# STATUS OF MINE ML RESOURCE INFORMATION FOR THE LOWER SIOUX, UPPER SIOUX, PRIOR LAKE, AND PRAIRIE ISLAND RESERVATIONS OF MINNESOTA

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## SUMMARY AND CONCLUSIONS

The potential for future production of mineral commodities on Lower Sioux, Upper Sioux, Prairie Island, and Prior Lake Reservations is low. Sand and gravel from unconsolidated glacial and alluvial deposits are present on all reservations, but only deposits at Prior Lake show good potential for marketing.

Upper Sioux and Lower Sioux Reservations, adjacent to the Minnesota River valley, have potentially minable deposits of clay. However, these do not warrant further exploration until known deposits near Redwood Falls and Morton are operated commercially. Possible uses for the clays include kaolin for filler and coating clays in the paper industry; raw materials for refractories and ceramic clays; and ball clays for both ceramic and refractory purposes. Associated iron-stained pisolitic clay could represent a future low-grade source of alumina.

## INTRODUCTION

This report was prepared for the Bureau of Indian Affairs (BIA) by the U.S. Bureau of Mines (USBM) and the U.S. Geological Survey (USGS) under an agreement to compile and summarize available information pertaining to the geology, mineral resources, and potential for development of certain Indian lands. Sources of information were published and unpublished reports, maps, and personal communications. No fieldwork was conducted.

Locations of Upper Sioux, Lower Sioux, Prior Lake, and Prairie Island Reservations are shown in Figure 1. The Upper and Lower Sioux Reservations are in the Minnesota River valley; they are discussed on the following pages with respect to the regional geology and mineral resources of the Minnesota River valley.

Glacial deposits, which are widespread in southeastern Minnesota (Figure 2), cover the Prior Lake and Prairie Island Reservations. Because the bedrock is not exposed on these reservations and specific data on the glacial material are lacking, it is not possible to evaluate the mineral resources of the Prior Lake or Prairie Island Reservations without field checking.

## GEOLOGY AND MINERAL RESOURCES OF THE MINNESOTA RIVER VALLEY, SOUTHWESTERN MINNESOTA

### Precambrian Rocks

Highly metamorphosed granitic gneisses and amphibolite compose most of the Precambrian crystalline rocks in the Minnesota River valley. Radiometric dating of the gneisses indicate that they are among the oldest known rocks in North America.

A widespread unconformity separates the crystalline basement rocks from overlying flat-lying sedimentary rocks of Cretaceous age and younger deposits of Quaternary age. Granite hills in the Minnesota River valley crop out as local knobs and mounds, rising as much as 100 feet above the valley floor.

Crystalline rocks in the Minnesota River valley, between Morton and the South Dakota line, are quarried locally for crushed aggregate and

dimension stone. The granitic rocks quarried near Morton are particularly known for their exceptional beauty. According to Sims and Morey (1974), 6 million pounds of Morton granite gneiss quarried in 1973 was shipped to 46 different states for memorial and facing stone.

A recent study of uranium potential in Precambrian rocks of Minnesota (Ojakangas, 1976) located several granitic plutons having anomalously high radioactivity in the Minnesota River valley. Although uranium potential appears to be low, aerial or detailed ground surveys were suggested as part of further investigations.

### Cretaceous Kaolin Clays

Throughout much of Minnesota, humid tropical weathering of Precambrian rocks during Cretaceous time resulted in the formation of a thick kaolinitic regolith. Although poorly exposed elsewhere in the state, residual kaolin clays as much as 100 feet thick occur at places along the Minnesota River valley (Figure 3).

Two units of Upper Cretaceous sedimentary rocks, identified by Parham (1970), overlie the kaolinitic clays. The lower unit, which is as much as 45 feet thick, is composed predominantly of kaolinite and quartz. A resistant, iron-stained pisolitic zone generally caps the unit. The upper unit consists of a basal kaolinitic bed, locally containing ball clays, overlain by lignite-bearing organic clays and shales. Unconformities separate the three units.

Investigation of the kaolin clays in the Minnesota River valley (Parham and Hogberg, 1964; Parham, 1970) indicates excellent potential for future commercial development. Possible uses include kaolin for filler and coating clays in the paper industry, raw materials for refractories, ceramic clays, and ball clays for ceramic and refractory purposes. Some possibility exists for future extraction of aluminum from pisolitic kaolin clays.

### Glacial Deposits

Glacial drift as much as 130 feet thick (Parham, 1970) overlies the Precambrian crystalline rocks and the Cretaceous sedimentary rocks in the Minnesota River valley and adjacent uplands. The deposits consist of a gray calcareous, clayey to silty till containing moderate amounts of sand and gravel and fragments of Cretaceous shale (Parham and Hogberg, 1964). Pleistocene river terraces occur locally along bluffs and on uplands (Parham, 1970).

Judged from previous production, the glacial deposits in the Minnesota River valley contain sand and gravel deposits of potential local use in the area.

## LOWER SIOUX RESERVATION

### Introduction

Lower Sioux Reservation (Figure 4) occupies 1,743 acres adjacent to the Minnesota River in Redwood County, one-half mile south of Morton (population 591) and 6 miles east of Redwood Falls (population 4,774). All land is tribally owned. Population in 1972 was 104.

U.S., state, and county roads provide access to the area. State Highway 19 and the Chicago and North Western railroad cross the northwest corner of the reservation.

About one-third of the reservation is situated in the Minnesota River valley and on slopes bordering the flood plain. Remaining land is a flat upland surface 250 feet above the valley floor.

## Geology

Outcrops on the reservation are rare because the bedrock is covered by glacial drift on the upland surface and by alluvial sediments on the Minnesota River flood plain. Slump material composed of Cretaceous sediments and glacial drift generally obscures bedrock on river bluffs.

Nearest exposures of crystalline rocks are the Morton Gneiss, which crops out about 0.3 mile north of the reservation. The outcrops form irregular knobs. Cuttings from a water well immediately north of the reservation (in SE¼NW¼ sec. 1, T. 112 N., R. 35 W.) indicate 10 feet of alluvium underlain by 50 feet of kaolinitic residuum (highly weathered gneiss), with fresh granite gneiss at the bottom (Parham, 1970).

A single occurrence of Cretaceous rocks (in SE¼SW¼NE¼ sec. 2, T. 112 N., R. 35 W.) was investigated by Parham (sample locality 62) on reservation uplands. Five feet of gray, lignitic clay was exposed, underlain by 1 foot of red pisolitic clay.

Pleistocene river terraces occur at elevations of about 860, 900, 980, and 1,000 feet near Redwood Falls (Parham, 1970). Sand and gravel comprising the 1,000-foot terrace covers the bulk of reservation uplands. A lower terrace is exposed at 980 feet along the southern reservation boundary.

## Mineral Resources

Sand and gravel is the only mineral resource previously produced on the reservation. Mineral resources of potential future importance include kaolin clays and kaolinitic high-alumina clays.

### Sand and Gravel

The potential for production of sand and gravel from Pleistocene terraces on reservation land appears good, although no record of previous production is reported by the Bureau of Indian Affairs. Evidence for a small production in the past is given by small abandoned pits along river bluffs in the 1,000-foot terrace (Parham, 1970). In addition, Bureau of Indian Affairs maps show a large pit near the southern reservation boundary, apparently in the next lower (980-foot) terrace.

### Kaolin Clays

Although geologic control is limited on the reservation, kaolin clays are well exposed adjacent to reservation land. According to Parham (1970), it is possible that kaolin clays in the vicinity of Redwood Falls and Morton are suitable for mining. Beds containing kaolinite as the only clay mineral are potentially valuable for use as coating and filler clays in the paper industry. Analyses indicate that one-fourth to one-third of the residual clays overlying Precambrian bedrock, and a larger proportion of lowermost sedimentary clays, meet this criterion

(Parham, 1970). Clays of all units are considered adequate for a variety of ceramic and refractory uses.

Despite moderate potential, relatively little interest has been shown in development of Minnesota River valley kaolin clays since Parham's study of 1970 (Dr. Matt Walton, Minn. Geol. Survey, oral commun., 1979). Major problems affecting exploration include an apparent lack of stratigraphic continuity of clays, resulting from unconformities in the geologic column, and a locally thick cover of glacial material.

### High-Alumina Clays

Kaolinitic clays and other nonbauxite alumina ($Al_20_3$) sources have been investigated as possible low-grade, domestic sources of aluminum (Federal Bureau of Mines, 1967). Pisolitic clays that cap the lower unit of Cretaceous kaolinitic sedimentary rocks in Brown, Redwood, Renville, and Yellow Medicine Counties comprise potentially large deposits of high-alumina kaolin clays. According to the U.S. Bureau of Mines (1967), high-alumina clays in the Minnesota River valley as a whole are estimated to total 75 million tons, averaging 36 percent $Al_20_3$.

Parham and Hogberg (1964) reported that Minnesota River valley pisolitic clays were analyzed during World War II as possible alternative sources of aluminum. Silica and alumina in the clays sampled along Crow Creek ranged from 31 to 35 and 40 to 42 percent, respectively. Available alumina--the amount of $Al_20_3$ recoverable by the Bayer process--ranged from 11 to 14 percent. Pisolitic clays tested elsewhere near Redwood Falls had only 2 to 3 percent available alumina.

At present, domestic alumina sources cannot compete with imported bauxite, containing 50 to 60 percent $Al_20_3$. However, changes in political or economic conditions, or advances in technology could lead to the development of domestic supplies.

The distribution of high-alumina clays on reservation land is not known, although occurrences along Crow Creek encourage further investigations. The exposure investigated by Parham (1970) on reservation land contained 1 foot of pisolitic clay. Better-exposed pisolitic clays along Crow Creek are as much as 6 feet thick (Parham, 1970).

### Stone

Although Precambrian crystalline bedrock of the type currently being quarried at Morton for memorial and facing stone is not exposed on reservation land, the possibility of near-surface granite may warrant investigation. According to Lund (1953), considerable prospecting has been conducted in the Minnesota River valley adjacent to Morton, and a number of small pits have been opened. The only long-term economic quarries, however, are those at Morton, where a high-quality stone produced occurs near rail facilities.

## Recommendations for Further Work

Sand and gravel have limited potential on the reservation for local use by the tribe. Lack of

nearby markets discourages further search for these deposits.

Kaolin clays occur in potentially minable deposits adjacent to the reservation and could be present on Indian land. Possible uses include filler and coating clays in the paper industry, refractory materials, ceramic clays, and ball clays for ceramic and refractory uses. Search for deposits on the reservation probably should await production of presently identified kaolin clays nearby.

High-alumina clays of possible future importance may occur on the reservation. No recommendations for further exploration are made at this time.

## UPPER SIOUX RESERVATION

### Introduction

Upper Sioux Reservation (Figure 5) occupies 746 acres adjacent to the Minnesota River in Yellow Medicine County, 3 miles south of Granite Falls (population 3,225). All land is tribally owned. Population in 1972 was 55.

State and county roads serve the area. State Highway 67 crosses reservation land.

The northern two-thirds of the reservation lies within the Minnesota River flood plain. Low-lying marshlands characterize much of this area. River bluffs, rising 250 feet above the valley floor, and adjacent uplands comprise remaining land. Hazel Creek bisects the reservation, flowing north to the Minnesota River.

### Geology

Bedrock is not known to crop out on reservation land. Precambrian rocks exposed north of the reservation (in secs. 10-14, T. 115 N., R. 39 W.) have been mapped by Hall (1899), Lund (1956), and Himmelberg (1968). The rocks are interlayered mafic gneisses and granitic gneisses.

Investigation of kaolin clays in the area has consisted of limited sampling in secs. 9, 10, and 14, T. 115 N., R. 39 W. by Parham (1970). A roadcut on reservation land (south side of highway 67, NW¼SW¼ sec. 14, T. 115 N., R. 39 W.) exposes 65 feet of glacial till underlain by 3 feet of Upper Cretaceous sandy, iron-stained, pisolitic kaolin clay with minor gray shale (Parham, 1970). Five geologic sections are described along a creek bed, 1 mile northwest of the reservation. Kaolinitic residuum, consisting of weathered Precambrian gneisses, represents the only Cretaceous unit exposed. Residual clays range from 3 to 25 feet thick and are covered by unmeasured Pleistocene glacial drift (Parham, 1970).

### Mineral Resources

Judged from relatively limited geologic and mineral data adjacent to the reservation, mineral potential appears to be similar to that of Lower Sioux Reservation. Sand and gravel occur in large supply on the reservation and should be adequate for local use by the tribe. Mineral resources of possible future importance include kaolin clays and high-alumina clays.

### Recommendations for Further Work

Recommendations for mineral exploration are the same as those for Lower Sioux Reservation.

## PRIOR LAKE RESERVATION

### Introduction

Prior Lake Reservation (Figure 6) occupies 258 acres in Scott County, 1 mile north of Prior Lake (population 1,114) and 4 miles southeast of Shakopee (population 6 ,876). Minneapolis-St. Paul is 20 miles to the north. Reservation land is divided into four tracts of which all 258 acres are tribally owned. Population in 1972 was 59.

U.S. and State highways serve the reservation. The Chicago, Milwaukee, St. Paul, and Pacific railroad crosses reservation land. Rail access is available at Shakopee and the village of Prior Lake.

Topography is gently rolling to pitted and irregular. Marshlands, ponds, and lakes occupy low areas.

### Geology

Bedrock is not exposed on Prior Lake Reservation. The reservation lies within an area of thick glacial morainal deposits that formed along the eastern edge of the Des Moines ice lobe. Based on well log data, thickness of glacial drift near the village of Prior Lake ranges from 134 to 210 feet (Schwartz, 1936; Thiel, 1944). Underlying bedrock, known from exposures near Shakopee and from drill holes, consists of Oneota and Shakopee Group dolomite of Ordovician age.

### Mineral Resources

The Eden Prairie and Prior Lake 7.5-minute quadrangles show several sand and gravel pits near Prior Lake, and it is probable that abundant deposits exist in glacial tills on reservation land. Location of reservation lands, adjacent to potential markets near the village of Prior Lake, favors local development of sand and gravel deposits.

### Recommendations for Further Work

The small size of Indian holdings appears to prohibit all but small scale mining operations. Because of the relatively limited mineral potential of Prior Lake Reservation, further work is not recommended at this time.

## PRAIRIE ISLAND RESERVATION

### Introduction

Prairie Island Reservation (Figure 7) occupies 534 acres in Goodhue County, 5 miles northwest of Red Wing (population 10,441) and about 50 miles southeast of Minneapolis-St. Paul. All reservation land is tribally owned. Population in 1972 was 89.

Several county roads serve the reservation. U.S. Highway 61 lies 3 miles to the southwest. The Chicago, Milwaukee, St. Paul, and Pacific railroad

crosses reservation land with access available at Red Wing.

Prairie Island Reservation occupies the southeastern end of a 9-mile-long island in the Mississippi River. Marshes, backwaters, lakes, and embayments characterize much of the area. According to the U.S. Department of Commerce (1974), most reservation land is leased for agriculture.

## Geology

Bedrock is not exposed on reservation land. Flood plain sediments consist of alluvial sands and gravels that range in thickness from 80 to 200 feet (Crain, 1957). Textural characteristics of Mississippi alluvial deposits in Goodhue County are given by Thiel (1944, fig. 17).

## Mineral Resources

Alluvial sand and gravel deposits are widespread in the Mississippi flood plain and in terraces along river bluffs. The Red Wing 7.5-minute quadrangle shows a single gravel pit adjacent to the reservation. Sand and gravel leases provide a portion of tribal income (U.S. Department of Commerce, 1974); however, production statistics are unavailable. The lack of major settlements on Prairie Island and limited access to nearby markets are unfavorable for substantial sand and gravel potential.

## Recommendations for Further Work

Aside from local use by the Indian community, commercial potential of sand and gravel is low. No further work on reservation land is recommended at this time.

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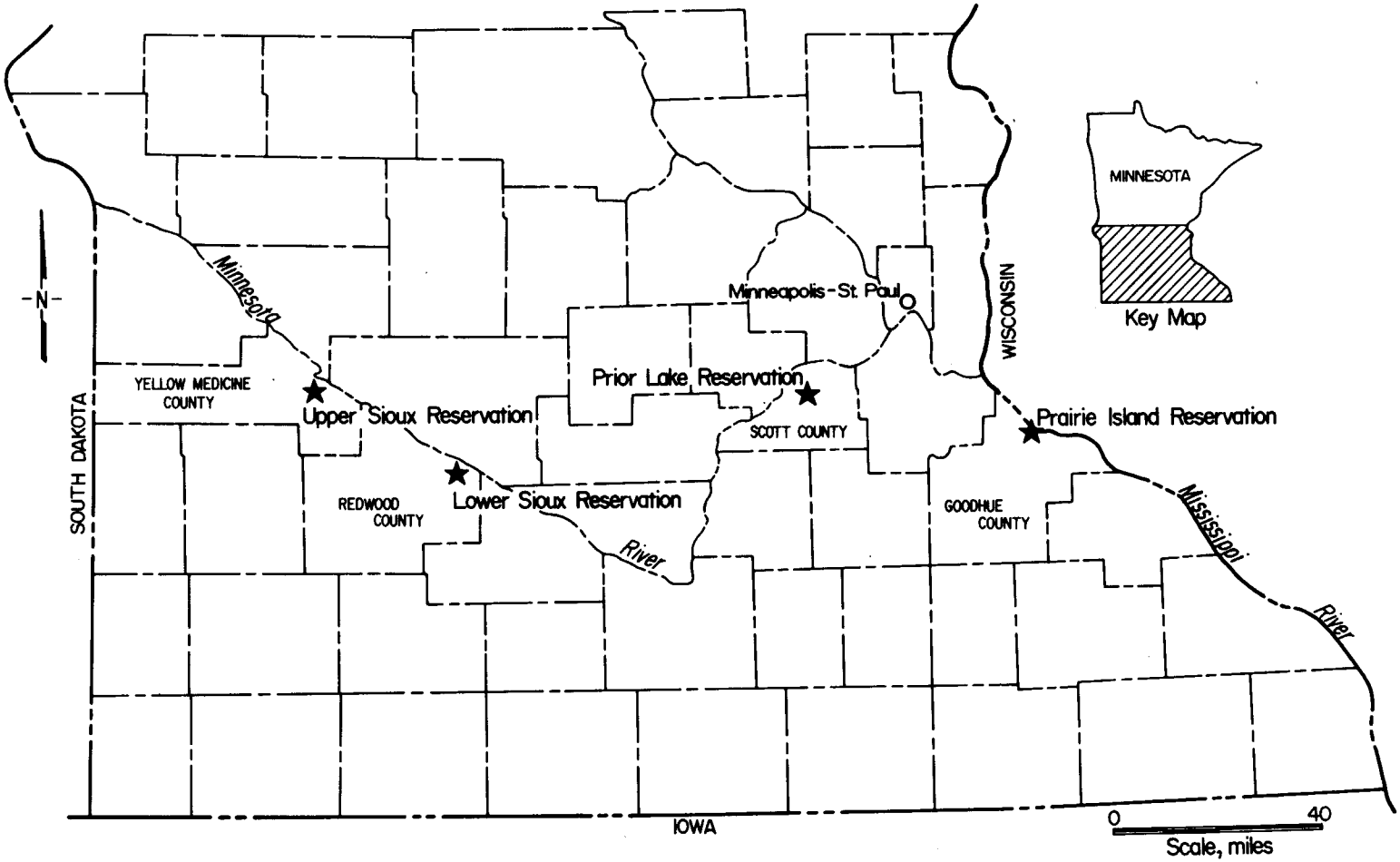


**Figure 1.** Index map of southern Minnesota showing locations of Lower Sioux, Upper Sioux, Prior Lake, and Prairie Island Reservations, Minnesota.

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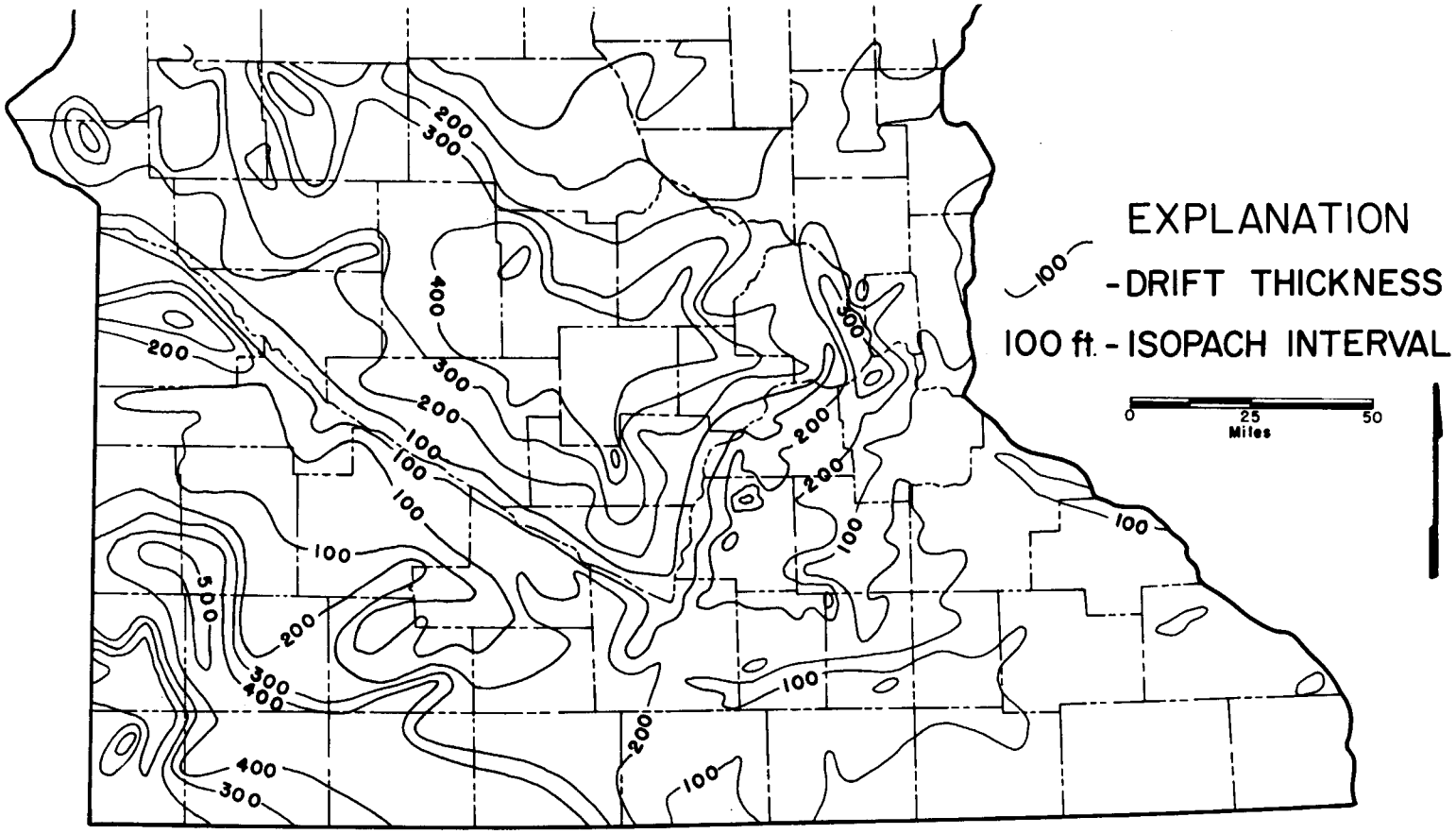


**Figure 2.** Map showing approximate thickness of glacial drift in southern Minnesota.

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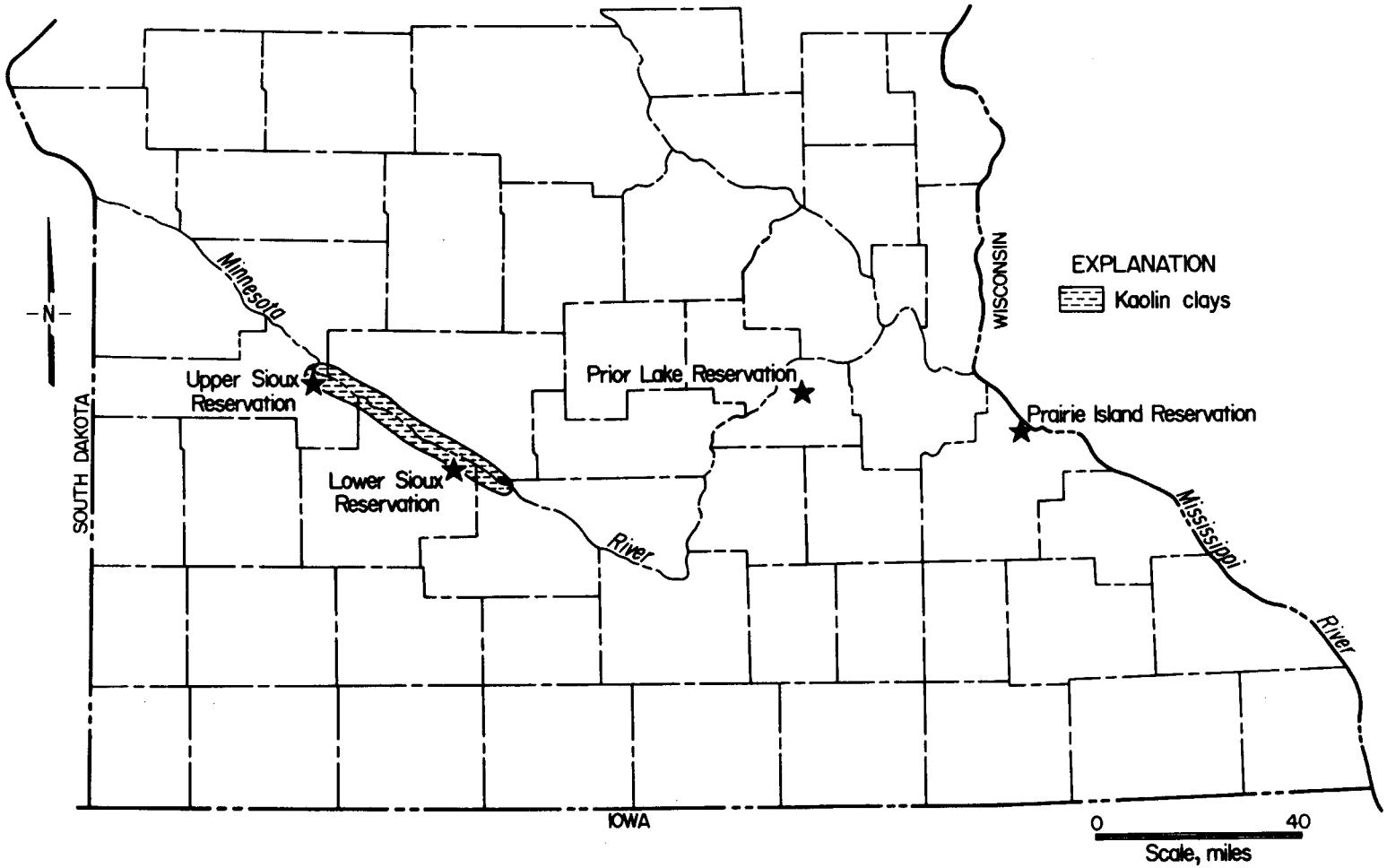


**Figure 3.** Map showing distribution of Minnesota River valley kaolin clays.

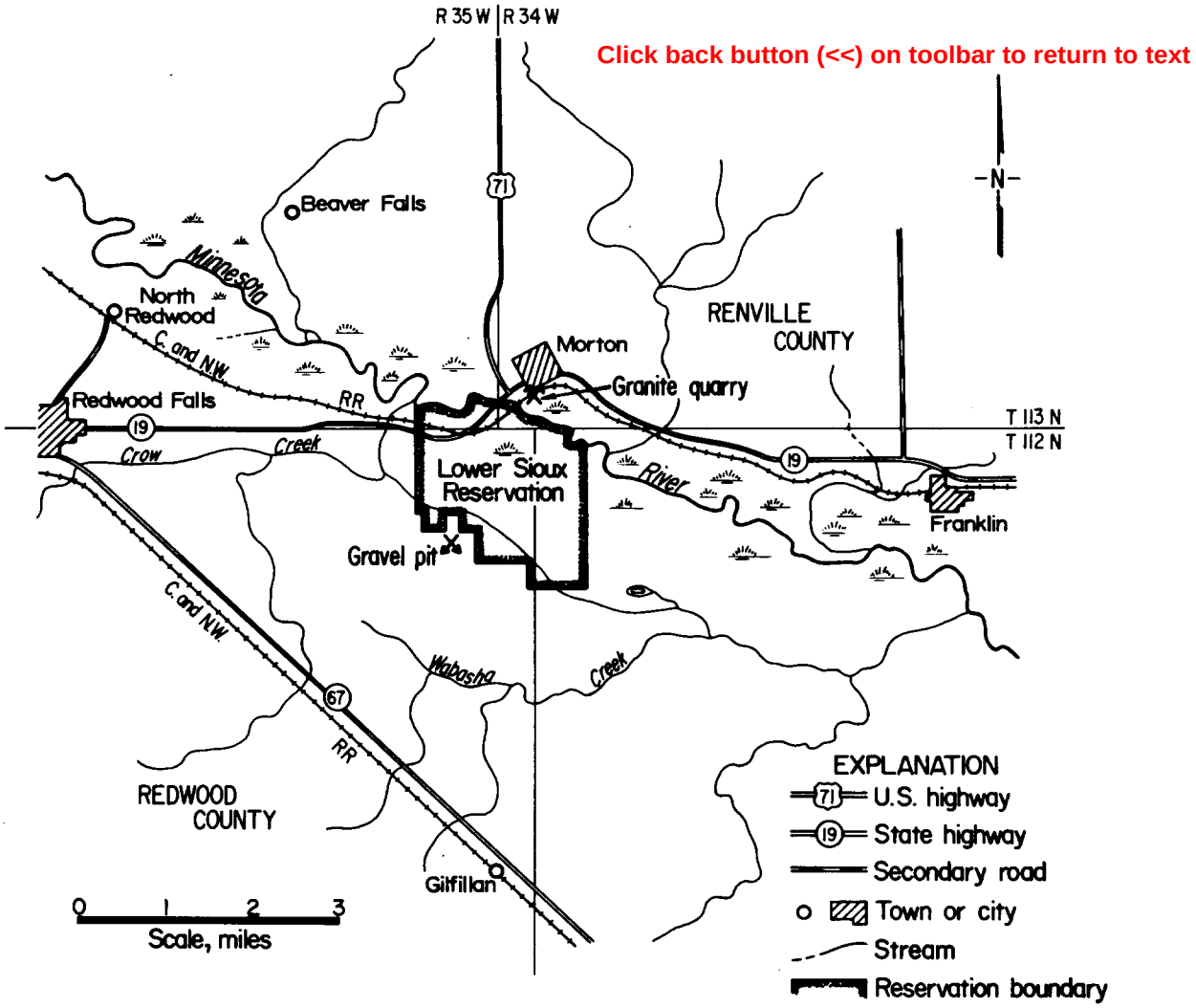


**Figure 4.** Index map, Lower Sioux Reservation.

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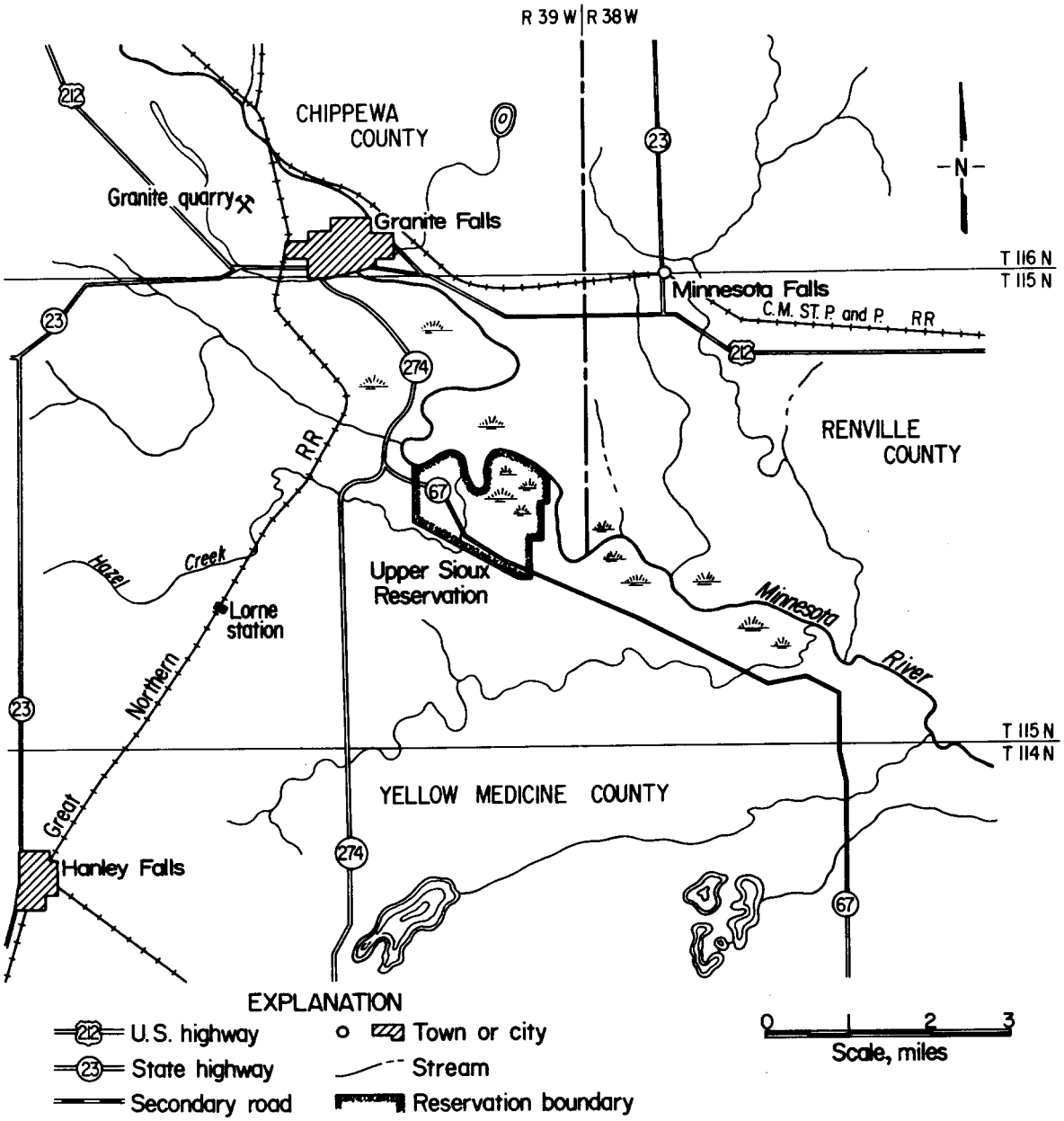


**Figure 5.** Index map, Upper Sioux Reservation.

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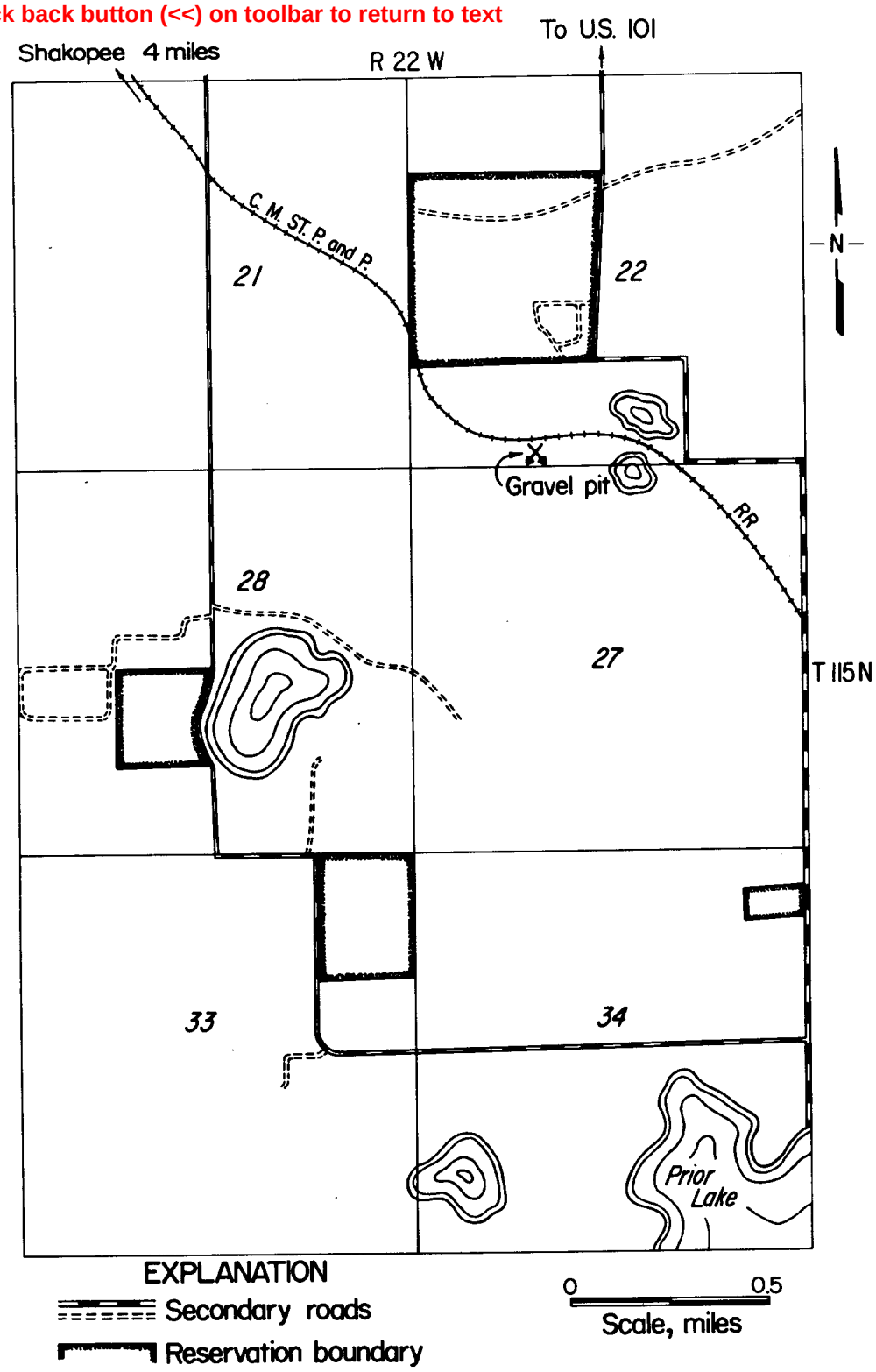


**Figure 6.** Index map, Prior Lake Reservation.

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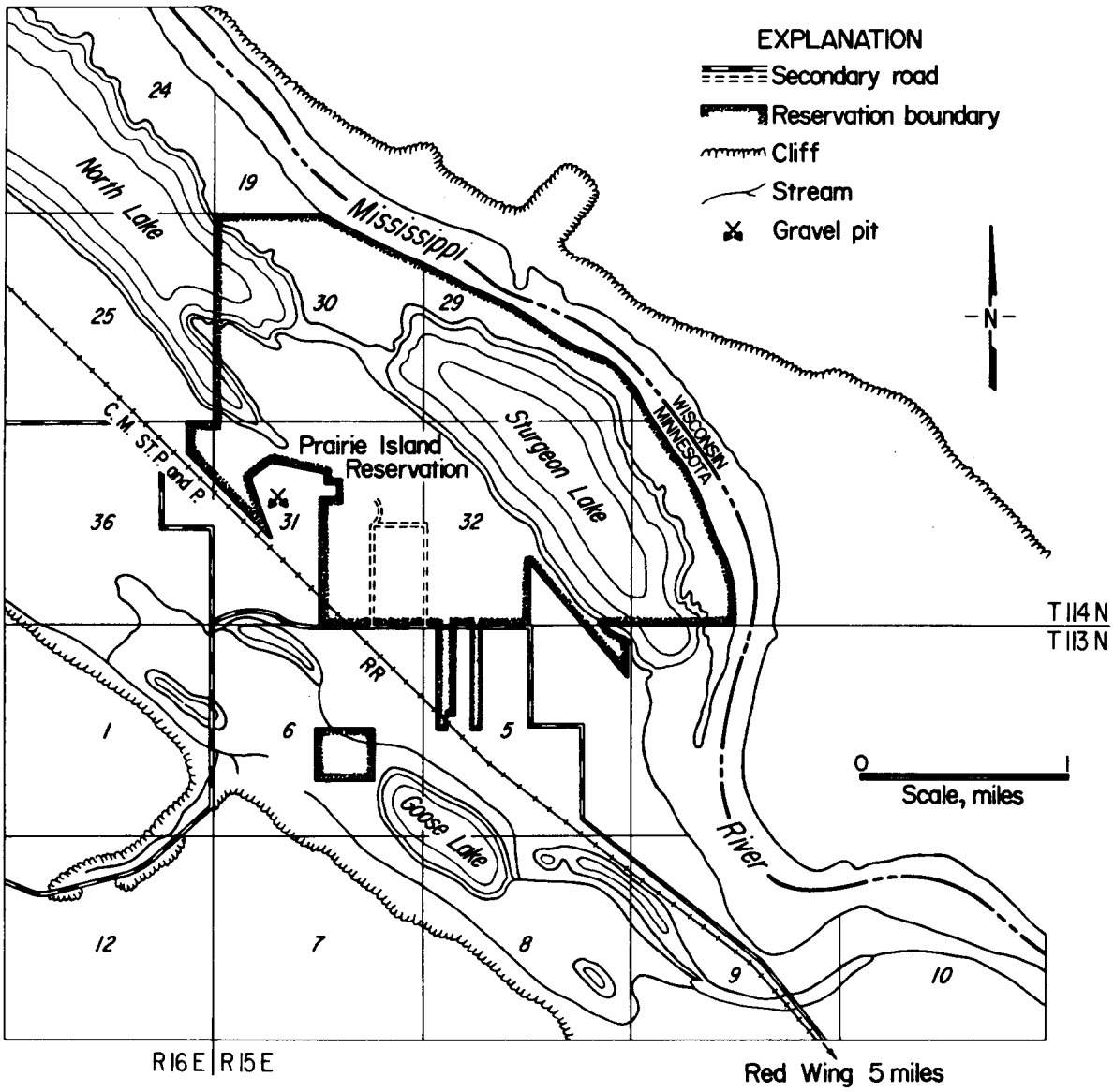


**Figure 7.** Index map, Prairie Island Reservation.