and Laboratory Methods

2.6.1.1 Soils

Soil types in the site area were mapped by personnel of the Soil Conservation Service office at Rhinelander, Wisconsin. The area mapped corresponded to those lands that in 1977 were believed to be most likely directly affected by the proposed Project. Soil mapping and classification were completed according to the Soil Conservation Service's current method for conducting modern soil surveys (Ludwig, 1978). This method involved extensive field investigation of the soil types in the site area combined with interpretation of aerial photographs.

2.6.1.2 Vegetation

Spencer and Thorne (1972) list Aspen-Birch, Maple-Basswood (Northern Hardwood), and Spruce-Fir as the most prevalent forest types in Forest County. A reconnaissance of the environmental study area indicated that the major plant communities in the environmental study area were also Northern Hardwood, Aspen-Birch, and Swamp Conifer. These communities were sampled using quantitative methods. Other less extensive plant communities/vegetation types such as bog, deciduous swamp, shrub swamp and marsh were qualitatively surveyed because they represented a very small portion of the environmental study area and site area.

Vegetation Mapping

Vegetation in the environmental study area and site area were mapped using color aerial photographs (dated April 1976; scale of 1:15,840) and color infrared aerial photographs (dated June 1978; scale of 1:24,000). Interpretation of aerial photographs was checked through on-site reconnaissance. Vegetation was classified into the following types; Northern Hardwood (including Aspen-Birch), Swamp Conifer, Shrub Swamp, Bog, Marsh, Old Field and Clearcut, and Agriculture. Areas of open water and urban or developed lands were also delineated. The relationship between these vegetation types and the classification of plant communities by Curtis (1959) is described in the text.

The minimum type size delineated on the vegetation map of the environmental study area was 16.2 ha (40 acres). The minimum type size delineated on the more detailed map of the site area was 4.0 ha (10 acres) for upland areas and 1.0 ha (2.5 acres) for wetlands.

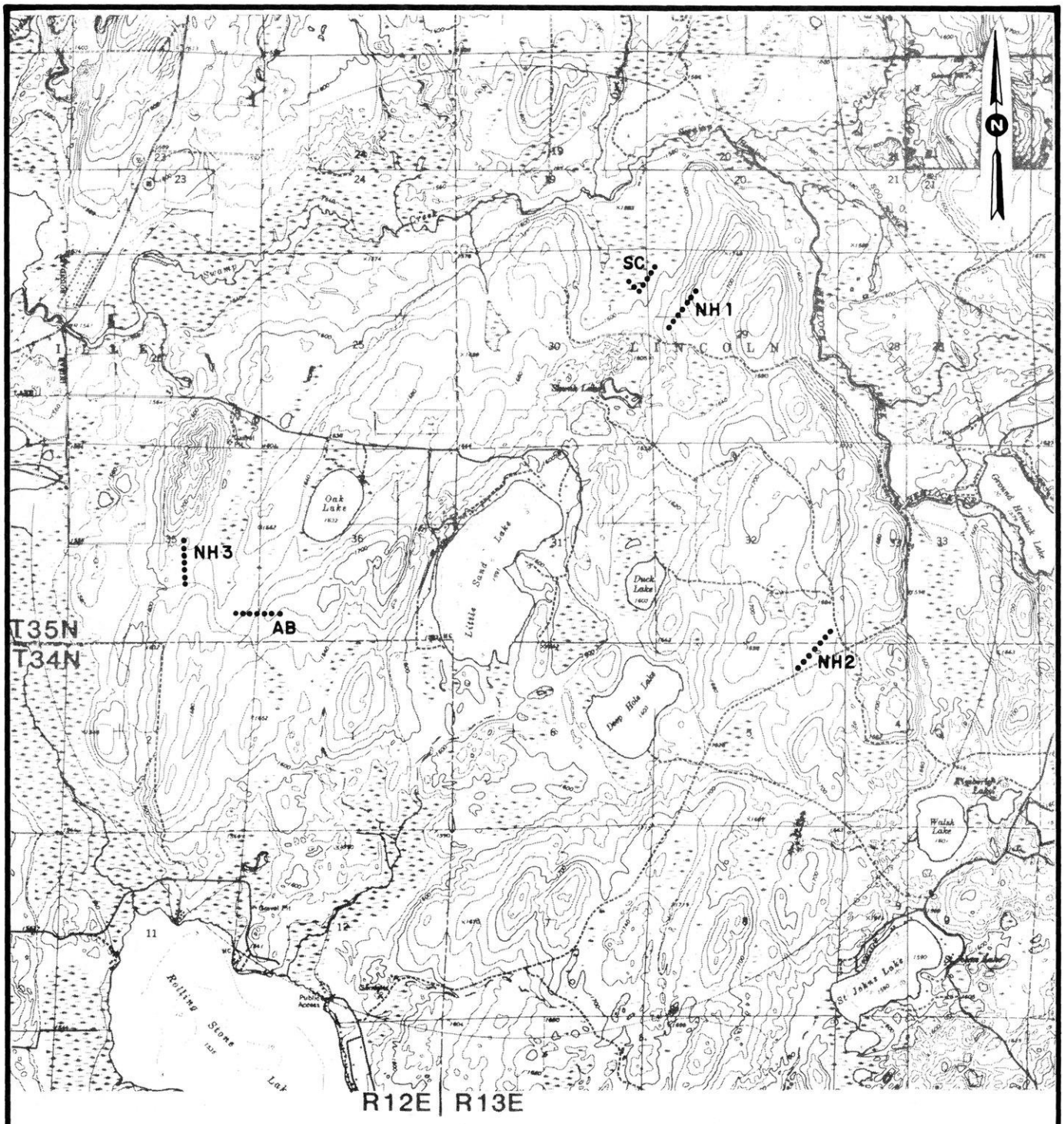
Vegetation Sampling

Quantitative vegetation sampling was conducted in mid-June 1977 and 1978. Five transects were located in the three major vegetation types of the site area (Figure 2.6-1). Thirty sample points were established along each transect at 15-m (50-foot) intervals.

The vegetation was divided into four strata and each stratum was sampled separately. The four strata were:

1) Overstory: $>$ 100 mm (4 inches) in diameter at breast height (dbh);

2) Upper understory: $>$ 25 mm (1 inch), $\leq$ 100 mm (4 inches) dbh;



KEY:

•••••• VEGETATION TRANSECT

NOTE: VEGETATION TYPE ALONG TRANSECT

AB ASPEN / BIRCH

NH NORTHERN HARDWOOD

SC SWAMP CONIFER

.5 0 1 MILE

.5 0 1 KILOMETER

BASE MAP REFERENCE:
PORTIONS OF THE FOLLOWING U.S.G.S. 7.5 MINUTE SERIES: CRANDON, WISCONSIN, 1965; LAKE LUCERNE, WISCONSIN, 1973; AND ROBERTS LAKE, WISCONSIN, 1973.

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VEGETATION SAMPLING LOCATIONS IN THE SITE AREA

DAMES & MOORE

FIGURE **2.6-1**

3) Lower understory: > 0.5 m (20 inches) in height, ≤ 25 mm (1 inch) dbh; and

4) Ground layer: woody plants ≤ 0.5 m (20 inches) in height and all herbaceous plants.

The overstory and upper understory were sampled at all 30 points using the Point-centered Quarter Method (Cottam and Curtis, 1956; Ashby, 1972). At every other point (that is, 15 of the 30 points), the lower understory and ground layer were sampled. The lower understory was sampled by estimating the percent aerial coverage of each species within a circular plot 28 m^2 (307 square feet) in size. The ground layer vegetation was sampled by estimating the percent aerial coverage of each species within a 1-m^2 (9-square-foot) quadrat. Descriptions of the above-mentioned methods can be found in Oosting (1956) and Daubenmire (1968).

An importance value was calculated for each of the species encountered in the sampling according to the method of Curtis and McIntosh (1951).

Qualitative Surveys

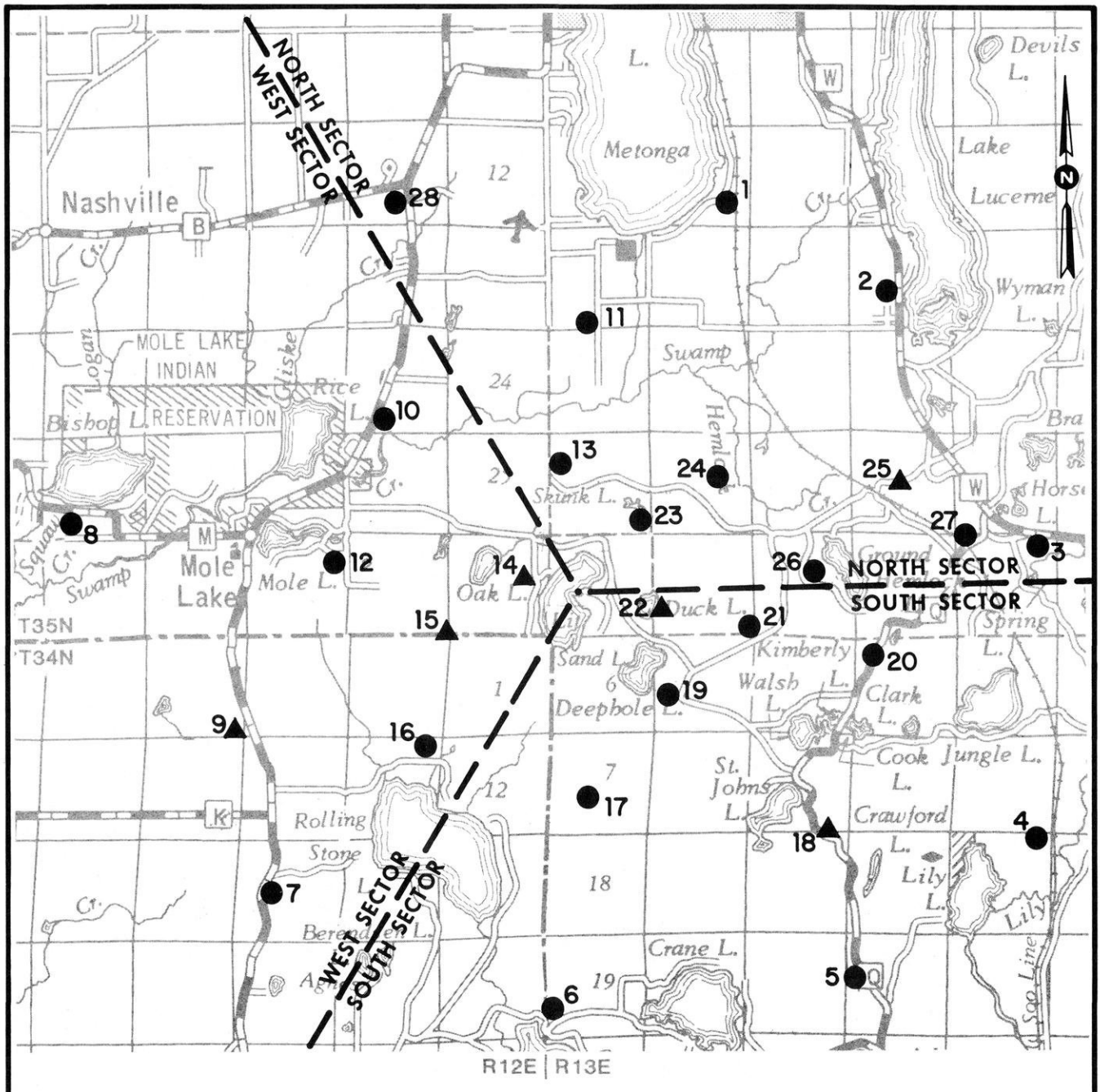
In addition to the quantitative sampling of the vegetation, qualitative observations and plant collecting were made throughout the site area. Many plants in a terrestrial community are not commonly encountered with various sampling methods because they are confined to special habitats or have limited local distribution. Because these species can be aesthetically important, are considered to be threatened or endangered, and/or serve as wildlife food, their presence was noted in the site area during searches of various habitats. These qualitative surveys and plant collections were

conducted during April, May, June, and August of 1977 and 1978 and were concentrated primarily in those areas believed to be directly affected by the proposed Project.

Heavy Metal Analysis in Vegetation

Vegetation samples were collected in June 1978 at 27 of 28 locations in the environmental study area for heavy metal analysis (Figure 2.6-2). Heavy metal analyses were conducted on the basis of potential concern for possible contamination from fugitive dust and the anticipated prevailing wind conditions. The nine metals selected for analysis were those generally found in base metal sulfide ores. These metals were manganese, zinc, cadmium, copper, arsenic, lead, mercury, cobalt, and total chromium.

The absorption, accumulation, and release of heavy metals are known to vary from species to species (Gerloff et al., 1966). To reduce the bias that might be introduced if only one plant species had been sampled, three species, one from each of the three major taxonomic groups of vascular plants (Gymnosperms, Monocotyledons, and Dicotyledons), were collected from each sampling location. Balsam fir (Abies balsamea) was selected as the gymnosperm because it is a widely distributed conifer in the environmental study area. Red raspberry (Rubus idaeus), the dicotyledon selected, grows commonly throughout the environmental study area. Pennsylvania sedge (Carex pennsylvanica) was selected as the monocotyledon because it is also common in the area. The new foliage (current summer's growth) was collected from plants of the above three species found near each of the sampling locations.



KEY:

- ● MATERIAL COLLECTED USED FOR COMPOSITE SAMPLE
- ▲ MATERIAL COLLECTED USED FOR INDIVIDUAL AND COMPOSITE SAMPLE
- — — COMPOSITE SECTOR BOUNDARY

NOTE: NO SAMPLES WERE COLLECTED AT LOCATION 17 DUE TO INACCESSABILITY.

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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LOCATIONS OF VEGETATION SAMPLED FOR HEAVY METAL ANALYSIS IN THE ENVIRONMENTAL STUDY AREA

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FIGURE 2.6-2

Plant tissue samples were placed in airtight polyethylene bags and shipped to Aqualab, Inc. for analysis. In the laboratory, the foliage collected was processed as follows. The foliage was washed in deionized water, dried at 105°C (221°F) for 24 hours, and ground to a fine powder in a food mill. The concentrations of manganese, zinc, cadmium, copper, lead, cobalt, and chromium in vegetation were analyzed as follows. Samples of ground vegetation were redried to a constant weight and then ashed in a muffle furnace at 500°C (932°F) for a minimum of 4 hours. After ashing, metals were dissolved in a 1+1 hydrochloric acid solution and warmed to facilitate complete dissolution. Samples were then diluted to a known volume and analyzed by atomic absorption spectrophotometry (U.S. EPA, 1974). Separate wet-ashed samples were analyzed for arsenic and mercury. Mercury was analyzed by a flameless atomic absorption method and arsenic by a gaseous hydrate generation atomic absorption method (U.S. EPA, 1974). The unused portions of these samples were placed in individual glass containers and retained for future reference. Approximately 0.5 g of processed tissue was used for each chemical analysis.

The processed tissue samples were subsampled in two ways prior to chemical analysis. For each species, samples were taken from the plant material collected at six of the sampling locations (Numbers 9, 14, 15, 18, 22, and 25; Figure 2.6-2) and analyzed separately. The environmental study area was then divided into three sectors: north, south, and west, with respect to the predominant wind directions. Equal-sized subsamples were then taken from the prepared material from each location and combined into composite samples for each of the three species by sector. The north sector

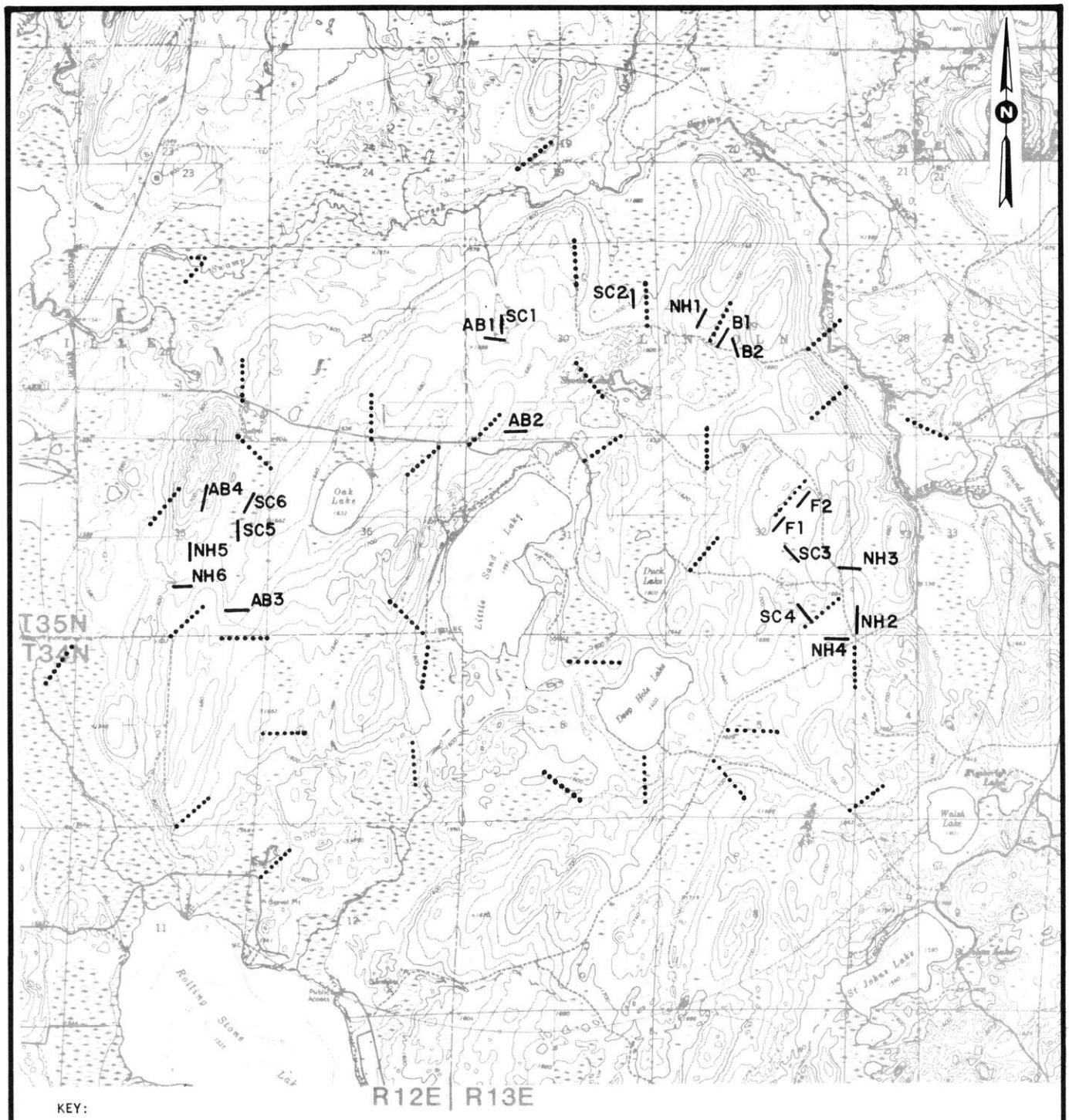
composite consisted of material from locations 1, 2, 3, 11, 13, 23, 24, 25, 26, 27, and 28; the south sector composite from locations 4, 5, 6, 18, 19, 20, 21, and 22; and the west sector composite from locations 7, 8, 9, 10, 12, 14, 15, and 16. These composite samples were then thoroughly mixed and a sample was removed for chemical analysis.

2.6.1.3 Wildlife

Mammals

Selection of the mammal species to be studied and the methodologies to be employed were finalized during discussions with the DNR in February 1977. It was concluded that data available from the DNR on white-tailed deer (Odocoileus virginianus), black bear (Ursus americanus), and medium-sized mammals, such as beaver (Castor canadensis), otter (Lontra canadensis), bobcat (Lynx rufus), marten (Martes americana), and squirrel, would generally be adequate to describe mammal populations of the environmental study area. Censusing to determine the densities of these medium-sized mammals in an area the size of the site area and with the population densities expected there, was not considered practical in light of the reliability of the data that could be obtained.

Of the mammals present in the site area the white-tailed deer was given special consideration because of its recreational value. During the spring and autumn of 1977 white-tailed deer were censused in the site area using the deer trail count method of McCaffery (1976) (Table 2.6-1; Figure 2.6-3). The method consisted of counting the number of deer trails encountered on a series of 0.4-km (0.25-mile) transects. Thirty-six transects



KEY:

••••••• DEER TRAIL TRANSECT

——— SMALL MAMMAL TRAPLINE IN SITE AREA

NOTE: HABITAT TYPE ALONG SMALL MAMMAL TRAPLINE:

- **NH** NORTHERN HARDWOOD
- **AB** ASPEN / BIRCH
- **SC** SWAMP CONIFER
- **F** OLD FIELD
- **B** BOG

BASE MAP REFERENCE:
PORTIONS OF THE FOLLOWING U.S.G.S. 7.5 MINUTE SERIES: CRANDON, WISCONSIN, 1965; LAKE LUCERNE, WISCONSIN, 1973; AND ROBERTS LAKE, WISCONSIN, 1973.

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

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MAMMAL SURVEY LOCATIONS
IN THE SITE AREA

DAMES & MOORE

FIGURE **2.6-3**

were used in the site area. This method was selected because the data collected can be compared with the results of similar surveys performed by the DNR.

The small mammals (mice, shrews, voles) are inconspicuous and only infrequently observed. Therefore, small mammals were qualitatively sampled using snap traps during August of 1977 and 1978 (Table 2.6-1) to collect data on relative abundance and species composition for the major habitats. At least four traplines were set in each of the three major plant communities. Two traplines were also set in an old field and bog (Figure 2.6-3). Traplines contained 15 stations approximately 10 m (30 feet) apart with two mouse traps and one rat trap at each station (Golley et al., 1965). Traplines were set for three consecutive days and checked each morning and rebaited with a mixture of peanut butter and dry rolled oats. Results of the snap-trapping effort were expressed as trap success (total number of captures of each species divided by total number of trapnights). One trapnight is defined as one trap set for 24 hours. All mammals collected were identified, sexed, weighed, measured, and examined for breeding condition. Voucher specimens have been preserved and are on file in the Environmental Laboratory of Dames & Moore's Park Ridge office.

Observations or signs of any mammals not previously observed in the environmental study area or site area were also noted.

Birds

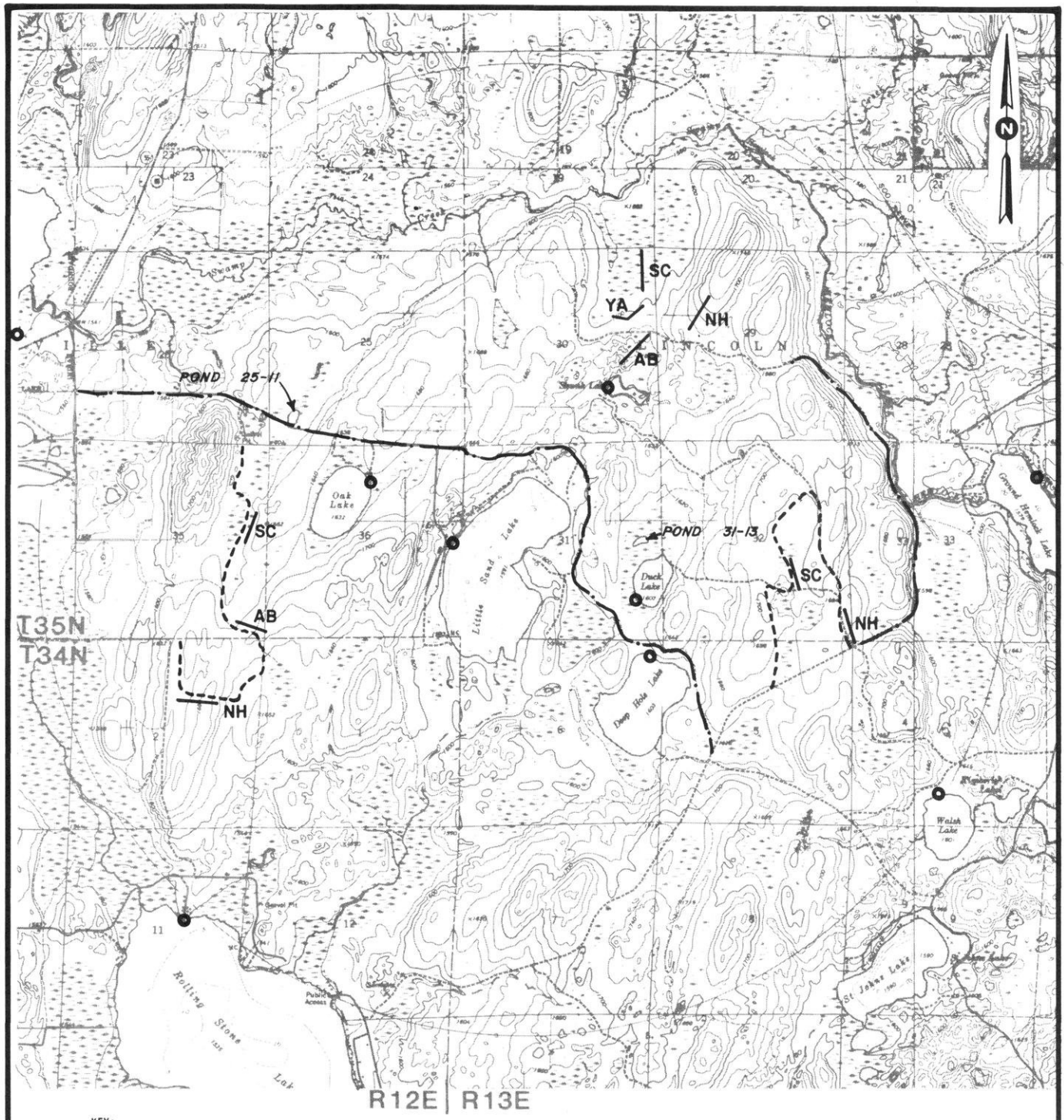
Bird censuses were conducted seasonally during 1977 and 1978 (Table 2.6-1). Special consideration was given to monitoring waterfowl and upland

game birds because of their recreational importance. The locations of bald eagle and osprey nests in the site area were obtained from DNR annual surveys.

Counts of drumming ruffed grouse were conducted during the spring of 1977 and 1978 along roads in the site area. The 1977 survey was qualitative to establish the relative abundance of ruffed grouse. The 1978 survey was designed to estimate ruffed grouse densities in the site area. Ruffed grouse surveys were conducted in a manner similar to that used by the DNR (Gullion, 1966; Vanderschaegen, 1977). Stops on DNR surveys are located 1.6 km (1 mile) apart, whereas the distance between stops on surveys used in these studies was 0.8 km (0.5 mile). The grouse surveys were conducted from April 27 through 29, 1977, and from April 26 through 28, 1978; the location of the route is shown on Figure 2.6-4.

Surveys of migrating waterfowl were conducted for 0.5 hour on each of 3 days during the late evening or early morning on Skunk, Duck, Little Sand, Rice, Ground Hemlock, Walsh, Oak, Deep Hole, and Rolling Stone lakes. Observations were made during both spring and autumn migratory seasons at each lake (Table 2.6-1). Locations of observation points are shown on Figure 2.6-4. Specific dates for these observations were between April 26 and 29, 1977; September 26 and 28, 1977; and April 26 and 28, 1978. Migrating waterfowl counts were also taken at several local ponds.

Waterfowl brood counts were conducted for a period of 0.5 hour once on the same 10 lakes as described above during the early morning or late evening. The observation points were the same as those used during surveys of migrating waterfowl. Observations were made during the period June 13 through 16, 1978 (Table 2.6-1).



KEY:

- WATERFOWL OBSERVATION POINT
- EMLEN BIRD CENSUS ROUTE
- RUFFED GROUSE SURVEY ROUTE
- SEASONAL BIRD TRANSECT IN SITE AREA

NOTE; HABITAT TYPE ALONG BIRD TRANSECTS:

- NH NORTHERN HARDWOOD
- AB ASPEN / BIRCH
- SC SWAMP CONIFER
- YA YOUNG ASPEN

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

BASE MAP REFERENCE:
PORTIONS OF THE FOLLOWING U.S.G.S. 7.5 MINUTE SERIES: CRANDON, WISCONSIN, 1965; LAKE LUCERNE, WISCONSIN, 1973; AND ROBERTS LAKE, WISCONSIN, 1973.

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BIRD SURVEY LOCATIONS
IN THE SITE AREA

DAMES & MOORE

FIGURE 2.6-4

Songbirds were surveyed using two different methods during the winter, spring, and summer of 1977 and 1978 in the site area (Table 2.6-1). One type of survey was conducted to determine relative abundance and seasonal distribution of songbirds along nine transects located in the major habitats of the site area (Figure 2.6-4). The spring survey was conducted in May at or near the peak of spring migration. Surveys consisted of walking a transect 0.4 km (0.25 mile) long and recording all birds identified by sight or song. Five stops for 3 minutes each were made at even intervals along the transects to observe and listen for birds. Transect locations are shown on Figure 2.6-4.

During the spring and summer of 1978, songbirds were censused using the method described by Emlen (1971, 1977). This method is a variable width strip census whereby a single observer slowly walks a transect and records the perpendicular distance from the transect to all birds observed or heard. Two 3.2-km (2-mile) long transects were censused (Figure 2.6-4).

Amphibians and Reptiles

The presence and relative abundances of amphibian and reptile species in the site area were noted during qualitative surveys during May and August 1977 and April, May and August 1978 (Table 2.6-1). Numerous micro-habitats were searched for amphibians and reptiles including pond banks, and beneath logs, pieces of bark, debris, and leaf litter. Care was taken to replace upturned material in order to preserve this habitat. During the spring surveys, "singing" amphibians were identified and their presence recorded. Searches were concentrated primarily in those areas believed to be

directly affected by the proposed Project, and adjacent ponds or wetlands. Observations of amphibians and reptiles not previously recorded in the site area were also noted during other seasonal vegetation and wildlife surveys.

2.6.1.4 Threatened and Endangered Species

The potential occurrence of threatened or endangered plant and animal species in the site area was investigated through literature searches and contacts with the DNR. From the literature search, preferred habitat types of threatened or endangered species were identified for the environmental study area. Subsequent field reconnaissances and previously mentioned qualitative surveys were conducted for threatened or endangered species in the site area. Evidence of threatened or endangered species was searched for during all terrestrial field work. Approximately 540 manhours of field time were spent in the site area and roughly 25 percent of this time was reconnaissance principally for threatened or endangered species. A discussion of each threatened or endangered species expected to occur in the environmental study area is presented in the following text, including their preferred habitat and reported sightings.

2.6.1.5 Quality Control Procedures

Quality control procedures were utilized by field and laboratory personnel as a means of assuring that the study was completed according to currently accepted standards and methods.

Field Procedures

A daily record of field activities was maintained by individual field personnel in the terrestrial ecology project journal. Included in this field journal were notes and maps used to describe:

1) Areas where sampling transects were located;

2) Areas covered during reconnaissance surveys;

3) Records of unusual observations;

4) Observation by DNR personnel regarding field investigations; and

5) Other miscellaneous information pertinent to the field studies.

Personnel from the DNR accompanied Dames & Moore investigators on at least one occasion during each phase of reconnaissance and during specific sampling operations to observe and verify field methodologies and techniques. The timing of critical seasonal surveys, such as ruffed grouse drumming and migrating waterfowl, was coordinated through the DNR to verify that sampling would be conducted at or near the breeding and migration peaks.

Voucher specimens were collected for plants, mammals, amphibians, and reptiles whenever practical.

Data sheets were used during all formal field surveys. The data sheets were used for point-centered-quarter vegetation sampling, deer-trail transects, nongame mammal trapping, ruffed grouse drumming counts, migrating waterfowl surveys, waterfowl brood counts, and songbird surveys.

Laboratory Procedures

Chemical laboratory analyses for heavy metals in plant material were conducted by Aqualab, Inc. All laboratory analyses were completed by Aqualab, Inc. and were subject to review and verification procedures.

Plant voucher specimens collected were dried and mounted, and are on file in the Environmental Laboratory in Dames & Moore's Park Ridge office. Specimens collected during this study were annotated by Dr. Hugh H. Iltis and Dr. Theodore S. Cochran of the Botany Department, University of Wisconsin-Madison.

Mammal, amphibian, and reptile voucher specimens have been preserved and are on file in the Environmental Laboratory in Dames & Moore's Park Ridge office. Dr. Phillip W. Smith of the Illinois Natural History Survey and Dr. Ronald A. Brandon of Southern Illinois University annotated amphibian and reptile specimens. Mammal specimens were not annotated since no unusually difficult identifications were encountered.

Data Analyses

Data from the point-centered-quarter vegetation surveys were reduced using a verified computer program. Input data to the program were checked for accuracy by an investigator other than the original investigator.

Data from all other surveys conducted as part of the terrestrial ecology baseline study were reduced with the aid of a desk top calculator. All results were checked for accuracy by an investigator other than the original investigator.

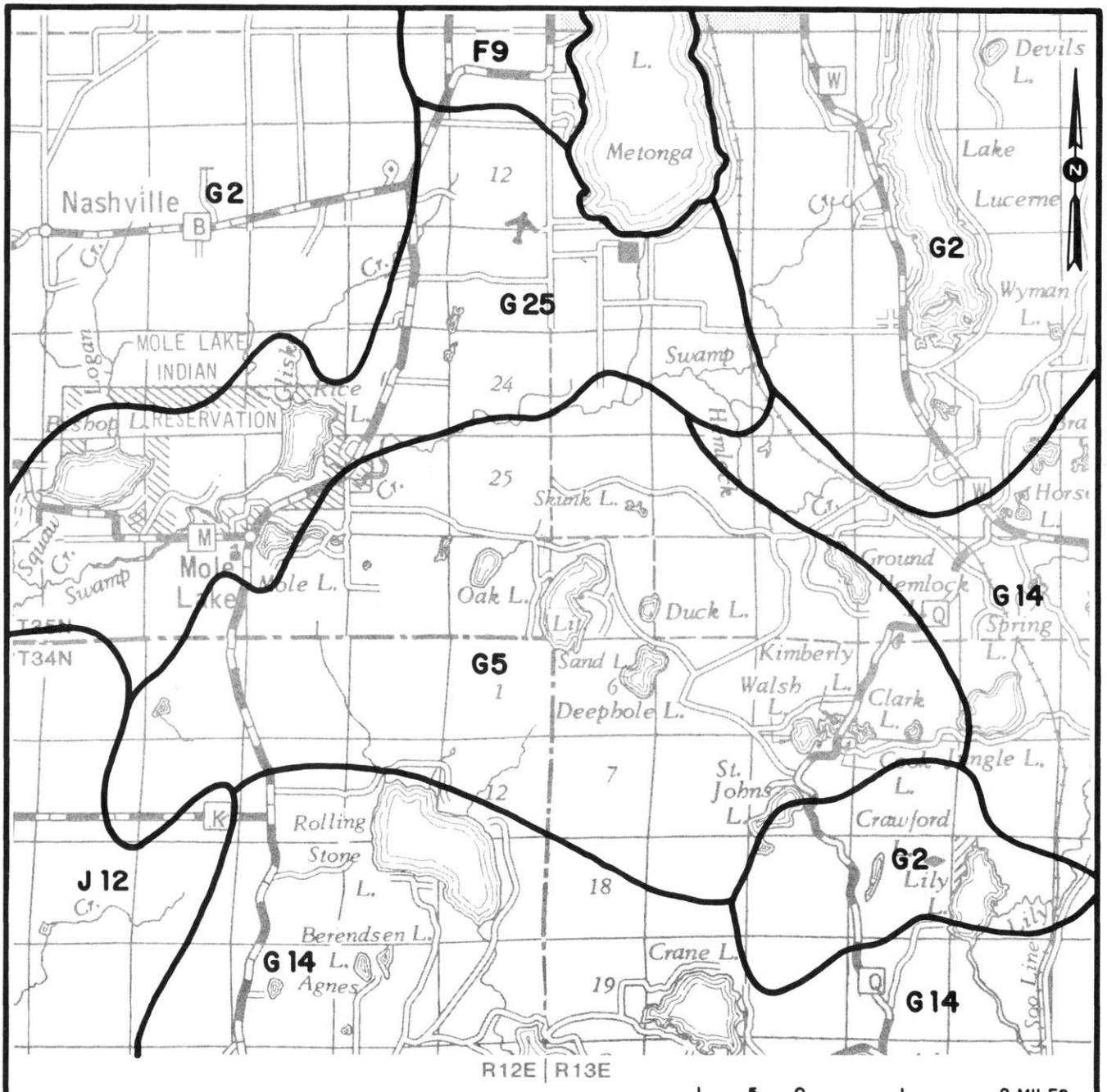
2.6.2 Soils

Three major soil regions occur in the environmental study area: (1) soils of the northern silty uplands and plains; (2) soils of the northern loamy uplands and plains; and (3) soils of the stream bottoms and major wetlands (Hole et al., 1968). The northern loamy soils of the uplands and plains represent the most common of the three soil regions in the environmental study area (Figure 2.6-5).

The site area is located within the Kennan, Iron River, Pence, Vilas Association (G5) (Figure 2.6-5), and the major soils are the Kennan, Iron River, and Pence loams; Vilas sands; and peat soils.

The most common soil type in the site area is the Iron River Variant Stony Loam (#21) (Figure 2.6-6), which is characterized as a moderately well-drained, nearly level to steep silt loam, 508 to 1,016 mm (20 to 40 inches) deep, over sandy loam glacial till. Monico Stony Loam is the second most common soil in the site area and is characterized as a somewhat poorly drained, nearly level to gently sloping loamy soil, 508 to 1,016 mm (20 to 40 inches) thick, over sandy loam glacial till. This moderately permeable soil has a high available water capacity.

Soils in the wetlands are primarily peats and mucks (700 Series). A detailed map of the soils of the site area is presented on Figure 2.6-6, and soil descriptions are presented in Table 2.6-2.



KEY:

SOILS OF THE NORTHERN SILTY UPLANDS AND PLAINS

F9 CLIFFORD AND AUBURNDALE SILT LOAM; AND PEAT SOILS

SOILS OF THE NORTHERN LOAMY UPLANDS AND PLAINS

G2 IRON RIVER AND PENCE LOAMS; GOODMAN, MONICO AND STAMBAUGH SILT LOAM; PEAT SOILS; SOME AREAS ARE STONY

G5 KENNAN, IRON RIVER AND PENCE LOAMS; VILAS SAND; AND PEAT SOILS

G14 KENNAN, IRON RIVER AND PENCE LOAMS; AND PEAT SOILS

G25 PENCE AND PADUS LOAMS; STAMBAUGH SILT LOAM; VILAS AND OMEGA SAND

SOILS OF STREAM BOTTOMS AND MAJOR WETLANDS

J12 MOSS PEAT OVER ACID SEDGE AND WOODY PEAT SOILS; AU GRES SAND; AND CABLE LOAMS

1 .5 0 1 2 MILES

1 .5 0 1 2 KILOMETERS

SOURCE: HOLE et al, 1968.

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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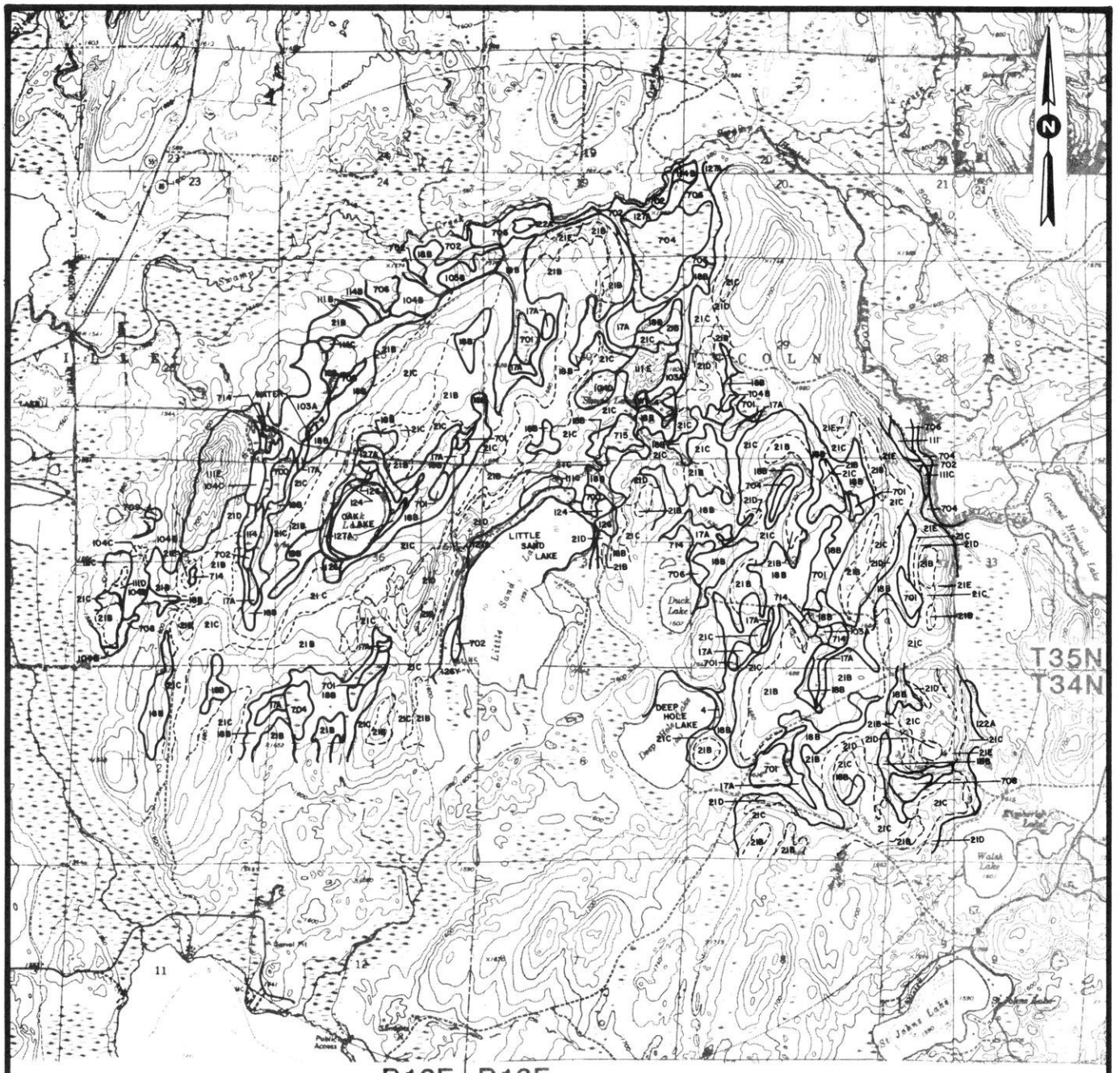
SOIL ASSOCIATIONS OF
THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.6-5



KEY:

SOIL NUMBER	SOIL TYPE
4	PONDED HISTOSOL
17	CABLE STONY SILT LOAM
18	MONICO STONY LOAM
21	IRON RIVER VARIANT STONY LOAM
103	WORCESTER LOAM
104	PADUS LOAM
105	PADUS SANDY LOAM
111	PENCE SANDY LOAM
114	SAYNER LOAMY SAND
122	WORCESTER SANDY LOAM
124	KINROSS LOAMY SAND
126	AU GRES LOAMY SAND
126Y	AU GRES VARIANT LOAMY SAND
127	CROSWELL LOAMY SAND

SOIL NUMBER	SOIL TYPE
700	SEELYEVILLE MUCK
701	CATHRO MUCK
702	MARKEY MUCK
704	LUPTON MUCK
706	TAWAS MUCK
708	LOXLEY MUCK
709	DAWSON MUCKY PEAT
714	GREENWOOD PEAT
715	MERWIN PEAT

SLOPE CLASS	
A	0 TO 2 PERCENT
B	2 TO 6 PERCENT
C	6 TO 12 PERCENT
D	12 TO 20 PERCENT
E	20 TO 30 PERCENT

SOURCE: LUDWIG, 1978.

BASE MAP REFERENCE:
PORTIONS OF THE FOLLOWING U.S.G.S. 7.5 MINUTE SERIES: CRANDON, WISCONSIN, 1965; LAKE LUCERNE, WISCONSIN, 1973; AND ROBERTS LAKE, WISCONSIN, 1973.

.5 0 1 MILE

.5 0 1 KILOMETER

EXXON MINERALS COMPANY
CRANDON PROJECT

SOILS OF THE SITE AREA

DAMES & MOORE

FIGURE 2.6-6

DESCRIPTIONS OF SOILS IN THE SITE AREA

SOIL NUMBER	SOIL TYPE	DESCRIPTION	SLOPES
4	Ponded Histosol	Miscellaneous land areas that are inundated most of the year.	0 - 2%
17	Cable Stony Silt Loam	Poorly drained nearly level loamy soil, 15 to 30 inches thick, over sandy loam glacial till. These moderately permeable soils have a high available water capacity.	0 - 3%
18	Monico Stony Loam	Somewhat poorly drained nearly level and gently sloping loamy soil, 20 to 40 inches thick, over sandy loam glacial till. These moderately permeable soils have a high available water capacity.	1 - 3%
21	Iron River Variant Stony Loam	Moderately well drained nearly level to steep silt loam, 20 to 40 inches thick, over sandy loam glacial till.	1 - 45%
103	Worcester Loam	Somewhat poorly drained gently sloping loamy soil, 20 to 35 inches thick, over sand and gravel glacial till. These moderately permeable soils have a medium available water capacity.	0 - 3%
104	Padus Loam	Well drained nearly level to steep loamy soil, 20 to 40 inches thick, over sand and gravel glacial till. These moderately permeable soils have a medium available water capacity.	0 - 25%
105	Padus Sandy Loam	Well drained nearly level sandy loam, 20 to 40 inches thick, over sand and gravel glacial till. These moderately permeable soils have a medium available water capacity.	0 - 6%
111	Pence Sandy Loam	Well drained nearly level to steep sandy loam, 20 to 40 inches thick, over sand and gravel glacial till.	0 - 45%
114	Sayner Loamy Sand	Excessively drained nearly level to steep loamy sand, 15 to 30 inches thick, over sand and gravel glacial till.	0 - 25%
122	Worcester Sandy Loam	Somewhat poorly drained, gently sloping loamy soil, 20 to 40 inches thick, over sand and gravel glacial till. These moderately permeable soils have a medium available water capacity.	0 - 3%
124	Kinross Loamy Sand	Poorly drained nearly level loamy sand, 10 to 35 inches thick, over sandy glacial till.	0 - 2%
126	AuGres Loamy Sand	Somewhat poorly drained nearly level loamy sand, 20 to 40 inches thick, over sandy glacial till.	0 - 6%

SOIL NUMBER	SOIL TYPE	DESCRIPTION	SLOPES
126Y	AuGres Variant Loamy Sand	Somewhat poorly drained nearly level sandy soil, 40 to 60 inches thick, over loamy glacial till. These rapidly permeable soils have a low available water capacity.	0 - 3%
127	Croswell Loamy Sand	Moderately well drained nearly level to gently sloping sandy soil, 20 to 40 inches thick, over sandy glacial till.	0 - 12%
700	Seelyeville Muck	Very poorly drained level organic soil, 40 to 60 inches thick, over loamy glacial till.	< 2%
701	Cathro Muck	Very poorly drained level organic soil, 16 to 50 inches thick, over loamy glacial till.	< 2%
702	Markey Muck	Very poorly drained level organic soils, 16 to 50 inches thick, over sandy loam glacial till.	< 2%
704	Lupton Muck	Very poorly drained level organic soils, 20 to 65 inches thick, over loamy glacial till.	< 2%
706	Tawas Muck	Very poorly drained nearly level organic, mucky peat soils, 16 to 50 inches thick, over sand or loamy sand glacial till. These moderately rapid permeable soils have a high available water capacity.	0 - 2%
708	Loxley Muck	Very poorly drained level acid organic soils, 15 to 50 inches thick, over loamy glacial till.	< 1%
709	Dawson Mucky Peat	Very poorly drained level organic soils, 40 to 60 inches thick, over sandy glacial till.	< 2%
714	Greenwood Peat	Very poorly drained level organic soil, 10 to 60 inches thick, over glacial till.	0 - 2%
715	Merwin Peat	Very poorly drained level organic soil, 40 to 60 inches thick, over glacial till.	0 - 1%

Source: Ludwig, 1978.

2.6.3 Vegetation

2.6.3.1 Regional Study Area

A vegetational transition zone crosses Wisconsin from the northwest to the southeast (roughly, from Eau Claire to Wausau to Milwaukee), separating two major vegetational provinces (Curtis, 1959). North of this zone, the species are primarily of northern distribution and adapted to short, wet summers and long, cold winters (Bailey, 1978). South of this zone, the species are adapted to longer, drier summers and shorter, milder winters and have primarily a southern distribution (Bailey, 1978). The northern province is primarily forest communities, while the southern is primarily prairie-forest border communities. The regional study area lies north of this transition zone in the area of northern forest communities.

Finley (1976) indicates that the original vegetation cover of the regional study area consisted primarily of two major forest types, mixed Coniferous-Deciduous Forest and Wetland vegetation. The Mixed Forest type that was most frequent in the regional study area was dominated by eastern hemlock (Tsuga canadensis), sugar maple (Acer saccharum), yellow birch (Betula lutea), white pine (Pinus strobus), and red pine (Pinus resinosa). The wetland vegetation type that was most frequent in the regional study area was dominated by swamp conifers that include white cedar (Thuja occidentalis), black spruce (Picea mariana), tamarack (Larix laricina), and eastern hemlock. Very few areas of original forest remain in northern Wisconsin since most were logged, burned, and/or cleared for agriculture around the turn of the century. Consequently, most of Wisconsin's forests currently are 50- to 100-year-old

second-growth forests. The most prevalent forest types in the region today are Northern Hardwood, Aspen-Birch, and Spruce-Fir (Swamp Conifer) (Spencer and Thorne, 1972).

Several uncommon plants that are listed as endangered or threatened in Wisconsin can be expected to occur in the region. These plants are discussed in subsection 2.6.5.1. The nearest uncommon plant community within the State Scientific Areas system is the Scott Lake-Shelp Lake Natural Area, located approximately 24 km (15 miles) north-northwest of Crandon. Staff members of the State Scientific Area Preservation Council have recently completed an inventory of Forest County for additional uncommon and rare plant communities; none were found in the environmental study area (Smith, 1982). During a field reconnaissance, Mr. Robert Read of the DNR stated that a small stand of bur oak (Quercus macrocarpa) in the site area (NW 1/4 of the SW 1/4, Section 29, T35N, R13E) was unusual but not worthy of inclusion into the State Scientific Area system.

2.6.3.2 Project Area

Environmental Study Area

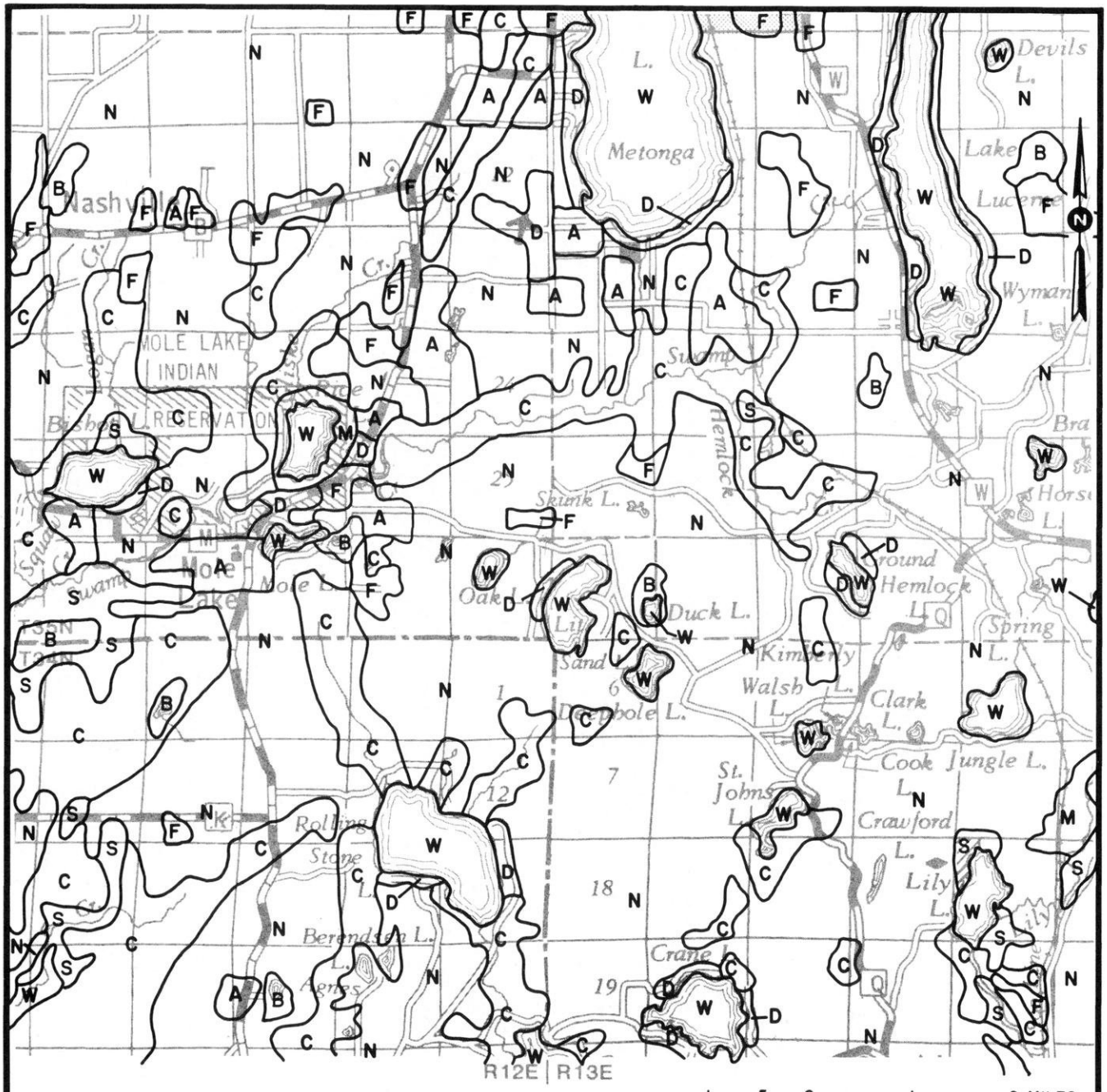
The environmental study area consists of heavily forested upland areas interspersed with forested lowlands and is typical of this region of Wisconsin. The two most abundant vegetation types in the environmental study area are Northern Hardwood (including Aspen-Birch) and Swamp Conifer, comprising approximately 79 percent of the total area. The remainder of the area consists primarily of shrub swamp, bog, marsh, urban or developed areas, old field and clearcut, agriculture and water (Table 2.6-3 and Figure 2.6-7). A brief description of each vegetation type is given below.

TABLE 2.6-3

VEGETATION TYPES OF THE ENVIRONMENTAL STUDY AREA AND SITE AREA

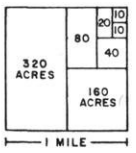
TYPE*	ENVIRONMENTAL STUDY AREA APPROXIMATE AREA HECTARES	ENVIRONMENTAL STUDY AREA APPROXIMATE AREA ACRES	ENVIRONMENTAL STUDY AREA PERCENT OF TOTAL	SITE AREA APPROXIMATE AREA HECTARES	SITE AREA APPROXIMATE AREA ACRES	SITE AREA PERCENT OF TOTAL
Northern Hardwood (including Aspen-Birch)	16,965	41,888	65	4,654	11,490	59
Swamp Conifer	3,620	8,937	14	1,565	3,865	20
Shrub Swamp	672	1,660	3	220	544	3
Bog	213	525	1	85	211	1
Marsh	93	229	<0.5	155	383	2
Urban or Developed	592	1,461	2	40	98	<0.5
Old Field and Clearcut	661	1,631	3	340	839	4
Agriculture	966	2,389	4	333	823	4
Water	2,138	5,280	8	546	1,347	7
TOTALS	25,920	64,000	100	7,938	19,600	100

*See Figures 2.6-7 and 2.6-8 for location.



KEY:

N	NORTHERN HARDWOOD (INCLUDING ASPEN/BIRCH)
C	SWAMP CONIFER
S	SHRUB SWAMP
B	BOG
M	MARSH
D	URBAN OR DEVELOPED
F	OLD FIELD AND CLEARCUT
A	AGRICULTURE
W	WATER



NOTE: MINIMUM SIZE DELINEATED IS 16.2 HECTARES (40 ACRES)

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

EXXON MINERALS COMPANY
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VEGETATION OF THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.6-7

Northern Hardwood, as described by Curtis (1959), can be subdivided into three communities: Mesic Northern Hardwood, Dry-Mesic Northern Hardwood, and Xeric Northern Hardwood. The dominant species of mesic sites in the environmental study area are sugar maple, eastern hemlock, yellow birch or basswood (Tilia americana). White pine, red maple (Acer rubrum), or northern red oak (Quercus borealis) are dominant in the Dry-Mesic Northern Hardwoods; jack pine (Pinus banksiana), red pine or Hill's oak (Quercus ellipsoidalis) are dominant in the Xeric Northern Hardwoods. Most of the Northern Hardwoods in the environmental study area are Mesic or Dry-Mesic Northern Hardwoods.

The Northern Hardwood forests in the environmental study area also include stands of Aspen-Birch. The Aspen-Birch forest type is an early successional stage of Northern Hardwood that commonly becomes established following logging and fires. The dominant species in Aspen-Birch are large-toothed aspen (Populus grandidentata), quaking aspen (Populus tremuloides), balsam popular (Populus balsamifera) or white birch (Betula papyrifera) (Spencer and Thorne, 1972). Stands of Aspen-Birch are common in the environmental study area.

Shrubs and herbaceous plants of Northern Hardwood communities typically include the following:

leatherwood	Dirca palustris
ironwood	Ostrya virginiana
beaked hazel	Corylus cornuta
honeysuckle	Lonicera spp.
Pennsylvania sedge	Carex pensylvanica
downy yellow violet	Viola pubescens
Carolina spring-beauty	Claytonia caroliniana
wild lily-of-the-valley	Maianthemum canadense
large-flowered trillium	Trillium grandiflorum
wild sarsaparilla	Aralia nudicaulis
clintonia	Clintonia borealis
large-leaved aster	Aster macrophyllus

Swamp Conifer can consist of two plant communities: Wet-Northern Forest, dominated by tamarack and black spruce, or Wet-Mesic Northern Forest, dominated by white cedar, balsam fir or black ash (Fraxinus nigra) (Curtis, 1959). Both Wet-Mesic Northern Forest and Wet Northern Forest are abundant in this region of Wisconsin. As in upland forests, the species composition of these types varies in response to available moisture. Wet-Mesic Northern Forests are often located along streams, whereas Wet Northern Forests are usually located in upland depressions, old lake basins and around bogs. Shrub and herbaceous plants of Swamp Conifer communities typically include the following:

clintonia	Clintonia borealis
false Solomon's-seal	Smilacina trifolia
pink lady's-slipper	Cypripedium acaule
yellow lady's-slipper	Cypripedium calceolus
willow	Salix spp.
speckled alder	Alnus rugosa
shrub birch	Betula gladulosa
starflower	Trientalis borealis
common wood sorrel	Oxalis montana
miterwort	Mitella diphylla
currant	Ribes spp.
narrowleaf meadowsweet	Spiraea alba
mountain holly	Nemopanthus mucronata
blueberry	Vaccinium spp.
twinflower	Linnaea borealis
bunchberry	Cornus canadensis
red-osier dogwood	Cornus stolonifera

Nonforested wetlands, which occupy less than 5 percent of the environmental study area, are usually small in size, frequently less than 16.2 ha (40 acres) (Figure 2.6-7).

Bogs occur fairly frequently in depressions throughout the environmental study area (Figure 2.6-7). Bogs are communities of plants and animals typically northern in distribution and uncommon south of the tension

zone. Bogs are typically dominated by low, evergreen, ericaceous shrubs such as leatherleaf (Chamaedaphne calyculata), blueberry, Labrador-tea (Ledum groenlandicum), bog rosemary (Andromeda glaucophylla) and pale laurel (Kalmia polifolia) (Curtis, 1959).

Shrub swamps comprise approximately 3 percent of the environmental study area and occur primarily along stream banks and in other lowland situations. Speckled alder is the dominant species in this type; other common species include red-osier dogwood, chokeberry (Aronia melanocarpa), shrub birch, wintergreen (Ilex verticillata), mountain holly, and willow. Curtis (1959) classifies this community as Alder Thicket.

Two marshes larger than 16.2 ha (40 acres) occur within the environmental study area. One is located in Rice Lake and the other is located approximately 1.6 km (1 mile) southeast of Jungle Lake (Figure 2.6-7). The marsh in Rice Lake is an uncommon vegetational community that contains wild rice (Zizania aquatica) as well as a variety of other emergent aquatic plants.

The remainder of the environmental study area consists primarily of lakes, abandoned agricultural fields, clearcuts, active farmland and developed land. These nonforested types occupy less than 20 percent of the environmental study area (Table 2.6-3 and Figure 2.6-7).

Site Area

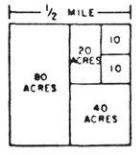
The areal coverage of the vegetation types in the site area is listed in Table 2.6-3 and is shown on Figure 2.6-8. Quantitative vegetation sampling during this study was conducted only in the three major vegetation

KEY:

- N NORTHERN HARDWOOD (INCLUDING ASPEN/BIRCH)
- C SWAMP CONIFER
- S SHRUB SWAMP
- B BOG
- M MARSH
- D URBAN OR DEVELOPED
- F OLD FIELD AND CLEARCUT
- A AGRICULTURE
- W WATER

.5 0 MILE

.5 0 KILOMETER



NOTE:
MINIMUM TYPE SIZE DELINEATED IS APPROXIMATELY 4 HECTARES (10 ACRES) EXCEPT FOR WETLANDS WHICH ARE DELINEATED TO APPROXIMATELY 1 HECTARE (2.5 ACRES).

BASE MAP REFERENCE:
PORTIONS OF THE FOLLOWING U.S.G.S. 7.5 MINUTE SERIES: CRANDON, WISCONSIN, 1965; LAKE LUCERNE, WISCONSIN, 1973; AND ROBERTS LAKE, WISCONSIN, 1973.

EXXON MINERALS COMPANY
CRANDON PROJECT

VEGETATION MAP OF THE SITE AREA

DAMES & MOORE

FIGURE 2.6-8

types of the site area, Northern Hardwoods, Aspen-Birch and Swamp Conifer. Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) have quantitatively sampled wetlands in the site area and Steigerwaldt and Sons (1982) have conducted a forest inventory and timber appraisal of those lands being considered for development. Presented below is a description of each vegetation type in the site area and the results of vegetation sampling.

Northern Hardwood - The Northern Hardwood communities are the most prevalent vegetation type in the site area. Three stands of Northern Hardwoods were sampled in the site area (Figure 2.6-1). Using Curtis' (1959) method of computing compositional indices, the three stands sampled were categorized into two groups: Stands 1 and 2 as Mesic Northern Hardwood, and Stand 3 as Dry-Mesic Northern Hardwood.

The two Mesic Northern Hardwood stands sampled were very similar (Tables 2.6-4, 2.6-5, and 2.6-6). In both stands, sugar maple was dominant in all three tree and shrub strata (Tables 2.6-5 and 2.6-6). The total density of trees and the average tree size were greater in Stand 1 than in Stand 2 (Table 2.6-4).

In the overstory stratum of Northern Hardwood Stand 1, sugar maple was the dominant species, with an importance value of 182.0 (Table 2.6-5). Sugar maple had the highest relative frequency, density, and dominance of any species and comprised 61 percent of the overstory stratum's total importance value. Basswood was the other dominant species of the overstory with an importance value of 89.2, or 30 percent of the total importance value. These two species were the community dominants with a combined importance value of

TABLE 2.6-4

SUMMARY OF THE OVERSTORY OF FOREST VEGETATION SAMPLED IN THE SITE AREA

STAND	SPECIES* SUGAR MAPLE	RED MAPLE	BASSWOOD	WHITE CEDAR	ASPEN	PAPER BIRCH	YELLOW BIRCH	WHITE PINE	NORTHERN OAK	BALSAM FIR	RED PINE	EASTERN HEMLOCK	BLACK CHERRY	IRON-WOOD	ASH	ELM	TOTAL
Northern Hardwoods																	
Stand 1 (Mesic)																	
Relative Frequency	53.7	0	33.3	0	0	0	0	0	0	0	0	0	1.9	0	1.9	9.3	100.1
Relative Density	65.8	0	27.5	0	0	0	0	0	0	0	0	0	0.8	0	0.8	5.0	99.9
Relative Dominance	62.5	0	28.4	0	0	0	0	0	0	0	0	0	0.9	0	1.5	6.6	99.9
Importance Value	182.0	0	89.3	0	0	0	0	0	0	0	0	0	3.6	0	4.2	20.9	300.0
Density (trees/ha)	684.7	0	286.0	0	0	0	0	0	0	0	0	0	8.7	0	8.7	52.0	1,040.1
Basal Area (cm^2/ha)	192,542.0	0	87,512.0	0	0	0	0	0	0	0	0	0	2,825.0	0	4,751.0	20,314.0	307,944.0
Stand 2 (Mesic)																	
Relative Frequency	44.4	0	27.0	0	1.6	1.6	1.6	0	0	0	0	0	0	0	12.7	11.1	100.0
Relative Density	59.2	0	21.7	0	0.8	0.8	0.8	0	0	0	0	0	0	0	10.8	5.8	99.9
Relative Dominance	46.6	0	30.0	0	1.6	1.0	1.0	0	0	0	0	0	0	0	12.1	7.9	100.2
Importance Value	150.2	0	78.7	0	4.0	3.4	3.4	0	0	0	0	0	0	0	35.6	24.8	300.1
Density (trees/ha)	499.7	0	183.0	0	7.0	7.0	7.0	0	0	0	0	0	0	0	91.5	49.3	844.5
Basal Area (cm^2/ha)	97,895.0	0	63,016.0	0	3,321.0	2,016.0	2,016.0	0	0	0	0	0	0	0	25,428.0	16,600.0	210,292.0
Stand 3 (Dry-Mesic)																	
Relative Frequency	7.5	21.2	0	0	21.2	15.0	0	5.0	7.5	8.7	5.0	5.0	0	0	0	3.7	99.8
Relative Density	5.8	24.2	0	0	20.0	20.8	0	5.0	5.8	6.7	3.3	5.8	0	0	0	2.5	99.9
Relative Dominance	3.4	24.1	0	0	24.2	13.9	0	10.7	5.3	2.5	8.5	5.4	0	0	0	1.9	99.9
Importance Value	16.7	69.5	0	0	65.4	49.7	0	20.7	18.6	17.9	16.8	16.2	0	0	0	8.1	299.6
Density (trees/ha)	52.2	216.4	0	0	179.1	186.6	0	44.8	52.2	59.7	29.9	52.2	0	0	0	22.4	895.5
Basal Area (cm^2/ha)	10,936.0	78,354.0	0	0	78,783.0	45,305.0	0	34,930.0	17,279.0	8,255.0	27,630.0	17,692.0	0	0	0	6,083.0	325,247.0

Note: Average tree size can be determined through dividing the basal area (cm2/ha) by the density (trees/ha); to convert from ha to acres divide by 2.47.

*Scientific names are listed in Appendix 2.6A.

TABLE 2.6-4 (continued)

STAND	SUGAR MAPLE	RED MAPLE	BASSWOOD	WHITE CEDAR	ASPEN	PAPER BIRCH	YELLOW BIRCH	WHITE PINE	NORTHERN OAK	BALSAM FIR	RED PINE	EASTERN HEMLOCK	BLACK CHERRY	IRON-WOOD	ASH	ELM	TOTAL
						SPECIES*											
Aspen/Birch																	
Relative Frequency	27.1	0	7.1	0	22.9	35.7	0	0	0	5.7	0	0	0	1.4	0	0	99.9
Relative Density	25.0	0	4.2	0	19.2	47.5	0	0	0	3.3	0	0	0	0.8	0	0	100.0
Relative Dominance	14.6	0	4.2	0	34.1	43.7	0	0	0	3.1	0	0	0	0.3	0	0	100.0
Importance Value	66.7	0	15.5	0	76.2	126.9	0	0	0	12.1	0	0	0	2.5	0	0	299.9
Density (trees/ha)	201.2	0	33.5	0	154.5	382.3	0	0	0	26.8	0	0	0	6.7	0	0	805.0
Basal Area (cm^2/ha)	31,170.0	0	9,002.0	0	73,116.0	93,503.0	0	0	0	6,699.0	0	0	0	617.0	0	0	214,107.0
Swamp Conifer																	
Relative Frequency	0	0	0	52.1	0	6.3	0	0	0	35.4	0	4.2	0	0	2.1	0	100.1
Relative Density	0	0	0	60.0	0	2.5	0	0	0	32.5	0	4.2	0	0	0.8	0	100.0
Relative Dominance	0	0	0	70.3	0	2.3	0	0	0	17.1	0	9.6	0	0	0.8	0	100.1
Importance Value	0	0	0	182.4	0	11.1	0	0	0	85.0	0	18.0	0	0	3.7	0	300.2
Density (trees/ha)	0	0	0	553.2	0	23.0	0	0	0	299.6	0	38.4	0	0	7.7	0	921.9
Basal Area (cm^2/ha)	0	0	0	219,691.0	0	7,107.0	0	0	0	53,341.0	0	30,063.0	0	0	2,504.0	0	312,706.0

TABLE 2.6-5

RESULTS OF VEGETATION SAMPLING IN SITE AREA
NORTHERN HARDWOOD - STAND 1

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
OVERSTORY							
Sugar Maple	29	79	--	53.7	65.8	62.5	182.0
Basswood	18	33	--	33.3	27.5	28.4	89.2
Elm	5	6	--	9.3	5.0	6.6	20.9
Ash	1	1	--	1.9	0.8	1.5	4.2
Black Cherry	1	1	--	1.9	0.8	0.9	3.6
Total	54	120	--	100.1	99.9	99.9	299.9
UPPER UNDERSTORY							
Sugar Maple	30	118	--	93.7	98.3	97.5	289.5
Basswood	2	2	--	6.3	1.7	2.5	10.5
Total	32	120	--	100.0	100.0	100.0	300.0
LOWER UNDERSTORY							
Sugar Maple	10	--	4.2	66.7	--	86.3	153.0
Basswood	2	--	0.3	13.3	--	5.5	18.8
Leatherwood	1	--	0.2	6.7	--	4.1	10.8
Elm	1	--	0.1	6.7	--	2.7	9.4
Bristly Black Currant	1	--	0.1	6.7	--	1.4	8.1
Total	15	--	4.9	100.1	--	100.0	200.1
GROUND LAYER							
Sugar Maple	14	--	17.2	19.7	--	45.8	65.5
Pennsylvania Sedge	7	--	5.3	9.9	--	14.2	24.1
Downy Yellow Violet	7	--	2.6	9.9	--	7.0	16.9
Wild Lily-of-the-Valley	6	--	2.3	8.5	--	6.0	14.5
Hairy Solomon's-Seal	6	--	1.7	8.5	--	4.4	12.9
Sweet Cicely	7	--	0.7	9.9	--	1.8	11.7
Maidenhair Fern	3	--	1.7	4.2	--	4.6	8.8
Fragrant Bedstraw	3	--	1.7	4.2	--	4.6	8.8
Ash	4	--	0.3	5.6	--	0.7	6.3
Large-Flowered Bellwort	2	--	0.7	2.8	--	2.0	4.8
Zigzag Golednrod	1	--	1.0	1.4	--	2.6	4.0
Jack-in-the-Pulpit	2	--	0.3	2.8	--	0.9	3.7
Basswood	2	--	0.3	2.8	--	0.7	3.5
Miterwort	2	--	0.1	2.8	--	0.4	3.2
Ironwood	1	--	0.5	1.4	--	1.4	2.8
Bloodroot	1	--	0.4	1.4	--	1.1	2.5
Rose Twisted Stalk	1	--	0.4	1.4	--	1.1	2.5
Large Flowered Trillium	1	--	0.2	1.4	--	0.5	1.9
Elm	1	--	0.1	1.4	--	0.2	1.6
Total	71	--	37.5	100.0	--	100.0	200.0

Note: -- indicates no data.

[a]Scientific names are listed in Appendix 2.6A.

[b]For Overstory and Upper Understory, the Importance Value equals the total of Relative Frequency, Relative Density, and Relative Dominance; for Lower Understory and Ground Layer, the Importance Value equals the total of Relative Frequency and Relative Dominance.

TABLE 2.6-6

RESULTS OF VEGETATION SAMPLING IN SITE AREA
NORTHERN HARDWOOD - STAND 2

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
OVERSTORY							
Sugar Maple	28	71	--	44.4	59.2	46.6	150.2
Basswood	17	26	--	27.0	21.7	30.0	78.7
Ash	8	13	--	12.7	10.8	12.1	35.6
Elm	7	7	--	11.1	5.8	7.9	24.8
Aspen	1	1	--	1.6	0.8	1.6	4.0
Paper Birch	1	1	--	1.6	0.8	1.0	3.4
Yellow Birch	1	1	--	1.6	0.8	1.0	3.4
Total	63	120	--	100.0	99.9	100.2	300.1
UPPER UNDERSTORY							
Sugar Maple	30	117	--	90.9	97.5	97.2	285.6
Ash	1	1	--	3.0	0.8	1.4	5.2
Yellow Birch	1	1	--	3.0	0.8	1.2	5.0
Basswood	1	1	--	3.0	0.8	0.2	4.0
Total	33	120	--	99.9	99.9	100.0	299.8
LOWER UNDERSTORY							
Sugar Maple	12	--	5.1	38.7	--	62.9	101.6
Ash	5	--	0.9	16.1	--	10.6	26.7
Currant	3	--	1.3	9.7	--	16.3	26.0
Leatherwood	4	--	0.5	12.9	--	5.7	18.6
Serviceberry	1	--	0.1	3.2	--	0.8	4.0
Beaked Hazelnut	1	--	0.1	3.2	--	0.8	4.0
Canada Honeysuckle	1	--	0.1	3.2	--	0.8	4.0
Red Maple	1	--	0.1	3.2	--	0.8	4.0
Basswood	1	--	0.0	3.2	--	0.4	3.6
Ironwood	1	--	0.0	3.2	--	0.4	3.6
Elm	1	--	0.0	3.2	--	0.4	3.6
Total	31	--	8.2	99.8	--	99.9	199.7
GROUND LAYER							
Pennsylvania Sedge	12	--	11.7	10.8	--	32.3	43.1
Rose Twisted Stalk	11	--	4.3	9.9	--	11.7	21.6
Downy Yellow Violet	9	--	2.8	8.1	--	7.7	15.8
Sugar Maple	13	--	1.1	11.7	--	3.1	14.8
Wild Lily-of-the-Valley	6	--	1.6	5.4	--	4.5	9.9
Large-Leaved Aster	6	--	1.6	5.4	--	4.5	9.9
Hairy Solomon's-Seal	4	--	1.9	3.6	--	5.3	8.9
Large-Flowered Trillium	6	--	1.1	5.4	--	3.0	8.4
Northern White Violet	6	--	1.0	5.4	--	2.7	8.1
Ash	4	--	1.6	3.6	--	4.4	8.0
Sweet Cicely	6	--	0.6	5.4	--	1.7	7.1
Maidenhair Fern	1	--	2.0	0.9	--	5.5	6.4
Fragrant Bedstraw	4	--	0.8	3.6	--	2.1	5.7

NOTE: -- indicates no data.

[a]Scientific names are listed in Appendix 2.6A.

[b]For Overstory and Upper Understory, the Importance Value equals the total of Relative Frequency, Relative Density, and Relative Dominance; for Lower Understory and Ground Layer, the Importance Value equals the total of Relative Frequency and Relative Dominance.

TABLE 2.6-6 (continued)

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
Bladder Sedge	3	--	0.9	2.7	--	2.4	5.1
Starflower	4	--	0.3	3.6	--	0.7	4.3
Ironwood	1	--	0.7	0.9	--	1.8	2.7
Schizanche purpurascens	1	--	0.7	0.9	--	1.8	2.7
White Baneberry	2	--	0.1	1.8	--	0.4	2.2
Poa saltuensis	2	--	0.1	1.8	--	0.2	2.0
Serviceberry	1	--	0.3	0.9	--	0.9	1.8
Currant	1	--	0.3	0.9	--	0.9	1.8
Common Elderberry	1	--	0.2	0.9	--	0.6	1.5
Clintonia	1	--	0.2	0.9	--	0.6	1.5
Large-Flowered Bellwort	1	--	0.1	0.9	--	0.4	1.3
Leatherwood	1	--	0.1	0.9	--	0.4	1.3
Wild Sarsaparilla	1	--	0.1	0.9	--	0.2	1.1
Round-Lobed Hepatica	1	--	0.0	0.9	--	0.1	1.0
Wood Anemone	1	--	0.0	0.9	--	0.1	1.0
Miterwort	1	--	0.0	0.9	--	0.1	1.0
Total	111	--	36.2	99.9	--	100.1	200.0

271.2. Elm (Ulmus spp.), ash, and black cherry (Prunus serotina) were also found in this community, and were less important to the community structure.

In Northern Hardwood Stand 1, only two species were encountered in the upper understory: sugar maple and basswood (Table 2.6-5). Of these two, sugar maple was by far the most dominant species comprising 96.5 percent of the total importance value of the upper understory stratum.

In the lower understory stratum of Northern Hardwood Stand 1, sugar maple was again the most dominant species, comprising 76.5 percent of the importance value for this stratum (Table 2.6-5). Sugar maple had a mean cover value of 4.2 percent in the lower understory of Stand 1. Basswood was the only other tree species occurring in the lower understory stratum. It comprised 9.4 percent of the lower understory stratum's importance value.

The ground layer of Northern Hardwood communities such as those in the site area generally supports herbaceous communities of lower density and diversity than many other communities (Curtis, 1959). Curtis listed wild lily-of-the-valley, hairy Solomon's-seal (Polygonatum pubescens), and rose twisted stalk (Streptopus roseus) as the three species most frequently encountered in Northern Hardwoods. The mean cover values for wild lily-of-the-valley, hairy Solomon's-seal and rose twisted stalk in Northern Hardwood Stand 1 were 2.3, 1.7, and 0.4 percent, respectively (Table 2.6-5). The five species with the highest mean cover values were sugar maple, Pennsylvania sedge, downy yellow violet, wild lily-of-the-valley, and hairy Solomon's-seal (Table 2.6-5).

In Northern Hardwood Stand 2, sugar maple was the dominant species in the overstory stratum, with an importance value of 150.2; 50.0 percent of

the total overstory importance value (Table 2.6-6). Basswood was also a major species. Sugar maple and basswood comprised 76.3 percent of the overstory stratum's total importance value. Ash and elm had higher importance values in this community than in Northern Hardwood Stand 1. Paper birch and yellow birch were also found in the overstory stratum.

Sugar maple, comprising 95.2 percent of the stratum's total importance value, was the dominant species in the upper understory stratum of Northern Hardwood Stand 2 (Table 2.6-6). Ash, yellow birch, and basswood also occurred.

In the lower understory stratum of Northern Hardwood Stand 2, sugar maple was the most prevalent species, with an importance value of 101.6 (Table 2.6-6), or 50.8 percent of the lower understory stratum's total importance value. Sugar maple had a mean cover value of 5.1 percent in this lower understory. Ash was the next most abundant species in the lower understory. The lower understory stratum of Northern Hardwood Stand 2 also had a moderate number of shrub species and several tree species: currant, leatherwood, serviceberry (Amelanchier spp.), beaked hazel, Canada honeysuckle (Lonicera canadensis), red maple, basswood, ironwood, and elm.

The ground layer stratum of Northern Hardwood Stand 2 contained the common species reported by Curtis (1959) as occurring in Mesic Northern Hardwood communities (Table 2.6-6). The five species with the highest mean cover values were Pennsylvania sedge, rose twisted stalk, downy yellow violet, maidenhair fern (Adiantum pedatum), and hairy Solomon's-seal. The mean cover values for wild lily-of-the-valley, hairy Solomon's-seal, and rose twisted stalk were 1.6, 1.9, and 4.3 percent, respectively.

The Dry-Mesic Northern Hardwood sampled (Stand 3) was the most diverse of any vegetative community sampled in the site area (Table 2.6-7).

Dominance in the overstory stratum of Northern Hardwood Stand 3 was evenly distributed among red maple, aspen, and paper birch (Table 2.6-7). Red maple had the highest importance value (69.5), and red maple, aspen, and paper birch comprised 61.5 percent of the overstory stratum's total importance value. The next group of six species all had importance values of 5 to 7 percent of the total. Collectively, they comprised 35.8 percent of the overstory stratum's total importance value. These six species were white pine, northern red oak, balsam fir, red pine, sugar maple, and eastern hemlock.

Red maple was the most abundant species in the upper understory stratum of Northern Hardwood Stand 3, comprising 35.6 percent of the total importance value (Table 2.6-7). Sugar maple comprised 26.0 percent of the total upper understory stratum importance value. These two species were the most dominant species of the upper understory, comprising 61.6 percent of the total importance value. Three other species moderately important to the upper understory stratum were balsam fir, northern red oak, and paper birch. Collectively, these three species comprised 25.8 percent of the total importance value for the upper understory stratum.

The dominant shrub in the lower understory stratum of Northern Hardwood Stand 3 was beaked hazel. This shrub had an importance value of 77.1; 38.5 percent of the stratum's total. The mean cover values for beaked hazel and sugar maple were 4.6 and 1.2 percent, respectively. Forty-one percent of the total importance value for the lower understory stratum

TABLE 2.6-7

RESULTS OF VEGETATION SAMPLING IN SITE AREA
NORTHERN HARDWOOD - STAND 3

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
OVERSTORY							
Red Maple	17	29	--	21.2	24.2	24.1	69.5
Aspen	17	24	--	21.2	20.0	24.2	65.4
Paper Birch	12	25	--	15.0	20.8	13.9	49.7
White Pine	4	6	--	5.0	5.0	10.7	20.7
Northern Red Oak	6	7	--	7.5	5.8	5.3	18.6
Balsam Fir	7	8	--	8.7	6.7	2.5	17.9
Red Pine	4	4	--	5.0	3.3	8.5	16.8
Sugar Maple	6	7	--	7.5	5.8	3.4	16.7
Eastern Hemlock	4	7	--	5.0	5.8	5.4	16.2
Elm	3	3	--	3.7	2.5	1.9	8.1
Total	80	120	--	99.8	99.9	99.9	299.6
UPPER UNDERSTORY							
Red Maple	24	46	--	32.9	38.3	35.5	106.7
Sugar Maple	17	33	--	23.3	27.5	27.2	78.0
Balsam Fir	9	14	--	12.3	11.7	13.6	37.6
Northern Red Oak	9	11	--	12.3	9.2	5.9	27.4
Paper Birch	3	4	--	4.1	3.3	5.2	12.6
White Pine	3	3	--	4.1	2.5	2.3	8.9
Basswood	2	3	--	2.7	2.5	2.5	7.7
Aspen	2	2	--	2.7	1.7	3.2	7.6
Elm	1	1	--	1.4	0.8	1.9	4.1
Eastern Hemlock	1	1	--	1.4	0.8	1.3	3.5
Black Cherry	1	1	--	1.4	0.8	0.8	3.0
White Spruce	1	1	--	1.4	0.8	0.6	2.8
Total	73	120	--	100.0	99.9	100.0	299.9
LOWER UNDERSTORY							
Beaked Hazelnut	7	--	4.6	26.9	--	50.2	77.1
Sugar Maple	4	--	1.2	15.4	--	13.5	28.9
Red Maple	3	--	1.1	11.5	--	12.5	24.0
Northern Red Oak	3	--	0.5	11.5	--	5.5	17.0
Quaking Aspen	2	--	0.5	7.7	--	5.1	12.8
Mountain Maple	1	--	0.5	3.9	--	5.9	9.8
Chokecherry	2	--	0.1	7.7	--	0.7	8.4
Balsam Fir	1	--	0.3	3.9	--	2.9	6.8
Round-Leaved Serviceberry	1	--	0.1	3.9	--	1.5	5.4
Canada Honeysuckle	1	--	0.1	3.9	--	1.5	5.4
White Spruce	1	--	0.1	3.9	--	0.7	4.6
Total	26	--	9.1	100.2	--	100.0	200.2

Note: -- indicates no data.

[a]Scientific names are listed in Appendix 2.6A.

[b]For Overstory and Upper Understory, the Importance Value equals the total of Relative Frequency, Relative Density, and Relative Dominance; for Lower Understory and Ground Layer, the Importance Value equals the total of Relative Frequency and Relative Dominance.

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
GROUND LAYER							
Pennsylvania Sedge	9	--	16.1	6.7	--	24.1	30.8
Lady Fern	6	--	8.0	4.5	--	11.9	16.4
Wild Sarsaparilla	7	--	6.3	5.2	--	9.4	14.6
Wild Lily-of-the-Valley	14	--	2.4	10.4	--	3.6	14.0
Bracken Fern	6	--	5.9	4.5	--	8.8	13.3
Large-Leaved Aster	6	--	4.2	4.5	--	6.3	10.8
Clintonia	7	--	2.6	5.2	--	3.9	9.1
Northern White Violet	7	--	2.5	5.2	--	3.7	8.9
Poa saltuensis	7	--	2.3	5.2	--	3.5	8.7
Rose Twisted Stalk	7	--	1.7	5.2	--	2.6	7.8
Red Maple	9	--	0.6	6.7	--	0.8	7.5
Wood Anemone	6	--	1.1	4.5	--	1.7	6.2
Large-Flowered Trillium	5	--	1.3	3.7	--	1.9	5.6
Ground Pine	4	--	1.6	2.3	--	2.3	4.6
Canada Honeysuckle	4	--	1.4	2.3	--	2.1	4.4
Early Meadow Rue	4	--	1.2	2.3	--	1.7	4.0
Interrupted Fern	1	--	2.0	0.7	--	3.0	3.7
Round-Lobed Hepatica	3	--	0.7	2.3	--	1.0	3.3
Bladder Sedge	2	--	1.2	1.5	--	1.8	3.3
Ironwood	3	--	0.6	2.3	--	0.9	3.2
White Baneberry	3	--	0.6	2.3	--	0.9	3.2
Slender Panic Grass	2	--	0.5	1.5	--	0.7	2.2
Aspen	2	--	0.2	1.5	--	0.3	1.8
Starflower	2	--	0.1	1.5	--	0.2	1.7
Eastern Hemlock	2	--	0.1	1.5	--	0.1	1.6
Club Moss	1	--	0.5	0.7	--	0.7	1.4
Sugar Maple	1	--	0.3	0.7	--	0.5	1.2
Common Wood Sorrel	1	--	0.3	0.7	--	0.5	1.2
Bristly Greenbrier	1	--	0.3	0.7	--	0.4	1.1
Northern Red Oak	1	--	0.1	0.7	--	0.2	0.9
Downy Yellow Violet	1	--	0.1	0.7	--	0.1	0.8
Raspberry	1	--	0.1	0.7	--	0.1	0.8
Northern Bush Honeysuckle	1	--	0.0	0.7	--	0.0	0.7
Balsam Fir	1	--	0.0	0.7	--	0.0	0.7
Total	137	--	66.9	99.8	--	99.7	199.5

consisted of sugar maple, red maple, northern red oak, and aspen. Six other shrub and tree species comprised the remainder of the lower understory stratum: mountain maple (Acer spicatum), chokecherry (Prunus virginiana), balsam fir, round-leaved serviceberry (Amelanchier sanguinea), Canada honeysuckle, and white spruce (Picea glauca).

The ground layer of Northern Hardwood Stand 3 was the most diverse of the three Northern Hardwood stands sampled. Frequency and dominance were fairly evenly spread among the six species in the ground layer vegetation with the highest importance value. These species were Pennsylvania sedge, lady fern (Athyrium felix-femina), wild sarsaparilla, wild lily-of-the-valley, bracken fern, and large-leaved aster. The five species with the highest mean cover values were Pennsylvania sedge, lady fern, wild sarsaparilla, bracken fern, and large-leaved aster (Table 2.6-7).

A recent forest inventory indicated that well stocked poletimber-size Northern Hardwoods was the most abundant forest type in the site area. This cover type was described as second-growth poles, approximately 35-45 years old, that originated from the original clear cutting of the virgin hardwood timber. This type contained an average volume of 39 cords and 2841 board feet per hectare (16 cords and 1,150 board feet per acre) (Steigerwaldt and Sons, 1982).

Aspen-Birch - The Aspen-Birch stand sampled in the site area was an example of a mature Aspen-Birch community, in a successional stage between the Aspen-Birch and young Mesic Northern Hardwood vegetation types. The dominance of sugar maple in the upper understory and lower understory, contrasted to that of paper birch and aspen in the overstory, illustrated this transition.

Paper birch, aspen, and sugar maple comprised 89.9 percent of the total importance value for the overstory. Paper birch was the major dominant overstory species; it had an importance value of 126.9, and comprised 42.3 percent of the overstory stratum's total importance value (Table 2.6-8). Aspen, the next most prevalent species, comprised 25.4 percent of the overstory stratum's total importance value. Sugar maple comprised 22.2 percent of the total overstory stratum importance value. Basswood, balsam fir, and ironwood also occurred in the overstory stratum.

Sugar maple, the dominant species in the upper understory (Table 2.6-8), comprised 72.8 percent of the total importance value for this stratum. Paper birch was the only other species in this stratum with a high importance value, comprising 17.6 percent of the total importance value.

The lower understory was almost exclusively sugar maple. This species had an importance value of 160.1, which was 80.0 percent of the lower understory stratum's total importance value (Table 2.6-8). The mean cover value for sugar maple was 6.6 percent.

The ground layer was typical of those sampled in upland forests. The four species with the highest importance values and highest mean cover values were Pennsylvania sedge, wild lily-of-the-valley, large-leaved aster, and violet (Viola spp.).

The majority of the Aspen-Birch forest type in the site area is medium or well stocked poletimber. The well stocked stands of Aspen-Birch averaged 51 years in age and volume averaged about 42 cords and 939 board feet per hectare (17 cords and 380 board feet per acre). The medium stocked stands of Aspen-Birch averaged 36 years in age and volume averaged 22 cords

TABLE 2.6-8

RESULTS OF VEGETATION SAMPLING IN SITE AREA
ASPEN/BIRCH

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
OVERSTORY							
Paper Birch	25	57	--	35.7	47.5	43.7	126.9
Aspen	16	23	--	22.9	19.2	34.1	76.2
Sugar Maple	19	30	--	27.1	25.0	14.6	66.7
Basswood	5	5	--	7.1	4.2	4.2	15.5
Balsam Fir	4	4	--	5.7	3.3	3.1	12.1
Ironwood	1	1	--	1.4	0.8	0.3	2.5
Total	70	120	--	99.9	100.0	100.0	299.9
UPPER UNDERSTORY							
Sugar Maple	30	100	--	62.5	83.3	72.7	218.5
Paper Birch	11	13	--	22.9	10.8	19.1	52.8
Basswood	2	2	--	4.2	1.7	3.2	9.1
Northern Red Oak	2	2	--	4.2	1.7	2.1	8.0
White Spruce	1	1	--	2.1	0.8	1.8	4.7
Ironwood	1	1	--	2.1	0.8	0.6	3.5
Balsam Fir	1	1	--	2.1	0.8	0.5	3.4
Total	48	120	--	100.1	99.9	100.0	300.0
LOWER UNDERSTORY							
Sugar Maple	12	--	6.6	66.7	--	93.4	160.1
Aspen	3	--	0.2	16.7	--	2.8	19.5
Basswood	2	--	0.1	11.1	--	1.9	13.0
Ironwood	1	--	0.1	5.6	--	1.9	7.5
Total	18	--	7.0	100.1	--	100.0	200.1
GROUND LAYER							
Pennsylvania Sedge	10	--	22.9	7.0	--	30.8	37.8
Wild Lily-of-the-Valley	14	--	9.8	9.8	--	13.2	23.0
Large-Leaved Aster	10	--	7.2	7.0	--	9.7	16.7
Violet	9	--	4.3	6.3	--	5.8	12.1
Schizachne purpurascens	8	--	3.8	5.6	--	5.1	10.7
Sugar Maple	13	--	0.9	9.1	--	1.3	10.4
Large-Flowered Trillium	8	--	2.6	5.6	--	3.5	9.1
Sweet Cicely	7	--	2.9	4.9	--	4.0	8.9
Starflower	10	--	1.1	7.0	--	1.4	8.4
False Spikenard	8	--	1.9	5.6	--	2.5	8.1
Wild Sarsaparilla	5	--	2.7	3.5	--	3.1	6.6
Clintonia	3	--	2.1	2.1	--	2.9	5.0
Clubmoss	3	--	0.9	2.1	--	1.2	3.3
Large-Flowered Bellwort	3	--	0.9	2.1	--	1.2	3.3
Black Snakeroot	4	--	0.3	2.8	--	0.4	3.2

Note: -- indicates no data.

[a]Scientific names are listed in Appendix 2.6A.

[b]For Overstory and Upper Understory, the Importance Value equals the total of Relative Frequency, Relative Density, and Relative Dominance; for Lower Understory and Ground Layer, the Importance Value equals the total of Relative Frequency and Relative Dominance.

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
Zigzag Goldenrod	2	--	1.1	1.4	--	1.5	2.9
Lady Fern	2	--	1.1	1.4	--	1.4	2.8
Shield Fern	1	--	1.3	0.7	--	1.8	2.5
Bracken Fern	1	--	1.3	0.7	--	1.8	2.5
Wood Rush	1	--	1.3	0.7	--	1.8	2.5
Downy Yellow Violet	2	--	0.8	1.4	--	1.1	2.5
Hairy Solomon's-Seal	3	--	0.2	2.1	--	0.3	2.4
Fringed Polygala	1	--	1.0	0.7	--	1.4	2.1
Alternate-Leaved Dogwood	2	--	0.5	1.4	--	0.6	2.0
Carex deweyana	1	--	0.3	0.7	--	0.4	1.1
Black Cherry	1	--	0.3	0.7	--	0.4	1.1
Bristly Greenbrier	1	--	0.3	0.7	--	0.4	1.1
Dandelion	1	--	0.1	0.7	--	0.2	0.9
Carex arctata	1	--	0.1	0.7	--	0.1	0.8
Poa saltuensis	1	--	0.1	0.7	--	0.1	0.8
Miterwort	1	--	0.1	0.7	--	0.1	0.8
Slender Panic Grass	1	--	0.1	0.7	--	0.1	0.8
Interrupted Fern	1	--	0.1	0.7	--	0.1	0.8
Clayton's Bedstraw	1	--	0.1	0.7	--	0.1	0.8
Ground Pine	1	--	0.1	0.7	--	0.1	0.8
Raspberry	1	--	0.1	0.7	--	0.1	0.8
Aspen	1	--	0.1	0.7	--	0.1	0.8
Total	143	--	74.8	100.1	--	100.1	200.2

and 395 board feet per hectare (9 cords and 160 board feet per acre) (Steigerwaldt and Sons, 1982).

Swamp Conifer - The stand sampled in the site area was an example of Wet-Mesic Northern Forest. In the overstory, white cedar was the dominant species with an importance value of 182.4 (Table 2.6-9). It comprised 60.8 percent of the total importance value for the overstory stratum. Balsam fir, with an importance value of 85.0, was the second most important species in the overstory stratum.

The dominant species in the upper understory stratum were balsam fir, speckled alder, and white cedar (Table 2.6-9). These three species have a combined importance value that comprised 79.8 percent of the total for the upper understory stratum. The remaining 20.2 percent was distributed among at least six species.

Red maple, balsam fir, and speckled alder were the important species of the lower understory (Table 2.6-9), comprising 76.8 percent of the total importance value for this stratum. Seven other species comprised the remaining 23.2 percent of the total importance value. Red maple, balsam fir, and speckled alder had mean cover values of 8.2, 8.0, and 5.9 percent, respectively (Table 2.6-9).

This community had the most diverse ground layer of any sampled; a wide variety of herbaceous and woody plants were common (Table 2.6-9). The five species with the highest mean cover values were dwarf blackberry (Rubus pubsecens), bunch-berry, clintonia, spotted touch-me-not (Impatiens biflora), and Pennsylvania sedge (Table 2.6-9). A rare orchid of the Great Lakes region, the calypso orchid (Calypso bulbosa), was found near the Swamp Conifer

TABLE 2.6-9

RESULTS OF VEGETATION SAMPLING IN SITE AREA
SWAMP CONIFER

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
OVERSTORY							
White Cedar	25	72	--	52.1	60.0	70.3	182.4
Balsam Fir	17	39	--	35.4	32.5	17.1	85.0
Eastern Hemlock	2	5	--	4.2	4.2	9.6	18.0
Paper Birch	3	3	--	6.3	2.5	2.3	11.1
Ash	1	1	--	2.1	0.8	0.8	3.7
Total	48	120	--	100.1	100.0	100.1	300.2
UPPER UNDERSTORY							
Balsam Fir	18	36	--	29.5	30.0	30.4	89.9
Speckled Alder	18	40	--	29.5	33.3	21.8	84.6
White Cedar	12	22	--	19.7	18.3	27.1	65.1
Ash	5	11	--	8.2	9.2	12.5	29.9
Paper Birch	3	6	--	4.9	5.0	4.7	14.6
Yellow Birch	2	2	--	3.3	1.7	1.5	6.5
Northern Red Oak	1	1	--	1.6	0.8	0.9	3.3
Red Maple	1	1	--	1.6	0.8	0.6	3.0
Willow	1	1	--	1.6	0.8	0.4	2.8
Total	61	120	--	99.9	99.9	99.9	299.7
UNDERSTORY							
Red Maple	12	--	8.2	27.3	--	31.8	59.1
Balsam Fir	10	--	8.0	22.7	--	31.0	53.7
Speckled Alder	8	--	5.9	18.2	--	22.7	40.9
Ash	4	--	1.0	9.1	--	3.9	13.0
Willow	2	--	1.3	4.5	--	4.9	9.4
Pin Cherry	2	--	0.7	4.5	--	2.8	7.3
Yellow Birch	2	--	0.1	4.5	--	0.5	5.0
Ironwood	2	--	0.1	4.5	--	0.5	5.0
Honeysuckle	1	--	0.3	2.3	--	1.0	3.3
Black Spruce	1	--	0.2	2.3	--	0.8	3.1
Total	44		25.8	99.9	--	99.9	199.8
GROUND LAYER							
Dwarf Blackberry	13	--	6.1	7.0	--	9.5	16.5
Bunchberry	10	--	5.9	5.4	--	9.3	14.7
Clintonia	9	--	5.8	4.8	--	9.1	13.9
Gold Thread	12	--	2.9	6.4	--	4.6	11.0
Pennsylvania Sedge	10	--	3.5	5.4	--	5.5	10.9

Note: -- indicates no data.

[a]Scientific names are listed in Appendix 2.6A.

[b]For Overstory and Upper Understory, the Importance Value equals the total of Relative Frequency, Relative Density, and Relative Dominance; for Lower Understory and Ground Layer, the Importance Value equals the total of Relative Frequency and Relative Dominance.

SPECIES[a]	NUMBER OF POINTS	NUMBER OF TREES	PERCENT MEAN COVER	PERCENT RELATIVE FREQUENCY	PERCENT RELATIVE DENSITY	PERCENT RELATIVE DOMINANCE	IMPORTANCE VALUE[b]
Brownish Sedge	12	--	2.5	6.4	--	3.9	10.3
Miterwort	10	--	3.1	5.4	--	4.9	10.3
Oak Fern	9	--	2.9	4.8	--	4.5	9.3
Sugar Maple	6	--	3.3	3.2	--	5.2	8.4
Shield Fern	7	--	2.6	3.7	--	4.1	7.8
Violet	6	--	2.8	3.2	--	4.4	7.6
Spotted Touch-Me-Not	1	--	4.3	0.5	--	6.8	7.3
Sensitive Fern	2	--	3.4	1.1	--	5.3	6.4
Balsam Fir	7	--	1.0	3.7	--	1.5	5.2
Wild-Lily-of-the-Valley	6	--	1.2	3.2	--	1.9	5.1
Star Flower	7	--	0.5	3.7	--	0.7	4.4
Common Wood-Sorrel	5	--	0.7	2.7	--	1.1	3.8
Wood Rush	5	--	0.5	2.7	--	0.7	3.4
Speckled Alder	3	--	0.3	1.6	--	1.7	3.3
Rough Bedstraw	2	--	1.3	1.1	--	2.0	3.1
Fragrant Bedstraw	4	--	0.3	2.1	--	0.5	2.6
Bristly Black Currant	4	--	0.3	2.1	--	0.4	2.5
Unidentified Grass	3	--	0.6	1.6	--	0.9	2.5
Twin Flower	3	--	0.5	1.6	--	0.7	2.3
Smaller Enchanter's Nightshade	2	--	0.8	1.1	--	1.2	2.3
Paper Birch	3	--	0.3	1.6	--	0.4	2.0
Long Beech Fern	2	--	0.6	1.1	--	0.9	2.0
Creeping Snowberry	3	--	0.2	1.6	--	0.3	1.9
White Cedar	3	--	0.2	1.6	--	0.3	1.9
Bladder Sedge	2	--	0.5	1.1	--	0.7	1.8
Strawberry	1	--	0.8	0.5	--	1.3	1.8
Marsh Thistle	2	--	0.4	1.1	--	0.6	1.7
Horsetail	1	--	0.7	0.5	--	1.0	1.5
Ironwood	1	--	0.7	0.5	--	1.0	1.5
Mad-Dog Skullcap	1	--	0.6	0.5	--	0.9	1.4
Zigzag Goldenrod	2	--	0.1	1.1	--	0.2	1.3
Wild Sarsaparilla	1	--	0.3	0.5	--	0.5	1.0
Ash	1	--	0.3	0.5	--	0.4	0.9
Red Raspberry	1	--	0.1	0.5	--	0.2	0.7
Panic Grass	1	--	0.1	0.5	--	0.2	0.7
Flat-Topped White Aster	1	--	0.1	0.5	--	0.2	0.7
Leatherwood	1	--	0.1	0.5	--	0.1	0.6
American Mountain Ash	1	--	0.1	0.5	--	0.1	0.6
Yellow Lady's-Slipper	1	--	0.1	0.5	--	0.1	0.6
Total	187	--	63.4	99.7	--	99.8	199.5

sampling transect (Figure 2.6-1). This plant is designated by the state as "advisory only" and receives no legislative protection (Wisconsin DNR, 1976b).

The forest inventory by Steigerwaldt and Sons (1982) indicated that the Swamp Conifer type in the site area likely to be affected by the Project consisted primarily of black spruce and tamarack. Four size-and-density classes were recognized in this type; poorly and medium stocked saplings or poorly and medium stocked poletimber. The average volume per hectare in the medium stocked poletimber was 22 cords and 1520 board feet (9 cords and 615 board feet per acre). Volume in the poorly stocked stands of poletimber averaged 10 cords and 445 board feet per hectare (4.2 cords and 180 cords per acre) (Steigerwaldt and Sons, 1982).

Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) also sampled stands of Swamp Conifer in the site area dominated by black spruce and tamarack. Their results indicated that these stands closely conformed to Curtis's (1959) description of Wet-Northern Forest. Species of secondary importance in the overstory in their sampling included eastern hemlock, balsam fir, and white cedar. Labrador tea, leatherleaf, and large cranberry (Vaccinium macrocarpon) were abundant in the shrub layer. The ground surface was largely covered by sphagnum. Vegetation in the ground layer was sparse and included wild lily-of-the-valley (Maianthemum canadense), cinnamon fern (Osmunda cinnamomea), sedges, goldthread (Coptis trifolia) and bunchberry.

Deciduous Swamp - Several deciduous swamps occurred in the site area. These swamps were quantitatively sampled by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) and were found

to be dominated by quaking aspen, American elm and red maple. The most abundant species in the shrub layer were speckled alder, green ash (Fraxinus pennsylvanica) and red maple. The flora in the herbaceous layer was sparse and consisted primarily of sedges and wild lily-of-the-valley. Steigerwaldt and Sons (1982) did not estimate timber volumes for these swamps or identify them in their forest type map of the site area.

One of the small swamps sampled by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) included the unusual bur oak swamp approximately 1.6 km (1 mile) east-northeast of the ore body. In decreasing order of importance value, the overstory of this swamp consisted of bur oak, American elm, green ash, quaking aspen, red maple, and paper birch. This swamp is considered unusual because bur oak is an important tree south of the transition zone in Wisconsin and only scattered occurrences of it are known in the north (Curtis, 1959).

Shrub Swamp - The shrub swamp communities in the site area were dominated by speckled alder and would be designated as Alder Thicket by the vegetation classification system of Curtis (1959). The herbaceous layer in this type was sparse and was dominated by sedges and blue-joint grass (Calamagrostis canadensis) (Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc., 1982). The shrub swamp type comprised approximately 3 percent of the site area (Figure 2.6-8 and Table 2.6-3).

Bog - The bogs in the site area were dominated by ericaceous shrubs, including leatherleaf and Labrador tea, and are typical of bog communities described by Curtis (1959). Sedges, cotton grass (Eriophorum spissum), and

clintonia were the most abundant plants encountered in the herbaceous layer by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982). Bogs comprised approximately 1 percent of the site area.

Marsh - Marshes in the site area were dominated by dense stands of sedges (59 percent cover) and blue-joint grass (28 percent cover). Other species encountered included steeplebush (Spirea tomentosa), wood bullrush (Scirpus cypernius), manna grass (Glyceria borealis) and goldenrod (Solidago sp.) (Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc., 1982).

2.6.3.3 Heavy Metals in Vegetation of the Environmental Study Area

The new foliage of balsam fir, red raspberry, and Pennsylvania sedge was collected in 1977 and 1978 and analyzed for heavy metal content. The quality control program detected inconsistencies in the results from the 1977 analyses that arose because insufficient amounts of plant material were analyzed. Results of the 1977 collections have therefore not been cited in this discussion.

There was little difference in heavy metal concentrations within and among the plant species sampled (Table 2.6-10). Small portions of the vegetation collected at each sampling location were combined to form composite samples for each of the three sectors. The values for the composite samples compared favorably with those of the individually analyzed samples (Table 2.6-10). The mean values for all composite and individual samples, combining the three species, compared favorably with values reported in the literature for baseline levels of these elements (Table 2.6-11).

TABLE 2.6-10

SUMMARY OF HEAVY METAL ANALYSIS OF VEGETATION SAMPLES*

SPECIES/SAMPLE	MANGANESE	ZINC	CADMIUM	COPPER	ARSENIC	LEAD	MERCURY	COBALT	CHROMIUM, TOTAL
Sedge									
Location 9	173	27	0.37	7.2	<0.01	1.1	<0.01	1.1	0.96
Location 14	243	62	0.28	12.4	<0.01	2.8	<0.01	1.4	1.08
Location 15	125	29	0.40	7.7	<0.01	3.5	<0.01	0.5	0.05
Location 18	367	40	0.32	11.1	<0.01	2.1	<0.01	1.6	<0.01
Location 22	70	37	0.36	6.2	<0.01	2.1	<0.01	1.5	0.52
Location 25	171	36	0.67	10.0	<0.01	4.1	<0.01	0.5	0.61
North Composite	253	48	0.32	6.7	<0.01	1.4	<0.01	1.2	0.49
South Composite	207	41	2.13	6.1	<0.01	1.2	<0.01	1.0	0.35
West Composite	258	32	0.25	7.0	<0.01	1.0	<0.01	0.6	0.31
Raspberry									
Location 9	315	39	0.59	12.5	<0.01	1.6	<0.01	1.6	0.69
Location 14	435	30	0.57	9.6	<0.01	2.1	<0.01	0.5	0.31
Location 15	928	72	0.53	12.6	<0.01	3.5	<0.01	2.4	0.95
Location 18	161	78	1.07	11.8	<0.01	2.7	<0.01	0.5	2.31
Location 22	117	117	0.63	20.8	<0.01	6.3	<0.01	3.1	3.47
Location 25	157	38	0.48	8.3	<0.01	2.7	<0.01	0.5	0.21
North Composite	429	69	0.43	11.7	<0.01	2.0	<0.01	1.3	1.31
South Composite	260	59	0.38	10.9	<0.01	2.2	<0.01	1.4	2.89
West Composite	429	44	0.38	18.3	<0.01	1.8	<0.01	0.6	0.61
Fir									
Location 9	291	39	0.69	12.6	<0.01	2.7	<0.01	1.6	0.11
Location 14	145	52	0.41	8.1	<0.01	1.5	<0.01	0.5	0.26
Location 15	613	75	0.46	9.6	<0.01	3.5	<0.01	0.5	0.10
Location 18	557	52	0.64	7.1	<0.01	2.1	<0.01	1.6	0.27
Location 22	326	72	0.42	10.7	<0.01	3.1	<0.01	1.0	0.16
Location 25	393	59	0.46	9.1	<0.01	2.1	<0.01	0.5	0.31
North Composite	337	58	0.31	7.2	<0.01	1.2	<0.01	0.7	0.32
South Composite	512	62	0.26	7.7	<0.01	1.5	<0.01	0.7	0.68
West Composite	528	59	0.39	7.4	<0.01	2.0	<0.01	0.7	0.24

*Results are given as mg/kg (parts per million, ppm) on a dry weight basis. Sampling locations and sector areas are shown on Figure 2.6-2.

TABLE 2.6-11

COMPARISON OF HEAVY METAL ANALYSIS WITH RESULTS REPORTED BY OTHERS

METAL[a]	ENVIRONMENTAL STUDY AREA		BOWEN[d]	SMITH[e]	GERLOFF[f]	CANNON[g]		
	INDIVIDUAL[b] MEAN	COMPOSITE[c] MEAN	MEAN	RANGE	RANGE	GRASSES (ABOVE GROUND)	FORBS (ABOVE GROUND)	CONIFER NEEDLES
Manganese	310	357	630	136 - 347	38 - 1225	-	-	-
Zinc	53	52	100	19 - 73	15 - 86	850	666	1127
Cadmium	0.52	0.54	0.6	0 - 5	-	-	-	-
Copper	10.4	9.2	14	5 - 17	2.7 - 8.5	119	118	133
Arsenic	<0.01	<0.01	0.2	-	-	-	-	-
Lead	2.7	1.6	2.7	0 - 20	-	33	44	75
Mercury	<0.01	<0.01	0.1	-	-	-	-	-
Cobalt	1.1	0.9	0.5	N/D[h]	-	10	11	<7
Chromium, Total	0.69	0.80	0.23	0.3 - 11	-	19	10	8

[a]All values given in mg/kg (parts per million, ppm) on a dry weight basis.

[b]Mean of all individual analyses irrespective of plant species, N = 18.

[c]Mean of all composite analyses irrespective of plant species or sector, N = 9.

[d]Bowen, 1966.

[e]Smith, 1973. Values listed are "normal" levels reported as occurring in sugar maple in New Hampshire and Vermont.

[f]Gerloff et al., 1966. Values listed are from various species sampled throughout Wisconsin.

[g]Cannon, 1960. Average metal content of vegetation growing in unmineralized ground.

[h]Not detected.

2.6.4 Wildlife

2.6.4.1 Mammals

Regional Mammal Populations

Sixty-seven species of mammals occur in Wisconsin (Jackson, 1961). Fifty-five of these mammals could occur in the environmental study area: 2 big game species, 4 small game species, 15 furbearers, and 34 nongame species (Appendix 2.6B). Long (1974) reported that 36 species of mammals occur in Forest County. During this study, 29 species of mammals were observed in the environmental study area, three of which were not listed by Long (1974).

For the purpose of discussion, the mammals have been grouped into the categories of big game, small game, furbearers and nongame.

Big Game - The big game of the environmental study area are white-tailed deer and black bear. These species are important recreationally, aesthetically, and economically.

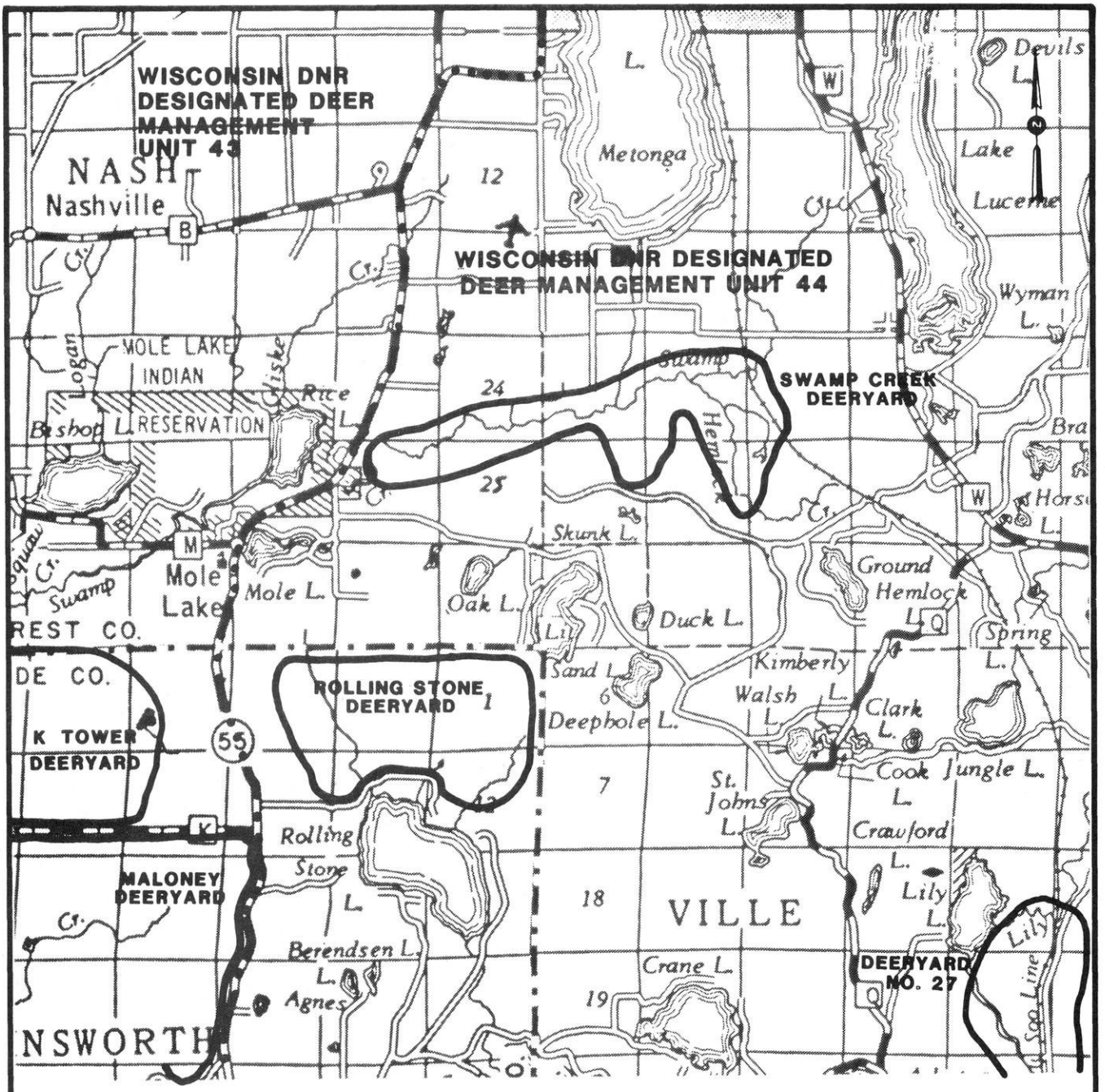
The DNR estimates of regional white-tailed deer populations vary between 8 and 19 per 259 ha (1 square mile) of deer range (McIlquam, 1982). These population levels are similar to those for other areas in northern Wisconsin but low when compared to prime areas in west-central Wisconsin. Historically, deer populations in the environmental study area have fluctuated considerably, which is similar to population levels in most of Wisconsin's northern counties. One hundred years ago, mature forests covered the environmental study area, and deer were scarce due to the lack of suitable habitat. Extensive logging increased the amount of their preferred habitat

(young aspen stands and openings) and the deer population increased sharply in the early 1900's. The population then declined as their preferred habitat was gradually replaced by pole-sized (dbh 130-280 mm [5-11 inches]) Northern Hardwood (Bersing, 1956).

The environmental study area lies within DNR Deer Management Units 43 and 44 that cover an area approximately 56 km (35 miles) long and 40 km (25 miles) wide (Figure 2.6-9). The management goal for these two units is 15 deer per 259 ha (1 square mile) after hunting harvest. Deer population densities in these two areas were high in 1967 and then declined until 1972, mostly from a series of severe winters (McIlquam, 1982). Populations have been generally increasing since 1972 with moderate winters being an important factor (McIlquam, 1982). Population estimates by the sex-age-kill method and annual harvests for these two units are presented in Table 2.6-12.

The density estimates presented in Table 2.6-12 are somewhat lower than expected from other methods such as the deer trail count and pellet group count methods. The sex-age-kill method is known to underestimate due to low hunting pressure, a situation that exists in Management Units 43 and 44 (McIlquam, 1982). In the next 20 years deer populations are expected to decrease in the environmental study area due to the maturing of the forests (McIlquam, 1982).

Deer populations in northern Wisconsin can be limited by the quantity and quality of winter habitat. In winters of deep snow and severe temperatures, deer often congregate in deeryards. Deeryards are usually lowland areas of Swamp Conifer, which provide food and shelter during severe winters. Five DNR-designated deeryards are located within the environmental



KEY:

DEER MANAGEMENT UNIT BOUNDARY

WISCONSIN DNR DESIGNATED DEERYARD

SOURCES: ECKSTEIN, 1977 AND 1982.

NOTE: K TOWER, MALONEY AND NO. 27 DEERYARDS EXTEND OUTSIDE OF ENVIRONMENTAL STUDY AREA.

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

EXXON MINERALS COMPANY

CRANDON PROJECT

SELECTED WILDLIFE RESOURCES IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.6-9

TABLE 2.6-12

WHITE-TAILED DEER DENSITIES
AND HARVEST IN THE REGION*

YEAR	DEER PER 259 ha (1 square mile)		TOTAL GUN HARVEST	
	UNIT 43	UNIT 44	UNIT 43	UNIT 44
1974	9	8	242	288
1975	7	9	216	330
1976	8	10	274	434
1977	12	16	408	723
1978	17	19	524	857
1979	14	12	487	563
1980	15	13	539	540
1981	20	17	902	873

*See Figure 2.6-9 for location of deer management units.

Source: McIlquam, 1982.

study area (Figure 2.6-9). Of the 11 deeryards on public lands in northern and western Langlade County, K Tower Deeryard and Maloney Deeryard are considered major yards, and Rolling Stone Deeryard is considered minor (Eckstein, 1982).

Forest County's annual black bear harvest is about average for the 18 counties in the state that allow black bear hunting (Kohn, 1982). The black bear harvest figures for Forest, Langlade and Oneida counties for the last eight hunting seasons are given in Table 2.6-13.

The preferred habitat of black bear is heavily forested areas containing a mixture of brushlands, swamps, and scattered openings, all of which are well distributed in the environmental study area. The black bear population in the environmental study area, based on approximate countywide densities (1 per 1,000 ha [4 square miles]) (Kohn, 1982) and available habitat, is approximately 30 to 40 black bear. Black bear sign was observed frequently in the environmental study area.

Small Game - In Wisconsin, small game constitute an important recreational and aesthetic resource. In the environmental study area, small game hunting is an important fall recreational activity.

Three small game mammal species occur in the environmental study area (Appendix 2.6B): snowshoe hare (Lepus americana), eastern cottontail (Sylvilagus floridanus), and gray squirrel (Sciurus carolinensis). These species all have high reproduction rates, and their population levels change readily in response to habitat changes. These three species are of varying importance and will be discussed separately. The fox squirrel (Sciurus niger) might occur on rare occasion in the environmental study area; however, none were observed.

TABLE 2.6-13

BLACK BEAR AND FURBEARER HARVEST IN THE REGION

COUNTY/SPECIES	YEAR 1974	1975	1976	1977	1978	1979	1980	1981
Forest County								
Black Bear	37	47	24	42	53	39	51	41
Bobcat	18	25	16	10	1	9	3	12
River Otter	39	67	19	33	36	29	51	42
Beaver	388	649	280	518	227	269	1016	469
Langlade County								
Black Bear	6	7	9	11	22	20	18	33
Bobcat	24	21	27	10	10	7	6	8
River Otter	23	30	30	48	23	31	52	30
Beaver	286	440	319	589	257	176	1086	444
Oneida County								
Black Bear	20	22	36	37	38	35	38	48
Bobcat	37	18	16	6	3	6	6	14
River Otter	91	76	77	71	54	55	77	78
Beaver	746	1020	586	898	549	398	1123	771

Source: Kohn, 1978 and 1982.

The snowshoe hare is one of the most abundant and commonly hunted small game animals in the environmental study area. It is native to Wisconsin and occurs throughout the northern third of the state. Snowshoe hare populations vary cyclicly with peaks every 7 to 12 years (Kieth, 1963). The habitat preferred by snowshoe hares is lowland areas including alder swamp, conifer swamp, and bog. There is substantial acreage of these habitats in the environmental study area.

The cottontail rabbit is less abundant in the environmental study area than the snowshoe hare. Cottontails did not occur in northern Wisconsin until the late 1800's when forest clearing created suitable habitat and allowed range expansion northward (Jackson, 1961). The cottontail's preferred habitat, an interspersion of fields, brushy areas and forest edges, is limited in the environmental study area.

The gray squirrel is a common small game species throughout Wisconsin. It is probably more abundant now in northern Wisconsin than during any time in the last century (Jackson, 1961). The gray squirrel's preferred habitat is hardwood forests with good mast producing capabilities. The environmental study area contains a moderate amount of this type of habitat.

Furbearers - Furbearers are "important" in the environmental study area, both ecologically and economically. The furbearers that occur in Forest County and the environmental study area are listed in Appendix 2.6-B. The "important" furbearers of the region are bobcat, river otter, red fox (Vulpes vulpes), coyote (Canis latrans), beaver, raccoon (Procyon lotor), muskrat (Ondatra zibethicus), mink (Mustela vison) and fisher (Martes pennanti).

The bobcat occurs in moderate densities, 1 per 1,295 to 5,180 ha (5 to 20 square miles) throughout the northern half of Wisconsin (Creed and Ashbrenner, 1976), and is listed in the "watch" category by the Wisconsin DNR (1979). The bobcat harvest for Forest, Langlade and Oneida counties between 1974 and 1981 is listed in Table 2.6-13.

The environmental study area contains excellent habitat for bobcat. Although no actual observations of bobcats were made, tracks were observed on several occasions during field surveys. Seventeen percent of the environmental study area is forested wetland that, according to Creed and Ashbrenner (1976), is a favorable habitat component for maintenance of bobcat populations in Wisconsin.

The river otter and beaver are more abundant in Wisconsin than the bobcat. The harvest of these two furbearers for Forest, Langlade and Oneida counties between 1974 and 1981 is presented in Table 2.6-13. The preferred habitat of river otters and beavers is primarily lakes, rivers and streams. Individuals or signs of these two furbearers were observed frequently in the environmental study area.

The red fox, coyote, raccoon, muskrat and mink are all important in the regional fur harvest, but no county harvest statistics are available. All are expected to be fairly common or common in the region (Appendix 2.6B) and all but the red fox was observed in the environmental study area.

The fisher is an important furbearer in the region that is currently on the "watch" list of the Wisconsin DNR (1979). The fisher was once common in the heavily forested areas of Wisconsin but the state population declined to the point of extirpation by 1932, due to extensive logging and fur

trapping. Fishers were successfully introduced into the Nicolet National Forest in Forest County in the 1950's and 1960's and the populations have been steadily increasing and expanding outside of the release sites. Captures of fishers have been reported in the environmental study area (Pils, 1982) but none were observed during this study.

Nongame - Thirty-four species of nongame mammals have been reported to occur throughout northeastern Wisconsin (Jackson, 1961) (Appendix 2.6B). Twenty-one species of nongame mammals occur in a wide variety of habitats in either Forest County or the environmental study area (Appendix 2.6B). Their abundance varies from "rare" to "abundant" and is a result of available preferred habitat and state-wide range. Two of the nongame species that could occur in the environmental study area, the wolf (Canis lupus) and marten, are listed as endangered by the Wisconsin DNR (1982b) and are discussed in subsection 2.6.5.

Site Area Mammal Populations

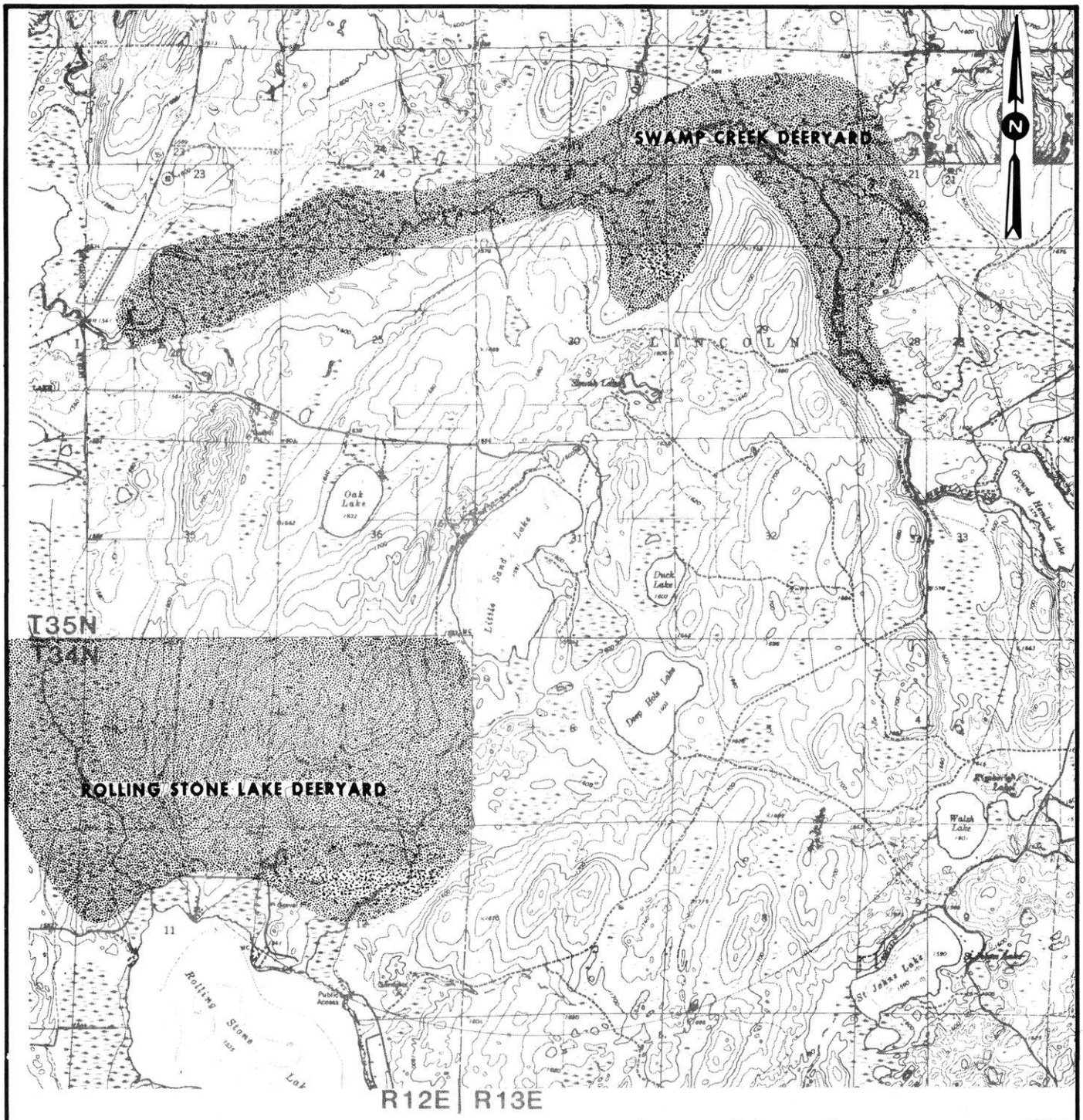
Mammals of the site area are similar in distribution and abundance to those of the environmental study area. Twenty-nine species of mammals were observed in the site area (Appendix 2.6B) during the course of all vegetation and wildlife field work. Given below are the results of the white-tailed deer survey and small mammal trapping survey.

White-tailed deer - The deer trail count results indicate that the 1977 prehunting-season population density of white-tailed deer in the site area was 6.9 deer per 259 ha (1 square mile) of deer range with 95 percent

confidence limits of 6.1 to 7.8. The mean number of deer trails observed per transect was 1.19 ± 0.45. Population levels estimated in this study were approximately one-half of the management goal (15 per 259 ha [1 square mile] of deer range) for deer management units in the vicinity of the environmental study area. The difference between the deer population estimate of this study and those of the DNR from the sex-age-kill method was most likely due to the distribution of habitat types in the site area and the deer management units. In general, the site area is not high quality habitat for deer because of the large acreage of pole-sized Northern Hardwood. There are few stands of young aspen in the site area, a preferred summer habitat for deer. There are two deeryards in the site area (Figure 2.6-10).

Nongame - Thirteen species of nongame mammals were captured during the small mammal trapping surveys (Table 2.6-14). The five most abundant species, in decreasing order, were the deer mouse (Peromyscus maniculatus), Gapper's red-backed mouse (Clethrionomys gapperi), masked shrew (Sorex cinereus), short-tailed shrew (Blarina brevicauda), and eastern chipmunk (Tamias striatus). Two species of Peromyscus occur in the Crandon area. The taxonomy is difficult, particularly with immature specimens, and those individuals listed under Peromyscus spp. in Table 2.6-14 were predominantly deer mice but may include an occasional white-footed mouse (Peromyscus leucopus). In these studies the capture rate (captures per 1,000 trap nights) was used as a measure of the relative abundance of a nongame mammal species.

Of the five habitats sampled, the Northern Hardwood type had the highest capture rate (127.1 per 1,000 trap nights) (Table 2.6-14). The capture rates in Swamp Conifer and Aspen-Birch were 72.7 and 57.4 per 1,000



SOURCE: ECKSTEIN, 1977 AND 1982.

BASE MAP REFERENCE:
PORTIONS OF THE FOLLOWING U.S.G.S. 7.5 MINUTE SERIES: CRANDON, WISCONSIN, 1966; LAKE LUCERNE, WISCONSIN, 1973; AND ROBERTS LAKE, WISCONSIN, 1973.

EXXON MINERALS COMPANY
CRANDON PROJECT

DEERYARDS IN THE SITE AREA

DAMES & MOORE

FIGURE 2.6-10

TABLE 2.6-14

NONGAME MAMMAL TRAPLINE RESULTS IN THE SITE AREA

SPECIES[a]	NORTHERN HARDWOOD					ASPEN/BIRCH				SWAMP CONIFER					OLD FIELD			BOG			
	TRAP-LINES 1 & 2 (1977)	TRAP-LINES 3 & 4 (1978)	TRAP-LINES 5 & 6 (1978)	TOTAL CAPTURED	CAPTURE RATE[b]	TRAP-LINES 1 & 2 (1977)	TRAP-LINES 3 & 4 (1978)	TOTAL CAPTURED	CAPTURE RATE[b]	TRAP-LINES 1 & 2 (1977)	TRAP-LINES 3 & 4 (1978)	TRAP-LINES 5 & 6 (1978)	TOTAL CAPTURED	CAPTURE RATE[b]	TRAP-LINES 1 & 2 (1978)	TOTAL CAPTURED	CAPTURE RATE[b]	TRAP-LINES 1 & 2 (1977)	TOTAL CAPTURED	CAPTURE RATE[b]	TOTAL CAPTURED
Deer Mouse																					
Total Captured	31	17	11	59		4	16	20		1	3	1	5		0	0		0	0		84
Capture rate	114.8	62.9	40.7		72.8	14.8	59.2		37.0	3.7	11.1	3.7		7.4	0		0	0		0	
White-Footed Mouse																					
Total Captured	0	0	2	2		0	0	0		0	0	0	0		0	0		0	0		2
Capture rate	0	0	7.4		2.5	0	0		0	0	0	0		0	0		0	0		0	
Peromyscus spp.																					
Total Captured	5	1	5	11		0	7	7		0	3	0	3		0	0		0	0		21
Capture rate	18.5	3.7	18.5		13.6	0	25.9		13.0	0	11.1	0		4.4	0		0	0		0	
Gapper's Red-Backed Mouse																					
Total Captured	4	4	6	14		0	0	0		10	11	12	33		0	0		0	0		47
Capture rate	14.8	14.8	22.2		17.3	0	0		0	37.0	81.5	44.4		48.8	0		0	0		0	
Masked Shrew																					
Total Captured	0	0	0	0		1	0	1		1	2	1	4		3	3		3	3		11
Capture rate	0	0	0		0	3.7	0		1.8	3.7	7.4	3.7		5.9	11.1		11.1	11.1		11.1	
Short-Tailed Shrew																					
Total Captured	0	7	1	8		0	0	0		0	0	0	0		0	0		0	0		8
Capture rate	0	25.9	3.7		9.9	0	0		0	0	0	0		0	0		0	0		0	
Snowshoe Hare																					
Total Captured	0	0	0	0		0	0	0		0	2	0	2		0	0		0	0		2
Capture rate	0	0	0		0	0	0		0	0	7.4	0		3.0	0		0	0		0	
Least Chipmunk																					
Total Captured	0	0	0	0		1	0	1		1	0	0	1		0	0		0	0		2
Capture rate	0	0	0		0	3.7	0		1.8	3.7	0	0		1.5	0		0	0		0	
Eastern Chipmunk																					
Total Captured	0	1	3	4		1	0	1		0	0	0	0		0	0		0	0		5
Capture rate	0	3.7	11.1		4.9	3.7	0		1.8	0	0	0		0	0		0	0		0	
Red Squirrel																					
Total Captured	0	0	0	0		1	0	1		0	0	0	0		0	0		0	0		1
Capture rate	0	0	0		0	3.7	0		1.8	0	0	0		0	0		0	0		0	
Southern Flying Squirrel																					
Total Captured	0	0	2	2		0	0	0		0	0	0	0		0	0		0	0		2
Capture rate	0	0	7.4		2.5	0	0		0	0	0	0		0	0		0	0		0	
Northern Flying Squirrel																					
Total Captured	0	0	1	1		0	0	0		0	0	1	1		0	0		0	0		2
Capture rate	0	0	3.7		1.2	0	0		0	0	0	3.7		1.5	0		0	0		0	
Meadow Jumping Mouse																					
Total Captured	0	0	1	1		0	0	0		0	0	0	0		0	0		0	0		1
Capture rate	0	0	3.7		1.2	0	0		0	0	0	0		0	0		0	0		0	
Woodland Jumping Mouse																					
Total Captured	0	1	0	1		0	0	0		0	0	0	0		0	0		0	0		1
Capture rate	0	3.7	0		1.2	0	0		0	0	0	0		0	0		0	0		0	
Meadow Vole																					
Total Captured	0	0	0	0		0	0	0		0	0	0	0		2	2		0	0		2
Capture rate	0	0	0		0	0	0		0	0	0	0		0	7.4		7.4	0		0	
Total Captured	40	31	32	103	--	8	23	31	--	13	21	15	49	--	5	5	--	3	3	--	91
Total Captures Per 1,000 Trap Nights	148.1	114.7	118.4	--	127.1	29.6	85.1	--	57.4	48.1	77.7	55.5	--	72.7	18.5	--	18.5	11.1	--	11.1	--
Number of Species	2+	5+	8	9	--	5	1+	5+	--	4	4+	4	6+	--	2	2	--	1	1	--	14

[a]Scientific names are listed in Appendix 2.6B.

[b]Capture rate = captures per 1,000 trap nights.

trap nights, respectively, and the lowest capture rates were in old field and bog habitats (Table 2.6-14). The nongame mammal survey results generally indicate that in the site area, Northern Hardwood communities have a higher density and diversity (number of species) of nongame mammals than Swamp Conifer or Aspen-Birch communities (Table 2.6-14). Trapline numbers 5 and 6 were located in Dry-Mesic Northern Hardwood (Figure 2.6-3). The vegetation in this stand was diverse, and this diversity was reflected in the high diversity of nongame mammal species (Table 2.6-14). The old field habitats sampled were small and thus may be the reason for the low density and diversity of nongame mammals found in this habitat type. Few nongame mammal species were found in bogs.

The capture of two southern flying squirrels (Glaucomys volans) was considered unusual since the northern limit of the southern flying squirrel generally coincides with the vegetational transition zone. Southern flying squirrels have not previously been reported in Forest County (McCabe, 1972; Long, 1974).

Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) also conducted small mammal trapping in the site area. Four wetland types were sampled; deciduous swamp, coniferous swamp, shrub swamp and bog. Eleven species were captured and the deciduous swamp had the greatest species richness with a total of seven species trapped. The fewest number of species was captured in the bog habitat. With the exception of a striped skunk, all of the species captured by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) were also captured during this study. The most abundant species captured by Normandeau

Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) were the meadow jumping mouse (Zapus hudsonius), masked shrew, Gapper's red-backed mouse, deer mouse and meadow vole (Microtus pennsylvanicus).

2.6.4.2 Birds

Regional Bird Populations

Approximately 332 species of birds occur in Wisconsin (Barger et al., 1975). Vanderschaegen (1981) has documented 244 species of birds in Forest, Oneida and Vilas counties, most of which could be expected to occur regularly in the environmental study area (Appendix 2.6C). Birds that have been observed in Forest County or in the environmental study area include those recorded on the U.S. Fish and Wildlife Service Breeding Bird Survey transect near Crandon from 1966-1976; observations by Robbins (co-author of Wisconsin Birds [Barger et al., 1975]), near Crandon in 1970; observations by Phil Vanderschaegen of the DNR; and sightings along specific bird survey routes and general observations during this study.

The environmental study area lies within the mixed hardwood-coniferous forests. The bird species diversities in this mixed forest type are among the highest of any of the forests in North America (Temple et al., 1979). Bird populations in this forest type in summer can range from 300 to 500 individuals per 40.5 ha (100 acres) and normally decline to less than 100 individuals during the winter (Back, 1979; Temple et al., 1979).

Because of their widely fluctuating seasonal populations, the discussion of birds in the following subsections is presented according to their residency status: permanent resident, summer resident, winter resident,

or migrant. Approximately 11 percent of the regional bird population are permanent residents, 66 percent are summer residents, 4 percent are winter residents and 19 percent area regular migrants (Vanderschaegen, 1981). Within each of these groups, emphasis is placed on the raptors (vultures, eagles, hawks, and owls), upland game birds (grouse), waterfowl, marsh and shore birds, and those whose occurrence in the study area might be considered unusual. Other birds, such as songbirds, are treated as a group in less detail.

Permanent Residents - The permanent residents include birds that occur in the environmental study area throughout the year. This does not necessarily mean that the same individuals remain in the region year-round but that the species is found continuously.

Four raptor species that are permanent residents were observed in the environmental study area: the great horned owl (Bubo virginianus), barred owl (Strix varia), saw-whet owl (Aegolius acadicus), and goshawk (Accipiter gentilis). Due to their large size and restrictive feeding habits, goshawks are the least common of the permanent resident raptors in Wisconsin. Goshawks prefer habitats such as maturing Aspen-Birch and Northern Hardwood (Bent, 1937). According to Bent (1938), barred owls prefer lowland/wetland edge habitats. Forested wetlands are quite common in the environmental study area and barred owls were frequently heard calling during late evening and early morning. Great horned owls prefer upland habitats (Bent, 1938) and based on the number of calls heard are less common than barred owls in the environmental study area. They generally prefer areas with more habitat variety as opposed to the heavily forested habitats of the environmental study area.

The only nonmigratory species of upland game bird occurring in the environmental study area and Forest County is the ruffed grouse. Ruffed grouse are an important game bird in Wisconsin, and the annual harvest averages near 700,000 (Eckstein, 1982). Forest County is frequently one of the top 10 counties for ruffed grouse harvested in Wisconsin. Generally, the environmental study area is not high quality habitat for ruffed grouse. Favorable habitats of young aspen, brush and creek bottoms exist but only comprise approximately 6 percent of the environmental study area.

In addition to the raptor and upland game bird species, 23 other species of birds that are permanent residents were observed during this study (Appendix 2.6C). Familiar species included the blue jay (Cyanocitta cristata), common crow (Corvus brachyrhynchos), common raven (Corvus corax), black-capped chickadee (Parus atricapillus), and downy woodpecker (Picoides pubescens).

Six species that occur in the environmental study area are "rare" permanent residents; these include the spruce grouse (Canachites canadensis), screech owl (Otus asio), great gray owl (Strix nebulosa), black-backed three-toed woodpecker (Picoides arcticus), northern three-toed woodpecker (Picoides tridactylus), golden-crowned kinglet (Regulus satrapa), and red crossbill (Loxia curvirostra). Some of these species, such as the golden-crowned kinglet and red crossbill, are more commonly observed as migrants or winter residents in the area.

The spruce grouse, which is nonmigratory, has been observed in the environmental study area by the DNR and Langlade County Forest Department staff (Hallisy, 1978; Hauge, 1978; McIlquam, 1978). The spruce

grouse is listed in a "watch" category by the Wisconsin DNR (1979). The favored habitat of this species is large Conifer Swamp communities, which are common in the region. The spruce grouse is "rare" in Wisconsin according to Robbins (1977), who suggested that there may be only a few hundred left in the state. None was observed during this study. Of the other "rare" birds listed above only the golden-crowned kinglet and red crossbill were observed in the environmental study area.

Summer Residents - Summer residents are the birds that breed in the environmental study area and migrate south to wintering areas. This group is by far the largest of the four avian residency groups and is an important part of the regional avifauna. There are four subdivisions: raptors, waterfowl, marsh birds and shorebirds, and other birds.

Eleven species of raptors occur as summer residents in northeastern Wisconsin, nine of these were observed during this study (Appendix 2.6C). The broad-winged hawk (Buteo platypterus) and sharp-shinned hawk (Accipiter striatus) are the most abundant breeding raptors in the environmental study area (Erdman, 1978). Uncommon or rare raptors are the red-tailed hawk (Buteo jamaicensis), red-shouldered hawk (Buteo lineatus), Cooper's hawk (Accipiter cooperii), marsh hawk (Circus cyaneus), osprey, bald eagle, and short-eared owl (Asio flammeus). All but the short-eared owl were observed in the environmental study area. The Cooper's hawk, osprey, bald eagle, and red-shouldered hawk are listed as endangered or threatened species and are discussed in subsection 2.6.5.

There are nine species of waterfowl that are summer residents in northeastern Wisconsin (Appendix 2.6C), all of which, except the red-breasted

merganser (Mergus serrator), were observed in the environmental study area (Appendix 2.6C).

The environmental study area is not a major waterfowl breeding area. Most waterfowl require meadow or marsh type wetlands for nesting, with open water nearby for courtship and brood rearing. Less than 1 percent of the environmental study area is meadow or marsh type wetlands, which is a factor limiting waterfowl production in the environmental study area. Waterfowl reported to nest in Forest County include: blue-winged teal (Anas discors), mallard (Anas platyrhynchos), wood duck (Aix sponsa), black duck (Anas rubripes), ring-necked duck (Athya collaris), and hooded merganser (Vanderschaegen, 1981). The Canada goose (Branta canadensis), common goldeneye (Bucephala clangula), common merganser (Mergus merganser), and red-breasted merganser have been recorded nesting in adjacent counties (Jahn and Hunt, 1964).

The best waterfowl habitat in the environmental study area supports low density waterfowl breeding populations. These areas are Rice, Bishop, Rolling Stone and Lily lakes, the small cluster of lakes southeast of Lake Lucerne, and the Swamp Creek and Hemlock Creek bottomlands (Jahn and Hunt, 1964).

The black duck and red-breasted merganser are listed in a "watch" category by the Wisconsin DNR (1979). Of these two species, only the black duck is known to nest in the environmental study area. Black ducks nest in a variety of habitat types including small lakes and some of the wetland types common in the environmental study area. During breeding waterfowl surveys conducted in 1978, black ducks were only observed at one location.

There are 24 species of marsh birds and shorebirds, excluding waterfowl and the marsh hawk, that nest in the wetlands or near lakes in the environmental study area (Appendix 2.6C). Sixteen of these species were observed during this study (Appendix 2.6C). They include the pied-billed grebe (Podilymbus podiceps), killdeer (Charadrius vociferus), great blue heron (Ardea herodias), red-winged blackbird (Agelaius phoeniceus), American woodcock and common snipe (Capella gallinago).

The American woodcock is a migratory game bird. The population levels of American woodcock in Forest County and the environmental study area are average for northern Wisconsin. The DNR spring population indices for American woodcock have varied only slightly in the last few years (Eckstein, 1982). The preferred habitat of woodcock is young aspen stands, shrub swamps, and openings.

The common loon (Gavia immer), great blue heron, upland sandpiper (Bartramia longicauda), and black tern (Chlidonias niger), which are listed by the Wisconsin DNR (1979) in a "watch" category, occur in the environmental study area (Appendix 2.6C). A pair of common loons nested on Deep Hole Lake during the summer of 1978. Black terns were frequently observed on Rice Lake and probably nest there. Upland sandpipers have been observed in Forest County during U.S. Fish and Wildlife Service Breeding Bird Surveys (Robbins, 1977).

The last group of summer resident birds (other birds) contains 89 species, approximately one-third of all the species expected in the environmental study area (Appendix 2.6C). Some of the most abundant summer residents in the region are the ovenbird (Sieurus aurocapillus), red-eyed

vireo (Vireo olivaceus), American robin (Turdus migratorius), chestnut-sided warbler (Dendroica pennsylvanica), chipping sparrow (Spizella passerina) and song sparrow (Melospiza melodia) (Vanderschaegen, 1981). Eighty-four species were observed in the environmental study area during this study (Appendix 2.6C).

The common flicker, eastern bluebird (Sialia sialias), grasshopper sparrow (Ammodramus savannarum), vesper sparrow (Pooectes gramineus), and field sparrow (Spizella pusilla) are listed in a "watch" category by the Wisconsin DNR (1979). All have been observed in the environmental study area.

Twelve species occur rarely in the environmental study area during the summer (Appendix 2.6C). They are the yellow-billed cuckoo (Coccyzus americanus), Swainson's thrush (Catharus ustalatus), blue-gray gnatcatcher (Polioptila caerula), blue-winged warbler (Vermivora pinus), Cape May warbler (Dendroica tigrina), palm warbler (Dendroica palmarum), western meadowlark (Sturnella neglecta), cardinal (Cardinalis cardinalis), dickcissel (Spiza americana), grasshopper sparrow (Ammodramus savannarum), LeConte's sparrow (Ammospiza leconteii), and field sparrow (Spizella pusilla). All but four of these species were observed in the environmental study area (Appendix 2.6C).

Winter Residents - Winter residents are those whose main breeding range occurs outside the environmental study area, primarily further north. Three species of winter resident birds, the pine grosbeak (Pinicola enucleator), common redpoll (Carduelis flammea), and snow bunting (Plectrophenx nivalis), were observed in the environmental study area (Appendix 2.6C).

Migrants - During spring and autumn migrations, a wide variety of birds occurs in the environmental study area as migrants.

All of the waterfowl species discussed under the heading "Summer Residents," as well as the 15 species of migrant waterfowl listed in Appendix 2.6C, may occur in the environmental study area during migration. Eight species of migrant waterfowl were observed in the environmental study area (Appendix 2.6C). Bishop Lake, Lake Metonga, Pickerel Lake, and the Wolf River, all within the environmental study area, are of moderate importance to migrating waterfowl (Jahn and Hunt, 1964). Rice Lake and Rolling Stone Lake are other lakes in the environmental study area that receive substantial use by migrating waterfowl. The DNR has documented flocks of waterfowl numbering in the several hundreds on Rolling Stone, Duck, Deep Hole, Rice, Bishop, and Crane lakes (Ramharter, 1981).

Migrating waterfowl surveys were conducted at the following lakes within the environmental study area: Skunk, Duck, Little Sand, Ground Hemlock, Walsh, Oak, Deep Hole, Rolling Stone, and Rice (Figure 2.6-4). The results of these surveys are presented in Table 2.6-15. Few migrating waterfowl were attracted to the environmental study area during the migrating waterfowl surveys of 1977 and 1978. Rice Lake received the heaviest use of any of the lakes surveyed, comprising 79 percent of the total waterfowl use observed. The next most important lake in the site area was Rolling Stone Lake, receiving 9 percent of the total waterfowl use observed. Skunk Lake comprised 6 percent of the total waterfowl use observed. The other six lakes received very low levels of use. The most numerous species was the ring-necked duck (Table 2.6-15). Other common species were the American coot

TABLE 2.6-15

MIGRATING WATERFOWL SURVEY RESULTS IN THE ENVIRONMENTAL STUDY AREA

SPECIES[a]	RICE LAKE S 1977	RICE LAKE F 1977	SKUNK LAKE S 1977	SKUNK LAKE F 1977	DUCK LAKE S 1977	DUCK LAKE F 1977	LITTLE SAND LAKE S 1977	LITTLE SAND LAKE F 1977	OAK LAKE S 1977	OAK LAKE F 1977	ROLLING STONE LAKE S 1978	ROLLING STONE LAKE F 1977	GROUND HEMLOCK LAKE S 1978	GROUND HEMLOCK LAKE F 1977	WALSH LAKE S 1978	WALSH LAKE F 1977	DEEP HOLE LAKE S 1978	DEEP HOLE LAKE F 1977	TOTAL	RELATIVE ABUNDANCE
Ring-Necked Duck	621	29	4	0	2	2	1	0	0	0	17	0	0	0	2	0	8	0	686	52.93
American Coot	98	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112	8.64
Scaup[b]	0	38	0	0	0	0	0	0	0	0	67	0	2	0	0	0	4	0	111	8.56
Blue-Winged Teal	79	7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	87	6.71
Wood Duck	8	0	0	66	0	0	0	0	0	0	0	0	0	0	3	0	0	0	77	5.94
Unidentified Ducks	0	58	0	0	0	0	0	0	0	0	12	1	0	0	0	0	0	0	71	5.48
Mallard	28	0	6	1	4	0	4	0	2	0	2	0	2	0	3	0	4	0	56	4.32
Bufflehead	9	0	0	0	0	0	2	0	0	0	5	0	3	0	9	0	0	0	28	2.16
American Wigeon	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	27	2.08
Whistling Swan	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0.69
Black Duck	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7	0.54
Canvasback	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.46
Canada Goose	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0.38
Common Merganser	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	5	0.38
Redhead	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	0.31
Pintail	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.23
Hooded Merganser	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0.15
Subtotal Individuals	861	165	10	67	6	2	7	0	2	0	116	1	8	0	17	1	19	14	1,296	99.66
Subtotal Species	9	6	2	2	2	1	3	0	1	0	10	1	4	0	4	1	4	1	17	-
Miscellaneous																				
Common Loon	0	0	0	0	0	0	1	1	0	0	3	0	0	0	2	0	0	0	7	
Pied-Billed Grebe	11	12	0	0	0	0	0	0	0	1	2	73	0	0	2	1	0	0	102	
Great Blue Heron	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6	
Canada Goose[c]	0	220	0	0	0	0	0	48	0	0	0	0	519	0	236	26	15	0	1,064	
Solitary Sandpiper	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
Ring-Billed Gull	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	6	
Total Individuals	877	398	12	67	6	2	8	50	2	1	121	80	527	0	257	29	34	14	2,483	
Total Species	11	9	3	2	2	1	4	3	1	1	12	3	5	0	7	4	5	1	24	

NOTES:

S = Spring 1977 or 1978
F = Autumn 1977

[a]Scientific names are listed in Appendix 2.6C.

[b]Both lesser and greater scaup have been identified in the environmental study area. However, frequently it was not possible to differentiate between the two species.

[c]Flying high overhead.

(Fulica americana), greater scaup (Aythya marila), lesser scaup (Aythya affinis), blue-winged teal, wood duck, mallard, and bufflehead (Bucephala albeola). Waterfowl were also observed several times on Pond 25-11 northwest of Oak Lake and Pond 31-13 north of Duck Lake (Figure 2.6-4). At Pond 25-11, 11 ring-necked ducks, 4 wood ducks, 3 buffleheads, 1 mallard, 1 black duck, and 2 pied-billed grebes were observed on two separate occasions. At Pond 31-13, 4 ring-necked ducks and 1 mallard were observed on one occasion during the migrating waterfowl surveys.

The migrant marsh birds and shorebirds group consists of 36 species, primarily shorebirds (Appendix 2.6C). Four of these species were observed during this study in the environmental study area (Table 2.6-15). They were the cattle egret (Bubulcus ibis), solitary sandpiper (Tringa solitaria), herring gull (Larus argentatus) and ring-billed gull (Larus delawarensis).

Site Area Bird Populations

Approximately 80 percent of the bird species breeding in the site area migrate to milder climates for the winter period (Barger et al., 1975). Temple et al. (1979) considered 17 bird species to be frequent winter residents in mixed hardwood/conifer forests of northern Wisconsin. During this study, 24 different species were observed during winter periods, compared to 110 additional species observed during spring and summer periods. On surveys conducted to establish the seasonal and habitat distribution of bird species, four species were observed during winter and 55 species during the spring or summer. A total of 150 species of birds were observed in the site area (Appendix 2.6C).

Raptors - Twelve species of raptors were observed in the site area, 11 of which are permanent or summer residents that could nest in the site area. Raptor nests found in the site area included 1 goshawk nest, 3 bald eagle nests, 3 osprey nests, and 3 broad-winged hawk nests. The location and productivity of the bald eagle and osprey nests are presented in subsection 2.6.5. The goshawk, an uncommon permanent resident, was found nesting near Rolling Stone Lake. The broad-winged hawk is the most common breeding raptor in the area, and nests were found near Rolling Stone Lake, Pond 25-11, and northwest of Exxon's field office (former Vollmar house).

Ruffed Grouse - Ruffed grouse drumming surveys were conducted in the site area during the spring of 1978. The ruffed grouse population density was estimated at 2.8 ± 1.3 per 40.5 ha (100 acres) at the 95 percent confidence level. Ruffed grouse populations undergo cyclical fluctuations approximately every 7 to 10 years. Wisconsin populations appear to have reached a high cyclical peak in 1981 after recovering from low levels in the early 1970's (Eckstein, 1982). The DNR spring survey of 1982 indicates that the grouse population has started its cyclical downward trend (Eckstein, 1982). In Wisconsin, density classes are assigned to population estimates based on the number of males drumming per 40.5 ha (100 acres). These classes are low (less than 1.56), moderate (1.56 to 2.66), and excellent (greater than 2.66) (Moulton, 1977). Estimates of males per 40.5 ha (100 acres) in the site area averaged 1.4 ± 0.65 at the 95 percent confidence level, indicating low or moderate population levels. These results, when compared to densities estimated by Moulton (1977) for other areas in northern Wisconsin, suggest that the habitats of the site area are of low value to ruffed grouse.

Waterfowl Brood Counts - Waterfowl brood counts were conducted during the summer of 1978 at the following lakes within the site area: Skunk, Duck, Little Sand, Ground Hemlock, Walsh, Oak, Deep Hole, Rolling Stone, and Rice. In addition, one pond (25-11) was inspected for the presence of waterfowl broods.

Brood count survey results indicate low and scattered waterfowl production among the various water bodies (Table 2.6-16). Rice Lake produced at least four broods, whereas no more than one or two broods were observed on the other lakes and ponds surveyed in 1978. Five species were observed during the brood counts (Table 2.6-16). The most commonly encountered species was the mallard, although wood ducks were also observed on several lakes. One pair of wood ducks with a brood of five young, one pair of ring-necked ducks, and one pair of mallards were observed on the small pond (25-11) northwest of Oak Lake in Section 25 (Figure 2.6-4). The extent to which other small ponds in the area contribute to waterfowl production is unknown. This region of Wisconsin is not noted for its waterfowl production, and these results tend to support this.

Songbirds by Habitat Type - Surveys were conducted during the spring and summer of 1977, and the winter of 1977-78 in the major habitats of the site area to establish relative abundances for songbirds. The habitats surveyed were Aspen-Birch, Swamp Conifer, Northern Hardwood, and Young Aspen. These survey results are summarized in Table 2.6-17. Species importance values were calculated by adding the relative abundances for the winter, spring, and summer surveys. Species are listed in decreasing order of importance. Permanent residents are of greatest importance because they are

TABLE 2.6-16

WATERFOWL BROOD COUNT RESULTS IN THE SITE AREA DURING THE SUMMER OF 1978

SPECIES[a]	RICE LAKE		SKUNK LAKE		DUCK LAKE		LITTLE SAND LAKE		OAK LAKE		ROLLING STONE LAKE		GROUND HEMLOCK LAKE		WALSH LAKE		DEEP HOLE LAKE		TOTAL		TOTAL NUMBER OF BROODS SEEN
	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	
Mallard	10	0	0	0	0	0	1	9	0	0	0	0	0	0	0	0	1	5	12	14	2
Black Duck	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	1	5	1
Blue-Winged Teal	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Unidentified Teal	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1
Wood Duck	7	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	9	0	0
Ring-Necked Duck	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Unidentified Ducks	3	19[b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	19	3
Subtotal Individuals	23	22	2	0	0	0	1	9	1	0	0	0	1	5	0	0	1	5	29	41	7
Subtotal Species	3+	1+	2	0	0	0	1	1	1	0	0	0	1	1	0	0	1	1	5+	2+	0
Miscellaneous																					
Common Loon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	1	
Pied-Billed Grebe	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
Great Blue Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	
Sora Rail	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	
Total Individuals	24	22	2	0	0	0	1	9	2	0	0	0	1	5	0	0	4	6	34	42	
Total Species	4+	1+	2	0	0	0	1	1	2	0	0	0	1	1	0	0	3	2	9+	3+	

NOTES:

A = Adults

Y = Young

[a]Scientific names are listed in Appendix 2.6C.

[b]Consisted of three broods.

TABLE 2.6-17

DISTRIBUTIONAL SONGBIRD SURVEY RESULTS IN THE SITE AREA

SPECIES[a]	FEBRUARY 1978 ENCOUNTERS						MAY 1977 ENCOUNTERS						JUNE 1977 ENCOUNTERS						IMPORTANCE VALUE[b]
	ASPEN/ BIRCH (6)	SWAMP CONIFER (9)	NORTHERN HARDWOOD (9)	YOUNG ASPEN (3)	TOTAL	PERCENT RELATIVE ABUNDANCE	ASPEN/ BIRCH (3)	SWAMP CONIFER (3)	NORTHERN HARDWOOD (3)	YOUNG ASPEN (3)	TOTAL	PERCENT RELATIVE ABUNDANCE	ASPEN/ BIRCH (3)	SWAMP CONIFER (3)	NORTHERN HARDWOOD (3)	YOUNG ASPEN (3)	TOTAL	PERCENT RELATIVE ABUNDANCE	
Black-Capped Chickadee	2	1	1	0	4	50.00	0	1	1	0	2	0.55	0	6	1	0	7	1.74	52.29
Blue Jay	0	0	1	0	1	12.50	10	25	8	12	55	15.19	10	7	5	16	38	9.48	37.17
Common Raven	0	0	1	0	2	25.00	0	0	0	2	2	0.55	0	0	0	1	1	0.25	25.80
Rose-Breasted Grosbeak	0	0	0	0	0	0	11	15	16	16	58	16.02	12	1	11	9	33	8.23	24.25
Ovenbird	0	0	0	0	0	0	10	3	19	6	38	10.50	16	4	22	6	48	11.97	22.47
Common Crow	1	0	0	0	1	12.50	5	4	0	0	9	2.49	0	4	3	1	8	2.00	16.99
Red-Eyed Vireo	0	0	0	0	0	0	4	1	6	0	11	3.04	17	6	19	13	55	13.72	16.76
White-Throated Sparrow	0	0	0	0	0	0	6	12	3	5	26	7.18	1	26	0	3	30	7.48	14.66
Chestnut-Sided Warbler	0	0	0	0	0	0	7	7	5	10	29	8.01	3	2	3	9	17	4.24	12.25
Great Crested Flycatcher	0	0	0	0	0	0	6	1	0	5	12	3.31	0	22	1	12	35	8.73	12.04
Wood Thrush	0	0	0	0	0	0	16	3	3	1	23	6.35	5	0	1	0	6	1.50	7.85
Least Flycatcher	0	0	0	0	0	0	0	5	2	0	7	1.93	5	4	3	1	13	3.24	5.17
Indigo Bunting	0	0	0	0	0	0	0	0	1	7	8	2.21	3	0	1	7	11	2.74	4.95
Nashville Warbler	0	0	0	0	0	0	0	1	0	1	2	0.55	1	14	0	0	15	3.74	4.29
Black-and-White Warbler	0	0	0	0	0	0	1	6	1	0	8	2.21	0	2	2	5	9	1.74	3.95
Veery	0	0	0	0	0	0	1	0	0	0	1	0.28	3	0	6	4	13	3.24	3.52
American Robin	0	0	0	0	0	0	1	0	3	0	4	1.10	5	0	4	0	9	2.24	3.34
Northern Parula	0	0	0	0	0	0	0	3	0	0	3	0.83	1	9	0	0	10	2.49	3.32
Common Flicker	0	0	0	0	0	0	0	0	0	1	1	0.28	2	2	5	0	9	2.24	2.52
Golden-Winged Warbler	0	0	0	0	0	0	1	1	0	3	5	1.38	1	0	1	2	4	1.00	2.38
Ruffed Grouse	0	0	0	0	0	0	1	3	0	2	6	1.66	0	0	0	1	1	0.25	1.91
Brown-Headed Cowbird	0	0	0	0	0	0	2	1	1	2	6	1.66	1	0	0	0	1	0.25	1.91
Rufous-Sided Towhee	0	0	0	0	0	0	0	0	0	6	6	1.66	0	0	0	0	0	0	1.66
Black-Throated Green Warbler	0	0	0	0	0	0	0	1	3	0	4	1.10	1	0	0	0	1	0.25	1.35
Scarlet Tanager	0	0	0	0	0	0	3	0	0	1	4	1.10	0	0	0	1	1	0.25	1.35
Mourning Warbler	0	0	0	0	0	0	0	0	0	4	4	1.10	0	0	1	0	1	0.25	1.35
Great Blue Heron	0	0	0	0	0	0	0	2	0	0	2	0.55	0	0	0	3	3	0.75	1.30
Yellow-Bellied Sapsucker	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	5	1.25	1.25
Osprey	0	0	0	0	0	0	0	2	0	0	2	0.55	0	2	0	0	2	0.50	1.05
Chimney Swift	0	0	0	0	0	0	0	0	0	3	3	0.83	0	0	0	0	0	0	0.83
Song Sparrow	0	0	0	0	0	0	0	0	0	1	1	0.28	1	1	0	0	2	0.50	0.78
Hairy Woodpecker	0	0	0	0	0	0	0	0	0	1	1	0.28	2	0	0	0	2	0.50	0.78
Pileated Woodpecker	0	0	0	0	0	0	0	1	1	0	2	0.55	0	0	0	0	0	0	0.55
Yellow-Bellied Flycatcher	0	0	0	0	0	0	0	2	0	0	2	0.55	0	0	0	0	0	0	0.55
Canada Goose	0	0	0	0	0	0	0	0	0	2	2	0.55	0	0	0	0	0	0	0.55
Common Yellowthroat	0	0	0	0	0	0	0	1	0	0	1	0.28	0	1	0	0	1	0.25	0.53
Killdeer	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0.50	0.50
Olive-Sided Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0.50	0.50
Cedar Waxwing	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0.50	0.50
Mourning Dove	0	0	0	0	0	0	0	1	0	0	1	0.28	0	0	0	0	0	0	0.28
Red-Breasted Nuthatch	0	0	0	0	0	0	0	0	0	1	1	0.28	0	0	0	0	0	0	0.28
American Woodcock	0	0	0	0	0	0	0	0	0	1	1	0.28	0	0	0	0	0	0	0.28
Canada Warbler	0	0	0	0	0	0	0	0	1	0	1	0.28	0	0	0	0	0	0	0.28
Eastern Wood Pewee	0	0	0	0	0	0	0	1	0	0	1	0.28	0	0	0	0	0	0	0.28
Gray Catbird	0	0	0	0	0	0	0	0	1	0	1	0.28	0	0	0	0	0	0	0.28
Chipping Sparrow	0	0	0	0	0	0	0	1	0	0	1	0.28	0	0	0	0	0	0	0.28
Barn Swallow	0	0	0	0	0	0	0	0	1	0	1	0.28	0	0	0	0	0	0	0.28
Black-Billed Cuckoo	0	0	0	0	0	0	0	0	1	0	1	0.28	0	0	0	0	0	0	0.28
Green Heron	0	0	0	0	0	0	0	0	1	0	1	0.28	0	0	0	0	0	0	0.28
Common Grackle	0	0	0	0	0	0	0	0	1	0	1	0.28	0	0	0	0	0	0	0.28
Yellow-Rumped Warbler	0	0	0	0	0	0	0	0	0	1	1	0.28	0	0	0	0	0	0	0.28
Red-Headed Woodpecker	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.25	0.25
Brown Creeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0.25	0.25
Red-Winged Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.25	0.25
Tree Swallow	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.25	0.25
Total	3	2	3	0	8	100.00	85	104	80	93	362	100.02	94	17	91	99	01	99.51	299.53
Number of Species	2	2	3	0	4	-	16	26	21	24	47	-	23	20	19	20	38	-	55

Note: Figure in parentheses indicates number of transects surveyed times the number of survey days.

[a] Scientific names are listed in Appendix 2.6C.

[b] Importance Value equals the total of Relative Abundance for winter, spring, and summer.

present in all seasons, and migrants are of least importance because they are only observed for a short time during the migration.

Results of the summer songbird surveys were used to identify the most frequently observed breeding songbirds. A summary of the five most abundant species in each habitat and the overall top five species is presented in Table 2.6-18.

Overall the most abundant songbirds in the site area were the red-eyed vireo, blue jay, ovenbird, rose-breasted grosbeak (Pheucticus ludovicianus), great crested flycatcher (Myiarchus crinitus), and white-throated sparrow (Zonotrichia albicollis).

A total of 38 species were encountered during summer surveys (Table 2.6-17). The number of species found in each habitat was approximately the same. Aspen-Birch was the highest with 23 species and Northern Hardwood the lowest with 19 species (Table 2.6-17). Swamp Conifer had the greatest number of individuals encountered (117) and Northern Hardwood the lowest (91).

The bird species/habitat associations found in the site area are similar to those reported by other investigators for Northern Hardwood forests. Temple et al. (1979) demonstrated that bird communities in mixed conifer/ hardwood forests are dominated by a relatively consistent group of species, the ovenbird, red-eyed vireo, black-throated green warbler (Dendroica virens), blackburnian warbler (Dendroica fusca) black-throated blue warbler (Dendroica caerulescens), veery (Atharus fuscescens), and white-throated sparrow. Three of these species, ovenbird, red-eyed vireo, and white-throated sparrow, were important components of songbird communities in the site area. Bird species diversity is generally higher in mixed conifer/hardwood forests than in hardwood forests (Temple et al., 1979).

TABLE 2.6-18

FIVE MOST ABUNDANT BREEDING BIRDS BY HABITAT TYPE

SPECIES	ASPEN/ BIRCH	NORTHERN HARDWOOD	SWAMP CONIFER	YOUNG ASPEN	OVERALL
Red-eyed vireo	1	2	-	2	1
Blue jay	4	5	5	1	2
Ovenbird	2	1	-	-	2
Rose-breasted grosbeak	3	3	-	4	3
Great crested flycatcher	-	-	2	3	4
White-throated sparrow	-	-	1	-	5
Nashville warbler	-	-	3	-	-
Chestnut-sided warbler	-	-	-	4	-
Northern parula	-	-	4	-	-
Veery	-	4	-	-	-
Wood thrush	5	-	-	-	-
Least flycatcher	5	-	-	-	-
American robin	5	-	-	-	-
Common flicker	-	5	-	-	-
Indigo bunting	-	-	-	5	-

NOTE: Numbers represent a ranking of the most frequently observed species during the summer surveys (Table 2.6-17). Scientific names are listed in Appendix 2.6C.

Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) also conducted bird surveys in the site area in May and June 1981. Six wetland types were sampled: aquatic bed, bog, coniferous swamp, deciduous swamp, shrub swamp and marsh. The total number of species observed was 49 in May and 55 in June. Five species were observed by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. that were not observed in the site area during this study: Cooper's hawk, solitary sandpiper, yellow-billed cuckoo (Coccyzus americanus), chimney swift (Chaetura pelagica) and purple finch (Carpodacus purpureus). Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc.'s studies indicated that in each of the six wetland types, values for species diversity, species richness and bird density were similar.

Songbird Densities - Sampling was conducted along two transects in two different portions of the site area during the spring and summer of 1978 to determine densities for the more abundant songbird species. Surveys were conducted according to the method described by Emlen (1971, 1977). The locations of these two transects are presented on Figure 2.6-4. The habitat types along the two transects were different. The western transect was approximately 41 percent Aspen-Birch, 30 percent Northern Hardwood, 17 percent Swamp Conifer, 7 percent young clearcut, and 5 percent marsh. The eastern transect was approximately 72 percent Northern Hardwood, 13 percent old field, 7 percent Swamp Conifer, and 6 percent shrub swamp. The habitats along the western transect were generally more diverse in vegetative species composition and stratification (layers) than those along the eastern transect. A total of 63 species were observed on these surveys.

A summary of the most abundant songbirds from the Emlen surveys is presented in Table 2.6-19. Many of these species were also common on the habitat surveys (Table 2.6-18).

The diversity and total density of the two songbird communities sampled were different reflecting the differences in habitat diversity (Table 2.6-20). The density per 40.5 ha (100 acres) (378 ± 98 [95 percent confidence interval]) on the west transect was higher than on the east transect (193 ± 62) during the summer. The same trend was apparent for the spring survey period (Table 2.6-20). Because many of the species were observed so infrequently, it was not practical to estimate densities. The lowest mean densities estimated during the breeding season (summer) were for the blue jay on the eastern transect and the red-winged blackbird and eastern wood peewee (Contopus virens) on the western transect (Table 2.6-20). The highest mean density estimated during the breeding season was for the ovenbird on the western transect at 66 ± 16.

Densities for these two transects in the site area were similar to those reported by others in northern forests. Back (1979) reported an average density of 408 individuals per 40.5 ha (100 acres). In two stands sampled by Mossman in Wisconsin, densities in mixed conifer/hardwood forests were 414 and 620 (Temple et al., 1979).

2.6.4.3 Amphibians and Reptiles

Fifty-nine species of amphibians and reptiles are known to be indigenous in Wisconsin (Vogt, 1981). Approximately 29 of these could be expected to occur in the environmental study area, including 7 salamanders,

TABLE 2.6-19

FIVE MOST ABUNDANT BIRDS IN SPRING AND SUMMER FROM EMLEN SURVEYS

SPECIES	SPRING		SUMMER		OVERALL
	WEST TRANSECT	EAST TRANSECT	WEST TRANSECT	EAST TRANSECT	
Ovenbird	1	2	2	1	1
Red-eyed vireo	3	1	1	2	2
Chestnut-sided warbler	2	-	3	-	3
Rose-breasted grosbeak	5	3	-	3	4
Brown-headed cowbird	-	5	5	-	5
Blue jay	-	-	-	4	6
Black-throated green warbler	-	4	-	-	7
Black-capped chickadee	4	-	4	-	8
Wood thrush	-	-	-	-	9
Least flycatcher	-	-	-	-	10
Common crow	-	-	-	5	-

NOTE: Numbers represent a ranking of the most frequently observed species (Table 2.6-20). Scientific names are listed in Appendix 2.6C.

TABLE 2.6-20

SONGBIRD DENSITIES IN THE SITE AREA

SPECIES[a]	SPRING 1978				SUMMER 1978				OVERALL RELATIVE ABUNDANCE
	WEST TRANSECT[b]		EAST TRANSECT[b]		WEST TRANSECT[b]		EAST TRANSECT[b]		
	MEAN DENSITY[c]	RELATIVE ABUNDANCE	MEAN DENSITY[c]	RELATIVE ABUNDANCE	MEAN DENSITY[c]	RELATIVE ABUNDANCE	MEAN DENSITY[c]	RELATIVE ABUNDANCE	
Ovenbird	51 ± 47	14.99	57 ± 23	19.03	66 ± 16	17.35	60 ± 14	23.86	75.23
Red-Eyed Vireo	46 ± 26	9.81	71 ± 38	19.78	65 ± 74[e]	17.65	54 ± 10	19.80	67.04
Chestnut-Sided Warbler	71 ± 58	14.44	0	0	49 ± 6	11.18	0	0	25.62
Rose-Breasted Grosbeak	20 ± 32[e]	4.63	14 ± 23	7.46	12 ± 10	2.64	10 ± 3	9.14	23.87
Brown-Headed Cowbird	11 ± 6	3.54	20 ± 30[e]	4.48	24 ± 20	5.29	5 ± 12[e]	4.06	17.37
Blue Jay	7 ± 14[e]	2.45	6 ± 5	4.10	8 ± 13[e]	2.35	4 ± 8[e]	7.61	16.51
Black-Throated Green Warbler	7 ± 17[e]	1.63	24 ± 6	6.72	14 ± 17[e]	3.53	6 ± 7[e]	4.06	15.94
Black-Capped Chickadee	11 ± 6	4.90	d	1.87	24 ± 25[e]	5.88	8 ± 23[e]	3.05	15.70
Wood Thrush	10 ± 15[e]	3.54	7 ± 3	3.36	16 ± 22[e]	4.41	d	2.03	13.34
Least Flycatcher	10 ± 6	2.18	28 ± 60[e]	4.10	16 ± 17[e]	4.11	6 ± 17[e]	2.03	12.42
Common Crow	1 ± 3[e]	2.18	d	2.61	d	2.35	d	5.08	12.22
Veery	d	0.27	d	1.49	16 ± 6	4.41	11 ± 15[e]	5.58	11.75
Golden-Winged Warbler	20 ± 37[e]	3.81	d	0.75	12 ± 10	2.64	d	1.02	8.22
Great Crested Flycatcher	d	0.27	11 ± 6	2.99	17 ± 47[e]	2.35	6 ± 26[e]	2.03	7.64
White-Throated Sparrow	d	0.82	20 ± 11	4.10	0	0	d	1.52	6.44
Common Yellowthroat	14 ± 6	2.99	0	0	7 ± 3	2.35	0	0	5.34
Nashville Warbler	11 ± 27[e]	1.63	d	0.37	d	0.29	10 ± 10	3.05	5.34
Black-and-White Warbler	4 ± 20[e]	0.82	20 ± 32[e]	2.99	8 ± 11[e]	1.47	0	0	5.28
Red-Winged Blackbird	3 ± 6[e]	2.72	d	0.75	4 ± 10[e]	1.47	0	0	4.94
Connecticut Warbler	12 ± 33[e]	2.18	d	1.12	0	0	10 ± 0	1.52	4.82
Eastern Wood Peewee	2 ± 5[e]	0.82	6 ± 17[e]	1.12	4 ± 7[e]	2.06	0	0	4.00
Tennessee Warbler	16 ± 25[e]	3.54	0	0	0	0	0	0	3.54
Cedar Waxwing	0	0	d	1.12	d	1.47	0	0	2.59
American Robin	6 ± 15[e]	1.63	0	0	d	0.29	d	0.51	2.43
Song Sparrow	d	0.82	0	0	d	0.29	d	1.02	2.13
Ruffed Grouse	d	1.36	d	0.75	0	0	0	0	2.11
Black-Throated Blue Warbler	6 ± 17[e]	1.09	0	0	6 ± 0	0.88	0	0	1.97
Yellow-Rumped Warbler	9 ± 20[e]	1.91	0	0	0	0	0	0	1.91
Evening Grosbeak	d	1.36	d	0.37	0	0	0	0	1.73
Gray Catbird	d	0.54	d	1.12	0	0	0	0	1.66

[a]Scientific names are listed in Appendix 2.6C.

[b]See Figure 2.6-4 for locations.

[c]Density per 40.5 ha (100 acres) ± 95 percent confidence limits.

[d]Too few birds observed to calculate densities.

[e]Lower confidence limits of these estimated densities cannot be less than zero.

TABLE 2.6-20 (continued)

SPECIES[a]	SPRING 1978 WEST TRANSECT[b] MEAN DENSITY[c]	SPRING 1978 WEST TRANSECT[b] RELATIVE ABUNDANCE	SPRING 1978 EAST TRANSECT[b] MEAN DENSITY[c]	SPRING 1978 EAST TRANSECT[b] RELATIVE ABUNDANCE	SUMMER 1978 WEST TRANSECT[b] MEAN DENSITY[c]	SUMMER 1978 WEST TRANSECT[b] RELATIVE ABUNDANCE	SUMMER 1978 EAST TRANSECT[b] MEAN DENSITY[c]	SUMMER 1978 EAST TRANSECT[b] RELATIVE ABUNDANCE	OVERALL RELATIVE ABUNDANCE
Common Raven	d	0.54	0	0	0	0	d	1.02	1.56
Indigo Bunting	d	0.27	0	0	d	0.59	d	0.51	1.37
Mourning Warbler	d	0.54	0	0	d	0.29	d	0.51	1.34
Common Flicker	0	0	d	0.75	d	0.59	0	0	1.34
Swamp Sparrow	d	0.54	0	0	d	0.59	0	0	1.13
Winter Wren	0	0	d	1.12	0	0	0	0	1.12
Chipping Sparrow	d	0.27	d	0.75	0	0	0	0	1.02
Yellow-Bellied Sapsucker	d	0.27	d	0.37	d	0.29	0	0	0.93
White-Breasted Nuthatch	d	0.54	d	0.37	0	0	0	0	0.91
Pileated Woodpecker	0	0	0	0	d	0.88	0	0	0.88
Blackburnian Warbler	d	0.27	d	0	0	0	d	0.51	0.78
Black-Billed Cuckoo	0	0	d	0.75	0	0	0	0	0.75
Bay-Breasted Warbler	0	0	0	0.75	0	0	0	0	0.75
Brown Creeper	0	0	0	0	d	0.59	0	0	0.59
Common Loon	d	0.27	0	0	d	0.29	0	0	0.56
Eastern Phoebe	d	0.54	0	0	0	0	0	0	0.54
Northern Oriole	d	0.54	0	0	0	0	0	0	0.54
Hairy Woodpecker	d	0.54	0	0	0	0	0	0	0.54
Goshawk	d	0.54	0	0	0	0	0	0	0.54
Broad-Winged Hawk	0	0	0	0	0	0	d	0.51	0.51
American Bittern	0	0	d	0.37	0	0	0	0	0.37
Mallard	0	0	d	0.37	0	0	0	0	0.37
Scarlet Tanager	0	0	d	0.37	0	0	0	0	0.37
Belted Kingfisher	0	0	d	0.37	0	0	0	0	0.37
Parula Warbler	0	0	d	0.37	0	0	0	0	0.37
Killdeer	0	0	d	0.37	0	0	0	0	0.37
Purple Finch	0	0	d	0.37	0	0	0	0	0.37
Downy Woodpecker	0	0	d	0.29	0	0	0	0	0.29
Goldfinch	d	0.27	0	0	0	0	0	0	0.27
Rufous-Sided Towhee	d	0.27	0	0	0	0	0	0	0.27

SPECIES[a]	SPRING 1978 WEST TRANSECT[b] MEAN DENSITY[c]	SPRING 1978 WEST TRANSECT[b] RELATIVE ABUNDANCE	SPRING 1978 EAST TRANSECT[b] MEAN DENSITY[c]	SPRING 1978 EAST TRANSECT[b] RELATIVE ABUNDANCE	SUMMER 1978 WEST TRANSECT[b] MEAN DENSITY[c]	SUMMER 1978 WEST TRANSECT[b] RELATIVE ABUNDANCE	SUMMER 1978 EAST TRANSECT[b] MEAN DENSITY[c]	SUMMER 1978 EAST TRANSECT[b] RELATIVE ABUNDANCE	OVERALL RELATIVE ABUNDANCE
Ruby-Crowned Kinglet	d	0.27	0	0	0	0	0	0	0.27
House Wren	d	0.27	0	0	0	0	0	0	0.27
Sora Rail	d	0.27	0	0	0	0	0	0	0.27
Total	355 + 76	99.89	288 + 145	100.00	378 + 98	99.94	193 + 62	100.03	399.86
Number of Species	48	-	37	-	33	-	23	-	-
Total Observed	-	367	-	267	-	340	-	197	1,171

8 frogs, 1 toad, 5 turtles, and 8 snakes. Fourteen of these species expected were observed in the site area (Appendix 2.6-D). Two of the expected species are considered endangered or threatened and are discussed in subsection 2.6.5.

During spring, amphibians concentrate around ponds and water bodies to breed. Blue spotted salamanders (Ambystoma laterale) and spotted salamanders (Ambystoma maculatum) were frequently observed around most water bodies during spring, but migrated to the uplands during the summer where they were seldom found. American toads (Bufo americanus), spring peepers (Hyla crucifer), and wood frogs (Rana sylvatica) were abundant around water bodies during the spring. During the summer, American toads and wood frogs were frequently found in upland situations as well as near water bodies. The gray treefrog (Hyla sp.), chorus frog (Pseudacris triserata), green frog (Rana clamitans), mink frog (Rana septentrionalis), and leopard frog (Rana pipiens) were less frequently observed or heard. The gray treefrog reported is most likely the eastern gray treefrog (Hyla versicolor), because it is more widely distributed throughout northeastern Wisconsin and Michigan than the similar southern gray treefrog (Hyla chrysoscelis) that does not penetrate the densly forested regions of north central Wisconsin (Vogt, 1981). No gray treefrogs were collected, so positive identification is not possible. Eastern gray treefrogs have been observed in Oconto, Oneida, and Marinette counties (Vogt, 1981), but observations made during this study may be the first record of the species in Forest County. The chorus frogs heard calling during evening surveys were somewhat unexpected since chorus frogs have not been reported in northeastern Wisconsin (Vogt, 1981). Chorus frogs were also reported in the site area by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982).

Four species of reptiles were observed in the environmental study area. Painted turtles (Chrysemys picta) were common in water bodies. Several garter snakes (Thamnophis sirtalis) and a single fox snake (Elaphe vulpina) were also observed, both of which are on the DNR "watch" list. The DNR has also observed snapping turtles (Chelydra serpentina) in the environmental study area (Ramharter, 1981).

Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) also conducted surveys for amphibians and reptiles in the site area. The most commonly observed species during their surveys were the American toad, spring peeper, chorus frog and wood frog. The leopard frog was the only species reported in the site area by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. that was not observed in the site area during the 1977-78 study.

2.6.5 Threatened and Endangered Species

Endangered species are those species of plants or animals that are in danger of extinction throughout all or a significant portion of their range. Populations of these species have usually been severely reduced in distribution and density from historical levels. Threatened species are those that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

A variety of species listed as threatened or endangered either by the DNR or the federal government might occur in the environmental study area. Throughout the course of the baseline studies special consideration was directed towards threatened and endangered species because of the "importance" of these species.

2.6.5.1 Plants

The northern wild monkshood (Aconitum noveboracense) is the only federally designated threatened or endangered plant species that occurs in Wisconsin (U.S. Department of Interior, 1982). This plant is found only in the driftless area of southwestern Wisconsin (Wisconsin DNR, 1982a).

There are 87 plant species listed as threatened or endangered by the Wisconsin DNR (1982b) (Appendix 2.6-E). Two of the state endangered plant species and five of the threatened plant species have ranges and habitat preferences that include the environmental study area (Wisconsin DNR, 1982a). The two endangered species are small yellow water crowfoot (Ranunculus gmelinii) and foamflower (Tiarella cordifolia). The five threatened species are ram's head lady's-slipper (Cypripedium arietinum), tubercled orchid (Habenaria flava), small round-leaved orchis (Orchis rotundifolia), New England violet (Viola novae-angliae) and algal-leaved pondweed (Potamogeton confervoides). The only endangered or threatened species observed was the algal-leaved pondweed. This species was observed during the aquatic surveys and is discussed in section 2.5, Aquatic Ecology. There is only a slight possibility that the six other species would occur in the environmental study area. A short description of these six species is given below.

Small Yellow Water Crowfoot - This aquatic plant had not been seen in Wisconsin since 1938, then in 1979 it was recorded in Douglas County (Wisconsin DNR, 1982a). Historical records show that this flower occurred in most counties along Wisconsin's northern border (Wisconsin DNR, 1982a). There is an abundance of aquatic habitat present in the environmental study area and a remote chance of its occurrence.

Foamflower - Foamflower grows on the shady floor of rich, mixed hardwood forests in eastern North America, south to Tennessee and North Carolina. Three colonies are known to occur in northeastern Wisconsin (Wisconsin DNR, 1982a). Although the likelihood of occurrence in the environmental study area is slight, there is suitable habitat present.

Ram's-Head Lady's-Slipper - This plant is very rare in Wisconsin, found only in a few locations in the eastern and northeastern portions of the state. This species is usually found in cold white cedar swamps, or beach sand over limestone, partly shaded by conifer forest (Wisconsin DNR, 1982a). White cedar swamps are present in the environmental study area.

Tubercled Orchid - Only three populations of this plant are known in Wisconsin, but records include northeastern Wisconsin. It prefers moist soils of partly shaded open meadows and swampy woodlands (Wisconsin DNR, 1982a). Suitable habitat is present in the environmental study area.

Small Round-Leaved Orchis - This plant is a boreal species, growing in the shade of black spruce, tamarack, and white cedar on cold and marly bog soils. Only three small populations are known in Wisconsin; one is located in a Forest County bog. Based on historic records, it may grow elsewhere in northeastern bogs (Wisconsin DNR, 1982a). Black spruce, tamarack, and white cedar swamps are common in the environmental study area.

New England Violet - This plant grows on open, rocky shores along northern rivers and in cold, boggy soils and gravels in northeastern Wisconsin (Wisconsin DNR, 1982a). This habitat is present in the environmental study area.

2.6.5.2 Wildlife

This subsection presents background information on the threatened and endangered wildlife that occur in northeastern Wisconsin and are likely to occur in the environmental study area based on the presence of favorable habitat (Table 2.6-21). Those species designated by the DNR as "watch" status have been discussed in previous subsections.

Mammals

Three mammal species found in Wisconsin are listed as endangered either by the state or the federal government (Table 2.6-21). All three have ranges and habitat preferences that make their occurrence in the environmental study area reasonably possible. No mammals are listed as threatened by the state or federal government in Wisconsin.

Gray Wolf - The gray wolf occurred throughout Wisconsin in nearly every habitat during pre-settlement times (Jackson, 1961). Widespread habitat loss and hunting/trapping pressure reduced the state population to the point of possible extirpation around 1960 (Thiel, 1982). Breeding populations became reestablished by 1975, and there are now approximately four to five packs in northern Wisconsin totaling about 25 individuals. These packs are located in Douglas County, Lincoln County, and on the Oneida/Price County line (Thiel, 1982). Wandering individuals have also been observed in other northern counties.

There have been no recent sightings of wolves in the environmental study area. The closest reporting of wolves has been two individuals

TABLE 2.6-21

ENDANGERED AND THREATENED TERRESTRIAL WILDLIFE OF WISCONSIN[a]

	FEDERAL STATUS		
	ENDANGERED	THREATENED	WATCH (ADVISORY)
BIRDS	Peregrine Falcon	Bald Eagle[b]	N/A
MAMMALS	Gray Wolf[c]		N/A

	STATE STATUS		
	ENDANGERED	THREATENED	WATCH (ADVISORY)
AMPHIBIANS	Blanchard's Cricket Frog	Tremblay's Salamander[c]	Bullfrog[c] Pickerel Frog Burns' Leopard Frog Leopard Frog[b] Tiger Salamander Spotted Salamander[b]
REPTILES	Ornate Box Turtle Slender Glass Lizard Queen Snake Massasauga Western Ribbon Snake Northern Ribbon Snake	Blanding's Turtle Wood Turtle[c]	Ring-Necked Snake[c] Black Rat Snake Eastern Hognose Snake Butler's Garter Snake[c] Milk Snake Smooth Green Snake[c] Bull Snake Fox Snake[b] Garter Snake[b] Red-Bellied Snake[c]
BIRDS	Bald Eagle[b] Osprey[b] Peregrine Falcon Piping Plover Forster's Tern Common Tern Barn Owl Loggerhead Shrike	Red-Necked Grebe Double-Crested Cormorant Cooper's Hawk[b] Red-Shouldered Hawk[b] Greater Prairie Chicken Great Egret	Common Loon[b] Great Blue Heron[b] Black-Crowned Night Heron Black Duck[b] Red-Breasted Merganser[c] Merlin[b] Marsh Hawk[b] Spruce Grouse[b] Sharp-Tailed Grouse Yellow Rail[c] Upland Sandpiper[b] Caspian Tern Black Tern[b] Common Flicker[b] Bewick's Wren Eastern Bluebird[b] Dickcissel Grasshopper Sparrow[b] Vesper Sparrow[b] Field Sparrow[b]
MAMMALS	Marten[c] Lynx[c] Gray Wolf[c]		Mountain Lion Bobcat[b] Moose Fisher[c] White-Tailed Jack Rabbit Gray Fox Woodland Vole Least Shrew Thompson's Pygmy Shrew

Sources: U.S. Department of the Interior, 1982; Wisconsin Department of Natural Resources, 1979, 1982b; Jurewicz, 1983a.

[a]Scientific names are listed in Appendices 2.6B, 2.6C, and 2.6D.

[b]Observed in the environmental study area.

[c]Could reasonably occur in the environmental study area.

N/A = Not applicable.

approximately 40 km (25 miles) northeast of Crandon, near Tipler, in the winter of 1981-1982 (Thiel, 1982).

Wolves are wide-ranging animals, small packs may have home ranges of 150 to 250 square miles (Jackson, 1961). Like most of Forest County, the environmental study area contains forested habitat suitable for timber wolves (Thiel, 1982).

Marten - Originally, the marten probably occurred in most wooded areas of Wisconsin, particularly where there were dense conifer forests (Jackson, 1961). Trapping and habitat destruction from the extensive logging period of the late 1800's steadily reduced the state population to the point of extirpation by 1925.

The DNR is presently attempting to reestablish martens in Wisconsin through a restocking program. In 1975, 124 martens were released in the Nicolet National Forest in northern Forest County; 37 more were released in 1980-1981.

Martens recently released are using a variety of existing habitats of mixed hardwood-conifer stands and are expected to expand their range beyond the release area (Wisconsin DNR, 1979). No martens were observed during this study.

Lynx - Historically, the lynx occurred throughout Wisconsin whenever mature forest and swamp brushland habitat was predominant (Jackson, 1961). However, the lynx has always been uncommon or rare in Wisconsin. Habitat changes that resulted from lumbering in the late 1800's and early 1900's, along with hunting/trapping pressure and possibly competition with bobcats,

have significantly reduced lynx populations in Wisconsin (Wisconsin DNR, 1979).

Since 1973, nine positive records of the lynx are known for Wisconsin (Jurewicz, 1983b). All of these are from the northern two tiers of counties. Since 1977, the Wisconsin DNR has summarized the number of lynx observations reported on bobcat hunter/trapper questionnaires. An average of 10 lynx have been reported every year, with a total of only six observations having been recorded in northeastern Wisconsin. There have been no recent sightings of lynx in the environmental study area, and the closest reported lynx sighting is at least 19.3 km (12 miles) west of the environmental study area in Oneida County (Jurewicz, 1983b).

The dense forests that characterize the environmental study area constitute suitable habitat for the lynx.

Birds

There are two federally designated endangered or threatened birds that occur in Wisconsin, the peregrine falcon (Falco peregrinus) and bald eagle (Table 2.6-21). The bald eagle is known to occur in the environmental study area. The peregrine falcon is a rare migrant in the region (Vanderschaegen, 1981) and would not be expected to regularly occur in the environmental study area.

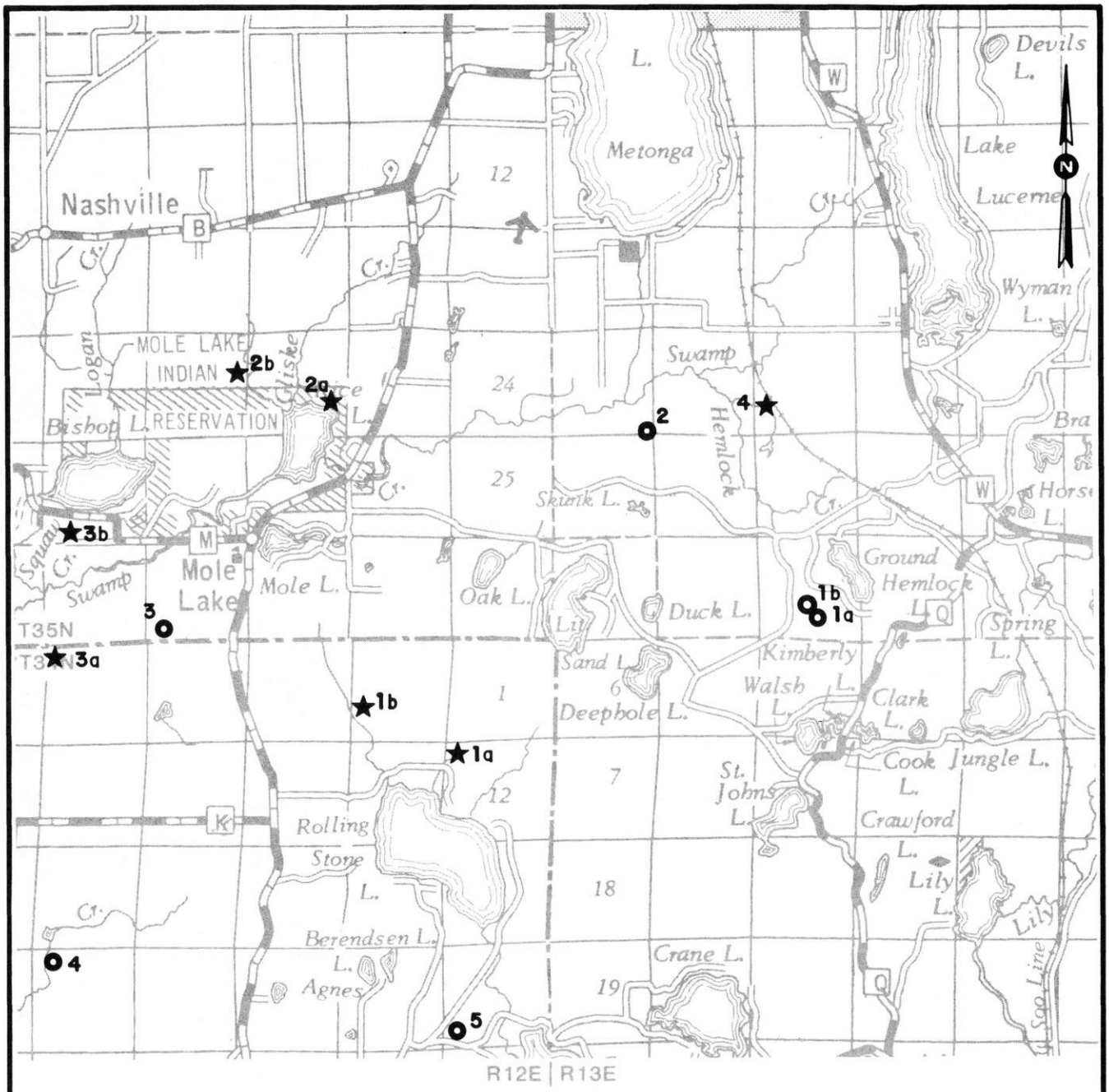
In addition to the federally designated peregrine falcon and bald eagle, there are 12 other birds listed as endangered or threatened by the DNR (Table 2.6-21). Three of these bird species (osprey, Cooper's hawk and red-shouldered hawk) have ranges and habitat preferences that make their

occurrence in the environmental study area possible. All three have been observed in the environmental study area.

Bald Eagle - Historically, bald eagles nested throughout Wisconsin. After a drastic decline in the 1950's and 1960's from habitat destruction, pesticides, and human disturbance, the species has made a comeback in Wisconsin. Nesting is now generally restricted to the northern one-half of the state. Bald eagle productivity has remained relatively stable since 1978, and the number of occupied territories has increased from 140 in 1978 to 207 in 1982 (Sindelar, 1982).

There are four known bald eagle territories in the environmental study area (Figure 2.6-11), two of which were active in 1982 (Table 2.6-22). Of the four bald eagle territories in the environmental study area, three appear to contain alternate nest sites. The Rolling Stone Lake territory has been the most productive and is approximately 4.0 km (2.5 miles) southwest from the center of the potential mining activities (Figure 2.6-11). The mean number of young produced per active territory in the environmental study area during the period 1974-1982 was 1.2.

Sindelar (1978) has indicated that nest sites are extremely important resources. Often a nest site will not be used for several years and appear to be abandoned when it again becomes active. When this happens, it is probably a different pair from those using the site prior to abandonment. For example, the Rice Lake nest site, which was inactive for a period during the early 1970's, was reused again in 1977 through 1981 (Table 2.6-22). Consequently, it is important that both inactive and alternate nest sites be protected and development precluded according to DNR guidelines for activities



KEY:

★ BALD EAGLE NESTS
1. ROLLING STONE LAKE (2 ALTERNATE NESTS)
2. RICE LAKE (2 ALTERNATE NESTS)
3. MOLE LAKE AND BISHOP LAKE (2 ALTERNATE NESTS)
4. SWAMP CREEK

O OSPREY NESTS
1. GROUND HEMLOCK LAKE (2 ALTERNATE NESTS)
2. SWAMP CREEK
3. MOLE LAKE
4. SPIDER CREEK FLOWAGE
5. PICKEREL CREEK

1 .5 0 1 2 MILES

1 .5 0 1 2 KILOMETERS

SOURCE: ECKSTEIN, 1978, 1980 AND 1982.

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

EXXON MINERALS COMPANY
CRANDON PROJECT

BALD EAGLE AND OSPREY NESTS
IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.6-11

TABLE 2.6-22

BALD EAGLE AND OSPREY NEST SUCCESS[a] IN THE ENVIRONMENTAL STUDY AREA

BREEDING TERRITORY NAME[b]	NUMBER OF YOUNG PRODUCED[c]								
	1974	1975	1976	1977	1978	1979	1980	1981	1982
Bald Eagles									
Rolling Stone Lake (Alternate A)	1	2	1	1	2	2	2	S	I
Rolling Stone Lake (Alternate B)	-	-	-	-	-	-	-	-	N-2
Rice Lake (Alternate A)	I	I	I	1	1	0	2	0	I
Rice Lake (Alternate B)	-	-	-	-	-	-	-	-	N-I
Mole and Bishop Lakes (Alternate A)	-	-	-	N-1	0	0	NG	-	-
Mole and Bishop Lakes (Alternate B)	-	-	-	-	-	-	N-0	2	2
Swamp Creek	-	-	-	-	-	N-I	I	I	I
Total	1	2	1	3	3	2	4	2	4
Production[d]	1.0	2.0	1.0	1.0	1.0	0.6	1.3	0.6	2.0
Ospreys									
Ground Hemlock Lake (Alternate A)	I	2	1	0	1	0	1	0	0
Ground Hemlock Lake (Alternate B)	-	-	N-I	I	I	I	I	I	I
Swamp Creek	-	-	N-2	2	2	0	2	0	0
Mole Lake	-	-	-	N-0	0	1	0	2	2
Spider Creek Flowage	-	2	3	2	0	1	0	1	3
Pickerel Creek	-	-	-	N-0	0	2	1	1	3
Total	0	4	6	4	3	4	4	4	8
Production[d]	0.0	2.0	2.0	0.8	0.6	0.8	0.8	0.8	1.6

[a]Sources: Eckstein, 1978, 1980, 1982; Sindelar, 1978.

[b]Locations shown on Figure 2.6-11.

[c]Key: I = Inactive
N = First year discovered
0 = Active but failed
- = No data
NG = Nest gone
S = Some activity.

[d]Mean number of young per active territory.

near bald eagle and osprey nest sites. Habitat disturbance or destruction while a nest site is inactive will often preclude the site from ever being used again.

The nearest bald eagle nests to any proposed mine related facility are the Swamp Creek nest located approximately 760 m (2,492 feet) south of the proposed south turnout for the railroad spur and the Bishop Lake nest located 805 m (2,640 feet) north of the proposed water discharge structure.

Osprey - Historically, ospreys probably nested throughout Wisconsin. As a result of habitat destruction, pesticides, and human disturbance, nesting is presently restricted to the northern half of the state and scattered locations in central Wisconsin. Osprey productivity has remained relatively stable since 1978 at approximately 1.1 young per active territory (Wisconsin DNR, 1983). The number of active breeding territories in Wisconsin has increased steadily from 125 in 1978 to 186 or more in 1982 (Wisconsin DNR, 1983). Estimates of young produced per active nest for the late 1960's varied between 0.6 and 0.8 (Sindelar, 1971). It has been estimated that Wisconsin osprey populations were declining at a rate of 12 to 13 percent during this period (Henny and Ogden, 1970). Henny and Wight (1969) indicated that an annual production of approximately 1.2 to 1.3 young per breeding age female is required to maintain a stable population.

The environmental study area contained five active osprey territories in 1982 (Figure 2.6-11). One of these territories, Ground Hemlock Lake, has two alternate nest sites. Of these five territories, three produced a total of eight young (Table 2.6-22). Annual osprey production in the environmental study area has varied from a high of 2.0 young per active

territory in 1975 to 0.6 young per active territory in 1978 (Table 2.6-22). The mean number of young produced per active territory in the environmental study area during the period 1974-1982 was 1.0 (Table 2.6-22). Osprey production in the DNR North Central District for the four summers 1979-1982 has been stable and similar to the previous four summers 1975-1978 (Eckstein, 1982). Annual osprey production per active territory in the North Central District from 1975 through 1981 was 1.3, 1.3, 1.2, 0.9, 1.3, 1.1 and 1.0, respectively (Eckstein, 1978 and 1982). This is an average production of 1.2 young per active territory for the 1975-1981 period.

The nearest osprey nest to any proposed mine related facility is the Mole Lake nest located within 402 m (1,320 feet) of the proposed water discharge pipeline.

Cooper's Hawk - The Cooper's hawk once occurred throughout Wisconsin but is now found only in scattered locations as a result of pesticide poisoning, persecution and habitat loss (Wisconsin DNR, 1979). Cooper's hawks prefer mixed deciduous-coniferous woods with frequent openings and wooded brushlands near farms.

One Cooper's hawk was observed building a nest in the environmental study area in April 1981, approximately 1 km (1.0 mile) northwest of Jungle Lake. The nest tree was destroyed a short time thereafter during land clearing for county highway improvement. Cooper's hawks were also observed by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) in the site area in May 1981.

Red-Shouldered Hawk - The red-shouldered was once a common Wisconsin hawk. It is now found primarily in undisturbed woodlands of the Mississippi and lower Wisconsin rivers, northern Kettle Moraine State Forest, and northeastern Wisconsin. Habitat destruction, particularly indiscriminate logging, is the main threat to the red-shouldered hawk (Wisconsin DNR, 1979).

The preferred habitat for red-shouldered hawks is a mixture of mesic conifers and hardwoods near swamps, rivers and marshes (Erdman, 1978). This type of habitat is common in the environmental study area. One red-shouldered hawk was heard calling during the summer breeding season of 1981 in the environmental study area, approximately 1.6 km (1.0 mile) south of Rolling Stone Lake. There have been a few nest records of red-shouldered hawks immediately east of the environmental study area (Erdman, 1982).

Amphibians and Reptiles

No amphibians or reptiles that are considered endangered or threatened by the U.S. Fish and Wildlife Service occur in Wisconsin (U.S. Department of the Interior, 1982). There are 10 species of amphibians and reptiles that are listed by the DNR as endangered or threatened (Table 2.6-21). Of these 10 species, two have ranges and habitat preferences that make their occurrence in the environmental study area possible; these include the wood turtle (Clemmys insculpta) and Tremblay's salamander (Ambystoma tremblayi).

Wood Turtle - The wood turtle has been found throughout Wisconsin in its preferred habitat of forested areas along fast-moving streams. Habitat destruction and widespread collection of this turtle by biological supply houses has reduced their populations to the point that they are considered

endangered by the DNR (Vogt, 1981). No wood turtles were observed during the field studies but they have been reported in Forest County (Vogt, 1981). Suitable habitat for this species is present in the site area and environmental study area.

Tremblay's Salamander - Tremblay's salamander is very similar to the blue-spotted salamander. It is only found in association with the blue-spotted salamander and the population consists exclusively of triploid females of hybrid origin. Adult individuals can be identified with reasonable certainty through measurements, but the only positive method for separating this salamander from the blue-spotted salamander is by chromosome number and red blood cell size. Both Tremblay's salamander and the blue-spotted salamander prefer mesic forests that contain woodland ponds for breeding (Vogt, 1981). This habitat is common throughout the environmental study area. There are no records of Tremblay's salamander in Forest County, although this species has been recorded in eastern Oneida County (Vogt, 1981).

2.6.6 Sensitive Receptors

2.6.6.1 Agricultural Crop and Native Plant Species

The vegetation of the site area and environmental study area, as well as the surrounding regional study area, consists primarily of Northern Hardwood, Aspen-Birch, and Swamp Conifer forest (see subsection 2.6.3 for further description). Less than 5 percent of the environmental study area is in agricultural use, and local crops include oats, barley, wheat, alfalfa, hay, and potatoes (see subsection 2.9.2, Land Uses).

There are no known experimental farms, State Scientific Areas, vegetation research plots or extensive forest plantations in the environmental study area. The only uncommon or unusual plant communities in the area are the wild rice beds in Rice Lake and a bur oak swamp east-northeast of the ore body. An aquatic plant designated by the state as threatened was found in Duck Lake.

Although several studies have been done on the effects of air pollutants on forest ecosystems, it would be difficult to evaluate the sensitivity of the extensive forest land in the regional study area to air emissions for several reasons: (1) forest stands differ greatly in species composition, age, stability and capacity to recover from disturbance; (2) individual plant responses to a given concentration of pollutant are appreciably modified by a variety of factors such as duration of exposure, age of plants, age of leaf, and prevailing environmental conditions; and (3) the sensitivity of different species to different pollutants varies considerably, even diurnally and seasonally (Kozlowski, 1979, 1980).

One biological advantage of forests in the environmental study area is that there are several different forest types and mixed stands containing a variety of dominant trees. Mixed forest stands generally have a greater capacity to recover from disturbance since they are more likely to contain species that are resistant to air pollution of insect and disease epidemics. Listed below are common trees in the environmental study area and their relative susceptibility to sulfur dioxide and ozone, the two compounds that are thought to cause the most injury to plants (Kozlowski, 1979):

Tree	Relative Susceptibility to Sulfur Dioxide	Ozone
Paper Birch	Sensitive	Not Given
Quaking Aspen	Sensitive	Sensitive
Large-Toothed Aspen	Sensitive	Not Given
Eastern Hemlock	Not Given	Tolerant
White Pine	Sensitive	Intermediate
Red Pine	Sensitive	Tolerant
White Cedar	Tolerant	Tolerant
Sugar Maple	Tolerant	Tolerant
Red Maple	Intermediate	Tolerant
Balsam Fir	Intermediate	Tolerant
Basswood	Intermediate	Tolerant

2.6.6.2 Wildlife

The bald eagle, osprey, and common loon are three "important" wildlife species of the environmental study area whose reproductive success is particularly susceptible to construction activity and human disturbance. Several bald eagle and osprey nests are present in the environmental study area (Figure 2.6-11), and a pair of common loons nested on Deep Hole Lake in 1978.

Freedom from human disturbance or intervention is one of the most variable factors involved in bald eagle and osprey nesting (Snow, 1973). The effects of human disturbance on nesting bald eagles are still being argued. Mathisen (1968) reported that human activity was not seriously affecting bald eagles. Nests in very isolated parts of Chippewa National Forest were occupied 78 percent of the time and 54 percent were successful. Nests in areas where human beings and associated activities were frequent were occupied 79 percent of the time and successful 48 percent of the time. Mathisen indicated that the timing of human disturbance in relation to the eagle's breeding chronology was important. The potential for impact by human disturbance is greatest during egg-laying, incubation, and when the eaglets are newly hatched. In Chippewa National Forest, human activity began to increase in mid-May, when the adults would have very small eaglets. Mid-June through the summer is when human activity would approach maximum levels, and by this time the young are half grown, and the potential impact of human disturbance is greatly reduced.

Human disturbance does not appear to be as important a consideration for ospreys as for bald eagles. Ospreys have often been known to nest close to human activity. Bald eagle and osprey nest sites may be vacant for a number of years and then be reused often by a different pair. It is important that inactive as well as active nest sites be monitored and development precluded from the immediate area surrounding the nest site. Habitat disturbance or destruction while a site is inactive may prevent the site from ever being used again. The sensitivity of bald eagles and ospreys to disturbance has prompted the Wisconsin DNR (1976a) and the U.S. Forest

Service to adopt policies governing human activities during the breeding season on lands they manage near bald eagle and osprey nests.

The common loon has suffered severe population declines in Wisconsin, and recent studies indicate that increasing human disturbance from shoreline development and vacationers could lead to further decline (Wisconsin DNR, 1979).

2.6.6.3 Aquatic Organisms

The aquatic resources of the site and environmental study area are typical of north central Wisconsin. Based on baseline data collection activities, sensitive receptors in the aquatic environment appear to be the algal-leaved pond weed (a threatened plant species found once along the shore of Duck Lake), trout streams, and wild rice.

The algal-leaved pond weed, a rooted macrophyte species, was found floating at the surface of Duck Lake on only one occasion (see EIR subsection 2.5.3.2, p. 2.5-91). A subsequent investigation of Duck, Deep Hole, and Skunk lakes located no other specimens of this plant. Therefore, the distribution of this species in terms of location and abundance, or the extent of potential impact from any Project activities, is uncertain.

Brook trout require silt-free, cold water streams, high in dissolved oxygen concentrations. Within the environmental study area, there are 11.7 km (7.3 miles) of Class I trout streams and 31.1 km of Class II trout streams. Streams located in the site area that are designated as Class II trout streams include Hemlock, Hoffman, Metonga, and Swamp (above State Highway 55) creeks.

No wild rice has been observed in Swamp Creek from a point approximately 0.4 km (0.25 mile) upstream of the proposed water discharge site to the confluence downstream with the Wolf River. However, Rice Lake contains extensive beds of wild rice, and concern over potential impacts to this sensitive species from mine development have been expressed by the Mole Lake Indian community and the DNR. The impetus for the concern arises from a Minnesota water quality standard (WPC 15, "Criteria for the Classification of Interstate Water of the State and Establishment of Standards of Quality and Purity") that, in one section, specifically limits sulfate levels in waters where wild rice grows to a concentration of 10 mg/l during the growing season.

Growth of wild rice has been shown to be dependent upon an interrelated set of biological, physical, and chemical variables. Lee and Stewart (1981) found wild rice density, water depth, water temperature, and water and sediment quality to be the four most important variables affecting wild rice growth in Minnesota. They modeled wild rice growth based on studies of rice growth in relation to a wide variety of environmental factors that included sulfate concentrations in the water.

Wild rice density was found to influence productivity through intraspecific competition. Commercial growers in Minnesota have found that mechanically thinned wild rice fields are more productive than denser, unthinned fields (Lundberg and Trihey, 1975). Changes in water levels at the critical submerged- and floating-leaf stages appear to increase plant mortality and, thus, to lower productivity (Lee and Stewart, 1978). An important chemical factor in wild rice growth, identified by Lee and Stewart (1981), was alkalinity. However, under natural conditions, no chemical

parameter, including sulfate and alkalinity, was found to act upon wild rice growth in isolation (Lee and Stewart, 1978). No single chemical element could be specifically identified as the factor controlling wild rice growth.

Minnesota's standard of 10 mg/l of sulfate in natural waters was based upon work done throughout Minnesota by Moyle (1944, 1945) and Trippler (1978). However, subsequent advances in quantitative ecology have allowed more thorough analysis of the impact of sulfate and other water quality parameters upon wild rice growth (Lee and Stewart, 1978, 1981, 1983).

Although Moyle suggested that sulfate levels above 10 mg/l inhibited wild rice growth, he acknowledged that wild rice occurs in Minnesota water with up to 282 mg/l of sulfates (Moyle, 1944). Wild rice planted in Saskatchewan has grown well in water with between 105 and 575 mg/l sulfate (median 220 mg/l) (Peden, 1982). Lee and Stewart (1978) have shown that sulfate in water in a Minnesota wild rice bed varied temporally from approximately 20 to 120 mg/l. Wild rice has also been found growing in lake bottom sediments where sulfate concentrations were 1500 mg/l (Vicario and Halstead, 1968). Lee and Stewart (1978) experimentally grew wild rice in water with varying concentrations of sulfate. They found a statistically significant linear relationship between increased weight per plant and increasing sulfate concentrations, up to at least 200 mg/l sulfate.

Sulfates in Rice Lake averaged 4 mg/l (range 4 to 8); in Swamp Creek, 5 mg/l (range 4 to 12); and in the Wolf River, 6 mg/l (range 4 to 9).

2.6.7 Ecological Relationships

2.6.7.1 Comparative Relationships

The environmental study area is a rural, sparsely populated area possessing intrinsic values for human uses and ecological relationships. These values enable the area to support some species preferring solitary habitats and to support the tourism industry, an essential element of the area's economy (Druckenmiller, 1983).

The site area, like most of the surrounding region, is predominantly forested. The soils, topography, and climate all favor the continued presence of forests in the site area. The forests of the site area are primarily second-growth northern hardwood poletimber. Landowner preferences dictate a variety of management practices. Many areas are managed for pulp production because of the quicker return on investment. Management for saw logs requires longer time between harvesting and the resultant economic return. Management for quality saw logs with intermediate cuts to release saw log crop trees and, thus, intermediate production of hardwood pulp is also a frequent management practice. In addition to providing forest products, these forest lands provide recreational opportunities such as fishing, hunting, and snowmobiling (see subsection 2.9.2, Land Uses).

Most wildlife species occurring in northern Wisconsin are found in the site area and the site area's wildlife community is typical of the surrounding region. The forested habitats of the site area support only low to moderate populations of white-tailed deer and ruffed grouse, two of the most popular game species of the environmental study area.

When the location, extent, and integrity of the terrestrial resources found in the site area are compared to those of the surrounding region, there are few notable and no unique resources. These notable resources are a bur oak swamp near Skunk Lake; the wild rice beds in Rice Lake; a possible population of algal-leaved pond weed in Duck Lake; breeding bald eagles, ospreys, Cooper's hawks, red-shouldered hawks; and a small population of the southern flying squirrel. The threatened and endangered species found in the site area are also found throughout northern Wisconsin. More detailed discussions of these resources and comparative relationships are presented in chapter 4.0.

2.6.7.2 Functional Relationships

The site area has limited functional relationships to terrestrial resources beyond the site area. This is primarily because of the extensiveness of similar ecosystems in the surrounding region. The only major functional linkage with other terrestrial resources is for migratory wildlife species. Some linkage also occurs through dispersion of plant seeds and emigrating wildlife species.

Disruption of terrestrial resources by site development is anticipated to have minimal influence upon the functional relationships of site area terrestrial resources to those beyond the site area.

2.6.8 Summary and Conclusions

Soils

1. There are three major surficial soil regions in the environmental study area: northern silty uplands and plains, northern loamy uplands and plains, and stream bottoms and major wetlands.

2. The site area is located within the Kennan, Iron River, Pence, Vilas Soil Association, which is part of the northern loamy uplands and plains surficial soil region.

3. In the site area the surficial soils are generally well drained loams in the uplands and poorly drained peats and mucks in the wetlands.

4. The most common soil type in the site area is the Iron River Variant Stony Loam.

Vegetation

1. Vegetation in the environmental study area generally consists of heavily forested uplands interspersed with forested wetlands and is typical of this region of Wisconsin.

2. Northern Hardwoods, including Aspen-Birch, cover approximately 60 percent of the site area. Sugar maple and basswood were the dominant overstory tree species in the Mesic Northern Hardwood vegetation type. In the Dry-Mesic Northern Hardwood vegetation type, red maple, aspen, and paper birch were the dominant overstory tree species. The Aspen-Birch community was dominated by paper birch, aspen, and sugar maple.

3. Wet-Mesic and Wet Northern Forests (Swamp Conifer) are the second most common vegetation types, covering approximately 20 percent of the site area. In the Wet-Mesic Northern Forest community in the site area, white cedar and balsam fir were the dominant overstory species. Black spruce and tamarack were dominant in the Wet-Northern Forest type.

4. Wetland vegetation types (marsh, shrub swamp, and bog) comprise approximately 6 percent of the site area. Small deciduous forested swamps also occur on the site but are less than 1 ha (2.5 acres) in size. The remaining 14 percent of the site area is comprised of urban or developed land, old field or clearcut, agriculture, and water.

5. A timber inventory within the site area indicated that the Northern Hardwoods consisted primarily of well stocked poletimber that contained an average volume of 39 cords and 2,842 board feet per hectare (16 cords and 1,150 board feet per acre). The majority of the Aspen-Birch is medium or well stocked poletimber, averaging 22 and 42 cords per hectare (9 and 17 cords per acre), respectively. The swamp conifer type contained the lowest poletimber volumes, averaging 11 to 22 cords per hectare (4.5 to 9 cords per acre).

6. The total cord volume and board foot volume for forest resources within the 1,407-ha (3,474-acre) area included in the forest inventory were 43,892 cords and 2,534,599 board feet, respectively. Sugar maple, American basswood, aspen, white birch, and red oak were the species with the highest cord and/or board foot volumes. The market value of merchantable forest resources in the inventory area was estimated at approximately $435,000.

7. A forest management plan for the inventory area was developed, based on DNR silvicultural guidelines, to stimulate timber production through prescribed stand treatments and to maintain aesthetic qualities. A harvesting schedule was prepared that would be most advantageous for wildlife and aesthetics.

8. Rice Lake supports an uncommon emergent aquatic community of wild rice. A small stand of bur oak, uncommon in this region, is located approximately 1.6 km (1 mile) east-northeast of the ore body. A calypso orchid, a rare orchid of the Great Lakes region but not listed as threatened or endangered by the state, was found approximately 1.6 km (1 mile) northeast of the ore body.

9. The concentration of nine heavy metals in plants collected in the environmental study area compared favorably with values reported in the literature. The metals and ranges of values from this study are as follows: Manganese 70 to 928 mg/kg, zinc 27 to 117 mg/kg, cadmium 0.25 to 2.13 mg/kg, copper 6.1 to 20.8 mg/kg, arsenic <0.01 mg/kg, lead 1.0 to 6.3 mg/kg, mercury <0.01 mg/kg, cobalt 0.5 to 3.1 mg/kg, and total chromium <0.01 to 3.47 mg/kg.

10. A total of 158 wetlands were inventoried and evaluated within the 4,735-ha (11,700-acre) wetlands study area. Approximately 692 ha (1,710 acres) were classified as wetlands in the study area. Wetlands in the Project area constituted 2.8 percent of the estimated total land area of wetlands in the region, Wolf River drainage basin upstream from Langlade, Wisconsin.

11. The most common wetland type in the study area was the coniferous swamp (383 ha [946 acres]). Less common types included bogs (130 ha [321 acres]), deciduous swamps (59 ha

[146 acres]), shrub swamps (59 ha [146 acres]), marshes (60 ha [148 acres]), and aquatic beds (2 ha [5 acres]).

12. Of the ten highest ranked wetlands in the study area, five were shallow marshes, two were bogs, two were coniferous swamps, and one was a shrub swamp. These wetlands were assigned high functional values because they possessed many of the following characteristics: large size (>1.9 ha [4.6 acres]), high number of wetland classes, favorable water/cover interspersion, high interspersion of wetland types, part of a riparian system, and high scenic or recreational qualities.

Wildlife

Mammals

1. Twenty-nine species of mammals were found in the site area. Nine additional species not recorded during the study are reported to occur in Forest County. The southern flying squirrels found are beyond previously recorded range limits in northeastern Wisconsin.

2. White-tailed deer population density in the site area was low and is approximately half of the DNR's goal for the management units, which include the site area. The 1977 prehunting season white-tailed deer population density in the site area was estimated to be between 6.1 and 7.8 deer per 259 ha (1 square mile) of deer range.

3. Two areas "important" to white-tailed deer occur in the site area: the Swamp Creek Deeryard and the Rolling Stone Lake Deeryard.

4. The environmental study area provides good habitat for black bears. Black bear density in the environmental study area is expected to be approximately 0.25 per 259 ha (1 square mile).

5. Three species of small game mammals, the snowshoe hare, cottontail rabbit and gray squirrel, occur in the environmental study area.

6. The important furbearers in the region are the bobcat, river otter, red fox, coyote, beaver, raccoon, muskrat, mink, and fisher. All but the red fox and fisher were observed in the site area. The bobcat and fisher are on the DNR "watch" list.

7. A total of 189 individuals representing 13 species of nongame mammals were collected during nongame mammal surveys. The five most predominant species, in decreasing order, were the deer

mouse, Gapper's red-backed mouse, masked shrew, short-tailed shrew and eastern chipmunk.

8. Nongame mammals were most abundant in northern hardwood communities followed by Swamp Conifer and Aspen-Birch. Capture rates were lowest in old field and bog communities. Diversity of nongame mammals was higher in northern hardwood communities than in other habitats sampled. Additional small mammal trapping was conducted in each wetland type by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982). Their results indicated that the deciduous swamp type had the greatest species richness and the bog type the lowest.

Birds

1. One hundred-sixty-four species of birds were observed in the environmental study area.

2. The bird communities in the environmental study area exhibited substantial seasonal variability. Approximately 80 percent of the bird species breeding in the site area migrate to milder climates for the winter. Densities during summer were approximately 400 to 600 individuals per 40.5 ha (100 acres), whereas during winter they declined to less than 100 individuals per 40.5 ha (100 acres). Twenty-four species were observed during winter and 110 additional species were observed during spring and summer.

3. During migrating waterfowl surveys, 1,296 individuals constituting 16 species were observed. Rice Lake received most of the use by migrating waterfowl observed in the environmental study area, 79 percent of the total numbers observed. Rolling Stone Lake and Skunk Lake were also important feeding and resting areas for migrating waterfowl. The remaining lakes received little use by migrating waterfowl.

4. During the spring of 1978, ruffed grouse densities in the site area were estimated at 2.8 ± 1.3 grouse per 40.5 ha (100 acres). When compared with densities estimated for other areas of Wisconsin, this value suggests that the site area is of low to moderate value to ruffed grouse.

5. The environmental study area received very little apparent use by breeding waterfowl. Rice Lake was the only water body with concentrations of breeding waterfowl. Rice Lake produced at least four broods, whereas no more than one brood was observed in each of the other lakes or ponds surveyed.

6. Songbird densities along two transects in the site area were similar to those reported by others in northern forests. Along

the east transect the density was 193 ± 62 per 40.5 ha (100 acres) and along the west transect 378 ± 98 per 40.5 ha (100 acres). Bird surveys by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) indicated that values for species diversity, richness, and bird density were similar in each of the wetland types found on the site.

7. Birds observed in the site area that are listed on the DNR "watch" list were the common loon, great blue heron, black duck, black tern, common flicker, grasshopper sparrow, vesper sparrow, and field sparrow.

Amphibians and Reptiles

1. Twenty-two species of amphibians and reptiles occur in Forest County. Fifteen species of amphibians and reptiles were observed in the environmental study area.

2. Small woodland ponds, often times emphemeral, provided important breeding habitat for amphibians. Eleven species of amphibians found in the environmental study area rely on these small ponds during the breeding and larval portions of their life cycles.

3. Amphibians and reptiles observed in the site area that are listed on the DNR "watch" list were the leopard frog, spotted salamander, fox snake, and garter snake.

Threatened and Endangered Species

1. No federally- or state-listed threatened or endangered plant species were found in the site area during the terrestrial surveys. One aquatic plant, the algal-leaved pondweed, is listed by the state as threatened and was observed in the site area (see section 2.5).

2. No federally- or state-listed threatened or endangered mammal species were observed in the site area.

3. The bald eagle is listed as threatened in Wisconsin by federal regulations and as endangered under state regulations. Three bald eagle territories lie within the site area. There were four bald eagle nests in the environmental study area, and the closest nest to any proposed mine related facility was the Swamp Creek nest, located approximately 760 m (2,492 feet) south of the proposed south turnout for the railroad spur.

4. The osprey is listed as endangered under Wisconsin regulations. Two osprey territories lie within the site area. The closest

nest to any proposed mine related facility is the Mole Lake nest, located within 402 m (1,320 feet) of the proposed water discharge pipeline.

5. The Cooper's hawk is listed by the state of Wisconsin as a threatened species. Cooper's hawks were observed in the site area; no nest sites were found.

6. The red-shouldered hawk, a state-designated threatened species, is known to have nested as close as within 16 km (10 miles) of the ore body. One red-shouldered hawk was identified in the environmental study area.

7. No amphibians or reptiles that are listed as threatened or endangered under federal regulations occur in Wisconsin. No amphibians or reptiles listed as threatened or endangered under Wisconsin regulations were observed in the site area.

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2.7 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

In April 1977, Beloit College initiated an intensive archaeological survey of approximately 1,521.6 ha (3,760 acres) of land in the area of the proposed Crandon Project in Forest and Langlade counties, Wisconsin (Salzer and Birmingham, 1978). Following clarification of project plans, an additional 437.65 ha (1,078.6 acres) were subjected to intensive archaeological survey by GLARC, Inc. (Overstreet and Brazeau, 1982; Overstreet, 1982, 1983). During the Beloit College field investigations in 1977 and 1978, three building groups, a total of five individual structures, were identified as having potential historical or architectural significance. These structures were evaluated by MacDonald and Mack Partnership in terms of the explicit criteria for National Register of Historic Places eligibility (MacDonald and Mack Partnership, 1982).

The investigations conducted by Beloit College, GLARC, Inc., and MacDonald and Mack Partnership were mandated by current state of Wisconsin legislation: Section 1.11, Wisconsin Statutes (The Wisconsin Environmental Policy Act), Section 23.11 (5), Wisconsin Statutes (Environmental Impact Report Submittal) and NR 150 of the Wisconsin Administrative Code. However, as several Federal agencies may have interest and authority regarding cultural resources, archaeological and historical studies were designed to comply with guidelines for implementing 36 CFR 800, Protection of Historic and Cultural Properties. This current federal regulation dated May 1979 and the draft revised section 106 regulations dated December 14, 1981 specify acceptable methods and techniques for identifying and evaluating archaeological and historic sites and structures. In turn, the guidelines for conducting

archaeological and historical studies jointly established by The Wisconsin Archaeological Survey, Inc., a state-wide professional organization, and the Historic Preservation Division, State Historical Society of Wisconsin are derived primarily from 36 CFR 800. As a result, all the aforementioned investigations were conceptualized and designed to meet the standards set forth by state organizations and are consistent with the mandates of the National Historic Preservation Act of 1966 (PL 89-665). The interim guidelines, 36 CFR 800.4, state:

> An intensive survey is designed to fully identify all historic properties within an area, and document them sufficiently to allow for determination of their eligibility for the National Register (National Advisory Council on Historic Preservation 1981: 22).

With regard to particular sites or properties these same interim guidelines note:

> A definition and evaluation study is directed at specific potentially eligible properties or at areas known or suspected to contain such properties; it includes such special studies as are necessary to apply the National Register Criteria, and where appropriate the Criteria of Effect and others, and/or to determine methods of treating the property (National Advisory Council on Historic Preservation 1981: 23).

The objectives of the Beloit College survey and the GLARC, Inc. survey were to identify and evaluate, in terms of the explicit criteria, any properties which might qualify for the National Register of Historic Places. The objectives of the MacDonald and Mack Partnership were more specific in scope and entailed architectural and historical evaluation of five structures in three distinct groups. Studies by Beloit College consisted of literature and archives investigation and on-site inspection while the GLARC, Inc. studies included literature and archives search, field inspection, and test excavations at two prehistoric archaeological sites. The MacDonald and Mack

Partnership study consisted of historical background research and on-site architectural investigations of the five structures. Figure 2.7-1 portrays the area of intensive archaeological survey conducted by Beloit College and GLARC, Inc., and provides locations of the building groups evaluated by MacDonald and Mack Partnership.

2.7.1 Field and Laboratory Methods

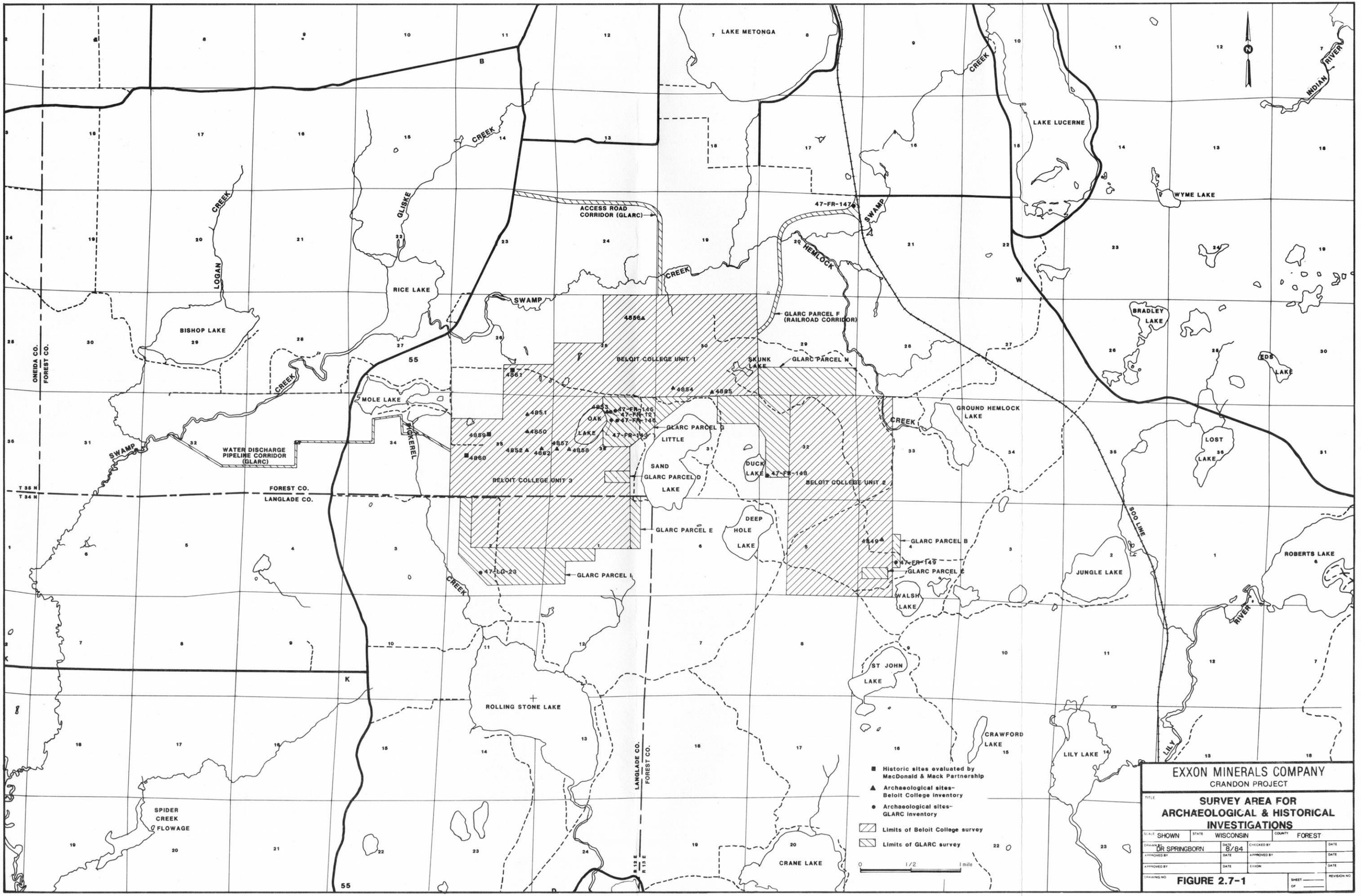
2.7.1.1 Literature Search

Prior to deployment of field crews to conduct on-site inspection, background information was compiled to allow assessment of the regional culture-history, environmental context of the project area, past and present land use patterns, and the known distribution of historic and prehistoric sites (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982; MacDonald and Mack, 1982; Overstreet, 1982, 1983). Traditional archaeological and historical literature, state site files, inventory files, unpublished manuscripts, and published contract reports were reviewed to provide a comprehensive tabulation of the extant data and to plot the locations of reported sites (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982; Overstreet, 1982, 1983). In addition to literature and archival sources, local informants were interviewed both to provide substantiation of library sources and to secure additional information (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982; MacDonald and Mack Partnership, 1982).

2.7.1.2 Archaeological Field Reconnaissance

Following the literature and archive investigations, an intensive field survey was conducted on 1,959.25 ha (4,838.6 acres). The proposed project area can be characterized as heavily forested (see section 2.9, Land Use and Aesthetics). As a result, field methods and techniques that allowed subsurface evaluation were required. In this instance, tight interval shovel testing along predetermined transects was the most effective method. This method entails the excavation of small pits at either 5-, 10-, or 15-m (16.4-, 32.8-, or 49.2-foot) intervals dependent upon topography, soil conditions, or the presence of an archaeological site (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982; Overstreet, 1982, 1983). In the few areas where soil surfaces were exposed, pedestrian survey or surface collection was used; however, the primary site location technique employed was systematic shovel testing. Shovel tests conducted by Beloit College were hand-troweled and any artifacts recovered were labeled and bagged (Salzer and Birmingham, 1978), whereas GLARC, Inc. shovel tests were passed through 6.35-mm (0.25-inch) mesh screen and then labeled and bagged. These methods of site location and techniques of artifact retrieval can be considered comparable for intensive archaeological surveys.

In addition to shovel probing, visual inspection was conducted over the surface of the entire project area noted on Figure 2.7-1. The purpose of this visual inspection was to secure evidence of any surficial manifestation of past occupation or utilization, for example, burial mounds, cabin foundations, or man-made pits or depressions. (For example see: Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982). Visual inspection was the



EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
SURVEY AREA FOR ARCHAEOLOGICAL & HISTORICAL INVESTIGATIONS

SCALE: SHOWN	STATE: WISCONSIN		COUNTY: FOREST		
DRAWN BY: DR SPRINGBORN	DATE: 8/84	CHECKED BY:	DATE		
APPROVED BY	DATE	APPROVED BY	DATE		
APPROVED BY	DATE	EXXON	DATE		
DRAWING NO.	**FIGURE 2.7-1**	SHEET ___ OF ___	REVISION NO.		

only technique used in low wet areas or where soil conditions or vegetation cover prohibited shovel testing.

Laboratory Methods and Techniques - Information, artifacts, and other data retrieved in the field require processing and analyses in the laboratory prior to final interpretations and conclusions (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982). A basic concern is the appropriate organization of notes, records, and artifacts. All artifacts were cleaned, assigned site numbers, and catalogued. Currently all data from these investigations are housed at the Logan Museum of Anthropology, Beloit College for permanent curation.

Soil samples were extracted in the field and returned to the laboratory for flotation (water screening and separation) to recover carbonized organic remains (Overstreet and Brazeau, 1982). Carbonized plant remains were identified with the aid of a binocular microscope and a comparative floral collection by Ms. Judith Smith (Overstreet and Brazeau, 1982).

Additional analyses were conducted on the lithic and ceramic assemblages (Overstreet and Brazeau, 1982). These analyses were directed to discovery of the processes of manufacturing and utilizing stone tools at prehistoric sites and the construction and design of clay pottery vessels.

Archaeological Test Excavations - Test excavations were conducted by both Beloit College and GLARC, Inc. for purposes of evaluating archaeological sites (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982). Formal test excavation units were dug in arbitrary 10-cm (3.93-inch) levels unless cultural stratigraphy was encountered. In this case excavation followed

cultural rather than arbitrary levels. Prior to excavation with shovels and hand tools, horizontal controls were established by developing a metric grid. Maps of profiles and plan views were drawn and photographic records were made of each excavation unit. Soil samples and charcoal samples were collected from various provenience units and returned to the laboratory for further processing and analysis.

2.7.1.3 Historical Field Reconnaissance

Remains of structures encountered by GLARC, Inc. crews in the field were subjected to preliminary evaluation. This evaluation consisted of making a hand-transit map in the field and selective surface collection of diagnostic artifacts used both to determine function of the structure and to assist in securing a date of occupation. Local tax rolls and land deed records were investigated to determine dates of occupation and ownership (Overstreet and Brazeau, 1982). No standing structures were encountered by GLARC, Inc. field crews; however, structural remains and associated trash heaps and other features were evaluated in terms of potential as archaeological sites.

The five structures clustered in three groups noted by Beloit College (Salzer and Birmingham, 1978) were evaluated by MacDonald and Mack Partnership. Field procedures consisted of photographic records, functional/ structural description, historical documentation, and preparation of floor plans (MacDonald and Mack Partnership, 1982). In addition, architectural features such as style, orientation, roof, wall, floor, door, and window forms were identified during the on-site inspections. Each structure, once architectural and historical data had been tabulated, was evaluated in accord with the National Register of Historic Places criteria (MacDonald and Mack Partnership, 1982).

2.7.1.4 Quality Control

Several quality control measures were employed by Beloit College and GLARC, Inc. during the archaeological survey. While some differences exist between the measures utilized by the respective institutions, they can be categorized as variations on a common theme. For example, to assure adequate survey coverage, Beloit College personnel subdivided their survey area into manageable sub-units. GLARC, Inc. also applied a sub-unit concept. Both survey crews took special consideration to maintain intervals between and within transects and both organizations labeled and bagged artifacts in the field to ensure that specific provenience (locational data) was maintained. Photographic records of individual survey units were kept for future reference, and any variations in standard methodology were fully detailed in submitted reports.

Shovel test intervals were decreased whenever cultural materials (artifacts) were encountered in the field (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982). Finally, site maps were drawn in the field with the aid of a Brunton hand transit and either Wisconsin Codification Site file numbers or Logan Museum of Anthropology site numbers were assigned to a specific site, and all artifacts recovered were properly cleaned and catalogued (number applied to artifacts) to enhance future data retrieval. This latter control measure is of critical importance because without proper provenience the artifacts have little scientific utility. Selection of a single repository for permanent curation of artifacts and records, again, enhances the value for both scientific purposes and public access.

Historic structure evaluation conducted by MacDonald and Mack Partnership relied upon several methods to assure control of the quality of recovered data. Photographic records were made from various angles of each of the structures and this allows for a comprehensive appraisal in their report. In addition, a comprehensive survey form was completed for each individual structure. These forms include such data as legal description, date surveyed and surveyor, film reference, plan/dimensions of each structure, and descriptions of specific architectural features (MacDonald and Mack Partnership, 1982).

Reviews by qualified archaeologists, historians, and architectural historians of the Historic Preservation Division, State Historical Society of Wisconsin of the four consultants' reports were positive. These positive reviews by qualified agency personnel serve to underscore the high quality of the archaeological and historical investigations.

2.7.2 Results of Literature Search

Fifty-four archaeological and historical sites were identified in the vicinity of the project region. Both the Beloit College and the GLARC, Inc. literature and archive searches focused on a more expansive area than the specific project boundaries (Salzer and Birmingham, 1978; Overstreet and Brazeau, 1982). By concentrating on an area larger than the zone enclosed within the project boundaries, additional information regarding the regional culture history was compiled. This more comprehensive literature and records review provided a stronger basis for understanding site distributions and variations within the project zone and investigators could more effectively assess areas of high and low archaeological potential. Table 2.7-1 summarizes

TABLE 2.7-1

PREHISTORIC AND HISTORIC ABORIGINAL SITES
IN THE CRANDON PROJECT REGION

SOURCE	FILE NUMBER	LOCATION	DESCRIPTION
Forest County			
C.E. Brown Atlas	47 Fr 1 (?)	T35N,R13E,Sec.11	Mounds
C.E. Brown Atlas		T35N,R13E,Sec.11	Garden Beds
C.E. Brown Atlas		T34N,R13E,Sec.11	Campsite
C.E. Brown Atlas		T35N,R13E,Sec.22	Campsite
C.E. Brown Atlas		T34N,R13E,Sec.28	Enclosure
S.H.S.W.*	47 Fr 1	T35N,R13E,Sec.11	Garden Beds
S.H.S.W.	47 Fr 4	T35N,R13E,Sec.14	Boulder mortar
C.E. Brown ms.	47 Fr 5	T35N,R13E,On shared line, Sections 14&15	Chippewa Village
C.E. Brown Atlas	47 Fr 6	T35N,R13E, Sec.22	Chippewa Village
S.H.S.W.	47 Fr 8	T35N,R13E,Sec.2	Potawatomi cemetery
S.H.S.W.	47 Fr 9	T36N,R12E,Sec.17	Village dance ground
S.H.S.W.	47 Fr 116	T35N,R12E,Sec.34	Habitation
S.H.S.W.	47 Fr 117	T35N,R12E,Sec.27	Habitation, cemetery
S.H.S.W.	47 FR 118	T35N,R13E,Sec.6	Mounds
S.H.S.W.	47 Fr 119	T35N,R12E,Sec.26	Habitation, cemetery
S.H.S.W.	47 Fr 120	T34N,R13E,Sec.20	Habitation
GLARC, Inc.	47 Fr 121	T35N,R12E,Sec.36	Habitation
Langlade County			
S.H.S.W.	47 Lg 2	T34N,R11E,Sec.11	Cemetery
S.H.S.W.	47 Lg 5	T34N,R12E,Sec.34	Mound
S.H.S.W.	47 Lg 7	T34N,R12E,Sec.2	Campsite
S.H.S.W.	47 Lg 18	T34N,R12E,Sec.14	Mounds
S.H.S.W.	47 Lg 20	T34N,R12E,Sec.12	Habitation
S.H.S.W.	47 Lg 21	T34N,R12E,Sec.25	Habitation, cemetery
S.H.S.W.	47 Lg 22	T34N,R12E,Sec.13	Mounds

*State Historical Society of Wisconsin.

the prehistoric and historic period aboriginal sites while Table 2.7-2 summarizes Euro-American sites. The literature and archives search indicates sporadic use of the project region throughout the 9,000-year prehistoric continuum. As well, several historic occupations related to the fur trade era, logging industry, and pioneer settlement were noted.

2.7.3 Archaeological Resources

During the 1977-1978 intensive survey conducted by Beloit College, artifacts or features were encountered at 14 locations. Three sites were recorded in Unit 1, one in Unit 2, and ten in Unit 3 (Salzer and Birmingham, 1978). Table 2.7-3 describes and summarizes archaeological resources discovered during the Beloit College intensive archaeological survey.

None of the 13 sites or locations reported by Salzer and Birmingham (1978) were determined eligible for the National Register of Historic Places. The structures noted during their survey have since been evaluated by a qualified architectural historian and are summarized in a subsequent discussion.

In eight survey units investigated by GLARC, Inc. 12 artifact locations and features were encountered. Of these, two were further investigated for purposes of evaluating their potential for National Register of Historic Places significance. Archaeological resources discovered during the intensive inventory are described in Table 2.7-4. Two sites, 47 Fr 121 (Beloit College's number 4853) and 47 Fr 143, were evaluated through controlled test excavations and laboratory analyses of materials recovered during the test excavations (Figure 2.7-1).

TABLE 2.7-2

EURO-AMERICAN SITES
IN THE CRANDON PROJECT REGION

SOURCE	FILE NUMBER	LOCATION	DESCRIPTION
Forest County			
GLARC, Inc.	R of I #88	T34N,R14E,Sec.3	Logging camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.1	Logging camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.4	Rail camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.9	Logging camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.10	Logging camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.20	Logging camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.6	Cemetery
GLARC, Inc.	R of I #88	T34N,R14E,Sec.17	Logging camp
GLARC, Inc.	R of I #88	T34N,R14E,Sec.29	Logging camp
Salzer & Birmingham (1978)		T35N,R11E,Sec.24	Logging camp
Salzer & Birmingham (1978)		T35N,R12E,Sec.25	Logging sleigh
C.E. Brown Atlas		T35N,R12E,Sec.27	Trading post
Salzer & Birmingham (1978)		T35N,R12E,Sec.35	Popple peeling
Salzer & Birmingham (1978)		T35N,R12E,Sec.35	Clearing
Salzer & Birmingham (1978)		T35N,R12E,Sec.26	Log Building
Salzer & Birmingham (1978)		T35N,R13E,Sec.(?)	Trading post
Salzer & Birmingham (1978)		T35N,R13E,Sec.17	Trading post
GLARC, Inc.	R of I #88	T35N,R14E,Sec.13	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.3	Logging camps
GLARC, Inc.	R of I #88	T35N,R14E,Sec.26	RR grade
GLARC, Inc.	R of I #88	T35N,R14E,Sec.29	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.32	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.35	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.36	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.36	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.4	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.7	Fish dam
GLARC, Inc.	R of I #88	T35N,R14E,Sec.17	Logging camp
GLARC, Inc.	R of I #88	T35N,R14E,Sec.36	Logging camp
S.H.S.W.*	47 Fr 113	T35N,R13E,Sec.24	C.C.C. camp

*State Historical Society of Wisconsin.

TABLE 2.7-3

ARCHAEOLOGICAL HISTORICAL SITES DISCOVERED
DURING BELOIT COLLEGE INTENSIVE SURVEY
(SALZER AND BIRMINGHAM, 1978)

SITE NUMBER	ARTIFACTS/FEATURES	EVALUATION METHODS	DETERMINATION/ RECOMMENDATIONS
Unit 1:			
4855	2 quartz flakes	Close interval shovel testing and test excavation yielded no additional artifacts	Site determined insignificant
4854	Buckets, paint cans, and tin cans indicated a post-1922 sugar maple	Cans were piece plotted, site was mapped, and artifacts were bagged and labeled	Site determined important, but mitigation completed through removal of artifacts
4856	Remains of a late 19th-early 20th century logging sleigh	Inspection revealed no associated features or structures, logging sleigh remains were collected and labeled	No further work recommended, mitigation completed with removal of logging sleigh
Unit 2:			
4849	1 quartz flake, 1 quartz cobble	Close interval shovel testing and test excavations revealed no additional artifacts	Site determined insignificant
Unit 3:			
4850	Clearing, tin plate, stove parts, tin cans, buckets, other modern debris	Shovel testing and informant interviews	Recent popple peeling camp, site preserved by avoidance
4851	Modern debris (refer to 4850)	Shovel testing and informant interviews	Recent popple peeling camp, site preserved by avoidance

TABLE 2.7-3 (continued)

SITE NUMBER	ARTIFACTS/FEATURES	EVALUATION METHODS	DETERMINATION/ RECOMMENDATIONS
4851	4 #10 cans	Shovel testing and surface collection	Recent berry picking or maple sugar camp. No further recommendations
4853	1 quartz fragment, clay pipe stem, possible hearth, window glass, stove	Surface collection	Site not in Beloit project area, should be evaluated if threatened by development
4857	Chert-like flakes and shatter	Shovel testing and test excavations	Insignificant, not of human origin
4858	Chert-like flakes and shatter	Shovel testing and test excavations	Insignificant, not of human origin
4859	Structures	Photographed	Should be evaluated by qualified architectural historian
4860	Structures	Photographed	Should be evaluated by qualified architectural historian
4861	Shack	Photographed	Should be evaluated by qualified architectural historian
4862	3 piece mold gin bottle (late 18th century)		Isolated find, no further recommendations

TABLE 2.7-4

ARCHAEOLOGICAL HISTORICAL SITES DISCOVERED
DURING GLARC, INC. INTENSIVE SURVEY

SITE NUMBER	ARTIFACTS/FEATURES	EVALUATION METHODS	DETERMINATION/ RECOMMENDATIONS
Parcel B:			
47Fr149	Various metal containers, metal cable	Shovel testing, surface collection, archive review, informant interview	20th century logging camp dump, no further work recommended
Parcel F:			
not assigned	Clearing related to settlement of Keith siding	Shovel testing, surface collection, archive search, informant interview	Results negative, no further work recommended
not assigned	Unfinished contemporary log structure	Photographic record, interviews	Determined insignificant, no further work recommended
Parcel G:			
47Fr121	Quartz flakes, fire-cracked rock	Close interval shovel testing, surface collection	Prehistoric site, test excavations recommended
47Fr143	Quartz flakes, pottery	Close interval shovel testing	Prehistoric site, test excavations recommended
47Fr145	Structural remains, midden	Surface collection, mapping archive review	Mitigation served by preservation in place
47Fr146	Structural remains, midden	Surface collection, mapping, archive review	Mitigation served by preservation in place

TABLE 2.7-4 (continued)

SITE NUMBER	ARTIFACTS/FEATURES	EVALUATION METHODS	DETERMINATION/ RECOMMENDATIONS
Parcel H:			
47Fr148	Cans, crockery, patent medicine bottle	Shovel testing, surface collection, photographic records, identification of artifacts, archive review	Logging company rail camp, mitigation served by preservation in place
Parcel I:			
47Lg23	Structural remains, midden	Shovel testing, surface collection, photographic records, identification of artifacts, archive review	Logging camp, mitigation served by preservation in place
Outside Project Area:			
47Fr144	Structural remains and midden	Surface collection, mapping, archive review	Preserved in place, outside project area
47Fr150	Structural remains and midden	Shovel testing, surface collection, archive review	Insignificant, previously disturbed
47Fr151	Structural remains and midden	Surface collection, archive review	1920's era logging camp, preserved in place, outside project area

At 47 Fr 121 two excavation units were established. The first of these produced more than sufficient data for evaluation so the second unit was not excavated. The excavations were conducted in arbitrary 10-cm (3.93-inch) levels. All earth was passed through hardware cloth. Photographic records, plan views and profiles were made for each excavation, and soil samples were extracted and returned to the laboratory for processing. The test excavations yielded significant numbers of readily identifiable or diagnostic projectile points and remains of ceramic vessels. Analyses and interpretation of these artifacts allowed for the determination that 47 Fr 121 and its features are Lakes Phase (Late Woodland) archaeological contexts that can be dated to about 1200 A.D. This prehistoric site is significant in the project area as well as the regional context and harbors undisturbed deposits.

The second prehistoric site recommended for controlled test excavations as a means of evaluating the site in terms of National Register criteria was 47 Fr 143. At 47 Fr 143 two units, one 2 m^2 (43.0 square feet) and the other a 1-m (3.28-foot) by 8-m (26-foot) trench, were excavated in 10-cm (3.93-inch) levels. A detail map was also made with a transit to provide precise locations and dimensions of 43 pits or depressions, interpreted as prehistoric wild rice processing pits. Finally, maps of profiles and plan views were constructed, photographic records maintained and and radiocarbon assay samples were collected for laboratory processing.

Many stone tools and associated waste products were recorded and recovered from 47 Fr 143. In addition, diagnostic ceramics were also found. The site is considered highly significant as it represents the only known Lakes Phase (Late Woodland) rice processing station in Wisconsin. It is likely that the site would qualify for the National Register of Historic Places.

More than 700 stone, ceramic, and bone artifacts were returned to the GLARC, Inc. laboratory for cleaning, recording, and analyses. Soil samples were processed and ethnobotanical samples were forwarded to a specialist for identification. Identification of these remains failed to specifically identify wild rice grains from the features; however, the flotation inventory resulted in the identification of charred nuts, seeds, and various species of plants. The identification fostered reconstruction of the tree cover and food resources during the prehistoric occupation. Further, the fact that carbonized plant remains can be expected in the archaeological contexts at the site serves to underscore the scientific and interpretive potential of 47 Fr 143.

Wood charcoal samples from two separate prehistoric pits at the site were submitted to the University of Wisconsin-Madison, Center for Climatic Research. Radiocarbon assay resulted in the determination of two closely bracketed dates for the prehistoric occupation at 47 FR 143. The first of these dates was: 750 $\pm$ 70 radiocarbon years; A.D. 1200 (WIS-1339). The second date was: 830 $\pm$ 70 radiocarbon years; A.D. 1120 (WIS-1340). Both dates are within the anticipated range of occupation for a Late Woodland Lakes Phase cultural component.

Both 47 Fr 121 and 47 Fr 143 are unique within the project area, contain significant areas of undisturbed prehistoric deposits, and probably qualify for The National Register of Historic Places. Management practices on the project site currently serve to provide additional protection for the sites as gates prohibit unauthorized access.

2.7.4 Historical Resources

Three sites noted in the Beloit College inventory had standing structures. Recommendations for the evaluation of these structures were made by Birmingham and Salzer (1978). This evaluation was conducted by MacDonald and Mack Partnership in December 1981 (MacDonald and Mack Partnership, 1982). Field survey and historical research were conducted and each structure was evaluated in terms of the eligibility criteria of the National Register of Historic Places. Preliminary evaluations were reviewed with Mr. Richard Dexter of the Historical Preservation Division of the State Historical Society of Wisconsin. The results of the evaluation of each structure are summarized in Table 2.7-5. None of the structures were found to be significant from an architectural or historical perspective.

2.7.5 Summary and Conclusions

During the years 1977-1983, investigations were conducted to inventory archaeological and historical resources in the proposed Crandon Project area. The following summary presents the conclusions of these investigations.

1. Beloit College inventoried 1,521.6 ha (3,760 acres) and identified artifacts or features at 14 locations. Eleven of the locations were identified as archaeological sites based on the occurrence of stone tool manufacturing debris, an abandoned logging sleigh of late 19th century origin, and late historic period artifacts such as bottles or cans. None of the 11 sites are considered eligible for the National Register of Historic Places. Three locations were identified as potentially significant building clusters and it was recommended that the standing structures be evaluated by a qualified architectural historian.

2. GLARC, Inc. conducted an intensive inventory of 437.65 ha (1,078.6 acres) resulting in the identification of 12 artifact locations or features. Four historic sites, all of 20th century origin, were determined ineligible for the National

TABLE 2.7-5

EVALUATION OF STANDING STRUCTURES
(MACDONALD AND MACK PARTNERSHIP, 1982)

BUILDING GROUP AND STRUCTURE	DESCRIPTION/STYLE	CONCLUSIONS
4859	Abandoned one story gable roofed house. Utilitarian, date of construction 1964.	Insignificant, lacking in architectural or historical merit.
4859-Tool Barn	Abandoned one story gable roofed barn. Utilitarian, date of construction circa 1920's.	Insignificant, lacking in architectural or historical merit.
4860-Residence	Abandoned low one story gable roofed house. Crudely constructed utilitarian. Date of construction of log house circa 1920's.	Insignificant, lacking in architectural or historical merit.
4861-Shack	Abandoned one story gable roofed shack. Strictly utilitarian. Date of construction post-1930.	Insignificant, lacking in architectural or historical merit.

Register of Historic Places. Two prehistoric sites were evaluated and considered eligible for the National Register of Historic Places. Six remaining sites, all related to late 19th and early 20th century logging activities, were subjected to preliminary evaluation and may be eligible for the National Register of Historic Places. All of the archaeological sites determined to be significant or potentially significant will be preserved in place.

3. MacDonald and Mack Partnership conducted an evaluation of the architectural and historical significance of the three building clusters identified during investigations by Beloit College. In all locations the standing structures were determined to be lacking in any historical or architectural significance.

4. Personnel of the Historical Preservation Division conducted review of the five consultants' studies: Birmingham and Salzer (1978), MacDonald and Mack Partnership (1982), Overstreet and Brazeau (1982), and Overstreet (1982, 1983). In all cases the reviews were positive, based on the criteria set forth in 36 CFR 800, and agreed with the consultants' conclusions: the investigations regarding cultural resources have been sufficiently thorough to meet both the letter and intent of legislative mandates.

2.7.6 References

MacDonald and Mack Partnership, 1982, Evaluation of Buildings in the Crandon Project Area, Forest County, Wisconsin. Report prepared for Exxon Minerals Company.

National Advisory Council on Historic Preservation, 1981, Draft Revised Regulations for The Protection of Historic Properties, dated December 14, 1981. National Advisory Council on Historic Preservation. Washington, D.C.

Overstreet, D.F., 1982, Archaeological Inventory and Evaluation at Exxon Minerals Company, Crandon Project Site in Forest and Langlade Counties, Wisconsin. Great Lakes Archaeological Research Center, Inc. Reports of Investigations No. 107. Addendum - May 1982.

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Overstreet, D.F. and Brazeau, L.A., 1982, Archaeological Inventory and Evaluation at Exxon Minerals Company, Crandon Project Site in Forest and Langlade Counties, Wisconsin. Great Lakes Archaeological Research Center, Inc. Reports of Investigations No. 107. Waukesha, WI.

Salzer, R.J. and Birmingham, R.A., 1978, Archaeological Research in the Potential Exxon Minerals Company, USA, Mining Area of Forest and Langlade Counties, Wisconsin. Report prepared for Exxon Minerals Company.

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2.8 NOISE

The range of sound pressure that can be heard by humans is very large, varying from sounds that are barely audible to sounds that are so loud as to be painful. The decibel (dB) notation system uses logarithms to compress this wide range of sound pressures to convenient quantities called sound pressure levels (Beranek, 1971).

$$\text{Sound pressure levels (dB)} = 20 \log_{10} \frac{P}{P_o}$$

where:

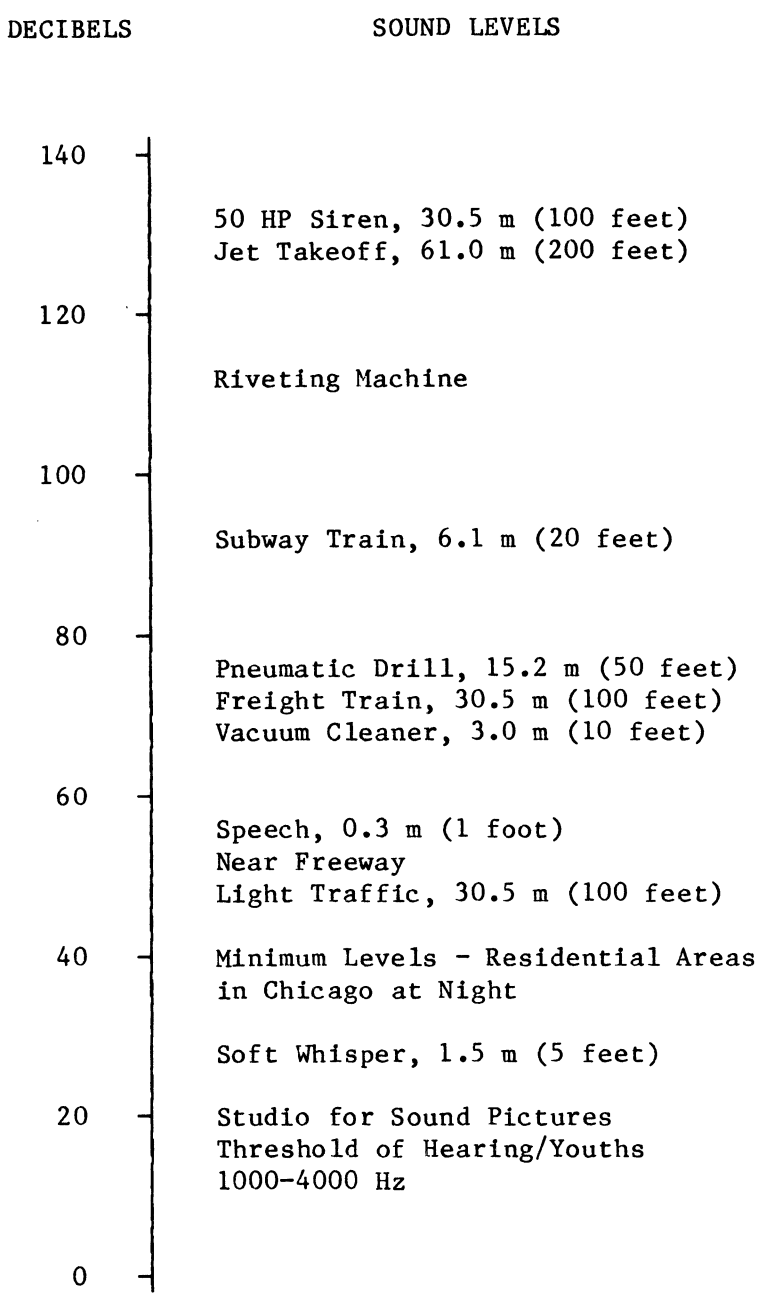
P_o = sound pressure required for a threshold sensation of hearing; equal to 20 μPa (microPascals, where 1 microPascal = 10^{-6} newton per square meter) or 0.0002 μ Atmosphere; and

P = the measured sound pressure in Pascals or Atmospheres.

On the decibel scale, 0 dB is assigned to P_o. Approximately 125 dB is the sound level at the threshold of pain (U.S. Department of Labor, 1980).

The human ear does not perceive sounds at low frequencies in the same manner as those at higher frequencies. Sounds of equal pressure level at low frequency do not seem as loud as those at higher frequencies. To simulate the human ear in evaluations of hearing damage risk or community annoyance impacts (Peterson and Gross, 1967), sound analysis systems incorporate an A-weighting network (American National Standards Institute, 1971a). A-weighted sound levels are expressed in decibels (dB) and are used in federal, state, and local noise (unwanted sound) ordinances. Typical A-weighted sound levels at a given distance from a sound source and in the environment are shown in the following chart (adapted from Peterson and Gross, 1967).

TYPICAL A-WEIGHTED SOUND LEVELS



Because sound is not constant with time, statistical analysis is used to describe the temporal distribution of a sound and to compute single-number descriptors for that sound. The following statistical, A-weighted sound levels (National Academy of Science, 1977; Bureau of National Affairs, 1978) are used in this report.

L_{90} - The sound level exceeded 90 percent of the time during the measurement period, often called the residual sound level.

L_{50} - The sound level exceeded 50 percent of the time during the measurement period; the median sound level.

L_{10} - The sound level exceeded 10 percent of the time during the measurement period, often called the intrusive sound level.

L_{eq} - The equivalent steady sound level that provides an equal amount of acoustic energy* as the time-varying sound.

L_d - Day sound level, Leq for the daytime period (0700-2200) only.

L_n - Night sound level, Leq for the nighttime period (2200-0700) only.

L_{dn} - Day-night sound level, defined as (U.S. EPA, 1974):

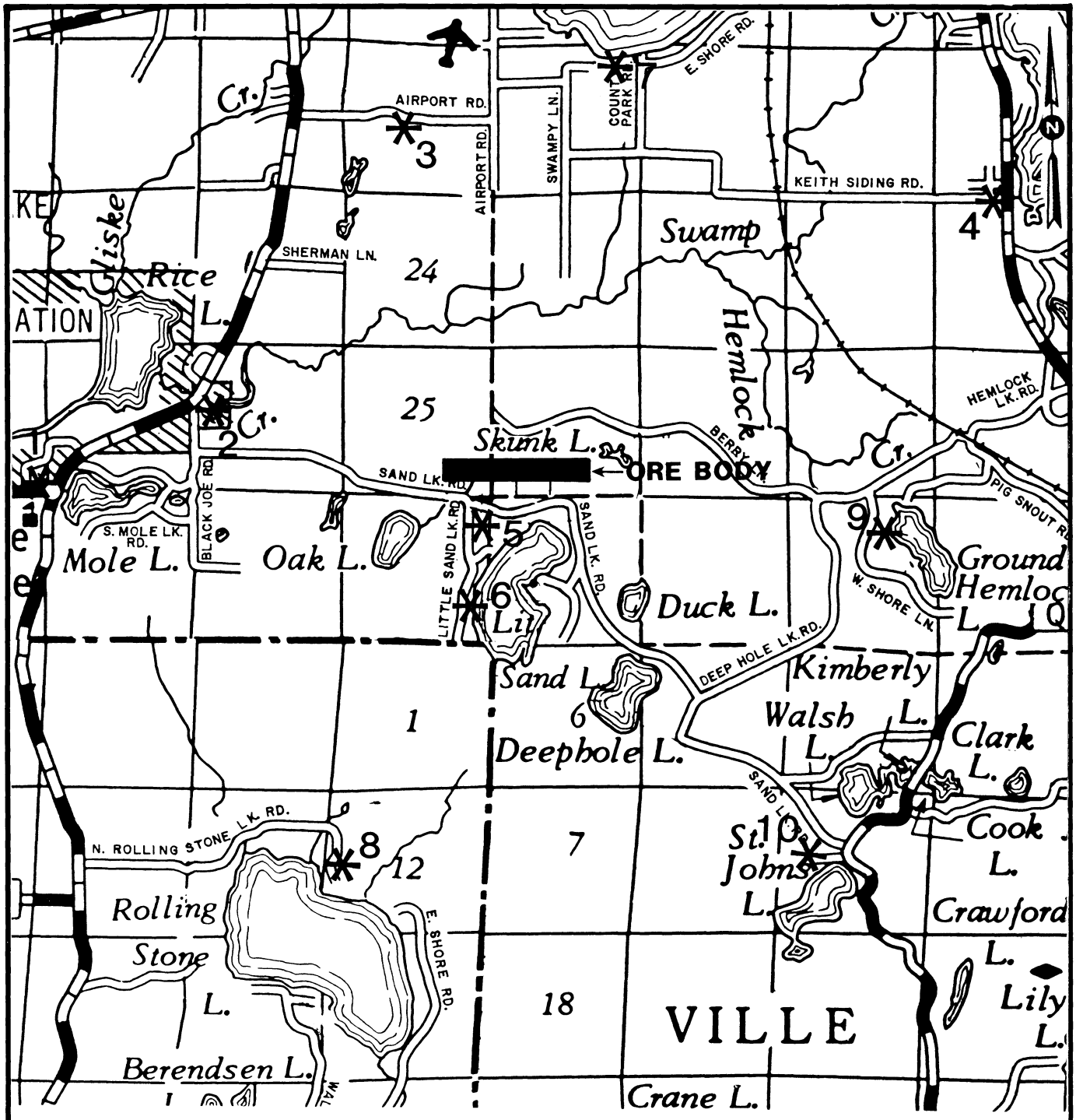
$$L_{dn} = 10 \log_{10} \frac{(15 \times 10^{(L_d/10)}) + (9 \times 10^{(L_n+10)/10})}{24}$$

Note: The EPA adds this 10 dB correction factor to the night sound level as a weighting to compensate for the greater annoyance of nighttime noise (U.S. EPA, 1974).

2.8.1 Field and Laboratory Methods

Background sound level data were obtained during the winter and summer and at three representative times of the day. During the periods of March 5 and 6 and July 16 and 17, 1977, background sound level data were collected at Locations 1 through 6 (Figure 2.8-1). An additional four sites (Locations 7 through 10) were monitored during the periods of March 29 through 31 and July 11 through 13, 1983. The 1977 measurements were made on weekends to exclude sounds uncharacteristic of the area such as site exploratory drilling. Similar site activities were not present during the additional monitoring conducted in 1983.

*Acoustic energy can be defined as follows: "Acoustic" means of or relating to sound; therefore, the sound energy of the given part of a medium is the total energy in this part of the medium minus the energy which would exist in the same part of the medium with no sound waves present (American National Standards Institute, 1971b).



KEY:

✱ NOISE SURVEY LOCATION

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, 1978.

EXXON MINERALS COMPANY
CRANDON PROJECT

1977 AND 1983 NOISE SURVEY LOCATIONS

FIGURE 2.8-1

Methods used for data acquisition and analyses are presented in the following subsections: Survey Locations, Measurement Program, Analytical Procedures, and Quality Control.

2.8.1.1 Survey Locations

To describe the background sound level within the environmental study area, sound measurements were obtained at the following ten locations, as presented on Figure 2.8-1:

Location 1 - Playground at the Mole Lake School yard near County Road M and State Highway 55;

Location 2 - In parking lot of the former Community Center at the Indian Subdivision near State Highway 55 and Sand Lake Road;

Location 3 - At the Mihalko residence on Airport Road;

Location 4 - In the driveway of residence No. 3712 on County Road W and Keith Siding Road;

Location 5 - Exxon Field Office on Sand Lake Road, across from the potential mining site;

Location 6 - Across from the C. F. Webb residence on Little Sand Lake Road;

Location 7 - South shore of Lake Metonga in parking lot of Forest County Veterans Memorial Park;

Location 8 - North shore of Rolling Stone Lake on the Simonson property;

Location 9 - Northwest shore of Ground Hemlock Lake on the Solper property; and

Location 10 - North of St. John's Lake on Sand Lake Road.

The above locations were monitored to represent the sound climate at selected noise-sensitive land use areas within the environmental study area.

Such land uses included homes and recreational areas that may be negatively affected by noise. Sleep interference, loss of tranquility, and hearing damage are examples of negative effects. No measurements were made in "wilderness" or undeveloped areas, since background noise levels in these areas would be similar to those near isolated residences.

2.8.1.2 Measurement Program

Background sound measurements were obtained during both winter and summer conditions (foliage attenuates sound propagation during summer months, and local activities tend to differ from winter to summer.). Measurements were made with a magnetic tape recorder data acquisition system consisting of a GenRad one-inch electret condenser microphone with windscreen, a GenRad Type 1933 Sound Level Meter, and a Nagra 4.2L single trace magnetic tape recorder. At each location, the microphone was located 1.2 to 1.5 m (4 to 5 feet) above the ground, at least 3.7 m (12 feet) from any large reflecting plane, and approximately 30 m (100 feet) from the observation station. During the data recording period, meteorological parameters that could affect the ambient sound were recorded on a data sheet, including wet and dry bulb temperatures (determined by a Bacharach hygrometer), barometric pressure, wind speed and direction (determined by a Sims BX anemometer). Humidity exceeding 95 percent reduces microphone output. High wind (>19.3 km/hour [>12 miles/hour]) generates self-noise in the microphone. Had these conditions been noted during a survey, the survey would have been postponed (see Appendices 2.8A, Table A-37 and 2.8B, Table B-48).

Also identified on the data sheet were all contributing sound sources, such as wind gusts and human and other animal activity. Sound level

meter readings were collected with a GenRad Type 1933 sound level meter, which records from 10 to 130 dB, for later confirmation of the recorded data.

Instrument calibration to a prerecorded tone of known sound pressure was undertaken in the field prior to each measurement. Background sound levels were recorded for continuous periods of 16 to 21 minutes, a time period considered sufficient to describe the character of the background sound (Safeer et al., 1972).

Sound level recordings for both winter and summer survey measurements were made during daytime (0700-1800), evening (1800-2200), and nighttime (2200-0700) periods. These periods are in accordance with the daytime (daytime and evening) and nighttime periods used by the U.S. EPA in its definition of day-night sound levels (U.S. EPA, 1974).

2.8.1.3 Analytical Procedures

The data recorded on magnetic tape were returned to the acoustic laboratory at Dames & Moore for statistical analysis by a computer-controlled data analysis system consisting of a GenRad Real Time Analyzer and a Digital Equipment Corporation minicomputer.

Analog data from the tape recorder were sampled after prefiltering by the A-weighting network; the sampled data were converted to digital binary form, and the binary numbers were used in the minicomputer to compute mean square level. Each sample was used to construct an A-weighted sound level histogram, indicating the number of times a particular sound occurred during the measurement period, and a cumulative distribution of the A-weighted sound levels, indicating the percentage of time a sound level was exceeded during the measurement period.

2.8.1.4 Quality Control

Quality control procedures were used by field and laboratory personnel during the background sound level study as a means of assuring that the study was completed according to currently accepted standards and methods.

Field Procedures - At each measurement location for each measurement period, a log of important information was maintained. The sound level meter setting, the weighting network, and the instrument response ("fast" or "slow") were noted. Noise sources observed by the operator were recorded, as were the times when overloads or intrusive (short duration, high pressure level) noises occurred. As discussed in subsection 2.8.1.2, meteorological parameters that might affect sound measurement were also noted, and measurements were made only when those parameters were within specified operating ranges for the instrumentation used.

The sound level recording system was calibrated before the acquisition of data using a GenRad 1562-A sound level calibrator. A 114-dB, 1000-Hz tone was recorded on magnetic tape at the start of each measurement period.

Data Analyses - The tape recorded data were analyzed using a Digital Equipment Corporation PDP 8/a digital computer controlling a GenRad real time analyzer, whose input was from a Nagra 4.2L tape recorder. The calibration tone recorded on magnetic tape in the field was used to calibrate the data analysis system. Once calibrated, the computer controls the analysis and prints the results without operator interface, thus maintaining a high quality of analysis.

2.8.2 Background Sound Levels

Background sound level data collected at the ten monitoring locations are presented in Table 2.8-1. This table contains the statistical A-weighted sound levels, L_{90}, L_{50}, L_{10}, and L_{eq}, for each measurement period and L_d, L_n, and L_{dn} for each of the measurement locations.

Appendices 2.8A, Tables A-1 through A-36, and 2.8B, Tables B-1 through B-47 contain (1) A-weighted sound level histograms, indicating the number of times a particular sound level occurred during the measurement period, and (2) the cumulative distributions of the A-weighted sound levels, indicating the percentage of time a sound level was exceeded. Also included are the L_{99},* L_{90}, L_{50}, L_{10}, L_1,* and L_{eq} of the sound pressure levels at octave band center frequencies. The octave band data on the appendix tables are unweighted.

The background sound level data obtained in 1977 sampling periods are representative of the acoustical environment during the period sampled. The A-weighted sound level values for the following five sampling periods were influenced by a small number of short duration, high sound pressure level events:

1) Location 6, 1617 Hours, March 5, 1977;

2) Location 4, 1900 Hours, March 5, 1977;

3) Location 5, 2350 Hours, March 5, 1977;

4) Location 3, 1905 Hours, July 16, 1977; and

5) Location 5, 2130 Hours, July 16, 1977.

The probability of such events occurring during the sampling periods was not under the control of the observers acquiring the data as the sampling periods were selected on a random basis. However, the data recorded during the above

*L_{95} and L_5 for 1977 data.

TABLE 2.8-1

SUMMARY OF A-WEIGHTED BACKGROUND SOUND LEVELS[a], dB

LOCATION	WINTER DAYTIME[b] (DATE-TIME)	WINTER EVENING[b] (DATE-TIME)	WINTER NIGHTTIME[b] (DATE-TIME)	SUMMER DAYTIME[b] (DATE-TIME)	SUMMER EVENING[b] (DATE-TIME)	SUMMER NIGHTTIME[b] (DATE-TIME)
1 - Mole Lake School	3/05/77 1155	3/05/77 2030	3/06/77 0025	7/16/77 1015	7/16/77 2015	7/17/77 0050
L_{90}	38	26	24	43	29	24
L_{50}	40	29	26	46	33	27
L_{10}	43	31	31	49	43	40
L_{eq}	44.1	30.9	29.8	47.2	44.6	42.7
L_d		42.8			46.6	
L_n		29.8			42.7	
L_{dn}		41.9			49.9	
2 - Community Center	3/05/77 1230	3/05/77 2000	3/06/77 0055	7/16/77 0930	7/16/77 1930	7/16/77 2345
L_{90}	33	23	26	36	27	26
L_{50}	35	28	27	39	32	32
L_{10}	41	37	31	46	42	45
L_{eq}	37.9	38.1	28.5	43.0	38.0	39.7
L_d		37.9			42.1	
L_n		28.5			39.7	
L_{dn}		38.1			46.5	
3 - Mihalko Residence	3/05/77 1312	3/05/77 1930	3/05/77 2250	7/16 77 1525	7/16/77 1905	7/17/77 0130
L_{90}	34	21	20	36	31	39
L_{50}	36	39	22	39	33	43
L_{10}	40	46	26	44	40	47
L_{eq}	37.8	41.9	23.9	45.3	50.1 (39.7)[c]	44.1
L_d		39.3			47.1 (44.4)[c]	
L_n		23.9			44.1	
L_{dn}		37.9			51.0 (50.5)[c]	
4 - Residence 3712	3/05/77 1455	3/05/77 1900	3/05/77 2215	7/16/77 1445	7/16/77 1810	7/17/77 0205
L_{90}	35	21	21	40	31	23
L_{50}	38	22	24	46	38	30
L_{10}	48	28	33	63	52	44
L_{eq}	44.6	39.8 (33.3)[c]	35.1	65.1	54.1	47.0
L_d		43.7 (43.4)[c]			63.8	
L_n		35.1			47.0	
L_{dn}		44.2 (44.1)[c]			62.2	

[a] L_{90}, L_{50}, and L_{10} are measured quantities rounded to the nearest whole number. L_{eq}, L_d, L_n, and L_{dn} are calculations rounded to the nearest tenth.

$$L_d = 10 \log_{10} \frac{[11 \times 10^{(L_1/10)} + 4 \times 10^{(L_2/10)}]}{15}$$

where: L_1 = Leq 0700-1800
L_2 = Leq 1800-2200

[b] The times shown for the daytime, evening, and nighttime periods signify the start time of recorded 16- to 21-minute data samples.

[c] Values were adjusted to reduce the contribution from short duration, high sound pressure level sources. The procedure for making these adjustments is described in subsection 2.8.2.

[d] Numbers in brackets [] are average L_{eq} values for each time period.

LOCATION	WINTER DAYTIME[b] (DATE-TIME)	WINTER EVENING[b] (DATE-TIME)	WINTER NIGHTTIME[b] (DATE-TIME)	SUMMER DAYTIME[b] (DATE-TIME)	SUMMER EVENING[b] (DATE-TIME)	SUMMER NIGHTTIME[b] (DATE-TIME)
5 - Exxon Field Office	3/05/77 1555	3/05/77 2130	3/05/77 2350	7/16/77 1600	7/16/77 2130	7/17/77 0020
L_{90}	31	25	22	35	21	25
L_{50}	37	27	24	41	23	26
L_{10}	45	30	29	53	26	28
L_{eq}	43.8	28.4	50.5 (37.7)[c]	58.2	42.7 (36.8)[c]	26.5
L_d		42.4			56.8	
L_n		50.5 (37.7)[c]			26.5	
L_{dn}		56.4 (45.2)[c]			54.7	
6 - Webb Residence	3/05/77 1617	3/05/77 2100	3/06/77 2320	7/16/77 1140	7/16/77 2050	7/16/77 2215
L_{90}	23	18	18	31	21	19
L_{50}	25	19	19	35	24	21
L_{10}	37	22	20	39	34	35
L_{eq}	53 (43.4)[c]	22.6	19.0	38.4	36.8	38.6
L_d		51.6 (42.1)[c]			38.0	
L_n		19.0			38.6	
L_{dn}		49.5 (40.2)[c]			44.9	
7 - Lake Metonga	3/30/83 1225 1300	3/29/83 2100	3/30-31/83 2340 0010	7/12/83 1500 1530	7/11/83 1910 1937	7/11-12/83 2350 0020
L_{90}	41 41	43	41 41	41 41	41 39	39 38
L_{50}	42 41	44	42 42	44 44	44 42	41 39
L_{10}	43 42	45	42 42	48 51	50 47	46 39
L_{eq}	46.9 41.4	44.3	41.9 41.7	46.4 48.8	47.7 44.5	42.9 38.9
L_{eq} (Avg)[d]	[44.2]	[44.3]	[41.8]	[47.6]	[46.1]	[40.9]
L_d		44.8			47.5	
L_n		41.8			41.3	
L_{dn}		48.8			49.3	
8 - Rolling Stone Lake	3/30/83 1345 1413	3/30/83 2045 2115	3/31/83 0100 0125	7/12/83 1530 1555	7/11/83 2036 2110	7/11/83 2230 2300
L_{90}	31 32	31 30	30 30	38 35	34 33	36 34
L_{50}	33 33	32 31	31 31	42 40	37 34	39 38
L_{10}	36 38	34 31	31 31	44 43	43 40	43 42
L_{eq}	33.7 35.5	32.1 30.7	30.8 30.8	42.1 40.6	39.3 36.2	40.2 38.9
L_{eq} (Avg)[d]	[34.6]	[31.4]	[30.8]	[41.4]	[37.8]	[39.6]
L_d		34.2			40.7	
L_n		30.8			39.6	
L_{dn}		37.9			46.2	

TABLE 2.8-1 (continued)

LOCATION	WINTER DAYTIME[b] (DATE-TIME)		WINTER EVENING[b] (DATE-TIME)		WINTER NIGHTTIME[b] (DATE-TIME)		SUMMER DAYTIME[b] (DATE-TIME)		SUMMER EVENING[b] (DATE-TIME)		SUMMER NIGHTTIME[b] (DATE-TIME)	
9 - Ground Hemlock Lake	3/30/83 1008	1027	3/30/83 1910	1940	3/29/83 2245	2310	7/13/83 1205	1230	7/12/83 1825	1847	7/12/83 2200	2230
L_{90}	30	31	30	30	30	29	37	37	31	28	26	25
L_{50}	31	33	30	30	30	29	42	39	33	32	26	26
L_{10}	34	35	31	31	31	30	47	42	39	35	28	29
L_{eq}	32.1	33.4	30.5	36.8	30.3	29.6	44.2	39.6	46.0	32.5	26.8	28.0
L_{eq} (Avg)[d]	[32.8]		[33.7]		[30.0]		[41.9]		[39.2]		[27.4]	
L_d			33.4						42.7			
L_n			30.0						27.4			
L_{dn}			37.1						41.4			
10 - St. John's Lake	3/30/83 1118	1143	3/30/83 1800	1827	3/30/83 2225	2250	7/13/83 1655	1725	7/12/83 2025	2055	7/12/83 2315	2345
L_{90}	31	33	30	30	31	31	34	33	26	26	25	24
L_{50}	33	34	31	31	31	31	38	37	28	29	25	25
L_{10}	35	36	32	32	31	31	42	43	36	40	27	26
L_{eq}	33.4	34.5	30.9	31.6	31.0	31.0	38.9	39.6	32.6	37.3	28.0	28.1
L_{eq} (Avg)[d]	[34.0]		[31.3]		[31.0]		[39.3]		[35.0]		[28.1]	
L_d			33.4						38.6			
L_n			31.0						28.1			
L_{dn}			37.8						38.4			

sampling periods were reviewed and were modified by comparing the data to that obtained at the same or similar locations during other sampling periods. The intrusive sounds, based on duration and sound pressure level, were eliminated from the A-weighted sound level histograms and new values for the Equivalent Sound Levels were computed. Elimination of these intrusive sounds was accomplished as follows:

Location 6, 1617 Hours, March 5, 1977 - The A-weighted sound level histogram was truncated at 66 dB (values greater than 66 dB were deleted). The new value for the Equivalent Sound Level is 43.4 dB which is presented in Table 2.8-1 in parentheses.

Location 4, 1900 Hours, March 5, 1977 - The histogram was truncated at 56 dB resulting in a new Equivalent Sound Level of 33.3 dB as presented in parentheses in Table 2.8-1.

Location 5, 2350 Hours, March 5, 1977 - The histogram was truncated at 58 dB resulting in a new Equivalent Sound Level of 37.7 dB as presented in parentheses in Table 2.8-1.

Location 3, 1905 Hours, July 16, 1977 - The histogram was truncated at 56 dB resulting in a new Equivalent Sound Level of 39.7 dB as presented in parentheses in Table 2.8-1.

Location 5, 2130 Hours, July 16, 1977 - The histogram was truncated at 63 dB resulting in a new Equivalent Sound Level of 36.8 dB as presented in parentheses in Table 2.8-1.

In five instances, the L_{eq} values (1983 data) reported in Table 2.8-1 exceed the summary components presented (L_{90}, L_{50}, L_{10}); these cases are the result of infrequently recorded high sound pressure levels that are reported in the corresponding appendix tables. Appendices 2.8A, Table A-37, and 2.8B, Table B-48 present a summary of the meteorological conditions during the measurement periods. The wind speed, humidity, and temperature data indicate that the range of meteorological conditions was within appropriate limits for optimal performance of the instrumentation (GenRad, 1976).

Sound levels at Location 1 during the winter survey were a result of sparse traffic on County Road M and occasional trucks on State Highway 55. During the summer survey, sound levels at Location 1 were dominated by traffic on County Road M and State Highway 55, and by resident and local farm activities.

Sound levels at Location 2 during the winter survey were dominated by children and a radio at a nearby home, by traffic on State Highway 55, and by a mercury vapor lamp. During the summer survey, sound levels at Location 2 were dominated by traffic on State Highway 55, local traffic at the Indian Subdivision, residents conversing, children playing, and occasional passing aircraft.

Sound levels at Location 3 at the Milhalko residence during the winter survey were mainly from wind in the trees and distant traffic. During the summer survey, sound levels were mainly attributable to traffic on Airport Road, distant traffic, birds, insects, and rustling foliage.

Sound levels at Location 4 during the winter survey were from traffic on County Road W, snowmobiles, and distant traffic. During the summer survey, sound levels at this location were dominated by cars and motorcycles on County Road W, resident activities, motorboats, and occasional passing aircraft.

Sound levels at Location 5 during the winter survey were dominated by occasional cars passing on Sand Lake Road, wind in the trees, dogs barking, and snowmobiles. During the summer survey, sound levels at this location were dominated by occasional cars passing on Sand Lake Road, resident activities, dogs barking, rustling foliage, and occasional passing aircraft.

During the winter survey, sound levels at Location 6 on Little Sand Lake Road were dominated by distant traffic, dogs barking, wind in the trees, and snowmobiles. During the summer survey, sound levels at this location were dominated by traffic on Little Sand Lake Road, resident activities, motorboats, and occasional passing aircraft.

Sound levels at Location 7 during the winter survey were the result of water flowing over a small dam and wind moving fallen tree leaves. During the summer survey, sound levels were mainly from human activities associated with the picnic area and campground.

Sound levels at Location 8 during the winter survey were from wind moving through nearby trees, bird sounds, and an occasional gunshot and dog barking. During the summer survey, wind moving tree leaves, birds, insects, and occasional aircraft were the major noise sources.

At Location 9 during the winter survey, the sound levels were caused by wind moving tree leaves, bird sounds, and occasional cars. During the summer survey, wind moving tree leaves, bird and insect sounds, cars, and distant aircraft were the major contributing noise sources.

Sound levels at Location 10 during the winter survey were mainly caused by wind blowing through nearby trees, bird sounds, distant chainsaws, and cars. Summer survey sound levels were from bird sounds, distant voices, cars, moving leaves, and occasional aircraft.

The day sound levels, L_d, night sound levels, L_n, and day-night levels, L_{dn}, obtained at the ten locations are summarized in Table 2.8-2. The data presented in this table indicate that, except for Location 6, winter daytime sound levels were lower than those in summer. The noise sources observed at each measurement location indicate the reason for higher summer noise levels. The residents' summer activities included use of motorcycles and motorboats that usually are not used in winter. Even though snowmobiles were heard in winter, their contributions to sound levels at all locations except Location 6 were not particularly high. During winter months of heavy snowfall or during early winter months when winter sports are popular, sound levels from snowmobiles may be more extensive, as indicated by measurements made at Location 6. At this location, activities such as snowmobiles, dogs barking, and wind in the trees raised the ambient sound levels to a higher value than the summer level.

The summer daytime and nighttime sound levels are representative of a rural or quiet suburban neighborhood (National Academy of Science, 1977). Only the day sound levels, L_d, at Locations 4 and 5 (63.8 and 56.8 dB, respectively) are somewhat high for rural background ambient sound levels. These sound levels are explained by a motorcycle and lawn mower recorded at Location 4, and by dogs barking and nearby residents' activities (conversation, car door slam) at Location 5. The daytime L_{50} at Locations 4 and 5 (46 and 41 dB, respectively, Table 2.8-1) was low, indicating that the high day-night sound levels in these instances were caused by intrusive sounds occurring only a small percentage of the time.

In winter, only the unadjusted day-night level at Location 5 exceeded the levels characteristic of quiet suburban neighborhoods. After

TABLE 2.8-2

DAYTIME, NIGHTTIME, AND DAY-NIGHT EQUIVALENT SOUND LEVELS (dB)

LOCATION	WINTER			SUMMER		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
1. Mole Lake School	42.8	29.8	41.9	46.6	42.7	49.9
2. Community Center	37.9	28.5	38.1	42.1	39.7	46.5
3. Mihalko Residence	39.3	23.9	37.9	47.1(44.4)	44.1	51.0(50.5)
4. Residence 3712	43.7(43.4)	35.1	44.2(44.1)	63.8	47.0	62.2
5. Exxon Field Office	42.4	50.5(37.7)	56.4(45.2)	56.8	26.5	54.7
6. Webb Residence	51.6(42.1)	19.0	49.5(40.2)	38.0	38.6	44.9
7. Lake Metonga	44.8	41.8	48.8	47.5	41.3	49.3
8. Rolling Stone Lake	34.2	30.8	37.9	40.7	39.6	46.2
9. Ground Hemlock Lake	33.4	30.0	37.1	42.7	27.4	41.4
10. St. John's Lake	33.4	31.0	37.8	38.6	28.1	38.4

*Values in parentheses were computed from truncated histograms which were adjusted to remove the contributions from short duration, high sound pressure level noise sources.

adjustment, the sound level at this location met the levels characteristic of a quiet suburban neighborhood. At all other locations, the sound sources were typically distant traffic and wind in the trees. A review of the A-weighted sound level histogram (Appendix 2.8A, Table A-17) indicates that most of the time the sound levels were low. For example, the L_5 (sound level exceeded 5 percent of the time) was 31 dB. However, high sound levels (greater than 70 dB) were measured for a very short time (approximately 9 seconds), resulting in an unadjusted high equivalent sound level of L_{eq} = 50.5 dB and an adjusted level of L_{eq} = 37.7 dB. The sounds were probably dog barks. The calculation of L_{dn} requires the penalization of nighttime sound levels by 10 dB to compensate for the greater annoyance factor of sound at night (U.S. EPA, 1974). The computation of L_{dn} at this location was 56.4 dB (unadjusted) and 45.2 dB after adjustment. Without the intrusive nighttime sound, the L_{dn} would be as low as that at other locations.

The U.S. EPA has identified a day-night sound level (L_{dn}) of 55 dB as requisite for the protection of public health and welfare (U.S. EPA, 1974). Since the sound levels in most communities across the United States generally exceed this level at present (Galloway et al., 1973), the agency has identified an L_{dn} of 65 dB as its short-term goal and an L_{dn} of 55 dB as its long-term goal (U.S. EPA, 1977). Day-night sound levels at all locations sampled in summer and winter were below the short-term goal. Only the unadjusted day-night sound levels at Location 4 in the summer and Location 5 in the winter exceeded the U.S. EPA's long-term goal. However, after adjustment all day-night sound levels except Location 4 in summer meet this

long-term goal. All daytime and nighttime sound levels sampled were representative of a rural or quiet suburban neighborhood (National Academy of Science, 1977).

2.8.3 Summary and Conclusions

1. Background sound level measurements were obtained at ten locations representing noise-sensitive land uses within 6 km (4 miles) of the mine/mill site, during both winter and summer conditions (without and with foliage, respectively), and at three representative time periods of the day.

2. The background sound levels were indicative of a rural or quiet suburban neighborhood, as defined by the National Academy of Science (1977).

3. All adjusted day-night sound levels except Location 4 in summer meet the U.S. EPA's long-term goal for the protection of public health and welfare.

2.8.4 References

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2.9 LAND USE AND AESTHETICS

The objectives of this section are to present a detailed description of land uses and to identify their geographical distribution within the environmental study area. This section also includes a discussion of the aesthetic characteristics of the environmental study area. The land uses discussed include forestry, agriculture, recreation, residential/institutional, commercial/industrial, transportation, public lands, special use areas, and multiple use areas. The discussion of this land use information is designed to complement regional information presented in section 2.10, Socioeconomics, and is intended to identify and discuss those specific local land uses that could be affected during project development.

A regional discussion of land use characteristics in the area surrounding the Crandon Project (most of Forest and Langlade counties and approximately one-half of Oneida County [Figure 2.10-1]) is presented in section 2.10, Socioeconomics. The objective of the regional land use discussion was to identify those uses that preclude future development and to analyze zoning and other constraints that could restrict growth in developable areas.

2.9.1 Field and Laboratory Methods

The land use and aesthetics investigation consisted of two tasks: a literature search and a field reconnaissance. The literature search was conducted to obtain published information on the land use and aesthetic characteristics of Forest, Langlade, and Oneida counties. The types of information obtained during the literature search included USGS 7.5-minute

topographic maps, plat books, regional plans, regional outdoor recreation plans, chamber of commerce publications, and forest resource assessments. An important portion of the literature search consisted of contacting governmental bodies that might have information useful to the land use investigation. The agencies contacted included, but were not limited to, the DNR; the Wisconsin Department of Administration; the Northeastern Wisconsin Regional Planning Agency; the North Central Wisconsin Regional Planning Commission; and offices of the Forest, Langlade, and Oneida county clerks.

During January and September 1978 and again in May 1982, field reconnaissances were conducted of the environmental study area. These reconnaissances were conducted by automobile and on foot to verify the information obtained during the literature search and from April 1976, June 1978, and April 1981 aerial photos. The type of information recorded included the distribution of land uses, vegetation types and residences, the location of recreational resources and businesses, and aesthetic characteristics. The minimum size of any land use delineated was 16.2 ha (40 acres). Linear land uses such as highways and railroads are not included in acreage calculations.

Quality control procedures were utilized during the land use and aesthetics investigation. Quantitative data were collected in conjunction with the field activities for terrestrial ecology. These quality control procedures are discussed in subsection 2.6.1.

In the land use and aesthetics investigation, a daily record of field activities was maintained by the investigator and summarized as field memoranda. No data sheets were required or used as a part of this study.

There were no laboratory analyses or data analyses for this investigation requiring quality control procedures.

2.9.2 Land Uses

Notable characteristics of the land uses within the environmental study area were similar to those of the regional study area. The area was primarily forested upland and forested wetland with an abundance of lakes and streams. It is popular for both land- and water-based recreation and has an abundance of publicly owned land (North Central Wisconsin Regional Planning Commission, 1979).

Land use within the environmental study area has been divided into nine categories. A definition for each of the land use categories is presented below:

Forestry - Land being used to produce forest products such as pulp wood, saw timber, wood chips and/or maple syrup. This includes all forested land capable of producing trees with a diameter at breast height of over 2.5 cm (1 inch) and where canopy coverage is greater than 25 percent. It also includes clearcuts that will be left to revert to forest cover and old agricultural fields that are obviously being allowed to revert to forest cover.

Agriculture - Land being used for agricultural purposes. This includes crop fields, hay fields, and pastures. Old agricultural fields that can potentially be used as pasture because they are fenced and are not reverting to forest cover were also included in this land use.

Recreation - This land use includes those lands whose primary use is recreation. It does not include areas where recreation is a secondary use, such as Forest Crop Law lands. Lands included within this category are primarily parks and water bodies. However, this category also includes marshes and shrub swamps as recreation is probably their only major active use.

Residential/Institutional - This includes all residential areas, both permanent and seasonal, as well as any institutional uses such as churches, schools, nursing homes, and/or hospitals.

Commercial/Industrial - Land being used for any business enterprise, excluding forestry and agriculture, is included within this land use category.

Transportation - Any lands used by transportation systems, such as roads, railroads and airports.

Public Lands - Any lands owned by a governmental unit whether they are open to public use or not. Governmental units include federal, state, county and township jurisdictions.

Special Use Areas - This category includes any lands that are valuable for scientific research, educational use (school forests), or identified threatened or endangered species habitats.

Multiple Use - Lands governed by official multiple use management objectives are included in this category. An example is land under the jurisdiction of the U.S. Forest Service.

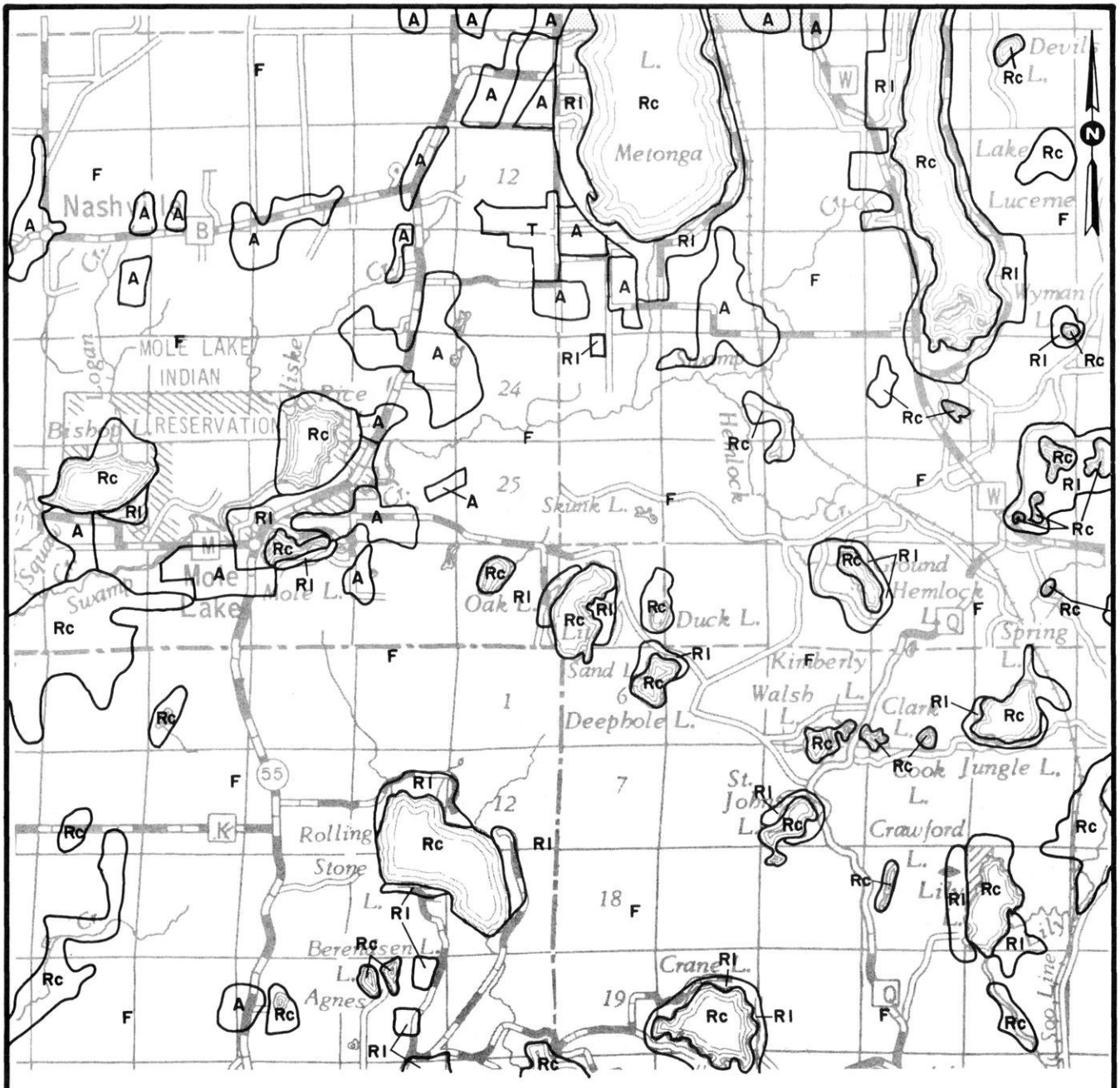
The distribution of major land uses in the environmental study area is illustrated on Figure 2.9-1.

The percentage of each land use, estimated from topographic maps, aerial photographs, and reconnaissance of the environmental study area, is presented below.

LAND USE
WITHIN THE ENVIRONMENTAL STUDY AREA

LAND USE	PERCENT OF TOTAL AREA	AREA	
		Sq. Kilometers	Sq. Miles
Forestry	76.5	198.0	76.5
Recreation	11.8	30.5	11.8
Residential	6.4	16.5	6.4
Agriculture	5.0	13.0	5.0
Transportation	0.3	1.0	0.3
Total	100.0	259.0	100.0

Forestry, recreation, residential/institutional, agriculture, and transportation were the primary land uses within the environmental study area. Commercial/industrial, special use, and multiple use comprised a minor proportion of the environmental study area and were, therefore, not illustrated on Figure 2.9-1. Although public lands constituted an important portion of the environmental study area, their use was predominantly for

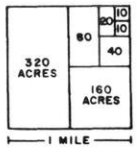


KEY:

A	AGRICULTURE
F	FORESTRY
Rc	RECREATIONAL
RI	RESIDENTIAL/INSTITUTIONAL
T	TRANSPORTATION

1 .5 0 1 2 MILES

1 .5 0 1 2 KILOMETERS



NOTE: MINIMUM SIZE DELINEATED IS 16.2 HECTARES (40 ACRES).

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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CRANDON PROJECT

LAND USE IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

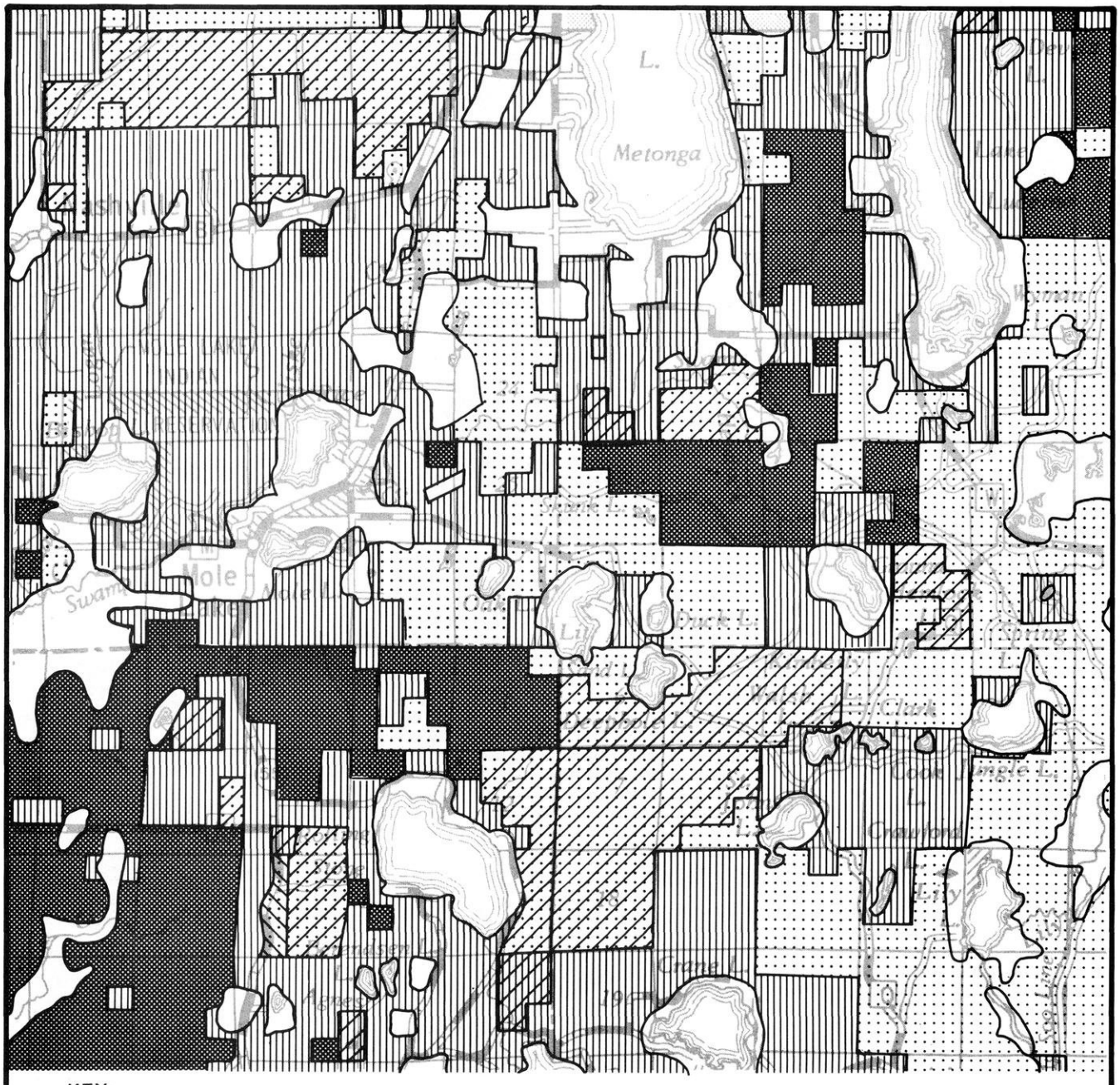
FIGURE 2.9-1

forestry or recreation; therefore, public lands were not mapped on Figure 2.9-1. For a discussion of public lands see subsection 2.9.2.7. Each of the nine land use categories is discussed in the following subsections.

2.9.2.1 Forestry

Approximately 76.5 percent of the environmental study area was forestland that could conceivably be harvested, that is, used for forestry (Figure 2.9-1). Pole-sized aspen-birch and northern hardwood consisting primarily of sugar maple and basswood were the most abundant upland forest types in the environmental study area (see section 2.6, Terrestrial Ecology). Tamarack and black spruce were the most common tree species in the coniferous forested wetlands, whereas ash, quaking aspen, American elm, and red maple were the most common tree species in deciduous forested wetlands. Logging during the late 1800's and early 1900's removed most of the original forest in the regional study area; however, forest is once again the principal land cover of the environmental study area (Figure 2.9-1). Maple-basswood and aspen-birch are the most abundant forest types and cover approximately 63 percent of the total commercial forest acreage in Forest, Langlade, and Oneida counties (Spencer and Thorne, 1972). Approximately 20 percent of the commercial forest acreage is in wetland stands of black spruce and balsam fir (Spencer and Thorne, 1972).

Forest lands in the environmental study area were owned by forest products corporations (43.6 percent), private individuals (37.8 percent), with the remainder in public ownership (18.6 percent) (Figure 2.9-2). Seven large corporations owned 8,610 ha (21,260 acres) of forest lands in the



KEY:

- NON-FORESTED AREAS
- PRIVATE OWNERSHIP
- PUBLIC OWNERSHIP
- CORPORATE OWNERSHIP
- FOREST CROP LAW LANDS
- WOODLAND TAX LAW LANDS

1 .5 0 1 2 MILES

1 .5 0 1 2 KILOMETERS

N

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FOREST OWNERSHIP IN THE ENVIRONMENTAL STUDY AREA

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

DAMES & MOORE

FIGURE 2.9-2

environmental study area. Consolidated Papers Inc., the largest corporate land owner in the environmental study area, owned 4,275 ha (10,556 acres) of forest land or 49.6 percent of the corporate forest land. The other corporate owners were: Owens-Illinois Inc., 1,175 ha (2,900 acres); Exxon Corporation, 805 ha (1,987 acres); Connor Forest Industries, 724 ha (1,789 acres); Kimberly-Clark Corporation, 409 ha (1,009 acres); American Can Company, 178 ha (440 acres); and Tigerton Lumber Company, 32 ha (80 acres). Two small forest products businesses owned the remaining 410 ha (1,012 acres) of the corporate forest land shown on Figure 2.9-2. The Mihalko Land and Logging Company owned 882 ha (2,179 acres) and Walentowski Logging owned 130 ha (320 acres).

The remaining forest areas were owned by private individuals (7,464 ha [18,429 acres]), with the balance of 3,675 ha (9,075 acres) in public ownership. Public ownership in the environmental study area was primarily county forest land. The Langlade County Forest comprised 55.8 percent, and Forest County forests 30.8 percent of the 3,149 ha (7,775 acres) of public forest land. The remaining 530 ha (1,300 acres) were owned either by the state of Wisconsin or local townships.

Two tax laws in Wisconsin, Forest Crop Law and Woodland Tax Law, allow owners of woodlands being managed primarily for wood production to be taxed at lower rates. The Forest Crop Law stipulates that lands receiving this tax reduction must be open to public hunting and fishing. There were 3,188 ha (7,871 acres) of land entered into these two tax programs in the environmental study area. The distribution of these lands is shown on Figure 2.9-2. In the environmental study area 3,136 ha (7,742 acres) of land have

been entered into the Forest Crop Law tax program and 53 ha (129 acres) into the Woodland Tax Law program.

Forestlands in the region surrounding the environmental study area are managed primarily for sawtimber and pulp production (Spencer and Thorne, 1972; Mihalko, 1977). Data on stand size for Forest, Langlade, and Oneida counties indicate that approximately 50 percent of the commercial forestlands are classified as pole timber size, 30 percent as sapling and seedling size, 15 percent as sawtimber size, and 5 percent as nonstocked (Spencer and Thorne, 1972). Volume of growing stock per acre in Forest, Langlade, and Oneida counties is well above the average for Wisconsin counties. The average net volume for saw timber and pole timber size classes on commercial forest lands in the three-county area is approximately 38 cords/ha (15.7 cords per acre) (Spencer and Thorne, 1972); saw timber volumes range from approximately 12,355 to 14,826 board feet/ha (5,000 to 6,000 board feet per acre) for saw timber stands only (Druckenmiller, 1984).

2.9.2.2 Agriculture

Approximately 5.0 percent of the environmental study area was in agricultural use, which included dairy farming, livestock production, and crops of oats, barley, wheat, alfalfa, hay, and potatoes. Agricultural lands are shown on Figure 2.9-1. Irregular slopes, stoniness, droughtiness on rises, wetness in depressions, and short growing season limit agricultural use of soils in the environmental study area (Hole et al., undated). The soils of the environmental study area are described in section 2.6, Terrestrial Ecology.

Information on agricultural use and production in the environmental study area was obtained from the Wisconsin Agriculture Reporting Service for the 1979 and 1980 seasons. The Wisconsin Assessor Farm statistics from the 1979 harvest are only available by townships (Young, 1982); more detailed reporting would essentially divulge the financial affairs of individual farmers. The environmental study area covers parts of Lincoln and Nashville townships in Forest County and Ainsworth Township in Langlade County. In these three townships information was reported for 36 farms with a total area of 3,084 ha (7,614 acres) and an average size of 85.7 ha (211.5 acres) (Young, 1982).

Hay and alfalfa were the most important crops, comprising approximately 48 and 15 percent of the reported crop acreage, respectively. Oats and potatoes, the only other prevalent crops, comprised 22 and 9 percent of the reported crop acreage, respectively. Barley and wheat were infrequent crops.

A substantial portion of the agricultural use in the environmental study area was related to dairy farming. A total of 783 cattle was reported for 1980, with 21 percent milk cows, 30 percent beef cows, and 49 percent other cattle (bulls, heifers, and calves).

The severe limitations placed upon farming by the frequently poor soil conditions and short growing season are apparent when countywide agricultural production for Forest and Langlade counties are compared with other counties in Wisconsin.

1980 AGRICULTURAL PRODUCTION IN FOREST AND LANGLADE COUNTIES*

CROP	FOREST COUNTY	LANGLADE COUNTY	STATEWIDE RANK FOREST/LANGLADE
Hay	1.9 tons/acre	2.1 tons/acre	55/23
Alfalfa	2.4 tons/acre	2.6 tons/acre	63/69
Oats	58.1 bu/acre	58.7 bu/acre	65/37
Potatoes	260 cwt.	295 cwt.	42/2
Barley	56.5 bu/acre	56.0 bu/acre	37/61
Wheat	32.0 bu/acre	27.7 bu/acre	60/45
Milk Production	10,900 lbs/cow	11,600 lbs/cow	66/49

*From 1981 Wisconsin Agricultural Statistics.

As suggested by the above data, Forest County is consistently low in the rankings for agricultural products produced by Wisconsin counties. Even though Langlade County has higher agricultural production, the portion of Langlade County in the environmental study area is much more like Forest County than the more agricultural portions of Langlade County to the south and west.

2.9.2.3 Recreation

The environmental study area is located approximately 2 to 6 hours by automobile from the metropolitan areas of Green Bay, Madison, Milwaukee, Minneapolis, and Chicago. These relatively short driving distances, the abundant forest and water resources, and the large public land areas contribute to the popularity of the regional area for recreation. Activity participation in the environmental study area was assumed to be similar to the Forest, Langlade, and Oneida county area where, based upon available resources, the most popular activities are fishing, hunting, swimming, boating, automobile camping, snowmobiling, and sightseeing (Langlade County and Wisconsin DNR, 1979; Johanesen, 1976; De Waal and Johanesen, 1977).

A recreational plan prepared by the North Central Wisconsin Regional Planning Commission in 1977 for Forest County (De Waal and Johanesen, 1977) encompassed approximately 75 percent of the environmental study area. A similar plan has also been prepared for Langlade County encompassing the remaining portion of the environmental study area (Langlade County and Wisconsin DNR, 1979). A general indication of the supply of recreational resources, demand for them, and needs for new recreational development can be obtained from these two reports. The situation in the environmental study area was assumed to be most like Forest County, and selected information from the 1977 Forest County recreation plan was used herein to characterize recreational supply, demand, and need.

Recreational resources in Forest County are generally adequate to meet demands (De Waal and Johanesen, 1977). A summary of supply, estimated demand, and estimated need is presented in Table 2.9-1. There is a projected need in 1980 and 1990 for only a few recreational uses (Table 2.9-1). A similar pattern has been found for Langlade County (Johanesen, 1979) (see section 2.10, Socioeconomics). The major deficiency of recreational resources in Forest County is in picnicking opportunities (70 percent). There is also a predicted shortage of campsites (9 percent) and cross-country ski trails (33 percent) in 1990. While there is a predicted shortage for canoeing, the resource is physically limited and there is little potential to increase the amount of resource available.

Lakes and streams in the environmental study area support a variety of water-based recreational activities such as boating, fishing, and water skiing. As calculated from values reported by Steuck and Andrews (1976),

TABLE 2.9-1

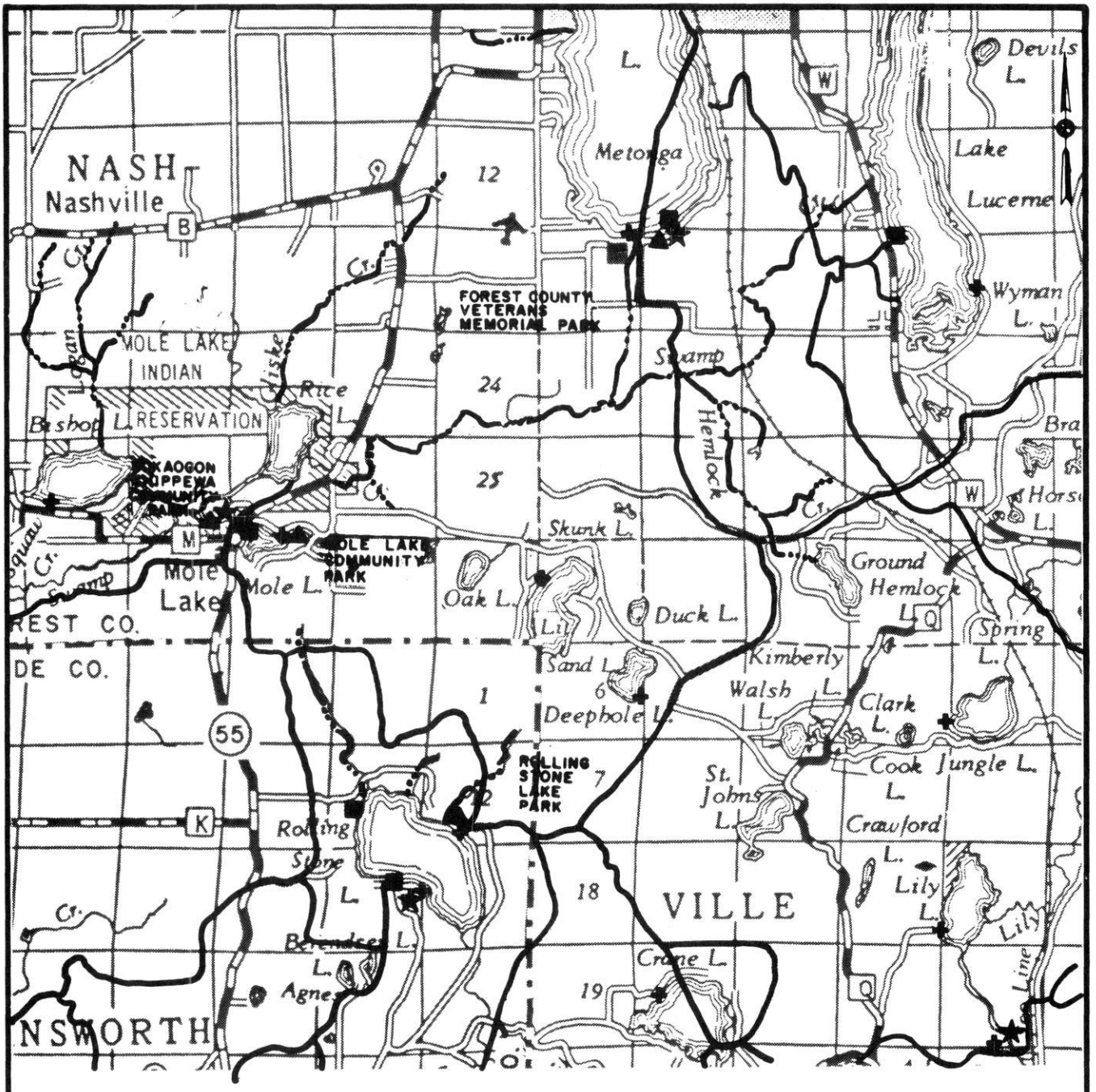
SUPPLY, ESTIMATED DEMAND, AND ESTIMATED NEED FOR SELECTED RECREATIONAL RESOURCES IN FOREST COUNTY

Activity (units)	1976 Supply	Estimated 1980 Demand	Estimated 1980 Need	Estimated 1990 Demand	Estimated 1990 Need
Swimming (ha/acres)	4.6/11.4	3.7/9.2	None	4.1/10.2	None
Boating (ha/acres)	6417/15,845	1715/4234	None	1953/4822	None
Water Skiing (ha/acres)	6417/15,845	1675/4135	None	1851/4570	None
Fishing-Lake (ha/acres)	8782/21,684	1518/3748	None	1709/4219	None
Fishing-Stream (km/miles)	767/477	Undetermined Demand and Need			
Canoeing (km/miles)	117/73	122/76	5/3	138/86	16/10
Camping (sites)	419	417	None	461	42
Picnicking (tables)	166	498	332	552	386
Auto. Sightseeing (km/miles)	Undetermined Supply, Demand and Need				
Hiking (km/miles)	125/78	29/18	None	34/21	None
Horseback Riding (km/miles)	2/1	5/3	2/1	6/4	2/1
Bicylcing (km/miles)	37/23	2/1	None	3/2	None
Cross-Country Skiing (km/miles)	16/10	51/32	25/16	77/48	25/16
Target Shooting (ranges)	1	1	None	1	None
Nature Trails (km/miles)	2/1	2/1	None	3/2	2/1
Snowmobile Trails (km/miles)	539/335	117/73	None	142/88	None

Source: DeWaal and Johanesen, 1977.

Steuck et al. (1977), and the Wisconsin DNR (1976), surface waters constitute 9 percent of the environmental study area, with 31 lakes that total 2,472 ha (6,103 acres) and 42.8 km (26.6 miles) of designated trout streams (Figure 2.9-3) (Wisconsin DNR, 1980). The Wisconsin DNR classifies trout streams into three categories: Class I streams are the highest quality trout waters with self-sustaining populations of native trout, Class II waters are moderate quality trout waters, and Class III are marginal trout habitat. There are 11.7 km (7.3 miles) of Class I, 31.1 km (19.3 miles) of Class II, and no Class III trout streams in the environmental study area. The 43 km (27 miles) of trout streams in the environmental study area were frequently used by fishermen. As reported by Steuck and Andrews (1976) and Steuck et al. (1977), most lakes within the environmental study area also support fish populations and are used by fishermen. Fish populations found in the lakes and streams are discussed in section 2.5, Aquatic Ecology.

Eleven of the larger lakes in the environmental study area have public access (Figure 2.9-3), and these lakes support the majority of water-based recreation. There are six lakes greater than 81 ha (200 acres) in the environmental study area that are generally considered suitable for fast boating and waterskiing: Lake Metonga, Lake Lucerne, and Little Sand, Crane, Rolling Stone, and Bishop lakes. Sandy shorelines are frequent on lakes within the environmental study area. Many of the smaller lakes have mud or muck bottoms, and most larger lakes usually contain some areas of muck bottoms (Ramharter, 1981). Public swimming is permissible at the Forest County Veterans Memorial Park on Lake Metonga (Figure 2.9-3). No streams identified in the Forest County Recreational Plan as providing canoeing opportunities are



BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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RECREATIONAL RESOURCES IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.9-3

found in the environmental study area. The nearest stream considered suitable for canoeing is the Wolf River downstream of Lower Post Lake, 3 to 5 km (2 to 3 miles) west and south of the environmental study area. For the adventuresome canoeist, portions of Swamp Creek can be canoed below the confluence of Outlet Creek and Swamp Creek.

There was ample opportunity for land-based recreational activities on the public lands in the environmental study area. Camping and hunting are popular recreational activities in the environmental study area. Public camping facilities are available at the Forest County Veterans Memorial Park (65 sites) and at private campgrounds on Rolling Stone Lake, Lake Metonga, the Lily River and near Rice Lake (Figure 2.9-3). Campgrounds in Forest County generally operate at less than 30 percent capacity (see section 2.10, Socioeconomics). Public picnic areas are located at the Forest County Veterans Memorial Park on Lake Metonga. Picnic tables are also available at town parks on the northern shore of Mole Lake and the northeastern shore of Rolling Stone Lake, and at local, private campgrounds. There are no designated hiking trails within the environmental study area. The nearest hiking trail is located at Ed's Lake, 1.6 km (1 mile) east of the environmental study area in Nicolet National Forest.

Winter recreational activities include snowmobiling and cross-country skiing. Segments of three snowmobile routes are located within the environmental study area: (1) the 100-mile Snow Safari Route, (2) the Lumberjack Memorial Trail, and (3) the Pearson-Tombstone Sno-Riders Trail system (De Waal and Johanesen, 1977; Langlade County Snowmobile Council, undated). In all, there are approximately 92 km (57 miles) of

snowmobile trails in the environmental study area (Figure 2.9-3). No public cross-country ski trails that can be used free of charge are located in the environmental study area. The closest public cross-country ski trail is approximately 1.6 km (1 mile) east of the environmental study area at Ed's Lake in Nicolet National Forest. There also are ample opportunities to cross-country ski within the environmental study area on unplowed logging roads and trails.

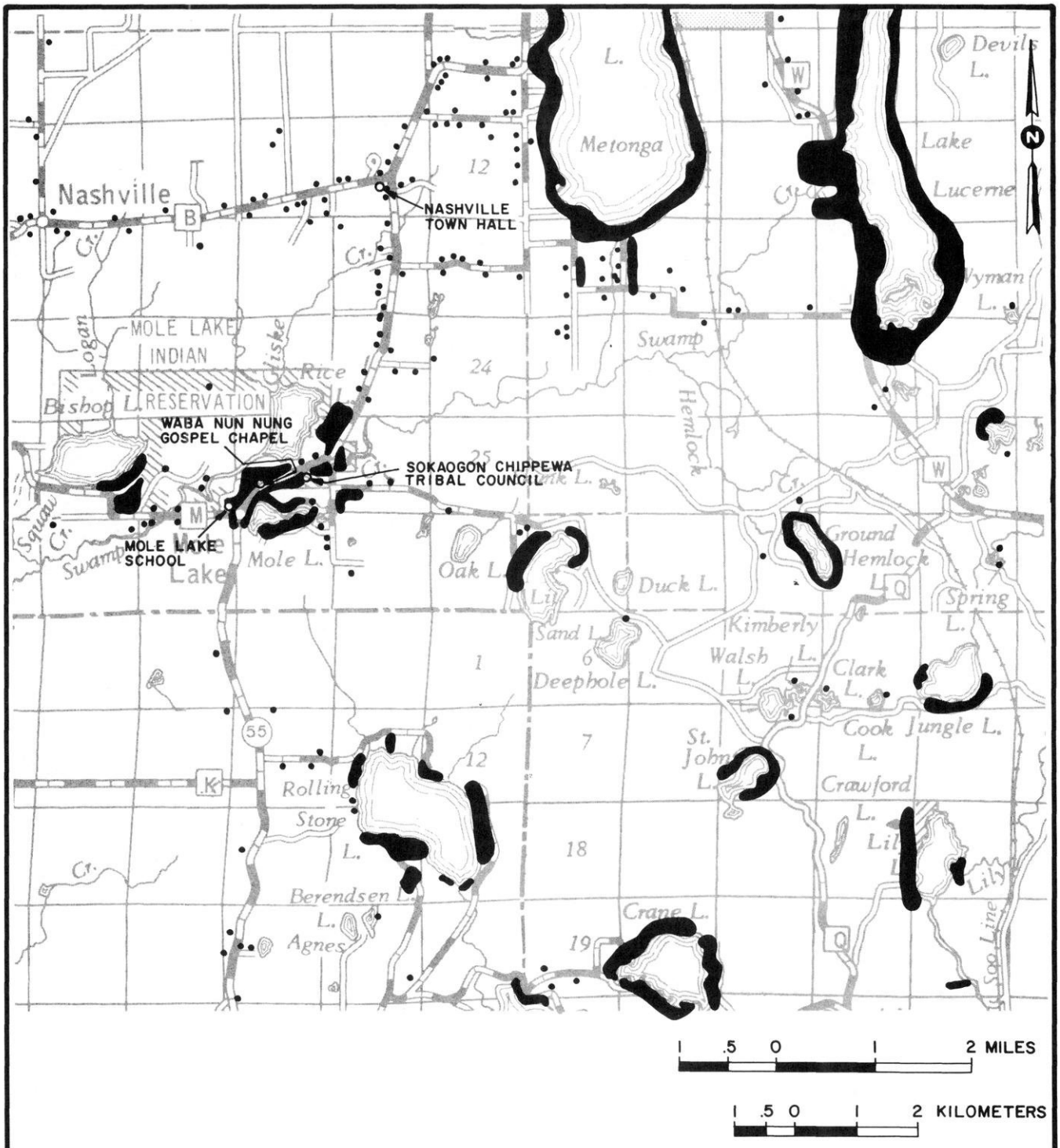
The large areas of public land and land open to recreation through Forest Crop Law supplement the recreational resources discussed above and shown on Figure 2.9-3. There were approximately 3,675 ha (9,075 acres) of public land in the environmental study area that are open to passive recreational activities, including the Lily Lake Wildlife Management Area, Spider Creek Wildlife Management Area, county forests, state trust lands, and a few small parcels of township land. Additional passive recreational opportunities are provided by the 3,136 ha (7,742 acres) of tax law lands in the environmental study area (see Figure 2.9-7 for the location and distribution of these lands). These lands can generally be used for passive recreational activities. Passive recreational activities such as automobile sightseeing, hiking, horseback riding, nature study, bird watching, and bicycling are available in the environmental study area even though no specific facilities have been created for these activities.

Although not located in the environmental study area, there are two nearby recreational areas that attract and receive substantial use by out-of-region visitors. The Nicolet National Forest, located 1.6 km (1 mile) east of the environmental study area, provides opportunities for most types of

recreation dependent upon natural resources. A large portion of the supply of recreational resources included in Table 2.9-1 is provided by Nicolet National Forest. The Upper Wolf River Fishery Area begins approximately 16 km (10 miles) south of the environmental study area along the Wolf River. This area is primarily used by canoeists and fishermen. Discussion of other regional recreational areas can be found in section 2.10, Socioeconomics.

2.9.2.4 Residential/Institutional

The environmental study area is located in the civil townships of Nashville and Lincoln in Forest County and Ainsworth Township in Langlade County. The final 1981 population estimates for the townships of Nashville, Lincoln, and Ainsworth are 781, 576, and 441, respectively (Davis, 1982). The 1981 estimated population densities for these townships were 10.7, 8.2, and 6.1 people per square mile, respectively, far below the 1980 state average of 86.4 (Davis, 1982). Most residences in the environmental study area were concentrated along large lakes (Figure 2.9-4). Forest and Oneida counties have peak seasonal populations that total nearly 190 percent of the resident population (Uekert, 1977), indicating that a substantial proportion of the residences in Forest and Oneida counties is used for seasonal recreational purposes. Nearly half (49 percent) of all housing units in Forest County are second homes (see section 2.10, Socioeconomics). Seasonal and permanent residences are so interspersed with one another that it was not practical to identify them separately. Most permanent residences were located in Mole Lake, along Lakes Metonga and Lucerne and along Highway 55, County Highway B, Keith Siding Road and Airport Road.



KEY:

CONCENTRATION OF RESIDENCES

• SINGLE RESIDENCE

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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CRANDON PROJECT

RESIDENTIAL CONCENTRATIONS AND INSTITUTIONS IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.9-4

Little Sand Lake, the closest large lake to the ore body, has a developed shoreline with approximately 44 residences. Many of the residences clustered along the northwest shore of Little Sand Lake, as well as other lakes in the environmental study area, were 1- or 2-room seasonal cottages. Several new seasonal residences have been constructed along the eastern shore of Little Sand Lake in recent years, but there was no new home construction concentrated in or adjacent to the mine/mill area. Other residences were sparsely located along roads in the site area.

The town nearest the ore body was the unincorporated community of Mole Lake. In early 1982 the Mole Lake Indian Community had a population of 262 (Divine, 1982).

There were only four institutional buildings in the environmental study area (Figure 2.9-4). There were no institutions generally considered sensitive receptors within the environmental study area other than the Mole Lake School. The nearest nursing homes are in Crandon, 8 km (5 miles) north; Laona, 29 km (18 miles) northeast; Rhinelander, 45 km (28 miles) west; Eagle River, 63 km (39 miles) northwest; and Antigo, 74 km (46 miles) southwest. The nearest hospitals are in Rhinelander, Eagle River, and Antigo.

2.9.2.5 Commerical/Industrial

Businesses and industries in the environmental study area were primarily related to tourism or forest products. The locations of the 28 commercial/industrial establishments in the environmental study area are shown on Figure 2.9-5. The numbers on Figure 2.9-5 correspond to the list of

.5 0 1 2 MILES

.5 0 1 2 KILOMETERS

KEY:

23 ● COMMERCIAL/INDUSTRIAL FACILITIES

NOTE: BUSINESSES ARE IDENTIFIED BY NUMBER IN TABLE 2.9-2.

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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COMMERCIAL/INDUSTRIAL FACILITIES IN THE ENVIRONMENTAL STUDY AREA

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FIGURE 2.9-5

commercial/industrial establishments presented in Table 2.9-2. The only area where there was a concentration of businesses was near Mole Lake (Figure 2.9-5). The most frequently provided services were food, taverns, lodging, and boat rentals (Table 2.9-2). The only businesses resembling industry are an auto salvage operation, two logging contractors, and a general contractor. All other businesses are service oriented. Crandon, 8 km (5 miles) north, is the nearest area with a concentration of business and light industry.

2.9.2.6 Transportation

For northern Wisconsin, the regional study area has a well-developed system of federal, state, and county highways, and all lands within the environmental study area are within 3 to 5 km (2 to 3 miles) of a county highway. Additional access is provided by numerous town roads (Figure 2.9-6). Average daily traffic counts in the environmental study area range between 100 vehicles on County Trunk Q and 1,840 vehicles on U.S. Highway 8, which passes through Crandon to the north of the environmental study area (Grossen, 1982). Seasonal traffic levels fluctuate widely in the region because of tourist traffic, and the average daily traffic in June, July, and August ranges from 50 to 100 percent greater than in the remaining months of the year (Wagner, 1977). Weight capacity on roads in the environmental study area is generally 8,172 kg (18,000 pounds) per axle; however, this may vary depending upon conditions. During spring frost breakup all county and town roads have 10,896 kg (24,000 pound) total weight limits (Pitts, 1982; Schallock, 1982). The only current plans for upgrading of roads in the environmental study area are being implemented as funds become available to surface the gravel portion of County Highway Q between County Highways W and DD.

TABLE 2.9-2

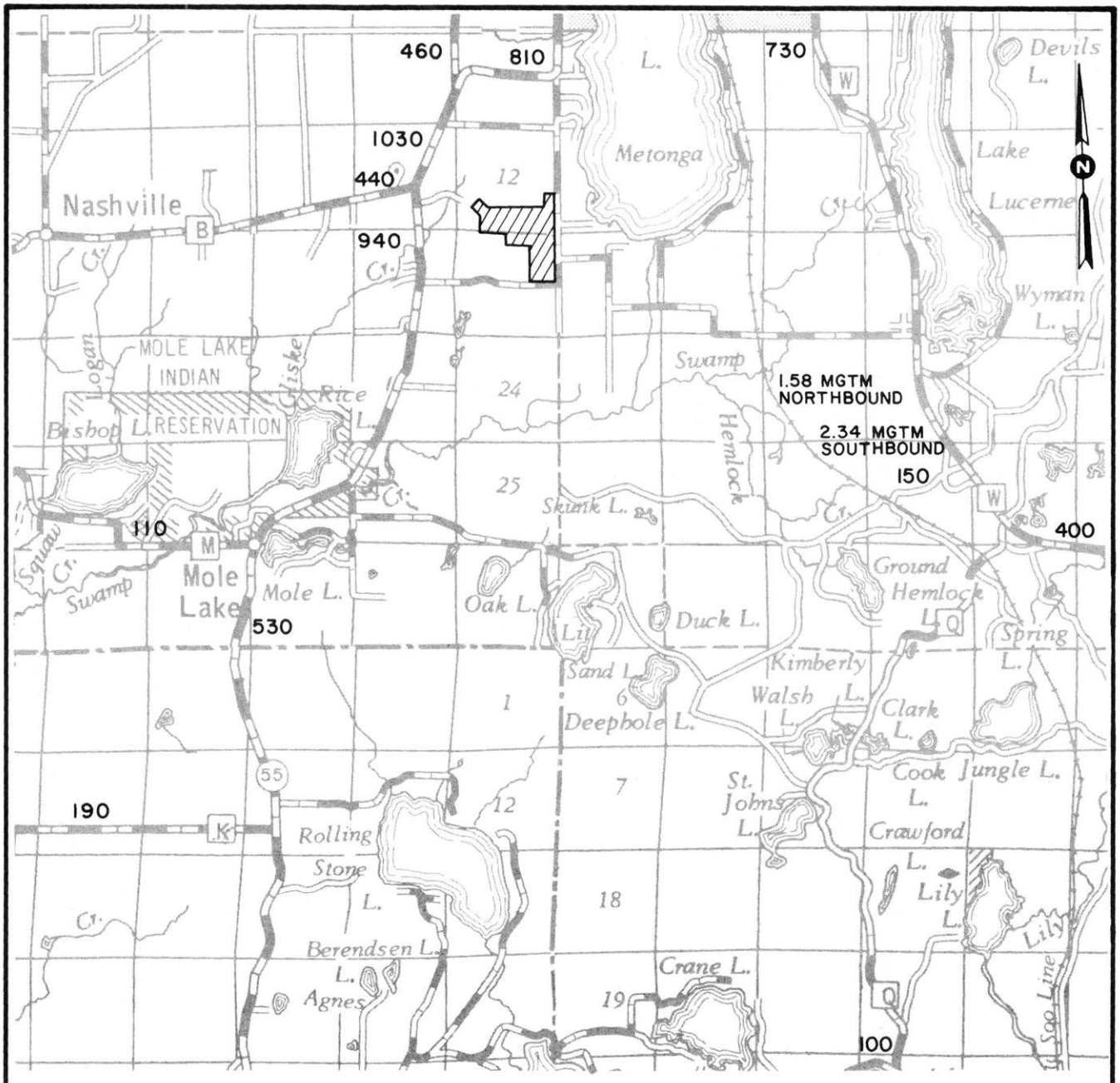
BUSINESSES AND INDUSTRIES IN THE ENVIRONMENTAL STUDY AREA

MAP[a] NO.	BUSINESS	TYPE														
		ARTS & CRAFTS	AUTOMOTIVE	SALVAGE	BAIT	TAVERN	BOATS & MOTORS	CABINS & COTTAGES	CAMPING	FOOD	GENERAL CONTRACTING	GROCERY	HORSES	LOGGING	RECREATION	SYRUP
1	Crandon Riding Stables												X			
2	Payless Tire Store		X													
3	Lemke's Maple Syrup															X
4	Miles Phalen & Sons Salvage			X												
5[b]	Kramer's Ski Trails														X	
6	Mihalko Land & Logging Co.													X		
7	Forest Transmission Service		X													
8	Lake Metonga Resort					X	X	X		X						
9	Radida Resort				X	X	X	X		X						
10	Island View Resort						X	X								
11	Rustic Haven Resort						X	X								
12	Lake Lucerne Resort				X			X		X						
13	Arrowhead Drive-In & Cafe	X								X						
14	Chippewa Arts & Crafts Coop Shop	X														
15	Walentowski Logging													X		
16	Grass Festival Grounds														X	
17	The Mole Hole					X				X						
18[c]	Mole Lake Community Center											X				
19	Mole Lake Trading Post	X														
20	Bauman's Grocery		X		X		X					X				
21	Sundown Tap					X				X						
22	Forest Inn					X				X						
23	Rolling Stone Lake Resort						X	X								
24	Schmidt's Walleye Lodge					X	X	X	X	X						
25	Hills East-Shore Resort					X	X	X		X						
26	Lily River Lodge				X	X	X	X	X	X						
27	Joe Perry & Sons Inc.										X			X		
28	Sokaogon Chippewa Community Park		X						X							
29	Forest County Veterans Memorial Park								X							

[a]See Figure 2.9-5 for location.

[b]No longer in operation.

[c]Under Construction.



KEY:

190 AVERAGE DAILY TRAFFIC (1979)

MGTM MILLON GROSS TON MILES

AIRPORT

BLACKTOP ROAD

GRAVEL ROAD

K COUNTY HIGHWAY

55 STATE HIGHWAY

1 .5 0 1 2 MILES

1 .5 0 1 2 KILOMETERS

BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

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CRANDON PROJECT

TRANSPORTATION SYSTEMS IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.9-6

The only airport in the environmental study area was the Crandon Municipal Airport, 4.8 km (3 miles) north of the ore body (Figure 2.9-6). It is classified as a less-than-basic utility airport and does not have commercial service. The longest runway is asphalt, 944.9 m (3,100 feet), oriented west-northwest to east-southeast. A second runway consists of turf and is 822.6 m (2,700 feet) in length oriented in a north-south direction. The main (asphalt) runway is open year round and the turf runway is open from April 1 to December 1. The main runway is lighted from dusk to dawn. In 1980-81, there were approximately 1,250 takeoffs and landings (Thomas, 1982). Of these, 50 were for a weekly charter taxi service from Milwaukee, 200 were from local users, and 1000 were from non-resident users. There is no regularly scheduled passenger service to the Crandon Municipal Airport.

The only railroad within the environmental study area was a branch of the Soo Line, located 4.1 km (2.5 miles) northeast of the ore body (Figure 2.9-6). This line begins at Wisconsin Junction, 8.1 km (5 miles) north of Crandon, passes through Crandon, and extends south to Milwaukee. At Wisconsin Junction, it joins another branch of the Soo Line that traverses Wisconsin from east to west.

The portion of the Soo Line through the environmental study area has an annual rail freight density of 1.58 million gross ton miles northbound and 2.34 million gross ton miles southbound (Henning, 1982). This rail line has recently been upgraded which included reballasting, tie replacement, and installation of welded rail. With this level of capital improvement, the line is unlikely to be abandoned in the near future. No rail passenger service is available in or near the environmental study area.

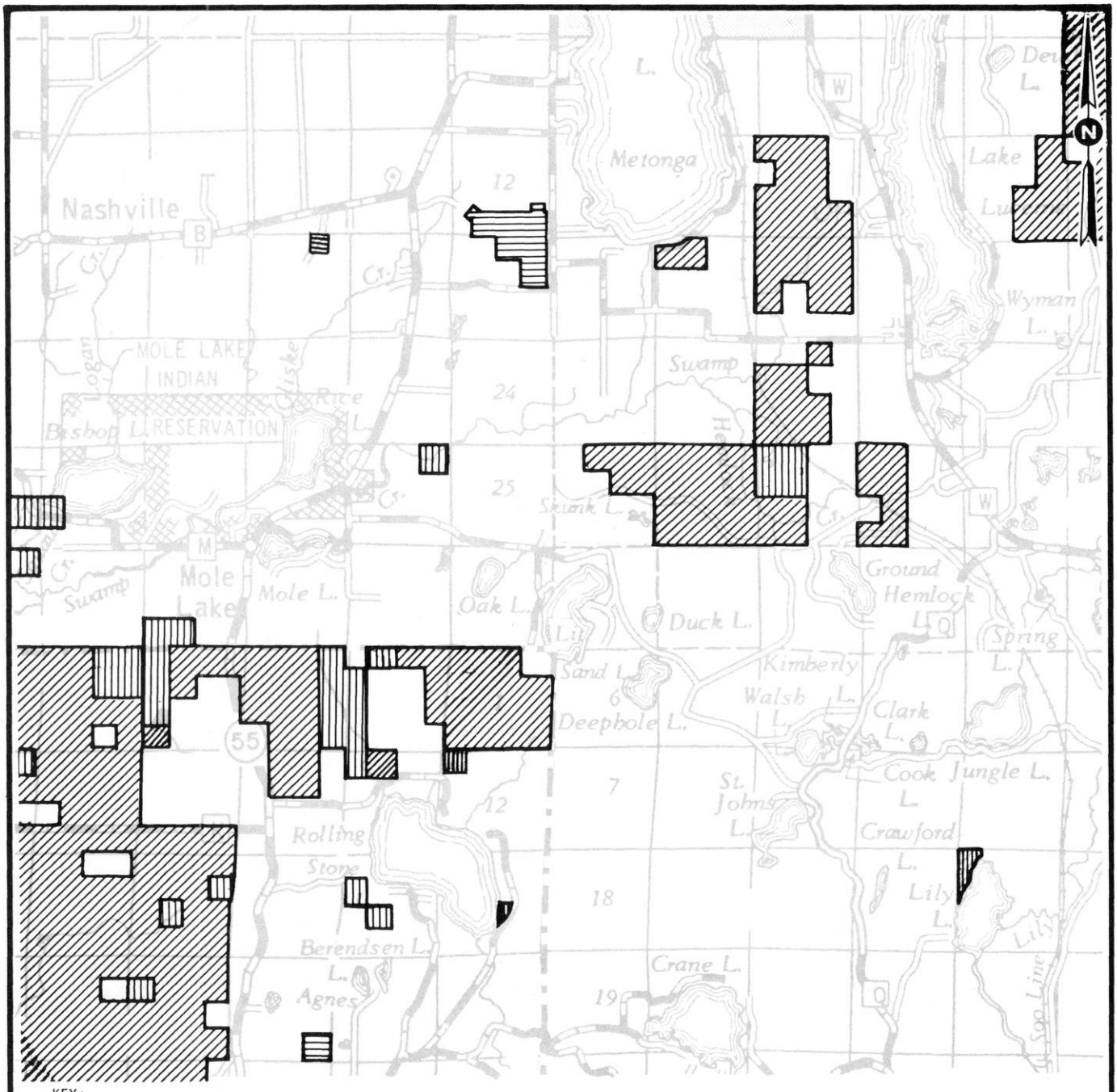
2.9.2.7 Public Lands

Approximately 15 percent or 3,824 ha (9,442 acres) of the land in the environmental study area was publicly owned, most of which was county forest land. County forest lands covered 3,181 ha (7,855 acres) of the environmental study area. Other public lands include state trust and DNR owned lands, 494 ha (1,220 acres); the county airport, 96 ha (237 acres); a county park, 32 ha (80 acres); and 20 ha (50 acres) of township land (Figure 2.9-7). County forests are multiple-use oriented, with timber production the primary land use as discussed in subsection 2.9.2.1. State trust lands are also managed for timber production but are often sold to finance educational needs (Wisconsin Board of Commissioners on Public Lands, 1974).

2.9.2.8 Special Use Areas

Resources within the environmental study area considered to be special use areas were limited to those associated with valuable wildlife habitat. Within the environmental study area, there were no special use areas associated with educational use, such as school forests, or with scientific research, such as state scientific areas.

The wildlife habitats that were considered to be special use areas were deeryards, bald eagle and osprey nest sites, and trout streams. These three types of resources are formally designated as special use areas by the DNR on lands under their management. The DNR also has cooperative agreements with other resource management agencies (U.S. Forest Service, U.S. Fish and Wildlife Service, county forest administrators) where these resources are managed as special use areas. The DNR encourages private and corporate land



BASE MAP REFERENCE: WISCONSIN DEPARTMENT OF TRANSPORTATION, JANUARY, 1978. FOREST CO. AND LANGLADE CO. HIGHWAY MAPS.

REFERENCES:

ROCKFORD MAP PUBLISHERS, INC., 1980 LAND ATLAS AND PLAT BOOK, FOREST COUNTY, ROCKFORD, ILL.

ROCKFORD MAP PUBLISHERS, INC., 1982 LAND ATLAS AND PLAT BOOK, LANGLADE COUNTY, ROCKFORD, ILL.

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PUBLIC LANDS IN THE ENVIRONMENTAL STUDY AREA

DAMES & MOORE

FIGURE 2.9-7

managers to treat these resources in a similar manner, as special use areas. There were five deeryards recognized by the DNR in the environmental study area. The State of Wisconsin lists bald eagles and ospreys as endangered species and recommends minimal disturbance of nest sites by land managers. There were seven bald eagle and six osprey nest sites in the environmental study area that were considered special land use areas. Trout streams have already been discussed. More detailed descriptions and discussions of deeryards and bald eagle and osprey nests are presented in section 2.6, Terrestrial Ecology; and of trout streams in section 2.5, Aquatic Ecology.

2.9.2.9 Multiple Use Areas

Multiple use of lands in the environmental study area most frequently occurred in the forestry, recreation, and public lands categories. For this study the primary use was mapped and discussed in subsection 2.9.2. In most cases, forestry is the primary use and it was given precedence over designation of areas as recreation, public lands, or special use. Although land management on county forest lands generally follows the concept of multiple use, its primary use was forestry.

2.9.3 Aesthetics

The environmental study area contains most of the visual amenities that are common to northern Wisconsin. The numerous lakes, streams, forestlands, low population, and rolling terrain contribute to the scenic diversity of the environmental study area, offering a pleasurable sightseeing experience. Seasonal attractions include the autumn leaf colors, winter snow scenes, and the spring flora.

The landscapes in the environmental study area are primarily natural. The topography is gently rolling with prominent hills and ridges located near Nashville, between Lake Metonga and Lake Lucerne, west of Oak Lake, and west of Hemlock Creek. Sugarbush Hill, the second highest point in Wisconsin, is located northeast of the environmental study area, 6.4 km (4 miles) east of Crandon. Forested upland and forested wetland are the predominant landscape views.

There are no state or federally designated scenic areas, such as state parks, Wisconsin Scientific Areas, or National Natural Landmarks, within the environmental study area. A state historical roadside marker is located on the Mole Lake Indian Community. A distant view of the environmental study area can be obtained from a lookout tower on Sugarbush Hill northeast of the environmental study area.

Most views along the county and state highways and town roads in the environmental study area consist of the adjacent forestland but are occasionally interrupted by open land, agricultural land, and rural shoreline residences. Scenic vistas are frequent along the shoreline roads of Lake Metonga and Lake Lucerne. Motorists traveling south from Crandon along State Highway 55 within the site area have a field of view that extends an average of approximately 1.4 km (0.9 mile) southeast. Views from gravel roads in the site area are largely screened and limited by the adjacent hardwood forest. Within the environmental study area, there are no known intrusive man-made features such as towers and airport beacons.

Evidence of mineral exploration activities can be partially viewed from Sand Lake Road, but a buffer strip of hardwood trees screens most of the

area. The areas cleared for drilling have been graded, seeded, and mulched, and most trees and slash have been disposed of properly.

2.9.4 Summary and Conclusions

Land Use

1. The major land use within the environmental study area is forestry. Other major land uses include recreation, residential, agriculture, and transportation.

2. The land use and land cover within the environmental study area is as follows: forestry, 77 percent; recreation, 12 percent; residential, 6 percent; agricultural, 5 percent; and transportation, less than 1 percent.

3. Approximately 15 percent of the land in the environmental study area is publicly owned, most of which is county forestland. There are three town parks and one county park within the environmental study area.

4. Thirty-one lakes and approximately 43 km (27 miles) of trout stream provide ample opportunities for water-based recreation. The abundant public land in the environmental study area also provide ample opportunity for land-based recreation. Hunting and snowmobiling are the most common land-based recreational uses.

5. The majority of the residences in the environmental study area are located along lake shores. There is also a concentration of residences at the village of Mole Lake and in the Mole Lake Indian Community.

6. There are no commercial or retail facilities in or immediately adjacent to the site area.

7. There is one airport in the environmental study area, and one railroad, the Soo Line, passes through the environmental study area in a north-south direction.

Aesthetics

1. The environmental study area contains the visual amenities common to northern Wisconsin. The numerous lakes and streams, forestlands, and gently rolling terrain contribute to the scenic diversity of the area.

2. Seasonal attractions include the autumn leaf colors, winter snow scenes, and spring flora.

3. There are no designated scenic areas, such as state parks, Wisconsin Scientific Areas, or National Natural Landmarks, in or near the environmental study area.

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