

**STEARNS COUNTY
QUARRY PARK AND
NATURE PRESERVE:**

A PRIMER



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STEARNS COUNTY QUARRY PARK AND NATURE PRESERVE

INTRODUCTION

Quarry Park and Nature Preserve, the newest addition to the Stearns County park system, is a magnificent prize for the people of central Minnesota. Within a few minutes drive from downtown St. Cloud, a visitor will be able to swim, fish, climb rocks, mountain bike, ski, hike, scuba dive, and learn about the history of the granite industry in a beautiful and unique setting. In addition to the numerous recreational opportunities in the park, scientists have long recognized the importance of the park area.

From a geological perspective, Quarry Park and Nature Preserve provides an unexcelled place to study ancient granite rock formations and glacial action, as well as present-day hydrological activity. Biologists look at the park and see a rich biological treasury of prairie, savanna, wetland and rocky outcrop communities of plants and animals, including many species that are uncommon in central Minnesota.

In order to help visitors to Quarry Park and Nature Preserve understand and appreciate the natural features of the park, we have written this primer. In it you will find sections about the cultural, geological, and natural history of the park area. This is followed by a "Walking Tour". At twelve locations throughout the park we describe the biological and geological features visible to the visitor. As you hike through the park we encourage you to stop at the walking tour locations and learn more about each one. We hope the primer will help you to better understand why Quarry Park and Nature Preserve is such a unique resource and why it excites biologists, geologists, and nature lovers, alike.

CULTURAL HISTORY

LOCATION AND DESCRIPTION

Quarry Park and Nature Preserve, owned and managed by the Stearns County Parks Department, is a unique park with a rich cultural history and diverse natural resources. The site, known to many local residents as the Hundred Acres Quarry, is located on 220 acres of land adjacent to County Road 137, southwest of Waite Park in eastern Stearns County, Minnesota. More precisely, Quarry Park is located at 94.3 degrees west longitude and 45.5 degrees north latitude, or SE 1/4, Section 19 and SW 1/4, Section 20, T. 24N, R. 28W.

The site of Quarry Park and Nature Preserve is characterized by extensive natural exposures of granitic bedrock and contains more than twenty quarries. All of the quarries contain water either year-round or during wet periods. Another sign of past quarrying are

piles of waste rock (known as grout or spoil piles) found throughout the park. In the center of the site is a meadow-like area covering about 100 acres. This meadow and other open areas in the southwest and northwest corners of the park, are underlain by glacial sediment and are the remains of cleared farm fields. The field in the southwestern part of the park was later planted as pine plantations. In addition to rocks and fields, Quarry Park and Nature Preserve also contains extensive wetlands. These swampy areas include both natural wetlands and areas that are wet because of changes in drainage patterns due to past human activities.

HISTORY

Quarry Park contains extensive rocky exposures of granite. The granite in the central Minnesota and St. Cloud area formed during a mountain-building event about 1800 to 1700 million years ago. Quarrying of this crystalline rock did not actually begin in the St. Cloud area until 1868 when granite was removed from a pit at the present site of the St. Cloud Reformatory and used for construction of the St. Paul Post Office. A year later, the stone was first used locally in the construction of the Normal School, now St. Cloud State University. By 1963, St. Cloud was considered the second largest granite-producing area in the United States. At this time there were ten active quarries within a ten-mile radius of St. Cloud.

Ownership of the three plats of land that make up today's park changed hands many times over the years. The first company to claim ownership was the Plymouth Rock Granite Company in 1903; the last to own the site was the Cold Spring Granite Company. Cold Spring Granite acquired the land in 1959 but never operated the quarries--the exact date of the end of quarrying operations in the park is not known. The area has been a favorite local recreational spot for people of all ages for almost 50 years. In the late 1950s six of the quarries were stocked with trout. On opening fishing day it was not at all unusual to see people lined up elbow-to-elbow along the edge of the quarries hoping to catch "the big one". Stocking some of the quarries with rainbow trout is again being considered. In particular, Melrose Deep Seven (quarry 2 on the map) and Red Six (quarry 1) have water with the right temperature and oxygen content to be ideal for trout.

In the 1970s the park area--then called the "Hundred-Acres Quarry"--was a party haven for teens and college students alike (the 100 acres of the name are actually the central meadows). In addition to "partying", biking, swimming, diving, and hiking have all been popular activities on the property. Officially, these activities came to an end in 1992 when the fence was installed. Nonetheless, there is still abundant evidence that the location has continued to be a popular recreational spot.

The history of Stearns County Quarry Park and Nature Preserve begins in the 1980s. In 1985 an updated inventory of the outdoor recreational facilities in Stearns County was completed. Little was done with this newly acquired information until 1987 when the

county's comprehensive recreational plan was revised. During this revision Mr. Charles (Chuck) Wocken, Director of the Stearns County Park Department, remembered references to a "granite park" in the '60s. At that time the State of Minnesota had considered such a park too small to be a potential candidate for a state park. Nonetheless, residents of the St. Cloud area, familiar with the quarries, wanted opportunities to share them with others and the Stearns County Park Department to begin to look for an appropriate spot for a "granite park".

Initially, Chuck Wocken and Mr. Ken Hopke, Stearns County Planning Director, collaborated with the J. L. Scheely Company--a state-wide quarrying firm-- to explore the possibility of reclaiming an abandoned quarry for recreation. The J. L. Scheely Co. was very supportive of this idea and the county, encouraged by their enthusiasm, hoped that other granite companies would react likewise. As momentum for the developing park grew, the catch-phrase adopted to promote the plan was "Reclamation for Recreation".

Research showed that eighty percent of the county's population lived in the eastern part of the county--from the western boundary of Albany Township to the Mississippi River. Therefore the search began for a site that would have water, scenery, and granite and be located within the eastern part of the county. It was not until 1991 that the county realized that the acreage they were interested in was indeed for sale, and had been for two years.

The property where Quarry Park is located was purchased from Cold Spring Granite Company. Cold Spring had not been willing to sell off any of their property until the company's international business took a downturn. Cold Spring Granite offered the 220 acres to Stearns County for \$250,000. The land had been appraised at \$307,000 and the county felt obligated to offer the appraised value. However, because the intent of the purchase was public recreation, Cold Spring Granite sold the property to Stearns County in December of 1992 for their original asking price of \$250,000. Included in this purchase was \$10,000 worth of fencing to enclose the parcel of land.

To fund the purchase of the park property, Stearns County applied for a grant through the Wetlands Preservation Bill. The availability of this money was brought to the county's attention by Representative Bernie Omann, then a state legislator from St. Joseph. The purchase of this parcel was the only time a 100% land acquisition has been approved under this program.

With development of the park in its infancy, a large amount of capital was needed to explore and catalog the resources of the site and to promote and develop the park. A \$50,000 grant from a fund supported by the state-wide cigarette tax, was received from the Legislative Commission on Minnesota Resources (LCMR). This money funded description of the site, scientific study of the park and its surrounding area, and creation of a master plan for park development. Additionally, a sum of \$10,000 has been donated by the Central Minnesota Initiative Fund as part of the effort to develop the park's potential. In

1996 Stearns County received an additional \$5000 grant from the LCMR for curriculum and environmental planning.

In mid-1994, the Stearns County Board of Commissioners authorized Brauer & Associates, Ltd. to prepare a master plan for Quarry Park and Nature Preserve. The objective of the plan was to enhance the inherent character of the park rather than disguise its history. With this goal, Brauer & Associates created a comprehensive long-term plan that mapped out future physical facilities such as buildings and trails, site reclamation and ecologic restoration plans, and intended recreational uses. The present goal is to open Quarry Park on a limited basis in fall of 1997. By this target date, the park will have an entrance road and parking lot, and trails to some of the quarries. It is hoped that a derrick to be used to demonstrate quarrying will be installed in 1997.

Many volunteer hours of work preparing the park have already been donated by a variety of groups and individuals. Staff from the College of Saint Benedict, St. Johns University, and St. Cloud State University have participated in a variety of biologic and geologic studies at the site. In addition, plant inventories have been compiled, scuba divers have conducted underwater inventories of the quarries, and toxicity testing of quarry water has been completed—all efforts are part of the groundwork necessary for development of the park. Physical clean-up efforts have included fishing automobiles out of quarries, disposal of abandoned vehicles and debris, and creation of access roads. Prairie and ecologic restoration is currently in progress. A new wetland has been designed to replace an area of wetland being impacted by development of the emergency access road. It is hoped that additional grants can be obtained to fund specific projects such as a boardwalk through the central wetland. For now, a three-bedroom home at the site will serve as the interim park headquarters.

The park area is presently being used for educational purposes by students from the College of St. Benedict, St. John's University, St. Cloud State University, and the local school districts. Classes come to the park to study geology, biology, wetland science, and environmental relationships between humans and the land. The park has also been included a local tour program for conventions held in St. Cloud. The Visitor and Convention Bureau refers to Quarry Park and Nature Preserve as "The Unpolished Nugget".

Implementation of the master plan will continue for many years with development of the park in stages as the budget allows. The achievements to date are due to many people providing energy and talent, insight and dreams. This has been a long but successful journey, transforming an abandoned industrial site to a public treasure. The process continues with high hopes for a happy ending.

WALKING TOUR

SITE 1-- QUARRY 13 BASALT AND GRANITE

Important features of this location:

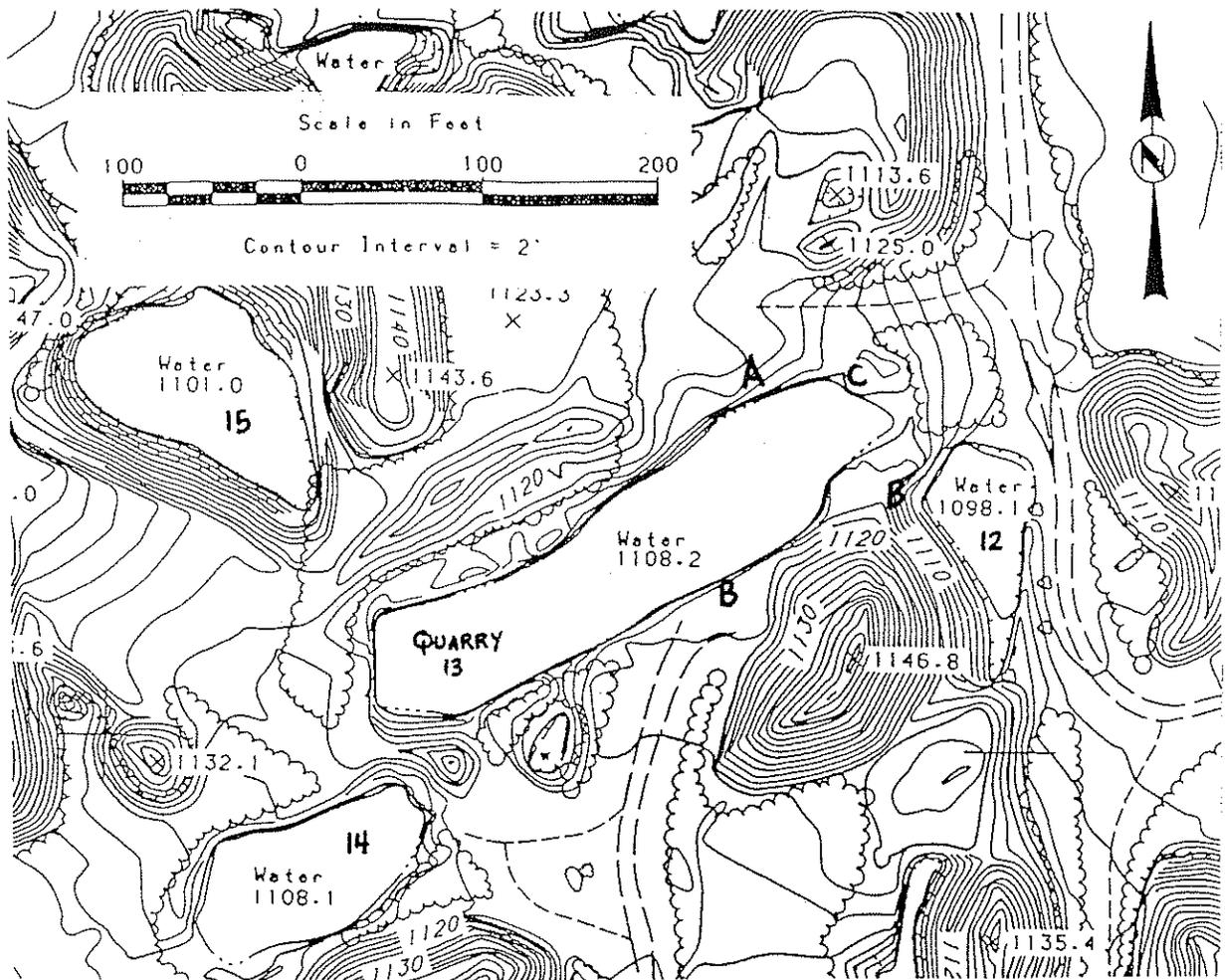
- red St. Cloud Granite
- dark basalt dikes
- glacial erosion--glacial polish and striations
- groundwater and surface water relationships

Rocks:

Visible at this location are Quarry 13, a long narrow quarry that runs roughly northeast-southwest, and Quarry 12, which is a small pit located to the east of Quarry 13, next to the road. Quarry 12 is shallow--only 23 feet deep at the most-- and is lower in elevation than Quarry 13 which has a maximum depth of 39 feet. Quarry 13 is an excellent place to see the relationships between two of the major rock types in the Park, the pinkish or red-colored **granite** officially known as St. Cloud Granite, and the darker black to brown **basalt**.

The most prominent geologic feature that can be seen at this site is a large basalt **dike** that forms the southern edge of Quarry 13. The dike formed when molten basalt **magma** "intruded" (oozed up under pressure) into a vertical crack or **fracture** in the red granite. Note the rounding and smoothing of the upper surface of the basalt. Contrast this with the surface of the adjacent red granite. The granite is smoother and in places appears to have been polished; in sunlight this contrast is easily seen--the granite reflects far more light than the basalt and appears shiny in many places. The smoothing of the rock is due to the movement of glacial ice across the rock. Sand and silt embedded in the ice at the base of the glacier acted like sandpaper to smooth and polish this surface. The **glacial polish** is more extreme--smoother, shinier--on the granite because the **minerals** that form the grains in the granite are physically harder than those in the basalt. Additionally, the minerals in the granite are chemically more stable (less easily weathered away) and the individual grains are larger in the granite. So the mineral grains of the granite were smoothed and polished, while the mineral grains in the basalt crumbled away when the glaciers moved across this rock.

In places, especially at the eastern end of Quarry 13, larger rocks embedded in the moving glacial ice carved long scratches or grooves called **glacial striations**. The grooves are oriented northeast-southwest and indicate that the glacier was either moving towards the northeast or towards the southwest. From other features in the park, for example from the shape of the granitic hill at walking-tour location 8, we know that the ice was moving from the northeast toward the southwest.



Location of site 1 showing Quarry 13 and Quarry 12. A) Basalt intruded into granite shown in photos A1 and A2. B) Large basalt dike rounded by glacial erosion shown in photo B. C) Excellent glacially polished granite and glacial striations.

Walking along the contact between the basalt and granite on the south side of Quarry 13 another feature of the basalt is visible--thin lines of a whitish mineral run across the basalt perpendicular the edges of the dike. These minerals were deposited in thin fractures or cracks that opened up in the basalt. Their alignment perpendicular to the margins suggests this occurred when the basaltic **magma** contracted as it solidified and cooled. The black to brown basalt can also be seen as you look across to the other side of the pit. The northern wall of Quarry 13 is also basalt but lacks the smooth rounded face, probably due to quarrying activity. This makes it easier, however, to see the fractures in the basalt. The brownish stains on the rock indicate weathering (chemical alteration) of the iron-bearing minerals in the basalt in contact with water and oxygen. The brown stains are in fact a form of rust.

The basalt in this area is younger than the granite. Thus, it was "intruded", or was incorporated into the granite after the granite was formed. We can tell that the basalt is younger than the granite because:

1) The basalt mineral grains are smaller where the basalt contacts the granite than in the middle of the dike. As the liquid magma cools, solid crystals begin to form and grow until all of the molten rock has turned into solid rock made of intergrown crystals. The quicker rate of cooling, the smaller, or finer the crystals. The finer texture of the basalt where it touches the granite indicates that the magma at the edges of the basalt dikes cooled faster than the magma in the center of the dikes. This is because the granite was cool rock and permitted heat to be conducted away very quickly from the dike margins, cooling this part of the basalt much faster than in the center of the dike. The finer grain-size or texture can be seen by looking closely at the rock with a magnifier. Other indications of smaller crystal size of basalt at the edge of the dike include the smoother way that it breaks, the lighter color, and the difference in the number and orientation of cracks or fractures.

2) 'Fingers' of the basalt that narrow and disappear into the granite. These show where basalt magma intruded into cracks in the granite, proving that the granite must have already existed and therefore be older than the basalt.

3) There are small, a few inches across at the most, angular pieces of granite in the basalt along the edge of the pit. These pieces of granite broke off during the cracking of the granite when the basalt magma was forced into the cracks in the granite, and were surrounded by basalt magma. Because the basalt cooled rapidly, the pieces were not altered by melting.

4) The granite along the contacts with basalt was changed very little by contact with the heat of the cooling basalt magma. This may be evidence that the granite simply broke and that heat from the basalt was conducted away in a geologically short time, without causing granite minerals to adjust to the new temperatures. Alternatively, these observations may indicate that the basalt magma was very "dry", that there was little water or any other fluid dissolved in the magma, since fluids can also speed the changes in minerals at a contact between rock (in this case the granite) and magma (the basalt).

This site is also a good location to look closely at the minerals that make up the St. Cloud (red) Granite. With a magnifier several different colored minerals are visible. The dominant mineral consists of large pinkish or reddish chunky grains of **potassium feldspar**. Whitish, chunky **sodium feldspar** (also called plagioclase feldspar) is also present. Clear glassy grey grains are **quartz**; the blackish grains can be any one of several different minerals. Dull-looking, chunky black grains may be **amphibole** (also known as hornblende) or **magnetite**, while flaky looking, shiny black grains are **biotite mica**.

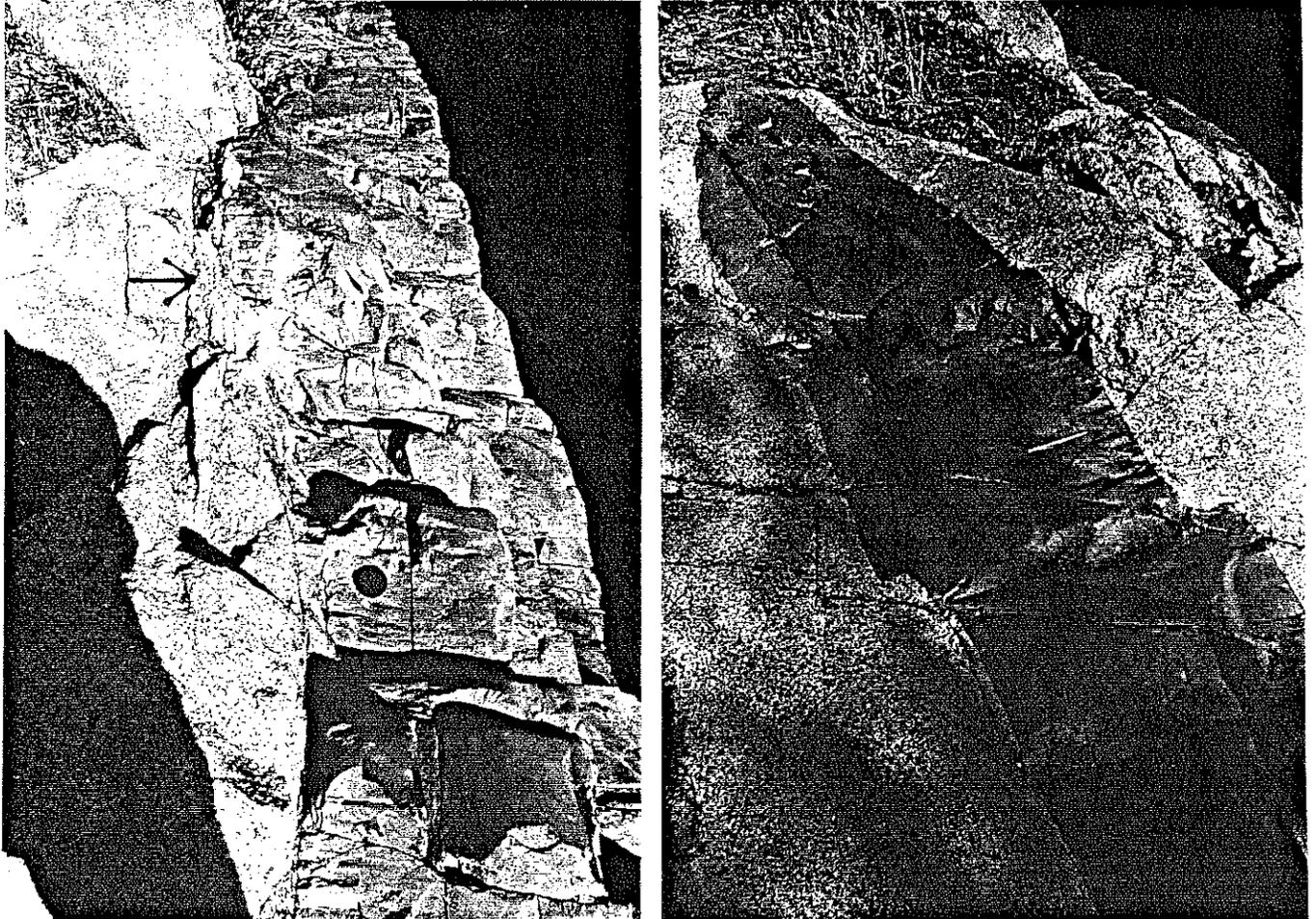
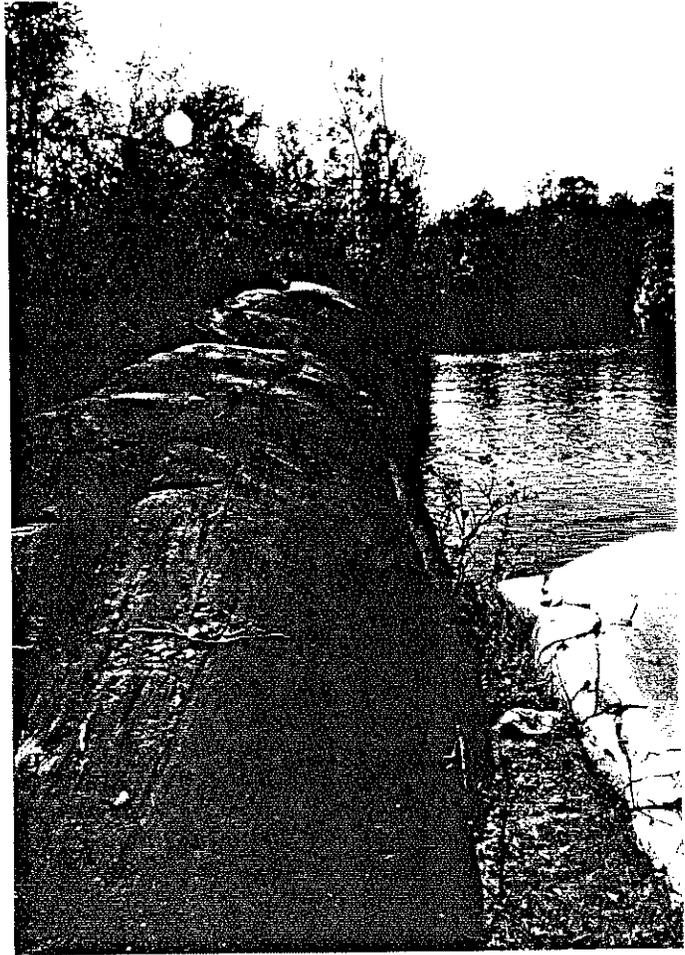


Photo A1 (right)--Basalt (dark fine textured rock) intruded into granite (coarse, rough textured rock). Arrow points to "fingers" of basalt into granite. Darkest area on right is water in Quarry 13. View is toward northeast along northern margin of quarry.

Photo A2 (left)--Another view of basalt in granite slightly west of location of A1.

Photo B--View of large, glacially rounded basalt dike (left in photo) along southern margin of Quarry 13, seen from southeastern corner of quarry. Shiny, smooth, light-colored rock on right is glacially polished granite.



Water:

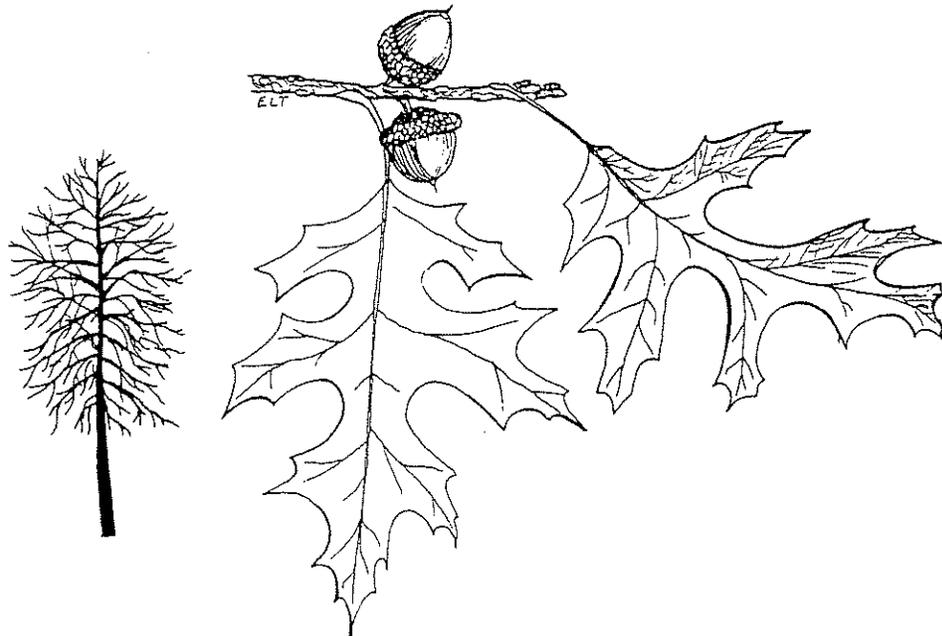
The relationship of the hydrology (water) of Quarries 13 and 12 to the **bedrock** geology is significant at this site. If you stand near the southeast corner of Quarry 13, where Quarry 12 is also visible, you can see a big difference in the water levels in the two pits. Water levels in Quarry 13 usually measure around 1109 feet ASL (above sea level), at least ten feet higher than in Quarry 12, where water levels are generally around 1099 ft. ASL. Water levels in the quarries of the Park are mostly controlled by movement of **ground water** through fractures in the hard bedrock. In the park area, ground water is shallow; in other words, it is not very far below the surface of the ground. The quarries were dug deeper than this level so ground water flows through cracks out of the ground into these holes. During quarrying, it was necessary to continuously pump out the ground water seeping into the pits to keep them dry. As we can see, when pumping stopped, the quarries filled with ground water.

At this location the abrupt change in ground-water level (and quarry water level) indicates that fractures do not connect the two pits. The large basalt dike that separates the two quarries has fewer fractures than does the red granite. Water levels in Quarry 12 also fluctuate more than in Quarry 13. This is probably because of greater rates of evaporation. Water in the smaller quarries warms and cools faster than in the large quarries in response to seasonal temperature changes. This effect also causes the small quarries to freeze weeks earlier than the large quarries in the fall.

Plants:

The plants growing at this site provide an introduction to the vegetation that occurs throughout the rest of the park. Many of the common plants in Quarry Park can be observed here. As you approach the quarry from the west, you pass through an overgrown oak **savanna**, which is the dominant vegetation type in the park. Northern pin oak, bur oak, and black cherry are common trees in this forested area. Along trails and in more exposed sunny areas, aspen, buckthorn, and poison ivy are common. These species, especially the latter two, are indicators of disturbance. **Herbaceous** plants at this site include alumroot, big blue stem and some other species that are more typically found in a **prairie**.

Near the water you can find red-osier dogwood with its beautiful red twigs, paper birch, and ash. Peering into the water you will see some submerged aquatic plants. The clear water in the quarry allows for good light penetration and photosynthesis by the submerged plants.



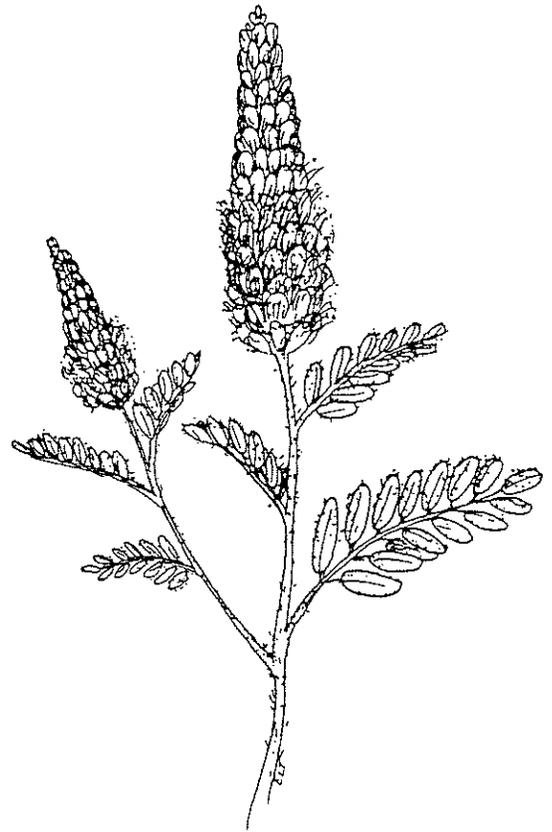
Northern pin oak (*Quercus ellipsoidalis*) is a common tree of dry, upland sites

SITE 2-- QUARRY 9 FAULT

Important features of this location:

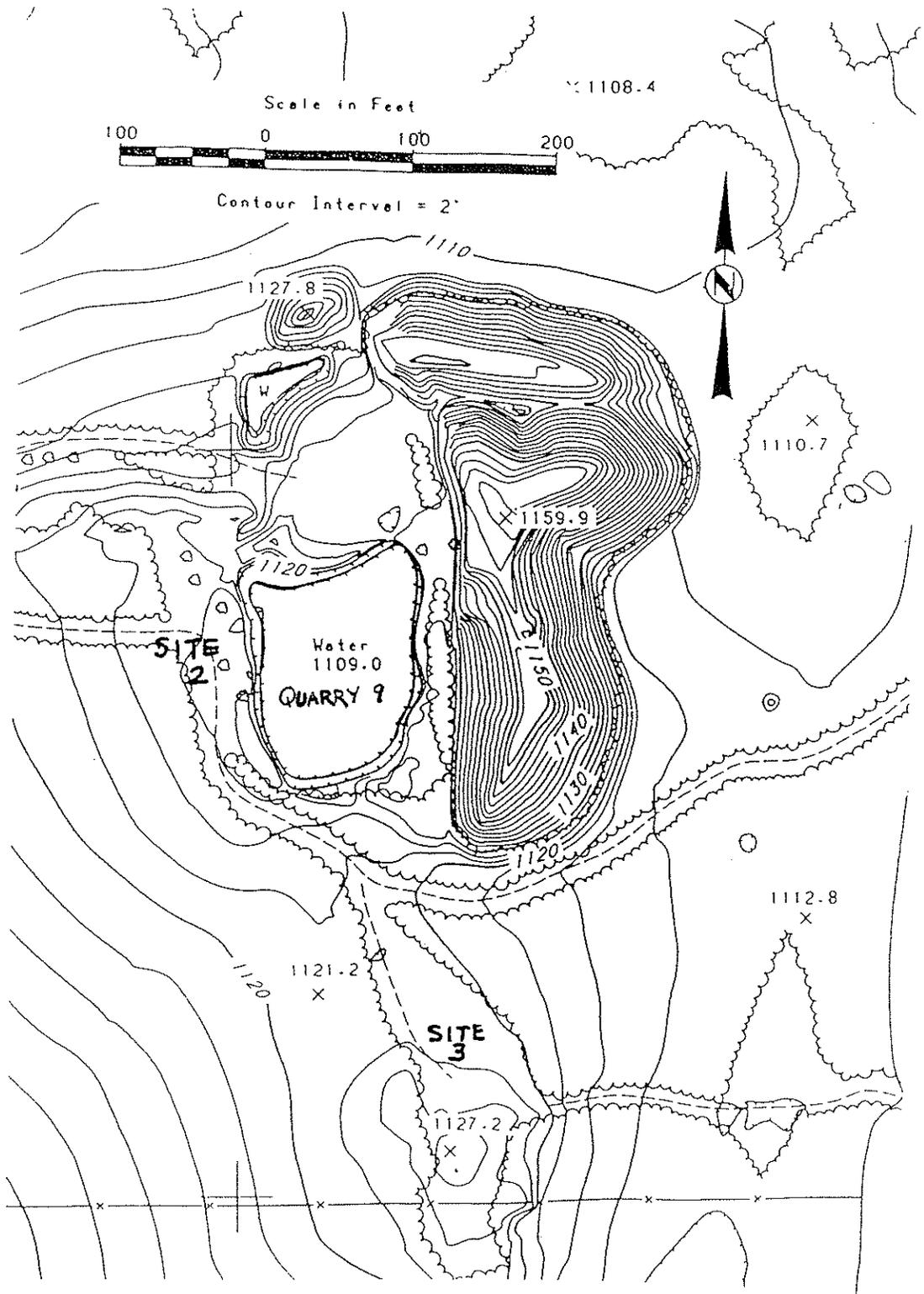
- red St. Cloud Granite
- gray Reformatory Granite
- reverse fault
- lead plant

As you approach this quarry from the west you will observe one of the better stands of lead plant in the park. These shrubs, which are in the legume (or bean) family, are indicators of undisturbed **prairie**. The delicate gray-green or "lead" colored leaves are apparently highly nutritious and tasty. Thus, these plants decline under grazing pressure. Lead plant exhibits several adaptations for survival in dry conditions. This is particularly obvious during drought periods, such as the summer of 1996 when lead plant seemed oblivious to the drought conditions that left its neighbors wilting and dying. Lead plant's deep root system helps in obtaining water from the soil and its lacy and finely-divided leaves reduce surface area to minimize the rate of water loss (transpiration). The light coloration of the leaves is also an adaptation to dry conditions; the leaves reflect sunlight which reduces solar heating. As with other members of the legume family, there are small nodules on the roots of lead plant that harbor bacteria that take nitrogen gas from the air and convert it into a form that the plant can use. These **nitrogen-fixing bacteria** enable lead plant and other legumes to grow well in nitrogen-poor soils.



Lead plant (*Amorpha canescens*) is a legume commonly found in grasslands

The significant rock feature that can be seen at Quarry 9 is a **fault** on the west wall of the pit, easily visible when standing on the east side. The fault appears as a prominent, almost horizontal, curved crack. The crack along the fault can often be seen oozing **ground water**; several dark-colored water-stains extend downward from this break in the rock. The rock on the top of the west wall is the Reformatory (gray) Granite; below the fault, visible on a shelf that extends out into the pit near water level, is St. Cloud (red) Granite. Compare the appearance of the red and gray **granites**--note the spotty appearance of the gray granite. The fault line runs north-south and is what is known to geologists as a **reverse fault**. This means that the gray granite moved from west to east,



Location of sites 2 and 3 showing Quarry 9 and rocky outcrop to south with the cactus.

other along the fault may have been marked by one or more earthquakes. These earthquakes are however, long in the past, and were part of a period of mountain-building that occurred in the upper Midwest between 1700 and 1800 million (1.7-1.8 billion) years ago.

This is a good location for seeing how the St. Cloud (red) Granite differs from the Reformatory (gray) Granite. The scientific answer is that the two granites differ primarily in the relative percentages of the feldspar **minerals**. The red granite has higher percentage of pink **potassium feldspar** than the gray granite. Unfortunately, the gray Reformatory Granite weathers to a pinkish color which makes it difficult to tell the **sodium feldspars** (white to light gray in fresh rock) from the potassium feldspars (pink in fresh rock). This makes it important to be aware of whether you are looking at "fresh" rock surface—for example a quarry cut, broken, or glacially polished rock surface—or at a grungy weathered rock when trying to tell the two granites apart. This is why the spotty appearance of the gray granite is helpful—the spots, formed by clumps of dark-colored minerals, are visible in both weathered and fresh rock.

This site was probably quarried because the fault limits the gray granite and exposed the more-desirable red granite near the surface. This pit extends 45 feet below the present water level—this may have been as far as the unfractured, desirable rock extended or perhaps pumping the pit dry for quarrying operations became too expensive at this depth. There is ample historical evidence that in the Quarry Park area the deeper quarries required continual pumping because of ground-water seepage from quarry walls. The water levels in Quarries 9 and 8 are the highest of any water surfaces in the park area. The water level in Quarry 9 is typically at a level of more than 1112 feet above sea level (ASL), and is three feet higher in Quarry 8 (more than 1115 ft. ASL). These quarries are located at the high point of the **water table** within the park. This means that the fractures and cracks in the bedrock are filled with water to within a few feet of the earth's surface. This is the water that would have continually seeped into the pits as they were deepened during quarrying.

Another feature of interest at this site can be observed when walking along the stacked retaining wall of the **spoil pile** along the eastern side of Quarry 9. During the summer months, cool humid air can be felt coming out of the wall. The cause of this phenomenon is not known. The amount of heat energy that rock can store is great enough that the temperature of the rock and air in the spoil piles can not change very rapidly. In other words, the rocks piles are not simply retaining the cool of nighttime into the day, therefore the cool air cannot simply represent daily temperature variations. The largest rock piles are probably thick enough and high enough that they never completely warm up inside during the summer. Air moving in and out of the piles may be cooled by this rock. We know that in most caves the temperature rarely rises above about 55 degrees Fahrenheit temperature—this may be a similar situation. An alternative idea is that the cool air is caused by **evaporative cooling**. This could be the case if there is water or soil moisture

inside of the spoil piles—air circulating through the piles in the summer would cool as heat is used to evaporate the trapped moisture. The air coming out of the pile would then be colder than when it went into the pile.

SITE 3-- CACTUS OUTCROP

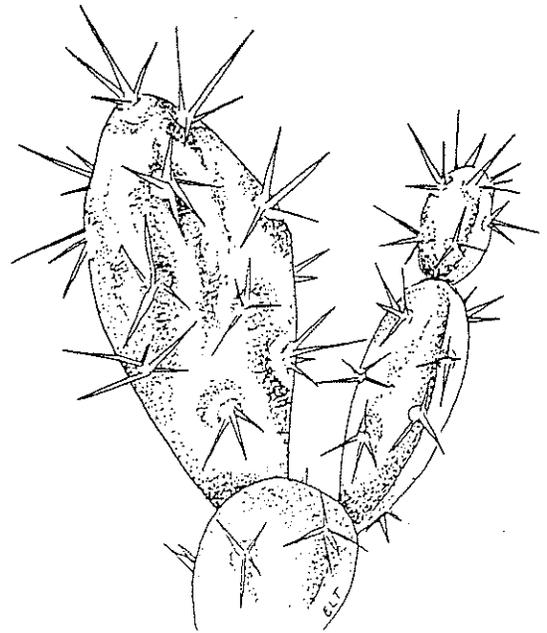
Important features of this location:

- prickly pear cactus
- rocky outcrop plant community

This site provides a good example of the type of plant **community** characteristic of a rocky, granitic outcrop in Central Minnesota. As you walk down the trail from the north (Quarry 9) you will come to an opening in the woods. Here the **granite bedrock** is exposed. Most of the granite is the Reformatory (gray) Granite, which is gray colored on freshly broken surfaces. The vegetation on the rock surface is sparse and occurs primarily in the shallow soils that have accumulated in cracks in the rock. Adjacent to the exposed bedrock is a mixture of grasses and **forbs** that are growing in the thin soils over buried bedrock. The plants of this site are primarily **herbaceous** since there is not enough soil to sustain larger woody plants. A listing of some of the plants likely to be found on this site is given in Box 1.

The most distinctive plant of this rocky outcrop is the brittle prickly pear cactus which forms a small, but dense mat of plants on the rock surface. These plants, which have a very shallow root system (no more than about one-half inch long), are ideally adapted to the harsh conditions of the rock surface. **Succulent** stems, no leaves, thorns, thick waxy outer layer (cuticle) and small size help to conserve water and tolerate the drastic temperature fluctuations that characterize this **habitat**.

Fameflower is a small **perennial** with succulent, tubular leaves and a short **taproot** that grows in Quarry Park in the thin soil in the cracks of exposed granite bedrock at this site and others in the park. This drought-tolerant species is more common in the Minnesota River valley and the southwest section of the state. In fact, fameflower and the brittle prickly pear reach their most northerly distribution in our area.



The brittle prickly pear cactus (*Opuntia fragilis*) can tolerate the hot, arid conditions on granite outcrops.

Crassulacean acid metabolism, abbreviated CAM, is another process used by both fameflower and the brittle prickly pear cactus to let them survive on the dry outcrops. CAM is a specialized version of **photosynthesis** in which plants do things “backwards”. Normal plants open pores in their leaves during the daytime to absorb carbon dioxide for photosynthesis. One unavoidable consequence of opening these pores is that the plant loses water. For most plants this isn’t a serious problem. However, plants like fameflower and brittle prickly pear can’t afford to lose much water. Thus, they have evolved a modification that allows them to open up the pores at night and then store the carbon dioxide until the daytime, when sunlight is available to complete the photosynthetic process. This is a tremendous advantage because it is usually much cooler at night so there are significantly lower water losses. A common weedy plant, purslane, is another CAM plant that can be found at this site intermixed with fameflower and the brittle prickly pear.

The exposed rock surfaces provide an excellent environment for mosses, spike-mosses, and lichens that tolerate drying. These species are capable of remaining dormant--in a dry state--for a long time. When moisture is available, they quickly hydrate and begin to photosynthesize for as long as conditions allow. A variety of mosses and **crustose lichens** can be observed growing on the rock faces. One of the **foliose lichens** at this site is the highly branched, grayish-green, reindeer moss. This species is uncommon in central Minnesota--it is more characteristic of rocky outcrops in the northeastern part of the state. Rock spike-moss, which appears moss-like, is a relative of the ferns. This species, which is reddish-brown and has hair on its leaf margins, prefers exposed acidic rocks.

A fern that is also adapted to rocky outcrops is the rusty woodsia which grows in clumps in slightly shaded areas. The numerous hairs and scales on the leaves help this species to reduce water loss. The leaves also curl up when it is dry to minimize further water loss. This species grows well in rock gardens and also prefers acidic conditions.

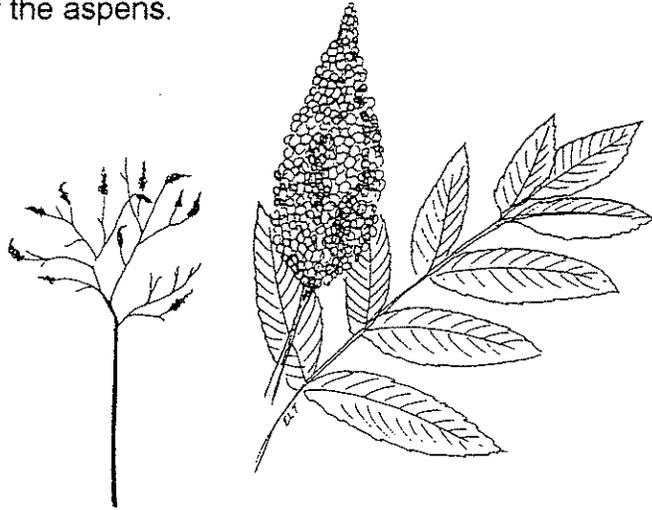
Plants of Granite Outcrops in Quarry Park

Bellflower	Pale corydalis
Big blue stem	Poison ivy
Brittle prickly pear cactus	Purslane
Canada wild rye	Rock spike-moss
Fameflower	Rusty woodsia
Giant hyssop	Wild onion
Long-leaved bluets	

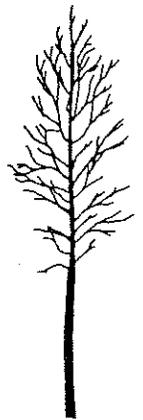
SITE 4-- QUARRY 8 LOOK OUT

Important features of this location:
quarrying spoils piles
savanna and grassland areas
evidence of past human activity
wetland

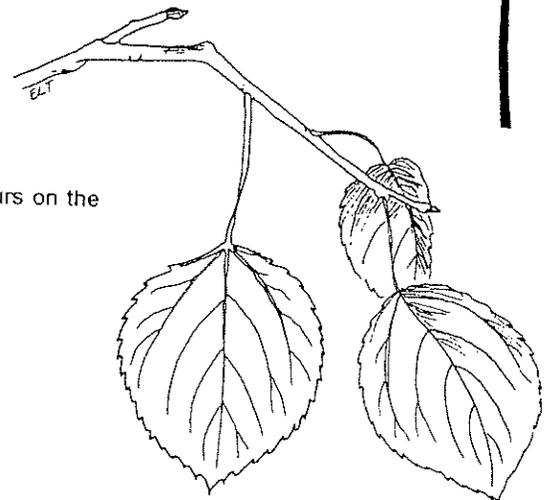
This site provides a spectacular panoramic view of the park. Looking north you will see the large central grassland (Site 5) that stretches in an east-to-west direction. Distinct zones of vegetation can be observed along the northern edge of the grassland. Directly adjacent to the grassland is an area of quaking aspen trees which are light greenish in color. This species is one of the woody **prairie** invaders, typically kept at bay by fire. Aspens thrive along the margins of the prairie where they can receive full sunlight. Their habit of sending out root **suckers** enables them to quickly colonize an area, forming extensive **clonal** patches. Normally aspens do not invade the forest because there is not enough light for them and they cannot survive in prairie because they are fire-intolerant. In several places areas of smooth sumac can be seen between the aspens and grassland. These shrubs, with their light-green leaves that turn blazing red in the fall, occupy a similar **niche** as that of the aspens.

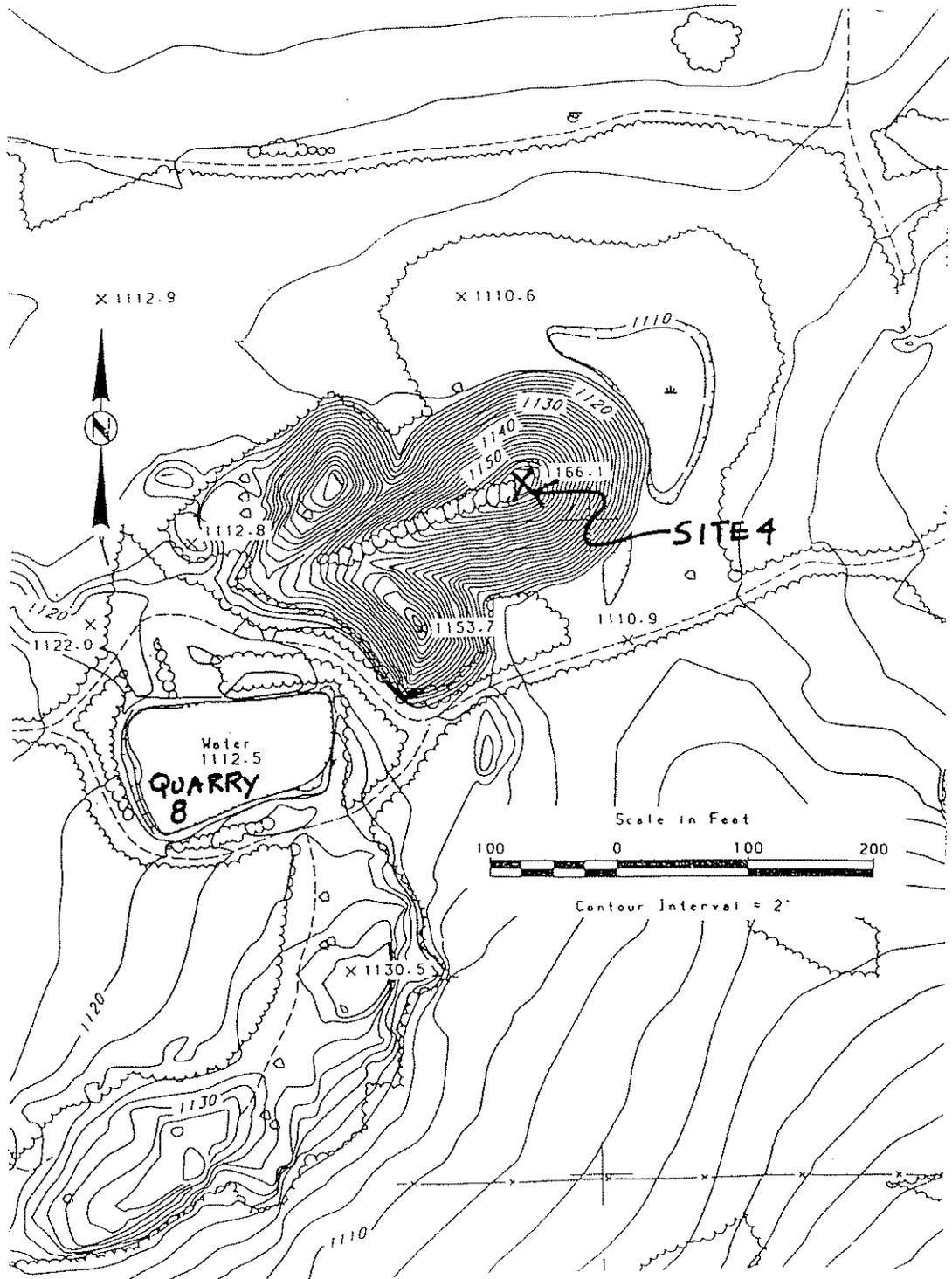


Smooth sumac (*Rhus glabra*) is a common shrub of open areas and it forms large colonies from underground shoots



Quaking aspen (*Populus tremuloides*) is a fast-growing tree that occurs on the edge of the grassland.





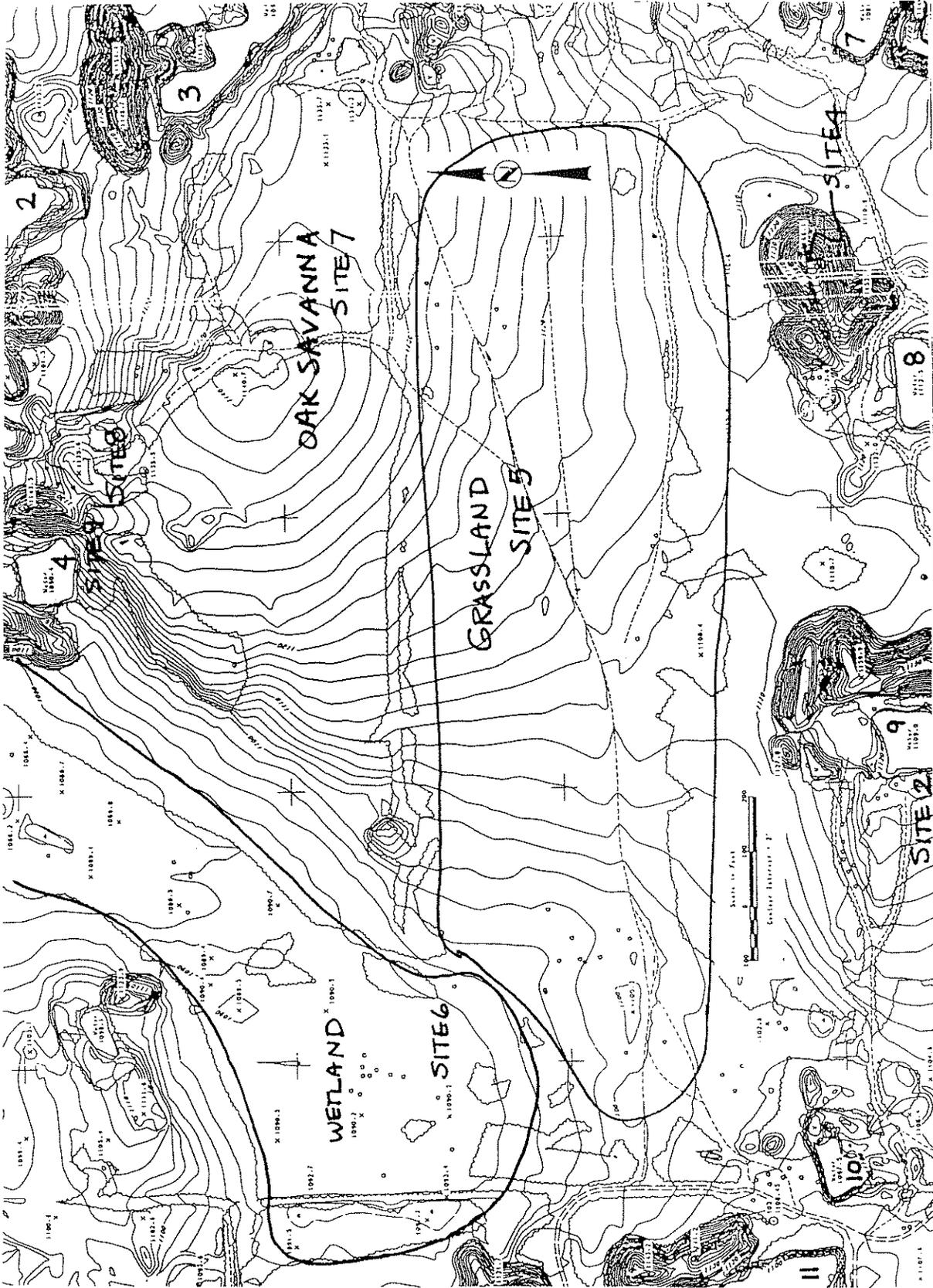
Location of site 4, the lookout east of Quarry 8. Lookout is the central and highest of the three spoil piles shown as steep hills on this topographic map. Note wetland area with marsh symbol at eastern foot of spoil pile. Former roadbed that dams the surface water to create the wetland is indicated by the dashed line running east from Quarry 8.

To the north of the aspen zone can be seen an area of oak trees in the overgrown **savanna** area. The trees with darker-green leaves are a mixture of northern pin oak and northern red oaks while those with silvery-green leaves are bur oak. These trees are characteristic savanna species (site 7) and at one time was the predominant type of vegetation in the park.

The savanna area has **soils** developed on a thin layer of **glacial till** (sandy and bouldery sediment deposited by melting glacial ice); **bedrock** is near the surface. In contrast, the grasslands are established on a thick layer of well-drained sandy glacial till which overlies ancient **sediment** and soil developed by tropical weathering about a hundred million years ago. This lower layer contains abundant clay and is very compacted and helps retain water in the overlying glacial till. The contrasting soils influence where the plant **communities** became established. Evidence of till is visible in the form of the piles of rounded boulders in and adjacent to the grassland. These indicate not only the presence of glacial material but also provide evidence of past cultivation. Such boulder piles are common next to farm fields in regions covered by glaciers during the **Ice Ages**.

A **wetland** can be observed at the foot of the overlook on the north, east, and south sides. The wetland has an extensive covering of duckweed, a small, floating aquatic plant that produces the smallest flowers in the plant kingdom. This wetland is probably the result of human activities. Under the **spoils pile** that forms this overlook, and under the adjacent wetland, the granitic bedrock is very close to the surface. This is also a low point on the bedrock surface. The **ground water** and **surface water** at this location should naturally flow towards the south across the low spot in the bedrock surface. However, water has been dammed by the remnants of a road that runs east-to-west along the south side of the overlook.

The oaks standing with "wet feet" along the margin of the wetland are indications of the unusual nature of this wetland. The presence of these trees, which normally prefer drier soil, indicates that the site has been flooded after the trees grew up on this location. Another unusual feature of this wetland when compared to other wetlands in the park, is the type of sedges (sword-like aquatic plants) here. The sedges here are species that grow as individuals rather than growing in the more typical clumps or hummocky mounds. Soils around the wetland are saturated most of the year but are formed from till similar to that in the grassland to the north. Within the center of the wetland the soil consists of **muck**--partly decayed aquatic plant material that sits directly on the granite bedrock.



Locations of sites 5 and 6, the central grassland and central wetland. Adjacent sites also marked. Approximate boundaries of grassland and wetland are marked with dark lines. Dark, thick numbers on water bodies are quarry numbers.

SITE 5-- CENTRAL GRASSLAND

Important features of this location:

- prairie and non-prairie plants
- insect galls and gopher mounds
- prairie restoration project

Walk to the middle of the grassland. At first glance the vegetation of this area will appear to be rather uniform. However, if you look closely you will find a surprising variety of plant species (Box 2--Common Plants of Quarry Park Grassland). This area is dominated by members of the sunflower family including species such as goldenrod, aster, and fleabane. With the exception of a few isolated patches of Big blue stem and Indian grass, there are few native grasses in this area. Introduced weedy grass species such as Smooth brome grass, Kentucky bluegrass, and Quack grass are common. The lack of native grass species indicates that this is a low-quality **prairie**, in other words this grassland contains a significant number of non-native plants and lacks the full range of plant species in an original prairie.

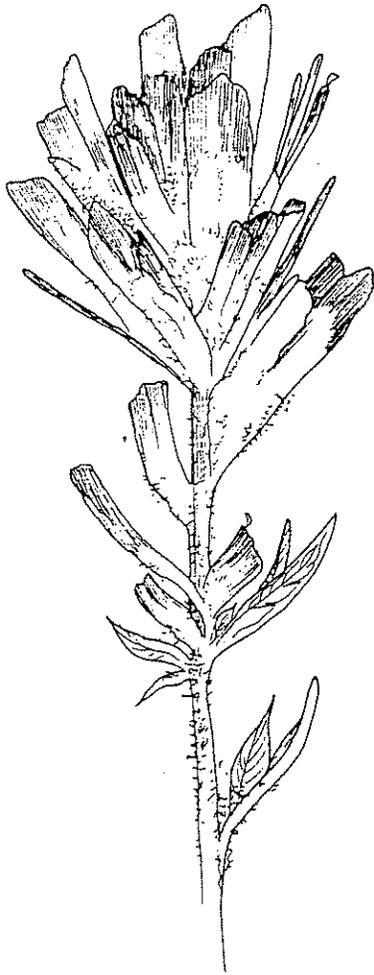


Big blue stem (*Andropogon gerardii*) is one of the dominant plants of the tall-grass prairie.

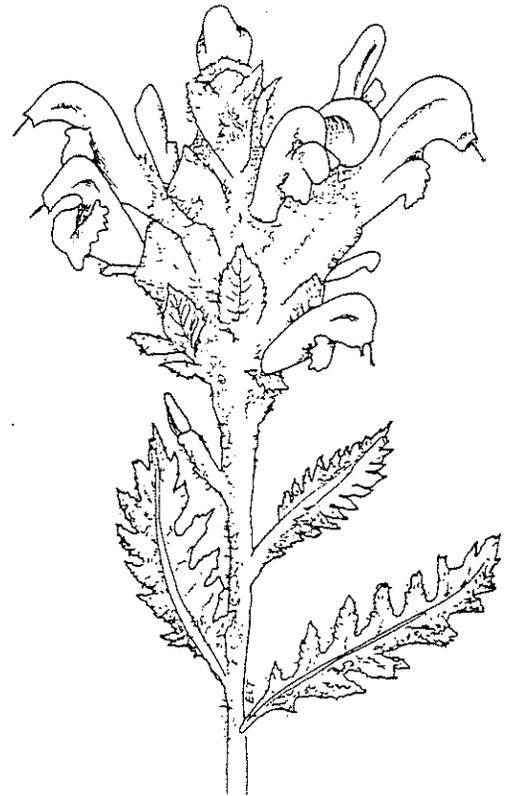
As you look around you will notice that there are a few trees and shrubs scattered in this area. Aspen trees and smooth sumac are the two major tree species that have invaded this area. Both are **clonal** species meaning that they form colonies of genetically uniform individuals that resulted from the establishment of a single individual. If you look very carefully, you may see isolated seedlings of bur oak, northern red oak, prickly ash, and hawthorn.

Among the interesting **forbs** (non-grass herbaceous plants) in this area are Indian paintbrush, lousewort, and green twayblade. The first two species, members of the figwort family, are both examples of hemi-parasites, plants that have root connections to other plants. They obtain water and nutrient elements from their host, but make most of their own food through **photosynthesis**. In addition, they can also "steal" some organic nutrients from the host plant. June is an excellent time to visit this area because the grassland is painted brilliant red from the colorful **bracts**, which are modified leaves that surround the inconspicuous flowers, of the Indian paintbrush. This species is also unusual because it is

one of the few non-perennial herbs of the prairie. In other words, it grows from seed each year. In contrast, most prairie plants live for many years, surviving during winter as an underground root or bulb or some similar structure.



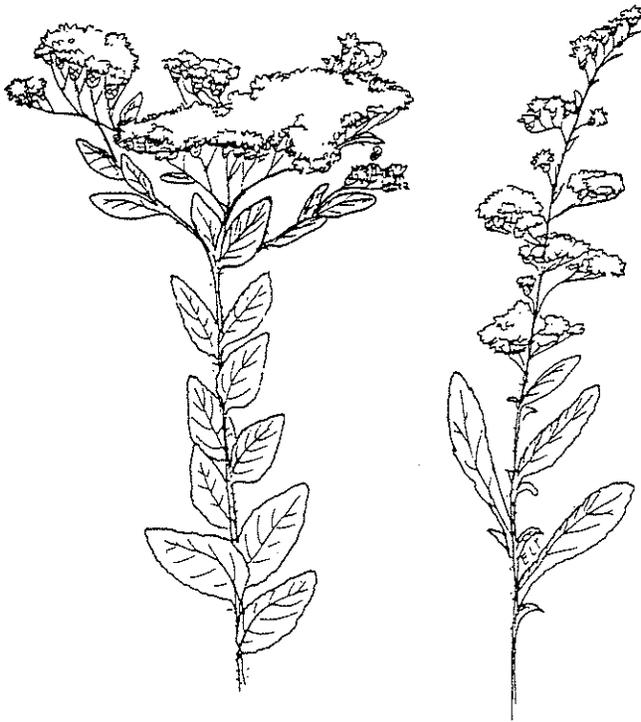
Indian paintbrush (*Castilleja coccinea*) can be readily identified by its scarlet-red flowering heads.



Lousewort (*Pedicularis canadensis*) has a yellow flowers and grows in prairie areas

Lousewort, so named because it was once thought to be the source of lice if it was eaten by cattle, produces yellow flowers and has fern-like **dissected** leaves. Lousewort is much less common in this area than Indian paintbrush. Twayblade is one of the more common, though inconspicuous orchids in Minnesota. It flowers in mid-June and can be difficult to find amidst the grasses and other plants. It is characterized by having two basal leaves and small, greenish flowers on a flowering stalk.

There are several kinds of goldenrods represented in the park flora. These plants with beautiful yellow flowers can be difficult to tell apart. The goldenrods all belong to the genus *Solidago* and are distinguished from one another by the shape of the inflorescences (flower clusters), the presence of hairs, and leaf shape. The goldenrods have a bad reputation-- many people erroneously believe that they cause hayfever. However, this is a case of guilt by association because the goldenrods flower at the same time as ragweed. Since the goldenrods are insect-pollinated they produce comparatively little allergy-inducing pollen in contrast to wind-pollinated species like ragweed. Another interesting characteristic of the goldenrods are the **galls** that are frequently found on their stems. Galls are a growth response by a plant to invasion by an insect. These structures, which can take various shapes and forms, then become the home for the insect. There are two common goldenrod galls, a spherical "ball gall" and a spindle-shaped "elliptical gall". The former is caused by a fly and the latter by a moth. The fly larvae (maggot) overwinters in the ball gall and can be observed by carefully cutting the gall open.



There are many species of goldenrod (*Solidago* sp.) that can be found throughout the park, but especially in the central grassland



Sleepy catchfly (*Silene antirrhina*) is a weed that has sticky purple regions on the stem that catches insects.

In various areas throughout the grassland you will observe small piles of aged and freshly-dug **soil** which are the workings of pocket gophers. Gophers and other animals such as earthworms are important in turning over the soil for nutrient cycling, reducing soil compaction, and increasing soil aeration. In addition, the gopher mounds provide a microenvironment that is colonized by plant species not common elsewhere in the grassland. These species tend to be weedy. For example, sleepy catchfly is found on many gopher mounds but is uncommon elsewhere in the prairie.

A project is currently underway to restore this area to the upland prairie community that would have been present on the site before European settlement. This project is a joint effort between the College of St. Benedict/St. John's University Biology Department, Stearns County Parks Department, and Prairie Restorations, Inc. (Princeton, Minnesota). The area will be seeded with native grasses and forbs and burned at intervals. The grassland area has been divided into 22m x 60m plots to study the effectiveness of various seeding and burning treatments. In addition, weedy trees and shrubs like sumac and aspen are being cut out or girdled (to block the flow of nutrients from the leaves to the roots).

Common Plants of the Quarry Park Grassland

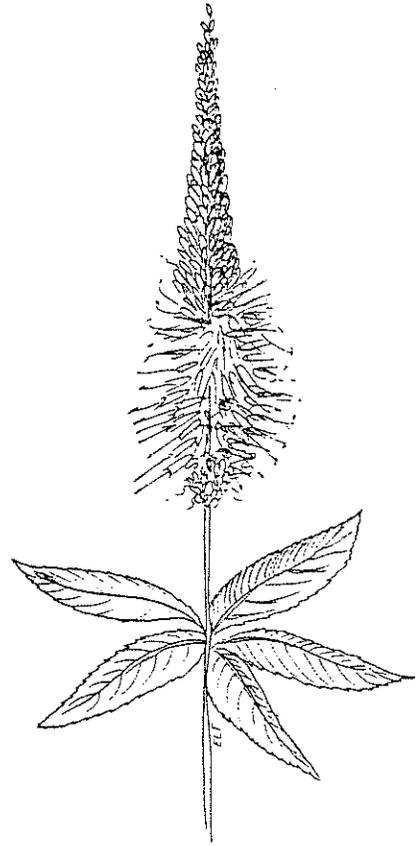
Aster	Fleabane	Pussytoes
Big blue stem	Green twayblade	Red clover
Blackberry	Hoary alyssum	Reed canary grass
Blue vervain	Indian paintbrush	Rough leaved goldenrod
Brown-eyed susan	Indian grass	Smooth brome
Bush clover	Kentucky bluegrass	Tall goldenrod
Dogbane	Lousewort	Tall cinquefoil
Dyer's goldenrod	Missouri goldenrod	Thistle
Evening primrose	Plantain	Wild strawberry
		Yarrow

SITE 6-- CENTRAL WETLAND

Important features of this location:

- wetland plants
- several wetland zones
- buried fault zone and ancient soil

At the western edge of the grassland is a **wetland** that stretches northeast from this point. If you start in the middle of the grassland and walk towards the wetland you will notice a significant change in the vegetation as the **soil** becomes moister. One obvious change is the predominance of prairie cord grass and reed canary grass. These species, which grow in distinct clumps that make it hard to walk, prefer more moisture than big blue stem and Indian grass. Moisture loving **forbs**--Joe pye weed, boneset, sensitive fern, water hemlock, and Culvers's root --also occur here. The wetland is also home to the beautiful purple-fringed orchid and a few scattered shrubs including spiraea, dogwood, and willow.



Culver's root (*Veronicastrum virginicum*) is often found in moist prairies

The plant species, soil types, and the amount of water are used to classify parts of the wetlands into different types. Minnesota uses a wetlands classification system with eight types of wetlands. In this wetland are examples of six of the eight wetland types. Type 1, seasonally flooded wetlands, are represented by the moister parts of the prairie on the southern and western edges. During wet springs these areas are very soggy for weeks at a time, but usually dry up as summer passes. Type 1 wetlands pass into type 2 wetlands, inland fresh meadows, where the soil is saturated during most of the year. Further into the wetland, types 3 and 4, shallow fresh marshes and deep fresh marshes, are present. These are areas where rubber boots would be desirable during most of the year. Shallow marshes may only have standing water during part of the year but deep marshes are covered by six inches to three feet of water during the growing season. The deep marshes are generally not visible from our vantage point, lying to the center and northeastward in the wetland. There are also spots with open water, type 5 wetlands, further to the northeast. The red-osier dogwood and willow clumps are characteristic of type 6 wetland, shrub swamps.

On a map, this wetland has a strongly linear shape. In fact, the wetlands on the southeastern, southern, and southwestern edges of the park are also long, thin, and

straight. The linear shape of these wetlands is probably due to the presence of **faults** beneath them. **Bedrock** along faults is more cracked and broken than elsewhere. Therefore, faulted areas have more rock surface exposed to the weather than other parts of the bedrock. These areas were exposed as part of the landscape during a period of time about a hundred million years ago; they reacted with water and air in what was then a tropical environment and were deeply **weathered**. This chemical alteration of the **granite** bedrock formed very clay rich **soils** and **sediments** which help to retain water in the wetlands today. Also, because the faulted areas weathered more rapidly than other parts of the bedrock, these faults formed valleys back in this ancient time.

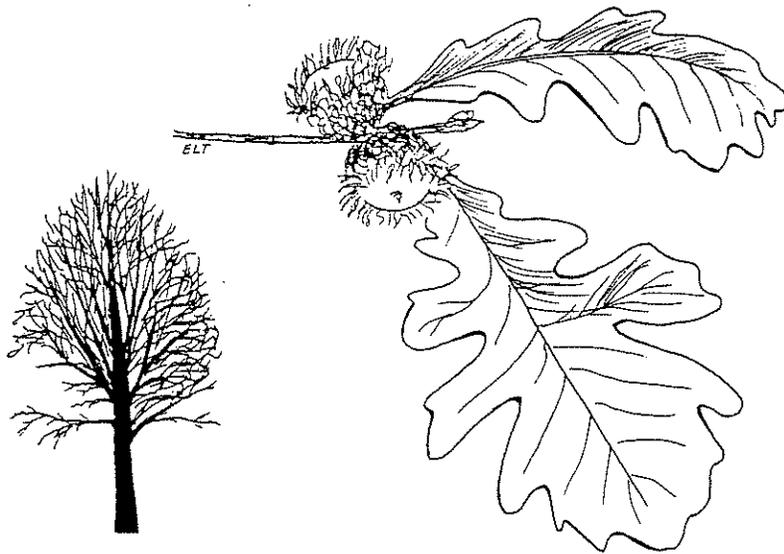
Amazingly enough, the wetland areas were still low areas when the **glaciers** moved through the park area. When the glacial ice that polished bedrock in other areas of the park melted, the water from the melted ice moved sediment--sand, gravel, and silt--around as it flowed away from the ice. These sediments, known as **outwash**, accumulated in the low spots of the landscape, for example, where linear wetlands are today. These areas form low points in the modern landscape and are places where both **surface water** and **ground water** flow out of the park area.

SITE 7--NORTHEAST SAVANNA AREA

Important features of this location:

- oak savanna
- thin soils
- Reformatory Granite

This area was mostly likely **savanna**, essentially a prairie with some interspersed trees, before European settlement. Savanna usually forms a transitional vegetation type between **deciduous forest** and **prairie**. Thus, in a savanna you find grasses and **forbs** characteristic of the prairie. The only trees that can grow and maintain themselves in a savanna are fire-tolerant species such as bur-oak which is common in this site. This species, with large fringed acorns, has a thick bark that protects it from periodic fire. In addition, Hill's oak, which is also called northern pin oak, and northern red oak grow in abundance at this site. These species are also fire tolerant. Northern pin oak and northern red oak are difficult to tell apart. Northern pin oak typically has narrower and deeper leaf lobes, smaller acorns and a yellow-colored inner bark. In contrast northern red oak has a reddish inner bark and its leaves have shallow, less deeply-cut lobes that are usually about twice (or less) the distance from the base of the lobe to the middle vein of the leaf.



Bur oak (*Quercus macrocarpa*) has corky bark that is well suited for survival in the fire prone savanna.

The **canopy** in this area is so dense that little light can penetrate to the forest floor. Thus, the **herbaceous layer** is rather minimal and few prairie/savanna grasses can be found. In some of the woodland openings and along trails, where more light is available, a variety of shrubs and small trees can be found including American hazel, honeysuckle, black cherry, prickly ash, and smooth sumac.

The **soils** in the areas of oak savanna are poorly developed. The top soil--the layer where most of the decaying organic material is concentrated--is thin and grades down to a well-drained **silt loam**. Such soils do not retain water well and provide a nutrient-poor growing medium for the savanna plant **community**. Furthermore, the **bedrock** is close to the surface as can be seen by the scattered, deeply altered **granite** outcrops. The granite has been **weathered** by long exposure to air, water, and plant activity. In fact, the rock has altered enough that the Reformatory (gray) Granite which is dominant in this area appears pink! There are some interesting geologic features visible even in the deeply weathered granites. Look for dark-colored bands of rock cutting through the granite. These are small (6-12 inches wide) **basalt dikes**--places where the granite broke and **magma** (liquid rock) was forced into the cracks. There are also several spots where angular pieces of darker-colored granite are surrounded by lighter-colored granite.

SITE 8--GRANITE HILL SOUTH OF QUARRY 4

Important features of this location: northern type plants
granite and aplite
sheet-type weathering
evidence of faulting

This site, which is the largest rock outcrop in the park, has a couple of interesting plants that are more common to the north of us. Bearberry is an evergreen creeping shrub which usually has a more "circumboreal" distribution; that is, you are more likely to find it in a rocky woods in a northern Minnesota conifer forest. The Native American name for this plant is kinnickinic. Bearberry leaves have been used to make a tea to treat urinary disorders, but this is not advisable because it contains the toxic chemical, arbutin.

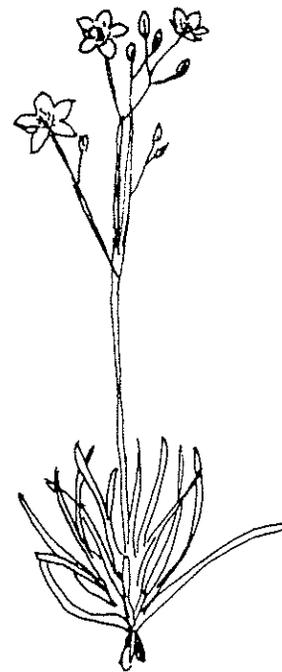


Bearberry (*Arctostaphylos uva-ursi*) is a creeping perennial shrub that grows on rocky outcrops.

A shrubby steeplesbush also makes its home in this site. This is near the southern distribution for these species. A lone juniper stands as a sentry at about the highest point of the outcrop. A close look at the foliage of this shrub will show that it has two types of leaves; one is needle-like and occurs in groups of three, and the other is scaly and closely **appressed** to the branches. The needle-like leaves are juvenile leaves, produced on immature branches. As the branch matures the new needles that are produced are scaly ones. Other plants characteristic of rocky outcrops, for example fameflower, can also be found here.

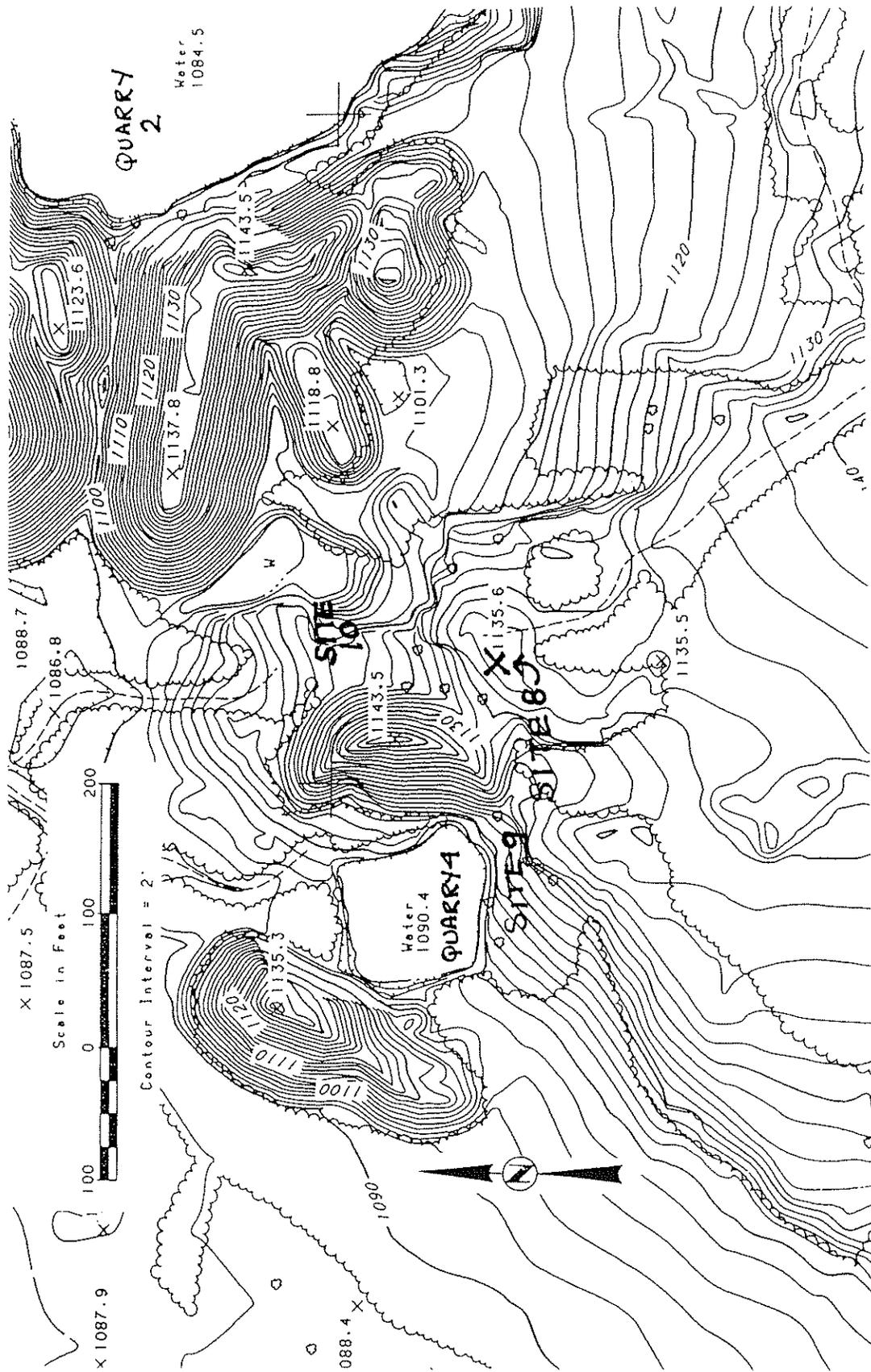
Distributed among the cracks in the **granite** surface are a variety of **prairie** grass species including big blue stem and panic grass. In the surrounding grassy areas you will find bush clover and Seneca snakeroot with its delicate stems and small white clusters of flowers. This species, like the others mentioned, prefers dry prairies.

This site is also the highest point in the park, at least, the highest "natural" feature, and stands around 1136 feet above sea level. The dominant rock is the Reformatory Granite. This granite is gray colored when seen in a fresh surface. Where deeply weathered the Reformatory "gray" Granite is pinkish and can be easily confused with the St. Cloud "red" Granite. The easiest way to tell the two rock types apart is to look for the dark "clots" or "spots" visible in the Reformatory Granite. Cutting through the granite are several kinds of long, relatively straight, thin rock bodies. Thin, finely textured, pinkish rock bodies are composed of **aplite**, which is really a type of granite with very small mineral grains. This is one of the youngest rock types in the park. Like the dark **basalt dikes**, the aplite bodies may have formed when **magma** (liquid rock) was squeezed into cracks in the granite. However, these aplites may also have formed by movement of a **fault**—a crack where two bodies of rock move past each other (commonly causing an earthquake at the time the movement occurs). If this is the case, the aplites formed when granite that was ground-up during the movement "recrystallized", or turned back into solid rock, after movement ended. The abundant dark streaky areas in the granite on this hill may also represent minor faults (called **shear zones**). Note that there are also many parallel fractures or cracks in the rock—these formed as a result of past stress or pressure upon the rock and may be due to the same geologic event that caused the faults in the park to form.



Fameflower (*Talinum parviflorum*) grows throughout the park in shallow soils on rocky outcrops.

The most interesting type of **weathering** seen in the park is found on this hill. Look for the many areas where, instead of looking solid, the granite seems to be covered by thin sheets of weathered rock. This type of "flaking"—called **exfoliation** (which means sheeting off)—is typically found on large outcrops of rock like granite. Understanding this process requires understanding that granite forms deep under the surface of the Earth in conditions of high heat and great pressure. When found at the surface, granite is not really chemically or physically stable. For example, the rock actually expands because the pressure at the surface is so much less than where it formed. This expansion is greatest toward the surface and cracks form at right angles to the expansion as the rock is broken by this slow movement. These sheets of granite can sound hollow as you walk across them because of the cavity beneath the slab. Note also that the slabs tend to break up into the little, flat-sided, angular pieces that are lying about all over this hill.



Locations of sites 8, 9, and 10. Note the wiggly line that indicates the forest edge. This makes it easy to find the areas of exposed granite bedrock that dominates the area.

SITE 9--SPRING AT QUARRY 4

Important features of this location:

- springs
- red and gray granite
- faults

[Note--this site can be viewed from either north or south sides of Quarry 4. The northern quarry edge is much lower and less slippery.] Standing on the southern edge of quarry 4, look across the water to the northeast (right) corner of the quarry. Note the large number of vertical cracks in the rock (look to the east or right of the large tree). This is a **fault** which runs northeast-southwest and also intersects the west wall of the pit. When movement took place along the fault, the rocks on the opposite wall (north side of the quarry) moved toward the left, or westward, relative to the rocks on which you are standing. This fault movement brought St. Cloud (red) Granite, seen on the south wall of the quarry, in direct contact with Reformatory (gray) Granite, located on the north and east walls. Faults have also been mapped running north-south just to the east of this quarry, and along the north side of the small unnumbered quarry to the east.

In the southeast corner of quarry 4, to your right as you face the water, are a series of small rock ledges with black stains on rock surfaces. This corner contains the most persistent set of **springs** in Quarry Park. In this corner, along the base of this wall, kept perpetually moist by seepage from the springs, are a variety of interesting plants. Growing among the dense cover of mosses is mountain ash (likely a species native to Europe that has escaped cultivation), as well as, false Solomon's seal, lead plant, and dogbane.



False Solomon's seal (*Smilacina racemosa*) is a beautiful herbaceous plant found in wooded areas in the park.

The springs produce enough moisture to keep the ledges wet at all times except during drought. For example, it took the extreme rainfall shortage of summer 1996 to dry the

springs up for a few weeks in August. During wet times of the year water will be seen actually flowing across the ledges and continually dripping from the edge. Even in the coldest part of winter, new ice is continually being added to the icicles that develop. This confirms that ground water is the source of the spring water--the icicles grow even during periods when no snow melt occurs. Where does the water come from? The **ground water** that feeds these springs is probably coming out of the many cracks in the granite hills along the south side of this quarry area and from the pore spaces in the **spoils pile** on the east.

The black stains on the rock ledges are very likely manganese oxide. Dissolved manganese is carried in the ground water and deposited on the rocks as the water emerges at springs and the manganese reacts with the oxygen in the air. This is a process chemically similar to the effect with iron in ground water seen when well water leaves reddish stains in sinks and toilet bowls.

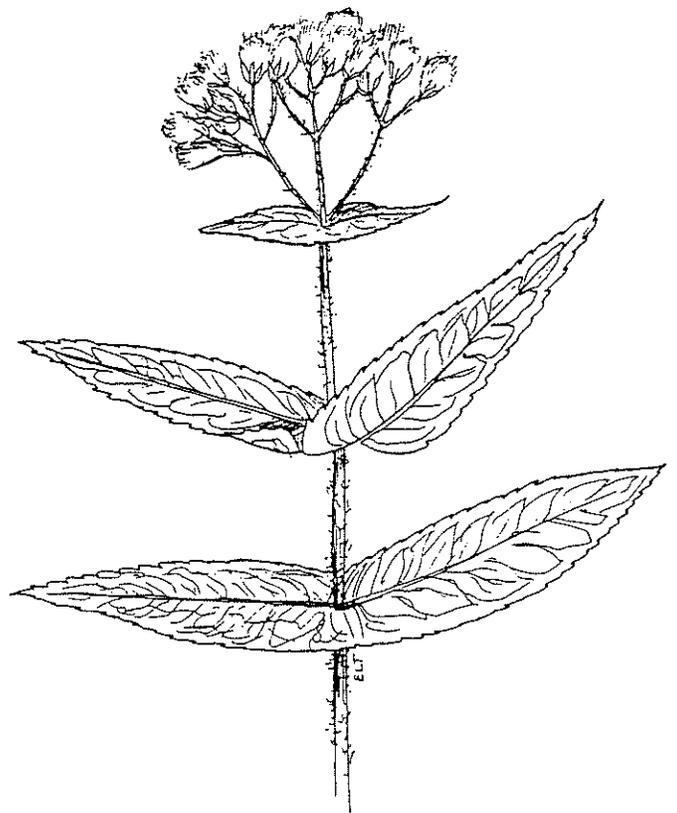
SITE 10--ROCK LEDGE AT UNNUMBERED QUARRY

Important features of this location:

- spring-fed perched wetland
- St. Cloud and Reformatory Granites
- faulting

This location, overlooking an unnumbered and unnamed quarry, is on the path climbing from the switchback trail to the top of the **granite** hill. Coming up the hill, north to south, you have passed from St. Cloud (red) Granite to Reformatory (gray) Granite and crossed an east-west trending **fault** where gray granite moved northward over red granite. See if you can find where the granite changes its appearance in the middle of this hill. Remember that the Reformatory Granite does tend to weather to a pinkish color but can be identified by the clumping or clotted-looking distribution of the dark **mineral** grains. Also note the extensive sheet-like flaking (**exfoliation**) of the granite on the hillside.

One place you don't expect to find cattails, tickseed, and bullrush growing is on a granite outcrop like this one--these are **wetland** plants! So what's going on here? On this small ledge, that is a remnant of the quarrying operation, a tiny wetland has developed. This wetland's existence is the result of the constant dripping of **ground water** from cracks, in other words, from **springs** at this location. The availability of moisture has provided a **niche** for the colonization by a variety of wetland-type plants. In addition to tickseed with its two-pronged seeds, admirably designed for hitching a ride on an animal, you may find some rushes, willow-herb, and boneset. The latter species gets its name from the fused leaves; settlers thought that it might do the same for broken bones.



Boneset (*Eupatorium perfoliatum*) typically grows in moist or low wet grounds.

SITE 11--QUARRY 1 SWIMMING HOLE

Important features of this location:

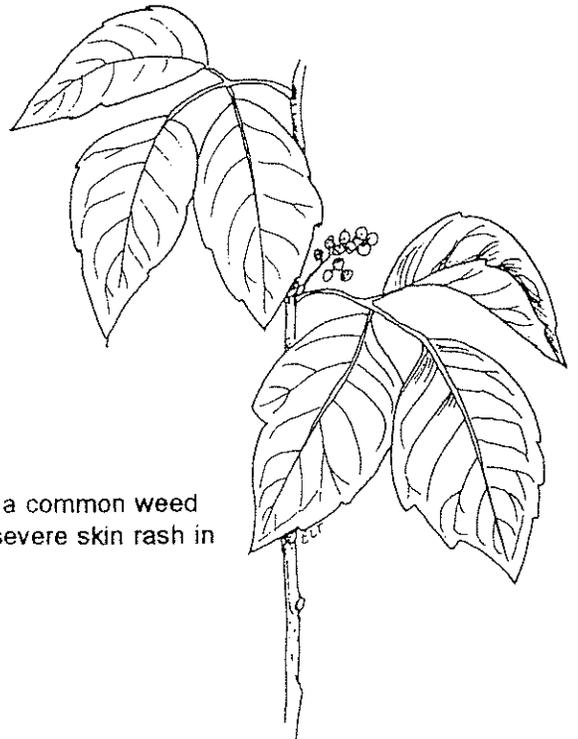
- social history of St. Cloud
- red St. Cloud Granite
- basalt dike
- birch trees

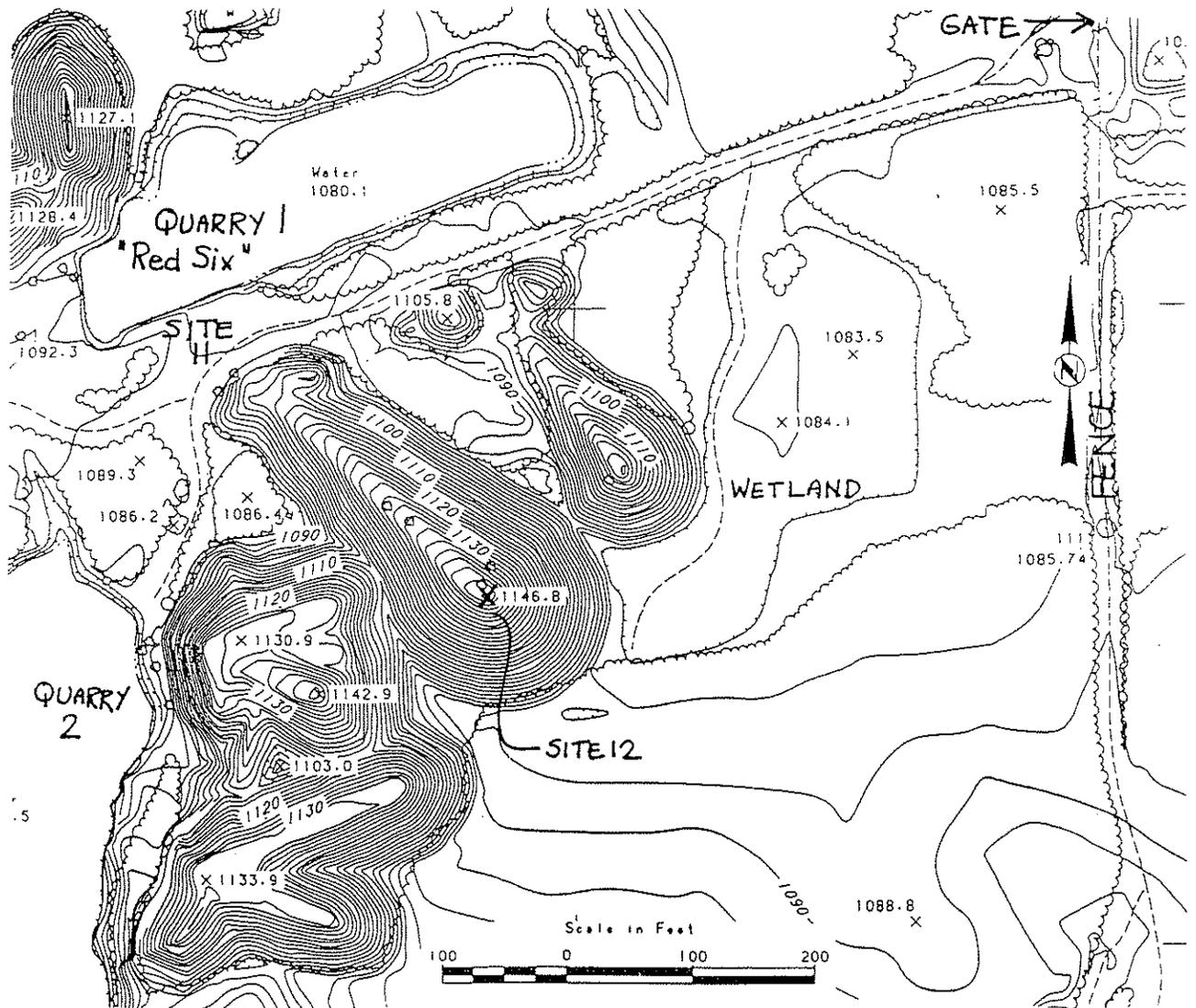
The St. Cloud (red) Granite was the target of quarryers in this pit, know as Red Six. Quarrying activity was limited to the location of the red **granite**. On the long southeast side of the quarry, rock removal stopped where a thick **basalt dike** was intruded into the red granite. This basalt dike is easily seen in the southeastern quarry walls. It appears to have originally run parallel to and along the entire long southeastern wall of the quarry (the side of the quarry the road runs along). On the narrow, western end of the quarry, gray Reformatory Granite begins only a few feet west of the quarry wall. Also of interest are the numerous artifacts remaining from quarrying activity. See how many you can spot.

A botanically interesting feature of this site is the white birch trees that are common in the cracks and ledges around the margins of the quarry. The presence of birch, which likes cool, moist, mineral-rich soils, suggests that **springs** are active and that moisture is readily available in fractures in the granite bedrock. The largest of these trees are between three to four inches in diameter. This suggests that the quarrying operations ended relatively recently since birch grows quickly and rarely reaches an age of more than 80 years old. One particularly large clump of birch that occupies a ledge on the west end of the quarry displays the basal sprouting exhibited by many birch trees. This group may have been a youthful witness to the quarrying operations at this site. Birch seeds are produced in tiny cone-like structures called **catkins**. The seeds have small wings that makes it easy for them to be blown into cracks in the rock.

The west end of this site also features a number of **prairie** species including big blue stem, Indian grass, and alumroot. Poison ivy has made a home in the cracks near the southwestern edge of this quarry. It forms a series of short, woody upright stems that bear attractive white berries in the fall. But beware, all parts of the plant can cause a reaction in sensitive individuals.

Poison ivy (*Rhus radicans*) is a common weed in the park that can cause a severe skin rash in sensitive individuals





Location of sites 11 and 12, Quarry 1 ("Red Six") and the eastern overlook. Access to the overlook is between two spoil piles along the road south of Quarry 1. It is on the center of the group of spoil piles. Note the wetland with its distinct zones of vegetation that lies at the eastern foot of this spoil pile.

Red Six (quarry 1) exemplifies the role the Quarry Park area and similar quarry sites had in the recent social history of the St. Cloud area. This quarry and others in the park were important social "hang-outs", frequented mostly by high school and college students, in the 1970s and 1980s. One of the quarries was known as the "nude" quarry and people even came from the Twin Cities to swim in it. Most of the activity took place in the daytime, simply because getting around was too dangerous at night. It was common for people to smoke marijuana and drink at the quarries in the early afternoon. For this reason, parents would wait to bring their families out to the quarries until late afternoon, when this activity had quieted down. Parking was a common problem—space was so limited that people would come early and "camp out" for the day, just so they could park. People were also

known to have their "own" rocks for sunbathing; others generally respected this territory. To minimize vandalism and monitor the area the sheriff's department would arrive, from time to time, and announce that everyone had 30 minutes to clear the premises before their car would be towed; people quickly cleared out. "Quarry people" were very protective of the area and would chastise those who left trash or had their music playing too loud.

In the early 1980s security was tightened but motorcycles and bikes were still able to get into the area. When the fence was erected around the newly purchased county land, the amount of graffiti on the rocks in the quarries increased as community use of the area decreased. Despite the fence, biking, swimming, and sunbathing are still common activities in the park. The area known to the community as "Hundred Acre Quarry" has continued to be a quiet refuge and unofficial recreation site until the present.

SITE 12--OVERLOOK NEAR EAST GATE

Important features of this location:

- grout or spoils piles
- plant succession
- wetlands

This **grout** or **spoil pile** provides an excellent example of **plant succession**. At the bottom of the hill, which is presumably the oldest part of the pile, you will find reasonably mature vegetation with assorted trees and a well-developed **herb layer**. The largest trees, about three inches in diameter, are mostly quaking aspen. Other trees include box elder, black cherry, and bur oak. There are several woody shrubs and vines at this site, most of which are indicators of disturbance and more exposed areas. These include buckthorn, prickly ash, gooseberry, honeysuckle, grapes, Virginia creeper, and even poison ivy. Among the **herbaceous** plants are a variety of grasses, wild sarsaparilla, and spikenard, a close relative of wild sarsaparilla.

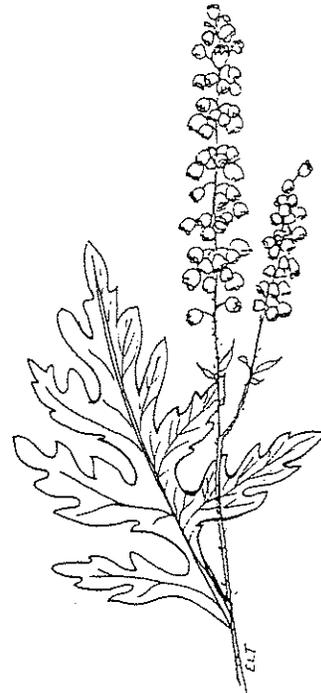
As you walk to the top of the overlook you will notice that the vegetation changes dramatically. You will quickly leave the protective canopy of the trees. Along the way you will pass a few clumps, or **clones**, of blackberry. Once these plants get established, they readily form large colonies by sending up underground **suckers**. As you near the summit the vegetation thins to a carpet of grasses, including foxtail. By time you reach the top, the soil is extremely thin and rocky and the vegetation is sparse, featuring an assortment of drought-tolerant weeds.

Plants growing on the rocky, dry soil at the top of the grout pile must be able to tolerate hot, arid conditions. An assortment of lichens can be observed among the rocks. Lichens can withstand extremely harsh conditions. Drought poses little problem for these organisms

that patiently wait out a dry period in a dormant, **desiccated** state. Most of the lichens observed at this site are called "crustose" because they grow as a thin crust or film that tightly adheres to the surface of a rock or other substrate. Other lichens are "foliose" and have a branched appearance, for example the reindeer moss--actually a lichen--that was described at site 3. The third growth form of lichens is termed thallose and appears as thin, leaf-like sheets. Foliose and thallose lichens, many of which are good indicators of air quality, are not particularly common in the park.

Many plants in this area become established in the cracks where enough soil has accumulated to support their growth. In these cracks the soil remains reasonably moist since it is protected from the direct exposure to sun and the drying winds. Plants that can tolerate these conditions include sleepy catchfly, hoary alyssum (a familiar roadside weed with pods that look like small "looking glasses"), figwort, yarrow, and the rock-loving fern, rusty woodsia.

From the overlook you can observe the distinct zonation of vegetation in the **wetlands** at the base of the grout pile. Lining the edges of the wetland are sun-loving aspen trees. To the east, directly adjacent to the open water, is a cattail marsh, which further to the east gives way to willows and other shrubs.



Few plants cause hay fever sufferers more misery than ragweed (*Ambrosia artemisiifolia*)

According to the wetlands classification officially used in Minnesota, the area containing the shrubs is a type 6 wetland--a shrub swamp. The area containing cattails and sedges and the area where, in normally wet years, there is open water with duckweed, are type 3 wetlands--shallow fresh marshes. The sedges extend all the way to the park fence line. The area beyond the shrub swamp contains abundant reed canary grass and only has standing water during very wet times of the year, such as after spring snow melt. This is classified as an inland fresh meadow or type 1 wetland. The zonation seen in the vegetation is also seen if one examines the **soils** in the different areas. The degree of saturation determines what soil-forming processes take place by controlling the chemical reactions that take place and types of soil bacteria that exist. For example, the soils under the shallow fresh marsh contain little **mineral** material, and instead, consist mostly of "muck"--gooey, black, partially decayed plant material.

GLOSSARY TERMS

Aplite: fine-grained pinkish to whitish igneous rock containing the same minerals as granite; mineral grains are usually small enough to be difficult to see with the naked eye

Basalt: fine-grained dark colored igneous rock made of tiny mineral crystals

Evaporative Cooling: cooling of the air due to energy (heat) being given up to liquid water and used to evaporate the water

Exfoliation: type of rock weathering; rock flakes off in large thin sheets parallel to the rock surface

Fault: a fracture or crack in rock along which movement has taken place

Forbs: herbs other than grass

Glacial Polish: smoothing of rock due to movement of glacial ice with embedded silt and sand

Glacial Striations: scratches and grooves caused by moving glacial ice dragging embedded rocks across a rock surface

Granite: coarse-grained igneous rock containing quartz and feldspars; mineral grains are large enough to see with the naked eye

Ground Water: water that lies beneath the ground surface filling the crevices and pore spaces of rocks

Igneous Rock: rock formed from the cooling and solidification of magma; when cooling mineral crystals grow in the magma until all of the rock has solidified

Magma: rock hot enough to be liquid; called lava if it comes onto the land surface

Prairie: large areas of rolling grassland

Reverse Fault: a sloping fault where the body of rock above the fault moved up and over the body of rock below the fault

Savanna: grassland naturally containing scattered large trees

Sediment: loose, solid, rock and mineral particles of all sizes which originate by weathering and erosion of pre-existing rock; sand, silt, clay, mud, and gravel are all types of sediment

Shear Zones: narrow band of rock representing a type of fault where instead of movement being along a single open crack, it occurs along a series of parallel breaks in the rock; rock pressure is great enough along shear zones that the breaks "heal" by the rock crystals growing together

Spoil Piles: also called grout piles; piles or stacks of loose angular rock fragments of any size representing the discarded rock material from quarrying activities

Water Table: upper surface of the zone of saturation; below the water table all rock openings, such as pores or cracks, are filled with ground water

Weathering: breaking down of rocks, at or near the Earth's surface by physical breakage or chemical alteration

additional terms needed:

potassium feldspar	plant succession
plagioclase feldspar	perennial
amphibole	herbaceous
magnetite	photosynthesis
biotite	foliose
quartz	crustose
spring	cilia
surface water	gall
soil	deciduous forest
glacial till	canopy
outwash	suckers
dike	clonal
wetland	

Listing of Scientific Names Used in the Text

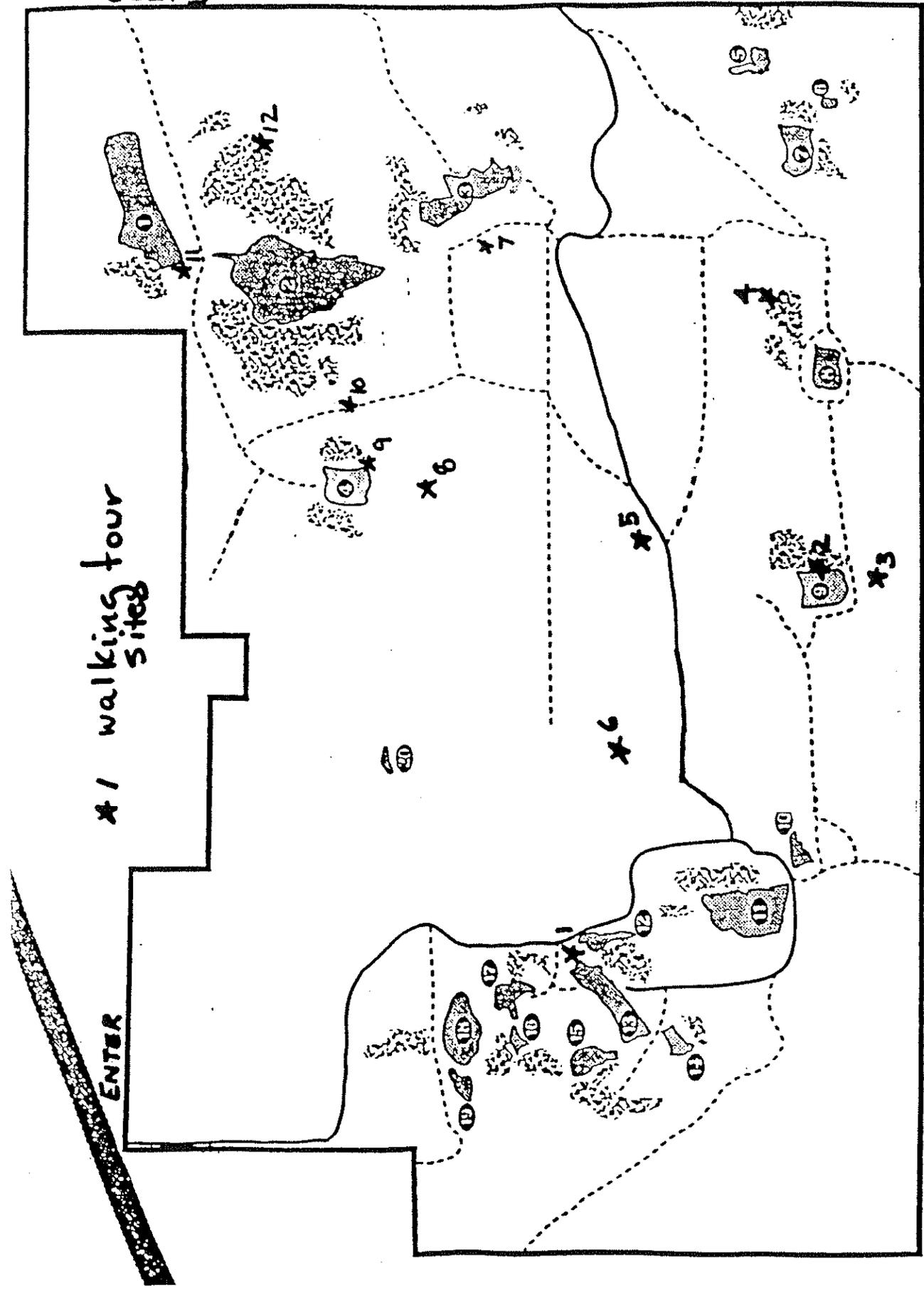
Alumroot	<i>Heuchera richardsonii</i>
American hazel	<i>Corylus americana</i>
Aster	<i>Aster sp.</i>
Bearberry	<i>Arctostaphylos uva-ursi</i>
Bellflower	<i>Campanula rotundifolia</i>
Big blue stem	<i>Andropogon gerardii</i>
Black ash	<i>Fraxinus nigra</i>
Black cherry	<i>Prunus serotina</i>
Blackberry	<i>Rubus sp.</i>
Blue vervain	<i>Verbena hastata</i>
Boneset	<i>Eupatorium perfoliatum</i>
Box elder	<i>Acer negundo</i>
Brittle prickly pear cactus	<i>Opuntia fragilis</i>
Brown-eyed susan	<i>Rudbeckia hirta</i>
Buckthorn	<i>Rhamnus cathartica</i>
Bulrush	<i>Scirpus sp.</i>
Bur oak	<i>Quercus macrocarpa</i>
Bush clover	<i>Lespedeza capitata</i>
Canada wild rye	<i>Elymus canadensis</i>
Cattail	<i>Typha latifolia</i>
Culvers's root	<i>Veronicastrum virginicum</i>
Dogbane	<i>Apocynum androsaemifolium</i>
Dogwood	<i>Cornus sp.</i>
Dyer's goldenrod	<i>Solidago nemoralis</i>
Evening primrose	<i>Oenothera biennis</i>
False Solomon's seal	<i>Smilacina racemosa</i>
Fameflower	<i>Talinum parviflorum</i>
Figwort	<i>Scrophularia sp.</i>
Fleabane	<i>Erigeron sp.</i>
Foxtail	<i>Setaria sp.</i>
Giant hyssop	<i>Agastache foeniculum</i>
Goldenrod	<i>Solidago sp.</i>
Gooseberry	<i>Ribes sp.</i>
Grape, wild	<i>Vitis riparia</i>
Green twayblade	<i>Liparis loeselii</i>
Hawthorn	<i>Crataegus sp.</i>
Hoary alyssum	<i>Berteroa incana</i>
Honeysuckle	<i>Lonicera sp.</i>
Indian grass	<i>Sorghastrum nutans</i>
Indian paintbrush	<i>Castilleja coccinea</i>
Indian grass	<i>Sorghastrum nutans</i>

Joe pye weed
Juniper
Kentucky bluegrass
Lead plant
Long-leaved bluets
Lousewort
Missouri goldenrod
Mountain ash
Northern pin oak
Northern red oak
Pale corydalis
Panic grass
Paper birch
Plantain
Poison ivy
Prairie cord grass
Prickly ash
Purple-fringed orchid
Purslane
Pussytoes
Quack grass
Quaking aspen
Red clover
Red-osier dogwood
Reed canary grass
Rock spike-moss
Rough leaved goldenrod
Rushes
Rusty woodsia
Seneca snakeroot
Sensitive fern
Sleepy catchfly
Smooth brome grass
Smooth sumac
Spikenard
Spiraea
Steeplebush
Tall goldenrod
Tall cinquefoil
Thistle
Tickseed
Virginia creeper
Water hemlock

Eupatorium maculatum
Juniperus communis
Poa pratensis
Amorpha canescens
Hedyotis longifolia
Pedicularis canadensis
Solidago missourensis
Sorbus aucuparia
Quercus ellipsoidalis
Quercus rubra
Corydalis sempervirens
Stipa sp.
Betula papyrifera
Plantago major
Rhus radicans
Spartina pectinata
Xanthoxylum americanum
Platanthera psycodes
Portulaca oleracea
Antennaria sp.
Agropyron repens
Populus tremuloides
Trifolium pratensis
Cornus stolonifera
Phalaris arundinacea
Selaginella rupestris
Solidago rigida
Juncus sp.
Woodsia ilvensis
Polygala senega
Onoclea sensibilis
Silene antirrhina
Bromus inermis
Rhus glabra
Aralia racemosa
Spiraea alba
Spiraea sp.
Solidago gigantea
Potentilla arguta
Cirsium sp.
Bidens sp.
Parthenocissus quinquefolia
Cicuta maculata

White birch
Wild sarsaparilla
Wild onion
Wild strawberry
Willow
Willow-herb
Yarrow

Betula papyrifera
Aralia nudicaulis
Allium stellatum
Fragaria virginiana
Salix sp.
Epilobium sp.
Achillea millefolium



*1 walking tour sites

LOCATION MAP
QUARRY PARK



- roads and paths
- quarries
- ⊞ spoil piles

Figure 4.2 - Quarry Park and Nature Preserve Master Plan.

