Woodlands

What is the best way to achieve a mixed native-species, mature forest in the least amount of time? Harvey Stork's Upper Arb woods from the 1930s is a successful example of one relatively long-term process, but the loss of some species (especially American elm, and probably now ash) and the introduction of other invasive species (especially buckthorn) have changed the mix in 85 years.

Other strategies have been tried with varying success:

Natural succession: Given time, seeds from surrounding woods will spread and take root.

- This seems to work better in the floodplain, where fast-growing cottonwood and willow have a good chance competing with aggressive buckthorn and other invasives, which still have to be controlled.
- Some grasses (notably reed canary grass) compete effectively with tree seeds, making the process even slower.

Tree seedlings can be planted in an open field, but because of deer and vole browsing and the need for some species to grow in the shade of pioneer species, early attempts like Earth Day Field and Alumni Field suffered very high sapling mortality.

- If seedlings are planted in staged series (pioneers first, shade-friendly species later), natural succession patterns are more closely followed.
- It is important to protect trees from deer browsing until they are tall enough to be out of reach.
- The grasses in a field will eventually become shaded out and be replaced by understory.

Seeding: Tree seeds sown into plowed fields have had good success thus far, but the plots where this has been tried are still too young to know how they will mature.

- Will shade-friendly species naturally spread, or will they need to be planted?
- How will browsing affect these more densely planted areas?

Management toolbox

The Arboretum is a managed natural area. In order to create and maintain the kind of landscape we want, we use various techniques, and will continue to use them indefinitely:

- **Fire**: Before European settlement, periodic fire (often set by Native Americans) controlled woody plants and encouraged the deep-rooted prairie. Periodic controlled burns in prairie, savanna, and forest areas mimic this process.
- **Manual removal**: Buckthorn, honeysuckle, and wild parsnip are being removed from the Arboretum by student workers, plant by plant.
- **Herbicide**: Some invasive species (notably buckthorn) will grow back indefinitely from roots. Herbicide prevents these plants from returning. We are careful to minimize effects on the surrounding ecosystem.
- **Timed planting**: When we restore woodland, we stage plantings of seeds or seedlings, so that plants that require shelter or shade can use "pioneer" species that provide those benefits.

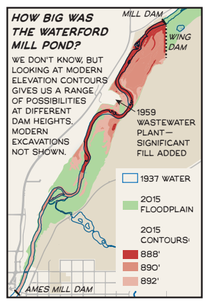
	NON-INVASIVE	INVASIVE
NATIVE	BUR OAK BUTTERFLY MILKWEED LITTLE BLUESTEM TRILLIUM WILD GINGER	ASPEN SUMAC GRAY DOGWOOD RED CEDAR
NON-NATIVE	GINKGO LILAC SHINGLE OAK DAY LILIES YELLOW IRIS	BUCKTHORN BUSH HONEYSUCKLE GARLIC MUSTARD WILD PARSNIP REED CANARY GRASS BULLFROGS EARTHWORMS

Invasive species spread aggressively into an ecosystem, crowding out others. Many are non-native, but some native species take advantage of disturbed land. Other species like smooth brome don't spread but are persistent and slow succession.

Non-native species were brought from outside the region. Predators and disease that keep them in check may not be present here, making it easier for them to dominate competition.

Pine plantations

Sandy hillsides in the northern part of the Arboretum made poor crop and pasture land. Between 1945 and 1955, they were planted with white, red, and jack pine, in part to see if they would work as a forestry crop. The pines are not native to the area, but do reseed. As they age, they become a fire hazard and tend to break and fall, becoming a danger to walkers. Portions have been removed in recent years, with the goal of replacing them with native upland forest and savanna.



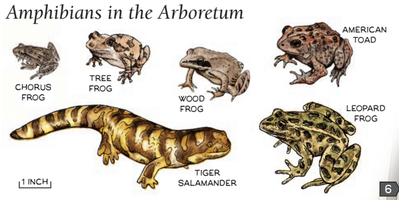
Cannon River

The Cannon River widens from a narrow valley in Northfield to a floodplain within which the postglacial stream meandered, but how extensively is not known. When the Waterford Mill was established in 1873, the millpond submerged much of the floodplain in the Arboretum; when it washed out in 1915, the river cut through the accumulated sediment and formed new, taller banks. These banks plus the remaining wing dam have narrowed the river's ability to meander, but the path does continue to shift slowly as banks erode and build up sediment at different points. Studies have shown that the effects of removed millponds can linger for centuries.

Wetlands

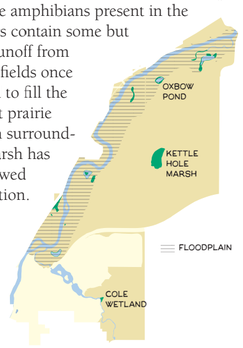
Most of the Arboretum's wetlands are located in floodplains. Some persist year-round, like the artificial Retention and Turtle Ponds and natural Oxbow Pond (formed in an old path of the Cannon River); others come and go with the seasons. All are an essential habitat for amphibians and turtles, including the threatened wood turtle.

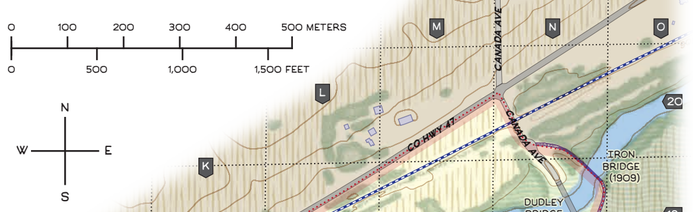
Amphibians in the Arboretum

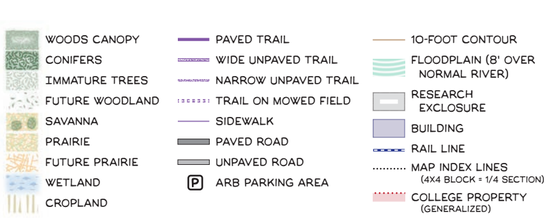


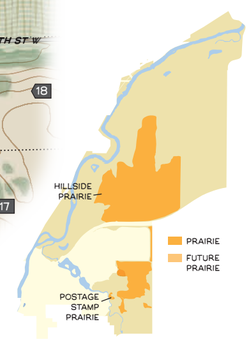
Kettle Hole Marsh

Formed by an isolated block of glacial ice that created a hollow where it melted, the perennial marsh does not drain directly into the Cannon. It contains examples of all of the amphibians present in the Arb (others contain some but not all). Runoff from cultivated fields once threatened to fill the marsh, but prairie restoration surrounding the marsh has greatly slowed sedimentation.





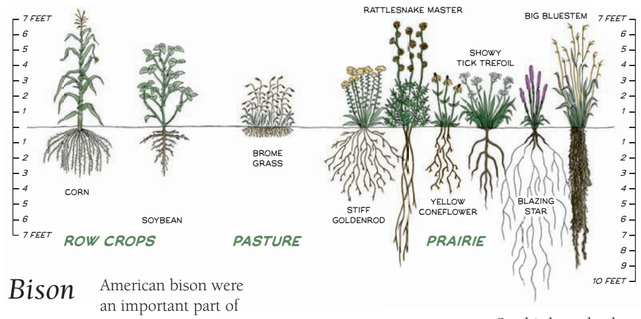




Prairie

After 12 years of small experimental restoration in former pasture at Hillside Prairie, Lower Arb prairies were planted into plowed land from 1995 to 2008.

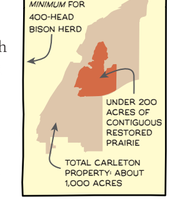
Prairie plant species are adapted to fire. Their deep roots help them to survive drought and build a thick organic soil layer that sequesters carbon. Their variety supports a richer animal diversity as well. Because of annual plowing, row crops allow greater soil erosion and result in a net loss of soil nutrients, requiring fertilizers. Our goal is a prairie that requires only periodic burns for maintenance; but, with few large grazers and many non-native plant species, we also have to mow, cut, and use herbicide treatments as part of our maintenance program.



Bison

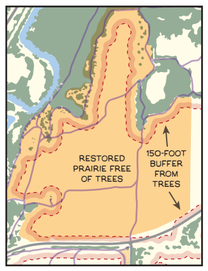
American bison were an important part of the historic prairie ecosystem. Why not put them on our prairie? Our 200 acres of contiguous prairie *might* be able support about 20 head of bison. This is less than the number of bison needed to fully engage in herd behavior, and risks inbreeding and loss of genetic diversity.

Also, bison require very strong fencing and can be aggressive to humans, both of which would diminish the welcoming qualities we treasure in the Arb and greatly reduce its recreational usefulness.



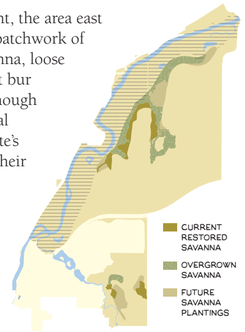
Sparrows and cowbirds

Cowbirds evolved in the presence of migrating bison herds. Constantly on the move, they deposit eggs in other species' nests. To find these, they perch in trees to scan surrounding prairies. In response, some ground-nesting bird species nest only where trees are at least 150 feet away. The Arb now hosts endangered Henslow's sparrows and other prairie birds, and the Arboretum plans to maintain the treeless zone they require.



Oak Savanna

At European settlement, the area east of the Cannon was a patchwork of open prairie and savanna, loose groups of fire-resistant bur oaks with prairie groundcover. Although some patches of Minnesota's original prairie have survived intact, the state's savanna oaks have almost all seen their fire-dependent prairie understory disappear. We are restoring our fragments of original savanna, which includes oaks that predate the college, by cutting away other woody species (especially buckthorn), reintroducing prairie plants, and periodic burning. We are also expanding savanna by planting new oaks.



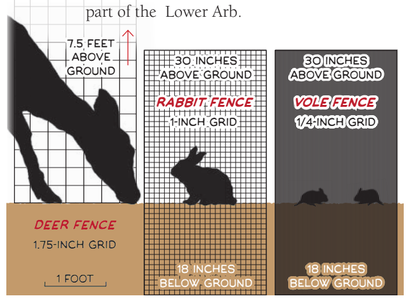
The Arb and the college

The Cowling Arboretum is part of what gives Carleton its identity. Whether through a casual walk, as part of a running or skiing race, or as part of a class, the Arb is an integral part of student life. The Arb…

- was created in the 1920s under the leadership of President Donald Cowling and Professor Harvey Stork.
- is approximately 800 acres, divided by Minnesota Highway 19 into the Upper Arb (south of the highway) and the Lower Arb (north of the Highway—"lower" because it contains the low-lying floodplain of the Cannon River).
- is used extensively as an outdoor classroom for courses in biology and geology, and also in art, literature, and other fields.
- provides space to walk, run, ski, and fish, or simply enjoy being outdoors.
- serves a valuable role in providing habitat for species of diverse natural communities. Habitat is provided for rare species of reptiles, mammals, birds, and plants. A primary goal of current management practices is to increase biological diversity, since this will enhance the Arb's value for education, conservation, and recreation.

Exclosures

A dense deer population means that young trees may be eaten before they can grow out of browsing reach. Rabbits and voles also eat newly planted species. Exclosures are helping researchers evaluate the true effects of these animals on restored areas. Most Arboretum exclosures are square deer fences 45 feet on a side, which also contain within them smaller rabbit and vole exclosures. Larger exclosures have been established in a reforested part of the Lower Arb.



Credits

Edited and drawn by Nat Case '88, INCase LLC.

Biological illustrations by Riley Jones and Emily Cisneros, Iowa State University.

Geological maps by Daniel Huffman.

Photographs courtesy of the Carleton College Archives or Northfield Historical Society (NHS) unless noted.

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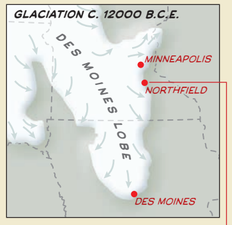
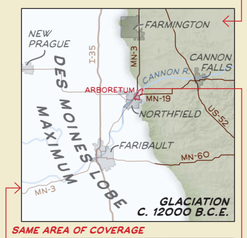
Glaciers, Prairies, and Big Woods

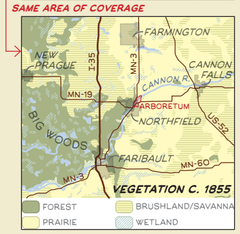
The most recent glacier in the area was the Des Moines Lobe of the Wisconsinan glaciation, extending from northwest Minnesota into Iowa about 14,000 to 12,000 years ago. Northfield sits astride its eastern limit. The Cannon River and Spring Creek carried meltwater from the glacier. The two streams follow the paths of older pre-Wisconsinan rivers; very different bedrock depths near where they meet suggests there was once a waterfall there.

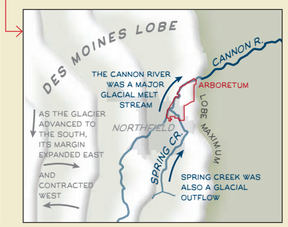
As the earth warmed and the glacier receded, vegetation returned in a way that mirrors the succession of vegetation seen from northern Canada to Northfield: bare earth was succeeded by boreal conifer forest, then deciduous forest, and finally a mix of prairie and oak savanna. At the time of European settlement, the Cannon River divided prairies and oak savannas on the east side and a lobe of the deciduous forest we call the Big Woods on the west side. Those woods existed in part because water bodies left behind by the glacier discouraged natural fire, and a declining Indian population after c. 1500 meant fewer set fires.

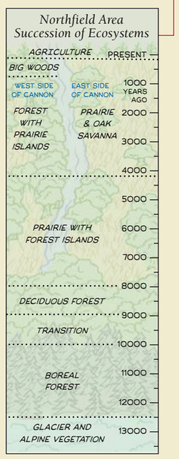




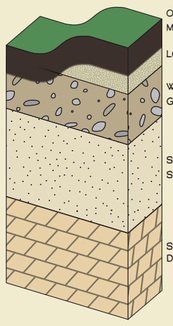
SAME AREA OF COVERAGE





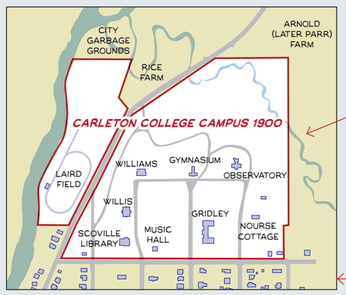


When a class digs a soil pit in the Arboretum, the top layer they find is made of organic matter. Below that in many places is soil developed on loess (fine windborne dust blown from the west after the glaciers receded). A thin layer here, it is the major component of soils just to the east. Beneath that, whether loess is present or not, lies glacial till (material dragged south by the Des Moines Lobe). The Arboretum marks the edge of this deposit; till from earlier glaciations underlies areas less than a mile to the east.



Outcrops of preglacial rocks, mostly limestone from the Shakopee dolomite formation, are visible in places such as the bottom of the Cannon River behind the stadium and outcrops on the east side of Spring Creek in the Upper Arb. Where surface elevation is higher, the dolomite is covered by a layer of very loose St. Peter sandstone; sandy deposits around the Arb might come from this layer. Northfield's drinking water supply comes from the aquifers in the dolomite and underlying Jordan sandstone.

Founding Carleton



Charles Goodsell's 1865 donation of the five acres from near Willis Hall north to Spring Creek helped secure Northfield as the site for the college. Donations to the east (including the Nourse farm, where Nourse Hall sits) meant that by 1900 the area of the main campus was largely in place.

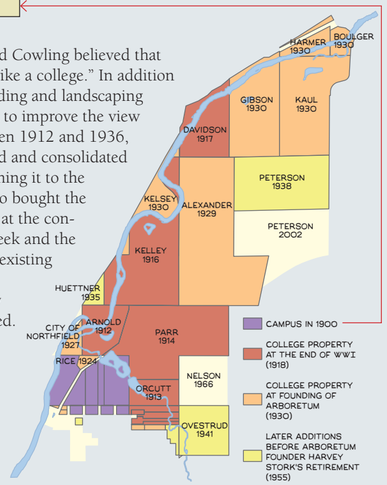

View across Spring Creek Meadows, before Lyman Lakes

Cowling's purchases


Donald Cowling in 1908

Carleton President Donald Cowling believed that the college should "look like a college." In addition to completing major building and landscaping programs, he sought to improve the view from campus. Between 1912 and 1936, the college purchased and consolidated working farms adjoining it to the north and east. It also bought the town dump, located at the confluence of Spring Creek and the Cannon River. Most existing farm buildings were demolished and new ones were constructed.

In 1916–1917, Cowling arranged for Lyman Lakes to be dredged out of what had been a marshy area. The lakes formed the edge of cam pus until married student housing was built on the site of present Goodhue Hall after World War II.

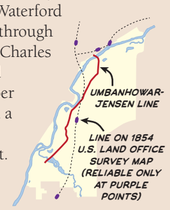


"Before World War I the view northwestward from the Observatory presented an eroded weed-grown pasture through which meandered a perennial creek. Beyond was a tumble-down farm that presented not a very inspiring picture. . . . A driveway. . . led to the city dump where bones and entrails from the local slaughter shops were mingled with superannuated Model T Fords, old tires, bottles, cans and such other effluvia. . . . [I]t provided a shooting ground for the Carleton students. Anyone who could not account for six rats in the course of a half hour's shooting. . . was not an accepted marksman."

PROFESSOR HARVEY E. STORK, 1950

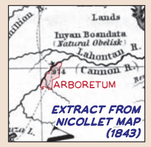
The Dakota

The Wahpekute band of the Dakota lived in the area at the time of European settlement. No significant native artifacts or sites have been found here, but a major north-south trail, which became a military road, crossed the Cannon River at Waterford and continued south through what is now the Arb. Charles Umbanhowar '85 and biology faculty member Paul Jensen identified a probable route of the trail, shown at at right.



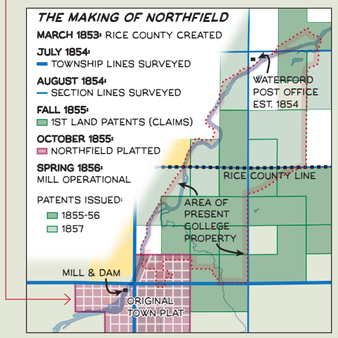
Nicollet

Joseph Nicollet created the first detailed map of Minnesota's river network, published after his 1843 death (detail at left). His travels took him in 1838 through what is now the Arboretum, and his field notes are the first European documentation of the area.

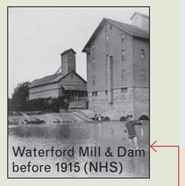


A tale of two mills

The land in this area was opened to homesteading in the fall of 1854. By December 1855, New Englander John North had purchased and laid out the town site of Northfield, and built a flour and lumber mill on the site that is now Bridge



Square. In 1864, the mill, now owned by the Ames family, produced some of the finest flour in the country, using techniques developed there.


Waterford Mill & Dam before 1915 (NHS)

In 1873, members of the newly formed Grange, an organization of farmers united against bank and railroad interests, built a dam and mill at Waterford. The millpond stretched to the Ames Mill, including some of the floodplain in the Lower Arboretum. The Waterford mill supplied Northfield's electricity from 1895 to 1915, when the Lake Byllesby dam 13 miles downstream went into operation.

Nature and the plow

In 1854, the same year Northfield was opened to settlement, Henry David Thoreau published *Walden*, the touchstone of a new American sense of nature as a spiritual haven. The next 20 years saw the invention of parks for the public to experience nature (Central Park, NY, 1857; Yellowstone, 1872).

Meanwhile, technology pushed agricultural productivity. Between 1850 and 1890, the amount of labor needed to grow a bushel of corn was halved (and halved again by 1930). Steam tractors and later gas tractors were part of an increasingly mechanized, "modern" farm life, which Carleton's farm exemplified.

The original Carleton Arboretum sat between these two: On one hand, the nature trail and specimen plantings were meant to draw students and visitors to experience the natural world directly and knowledgeably. On the other hand, the pine plantations and experimental nursery were meant to help Minnesotans make the land fruitful.

The urgency of modern ecology-based environmentalism, while present in older preservation movements, only really began to affect management of the Arb in the 1970s, while interest in sustainability brought agriculture back to the college in the 2000s.

The Carleton Farm

Founded in 1914, the Carleton Farm focused on dairy farming for most of its 50-year lifetime. Hogs were a profitable sideline, and horses were kept for work and student riding.

Students were employed by the farm as a work-study program; these students lived at Farm House. Although agriculture was a part of the curriculum one year (1919), Cowling's desire to integrate the subject into the curriculum failed to gain traction.

The Holstein dairy herd was one of the best milk-producing herds in the state, supplying 300 gallons of milk a day to the college's dining halls. A horse-breeding and riding program was located at the former Ovestrud farm, purchased in 1941, at the southeast corner of the current Arboretum.

When the Carleton Farm was closed in 1964, the equestrian program ended, the dairy herd was sold off, and the crop fields were leased to area farmers.

1930–1955

Harvey Stork's vision


Stork in 1947

Professor Harvey Stork first proposed an arboretum to the college in 1926, with the goal of expanding the variety of plants available to homeowners in what he found a generally bleak Minnesota landscape. Enthusiastic support from regional nurserymen led to a wide variety of experimental plantings in a nursery on the site of the old town dump. Stork saw the Arboretum as an educational resource to the college and the wider community: a nature trail and an outdoor museum (a kiosk with specimens) were established, and biology-related classwork was encouraged. Stork's vision was largely carried out by D. Blake Stewart ("Stewsie"), who claimed at his retirement in the 1970s to have planted over a quarter million trees in the Arb.


Stewsie in 1960s

Trail and bridges

From 1930 to 1957, a 3.5-mile nature trail followed both sides of the river. From 1930 to 1941, and again between 1955 and 1957, signs matched weekly mimeographed guides to what was in bloom and what to look for.

Two 1930 suspension bridges, part of the nature trail system, spanned the Cannon River near campus. In poor repair, they were removed in 1987, but concrete abutments remain. A third bridge at Waterford had washed out in the 1940s.

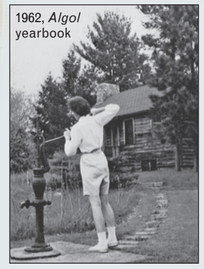
Lilac Hill

In 1935, more than 90 varieties of lilac were planted here, donated by a Faribault nursery. Aged and overgrown, they were mostly removed in the early 2000s, though a handful can still be seen and smelled in May.

The Arboretum in 1937

Iron Bridge

Built in 1909 to replace a river ford, this Camelback through truss bridge was one of the last cast-iron bridges built in Minnesota, and is the only surviving one built with bolted connectors (rather than earlier pins or later rivets). It was closed to vehicles in 2011.


1962, *Algol* yearbook

The Women's League Cabin

Built in 1938–39 on the site of an older farm structure, the rustic cabin provided a space for women students "far enough away from the campus for independence but close enough to reach on a bicycle." Oversight was transferred to the Outing/Natural History Club in 1971, and it became a coed retreat. Always maintained on a tight budget and prone to vandalism, it was torn down in the late 1990s.

Stork Forest

It is not clear what Harvey Stork had in mind, but because most of the trees in Stork Forest—planted in about 1930—are local, it may be the earliest native-forest restoration in North America. This is now the most mature, complex area of restored Big Woods-style forest at Carleton (Best Woods in the Lower Arb is an original fragment). It's still a few decades away from full old-growth maturity, and provides a model as Carleton restores other areas.

1955–1985

Neglect and revival

When Stork retired in 1955, laboratories and experiment stations had largely replaced arboreta for hardiness research and development. The Carleton Arb fell fallow; trails were maintained for athletics and recreation, and not much else was done with the property. Meanwhile, Aldo Leopold's 1949 *A Sand County Almanac* and Rachel Carson's 1960 *Silent Spring* marked a shift in thinking about nature to an interconnected ecological model. Carleton faculty and students began considering how to apply it on Carleton's land.

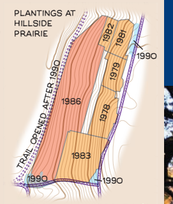
The Arboretum in 1985

Earth Day Field

On April 22, 1970, the first Earth Day, Professor Paul Jensen led students to plant trees in a field that had been abandoned in 1969. Many of those seedlings died, but seeds from surrounding forest (mostly cottonwoods, silver maple, and willows) filled in, and now the former field forms a closed canopy like the older woods.

Hillside Prairie

Between 1978 and 1986, Carleton students experimented planting prairie on this former Carleton Farm pasture. Non-native grasses including brome and Kentucky bluegrass have been a persistent problem, despite regular burns.



Since 1995, Arb managers have eradicated to bare earth before planting prairie seeds, based on lessons learned from Hillside.

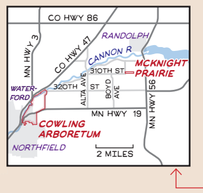
Oak Opening

Many of the bur oaks on Carleton's property predate the college. They are part of the savanna or oak opening landscape that was dominant before Europeans arrived. Many oaks were cleared for farming or allowed to become overgrown. In the early 1980s, students began clearing around the survivors, planting prairie species in the understory, and performing controlled burns. This process continues today.

Prairie remnants

The Postage Stamp Prairie, the Arboretum's lone patch of original prairie, began to receive attention in the 1970s through controlled burns and clearing of encroaching shrubs and trees. New plantings beginning in the late 1980s helped expand and buffer the area, which sits on the western edge of the Upper Arb above Spring Creek.

The McKnight Prairie, seven miles east of campus, is a largely intact 33.5-acre remnant purchased by the college in 1968. It provides a significant source of seeds for Carleton prairie restorations.



Remaking the Arb 1985–present

In the late 1970s the college began to reinvest in Arboretum staffing and long-term planning. Appointments of a part-time director and a full-time manager in 1989 allowed for consistent restoration and management. Today an endowed full-time director, a full-time manager, a faculty research supervisor, and a half-time trails manager encourage a variety of college uses of the Arboretum.

- 140 acres of high-diversity prairie have been restored using local native seeds.
- Upland forest and savanna are being cleared of buckthorn and other invasive trees.
- Most land has been taken out of cultivation, reducing wetlands-damaging sediment.
- The trail system has been modified to accommodate vulnerable species.
- The Arb is used extensively for curricular activities.
- Student workers log thousands of hours annually on maintenance and participate in ongoing faculty research projects.

PHOTO CREDITS:
FRONT: BERETT WILBER '14; BACK: NANCY BRAKER '81

Carleton College
100 North College St.
Northfield, MN 55057
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507-222-4000

Campus Security: 507-222-4444
Emergencies: 911

Rules for Arboretum visitors

- Bikes are allowed only on specifically designated trails in the Upper Arb. No bike use is permitted in the Lower Arb. Off-trail biking is prohibited throughout the Arb.
- Motorized vehicles are not allowed except for maintenance and emergency use.
- Because of the lack of sanitary facilities, the Arb is not open for camping.
- Dogs are welcome if they are on a leash and if droppings are carried out of the Arb.
- Horses are not allowed.
- The Arb is a state game refuge, so general hunting is prohibited. Archery hunting by written permit is allowed each December to reduce the overly abundant deer herd.

For more information, visit the Arb web site.

Cowling Arboretum
apps.carleton.edu/campus/arb
507-222-4543

Cowling Arboretum
Carleton College, Northfield, MN
Map and Guide

Carleton