BLACK DOG PRESERVE

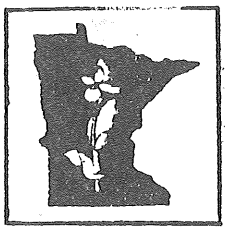
1984 RESOURCE INVENTORY

Portions
of
Sections 27 and 34
Township 27 North, Range 24 West
Bloomington Quadrangle
Burnsville Township
Dakota County
Minnesota

Prepared by
The Scientific and Natural Areas Program
and
The Minnesota Natural Heritage Program

Division of Fish and Wildlife
Minnesota Department of Natural Resources

April 1984



Scientific and Natural Areas

Scientific and Natural Areas serve:

Education - elementary through high school groups use such areas as outdoor classrooms.

Nature Observation - the public uses these areas to observe Minnesota's most unique or rare natural resources.

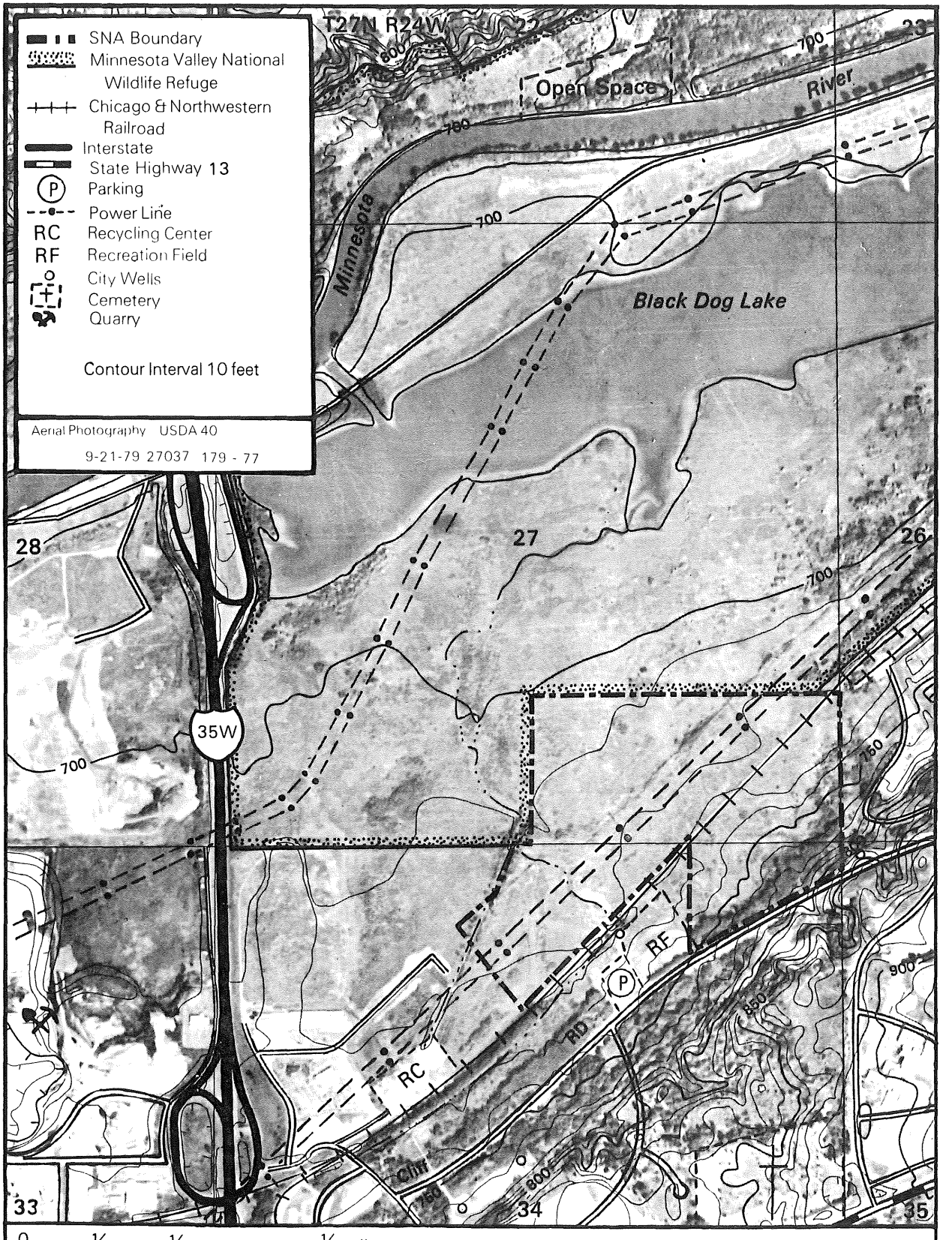
Protection Functions - Minnesota's rarest species or most unique features are protected for the citizens of today and tomorrow.

Recreation - the public uses such areas for informal, dispersed recreation.

Research - colleges are able to establish long term research projects secure in knowing the area will not be influenced by other management activities.

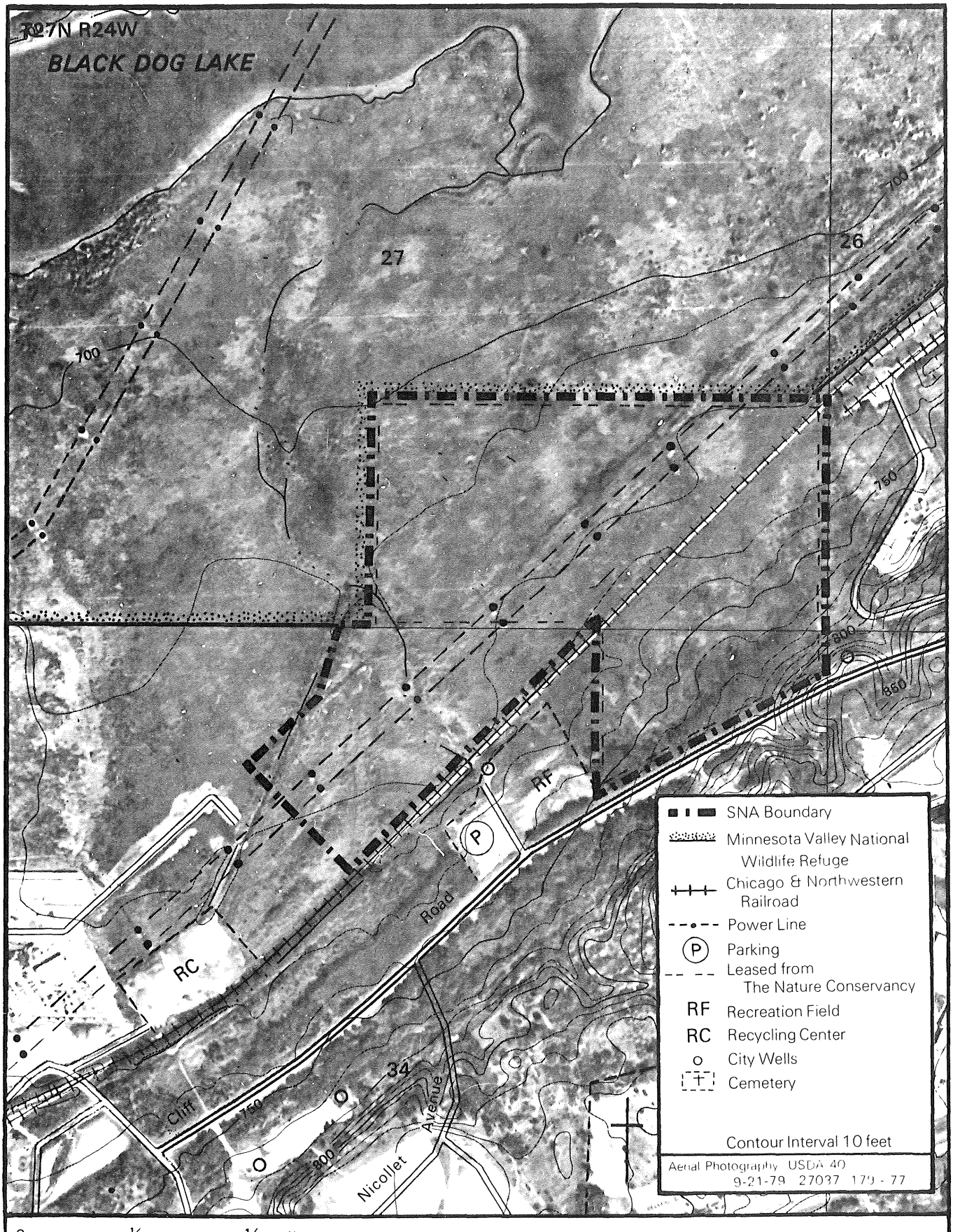
Genetic Storehouse - potentially valuable plants and animals are retained thereby offering potential for new medicines, resistance to plant diseases, and other unknown secrets.

Currently there are 36 Scientific and Natural Areas protecting undisturbed remnants of Minnesota's plant communities and plant and animal species. These areas encompass maple basswood forests, virgin prairies, orchid bogs, heron rookeries, sand dunes, and virgin pine stands, as well as many rare plant and animal species.



BLACK DOG PRESERVE SNA

VICINITY



0 1/8 1/4 mile
0 200 m 400 m

BLACK DOG PRESERVE SNA

SITE

PREFACE

This report documents the information collected during a 1983 inventory of the Black Dog Preserve Scientific and Natural Area. The inventory was designed to collect information on the physical and biological resources of the site, including its geology, soils, climate, water resources, and flora. The land-use history of the site was also investigated in an attempt to understand how such practices may have altered the resources of the natural area. The report will be a valuable aid for individuals responsible for future management decisions and for scientists, educators, and others interested in the area.

The Engineering Department of the City of Burnsville was especially helpful in the preparation of this document. Their research assistance greatly improved the quality of the report.

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DESCRIPTION OF THE STUDY AREA

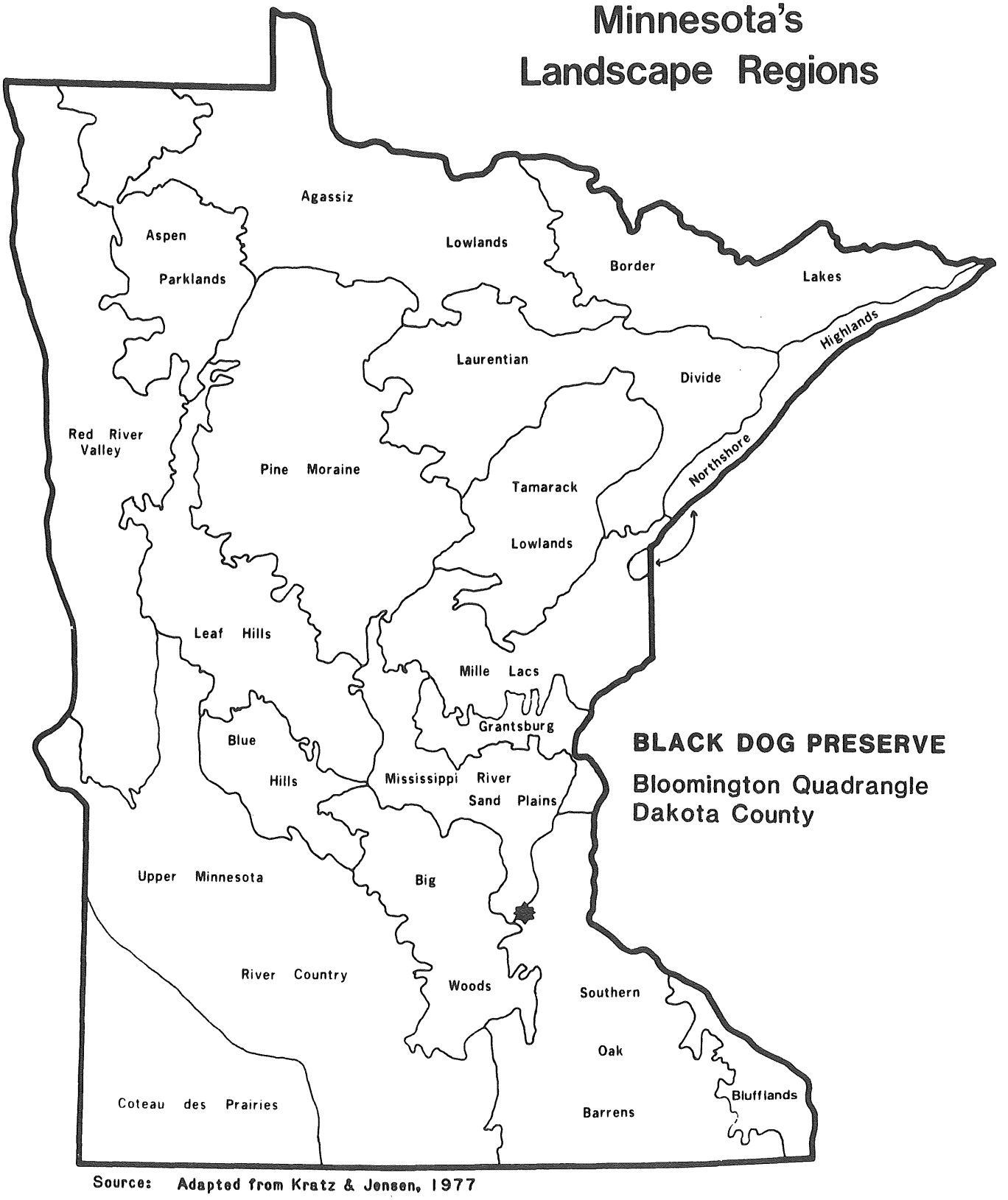
Black Dog Preserve Scientific and Natural Area (SNA) is a 130-acre unit within the Minnesota River Valley in northwestern Dakota County, approximately 11 miles south of Minneapolis, Minnesota. The fen is situated on the boundary between the Southern Oak Barrens and the Mississippi River Sand Plains landscape regions (Fig. 1). The Southern Oak Barrens is a transition between the prairie to the west and the deciduous forest to the north and east. The Mississippi River Sand Plains is predominantly oak barrens and openings with conifer bogs and wet prairies that are sometimes found occupying depressions in the landscape. (Kratz and Jensen 1977).

Black Dog Preserve contains two unique plant communities: a calcareous fen complex, and a mesic prairie. A calcareous fen is a grass-sedge dominated peatland which is fed by groundwater rich in calcium and magnesium bicarbonates. Calcareous fens are a climax vegetation type, which, due to their unusual hydrology, remain stable for thousands of years and often harbor relict plant species.

The flora of the SNA includes eight rare plant species. Valarian (Valeriana edulis), Nut Rush (Scleria verticillata), Beak Rush (Rhynchospora capellacea), and a species of sedge, (Carex sterilis) are all classified as threatened.* Plants classified as special concern are: Small White Lady's Slipper (Cypripedium candidium), Sticky False Asphodel (Tofieldia glutinosa), Twig Rush (Cladium mariscoides), and Marsh Arrow Grass (Triglochin palustris). Bells vireo (Vireo belli), is the only rare animal documented on the fen.

Settlement of the Black Dog area brought about three main types of land use: oak openings were cut for lumber and fuel, uplands were cultivated, and bottomlands were mowed for hay. In more recent years almost all of the uplands have been developed into residential areas and the bottomland is being filled and developed for light industry.

* Classification of a plant or animal as endangered, threatened or special concern follows the designations outlined in the Minnesota Statute Section 97.488.



Source: Adapted from Kratz & Jensen, 1977

Figure 1: Black Dog Preserve in relation to Minnesota's landscape regions.

LAND-USE HISTORY

INTRODUCTION

The designation of Black Dog Preserve Scientific and Natural Area in 1984 was preceeded by 130 years of european settlement. Mans land-use activities during that time visibly altered features of the tract. Aspects of the area's land-use history were reconstructed by investigating these features in the field and from aerial photos. This research was supplemented with city and state records and interviews with past landowners. Original land-use was agricultural, beginning at the time of settlement in the mid 1850's and continuing through the early 1960's. Since 1962, development has replaced agriculture. Discussion in the text is therefore divided between these two time frames and land-use types. Various aspects of the land-use history are illustrated in Figures 2, 3, and 4.

AGRICULTURE 1855-1962

INTRODUCTION

Up until the year 1853, with the coming of the first settlers, the area around Black Dog Lake was inhabited by about 250 Dakota Indians and their chief, Black Dog. Because the Dakotas were hunter-gatherers, Black Dog and his people left no discernable mark on the land. Ownership of the study area began in October 1855 when Carlos Wilcox took out a patent on a number of parcels, including the fen (Appendix I); thus began the era of agriculture. Farmers at the time required land suitable for three different types of use: woodland for lumber and fuel, flat open areas for cultivation, and bottomland to provide hay for animals. Black Dog Preserve is located within this bottom or meadow land. The following discussion focuses on agricultural activities in the area and the railroad.

THE RAILROAD

One of the oldest and most conspicuous land-use features on Black Dog Preserve is a railroad right-of-way. The rail was laid in 1865 by the Minnesota Valley Railroad Company as part of its line between West St. Paul and Shakopee. In addition to the rail bed itself, the railroad produced a number of other modifications along its easement. These modifications included trestles to facilitate drainage and farm crossings to provide access to the hay meadows north of the tracks (Fig. 2). While the railroad maintained these farm crossings into the early 1960's, they are now barely discernable beneath the vegetation. The railroad also fenced both sides of its right-of-way with five-strand barbed wire and wooden posts. Almost no evidence of this fence remains today. The railroad also erected telephone lines along the southern border of its easement and these are still maintained in good repair.

Ownership of the line went through a number of changes before it was acquired by its present owner, the Chicago and Northwestern Railroad Company (C&NW) in 1904. The C&NW still runs freight along this line.

HAYING

Since the bottomlands that make up the SNA were too wet and marshy for cultivation, haying was the single most important agricultural land-use that occurred on Black Dog Preserve. Through interviews with Pat Connelly, a past-landowner (1983), and the use of aerial photos, a general outline of haying operations from 1930 to 1964 was formed. Information gleaned from Burnsville '76, a Community History (Burnsville Bicentennial Heritage Committee 1976), and Pat Connelly indicates that haying methods from that time period were simply a continuation of farm practices since settlement times. Farmers mowed around August using a team of horses and a horse-drawn mower. Once cut, the hay was stacked and left standing in the fields until winter. After the ground froze the farmers hauled the hay up out of the valley with a horse-drawn sleigh. Roads used for haying are illustrated on Figure 2. The only changes in haying practices came in the mid-1950's when tractors replaced horses and the hay was baled instead of stacked. Aside from these changes, haying continued as usual until around 1962.

FIRE HISTORY

Fire history at Black Dog Preserve closely parallels its mowing history because fire was utilized by all the landowners in the area to enhance their hay production. Since the tract is bounded on the north by Black Dog Lake, on the west by Interstate 35W, and on the south by the railroad and bluff, there was never any need to mow artificial firebreaks. Burning was done early in the spring before the ground thawed and occurred every 1 or 2 years. Fire burned off the stubble from the previous year, accelerated the return of nutrients to the soil, and eliminated the encroachment of woody species on the grassland. There have been at least 2 fires in the study area since haying ceased in 1962. The first was a grass wildfire which occurred in March 1981 and burned 100 acres just east of Interstate 35W. The second was a U.S. Fish and Wildlife Service prescribed burn in May 1983. This fire burned the land east of the creek including the northern 80 acres of the SNA.

DRAINAGE

Meadowland adjacent to the bluff line was often too wet and marshy to mow. To alleviate this problem and increase their hay yield, some farmers altered natural drainage in the study area by ditching (Fig. 2). This occurred in the late 1920's and early 1930's, and most of the ditches were hand dug by individual landowners. Drainage on the SNA tract itself was enhanced only slightly by widening and cleaning out pre-existing drainage channels. Owners of adjacent land, however, put in more extensive drainage ditches. One farmer used ditches to enhance the pre-existing topography, while another put in a North-South trending row system in an attempt to make his land dry enough to cultivate.

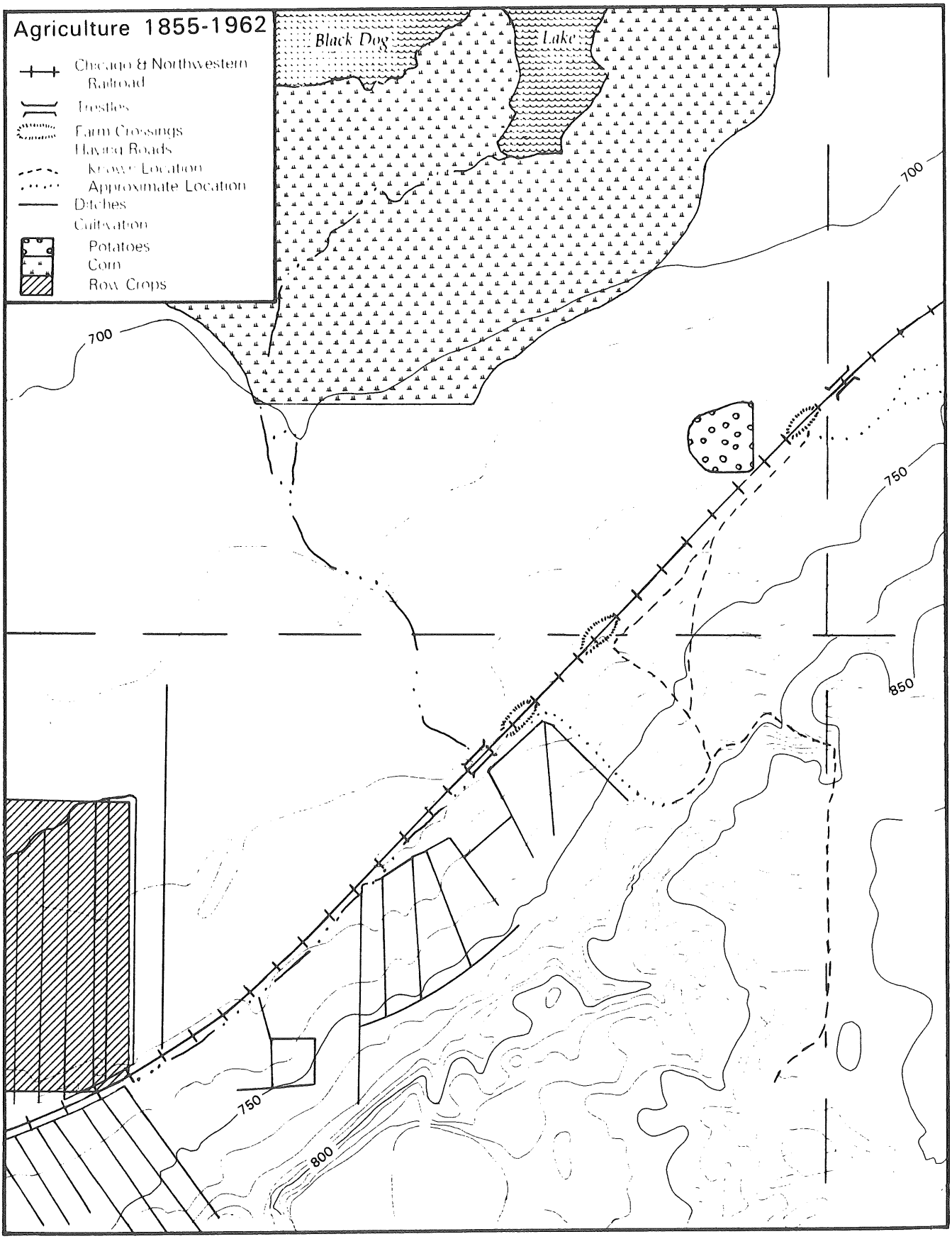


Figure 2: Land use – agriculture.

CULTIVATION

As a rule, farmers in the study area used the bluff for cultivation, and the wet bottomlands for hay, however, cultivation did occur in the bottomlands under certain conditions (Fig. 2). For one season in 1926, one farmer tried planting 3-4 acres of potatoes on a high piece of ground but experienced little success. During the drought of the late 1930's and early 1940's, when Black Dog Lake almost disappeared from lack of water, one farmer was able to plant about 100 acres of corn (out on the floodplain) for a number of years. Another farmer--one with an ambitious ditching system--was able to cultivate row crops through the drought and even into the 1950's.

DEVELOPMENT

INTRODUCTION

Black Dog Preserve is located within one of the fastest growing communities in the state. During the decade from 1962 to 1972, almost the entire bluff changed from farmland to residential neighborhoods. Around 1978 development of light industry began in the bottomlands. Development of the bottomlands was late in starting because of the significant capitol investment required to excavate the peat soil, and replace it with fill material. Discussion of development is split into two sections; the first deals with land-use features found within SNA boundaries, the second deals with adjacent land-use features. Development features are illustrated on Figures 3 and 4.

SNA DEVELOPMENT FEATURES

The most striking development features on Black Dog Preserve SNA are associated with Northern States Power's (NSP's) transmission lines. The lines originate on the north side of Black Dog Lake at the Black Dog Power Plant and run through the SNA parallel with the railroad tracks (Fig. 3). Land within NSP's 226 foot wide easement has been repeatedly disturbed by heavy machinery. The erection of the towers in 1951-52 and 1968-69 required trucks, cranes, and caterpillar tractors. Since 1962, when haying on the SNA ceased, NSP's main management problem on the easement has been to prevent the growth of trees to a size that would interfere with the power lines. This control was originally accomplished by the farmer's annual burning and mowing; but is now accomplished with occasional cutting and herbicide application. NSP's maintenance history began in 1976 when the entire line was cut with a hydroaxe, a large hydraulic brush-cutter mounted on a heavy truck. In 1979 the northern half of the line within the study area was hydroaxed again while the few trees in the southern half were hand cut. Finally, in 1981, NSP foliage- sprayed to try and kill off the fast-growing poplars. The herbicide used was 1/2 gallon of Tordon 101, 3/8 gallon of Garlon 4, and 16 oz. of the surfactant Acutrol, in 100 gallons of water. This was broadcast-sprayed over the entire length of easement with an all-terrain tract vehicle. In between these dates, periodic maintenance checks were made with either tract vehicles or snowmobiles. The vehicles used in the various phases of NSP's management plan have left furrows and tracks all along the easement (Anderson and Lawrence 1983).

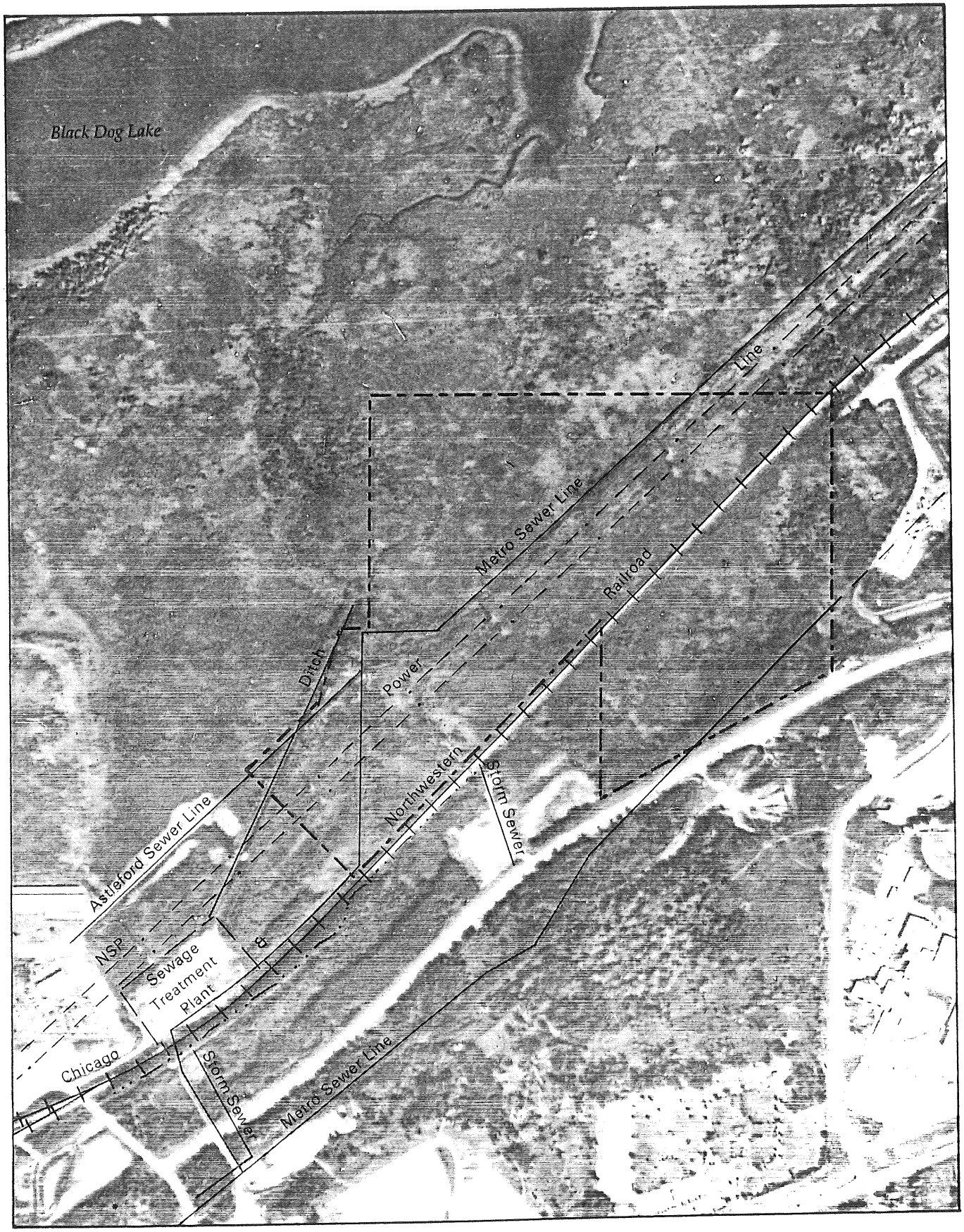


Figure 3: Development features – on SNA.

A second set of important land-use features on Black Dog Preserve is associated with a sewage treatment plant that once occupied the site of the present Burnsville Recycling Center. The treatment plant was built in 1962 to accommodate the fast-growing community. At that time an effluent ditch was dug to channel the treated sludge through the peatland to a creek that emptied into Black Dog Lake and eventually into the Minnesota River. In 1963 the city put in one sanitary sewer line from the treatment plant north through the preserve and then north-east on a line parallel with NSP's power lines, and another, running parallel to the railroad on the south side of the tracks. To facilitate movement of heavy equipment through the marshy area while building the line, coarse gravel was mixed with the peat soils used to bury the pipe. Trucks then traveled over the already buried line on a dry, stable surface (City of Burnsville Eng. Dept. 1983).

The Metropolitan Sewer Board demolished the sewage treatment plant in 1974 but the effluent ditch was never filled. Water flows into it from the surrounding peat and is channeled off into the creek. Cottonwoods have established themselves on the spoils produced in digging the ditch. Similarly, a line of quaking aspens also grow on the land that was disturbed when the sewer line went in.

In 1979 the Astleford Construction Company built a sanitary sewer line to service their new industrial development adjacent to Black Dog Preserve. This sewer runs along the northwestern boundary of the SNA and ties in with the old Metro Sewer line (Fig. 3).

ADJACENT LAND USE

Land use on the area surrounding Black Dog Preserve takes many different forms, ranging from a wildlife refuge to a parking lot. Due to the complexity of adjacent land use, this discussion is organized in a counter-clockwise direction beginning north of the SNA and working around. The discussion can be followed on Figure 4.

Land due north of the SNA is owned by Northern States Power Company but leased to the U.S. Fish and Wildlife Service, which manages it as a part of the Minnesota Valley National Wildlife Refuge. Northwest of the SNA, adjacent to Interstate 35W, is an abandoned sanitary landfill which received municipal wastes from 1966 through 1971. Adjacent to the SNA's western boundary are two parcels of land owned by Astleford Construction Company; 1. Astleford Development, and 2. Astleford Propety. The Astleford development will be filled and developed sometime in the near future. A road and sanitary sewer to service these lots has already been constructed. No development is presently planned on the Astleford property. West of Astleford's Property is an area known as the Burnsville Industrial Park, Third Addition. Three of the industrial park's five lots have been excavated and filled, and now house a car dealership, a van conversion company, and a public storage facility. The remaining two lots are still idle. The study area is bounded on the far west by Interstate 35W. This road was originally built around 1920 as U.S. Trunk Highway 50. It became Trunk Highway 65 around 1950, and finally, in 1960, it was rebuilt and became Interstate 35W, (also U.S. 65). Cliff Road bounds the study area on the south; built in 1965 to service the growing community of Burnsville. The city of Burnsville owns all the land between the railroad tracks and

Cliff Road, bounded by the Burnsville Industrial Park and the SNA, as well as the Recycling Center land already discussed. At this time the northeast portion of this strip has been developed into a Burnsville city well, a parking lot, and two soccer fields. The city well was the first to go in and was built in 1971. In 1977 the city began using the area just south of this well as a dumping site of city produced fill, such as bricks, trash, wire, metal, boards, and pieces of concrete and stones. In 1980 this fill area was graded, paved and turned into a bus commuter 'Park-and-Ride' lot for the Minneapolis Transportation Company (MTC). Fill materials that accumulated after 1980 were dumped just east of the MTC lot until 1981 when the area was graded, buried with black soil, and seeded with grass, resulting in a soccer field. This process was repeated between 1981 and 1983 to produce a second soccer field adjacent to the first. Filling ceased in 1983 when the city of Burnsville was alerted to the significance of the land being filled. Finally, the land east of the SNA is owned by the Minneapolis Gas Company (Minnegasco).

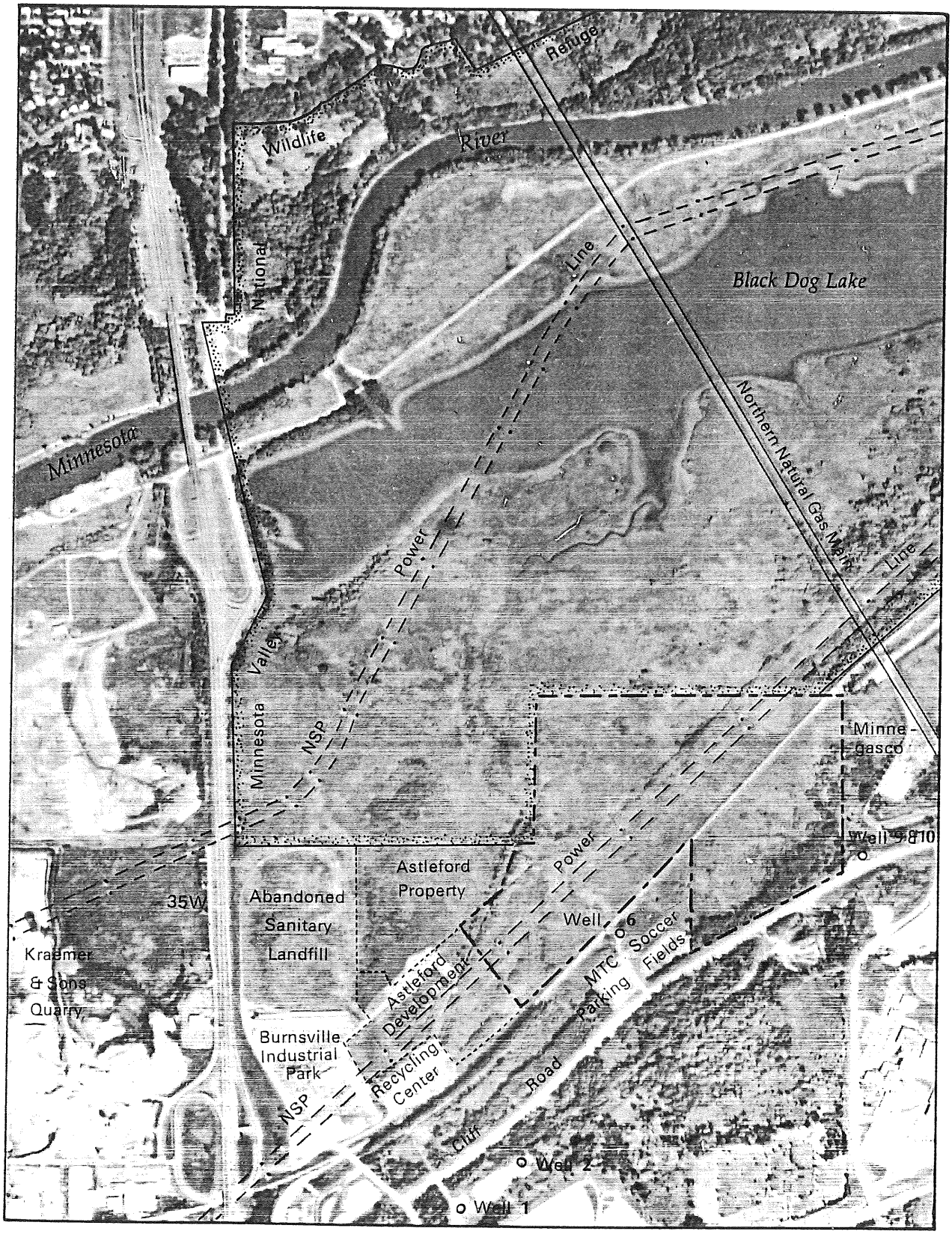


Figure 4: Development features – on adjacent land.

PHYSICAL RESOURCES

INTRODUCTION

The physical resources of the study area have been broken down into separate sections on geology, soils, climate, and water resources. Geology, generally referring to the study of the earth, has been further subdivided into separate parts on stratigraphy and geomorphology. The former discusses the various geologic units underlying the tract, while the latter explains the evolution of the surface landforms on the tract. The second major topic discussed is soils. Simply defined, soil is the weathered surface on the earth and essentially represents a transition from the geological to the biological realms of any area. Climate, the third major topic, relates to the long-term atmospheric characteristics of an area, principally temperature and precipitation. Finally, the water resources section discusses soil moisture, groundwater, surface water features, and flooding.

In the discussion of these physical resources, particularly of geology, attention is given to historical as well as to purely descriptive aspects. An historical view not only aids understanding of the area, but also helps to identify unique physical features.

GEOLOGY

STRATIGRAPHY

On the floodplain, the top unit of bedrock beneath Black Dog Preserve is covered by approximately 11 feet of 'overburden'. The topmost layer is organic soil, predominantly muck and peat. Beneath the soil is a layer of alluvium and colluvium. It is unknown whether the alluvium-colluvium layer rests directly on bedrock or on a layer of glacial material. If there is glacial material present here, it is either part of the St. Croix Moraine, or a mixture of Superior and Des Moines Lobe drifts. The St. Croix Moraine is composed of reddish-brown, sandy material with a high concentration of lithic fragments. If the drift resulted from a mixture of both lobes its composition would be gray, calcareous shale and limestone, interbedded with red drift. The floodplain escarpment in the southeast portion of the area is Superior Lobe Drift. The top layer of bedrock on the site is the Prairie du Chien, a buff-colored, thin to thick bedded, medium-grained, quartzose sandstone and finely crystalline dolomite. This, in turn, overlies the Jordan Sandstone, a white or yellow, massively bedded, medium- to coarse-grained orthoquartzite. These strata together act as a hydrologic system and comprise the principal aquifer of the Twin Cities Basin. There are approximately 4,500 more feet of sedimentary rocks between the Jordan Sandstone and Precambrian basement. Figure 5 is a stratagraphic column for the Black Dog Preserve.

GEOMORPHOLOGY*

The region around Black Dog SNA can be conveniently divided into two major landform units:

1. A bluff, capped by young glacial drift of approximately late-Wisconsin age.

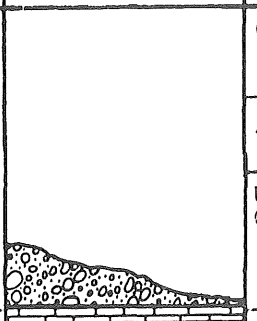
2. A floodplain, covered with a thin veneer of alluvium and colluvium.

The bluff is composed of barely eroded terminal moraine and exhibits typical knob-and-kettle topography. The sides are steep with numerous gullies and ravines. The slopes gradually flatten out into a broad, nearly level floodplain. Both of the present landforms are the result of glacial action within the area about 14,000 years ago, but the bluff is a constructional landform while the floodplain is erosional.

Glaciation in southeastern Minnesota occurred in two phases. First, the Superior Lobe advanced from the northeast, bringing with it drift from the Canadian Shield and Superior Basin. While this drift is generally a non-calcareous, reddish-brown sand and shale with crystalline pebbles, in the Twin Cities area it is calcareous due to incorporated local limestone bedrock. At its southernmost advancement, the Superior Lobe deposited the St. Croix Moraine, which covered this area. Before all the ice within the St. Croix Moraine had melted, the second stage of glaciation began. The Des Moines Lobe advanced toward the southeast from the northwest, bringing with it drift from Manitoba and North Dakota. It followed the bedrock depression along the Red River Valley and then the Minnesota Valley. When the ice sheet reached the big bend in the Minnesota River Valley at Mankato, the Grantsburg Sublobe separated from the main sheet and advanced to the northwest into Minneapolis, overrunning part of the St. Croix Moraine. Drift deposited by the Grantsburg Sublobe is typically gray calcareous shale and limestone. Where its lower point rests on the red drift of the St. Croix Moraine it consists of interlaminated red sandy and gray silty till. This combined glacial construction is what formed all the highlands within the Black Dog area (Fig. 6).

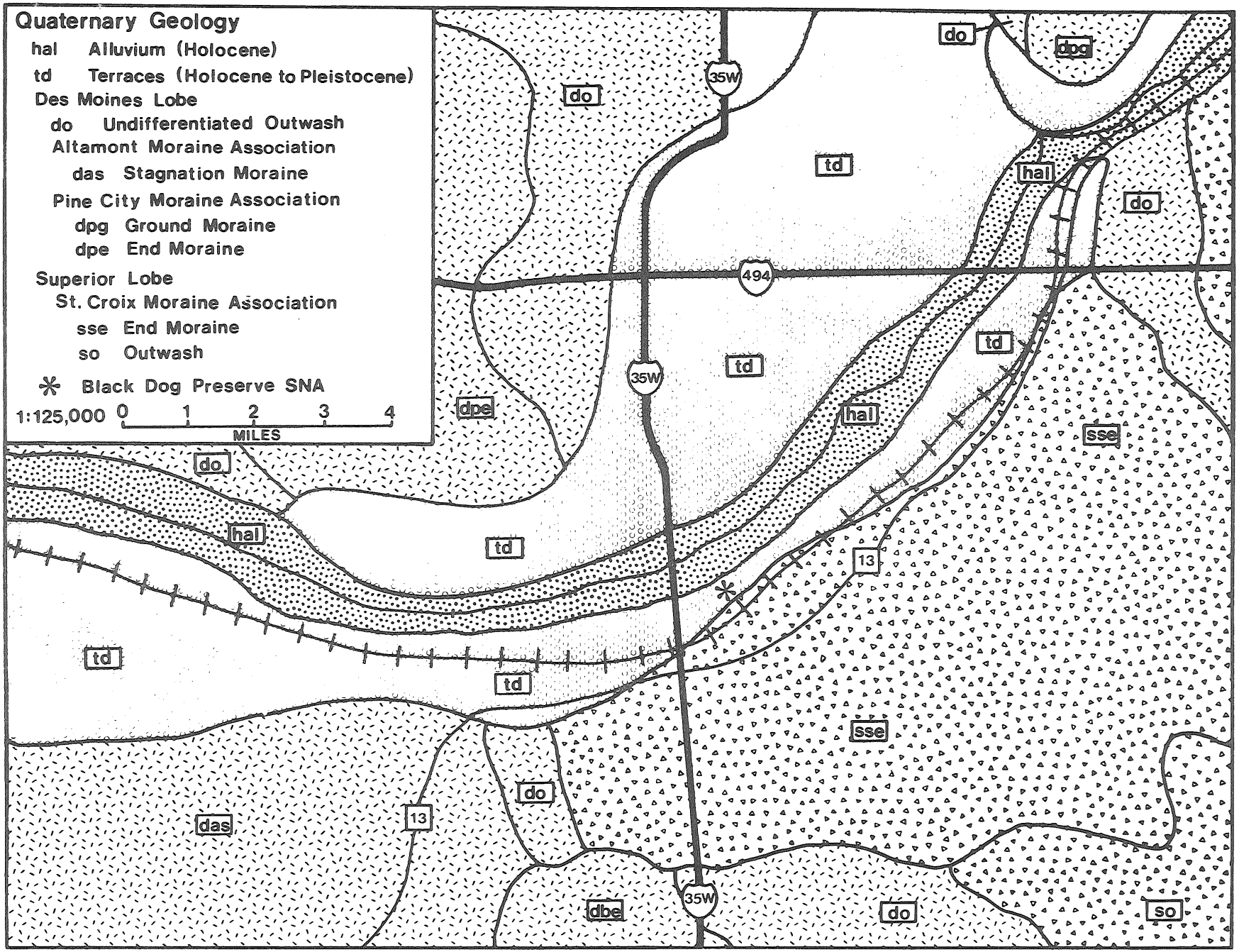
After the Des Moines Lobe withdrew from the area, during its final retreat to the north, it deposited the Big Stone Moraine across the Minnesota and Red River Valleys, essentially damming its southward drainage. The meltwater that accumulated behind this dam formed Glacial Lake Agassiz. As the ice withdrew further to the north, the lake enlarged, repeatedly breaching its southern impoundment and creating the Glacial River Warren. This huge river cut a broad channel, greater than a mile across, down

* Sims, P.K. and G.B. Morey, ed. 1972. Geology of Minnesota: A Centennial Volume. Minnesota Geological Survey. St. Paul, Minn., 632pp.

SYSTEM	APPROX. THICKNESS (in feet)	GEOLOGIC COLUMN	ROCK UNIT	GENERAL DESCRIPTION
QUATERNARY	11		COLLUVIUM	Unsorted slope sediment composed largely of rock rubble in a matrix of finer grained material.
			ALLUVIUM	Sand, gravel, silt & clay deposited in channals and floodplains.
			UNDIFFERENTIATED GLACIAL DEPOSITS	Gray calcareous drift of shale and limestone clasts interbedded with reddish-brown sandy, stoney till of predominantly igneous and metamorphic clasts.
ORDIVICIAN	50		PRAIRIE DU CHIEN GROUP: SHAKOPEE FORMATION	Buff dolostone, thin to thick bedded, silt- and sand-rich, med.-gr.; some interbedded quartzose s.s. and shale; chert and stromatolites common.
	100		PRAIRIE DU CHIEN GROUP: ONEOTA DOLOMITE	Buff dolostone, thin to thick bedded finely crystalline dolomite with silt sized dolomite matrix.
CAMBRIAN	90		JORDAN SANDSTONE	White or yellow orthoquartzite s.s., massively bedded, med.- to coarse-gr., well sorted, poorly cemented.
	50		ST. LAWRENCE FORMATION	Gray to tan dolostone, silty or sandy, argillaceous; glauconitic in upper part.
	155		FRANCONIA FORMATION	Greenish-gray s.s., thin bedded, fine- to coarse-gr., feldspathic to dolomitic, commonly glauconitic.
	30		IRONTON FORMATION	White or light gray s.s., poorly to moderately well sorted, med.-gr. silty quartz arenite.
	35		GALESVILLE FORMATION	White to light gray s.s., well sorted, fine- to med.-gr., quartzose.
	85		EAU CLAIRE FORMATION	Red s.s., fine- to med.-gr., silty, glauconitic, interbedded with grayish-green to red fissile shale.
	160		MT. SIMON SANDSTONE	White, light gray or yellow-gray s.s., med.- to coarse-gr., friable quartzose; shale stringers in upper part; pebble conglomerate or very coarse s.s. at base.
PRECAMBRIAN	to 4,000		KEWEENAWAN RED BEDS	Dark reddish-brown very silty s.s., poorly sorted, fine- to med.-gr., arkosic to lithic.
			BASEMENT	Middle Keweenawan Volcanic Rocks: mostly mafic lava flows with thin interflow sediments.

Source: Adapted from Hogberg, 1972

Figure 5: Geologic column.



Source: Adapted from Hobbs & Goebel, 1982

Figure 6: Quaternary geology of the Black Dog Region.

through the accumulated glacial sediments and into the bedrock below. Several terrace levels observable along the Minnesota River Valley are related to this gradual downcutting. The deepest portion of the valley cut into the Jordan Sandstone, though in our area it only reaches into the Prairie du Chien. About 9,200 years ago, as Glacial Lake Agassiz itself retreated in the wake of the ice sheet, its southern outlet was abandoned. This drastic reduction in water volume left only the stream that is the Minnesota River to meander through a greatly oversized valley.

Sedimentation and erosion have both been at work since glacial times, altering the landforms. The Minnesota River, whenever it tops its shallow banks and floods the valley, deposits sand, gravel, silt, and clay over the plain. Erosion is wearing away the moraine and depositing an unsorted slope sediment at the base of the bluff. Both of these natural processes is presently being enhanced by development in the area. Encroachments into the floodplain such as fills and buildings reduce the capacity of the floodplain to carry flood water. This decrease in capacity will increase the height and frequency of floods. Development in the uplands has increased both the volume and the velocity of surface runoff, which in turn has sped up erosion, both on the slopes and in the floodplain.

SOILS*

The soils of Black Dog SNA are not highly developed. This can be attributed to both the relatively recent surface deposits on the site, no more than 12,000 years old, and the cold climate, which has inhibited many soil-forming properties. The soils present on the site, like the landforms, can be broken down into two categories: those found on the bluff and those found on the floodplain. The bluff soils formed on glacial till, while the floodplain soils formed on alluvium and colluvium. The soils can be easily differentiated by texture, degree of horizon development, and percent of organic matter.

Floodplain soils are organic, primarily mucks and mucky peats. They are often black throughout a 60-inch profile, or they grade from black at the surface to gray or dark mottled in the subsoil. Organic content averages greater than 25% and may exceed 75%. In contrast, the bluff soils are loams and loamy sands. They tend to have more pronounced horizons and grade from very dark brown and gray-brown at the surface to very dark gray in the subsoil. Organic content in in these soils ranges from less than 1% to 6% and averages only 2-4%. This trend of muck and peat soils in the floodplain, and loams and sands on the bluff occurs in an unbroken band all along the south side of the Minnesota River, from Dean Lake to Fort Snelling (Fig. 7).

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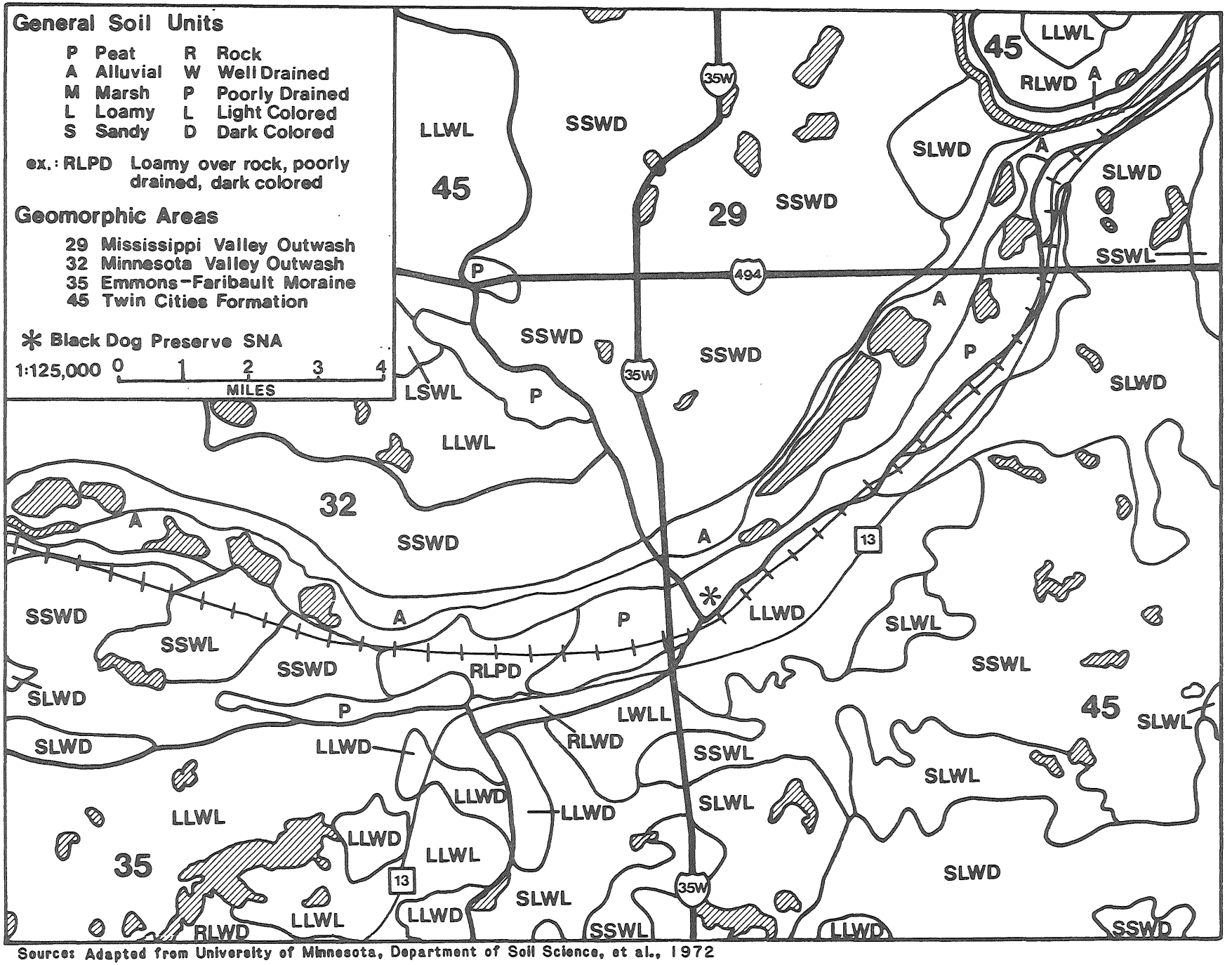
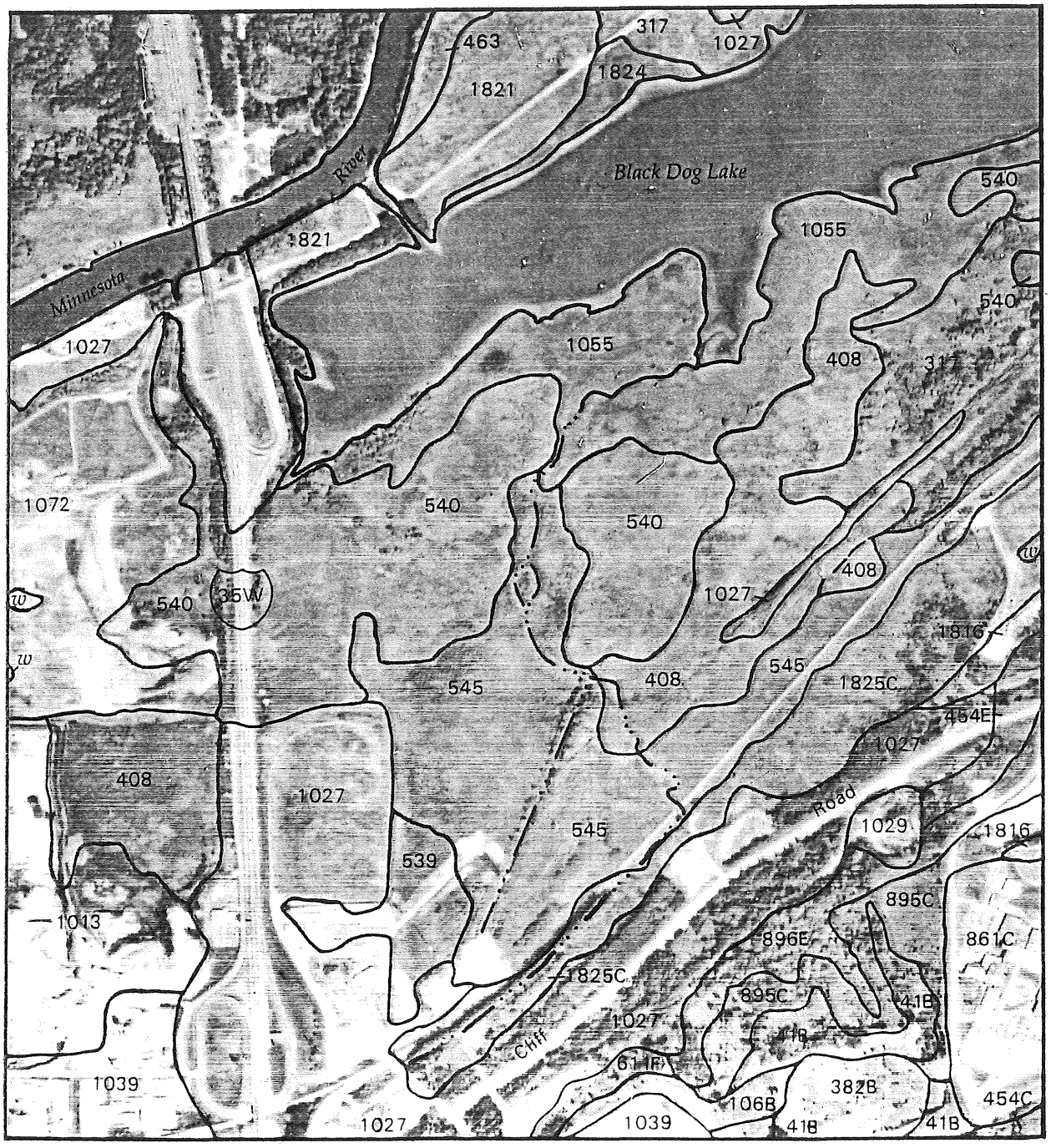
* U.S. Department of Agriculture, 1983. Soil Survey of Dakota County Minnesota, U.S. Dept. of Agricult., Soil Cons. Serv., Unpubl. Doc.



Source: Adapted from University of Minnesota, Department of Soil Science, et al., 1972

Figure 7: General soils map.



Source: Adapted from U.S. Department of Agriculture, 1983 & 1979

Figure 8: Detailed soils map.

Major soil series occurring in the SNA are described below and correspond to the more detailed soil map of the study area (Fig. 8).

41B Estherville sandy loam, 2-6% slopes: Moderately dark-colored excessively drained loam about 20 inches thick overlaying gravelly loamy sand and sand about 40 inches thick. (Typic Hapludolls). Gently sloping soil found on outwash plains and stream terraces.

94C Terril loam, 4-6% slopes: Moderately dark-colored, moderately well drained loams about 60 inches thick. (Cumulic Hapludolls). Gently sloping soil found on plane or concave upland foot slopes.

106B Lester loam, 2-6% slopes: Moderately dark-colored, well drained loam and clay loam about 60 inches thick. (Mollic Hapludalfs). Gently sloping soil found on ridge crests and side slopes on end moraines.

317 Oshawa silty clay loam: Dark-colored, very poorly drained silty clay loam about 40 inches thick over mottled silty clay loam about 20 inches thick. (Cumulic Haplaquolls). Level soil found on flood plains of major rivers.

382B Blooming silt loam, 1-6% slopes: Moderately dark-colored, well drained silty clay loam grading down to sandy clay loam for 40 inches, over calcareous sandy loam about 12 inches thick. (Mollic Hapludalf). Gently sloping soil found on summits and side slopes of end moraines.

408 Faxon silty clay loam: Dark-colored, poorly to very poorly drained silty clay loams about 40 inches thick underlain by limestone bedrock. (Typic Haploquall). Nearly level soil found on bedrock terraces along the floodplain.

454C Mahtomedi loamy sand, 8-15% slopes: Moderately dark-colored, excessively drained loamy sand about 5 inches thick overlaying gravelly coarse sand and coarse sand about 30 inches thick. (Typic Udipsamments). Rolling to hilly soil found on end moraines and pitted outwash plains.

454E Mahtomedi loamy sand, 15-25% slopes: Dark-colored, excessively drained loamy sand and coarse sand about 50 inches thick covering sandy and gravelly coarse sand about 30 inches thick. (Typic Udipsamments). Hilly to steep soils found on side slopes and narrow crests of ridges and hills and on end moraines.

463 Minneiska loam, occasionally flooded: Moderately dark-colored, moderately well drained loam about 8 inches thick on loam and loamy fine sand about 50 inches thick. (Mollic Udifluvents). Nearly level soil found on floodplains of major rivers.

539 Palms muck: Dark-colored, very poorly drained muck about 50 inches thick underlain by clay loam about 15 inches thick. (Terric Medisaperists). Nearly level soil found on the Minnesota River floodplain.

540 Seelyeville muck: Dark-colored, very poorly drained muck and mucky peat about 60 inches thick. Sometimes all mucky peat. (Typic Borosaprists). Nearly level soil found in broad areas along the Minnesota River floodplain.

545 Rondeau muck: Dark-colored, very poorly drained muck about 45 inches thick underlain by marl about 15 inches thick. (Limnic Borosaprists). Nearly level soil found in areas on the Minnesota River floodplain and in upland depressions.

611F Hawick loamy sand, 35-50% slopes: Dark-colored, excessively drained loamy sand and sand about 20 inches thick over coarse sand about 40 inches thick. (Entic Hapludolls). Soil found on very steep side slopes, on outwash plains, and in stream valleys.

861C Urban land-Kingsley complex, 3-15% slopes:
50-60% Urban land: Streets, parking lots and buildings.
20-35% Kingsley: Moderately dark-colored sandy loam about 38 inches thick over sandy loams and loamy sand about 22 inches thick. (Mollic Halpludalfs). Undulating to rolling soils found on hill crests and side slopes on end moraines.

895C Kingsley-Mahtomedi-Spencer complex, 8-15% slopes:
Kingsley: See 861C.
Mahtomedi: See 454C.
Spencer: Moderately dark-colored, moderately well drained silt loam and silty clay loam about 40 inches thick covering sandy loam about 20 inches thick. (Typic Glassoboralfs). Rolling to hilly soils found on side slopes and ridge crests of end moraines.

896E Kingsley-Mahtomedi complex, 15-25% slopes:
Kingsley: Dark-colored, well drained sandy loam and loamy sand about 30 inches thick underlain by loamy sand and sandy loam about 30 inches thick. (Mollic Hapludalfs).
Mahtomedi: See 454E.
Hilly to steep soils found on side slopes and narrow crests of ridges and hills and on end moraines.

1013 Pit, quarry: Areas that have been mined for limestone or sandstone. The areas include excavations and piles of unconsolidated materials such as bedrock fragments. Water is in the deeper parts of some quarries.

1027 Udorthents, wet: Heterogenous, earth fill material and industrial waste on poorly drained and very poorly drained mineral and organic soils. Nearly level.

1029 Gravel pits: Sand, gravel or loamy earth pits. Reclamation includes extensive filling and grading.

1039 Urban land: More than 90% of the surface of this map unit is covered with buildings, asphalt, concrete, or other impervious surfaces. Developments on these areas include factories, shopping centers, warehouses, railroad yards and parking lots.

1055 Aquolls and Histosols, ponded: Very poorly drained mineral and organic soils. (Mesic Haploquolls). Level soils around rivers and in depressions on till and outwash plains.

1072 Udorthents, moderately shallow: Active sanitary landfill where solid waste is covered daily. Some of these areas filled with soil and waste material are higher in elevation than the adjacent soils.

1816 Kennebec Variant silt loam: Moderately dark-colored, moderately well drained silt loam and loam about 40 inches thick covering silty clay loam about 15 inches thick. (Cumulic Haplodolls). Nearly level soil found in closed depressions on end moraines.

1821 Alganssee sandy loam, occasionally flooded: Moderately dark-colored, somewhat poorly drained sandy loam about 12 inches thick underlain by sand about 48 inches thick. (Aquic Udipsamments). Nearly level soil found on floodplains of major rivers.

1824 Ouam, silt loam, ponded: Dark-colored, very poorly drained silt loam to 60 inches deep. Commonly ponded in all seasons. (Cumulic Haplaquolls). Level soil found in closed depressions and around lake borders on end moraines.

1825C Seelyeville muck, sloping: Dark-colored, very poorly drained loamy sand and sand about 20 inches thick over coarse sand about 40 inches thick. (Entic Hapludolls). Soil found on side slopes of outwash plains and in stream valleys.

WATER RESOURCES

SOIL MOISTURE

Soil moisture, like soil type, differs greatly between the bluff and the floodplain. Floodplain soils, though moderately permeable, exhibit very poor drainage. This is due to properties of muck and peat soils, the seepage of water from the base of the bluff, and the low relief of the floodplain. In contrast, the bluff soils are also moderately permeable yet exhibit moderate to excessive drainage. This can be attributed to the high relief of the bluff and its loamy soils.

GROUNDWATER

The groundwater system of Black Dog Preserve is quite complex due to both the glacial deposits and the bedrock. Unconsolidated glacial deposits are composed primarily of sands and gravels, which produce inconsistent and erratic groundwater flow. This water eventually seeps out at the base of the Minnesota River escarpment. The site also sits on top of three separate systems of aquifers comprised of six different formations (Fig. 9). The

Prairie du Chien-Jordan Aquifer System is quite close to the surface and may provide water to the site. It is separated from the other aquifer systems by the St. Lawrence Formation, which acts as a confining layer. The Minnesota River Valley serves as a regional discharge zone for groundwater in both the Prairie du Chien-Jordan System and the glacial drift. The aquifers beneath the Jordan do not appear to discharge into or to be influenced by either the Jordan Aquifer or the Minnesota River.

The natural flow of water in the Prairie du Chien-Jordan system is north/northwest, towards the river, but there is also vertical movement of water from the Jordan into the Prairie du Chien. The natural flow of this system is presently affected by two major developments:

1. Kraemer Quarry, which mines the Prairie du Chien for limestone (Fig. 4).

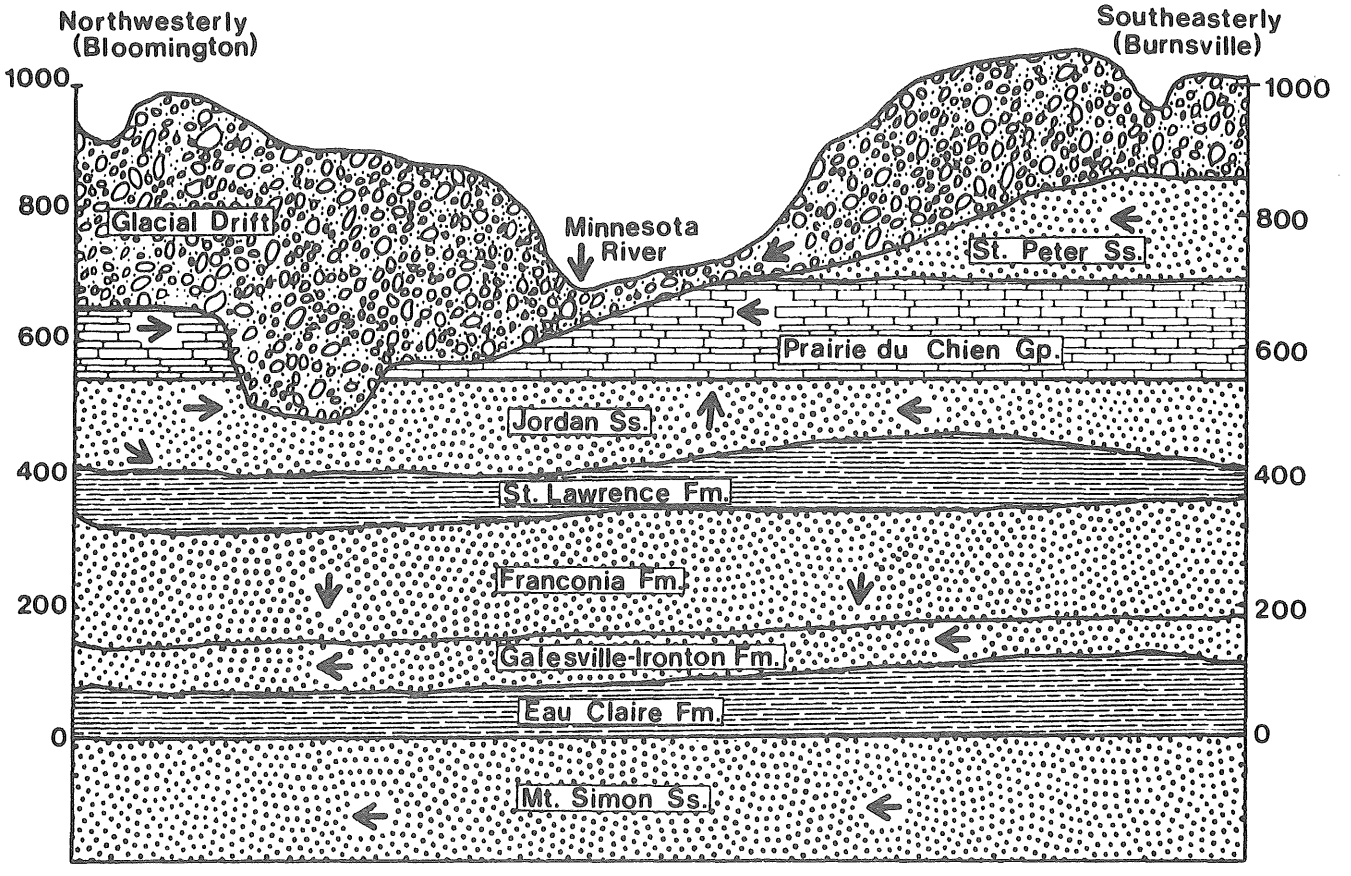
2. Burnsville city water wells, which tap into the Jordan Sandstone for drinking water (Fig. 12).

Edward Kraemer and Sons Quarry began mining operations in 1957. At this time, their pit averages about 25 feet in depth, with the deepest portions reaching 40 feet--still within the Prairie du Chien. The quarry acts as a wide shallow well, with its drawdown affecting both the Prairie du Chien and the Jordan Aquifers (Figs. 10a and 10b). This dewatering of the aquifers changes the direction of flow from north/northwest, towards the river, to almost due west, towards the quarry. The resulting cone of depression also increases the volume of water transfer from the Jordan into the Prairie du Chien.

Burnsville city wells also modify flow directions in the aquifers. During heavy pumping periods, the flow of water in the Jordan is reversed. Horizontally, the flow changes from north, towards the river, to the south, towards the city well field. The vertical direction of flow is also reversed. The normal flow direction is from the Jordan into the Prairie du Chien; after pumping, flow is from the Prairie du Chien into the Jordan (Fig. 11). The drawdown caused in the Jordan by 10 hours of pumping water from the city wells is illustrated in Figure 12.

SURFACE RUNOFF

Surface runoff has also been modified as the city of Burnsville has developed. Original drainage in the area consisted of numerous landlocked depressions. The surface drainage collected in the depressions and either seeped away, was utilized by plants, or evaporated into the air. Many of these depressions never overflowed. When the city designed its drainage plan, it first determined which way the water would flow if the depressions ever filled beyond their capacity and then planned its drainage system utilizing that information (Fig. 13). At the present time four small drainage basins have been consolidated into one large one --the East Central Basin-- employing a system of trunk sewers. As residential development of this area increased, so did the amount of inpermeable land surface, buildings, asphalt, and cement. Water that in the past was allowed to seep away, now was collected and channelled off by the storm sewer system. The East Central Basin releases most of its increased volume of runoff into an

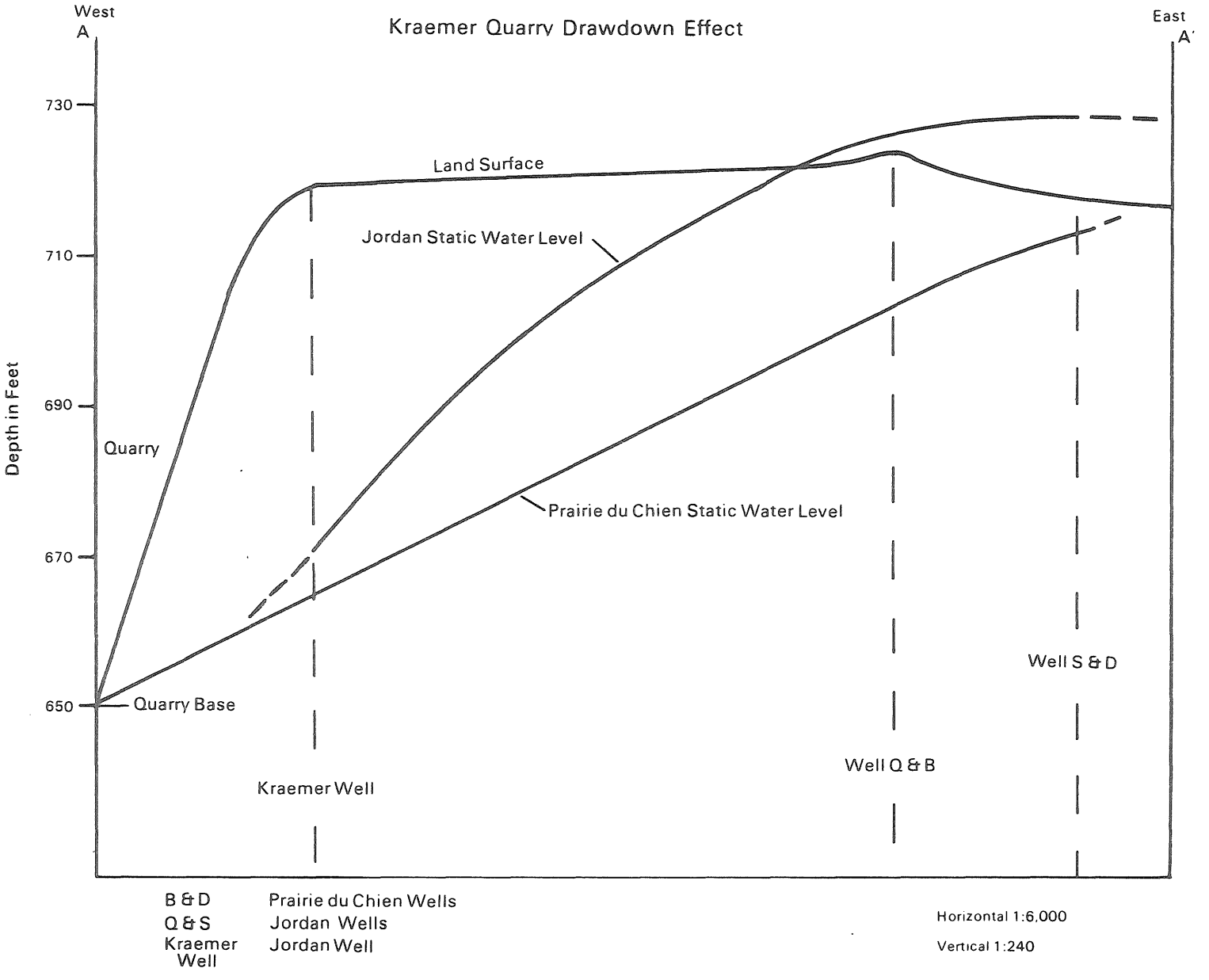


Vertical 1:2760
Horizontal 1:69,000

GLACIAL DRIFT	Aquifer; sand and gravel aquifers that yield moderate to large amounts of water, common in buried bedrock valleys. Distribution of aquifers and confining beds is poorly known.
PRAIRIE DU CHIEN GP. & JORDAN S.S.	Aquifer; high yields from fractures in dolostone and from poorly cemented s.s.; principle aquifer of the Twin City Basin.
ST. LAWRENCE FM.	Confining bed.
FRANCONIA FM.	Aquifer; low yields and confining bed.
IRONTON S.S. & GALESVILLE S.S.	Aquifer; moderate to high yields.
EAU CLAIR FM.	Confining bed.
MT. SIMON S.S.	Aquifer; moderate to high yields; second most important aquifer of the Twin City Basin.

Source: Adapted from Metropolitan Council, 1981 & Hogberg, 1972

Figure 9: Generalized cross section.



Source: Adapted from Bruce A. Liesch & Associates, Inc., 1981

Figure 10a: Draw-down effect of the Kraemer Quarry.

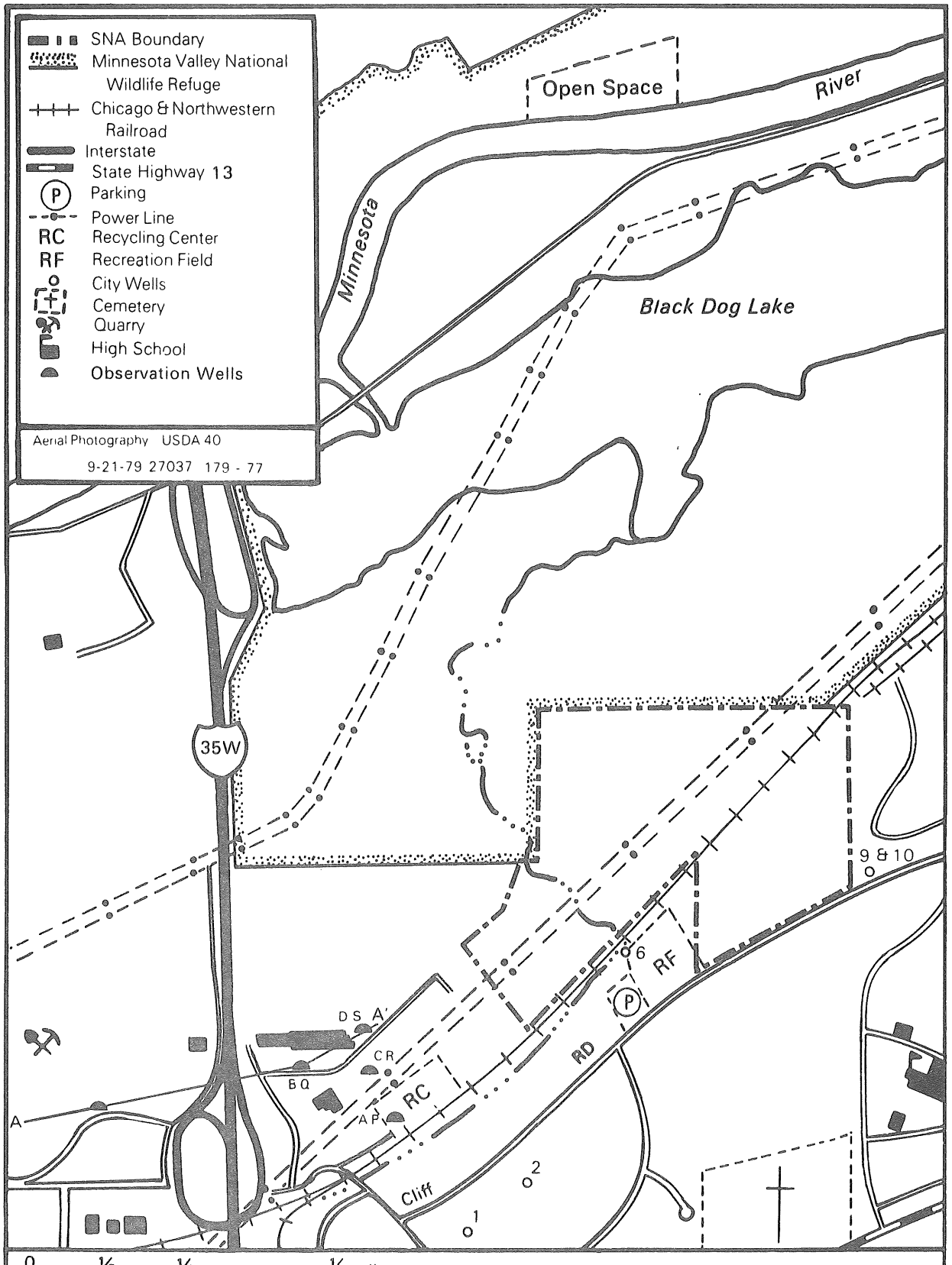
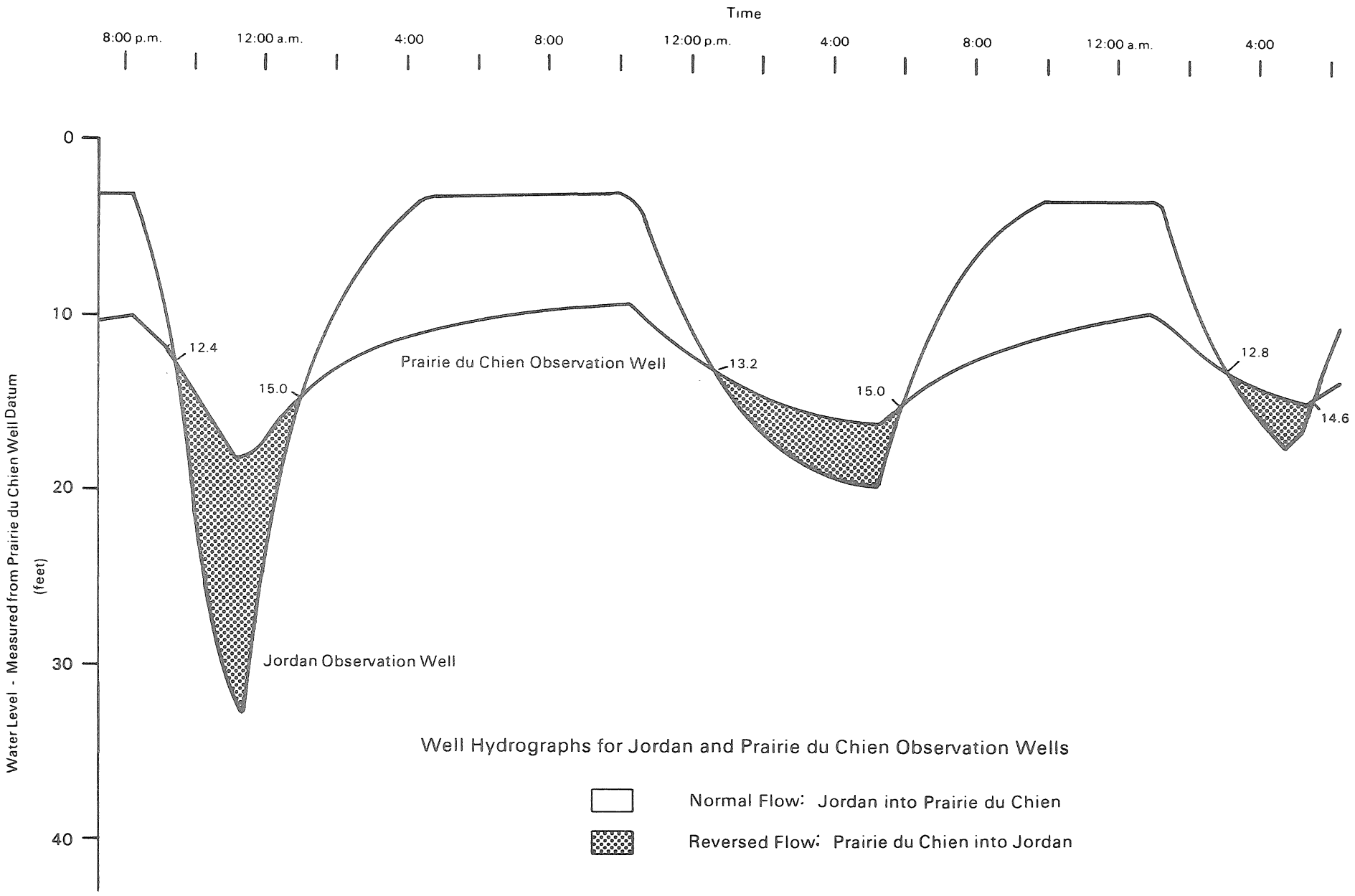
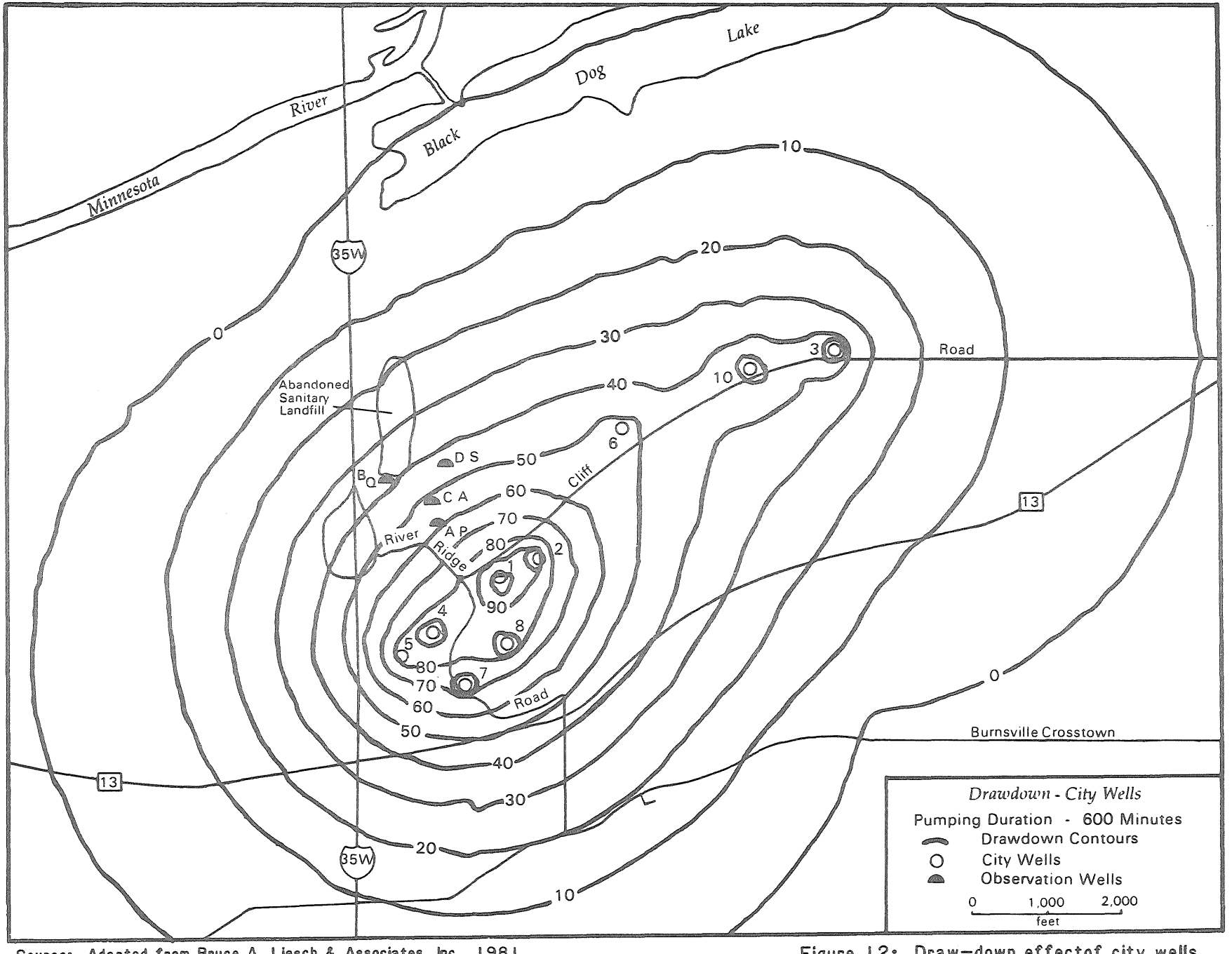


Figure 1 Ob: Location of observation wells and cross-section.



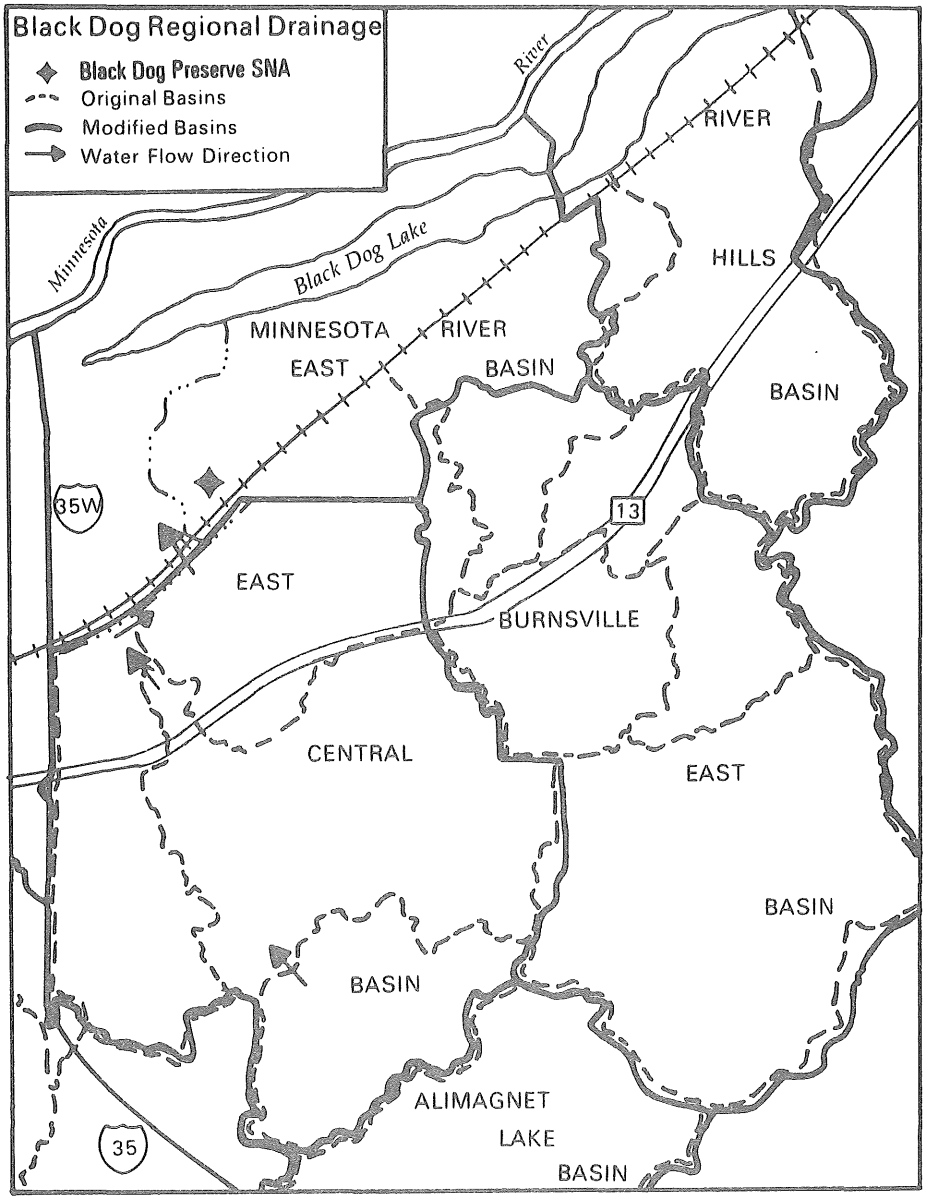
Source: Adapted from Bruce A. Liesch & Associates, Inc., 1981.

Figure 11: Flow reversal.



Source: Adapted from Bruce A. Liesch & Associates Inc., 1981

Figure 12: Draw-down effectof city wells.



Source: Adapted from Barr Engineering Co., 1966

Figure 13: Drainage map.

open ditch that runs along the south side of the railroad right-of-way (Fig 13). The water then dumps into the creek that flows into the Minnesota River East Basin beneath the railroad trestle on the southern boundary of the Preserve (Fig. 3). The creek flows through the SNA and eventually into Black Dog lake. U.S. Geological Survey topographic maps show this creek to be intermittent; however, it is not known to run dry. This is the same creek that the old Metro Sewer ditch flows into. The metro ditch drains the peat throughout the year and possibly modifies both the surface waterflow and the shallow groundwater flow.

FLOODING

Snowmelt, thawing, and substantial rainfall in April and May recharge soil moisture and groundwater, and increase surface runoff. That is the season that flooding is most likely to take place. The 2-year, 10-year, 100-year floodlines for the Black Dog area are listed below and illustrated in Figure 14.

700 ft. 2-year flood
707 ft. 10-year flood
717 ft. 100-year flood (DNR 1978)

Known historical floods and floodlines include:

March 1936	712 ft.
April 1951	715 ft.
Spring 1957	717 ft.
April 1965	738 ft.

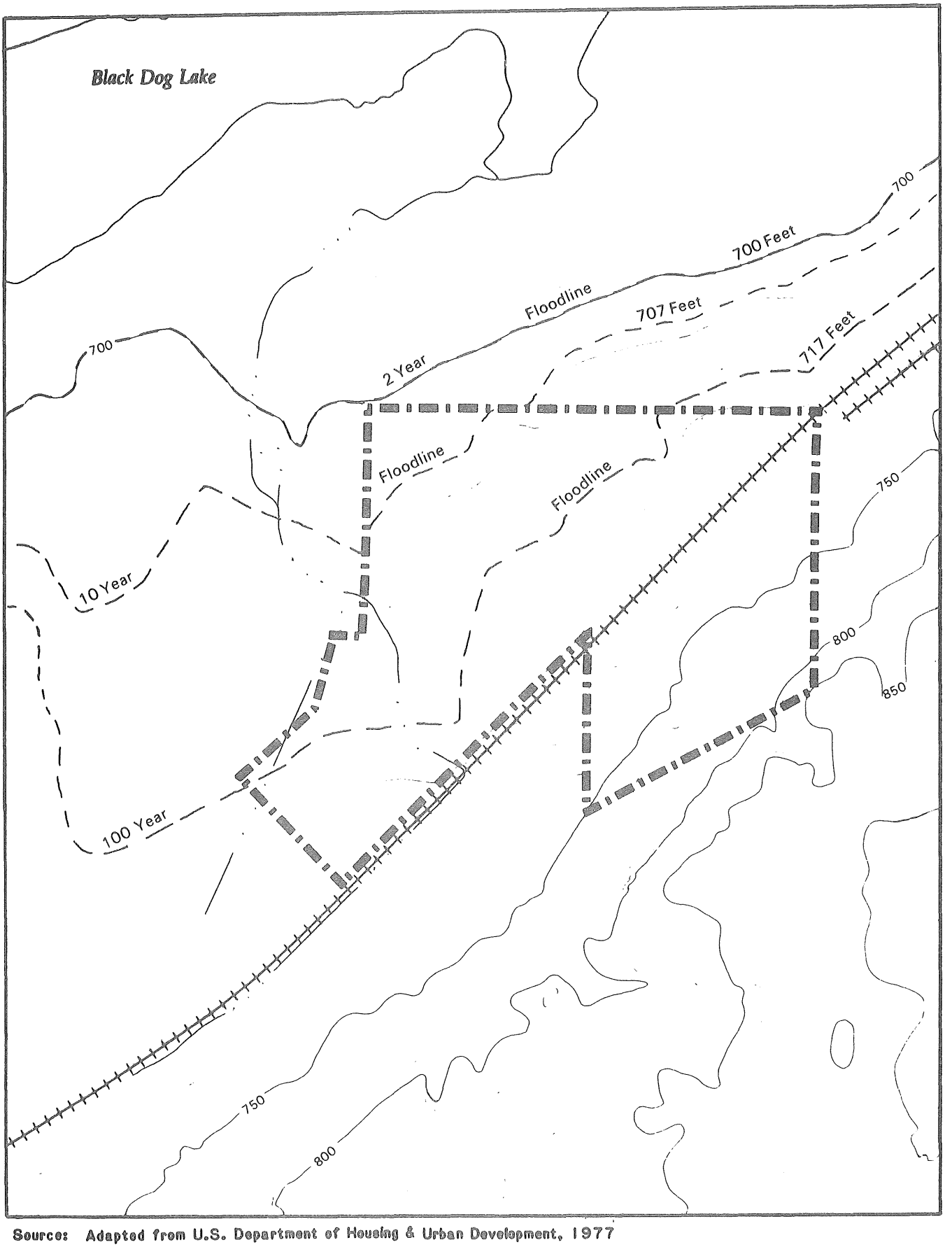
CLIMATE*

Black Dog Preserve has a moist continental climate with wide seasonal temperature extremes. Winters are cold with January average daily maximum and minimum temperatures of 21° F (-6° C) and 3° F (-16° C), respectively. Summers are hot with occasional cool periods. Average daily maximum and minimum temperatures in July are 82° F (28° C) and 61° F (16° C), respectively. The average date of the last spring frost is 29 April, and the average date of the first fall frost is 13 October.

The average annual precipitation in the area is 26 inches (66.4 cm). Of this, about 18% falls as snow from November through March. Precipitation, in the form of rainfall, increases through spring and peaks in June or July. Much of the summer rainfall results from heavy thunderstorms. Precipitation commonly decreases in the fall to a low in January or February.

The prevailing wind direction in the summer is south/southeast and in the winter northwest.

* State Climatologist, Earl Kuehnast, Personal Communication (1983).



Source: Adapted from U.S. Department of Housing & Urban Development, 1977

Figure 14: Floodline map.

VEGETATION HISTORY

The present vegetation of Black Dog Preserve is a reflection of both natural climatic modifications since glacial times and human modifications since the area was originally settled. In an attempt to understand what the magnitude of the human impact may have been, it is important to know how the vegetation appeared prior to settlement.

When the Superior Lobe was still advancing and retreating in northeastern Minnesota, most of southern Minnesota was marked by boreal spruce forest which spread northward with the retreat of the ice mass about 11,500 years ago (BP). The spruce forest itself could not survive the continued trend toward a warmer, drier climate and it was replaced in rapid succession by pine forests about 10,000 BP, and then prairie, 8,000-7,500 BP. About 7,000 BP, at the peak of the warming trend, the prairie was at its maximum northward border (about 75 miles north of its present position). Reversal of the climatic trend at that time led to gradual invasion of prairie by forest and to the advance of coniferous forest into deciduous forest (Wright 1972b).

Tools for reconstructing the state's vegetation at the time of settlement are available in records of the General Land Survey Office. Those records constitute the field notes of the men who originally surveyed Minnesota during the late 1800's.

As the men surveyed each township, they walked along the section lines, marking the mile and half mile intervals by recording tree species, diameter at breast height (dbh), and distance from the survey corner to the nearest tree. Theoretically, the only criteria for selecting these bearing trees was that they had to have a minimum dbh of five inches. As the surveyors travelled through the townships, they also recorded the location of uplands, swamps, prairies, marshes, groves, and windfalls, as well as all streams, rivers, lakes, and roads. Houses, cabins, fields and other 'improvements' were noted with less regularity, depending on the surveyor and the year the survey was done. Although there are several problems in the use of survey notes for determining past vegetation, including fraud, bias, and species name duplication, the records remain a valuable source of information regarding the nature of the vegetation prior to settlement by European-man.

The transcription of the survey notes has been carried one step further by Francis J. Marschner (1930), who used the records to develop comprehensive maps of the state's original vegetation. Using the General Land Office Survey notes and maps as well as Marschners Map, a general description of the original vegetation of the area can be prepared.

On Marschners Original Vegetation Map of Minnesota (1966), a general vegetation pattern can be seen running parallel to the Minnesota River in the Black Dog area (Fig 15). Adjacent to the river channel itself is a strip of River Bottom Forest: elm, ash, cottonwood, oaks, soft maple, and willow. Out on the floodplain a continuous grassy expanse up to the base of the bluff, is a band of Wet Prairies, Marshes and Sloughs: marsh-grasses, flags, reeds, and rushes. The slopes contained Oak Openings and Barrens: scattered trees and groves of oaks, mostly bur oak, of scrubby form with some brush and thickets. Finally, on the uplands are Oak Openings and

Prairie, which give way to Big Woods in the South: bur oak, black oak, elm, basswood, ash, maple, and aspen (Marschner 1930).

The original surveyor described the section line that runs through Black Dog Preserve as follows:

> "Surface level: soil of first third dry peat covered with grass, of remainder alluvial, covered with weeds and cane reeds, some portions shaking bog."*

At other points within the marshy areas on the south side of the river--between Pike Island and Dean Lake--the original surveyor noted areas of 'low marshes', 'wet and mirey bottoms', 'floating turf', and 'mounds of tussocks'.

* Jarrett, Jesse G. 1853. Original Surveyor notes. U.S. Gen. Land Off. Washington, D.C.

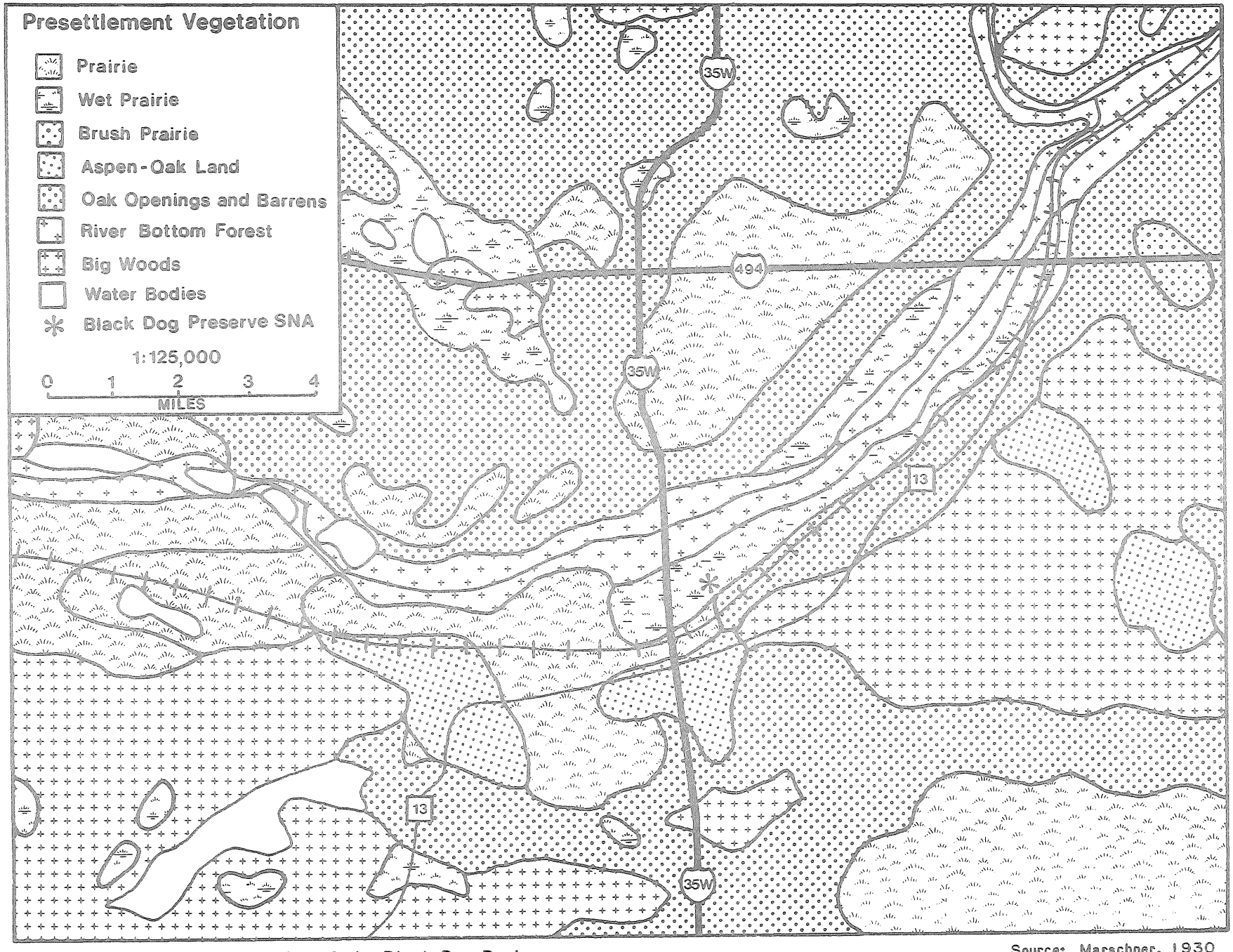


Figure 15: Original vegetation of the Black Dog Region.

Source: Marschner, 1930

PRESENT VEGETATION

INTRODUCTION

The Black Dog Preserve SNA contains fine examples of vegetation community types that were once common within the Minnesota River Valley. Two of these communities--the Calcareous Fen and the Blacksoil Prairie--are among the rarest natural communities on the Minnesota landscape today (see element abstracts, Appendix II). Due to the history of man-induced disturbances at the Black Dog Preserve, the original vegetation has been altered to varying degrees. In some areas the vegetation has been heavily degraded, while in other areas the vegetation still maintains its original structure and composition.

The Calcareous Fen community was once the dominant vegetation type on the Black Dog Preserve. The original aerial extent of the fen is difficult to determine. More detailed mapping of the peat surface, peat depth, substrate, and water levels is needed to reconstruct its former extent. To date, three major areas containing fen vegetation occur at the preserve. These areas--probably once continuous--have been separated from each other by a series of major disturbances: 1) excavation of a drainage ditch from the nearby sewage disposal site, 2) construction of power lines, and 3) construction of the railroad bed. Due to these and other disturbances, the fens at Black Dog Preserve have been reduced in size and now exhibit varying degrees of natural area quality ranging from degraded to nearly pristine.

The Calcareous Fen community is extremely sensitive to alteration of the local hydrologic regime. Alterations in water levels, pressures, or supply rates can significantly alter the plant community composition. Generally, impacted fens show a loss of the fen "calcicoles" (plants adapted to calcareous substrates) and an invasion of weedy opportunists--both upland and lowland species. The disturbed portions within the fen communities at Black Dog Preserve fall into two categories: 1) those dominated by woody plants that colonized where disturbance resulted in drier conditions, and 2) those dominated by rank wetland forbs that also invade disturbed peat soils. These vegetation assemblages appear to be a natural emergent of hydrologic alterations, fire suppression, and soil surface impacts that have occurred at the Black Dog Preserve site.

The fen, wet meadow and disturbance communities occur in areas of very poorly drained peat and muck soils that dominate the preserve. In addition there is an area of mineral soils--silty clay loams--that supports Blacksoil Prairie.

The vegetation communities on the Black Dog Preserve are mapped and described in the following section. The vegetation has been stratified into 3 types. The classification is based on vegetation composition. In addition, the vegetation community types that are considered elements* by the Minnesota Natural Heritage Program were ranked according to their quality (i.e., how close they resemble presettlement conditions). Four element occurrence ranks are given: Grade A=excellent, Grade B=good, Grade C=marginal, Grade D=poor. Definitions of the above ranks are provided in the element abstracts for Calcareous Fen and Blacksoil Prairie (Appendix II). This assessment was done in order to document the significance of the Calcareous Fen and Blacksoil Prairie community types at the Black Dog Preserve. The rankings are also useful for management consideration as they reflect the degree in which the original vegetation has been altered and the propensity of the vegetation to return to more natural conditions.

The vegetation boundaries on the cover type map (Fig. 16a) were identified with the use of aerial photographs, soil maps, and on-site field evaluations. These boundaries are somewhat arbitrary in a number of areas. Sharp discontinuities between the vegetation types are rare; instead, they grade imperceptibly into one another. Hence the community descriptions apply to the centers of the mapping units and become less appropriate moving toward their boundaries. In some cases dashed lines are used on the cover type map when boundaries are particularly obscure.

In addition to the classification categories, a numbering system corresponding to more detailed map explanations is provided on Figure 16b. The numbers are used to more precisely describe the vegetation or the disturbance history of a site.

* An element is a natural feature of particular importance because it is exemplary, unique, threatened, or endangered on a national or statewide basis.

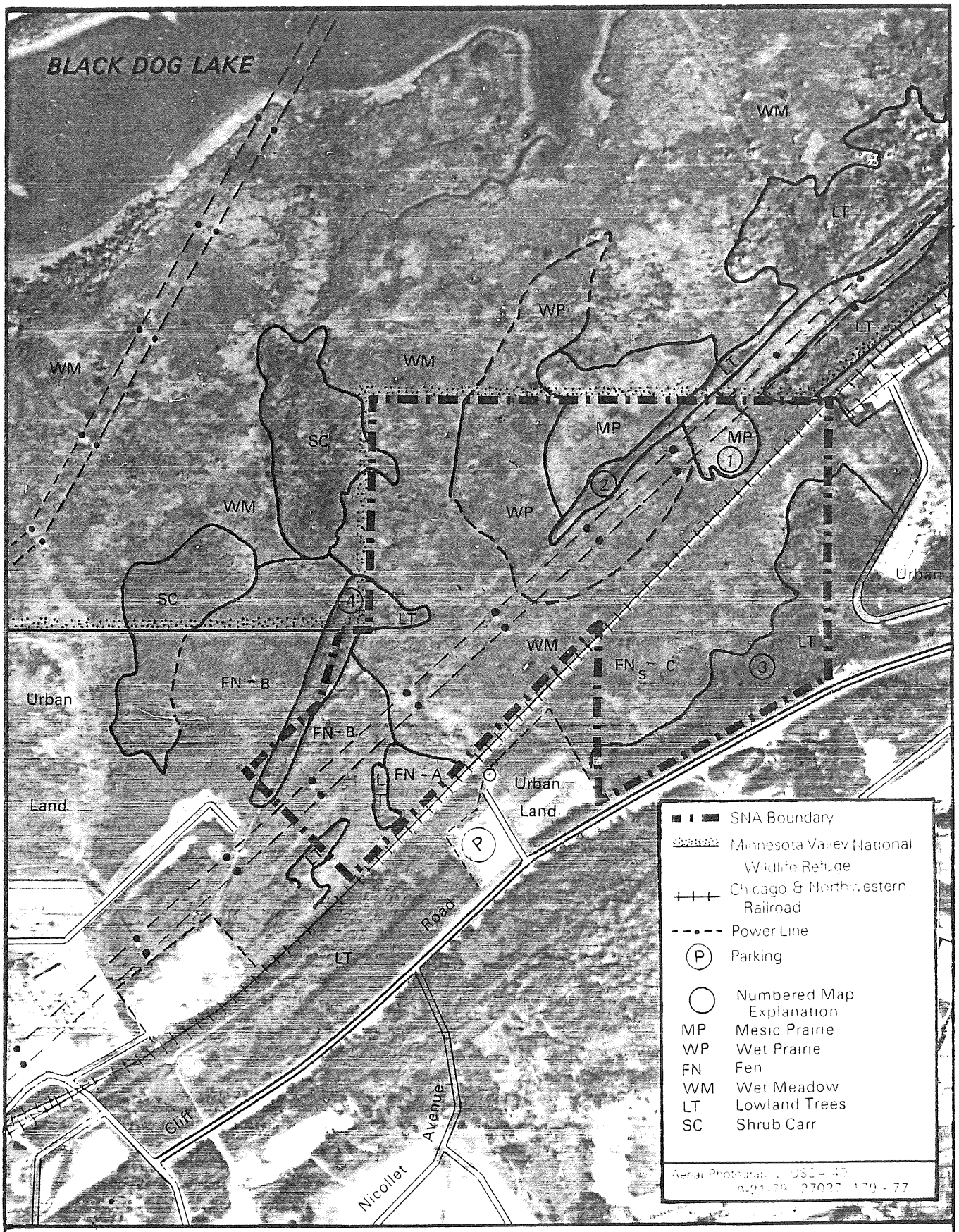


Figure 16: Vegetation cover type map.

SITE

Area (1): This site is a slightly elevated knoll that was cultivated one year and planted to potatoes. Since abandonment, the area has been recolonized by native prairie species. Big bluestem and Indian grass are the dominant plants.

Area (2): This area is dominated by Cottonwood trees, which invaded the gravel fill placed on the poorly drained soils. Many of the trees are dying as a result of herbicide spraying under the adjacent power line right-of-way. The understory vegetation contains a large number of prairie species including Andropogon gerardi, Petalostemum purpureum, Sorghastrum nutans, and Liatris ligulistylis.

Area (3): This wooded area on sloping land has been extensively filled. The original vegetation of the site has been obliterated. The surface soil is dry and dominated by solid stands of Impatiens sp.; Cottonwood dominates the tree layer.

Area (4): The dredge spoils piled up on either side of the open ditch are colonized by Cottonwood, Paper birch, Aspen, and Willows. The immediate banks are dominated by Reed-canary grass.

Figure 16b: Numbered Map Explanations.

MESIC BLACKSOIL PRAIRIE: Element occurrence rank = AB

The mesic blacksoil prairie at the Black Dog Preserve occurs in an area of silty clay loam soils. These are black, somewhat poorly drained soils of moderate permeability. The vegetation is dominated by the mesic prairie grasses: big bluestem (Andropogon gerardi), Indian grass (Sorghastrum nutans), and prairie dropseed (Sporobolus heterolepis). The associated forb species are: yellow cone flower (Ratibida pinnata), blazing star (Liatris liqulistylis), Canada tick trefoil (Desmodium canadense), blazing star (Liatris pycnostachya), purple prairie clover (Petalostemum purpureum), and frost aster (Aster ericoides). This area has a moderately high species richness with good interspersion of grasses and forbs. There is no evidence that the site was ever plowed or grazed. Mowing for hay has apparently been the only activity in this area--this has done little to change the composition or structure of the community. Three plant elements are found in this area: white lady's slipper orchid (Cypripedium candidum), cowbane (Oxypolis rigidior), and valerian (Valeriana edulis).

WET BLACKSOIL PRAIRIE: Element occurrence rank = B

The wet blacksoil prairie community is found on poorly drained muck to better drained silty-clay loam soils. The vegetation is dominated by prairie cordgrass (Spartina pectinata), big bluestem (Andropogon gerardi), and tall sunflower (Helianthus grosseserratus). The most common associated species are the following: New England aster (Aster novae-angliea), blazing star (Liatris ligulistylis), mountain mint (Pycnanthemum virginianum), and Joe-pye weed (Eupatorium maculatum). This site has had a long history of haying and probably fire suppression. There are large areas here where species interspersion is poor, and large populations of rank wetland forbs dominate. The wet blacksoil prairie grades imperceptibly into the wet meadow community.

FEN-A: Element occurrence rank = A

The fen site is a small, two acre, open graminoid community. It occurs on domed peat that is well saturated with water. The fen maintains an assemblage of species that typify and are relatively restricted to undisturbed calcareous fen communities. Calciphilic species (those adapted to calcareous substrates) are abundant and include the following: twig rush (Cladium mariscoides), slender beak-rush (Rhynchospora capillacea), whorled nut rush (Scleria verticillata), fringed gentian (Gentiana procera), the fen sedges (Carex sterilis, C. prairea), asp of brome grass (Bromus ciliatus), shrubby cinquifoil (Potentilla fruticosa), and grass of parnassus (Parnassia glauca). The site also contains numerous prairie species including big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), and phlox (Phlox pilosa). In addition, other specialized plants of different floristic associations that tolerate the wet, high-lime substrate are found here. These plants are arrow-grass (Triglochin maritima) and marsh

arrowgrass (Triglochin palustrus).

Unlike Fen-B, this site lacks the presence of opportunistic wetland species, and the large shrub population. The springy, constantly wet peat substrate of this area apparently prevents the colonization of those weedy plants that are common throughout the rest of the preserve. Conditions here support a dominance of the characteristic fen species.

FEN-B: Element occurrence rank = B

Fen-B occurs on very poorly drained peat soils over marl. The present vegetation composition reflects moderate-light disturbances. Fire suppression, haying, and drainage attempts are the probable disturbances that have altered the original plant community makeup in this area. Opportunistic wetland species and woody plants are common throughout the area. These species, which increase in impacted fen communities, include Canada goldenrod (Solidago canadensis), tall sunflower (Helianthus grossesaratus), giant reed grass (Phragmites communis), common cattail (Thypha latifolia), and meadow rue (Thalictrum dasycarpum). In addition woody shrubs--notably red-osier dogwood Cornus stolonifera--reach upwards to 50% cover in a number of areas. Colonization of fens by woody plants is often a response to drying of the peat surface and lack of fire. Woody plants further accentuate drier conditions through increased evapotranspiration.

The major fen areas throughout this fen/wet meadow complex are dominated by the fen shrubs: shrubby potentilla (Potentilla fruticosa) and bog birch (Betula pumila). There are also small open graminoid areas throughout, where the peat surface is saturated with water. These areas display the characteristic assortment of fen plants and have a large number of calcophiles, including fen muhly grass (Muhlenbergia glomerata), flat-topped aster (Aster umbellatus), Kalm's lobelia (Lobelia kalmiia), fringed gentian (Gentiana procera), Riddells goldenrod (Solidago ridellii), and grass of parnassus (Parnassia glauca).

FEN/sloping-C: Element occurrence rank = C

This Fen area occurs in an area of gently sloping very poorly drained soils at the base of a moderately steep escarpment. The upper slope, beginning at the 750 ft. contour line, is wooded and is classified as a lowland tree community. The soils of the lower slope are primarily peat and muck with inclusions of seepy mineral soils. This is a heterogenous habitat characterized by a mosaic of fen and wet meadow vegetation. The area is dominated by wet meadow species: giant reed grass (Phragmites communis), cattail (Thypha latifolia), Joe-pye weed (Eupatorium maculatum), nettle (Urtica dioica), touch-me-not (Impatiens sp.), cup plant (Silphium perfoliatum), Canada goldenrod (Solidago canadensis), dogbane (Apocynum sp.), tall sunflower (Helianthus grossesaratus), swamp thistle (Cirsium muticum), and reed canary grass (Phalaris arundinacea). Within this area are small rivulets, fed by groundwater, which cut into the substrate. These

seep areas, with their associated saturated peats, display a typical fen community composition and structure. Due to the low oxygen availability, cold temperature, and low nutrient levels of the saturated peat the height of the plants is much reduced relative to the surrounding vegetation. In addition, these areas are dominated by an assemblage of plants adapted to these high-lime substrates. The calcophilous plants present are grass of parnassus (Parnassia glauca), fringed gentian (Gentiana procera), asp of brome-grass (Bromus ciliatus), flat-topped aster (Aster umbellatus), a fen grass (Muhlenbergia glomerata), and slender beak-rush (Rhynchospora capillacea). Prairie species are also found in this area including big bluestem (Andropogon gerardi), blazing star (Liatris ligulistylis), and cow bane (Oxypolis rigidior). The rank wetland species that dominate the surrounding wet meadow vegetation are conspicuously absent in these fen seep areas.

The vegetation in this area has been subjected to a variety of man-made disturbances. The area has a long history of hay mowing and drainage attempts--in the 1920's, two ditches were dug on the east and west boundaries of the area. These modifications may have caused a considerable shift in the original vegetation on the site. The dominance of wet meadow species and scarcity of fen plants may have been one of the responses to these disturbances. Opportunistic wet meadow species typically invade impacted fens--especially as a result of drying of the peat surface.

WET MEADOW:

The wet meadow community occurs on very poorly drained muck soils. The vegetation is characterized by a dominance of those wetland forbs that frequently increase dramatically with disturbance. Large monotypic clones of Canada goldenrod (Solidago canadensis), tall sunflower (Helianthus grossessaratus), and Joe-pye weed (Eupatorium maculatum) are present throughout the area. The dominant graminoids are tussuck sedge (Carex stricta), bluejoint grass (Calamagrostis canadensis), and occasional clumps of big bluestem, (Andropogon gerardi). There is no evidence of fen plant species in this area. This community occurs within the 100-year floodplain. Outside the SNA boundary the wet meadow is the predominant community type moving north toward Black Dog Lake. Here the wet meadow appears more natural, is wetter, and has a greater proportion of reeds to forbs. The dominant plants are common cattail (Typha latifolia), giant reed grass (Phragmites cummunis), and river bullrush (Scirpus fluviatilis).

LOWLAND TREES:

The lowland tree cover type is defined as any habitat where tree canopy cover is greater than 50%. Encroachment upon the fen and wet meadow communities by trees is associated with man-induced disturbances. Drainage of the peat by surface ditching and placement of fill on the wet peat soils has allowed trees to invade a number of areas on the preserve. Fire suppression is also an important factor in the increase in woody plants in the area. Aging of trees on a number of sites indicates the peat surface

was colonized by trees within the last 20 years in most areas. The dominant woody plants are: cottonwood (Populus deltoides), paper birch (Betula papyrifera), aspens (Populus spp.), and willows (Salix spp.). Shading and further drying of the peat surface by high evapotranspiration has resulted in the elimination of the characteristic fen and prairie species in most of these areas.

SHRUB CARR:

Encroachment of fen and wet meadow communities by woody shrubs has occurred in a number of areas. Increased shrub populations are related to fire suppression and ditching. The dominant shrubs are: red-osier dogwood (Cornus stolonifera), bog birch (Betula pumila), false indigo (Amorpha fruticosa), and long-beaked willow (Salix bebbiana). The shrub carr community occurs on very poorly drained muck soils. The herbaceous understory is typically dominated by tussock sedge (Carex stricta) and other common wetland plants.

FLORA

INTRODUCTION

The following list represents all of the vascular plant species collected from calcareous fen habitats on the Black Dog SNA and adjacent land currently owned by the Astleford Construction Company. Those species marked with an asterisk were found only on the Astleford fen and not on the SNA fen. Most of the species occurring only in the Astleford fen became established as a result of drying conditions. Some of the species were not seen before the fire in 1981 and may have become established after that event. There are likely additional species which occur in the fen, but have not yet been collected. All vouchered specimens are on deposit in the herbarium of the University of Minnesota, St. Paul.

There are many ubiquitous wetland species in the fen, such as: Asclepias incarnata, Zizia aurea, Campanula aparinoides, Cicuta maculata, Calamagrostis canadensis, and Caltha palustris.

There are also several species characteristic of fens, such as: Carex prairea, Carex sterilis, Cladium mariscoides, Rhynchospora capillacea, Scleria verticillata, Scirpus cespitosus, Gentiana procera, Triglochin palustris and Tofieldia glutinosa.

There are three species of plants in Minnesota that are obligate fen species. All three of these species occur on the SNA. They are: Carex sterilis, Rhynchospora capillacea and Scleria verticillata.

There are eight species of plants that occur on the SNA which are considered endangered, threatened or special concern in Minnesota. A brief description of each follows:

Carex sterilis (threatened); Common throughout much of the fen.

Cladium mariscoides (special concern); Apparently limited to a single clone

on the eastern edge of the fen.

Cypripedium candidum (special concern); Infrequent (5-10 plants) on the northern edge of the fen.

Rhynchospora capillacea (threatened); Scattered throughout the lower zone on the eastern edge of the fen.

Scleria verticillata (threatened); Scattered throughout the lower zone on the eastern edge of the fen.

Tofieldia glutinosa (special concern); Infrequent along southern edge of fen.

Triglochin palustris (special concern); Apparently rare on the eastern edge of the fen. Not seen until 1982.

Valeriana edulis (threatneed); Common throughout the fen.

PLANT SPECIES LIST

Amaryllidaceae	
Hypoxis hirsuta (L.) Coville	Stargrass
Apiaceae	
Oxypolis rigidior (L.) C. & R.	Cowbane
Zizia aurea (L.) W.D.J. Koch	Golden Alexanders
Asclepiadaceae	
Asclepias incarnata L.	Swamp Milkweed
Asteraceae	
*Artemissia serrata Nutt.	A species of Wormwood
Aster junciformis Rydb.	A species of Aster
Aster novae-angliae L.	New England Aster
Aster umbellatus Milk.	A species of Aster
Cirsium muticum Michx.	Swamp Thistle
*Crepis tectorum L.	Hawk's-beard
Erigeron philadelphicus L.	Fleabane
Eupatorium maculatum L.	Joe-Pye-weed
Euthamia graminifolia (L.) Nutt.	Grass-leaved Goldenrod
Helenium autumnale L.	Sneezeweed
Helianthus grosseserratus Martins	A species of Sunflower
Liatris ligulistylis (Nels.) K. Schum	Blazing-star
Rudbeckia serotina Nutt.	Black-eyed Susan
Senecio pseudaureus Rydb. var semicordatus (Mack. & Bush)	A species of Ragwort
Solidago canadensis L. var. gilvocanescens Rydb.	Canada Goldenrod
Solidago riddellii Frank	Riddell's Goldenrod
*Sonchus arvensis L. var. glabrescens Guenth., Grab. & Wimm. Sow thistle	
Boraginaceae	
Lithospermum canescens (Michx.) Lehm.	Hoary Puccoon
Brassicaceae	
Cardamine bulbosa (Schreb.) BSP.	Spring-Cress
Campanulaceae	
Campanula aparinoides Pursh	Marsh-Bellflower
Lobelia kalmii L.	Kalm's Lobelia

Convolvulaceae	
Cuscuta campestre Yunker	Dodder
Cornaceae	
Cornus stolonifera Michx.	Red Osier Dogwood
Cyperaceae	
Carex bebbii (Bailey) Fern.	A species of Sedge
Carex hystricina Muhl.	A species of Sedge
Carex interior Barley	A species of Sedge
Carex prairea Dew.	A species of Sedge
Carex sterilis Willd.	A species of Sedge
Carex stricta Lam	A species of Sedge
Carex tetanica Schkuhr.	A species of Sedge
Cladium mariscoides (Muhl.) Torr.	Twig Rush
Eleocharis elliptica Kunth	A species of Spike-Rush
Eriophorum angustifolium Honcheny	Cotton Grass
Rhynchospora capillacea Torr.	Slender Beak-rush
Scirpus acutus Muhl.	Hard-stem Bullrush
Scirpus cespitosus L. var. callosus Bigel.	Deer-Grass
Scleria verticillata Muhl.	Whorled Nut-rush
Equisetaceae	
*Equisetum arvense L.	Common Horsetail
Fabaceae	
Amorpha fruticosa L.	False Indigo
Lathyrus palustris L.	Vetchling
Gentianaceae	
Gentiana procera Holm.	Fringed Gentian
Iridaceae	
Iris versicolor L.	Blue Flag
Juncaceae	
*Juncus dudleyi Wieg	A species of Rush
Juncaginaceae	
Triglochin maritima L.	Arrow-grass
Triglochin palustris L.	Marsh Arrow-grass
Lamiaceae	

Cicuta maculata L.	Spotted Cowbane
Lycopus americanus Muhl.	Water-Horehound
Lycopus uniflorus Michx.	Water-Horehound
Pycnanthemum virginianium (L.) Durand & Jackson	Mountain Mint
*Scutellaria parvula Michx. var. leonardi (Epling) Fern.	Skullcap
*Teucrium canadense L.	American Germander

Liliaceae

*Alluim canadense L.	Wild Garlic
Lilium philadelphicum L.	Wood Lily
Smilacina stellata (L.) Desf.	False Solomon's-seal
Tofieldia glutinosa (Michx.) Pers.	False Asphodel
Zigadenus elegans Pursh	White Camass

Lythraceae

Lythrum salicaria L.	Purple Loosestrife

Orchidaceae

Cypripedium calceolus L. var. parviflorum (Salisb.) Fern	Yellow Lady's-slipper
Cypripedium candidum Muhl.	Small White Lady's-slipper
*Cypripedium reginae Walt.	Showy Lady's-slipper

Poaceae

Agrostis stolonifera L.	Red Top
Andropogon gerardi Vitman	Big Bluestem
Andropogon scoparius Michx.	Little Bluestem
Bromus ciliatus L.	A species of Brome-Grass
Calamagrostis canadensis (Michx.) Nutt.	Canada Blue-joint
Glyceria striata (Lam.) Hitchc.	Fowl-meadow Grass
Hierochloe odorata (L.) Beauv.	Sweet Grass
Muhlenbergia glomerata (Willd.) Trin.	No common name
Muhlenbergia richardsonis (Trin.) Rydb.	No common name
Panicum lanuginosum Ell.	A species of Panic-Grass
Phalaris arundinacea L.	Reed Canary Grass
Phragmites australis (Cav.) Steud.	Reed Grass
*Spartina pectinata Link	Cord Grass

Polemoniaceae

Phlox pilosa L. var. fulgida Wherry	Phlox

Polypodiaceae

Thelypteris palustris Schott.	Marsh Fern

Primulaceae	
Lysimachia quadriflora Sims.	A species of Loosestrife
Ranunculaceae	
Anemone canadensis L.	Canada anemone
Caltha palustris L.	Marsh Marigold
Thalictrum dasycarpum Fisch. & Lall.	Tall Meadow Rue
Rosaceae	
Fragaria virginiana Duchesne.	Strawberry
Potentilla fruticosa L.	Shrubby cinquefoil
Rubus pubescens Raf.	A species of Rubus
Rubiaceae	
Galium boreale L.	Northern Bedstraw
Galium obtusum Bigel.	A species of Bedstraw
Salicaceae	
Salix bebbiana Sarg.	Long-beaked Willow
Salix candida Fluegge	Hoary Willow
Santalaceae	
Comandra richardsiana Fern.	Bastard Toad-flex
Saxifragaceae	
Parnassia glauca Raf.	Grass of Parnassis
Scrophulariaceae	
Chelone glabra L.	Turtle-head
Pedicularis lanceolata Michx.	Swamp Lousewort
Typhaceae	
Typha angustifolia L.	Narrow-leaved Cattail
Typha latifolia L.	Broad-leaved Cattail
Valerianaceae	
Valeriana edulis Nutt.	Valerian
Violaceae	
Viola nephrophylla Greene	Violet

APPENDIX I - OWNERSHIP HISTORY

Area of Preserve: That part of the W 1/2 of the Northeast 1/4 North of the Railroad, Section 34, Township 27, Range 24.

In the 33 year period between 1850 and 1883 this tract was divided up into shares; first into thirds and later into ninths, with numerous ownership switches made within the group of owners. This is a list of all the people who had any share in the tract during the period 1850 to 1883:

Carlos Wilcox	1855-1857	
Gustavus A. Austin	1855-1868	
Daniel R. Barber	1855-1858	1868-1871
Ebenezer L. Hubbard	1857-1868	
Roswell Bottum	1858-1868	
John Simonds	1858-1883	
William O. Wheeler	1858-1883	
Timothy O'Regan	1871-1902	

Ownership since 1883:

Date of Acquisition	Owner	Means of Acquisition
May 1883	Timothy O'Regan	Executors Deed
September 1874	St. Paul & Sioux City Railroad	Easement
July 1902	Timothy O'Regan Jr.	Warranty Deed
October 1915	John H. O'Regan	Warranty Deed
October 1915	Timothy O'Regan	Warranty Deed
June 1944	Elizabeth M. Daly	Executors Deed
August 1951	Northern States Power Company	Easement
November 1969	Timothy A. O'Regan 1/3 Harold T. Lanigan 1/3 Frances R. Burns 1/3	Decree of Distribution
September 1971	Metropolitan Sewer Board	Easement
February 1972	M. G. Astleford	Warranty Deed
October 1981	City of Burnsville	Quit Claim Deed
October 1982	State of Minnesota	Quit Claim Deed
October 1982	The Public	Certificate of Acceptance

NATURAL COMMUNITY
ELEMENT NAME: (SE) Mesic Blacksoil Prairie

PLANT COMMUNITY COVER TYPES:
Andropogon gerardi - Sorghastrum nutans (L6.00A)
Andropogon gerardi - Spartina pectinata - Sorghastrum nutans (L5.00A)
Andropogon scoparius - Andropogon gerardi - Sporobolus heterolepis (L7.00A)

BASIS FOR CONCERN: Less than 500 acres of intact (SE) Mesic Blacksoil Prairie are known to exist in Minnesota; the remnants are largely confined to railroad rights-of-way and other areas unsuitable for cultivation.

DESCRIPTION AND DISTRIBUTION: Mesic Blacksoil Prairie, often referred to as "tallgrass prairie", is found throughout the prairie region of Minnesota on deep, nutrient rich, loam soils with a dark A horizon. Soil moisture ranges from dry-mesic to wet-mesic; the vegetation is dominated by the tall grasses: Big Bluestem (Andropogon gerardi) and Indian Grass (Sorghastrum nutans). The Mesic Blacksoil Prairie is the most productive and species rich grassland in Minnesota. This prairie was once the most prevalent grassland type in the state; it was widespread on the gently rolling to level glacial landforms throughout the prairie region.

Considerable environmental variation occurs within the range of Mesic Blacksoil Prairie in Minnesota. This variation is however somewhat obscured by the broad distribution of the dominant grasses which give the prairie a uniform physiognomy across its range. Despite this, distinctive natural communities can be separated out based on species compositional differences which are correlated with changes in climate soils, and landforms as one moves from the southeast to the northwest part of the state. Four natural communities within the Mesic Blacksoil Prairie have been separated out and named by geographic region: southeast (SE), southwest (SW), eastcentral (EC), and northwest (NW) Mesic Blacksoil Prairie.

In southeast Minnesota, Mesic Blacksoil Prairie was once the dominant vegetation on the till plains and lake beds found east of the Prairie Couteau, south of the Minnesota and Cottonwood Rivers and west of the "Driftless Area". The (SE) Mesic Blacksoil Prairie of Minnesota lies near the northwestern edge of the Prairie Peninsula - an eastern extension of the "tallgrass prairie". This peninsula extends as far east as Indiana ad Ohio, and was the first area of the North America Tallgrass Prairie to be settled. The Blacksoil Prairie throughout this entire area has been nearly completely destroyed by conversion to agricultural cropland.

Due to geographic location and favorable climatic conditions the (SE) Mesic Blacksoil Prairie is the most species diverse prairie community in Minnesota. The flora shows a strong eastern and southern influence with only minor representation from the Great Plains flora to the west. Prairie species restricted to or modal to this natural community are wild indigo (Baptisia leucophaea), false white indigo (Baptisia leucantha), rattlesnake master (Eryngium yuccifolium), wild quinine (Parthenium integrifolium), indian plantain (Cacalia tuberosa), and prairie parsley (Polytaenia

nuttallii). In general the soils associated with the (SE) Mesic Blacksoil Prairie are deep, dark-colored, well drained to somewhat poorly drained, loam soils derived from glacial till and loess capped till. Representative soils are the Clarion, Nicollet, and LeSueur series formed in glacial till which are found in the western part of this region. These soils grade into the Ostrander, Racine, Kenyon and Kassen series to the east which are formed in a mantle of loess over till. The climate of southeastern Minnesota has a mean annual percipitation ranging from 28-31 inches a year. The average length of the frost free season is 140-150 days.

CURRENT STATUS: Less than 500 acres of intact Mesic Blacksoil Prairie in southeast Minnesota are known to exist. Occurrences of this natural community are today largely restricted to railroad right-of-ways and poorly drained sites unsuitable for cultivation. A number of railroad prairies are now protected in southeast Minnesota and are being managed to enhance the native prairie community. These railroad prairies maintain, in near original condition, the vegetation structure and composition of the (SE) Mesic Blacksoil Prairie. However, confinement to narrow 100 foot right-of-ways, typically bordered by cropland, makes this natural community especially susceptible to degradation. Herbicide drift from crop spraying, soil disturbance from maintenance of the railbed, and siltation resulting from erosion of adjacent cropland are the major disturbances which can significantly alter this natural community.

NUMBER OF OCCURRENCES: 7 occurrences

REPRESENTATIVE SITES: Black Dog Preserve, SNA, Dakota Co.
Wild Indigo Scientific and Natural Area, Mower Co.
Dodge Co. Prairie, Dodge Co.

PREPARED BY: Keith Wendt, Plant Ecologist, MN Natural Heritage Program, 2/84

(SE) MESIC BLACKSOIL PRAIRIE - ELEMENT OCCURRENCE RANKING

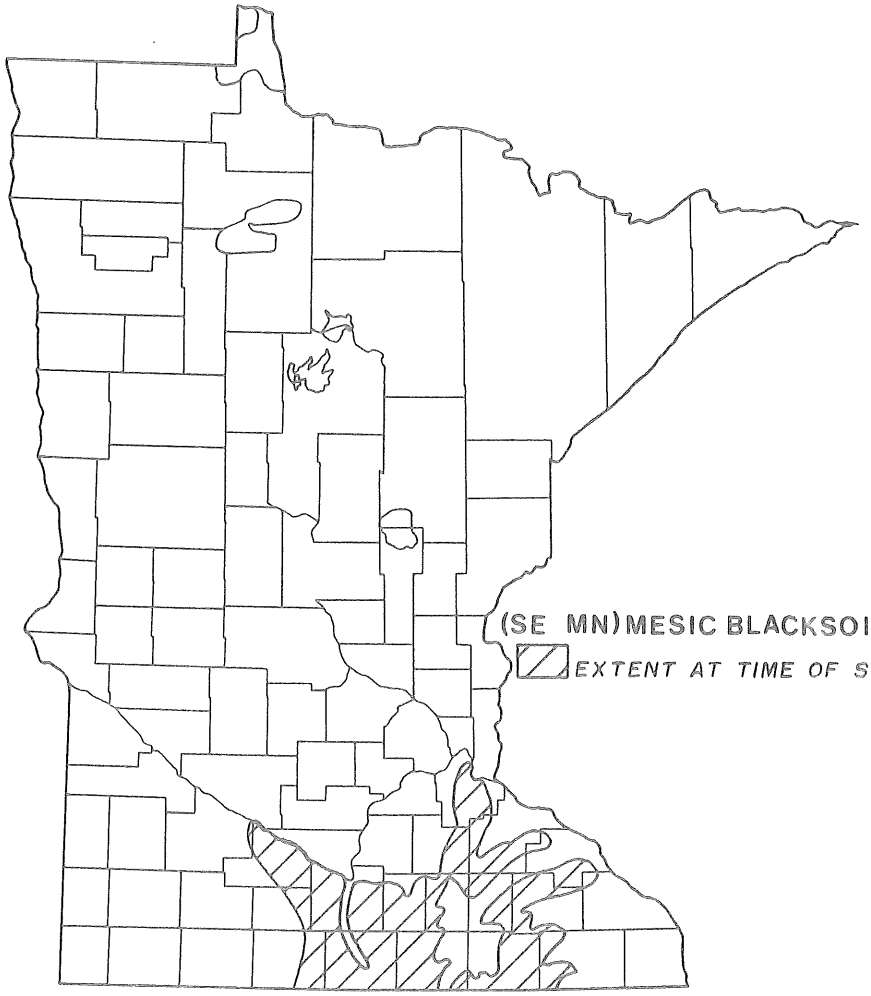
RANK A -- Prairie occurrences which are virtually undisturbed by man, or recovered to an extent where community structure and composition is intact and reflects presettlement conditions. Such areas occur where the soil has not been disturbed; they display a high native species diversity, a lack of exotic or weedy species and a presence of conservative species (those which typify and are relatively restricted to stable undisturbed conditions). Conservative species which are modal to the (SE) Blacksoil Prairie include cream wild indigo (Baptisia leucophaea), wild quinine (Parthenium integrifolium), rattlesnake master (Eryngium yuccifolium), valerian (Valeriana edulis), and cowbane (Oxypolis rigidior).

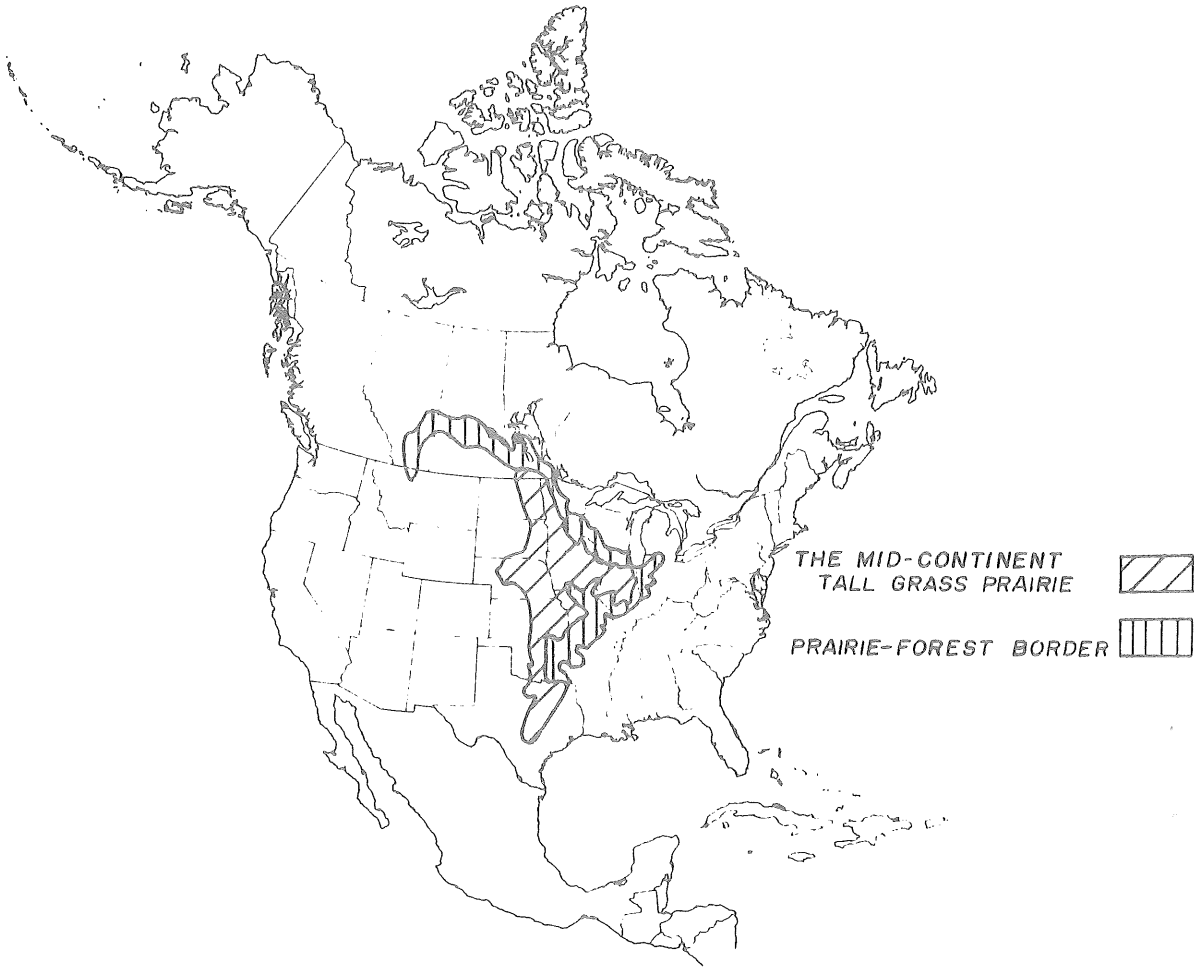
RANK B -- These prairies are similar in species composition to Rank A sites, except some of the conservative species may be absent, or the complement of characteristic species may not be fully represented. These tracts typically have had a history of light-moderate disturbance from grazing, haying, fire suppression and/or light soil disturbance. As a result the vegetation may have a somewhat weedy composition. However the site still maintains a relatively natural character. With removal of disturbance these sites will

recover to more natural conditions.

RANK C -- These sites are characterized by a species composition which has been altered by moderate disturbance. The disturbed habitat has a low native species diversity reflecting the loss of native species and replacement by weeds. These sites are often characterized by ubiquitous native plants whose populations dramatically increase under disturbed conditions. Dense stands of the following often characterize the habitat: Canada goldenrod (Solidago canadensis), tall sunflower (Solidago grosseserratus), bergamot (Monarda fistulosa), yellow coneflower (Ratibida pinnata), and heath aster (Aster ericoides.

RANK D -- These are heavily disturbed sites where the natural prairie vegetation has been significantly altered. The vegetation is dominated by weedy species which are not part of the native prairie community. Characteristic weedy plants include giant ragweed (Ambrosia trifida), sweet clover (Melilotus alba), thistle (Cirsium arvense), bluegrass (Poa pratensis), milkweed (Asclepias syriaca), and prickly lettuce (Lactuca scariola).


(SE MN) MESIC BLACKSOIL PRAIRIE
EXTENT AT TIME OF SETTLEMENT


THE MID-CONTINENT TALL GRASS PRAIRIE
PRAIRIE-FOREST BORDER

CALCAREOUS FEN
ELEMENT ABSTRACT

NATURAL COMMUNITY
ELEMENT NAME: Calcareous Fen

PLANT COMMUNITY
COVER TYPES: Potentilla fruticosa - Betula pumila - Salix candida (JA.OA0)
Carex sterilis - Andropogon gerardi - Muhlenbergia glomerata

BASIS FOR CONCERN: Calcareous fen are dependent upon very localized water chemistry and hydrologic conditions. They are characterized by a distinctive assemblage of plants adapted to wet, calcareous substrates. Many of these plants - called calcicoles - are rare in Minnesota. The calcareous fen community is very uncommon throughout its entire range; in Minnesota 21 occurrences are known, totaling less than 700 acres.

DESCRIPTION: The term "fen" has been used variously in describing wetlands. The term, as used here, largely follows the narrow definition of Curtis (1959): "...a plant community on a wet and springy site, with an internal flow of water rich in calcium and magnesium bicarbonates and sometimes calcium and magnesium sulfates as well." "Springy" is interpreted to indicate the presence of peat deposits, and "internal flow" indicates water supply from groundwater. Calcareous fens, which occur within the prairie formation of Minnesota, are considered distinct from the rich fens and poor fens which occur in the northern peatlands of the coniferous formation. All three fen community types are related through minerotrophy and a water supply rich in calcium and magnesium. The calcareous fens however show distinct differences from the northern fens in floristics and physiography.

Calcareous fens apparently only develop where discharges of calcium-magnesium-bicarbonate groundwater occur. This groundwater is typically discharged from dolomitic bedrock and/or calcareous glacial deposits. Many calcareous fens are noticeably raised in the middle, exhibiting a convex profile --some even have an almost steep dome of peat. The extent of the build-up of peat (which in calcareous fens is a graminoid peat) reflects the height at which the rate of peat accumulation equals peat decomposition.

Conditions associated with calcareous peat soils --low oxygen availability, cold temperatures, and low nutrient availability -- determine the characteristic floristic composition and structure of the calcareous fen community. The poor growing conditions are reflected by the low productivity and short stature of the vegetation (Van der Valk 1977). Minnesota fens may be dominated by herbaceous plants (sedges, grasses, and forbs) or by shrubs (Potentilla fruticosa, Betula pumila, and Salix candida). The floristic composition is characterized by calciphilic plant species which form a significant component of the fen flora. Associated with the calcicoles are plant species of different floristic associations. These include species from the prairies (Andropogon gerardi, Liatris ligulistylis, Hypoxis hirsuta, Oxypolis rigidior, Pycnathemum virginianum and Phlox pilosa); from the acid bogs (Eriophorum angustifolium, Sarracinia

purpurea, and Solidago uliginosa); and saline wetlands (Triglochin maritima, T. palustris). In addition, Minnesota fens harbour a disporportionately high number of rare plant species.

DISTRIBUTION: Calcareous fens are relic communities which occur infrequently throughout the glaciated region of North America (Figure 2). Fens have been reported to occur in: New York (1), Ohio (40), Indiana (7), Illinois (12+), Missouri (?), Wisconsin (45), Iowa (7), Michigan (10+), North Dakota (9+), and Minnesota (21). The number of fens reported may reflect the inclusion of wet alkaline prairies, calcareous seeps, marl flats and/or other sites floristically similar to calcareous fens. Calcareous fens may be quite small, often covering less than 10 acres.

In Minnesota, calcareous fens have a sporadic distributin throughout the prairie region of the state (Figure 1). Minnesota fens occur in three broad geomorphic areas, 1) at the base of terrace escarpments in the major river valleys of S. Minnesota, 2) sides of glacial hills in the morainic uplands of western Minnesota and 3) adjacent to Glacial Lake Agassiz beach ridges in NW Minnesota.

CURRENT STATUS: As of December 1983, twenty-one calcareous fens have been located in Minnesota; seven of these are in public ownership. The known calcareous fens vary widely in size and in natural area quality. A number of the known existing fens have been heavily degraded and have lost much of their original character. In general, impacted fens show a loss of the fen calcicoles and their replacement by weedy opportunists -- both upland and lowland species. Calcareous fens are threatened by agricultural activities (draining, ditching, and filling), commercial development, and highway construction.

NUMBER OF OCCURRENCES: 21 occurrences

REPRESENTATIVE SITES: Black Dog Preserve SNA, Dakota Co.
Kilen Woods S.P.Fen, Jackson Co.
Pankratz Fen, Polk Co.
Clearbrook Fen, Clearwater Co.

LITERATURE CITED:

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Van der Valk, A.G. 1976. Zonation, competitive development, and standing crop of N.W. Iowa fen communities. Proc. Iowa Acad. Sci. 83:51-54.

PREPARED BY: Keith Wendt, Plant Ecologist, Natural Heritage Program, 2/84

Calciphilic species found in Minnesota calcareous fens:

Betula pumila	Bog birch
Potentilla fruticosa	Shrubby cinquifoil
Lobelia kalmia	Kalm's lobelia
Parnassia glauca	Grass of Parnassus
Solidago riddellii	Riddell's goldenrod
Triglochin maritima	Arrow grass
Gentiana procera	Fringed gentian
Utricularia intermedia	Small bladderwort
Liparis loeselli	Yellow twayblade
Pedicularis lanceolata	Swamp lousewort
Carex sterilis	a sedge
Carex prairea	a sedge
Muhlenbergia glomeata	Fen muhly grass
Cladium mariscoides	Twig rush
Bromus kalmii	Kalm's brome grass
Rhynchospora capillacea	Fen beak-rush
Scleria verticilata	Nut-rush
Gerardia paupercula	Pink gerardia

The following plant Elements* have been documented to occur in calcareous fen habitats in Minnesota:

Carex sterilis	a sedge	State threatened
Cladium mariscoides	Twig-rush	State special concern
Scleria verticillata	Nut-rush	State threatened
Rhynchospora capillacea	Fen beak-rush	State special concern
Valerian edulis	Valerian	State threatened
Tofieldia glutinosa	False asphodel	State special concern
Elocharis rostellata	Beaked spike rush	State threatened
Triglochin palustris	Arrow grass	State special concern

* An Element is a natural feature of particular importnce because it is rare or threatened on a national or statewide basis.

GRADE A

Fens which reflect native presettlement conditions --fens on undisturbed peat and maintaining natural plant species composition. Such areas have have high native species diversity, a lack of exotic or native weedy species, dominance by fen sedges (i.e., Carex sterilis, C. prairea) and/or grasses (i.e., Muhlenbergia glomerata, M. richardsonii), and presence of calciphiles such as Gentiana procera, Lobelia kalmii, Parnassia glauca, Triglochin palustris, Scleria verticillata, and Rhynochospora capillacia which typify and are relatively restricted to calcareous fen communities.

GRADE B

Fens which have recently been lightly disturbed or moderately disturbed in the past but have recovered to the extent where vegetation composition is relatively natural. Man-induced disturbances include light grazing or haying; water supply has not been significantly altered. Grade B fens still maintain a high native species diversity and characteristic fen species. However disturbance may have caused a shift in species composition favoring pioneer species or wetland species which tolerate or increase with disturbance; densities of certain fen species may be low. Disturbance may also result in the increase of woody species or invasion of weedy species in small areas of the fen. Grade B areas normally will return to Grade A condition with protection (removal of disturbance) and appropriate management.

GRADE C

Disturbed fens, where the original species composition has been altered and no longer reflects natural conditions. The disturbed habitat is characterized by low species diversity and an absence of certain calcophiles which have been replaced by rank wetland species which are normally sparse and depauperate in undisturbed fens. Prevalent species which increase with disturbance include Solidago canadensis, Agrostis alba, Typha latifolia, Thalictrum dasycarpum, Phragmites communis, and Eupatorium spp.; woody species of Salix and Cornus also invade disturbed fen habitats. Disturbance may have been caused by partial drainage through ditching and/or tiling, heavy grazing or herbicide spraying. Disturbed fens still maintain some characteristic fen species and have some potential for recovery.

GRADE D

Degraded fens, where man-induced disturbance has significantly altered the original species composition. The dominant fen sedges and characteristic fen species have been replaced by weedy species such as Poa pratensis, dense monotypic stands of disturbance species such as Urtica dioica, Aster spp., and Solidago spp., and invasion by woody plants. Grade D fens are most commonly associated with drainage and the resultant drying and oxidation of the peat surface. Most of the original community structure and composition has been destroyed, with little chance of recovery.

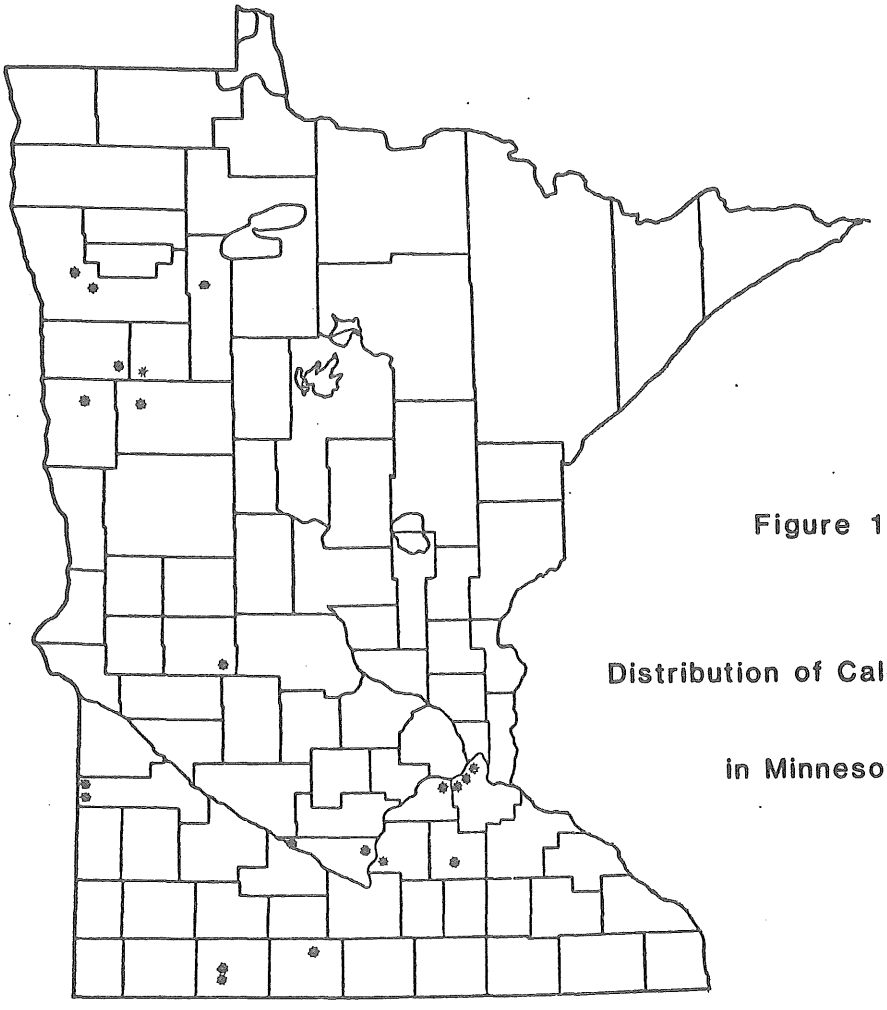


Figure 1

Distribution of Calcareous Fens

in Minnesota

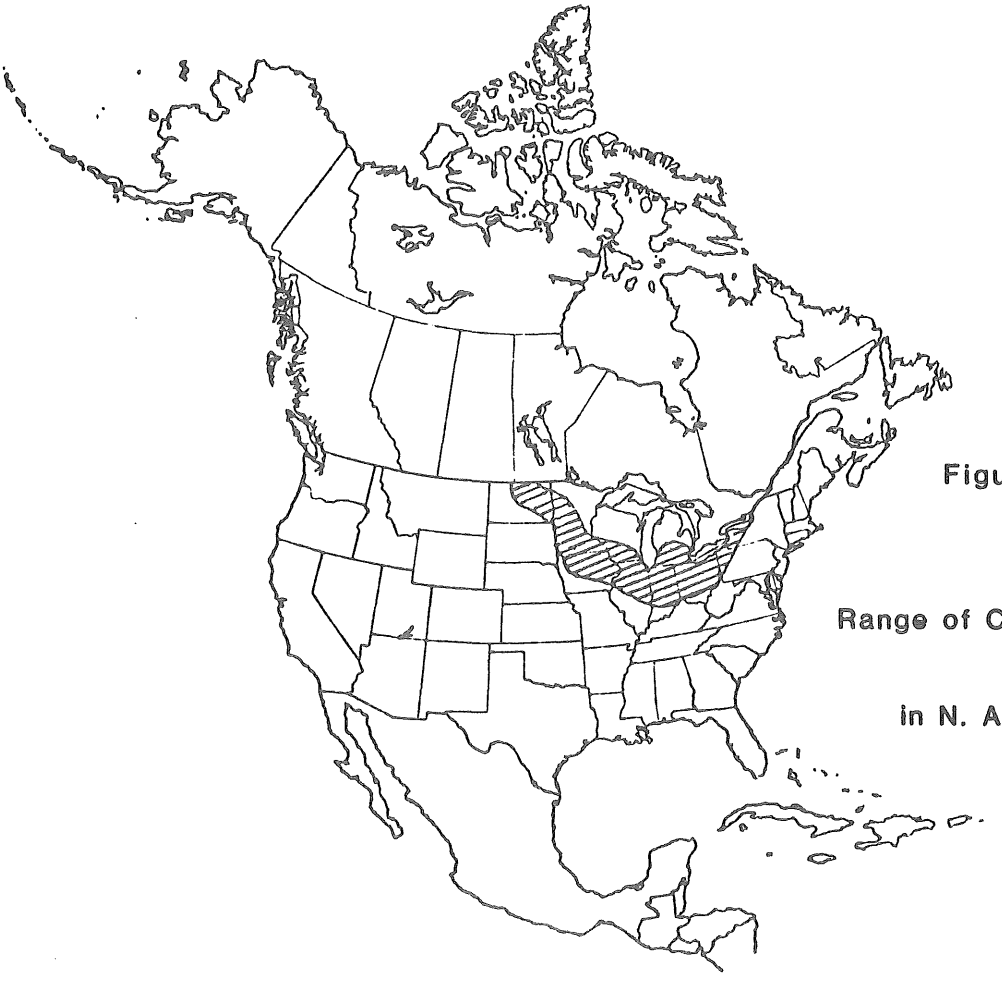


Figure 2

Range of Calcareous Fens

in N. America

APPENDIX III - SPECIES STATUS SHEET

SCIENTIFIC NAME: *Carex sterilis* Willd.

FAMILY: Cyperaceae

COMMON NAME: None

STATE STATUS: Threatened

FEDERAL STATUS: None

BASIS FOR MINNESOTA STATUS: Populations of *Carex sterilis* are generally limited to the recently glaciated territory of North America, but it is common only in the heart of its range (portions of Michigan and southern Ontario). Elsewhere it is rare or local because of the sporadic occurrence of its habitat. This is certainly true in Minnesota where *C. sterilis* ranges over a relatively large portion of the state but is entirely restricted to small, fragile fen habitats. Fens are highly localized phenomena that are maintained by the surface discharge of cold, calcareous groundwater. This makes fens and their dependent flora vulnerable to changes in groundwater levels (drawdown). *C. sterilis* has already suffered a serious decline in Minnesota, and several of the remaining populations are in jeopardy.

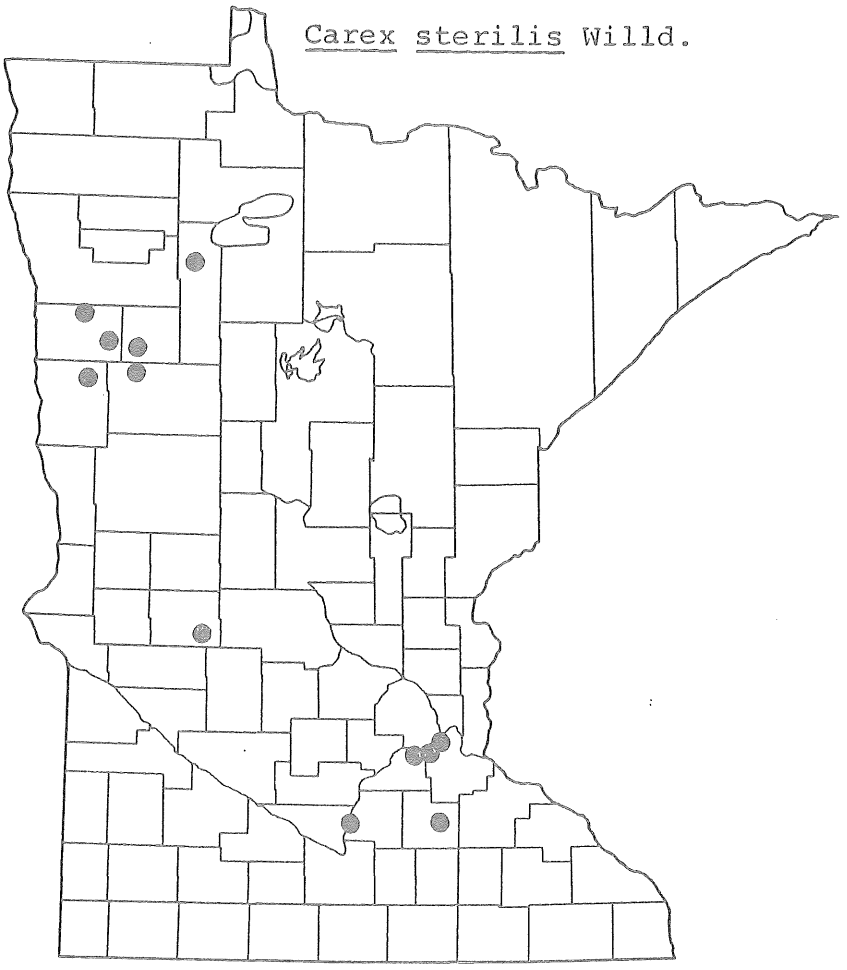
One of the two populations in Dakota County is currently threatened by drawdown from a nearby limestone quarry. The population in Clay County is primarily threatened by drawdown caused by irrigation of previously wild land. The population in northern Norman County was destroyed in 1983 by a water impoundment project and a very large population in Clearwater County was recently destroyed by the construction of wild rice beds. The serious threats to this species and its severely limited habitat makes its survival in Minnesota a matter of immediate concern.

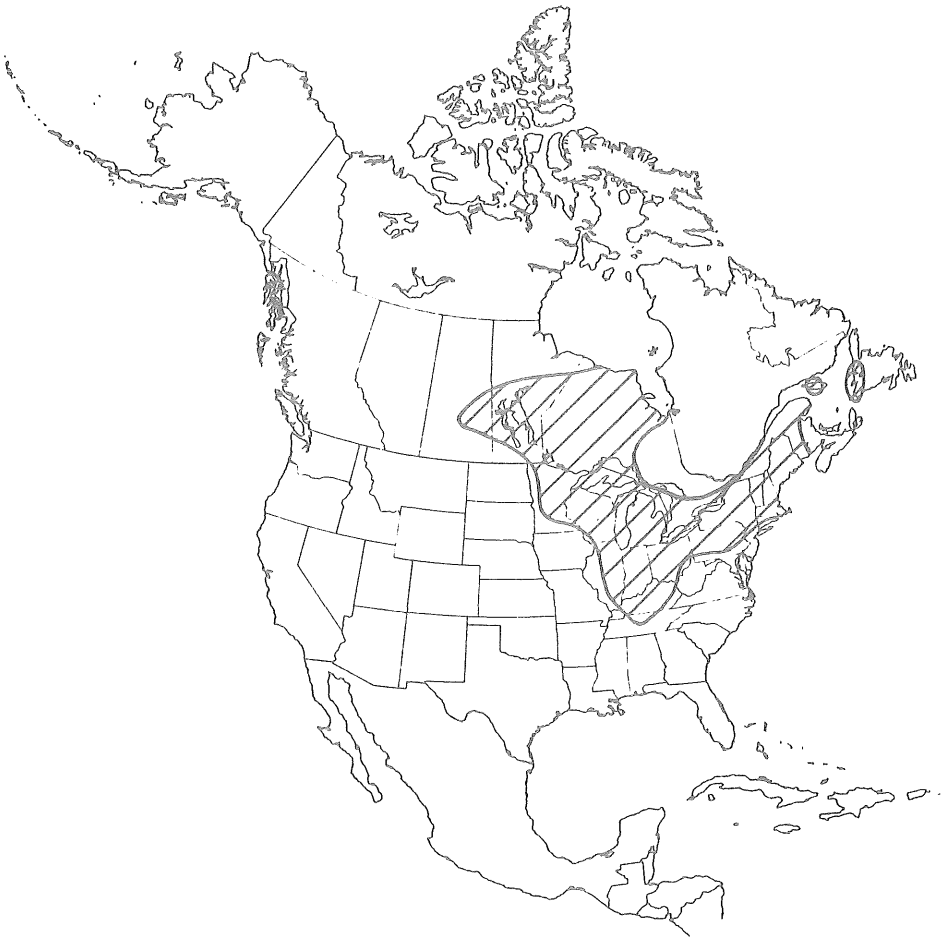
PREFERRED HABITAT IN MINNESOTA: *Carex sterilis* is an obligate fen species in Minnesota and throughout much of its range. Within fens it may become a dominant species along with *Scirpus cespitosus* and *Carex interior*. It often occurs with other rare fen species such as *Eleocharis rostellata*, *Rhynchospora capillacea*, and *Scleria verticillata*.

COMMENTS: Because of their delicate hydrology, fens can be indirectly affected by activities several miles away. This makes it difficult to assure the protection of a fen by setting aside the small parcel of land on which it may occur.

REFERENCES: Reznicek and Ball (1980).

Carex sterilis Willd.





SPECIES STATUS SHEET

SCIENTIFIC NAME: Rhynchospora capillacea Torr.

FAMILY: Cyperaceae

COMMON NAME: Hair-like Beak-rush

STATE STATUS: Threatened

FEDERAL STATUS: None

BASIS FOR MINNESOTA STATUS: Although this species occurs over a relatively large portion of Minnesota, it is largely restricted to small, fragile fen habitats. These habitats are often only a few acres in size and are maintained by the local discharge of cold, calcareous groundwater. The groundwater is critical to the survival of these habitats, and several of the sites are currently threatened with disruption or contamination of their groundwater supply.

The population east of Red Lake (Koochiching County) were only discovered in 1983, and occur in expansive peatland systems rather than isolated fens. The remote peatland interiors are accessible only by helicopter, and so have been poorly botanized until recently. The populations of R. capellacea, however, do not occur in the vast area of level bog, but only in small, raised fen-like features which appear to be very rare in Minnesota.

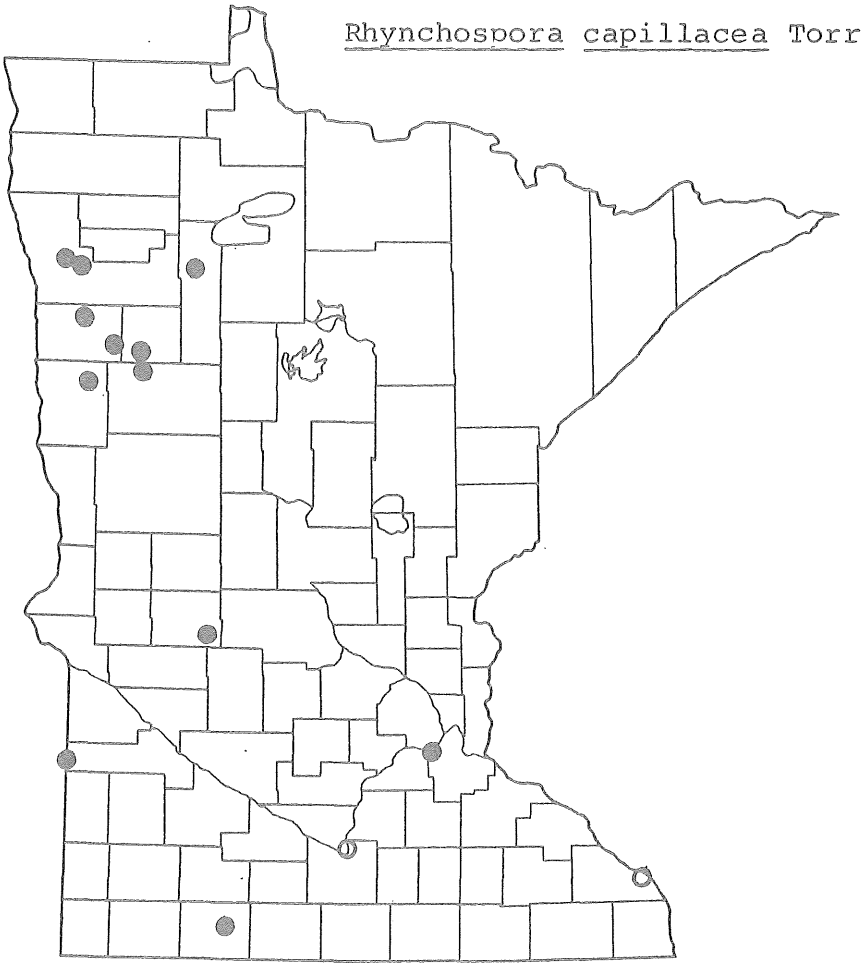
Although the more remote populations east of Red Lake are small, they appear to be stable at this time. Unfortunately, the populations in the rest of the state are experiencing a serious decline, and several local extirpations have already been documented. The population in Blue Earth County was destroyed by industrial development and one of the two populations in Dakota County was recently destroyed by road construction. The population in northern Norman County was destroyed in 1983 by a water impoundmnt project.

PREFERRED HABITAT IN MINNESOTA: The primary habitat of R. capillacea in Minnesota is calcareous fens, where it occurs with other fen species such as Carex sterilis and Scleria verticillata. Within fens it prefers the margins of fen pools and marl flats where the extreme environmental conditions keep competition minimal.

A secondary habitat for this species is fen-like habitats in large peatland complexes. These habitats are restrictd to small raised features that are apparently fed by groundwater, although not the nutrient-rich groundwater that support typical fens. The associated species here are more characteristc of bogs and include species like Rhynchospora alba, Carex livida, and Scirpus Hudsonianus.

COMMENTS: The distribution of Rhynchospora capillacea (like many highly specialized species) is very local and disjunct. It is considered very rare west of the Mississippi River, as well as in many portions of its eastern range.

Rhynchospora capillacea Torr.



SPECIES STATUS SHEET

SCIENTIFIC NAME: *Scleria verticillata* Muhl.

FAMILY: Cyperaceae

STATE STATUS: Threatened

FEDERAL STATUS: None

BASIS FOR MINNESOTA STATUS: This calciphile is generally rare or local throughout the region. This is largely because of unusual and restrictive habitat requirements that limit its occurrence to calcareous fens. Fens are small, fragile wetlands that are maintained by the surface discharge of cold, calcareous groundwater. Fens are highly localized phenomena that develop over a period of thousands of years, and are themselves threatened in Minnesota. Originally, as much as 5,500 acres of fen habitat occurred in the lower Minnesota Valley, but human activities have reduced fens there to less than 100 acres. The other major center of fens in Minnesota is along the ancient beach ridges of Glacial Lake Agassiz in Northwestern Minnesota, but most of those fens have been destroyed by agriculture, gravel mining and water projects.

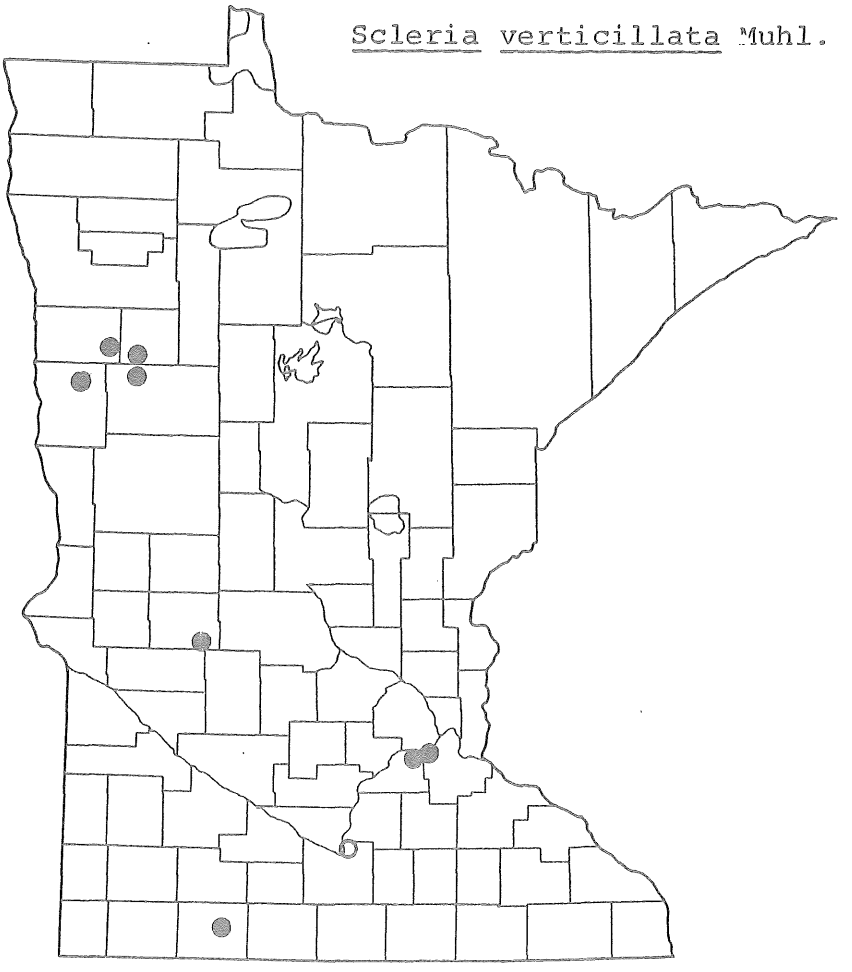
The decline in fen habitat has been closely paralleled by a decline in *S. verticillata*. The populations in Becker and Mahnomen Counties are remnants of a much larger and continuous population that has been fragmented by agricultural expansion. Other populations are known to have been destroyed by road building and industrial development. Any further decline n *S. verticillata* and its fen habitat could endanger the existence of this species in Minnesota.

PREFERRED HABITAT IN MINNESOTA: In Minnesota, *S. verticillata* is entirely restricted to calcareous fens. Within fens it acts as a pioneer on exposed marl and along the margins of pools. It is typically found in association with other notable fen species such as *Rhyschospora capillacea* and *Carex sterilis*.

COMMENTS: The preservation of *S. verticillata* is complicated by the nature of its fen habitat. A typical fen may be only 5 acres in size, but the recharge area that maintains its groundwater supply may cover thousands of acres. Without safeguarding the recharge area, the security of the fen would be tenuous.

REFERENCES: Smith (1983).

Scleria verticillata Muhl.



SPECIES STATUS SHEET

SCIENTIFIC NAME: Valeriana edulis Nutt. ssp ciliata (T.&G.) Meyer [Valeriana ciliata T. & G.]

FAMILY: Valerianaceae

COMMON NAME: Valerian

STATE STATUS: Threatened

FEDERAL STATUS: None

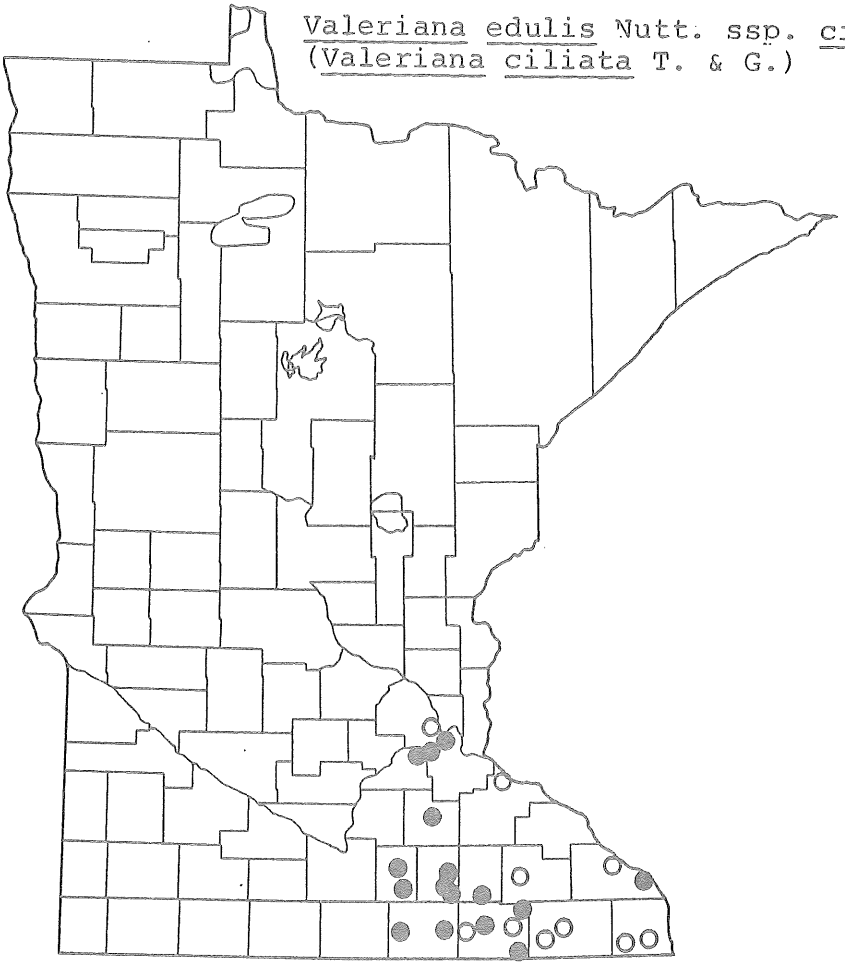
BASIS FOR MINNESOTA STATUS: Although this species was not formerly rare in Minnesota, the nearly total destruction of prairie and fen habitats has reduced its populations to a few isolated colonies. Most of the recent collections are from remnant prairie strips on railroad right-of-ways. These right-of-ways are rapidly being sold by the railroad companies, and are invariably bought by adjacent landowners for conversion to crop land. Two populations occurring in calcareous fens in the Minnesota Valley have recently been destroyed by road construction and commercial development. The typical subspecies occurs in western United States.

PREFERRED HABITAT IN MINNESOTA: This species occurs in three distinct habitats in Minnesota: deep soil mesic prairies, calcareous fens and limestone bluffs. It seems, however, to be most widely occurring on prairies where it may be found with other rare species such as Parthenium integrifolium, Caclia tuberosa, and Asclepias sullivantii.

COMMENTS: Attempts should be made to protect prairie habitats on right-of-ways from being converted to agricultural land.

REFERENCES: Meyer (1951).

Valeriana edulis Nutt. ssp. ciliata (T.&G
(Valeriana ciliata T. & G.)



Cladium mariscoides (Twig Rush) Special Concern.

There are currently 10 confirmed occurrences of this species in Minnesota. Most are from fens and peatlands in northwestern Minnesota, but there are two records from lake shores in eastern Minnesota. The two records from fens in the lower Minnesota Valley are disjunct about 150 miles from the next nearest population, and are usually considered relicts. It is listed as Special Concern because of its rarity and the threats to its habitat.

Cypripedium candidum (Small White Lady's-slipper) Special Concern.

This species has experienced a severe decline rangewide and has been reviewed for listing as a federally threatened species. About one half of the surviving populations occur in Minnesota. Habitat loss and exploitation are the main threats to this species.

Tofieldia glutinosa (False Asphodel) Special Concern.

There are about 20 confirmed occurrences for this species in Minnesota. They are mostly scattered through the northern prairie region, but there are a few records from bogs in the forest region. The Populations in the Metropolitan Area have suffered a severe decline, and only two small colonies are known to survive.

Triglochen palustres (Bog Arrow-grass) Special Concern.

There are 15 confirmed occurrences of this species in Minnesota. All of them are restricted to calcareous wetlands, mostly fens. There are records from all over the state, but most extant populations occur in Northwestern Minnesota. Threats to extant sites are usually from loss of habitat, or an unnatural change in the water regime.

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AERIAL PHOTOS

1937	10-30-37	WK-8-650, 651, 652.	ASCS
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MAPS

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N 1/2 of Sec. 34, T27N, R24W
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