...lge Ecological Corridor Neighborhood

Using Ecological Patterns to Guide Urban Growth

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The Cambridge Ecological Corridor Neighborhood

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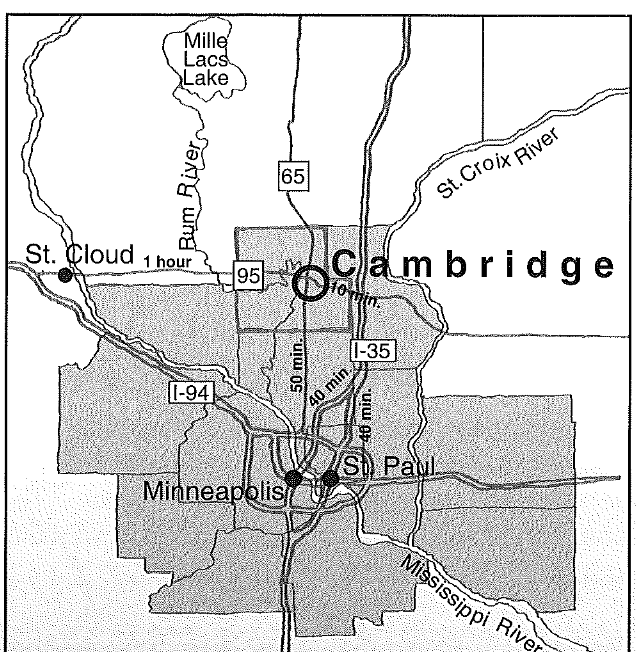
Introduction

This case explores how strategically located and carefully designed residential development can help to define the edge of a growing city. A key element of the design strategy is to reinforce patterns of existing ecosystems, including wetlands, so that ecosystem patterns guide growth. This case also suggests how an innovative range of land-ownership types can be matched with ecosystem types to maintain ecological patterns.

Since 1990, the City of Cambridge population has grown by more than 10% to 5700 residents. Both city and county governments accurately anticipate that the city and surrounding townships soon will be subject to even greater development pressures. The city is a thriving commercial, manufacturing, and service center for Isanti County, and almost as many people enter the city for jobs as commute to work each day. Those who commute 45 miles south to the Twin Cities use either Highway 65 or take County Road 95 to Interstate 35.



Cambridge is on the growing edge of the Twin Cities Metropolitan Area

Isanti County lies just outside the state designated Twin Cities Metropolitan Area, which has mandated growth controls and related opportunities for enrollment in agricultural land preservation programs. The county lies inside the US Bureau of Census 1990 designated metropolitan area as shown on this page. Regardless of the designation, population growth including a high proportion of commuters has begun to roll through Isanti County.

Perhaps the most critical determinant of the city's ability to manage growth is coordination with county and township planning through the state annexation process (MN Statute 414.033). Around the state and around the country, a critical question for cities and nearby unincorporated areas is: Where is the edge of the city? Minnesota state law provides a rather ambiguous answer: the edge of the city is where rural residential land use begins, and the law provides a widely criticized process for resolving disputes: review by the Minnesota Municipal Board. Under Board review some townships have incorporated themselves to be cities, and some cities have had to fight to annex areas where they have been required to provide city sewer and water services. Many cities are concerned about the cost of providing services to outlying residential areas that were developed at low densities under township control and without city jurisdiction.

Vivid ecological landscape patterns can help a city define its edge. This project illustrates how building strong ecological and amenity connections across ecosystems can complement an extension of sewer and water services to define the edge of development.

Project Framework : Wetlands as Community Amenities

The lake and wetland ecological patterns along the southeastern side of Cambridge help to delineate an Ecological Corridor, within which development could be designed to contribute to the overall ecological pattern. Within the Ecological Corridor, wetlands are protected, restored, and constructed to increase ecological quality and to create an amenity open space system for people. Storm water is drained over the surface of the land and cleaned before it enters local lakes and wetlands. To build habitat quality within the Corridor, wetlands are connected to other ecosystems that have biodiversity: for example, woodlands or stream corridors. This project describes how to define an Ecological Corridor edge to growth, and it provides an example of how development should be designed within the Corridor.

When wetlands are restored or constructed, communities can gain more than habitat or cleaner water. Wetland restoration or construction is an opportunity to design landscapes that are amenities in the community. A community amenity is a physical feature or quality of the landscape that makes a more pleasant place to live. Parks, lakes, trees, and panoramic views traditionally have been recognized as amenities in a neighborhood. Everyone can enjoy these amenities - living in a place or walking or driving through it. By designing wetlands so that everyone sees that they are amenities, we heighten the economic value and quality of life in a community at the same time as we accomplish ecological goals.

The Cambridge Ecological Corridor Neighborhood shows how wetlands and other native ecosystems like lakes, streams, and woodlands, can be large scale amenities that help to organize the city for human experience and define the edge of growth.

FORCES OF WETLAND DEGRADATION

- **Construction of roads and buildings (impervious surfaces)**
- **The clearing of forests, prairies and other vegetation including draining of wetlands**
- **Nonnative species invasion**
- **Soil erosion**
- **Construction and the clearing of vegetation disturbs soil causing the erosion of fine particles of soil called silt**
- **Fertilizing lawns and fields**
- **Animal waste washed from farm yards, feed lots, and from cattle allowed in water bodies**
- **Grazing of wetlands**
- **Haying**
- **All terrain vehicles in wetlands**
- **Petroleum products, acid rain, and heavy metals washed from many man made surfaces**

Three essential ingredients make a wetland:

Water: Wetlands occur where water collects on the surface of the land and where water saturates the soil for at least part of the year. Wetlands receive water both from a direct connection to the ground water table and/or from the surrounding upland from which storm water drains (the watershed).

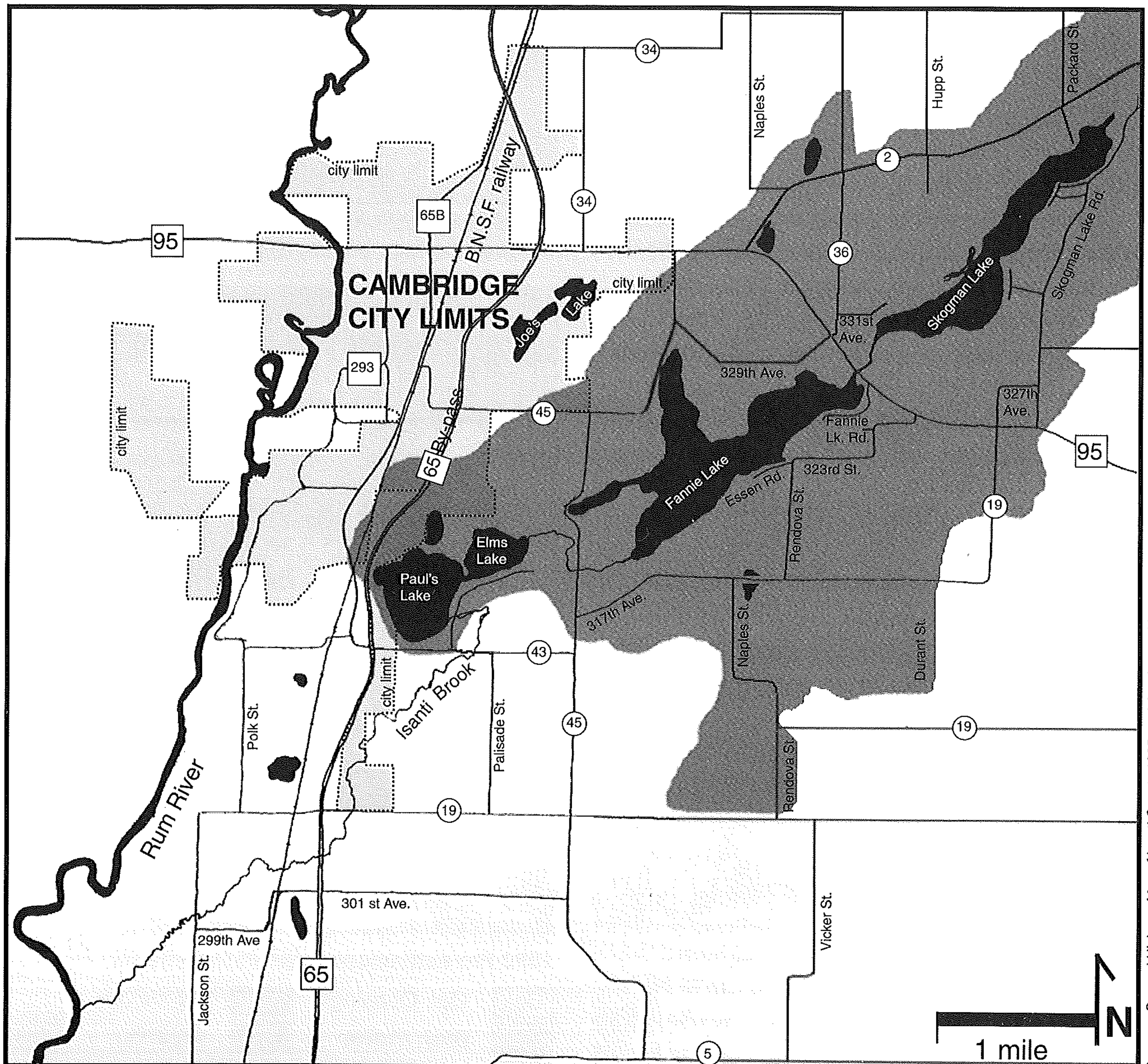
Soil: Wetland soils are distinct from all other soil types. They are characterized by having a large clay component making them fairly impervious to water, and often they have a large organic component (decaying vegetation which gives wetland soils their dark color).

Vegetation: Plants that are able to grow in saturated soil or in standing water are called hydrophytic. Many hydrophytic species grow in wetlands, and because of the rich soils, the constant water supply and the exposure to full sun, wetlands are one of the most productive plant communities in the world.

Together water, soil, and plants make wetlands. When the water is clean and the soil is undisturbed and the plants have not been eliminated, wetlands provide food and shelter for a rich variety of wildlife species.

Since European settlement, however, wetlands have been viewed as waste lands; areas best drained and farmed, or areas best filled and built upon. Today we have come to realize the significance of wetlands to our health and well-being. Wetland values include: flood water storage, water purification, wildlife habitat, recreation, education, and beauty.

Wetlands also have value simply as wetlands, just as rain forests, prairies, and our local old growth forests have value because they exist. These ecosystems are fascinating and beautiful places, full of amazing natural phenomena that everyone deserves to experience.



Sources: General Highway Map of Isanti County 1995 and Junghans 1996

Chain of lakes watershed at the southeastern edge of the city of Cambridge

The Cambridge Ecological Corridor Neighborhood

Context Analysis

Landscape Change

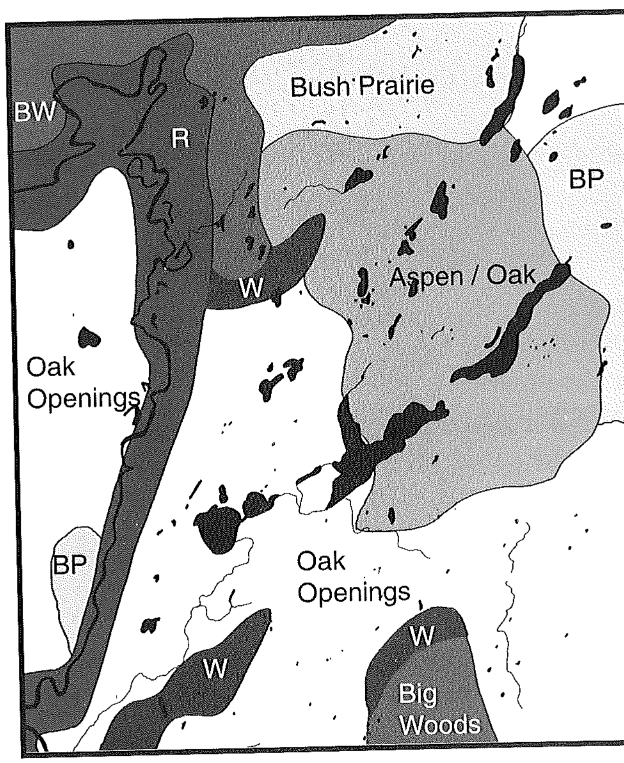
In the study area prior to European settlement, oak woodlands interspersed with openings of prairie and wetlands were home to Dakota and Ojibwe people, who found deer in the woodlands, bison on the prairies, and ducks, geese and wild rice in the marshes. They also gathered nuts and fruits. These woodlands Indians set camp along lakes and marshes of the area to take advantage of the abundant fish, waterfowl, turtles and other small animals.

By the arrival of the first European settlers in the 1840s, the fur trade had contributed to the local extinction of beaver, elk and bison. Logging of white pine, primarily along the Rum River, was the first industry in the area. It lasted 40 years until the resource was exhausted. Agriculture started with subsistence farming. New technologies in plowing, planting and harvesting were developed, and increased population led to increased food production.

By the 1930s. the potato became the primary cash crop. Carrots and cabbage was also produced in the peat soil of drained wetlands. Both the railroad, established in 1899, and the Cambridge starch factory opened both local and distant markets and further stimulated production. Potato production decreased in the 1930s due to a severe blight. By the late 1930s dairying and more diversified farming replaced potatoes as a major industry. With the advent of chemical fertilizers and large farming equipment, corn and soybeans emerged as the primary crops.

Around the larger lakes, recreational homes have been constructed throughout the century. Nearly all of the desirable land along the lakes has been developed. Building now continues on less buildable sites with a trend towards large lot development. The multitude of septic tanks compromise lake water quality by leaching contaminants into the water table which makes its way to the lakes.

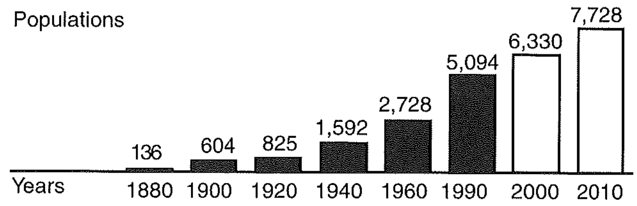
Small oak trees, brush, prairie grass and wildflowers covered the area prior to European settlement.



1852 Pre-settlement vegetation patterns

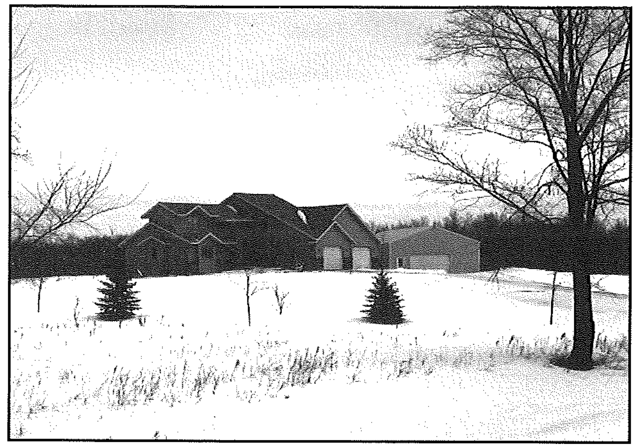
Oak	Oak Openings	BW	Big Woods
BP	Bush Prairie	R	Riparian
AOak	Aspen/Oak	W	Wetlands

Today, as diversified industries flourish in the area, the population of Cambridge grows. The logical direction of residential expansion is to the east and south around the Highway 65 corridor to the Twin Cities. Large lot exurban growth is the current trend. Thoughtful planning can establish neighborhoods that protect natural resources and can preserve a historical connection to the land.

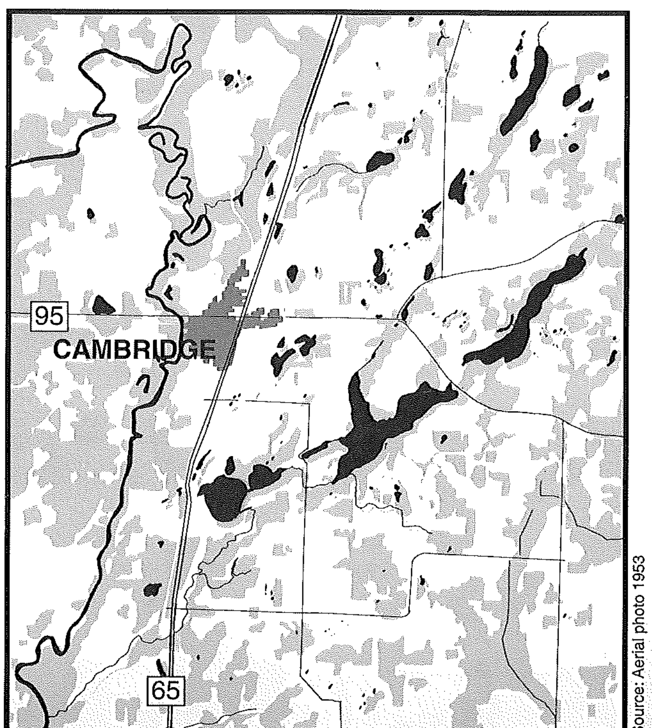


Cambridge population growth and projection.

Dairy farming became the primary land use after the potato blight in the 1930s.

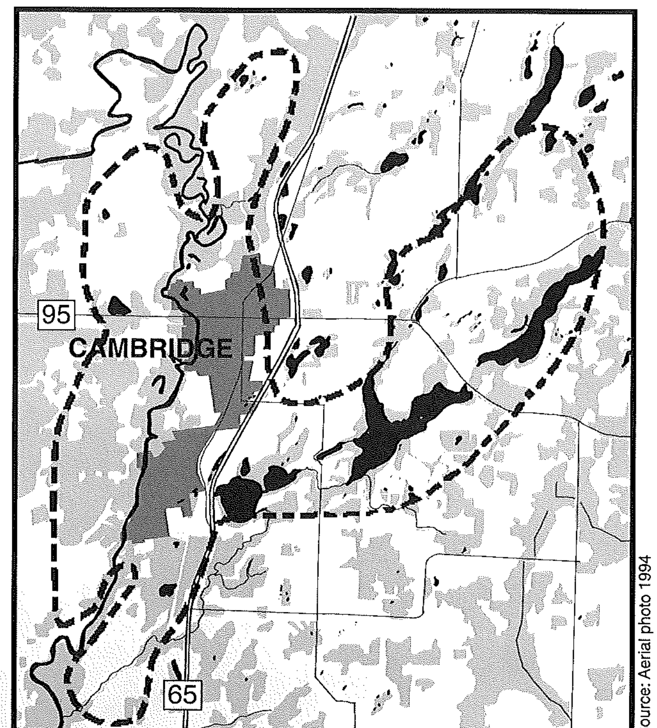


Today, homes are being constructed on large lots throughout the area.



1953 Development Pattern

- Other, mainly farmland
- Residential
- Remaining Marsh and Tree Canopy

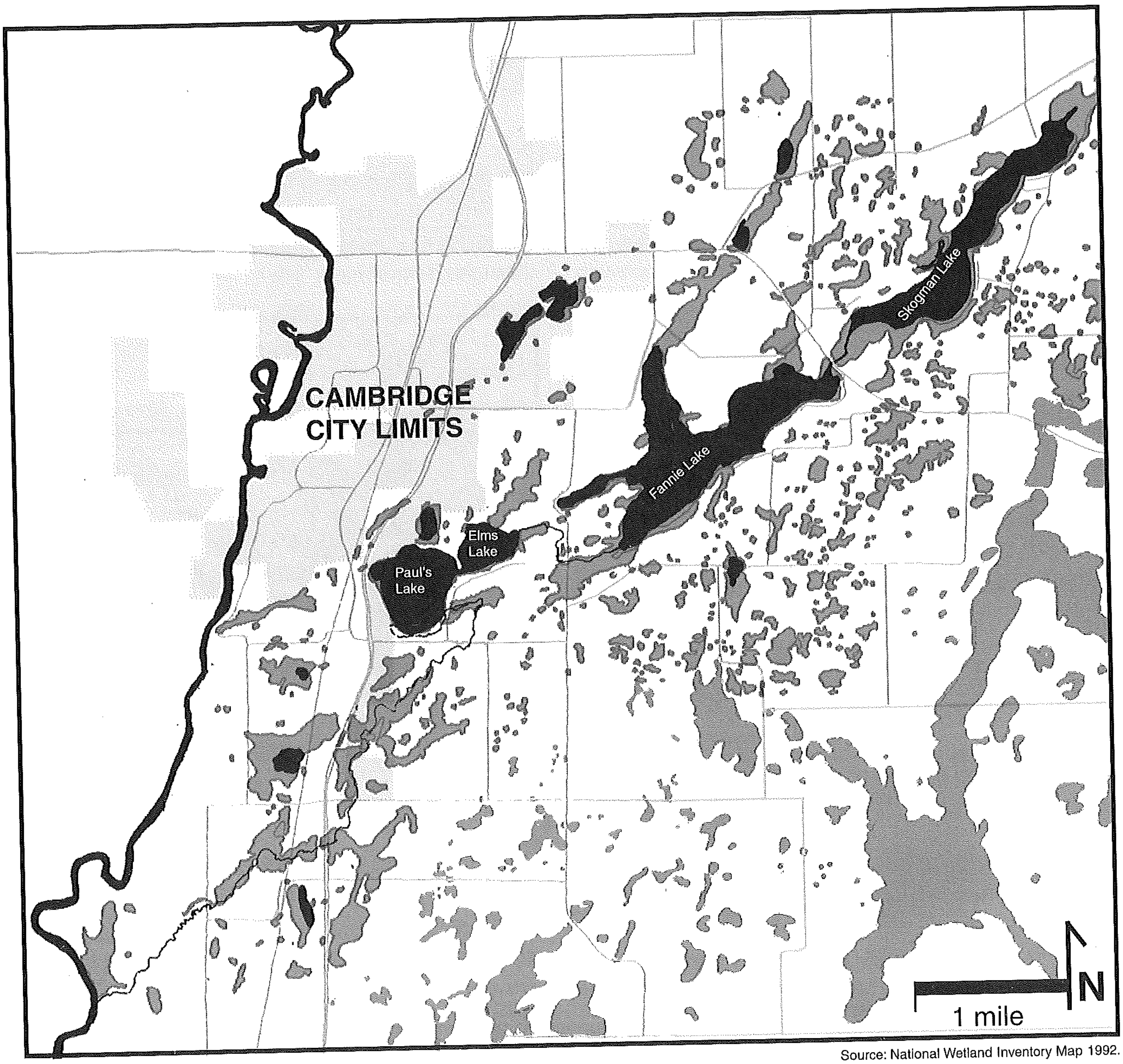


1994 Development Pattern

- Other, mainly farmland
- Residential
- Remaining Marsh and Tree Canopy
- Large lot exurban

Landscape Structure

When viewed from high above, the southeastern edge of Cambridge presents a bold landscape pattern formed by water. Draining the area from north to south is the Rum River. This wild and scenic river winds over the flat sandy earth to the Mississippi River fifty miles to the south. Stretching down to the Rum River from the northeast are water systems (lakes, wetlands, ditches and streams) that form green corridors extending through agricultural land. This system, surrounded by oak woodland and marsh vegetation, forms corridors not only for water movement to the Rum River, but also for the movement of plant and animal species. The corridor, however, has been severed in several places by development. First in the late eighteen hundreds by the railroad, then by the growing city and by agriculture, and most recently by the construction of the Highway 65 bypass.



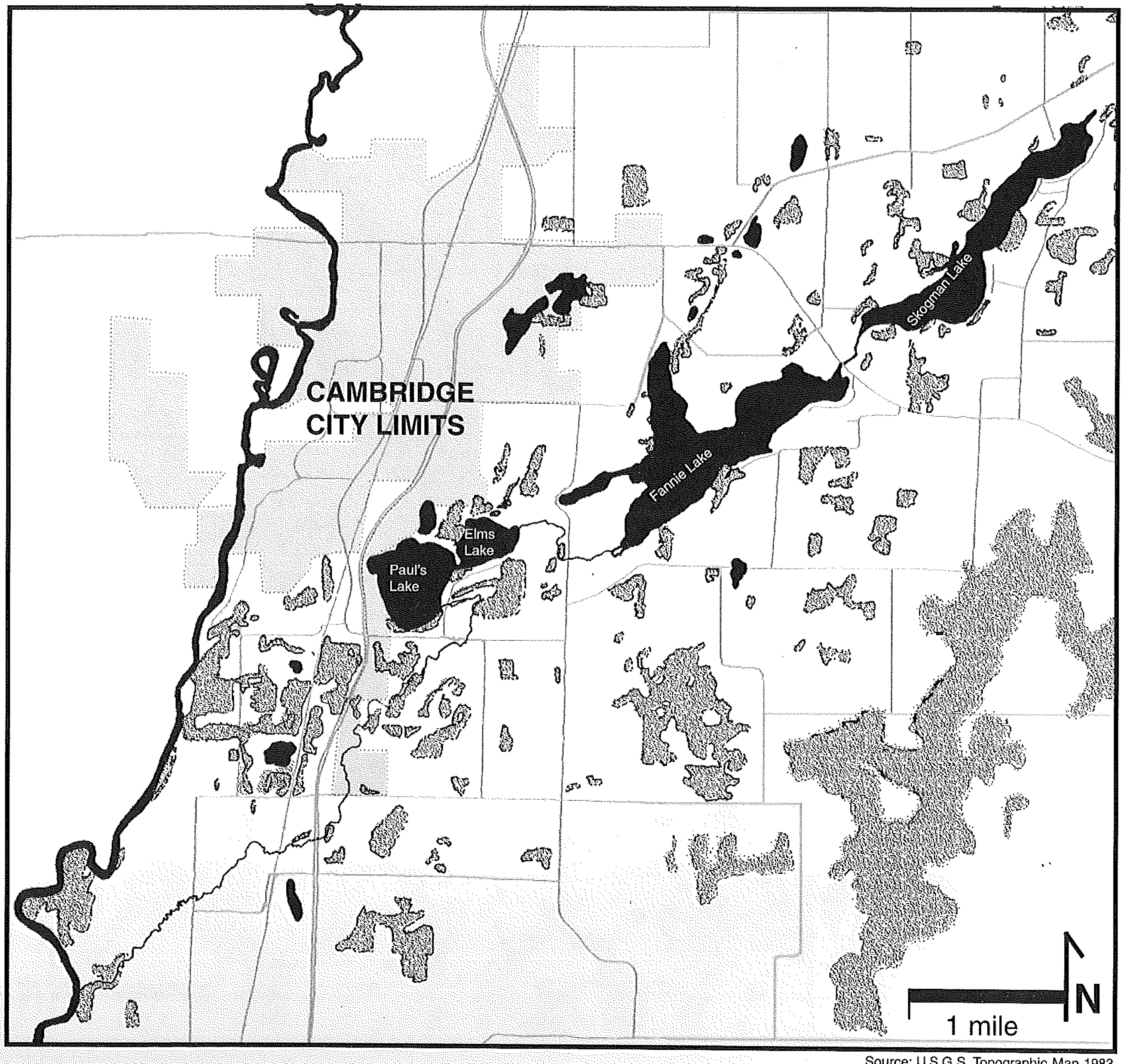
Source: National Wetland Inventory Map 1992.

Wetlands at the southeastern edge of the city of Cambridge

Watersheds

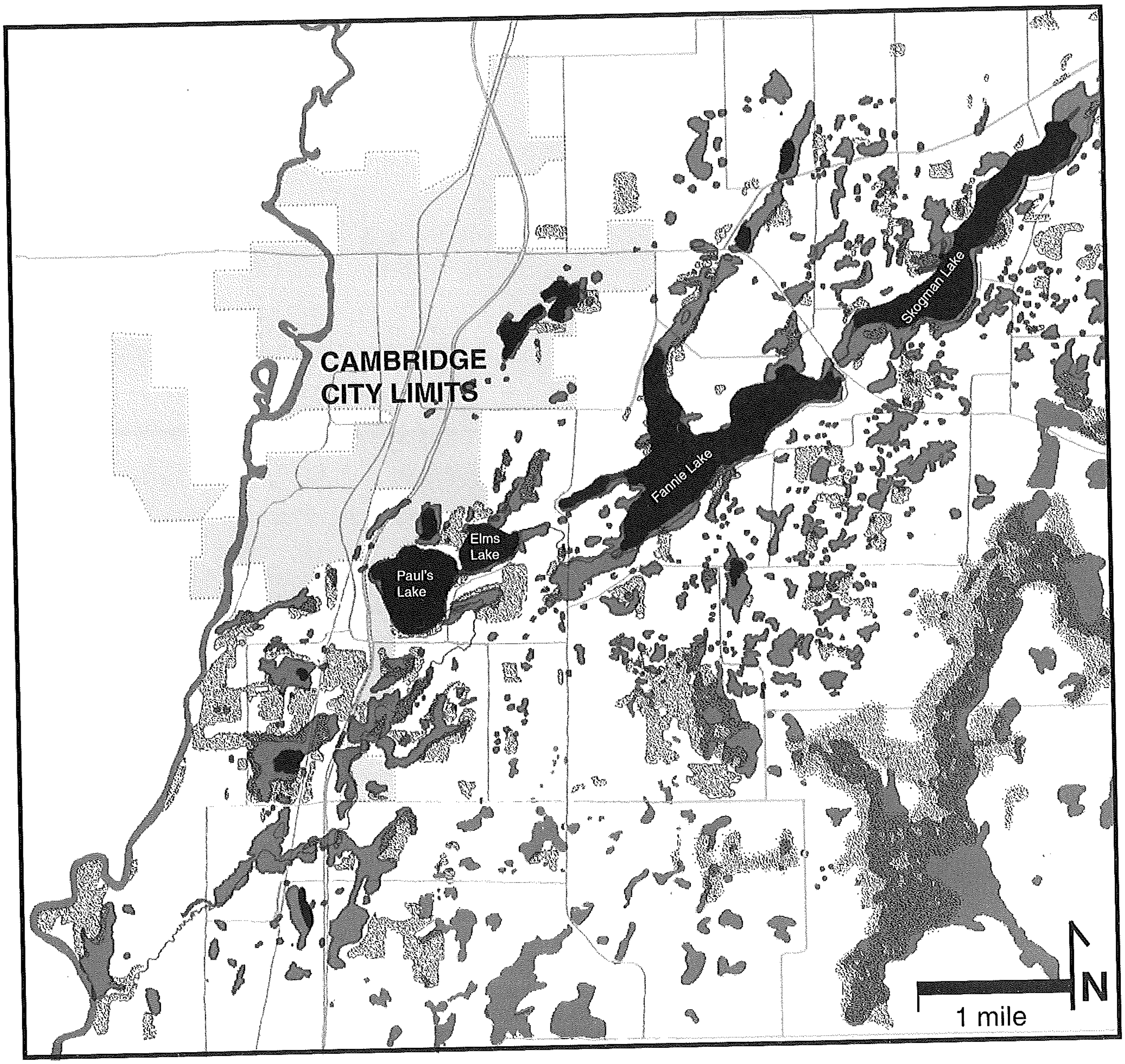
Within the corridor on the southern edge of Cambridge, wetlands, lakes, and streams make a tightly connected chain of lakes within watersheds that flow into the Rum River.

A watershed is the area of land that is drained by a particular water body. Human activities within a watershed affect the quality and quantity of water that drains to its water body. Within the major watersheds that drain eastern Cambridge, agriculture has been the primary land use. Typically, clearing the land for agriculture increases the rate and volume of storm water run-off over the land surface. Because of the sandy soils in Cambridge, run-off has not increased appreciably in this area. However, sandy soils pose a risk of water contaminants such as fertilizers and herbicides soaking into the ground and reaching the underground aquifer from which drinking water is pumped. Ground water contamination has occurred in the Anoka Sandplain of which Cambridge is part.



Tree canopy at the southeastern edge of the city of Cambridge

As residential development proceeds in eastern Cambridge, care must be given to prevent ground water contamination from lawn chemicals, automobile by-products such as oil and anti-freeze, and from septic systems. Also, the construction of hard surfaces such as roads, driveways and roofs within a watershed will prevent water from infiltrating into the ground, therefore increasing the amount of water that runs off the surface of the ground. This additional run-off water can cause abnormally high water levels in lakes and wetlands destroying vegetation, eroding banks and flooding basements. Increased run-off caused by development should be caught and temporarily held near its source to be released slowly later.

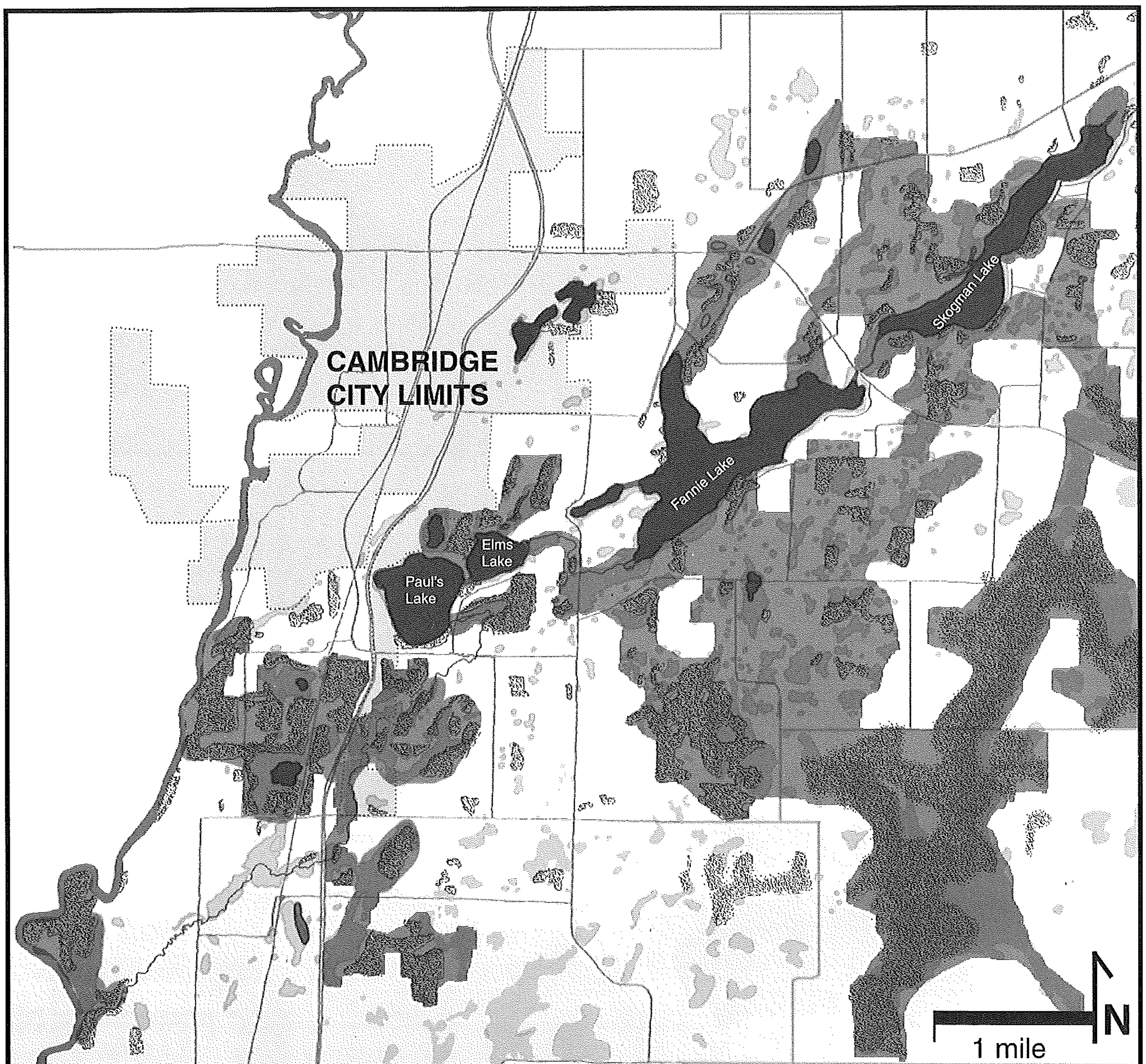


Ecosystem complexes (wetlands and canopy) at the southeastern edge of the city of Cambridge

Ecological Corridor Overlay District

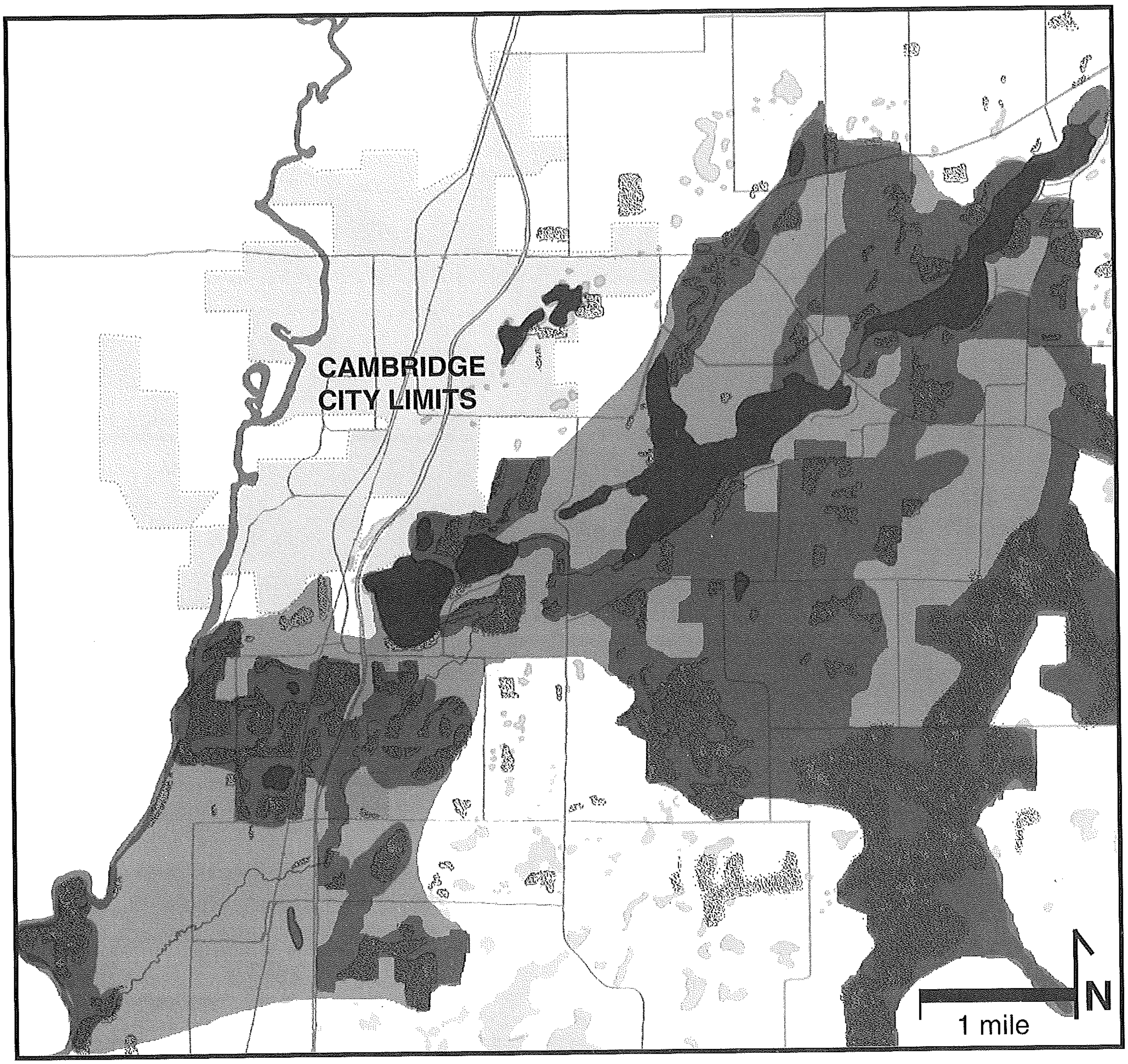
The chain of lakes watershed and habitat connection pattern could define an overlay district where future development is designed to enhance corridor flows within the connected hydrological and biological system. It could also define neighborhoods connected to natural amenities. Finally, it could include a recreational trail system that lets local people enjoy the amenity value of the chain of lakes and the agricultural landscape just beyond the edge of the town.

While we immediately recognize the value of lakes and streams for outdoor recreation and beautiful home sites, other ecosystems are equally important to overall ecological quality. In fact, it is the connection of different native ecosystem types in ecosystem complexes that makes for essential habitat characteristics. We mapped existing wetlands (page 6) and existing tree canopy (page 7), to show how their combined area makes a broad band of ecosystem complexes at the southeast edge of Cambridge (page 8).



Habitat connections at the southeastern edge of the city of Cambridge

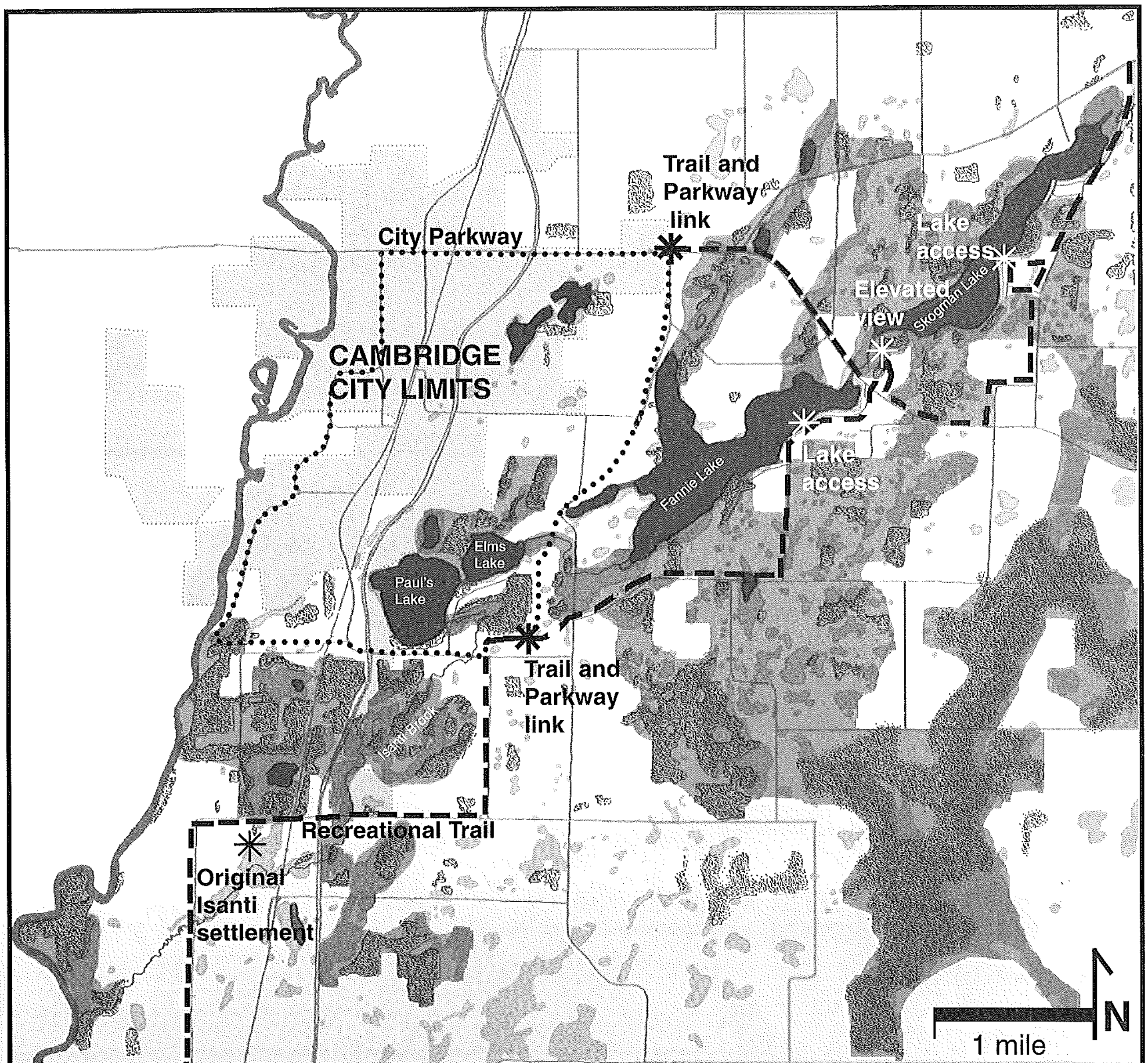
The corridor that would support hydrological and biological flows to the Rum River should be broad. It should connect ecosystem complexes into a more complete network of habitat connections - actual and potential (page 9). These habitat connections are the areas where future land cover changes should promote native vegetation with good nesting, resting, rearing and feeding potential for wildlife. The ecological corridor also should include areas between the habitat connections so that development or other land cover changes in these areas can be carefully designed to avoid degrading the habitat character or hydrological flows within the corridor (below).



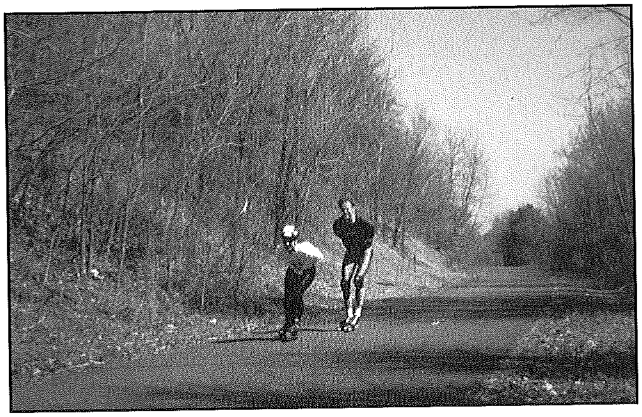
Ecological corridor at the southeastern edge of the city of Cambridge

Recreational Trail System and Cambridge Parkway

A new recreational trail system in the map below, has been designed to give all local people access to the beauty of the streams, wetlands, and woodlands that connect to the chain of lakes. The trail brings trail users to key viewpoints along the habitat connections. It uses existing county and township road right-of-ways along the countryside edge of Cambridge development, and it connect the recreational trail to the proposed Cambridge Parkway for bicyclists within the city. Ultimately this trail alignment could follow County Road 2 to join the regional trail and open space network and link south to the City of Isanti (page 12).

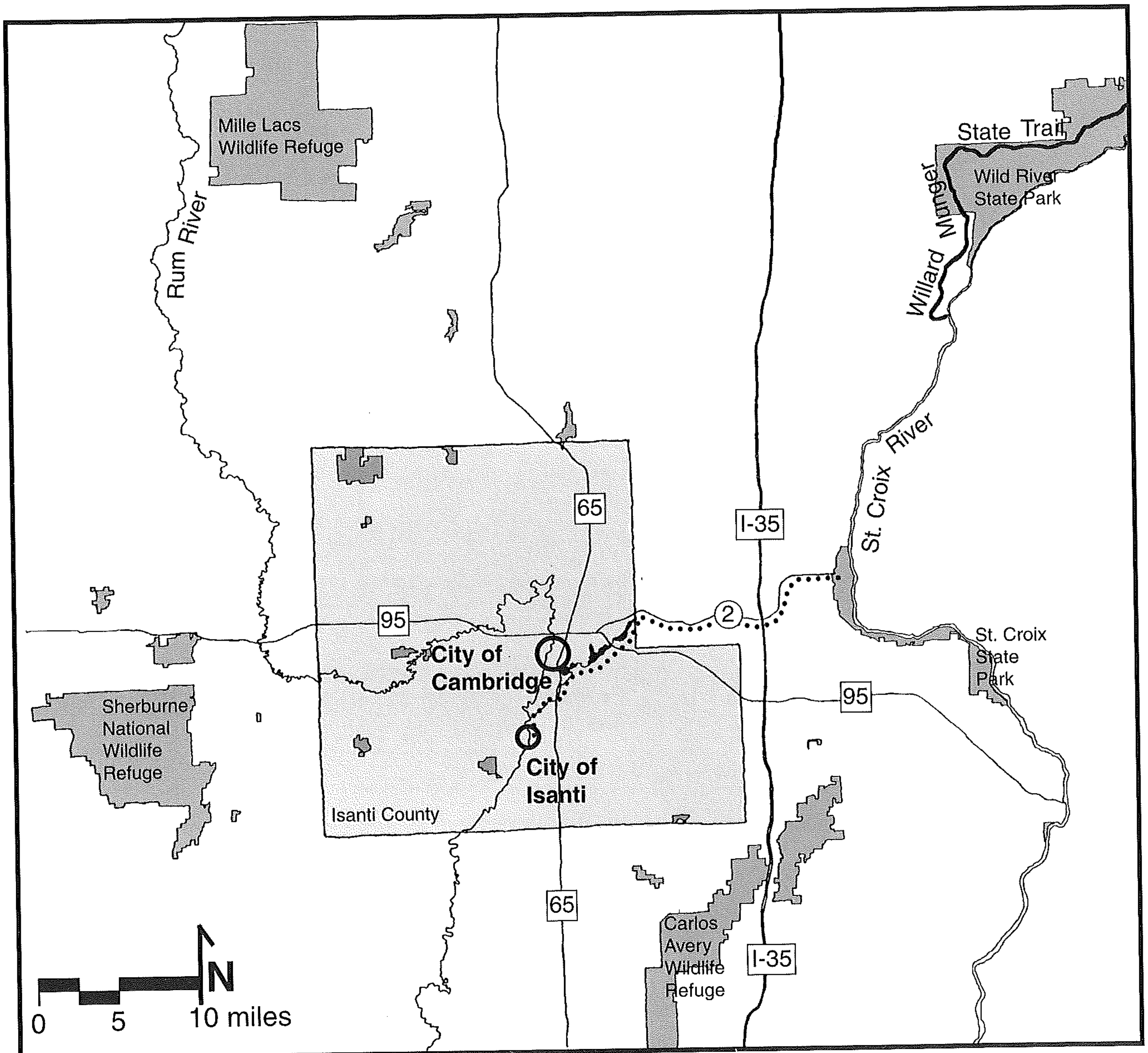


Proposed Cambridge Parkway and Isanti County Recreational Trail



In-line skaters using a recreational trail

Bicyclists, in-line skaters, and pedestrians could use the new recreational trail. It could be extended to connect to nearby state parks and the Willard Munger State Trail.



Source: Public Recreational Information Map, Minnesota Department of Natural Resources, 1991.

Proposed trail connections to regional recreational opportunities

The Cambridge Ecological Corridor Neighborhood

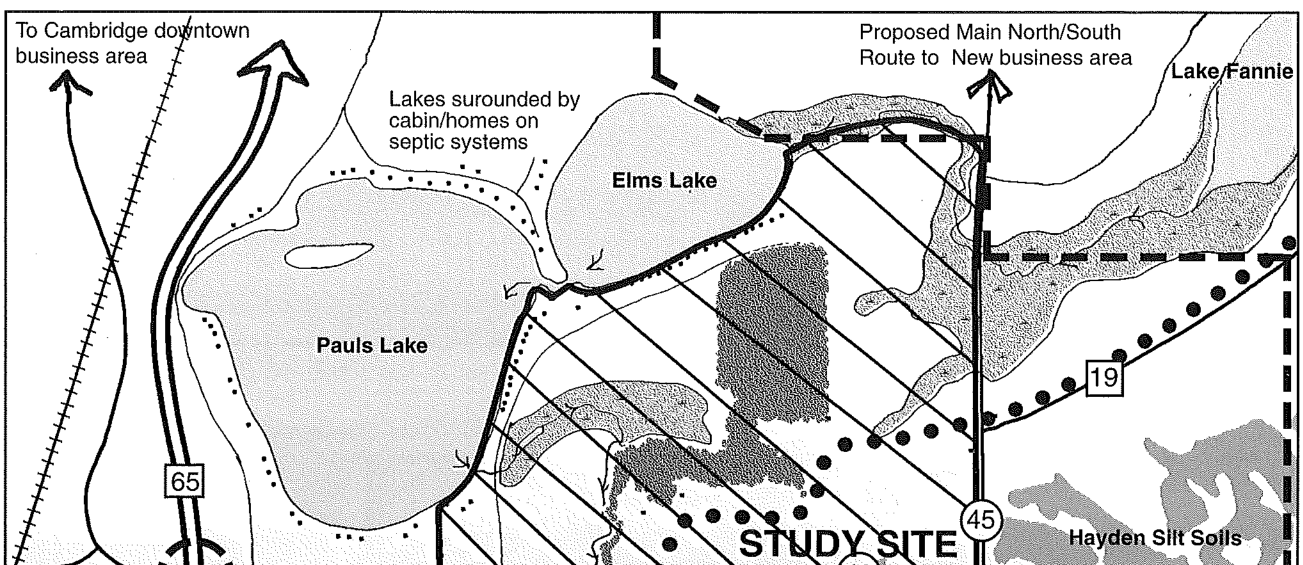
Site Analysis

Site Location

Within the Corridor, a 306 acre site was chosen to demonstrate the potential for ecologically appropriate residential development. The Corridor Neighborhood is located in the southern corridor, east of one of the three safety controlled city crossings of Highway 65 shown in map below. The proposed new recreational trail runs through the southern portion of the site. The most productive agricultural land in the area occurs off the site to the south and east. The scenic lakes, woodlands, and wetlands makes this a desirable place to live, and development is proceeding in the area at a fairly rapid rate.

The areas of habitat connection, defined by the Corridor overlay process, form the core of the site. The existing system of wetlands and lakes served as a corridor for species movement in the past. Uncontrolled development can sever these links and eliminate habitat. Housing and habitat can coexist, however, by siting development out of the logical pathway of species movement. Residential development can exist beside habitat corridors in a manner that provides favorable habitat for both people and wildlife.

The site is within the new city limits of Cambridge as defined by its proposed sewered areas and by Isanti County's municipal urban service area, shown on pages 14 and 15. City infrastructure plans identify the site as a high priority for future sewer and water services. It's eastern edge is formed by County Road 45, which the city plans to make the main north-south arterial street on its rapidly expanding east side. The north and western edges of the site are formed by Paul's Lake and Elm's Lake, part of the Ecological Corridor Chain of Lakes. It's south edge is County Road 43, the southern limit of the city's proposed sewered area. Isanti Brook drains the southern most lake, Paul's Lake, and runs out of the wetland on the site on its way to the Rum River.



Larger Context of Study Site

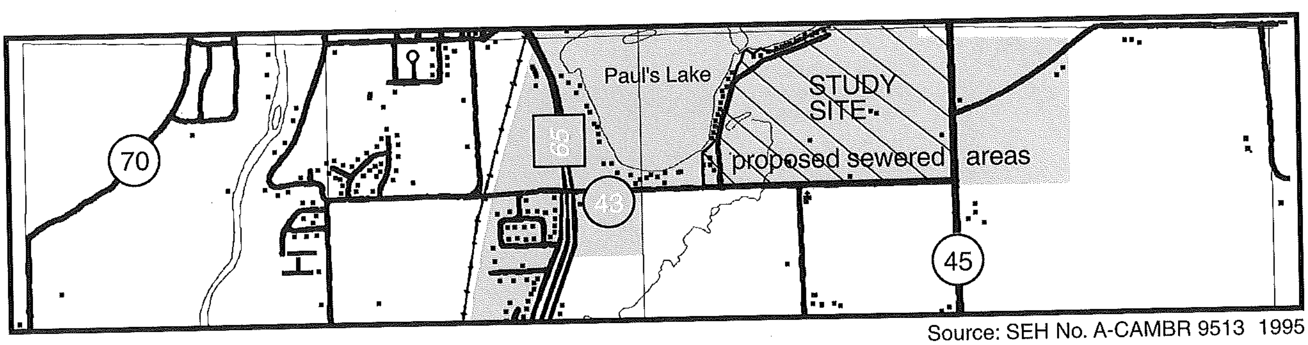
Sources: Isanti County Soil Survey

City Infrastructure

Homes around Paul's Lake and Elm's Lake date from as early as World War II. All of these homes rely on private septic systems and wells, and associated water pollution is affecting Paul's Lake. (Paul's Lake Area Utilities Feasibility Report SEH No. A CAMBRASIS13. June 1995, Short Elliot Hendrickson, Inc.). While existing homes must be provided with city sanitary sewer and water, the number of existing homes that would be served by a new sewer main that would extend along the lakes is not large enough to make homeowner assessments economical. To make the new main economically feasible, a large number of new homes in the area of Paul's Lake and Elm's Lake should be served.

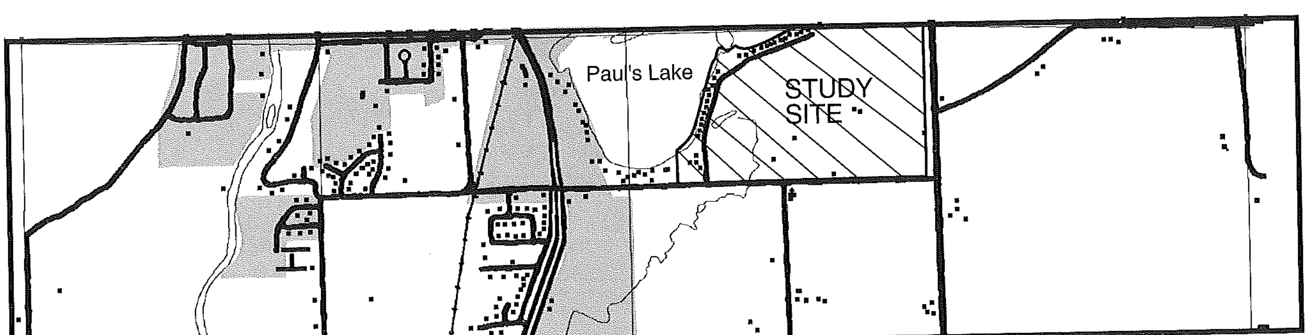
In 1994 Cambridge built an $11 million wastewater treatment plant that can serve 10,000 people, and was sized to expand to serve 20,000. The ecological need to reduce water pollution from outdated individual home septic systems near the city matches the city's fiscal need to efficiently extend sewer services and use the capacity of the treatment plant, and the city has studied how its boundaries could be extended to include new areas for development (see Municipal Boundaries Map and Infrastructure Map below). At the same time, Isanti County's 1995 Comprehensive Plan articulates its commitment to limiting development (page 15). The county has designated the area one mile beyond municipal boundaries as an urban service area with development decisions to be determined by the city's comprehensive plan. Between one and two miles from the municipal boundaries, the county determines future land use. In county designated agricultural zones beyond the municipal boundary, residential development is allowed at densities of 4 units per 40 acres.

The difference between the Cambridge municipal boundary, the county-designated urban service area, and township land beyond the urban service area is significant because coordination between local governments is critical to urban growth management. City annexation of land in unincorpo-



Source: SEH No. A-CAMBR 9513 1995

Infrastructure Map



Source: City of Cambridge Planning Dept.

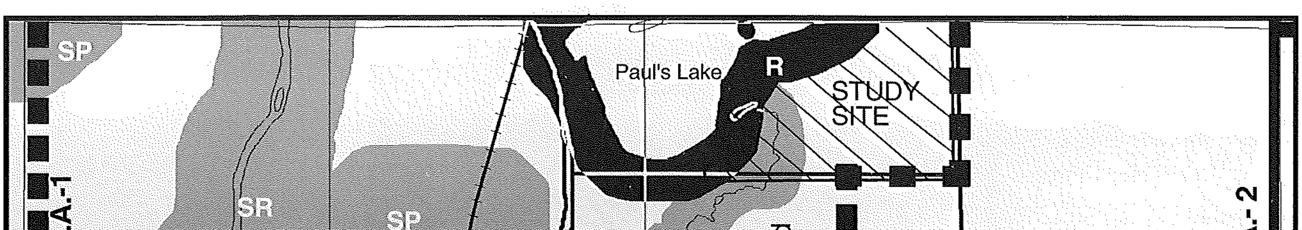
Municipal Boundaries Map

rated areas and city extension of sewer and water services are the main levers for effecting growth. The city may not necessarily be able to annex land it will ultimately be required to provide with services. Where the county or adjacent townships allow unsewered growth beyond the city corporate boundary, the city ultimately may be required by the state to provide city sewer and water services. To allow for future growth, to avoid preempting township rights by municipal rights, and to avoid placing an undue burden on the city to provide services where it has had no voice in determining the land use, the county has established urban service boundaries beyond municipal boundaries. This project demonstrates how the very malleable pattern of sewer and water extension and the frequently incidental pattern of existing municipal boundaries can be rationalized with large scale ecological patterns to define defensible boundaries for growth.

SITE LOCATION

- **The site straddles the proposed corporate boundary of Cambridge. Sewer and water utilities are proposed to extend to the corporate boundary.**
- **The area is currently zoned for four residences per forty acres except for a band 1000 feet from any lakeshore which is zoned for two acre lots.**
- **The site is scenic, and residential development is proceeding in the area.**
- **An opportunity exists to guide development by forming edges to the city with wetland amenities that can serve as wildlife corridors.**

New large lot housing development in the area, served by septic systems and wells.



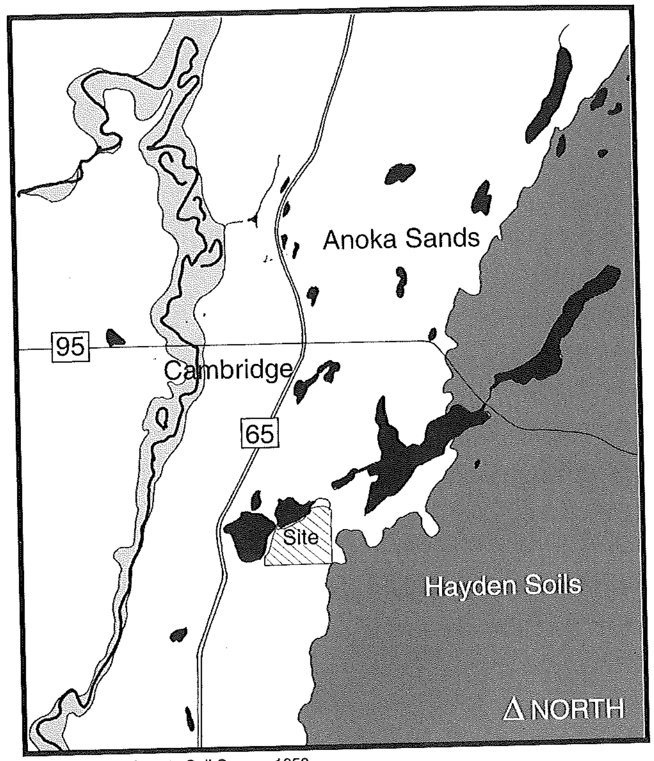
County Plan Map

Source: Isanti County 1995

Soils

Soils of this area are of two major types. The first type is the Anoka sand which deposited during glacial melting by the Mississippi River. The second is Hayden soil which was carried by the glacier from northwest of Isanti County and dropped, unsorted by waters. Potatoes have been the primary crop on the western sections of the site with well drained Anoka sand soils, but continuous production rapidly depleted soil fertility. Today, with the use of chemical fertilizer, corn is the primary crop on Anoka soils. Because of the permeability of the soil to water the risk of ground water contamination from pesticides and fertilizers is great. Anoka sands are also very susceptible to wind erosion.

Hayden soils located on the eastern section of the site are probably the best agricultural soils in the dairy-farming region of east-central Minnesota. They are generally well drained, their natural fertility is comparatively high, and their productivity is easily maintained. Their sandy single-grain structure, however, makes them very susceptible to wind erosion. Because of the presence of clay in the subsoil, enough moisture is retained so that plants are seldom adversely affected by extended dry weather.

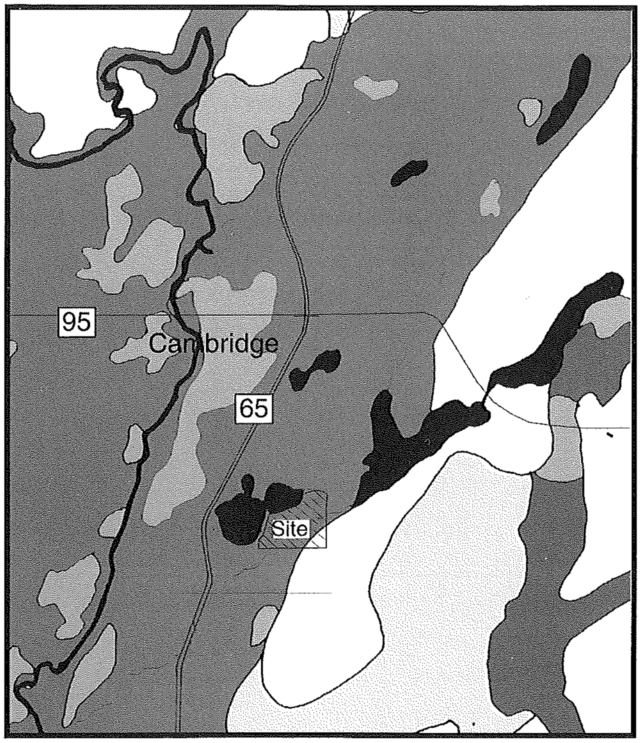


Source: Isanti County Soil Survey, 1958.

Soil Groups

- Water bodies
- Hayden Soils (productive ag. land, suitable for development)
- Alluvial Deposits
- Anoka Sands (corn & soybean production, vulnerable to groundwater contamination)

Sandy soils are easily carried by the wind.



Source: USGS Anoka sand plain regional hydrogeologic assessment, 1993.

Ratings of sensitivity to aquifer contamination

- Very High (hours to months)
- High (weeks to years)
- Moderate (years to decades)
- Low (decades to centuries)
- Water bodies

Sensitivity ratings are an indication of the time it takes for water soluble contaminants to vertically travel to the uppermost aquifer.

Hydrology

Sandy soils allow water to drain quickly into the ground because of the air spaces between individual grains. Large, deep underground deposits of sand and gravel hold water and are called aquifers. Aquifers are the reservoirs form which we pump our drinking water. In the Cambridge area, a deep, continuous layer of sand connects the land surface with the aquifer. In this sand, water quickly soaks down to the aquifer, and when it contains fertilizers, pesticides, oil or heavy metals, these contaminants enter the drinking water supply. For this reason drinking water stored in aquifers should be protected by wise land use. The attached map delineates the time it takes for water-borne contaminants at the land surface to reach the aquifer.

The water table of the area is fairly high, and is reflected in the levels of lake water. Because of the high water table there are many wetlands. Where the sandy soil undulates below the water table, water surfaces and wetlands have evolved.

SOIL AND HYDROLOGY

- **Soils of the site are well drained sands of fairly low fertility that are susceptible to wind erosion.**
- **Continuous cropping of potatoes have further decreased soil fertility, now corn is produced with the aid of chemical fertilizers.**
- **Rapid water infiltration through the sandy soils creates a risk of drinking water contamination.**
- **A fairly high water table contributes to the number of wetlands in low lying areas.**

Vegetation

Prior to European settlement, the area of Cambridge was often swept by fire which ran across the flat landscape consuming the dry vegetation on the sandy soils. A plant community called the Oak Barrens or Oak Savanna grew under these conditions. It was a relatively open community of scattered, short, bur oak trees above a herbaceous layer of wildflowers and grasses. Aspens and pin oaks grew in low thickets stunted by frequent burning. Where fire was halted by wetlands, oak woodlands matured. In the fire shadow created by the Rum River isolated oak forests developed.

People have significantly altered the vegetation since that time. First logging, then agriculture have reduced the size of the oak savanna to isolated patches ringing lakes and wetlands. With the absence of fire, oak savannas have grown into oak woodlands. Many of the wetlands have been ditched and drained for agriculture. Those wetlands left undrained are threatened by invasive plant species, like reed canary grass and hybrid cattail, which displace native species. This results in lowered biodiversity and compromised wildlife habitat. Due to these forces, what exists today is an agricultural landscape with isolated islands of woodlands and wetlands. Isolated natural areas are susceptible to many types of damage.

The potential for reconnecting these vegetative patches along lakes and marshes is an exciting challenge for planners and developers that are interested in insuring environmental quality and providing quality of life.

Large flowered penstemon, a native wildflower, thrives on the dry, sandy soil of Cambridge.

Wildlife

Local diversity of wildlife species has been reduced by alteration of the landscape. Elk and bison once roamed the area and flocks of passenger pigeons once darkened the sky. Today waterfowl and shorebirds visit wetlands and lakes, and a variety of wildlife species take shelter in the forests along the Rum River. The creation of connections between the Rum River and the lakes and wetlands and associated woodlands to the east, would greatly benefit wildlife populations because a continuous canopy of trees allows for greater nesting and cover opportunities for song birds. Nest predation is most common in small groups of trees where nests are easily spotted. Uninterrupted cover, be it trees, shrubs or herbaceous plants in forest or wetland situation, allows for the movement of small mammals, reptiles and plants that need to search out new food sources and expand populations in order to survive.

Species that are found in the area that would benefit from habitat connection and expansion include:

Birds: Mourning dove, Blue jay, Indigo bunting, Chipping sparrow, Song sparrow, Least bittern, Virginia rail, Black tern, Yellow-headed blackbird, Sedge wren, Canada goose, Mallard, Common yellowthroat.

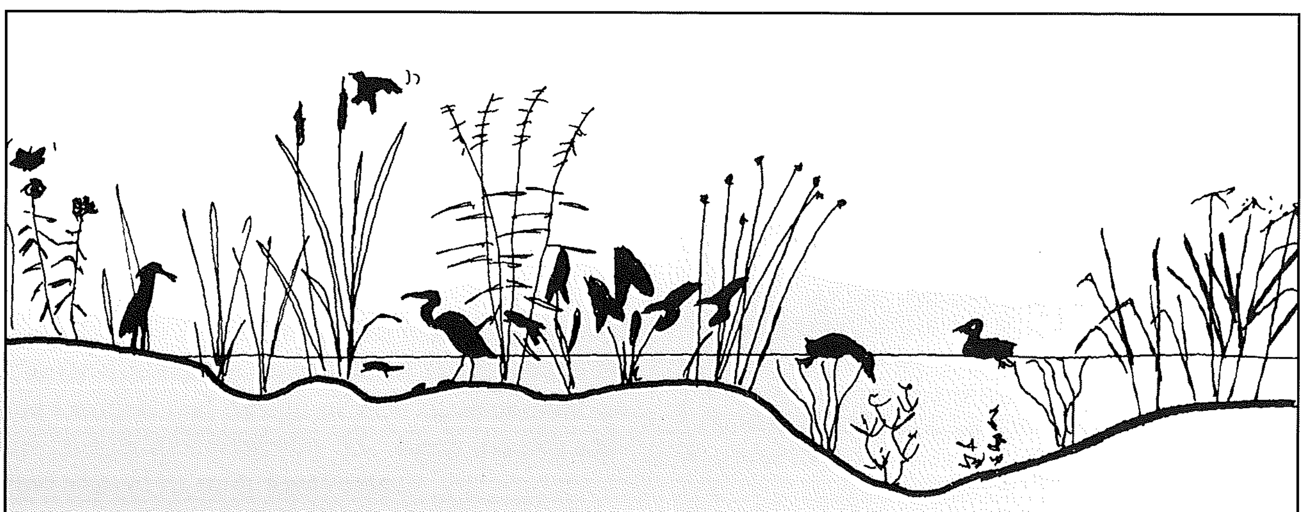
Reptiles and amphibians: American toad, Spring peeper, Chorus frog, Painted turtle, Tiger salamander, Prairie skink, Plains garter snake, *Blanding's turtle.

Mammals: Common muskrat, Common raccoon, Thirteen-lined ground squirrel, Fox squirrel, Plains pocket gopher, Red fox, White-tailed deer.

*The area contains habitat considered good by the Department of Natural Resources, non-game biologists for the state threatened Blanding's turtle.

VEGETATION AND WILDLIFE

- **Pre-European settlement vegetation was primarily oak openings; scattered, low thickets of pin oak and aspen stunted by fire and interspersed with prairie grasses and wildflowers.**
- **Today, with the lack of fire, the thickets have evolved into oak woodlots. Mostly displaced by agriculture they now surround lakes and marshes which form islands of vegetation in a sea of crop land.**
- **Many species of wildlife still exist in the area, but wildlife habitat would be enhanced and different species accommodated by creating vegetative connections between local lakes, marshes and the Rum River.**



Waterfowl and shorebirds visit area wetlands.

What to Learn from the Site

This site presents particular opportunities to demonstrate how development can be balanced with nature in a biologically rich and hydrologically sensitive landscape. Design for development must take care to protect wetlands, connected upland, lake, and stream ecosystems, and groundwater. In typical development processes, natural wetlands are often used for storm water storage, reducing their ecological quality. Design must prevent excessive storm water loading into wetlands and prevent urban pollution from reaching the water table. Protection of water quality in this project can be a valuable demonstration for other communities on the Anoka sand plain, where similar hydrological issues exist.

The site lies inside the Ecological Corridor formed around the beautiful chain of lakes and wetlands. Within the corridor, landscape structure can be enhanced by containing development to appropriate areas and designing development to include native plant communities. Southern Cambridge can demonstrate how wetland ecological corridors create a system of focal amenties and impart a truly natural character to development, and also demonstrate how wetland ecological corridors make a conduit for movement of plants, animals, and water to larger riparian systems like the Rum River.

OPPORTUNITIES OF THE SITE

- **Enhance habitat connections and biodiversity within the ecological corridor,**
- **Demonstrate development that protects and enhances wetland and connected upand, stream and lake ecosystems,**
- **Demonstrate ground water protection in residential development,**
- **Demonstrate how a wetland can be an amenity to the neighborhood and city,**
- **Demonstrate how ecological corridors can shape urban growth,**
- **City sewer and water services are scheduled to be extended onto the site.**

LIMITATIONS OF THE SITE

- **The corridor connection from the site to the Rum River is severed by highway, railroad and city,**
- **The ground water is very highly susceptible to contamination from the land surface,**
- **Wetlands of the area are dominated by invasive plant species which limit biodiversity,**
- **Some development has already occurred in sensitive areas.**

The Cambridge Ecological Corridor Neighborhood

Community Directives for Design

The needs and desires of the community, community perceptions, and community involvement in the planning and design process all fundamentally affect the quality of design and planning projects. Community directives for design of the Cambridge Ecological Corridor Neighborhood were drawn from a series of meetings with city staff and elected officials and also from two parallel activities that complemented this project. First, the University of Minnesota Humphrey Institute Rural Economic Development Initiative supported a landscape architecture student's internship in the City Planning Department during 1996-7. From his weekly work with city staff, the intern brought extremely useful insights into community needs, desires, and perceptions. Second, during 1996-7 Minnesota Agricultural Experiment Station project #39-077 focused on case study areas within or adjacent to the Ecological Corridor (see Nassauer and Caddock 1997). As part of those case studies, analysis of local county and city planning documents and consultant studies helped to identify issues that could be addressed by this project in order to assist local planning.

Together these avenues suggested three important overarching needs that helped to generate critical community directives for design:

1. Build collaboration and consistency between city and county/township plans and policies for extension of municipal boundaries (annexation), extension of city services to nearby areas, and residential development beyond municipal boundaries.

2. Reinforce the vitality of the traditional core of Cambridge on the west side of Highway 65 by the location and design of new development on the east side of Highway 65. Keep the city unified around its traditional core.

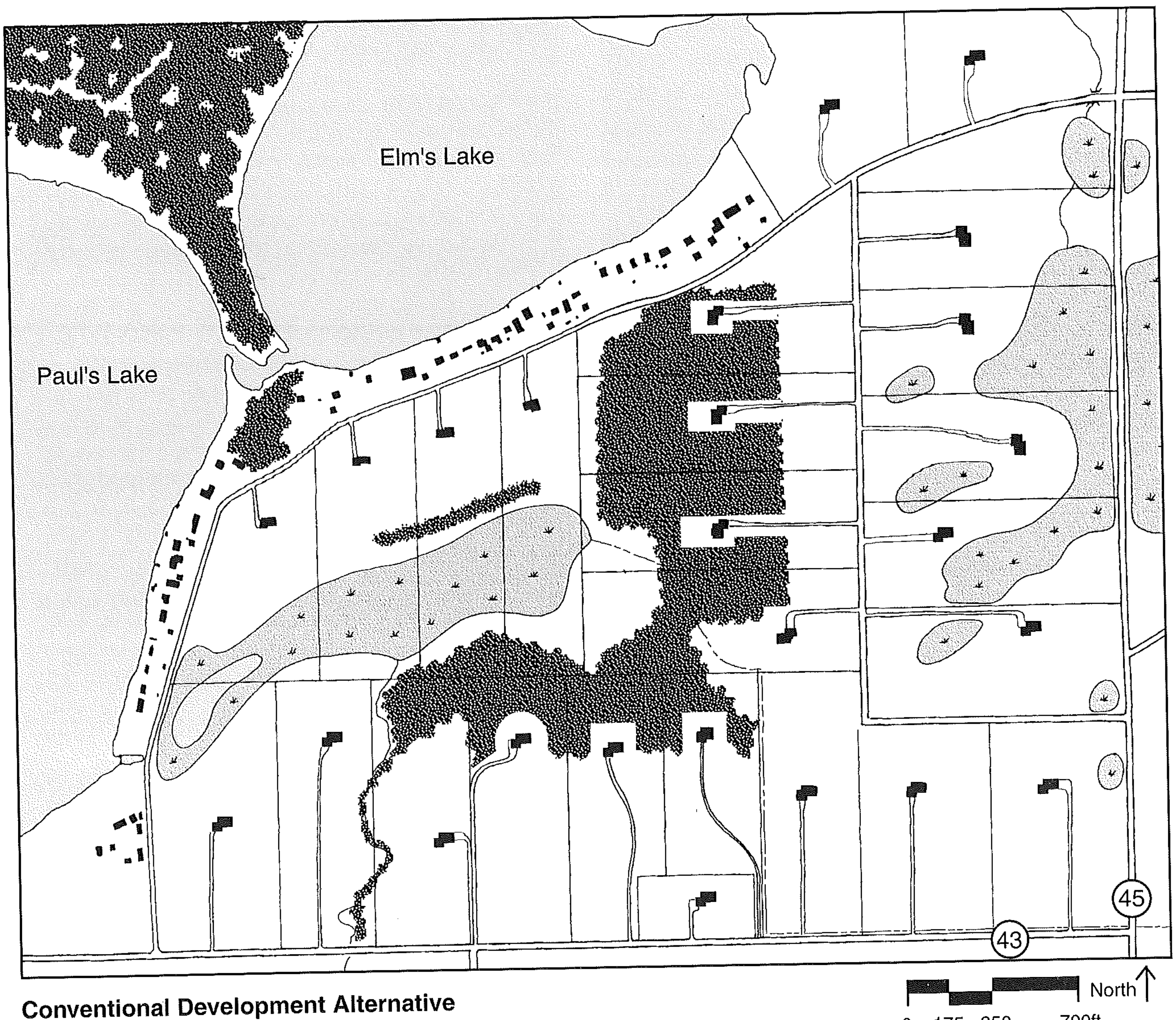
3. Use new development to strengthen the public recreation and open space system.

CRITICAL COMMUNITY DIRECTIVES

- **Increase the number of housing units in the city to serve a range of income and age groups - including housing that would be attractive to older people who are looking for lower maintenance housing.**
- **Locate new development where new sewer and water lines can replace existing septic systems and wells that are failing.**
- **Minimize public costs by concentrating new development so that it uses city infrastructure and public services efficiently.**
- **Locate new development within one mile of the existing municipal boundary as designated by the county comprehensive plan.**
- **Locate new development to be served by existing arterial streets, especially including the upgrade of County Road 45 to become the north-south arterial street on the new east side of the city.**
- **Locate new development to strengthen connections between the traditional core of the city on the west side of Highway 65 and the expanding area of commercial and residential development on the east side of Highway 65.**
- **Strengthen the recreational open space and trail system for the city.**
- **Help to manage growth by establishing a strong rationale for the functional edge of the city.**

These critical community directives for design would yield a development pattern very different from the pattern that typifies rural residential development in Isanti County and very different from the pattern that would be allowed by the current agricultural zoning: 4 dwelling units (served by private well and septic system) for every 40 acres of land. While local elected officials and staff reviewed several design alternatives for the Ecological Neighborhood Site, probably the most striking alternative to the design presented in this report is the pattern that would result from applying the existing zoning ordinance to future residential development, shown below. This is a pattern that undermines public amenity, biodiversity, and water quality. It produces no additional land or trails to be enjoyed by all citizens, it fragments woodlands and wetlands, it exposes existing lakes, streams, and wetlands to pollution from adjacent lawns and roads, it relies on individual homeowners to maintain costly septic systems and wells in a location that is very sensitive to aquifer contamination. And it is a pattern that has high public service costs.

Equally important, this pattern does not preserve a landscape that can be economically used for agriculture. A parallel project (Minnesota Agricultural Experiment Station #39-077 Nassauer and Caddock 1996,1997) illustrates some alternatives for more effective long-term agricultural land use.



Conventional Development Alternative

Ten Acre lots with septic systems and wells. Gross Density =.18 DU/Acre, Net Density =.23 DU/Acre

The Cambridge Ecological Corridor Neighborhood

Design Plan

The Ecological Corridor Neighborhood was designed to demonstrate that development may be appropriate in some locations as part of a larger strategy to protect ecologically valuable areas. The neighborhood was also designed to show how ecologically sensitive areas can provide a strong rationale for establishing boundaries for growth.

Watersheds, groundwater flows, and habitat connections combine to objectively define the ecological corridor. Within the corridor, development may occur where 1) development will not fragment a habitat connection, 2) the city plans to extend sewer and water in order to efficiently use existing capacity, and 3) the county and township plans, consistent with soil productivity, do not designate the area for long-term agriculture.

Within the Ecological Corridor, development should not only avoid fragmentation, contamination from private sewer systems, and conversion of productive agricultural land. In the appropriate location, development also can enhance the ecological health of the landscape. As described in the points outlined on this page, development can contribute to water quality, biodiversity, and cultural sustainability.

HOW DEVELOPMENT CAN ENHANCE ECOLOGICAL HEALTH

Water Quality
- **Replace failing septic systems with city sewer that protects groundwater and aquifers.**

Biodiversity
- **Buffer native ecosystems from pollution: from lawns, off-site agricultural fields, and roads.**
- **Integrate new, small scale ecological features within developed areas to contribute to the function of larger ecosystems.**
- **Restore ecosystems, like lakeshore vegetation and riparian vegetation, that had been removed in previous land uses, and connect them to wetland and woodland ecosystems.**
- **Remove barriers that currently fragment native ecosystems like wetlands.**
- **Extend the boundaries of ecosystems to include a more complete range of ecological functions and to connect with other ecosystems.**

Cultural Sustainablitiy
- **Establish a range of public and private land ownership types that will make the stewardship of ecosystem health culturally sustainable.**

Critical Site Issues

Site analysis continued throughout the design process. While many of the site analysis issues identified early in the process were critical directives for defining the Ecological Corridor, city infrastructure issues (identified as Community Directives for Design), led to the selection of the site that best demonstrates how to develop within the Ecological Corridor, shown on the opposite page.

City Infrastructure

The 306 acre site is located at the northeast corner of the intersection of County Road 45, the primary north-south arterial street on the east side of Cambridge, and County Road 43. County Road 43 is southernmost of three controlled crossings of Highway 65 in the City of Cambridge, and it is identified as the southern edge of planned city sewer extension (SEH 1995, ibid.) in east Cambridge.

The plan for city sewer extension meets an important water quality need. Existing lake home development on the site includes failing septic systems on very small lots. Some of these homes are in poor repair. In addition, older lake homes to the west, between the site and the existing edge of city sewer services, also have inadequate septic systems.

CRITICAL SITE DIRECTIVES

- **Use existing and planned infrastructure.**
- **Enhance the amenity character of planned infrastructure construction.**
- **Demonstrate how infrastructure design can minimize conflicts between agriculture and residential development.**
- **Prevent water pollution from agriculture or residential land uses.**
- **Protect and enhance biodiversity.**
- **Avoid causing fragmentation and heal existing fragmentation of habitat connections.**
- **Build long-term stewardship by using innovative land ownership patterns.**

Design of County Road 45 as the primary arterial for new east Cambridge gives the city an important opportunity to construct a public signature amenity - a road that is appropriate to and communicates the natural beauty of the ecological corridor. The connection from County Road 45 back west to the traditional core of Cambridge across Highway 65, can be completed by the Design of County Road 43. Agriculture will continue on the south side of this city arterial. The arterial road design can emphasize the beauty of rural landscapes and also minimize conflicts between agriculture and residential land uses.

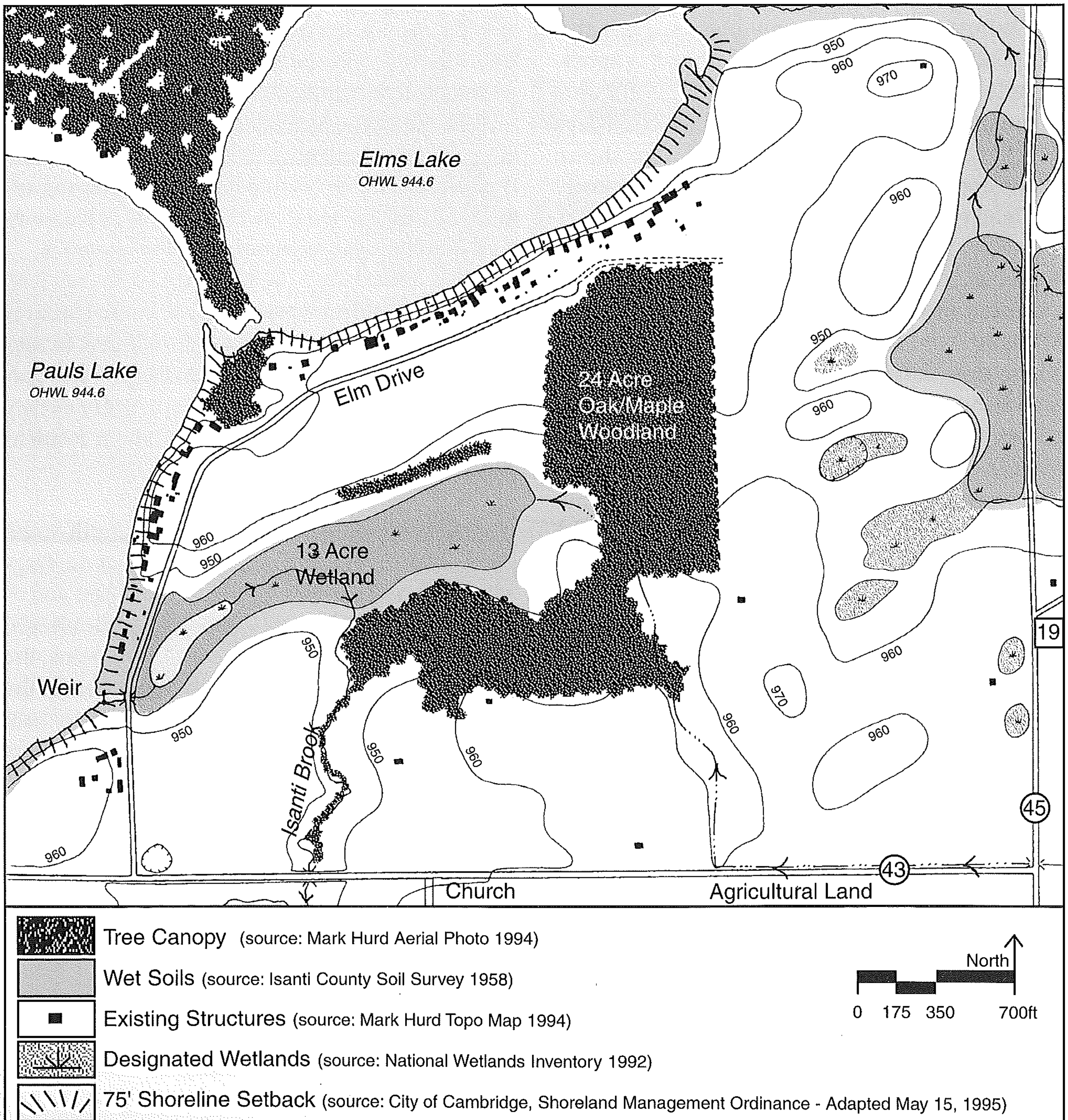
A Diversity of Ecosystems

The site includes an excellent example of potential habitat connections among: the lakeshore of Paul's Lake and Elms Lake, a state designated 13-acre wetland adjacent to a 24-acre patch of woodland that includes mature oak trees, and the chain of lakes outlet into Isanti Brook. The wetland is also fed by a ditch that drains agricultural fields to the southeast. Many smaller wetlands and former wetlands on wet soils also run across the site.

Both County Road 45 and Elm Drive fragment wetlands in the current development pattern. Elm Drive severs a potentially important connection between the wetland and Paul's lake. Run-off from agricultural fields has little buffer before it flows into the large wetland from the southeast. The new development pattern can eliminate fragmentation and increase buffering from upstream pollution.

While the lakes and large wetland on the site are protected by state law, the small wetlands, stream corridor, and woodland are subject to private development. A city ordinance based on a state model prohibits development within 75' of the lake. To maximize the effect of the existing protections, the design concept illustrates a range of private ownership types that would help to protect all the important ecosystems on the development site. (see page 31).

Protecting a diversity of native ecosystems types on the site would enhance its habitat potential for plant and animal species. A stronger connection between the wetland and the Paul's Lake, at the outlet of the chain of lakes would make an important link for fish, amphibians, and water fowl to move between wetland and lake environments. Reengineering the weir connection at this juncture should be investigated.



Critical Site Issues

The Cambridge Ecological Corridor Neighborhood

Features of the Design Plan

The design plan shows how appropriately located development and innovative land ownership can enhance stewardship of valuable ecological areas. The ecological corridor analysis combined with city infrastructure and county plans suggest that the Ecological Corridor Neighborhood is appropriately located. Its location meets all the criteria summarized in the Critical Site Directives on page 24. Several characteristics of the design shown on the opposite page, illustrate how development and land ownership can enhance stewardship.

A Dense, Economical Infrastructure Pattern Oriented to Amenities

698 homes are located on 241 developable acres on the site. A range of housing types from multiple family housing to more costly high amenity homes are included in the design plan. Development is compactly located around the main arterial street, a parkway linking new southeast Cambridge to the traditional core of the city on the west and the new commercial area on the northeast. Consequently, the layout of city sewer and water extension can be relatively economical. Future services, like school buses and emergency services, will also find this pattern accessible and efficient. Each of these home sites is oriented to enjoy the amenity characteristics of wetlands, woodlands, stream corridor, or parkway. The most popular landscape amenity, lakeshore, has been converted to a public park use for all citizens, shown in the map on page 31. The proposed recreational trail system and Cambridge city parkway bicycle path intersect and run through the site as well.(page 33)

Ecological Value Added

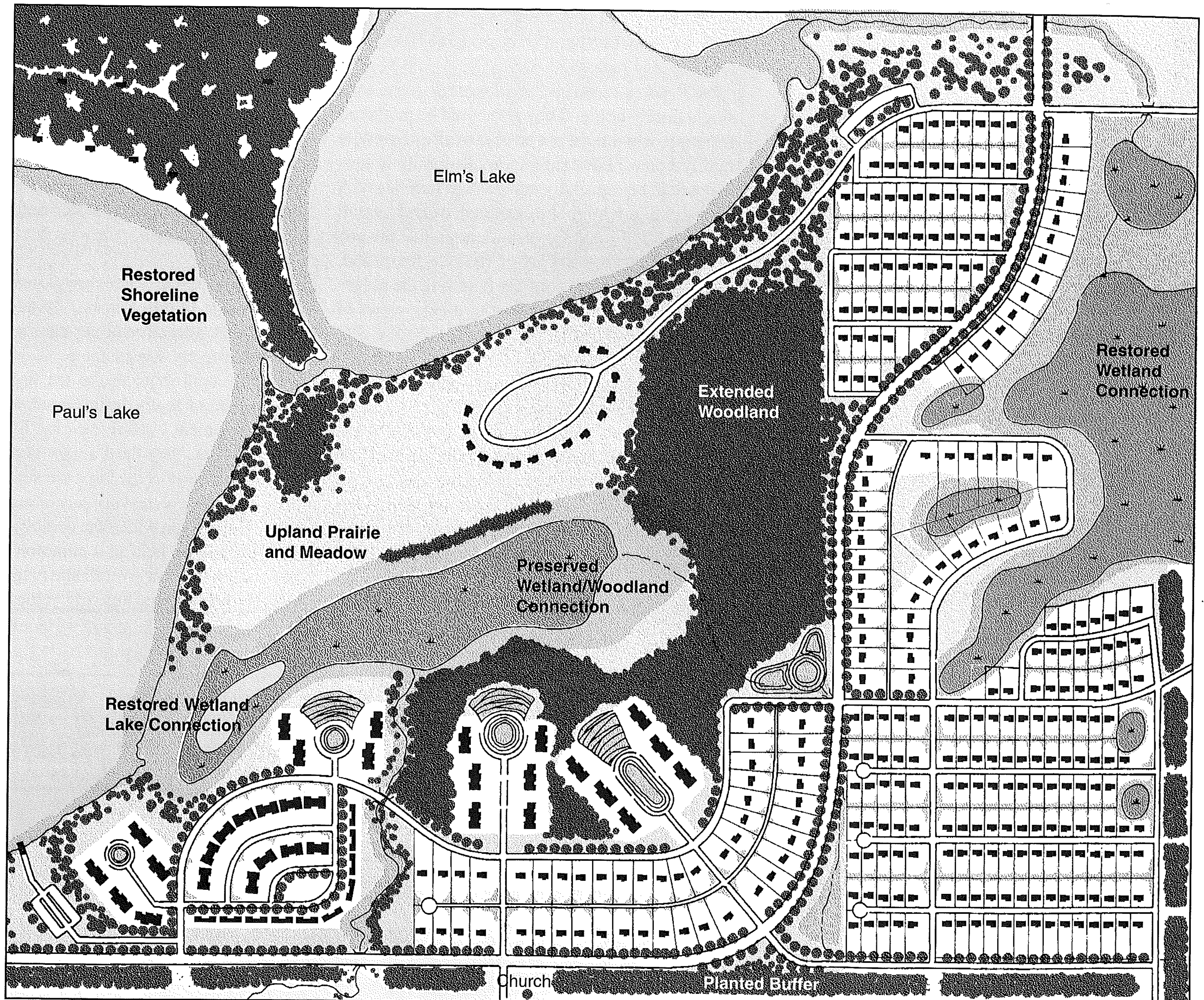
Development of the Ecological Corridor Neighborhood would actually add value to the native ecosystems that exist on the site now. Water quality in lakes, streams, and wetlands would be improved by removing failing septic systems and providing city sewer and water. Existing small lots along the shoreline contribute to surface water pollution of the lake. They are replaced by a public, restored shoreline that keeps the lake clean and adds to biodiversity. Sediment and pollutants in run-off from nearby agricultural fields and from streets and lawns are cleaned in storm water run-off wetlands upstream of existing natural wetlands. Throughout the development, storm water run-off wetlands are located to be beautiful focal elements that introduce the adjacent native ecosystems.

Much of the storm water from residential areas is infiltrated and cleaned even before it gets to run-off wetlands. Garden swales and rain water gardens clean water and enhance biodiversity as they knit together individual lots throughout residential areas.

Equally important, the new primary north-south arterial street has been realigned to heal the fragmentation of the large wetland to the east and to contribute to the parkway character of the arterial street. To further connect native ecosystems, the existing woodland has been extended to meet the wetland on the south side, and on the east, to meet the new parkway as a focal element on the curve.

The ecological value added to the carefully designed development will be in:

1. Cleaner lakes and streams and cleaner groundwater.
2. Better habitat for a greater diversity of plants and animals.
3. Involving people in ecological health by making native ecosystems a beautiful part of their everyday experience.

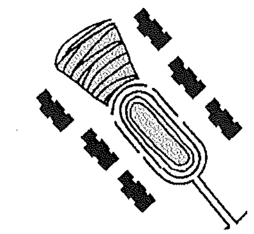


Ecological Corridor Neighborhood Design Plan

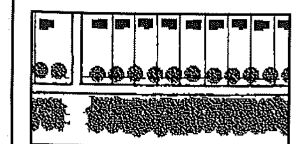
North

0 125 250 500ft

Key Component Features of Design

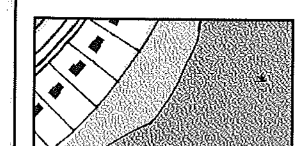


Storm Water Runoff Wetland



Agriculture Buffer

City Parkway



Wetland Buffer

Rain Water Gardens and Garden Swales

Housing Structures

- 15 Unit Homes
- 4 Unit Homes
- 2 Unit Homes
- Single Unit Homes

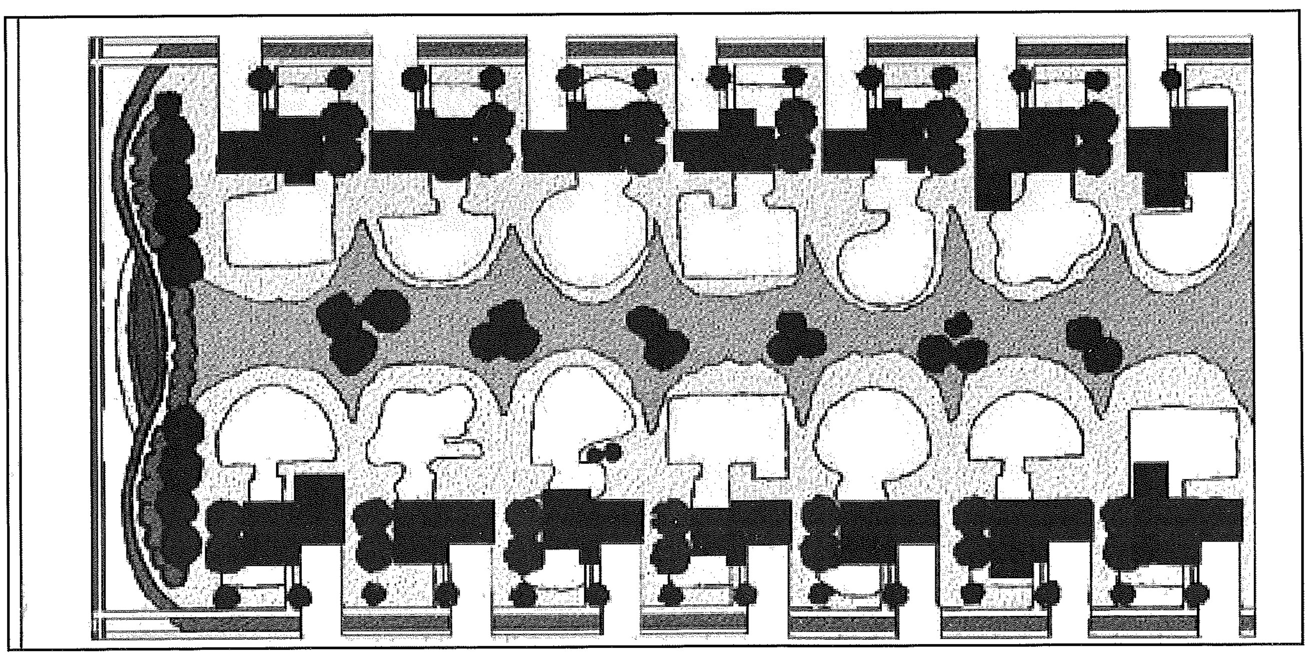
Home Site Types

A wide variety of home site types is included within the neighborhood, seen on the map on the next page. Multi-family homes have high amenity and easy access locations. They could be marketed to people who no longer want to maintain a single family home. They also could be marketed to people who might not be able to afford a single family home. For example, multi-family homes that would be especially attractive to families with young children might be clustered around a small neighborhood park away from traffic, like the one in the southwestern part of the neighborhood. Nearly all of the multi-family homes in the neighborhood are sited to have extraordinary views of the lake or large wetland.

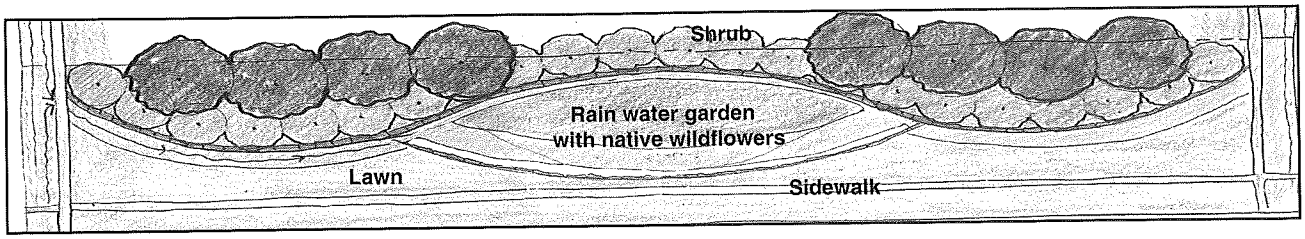
Parkway homes have the largest traditional single family lots in the neighborhood (80' x 150'). They have large front yards facing out onto the parkway. Their garages and utility service access from alleyways in the rear, enhancing the stately tree-lined parkway character of these home sites. Garden swales that infiltrate storm water run along the alleys and the parkway edge of these homesites.

Garden homes are set within a traditional urban grid pattern adjacent to amenity woodlands or wetlands or agricultural views. They have the most efficient density of the single family homes, with lots that are 60' x 110'. Each block of garden homes is connected along the backyard spine by a garden swale blooming with wildflowers and infiltrating storm water. At the end of each block, a rain water garden makes a neighborly space for walkers to pause and a blooming garden to collect and infiltrate storm water before it reaches the natural wetland.

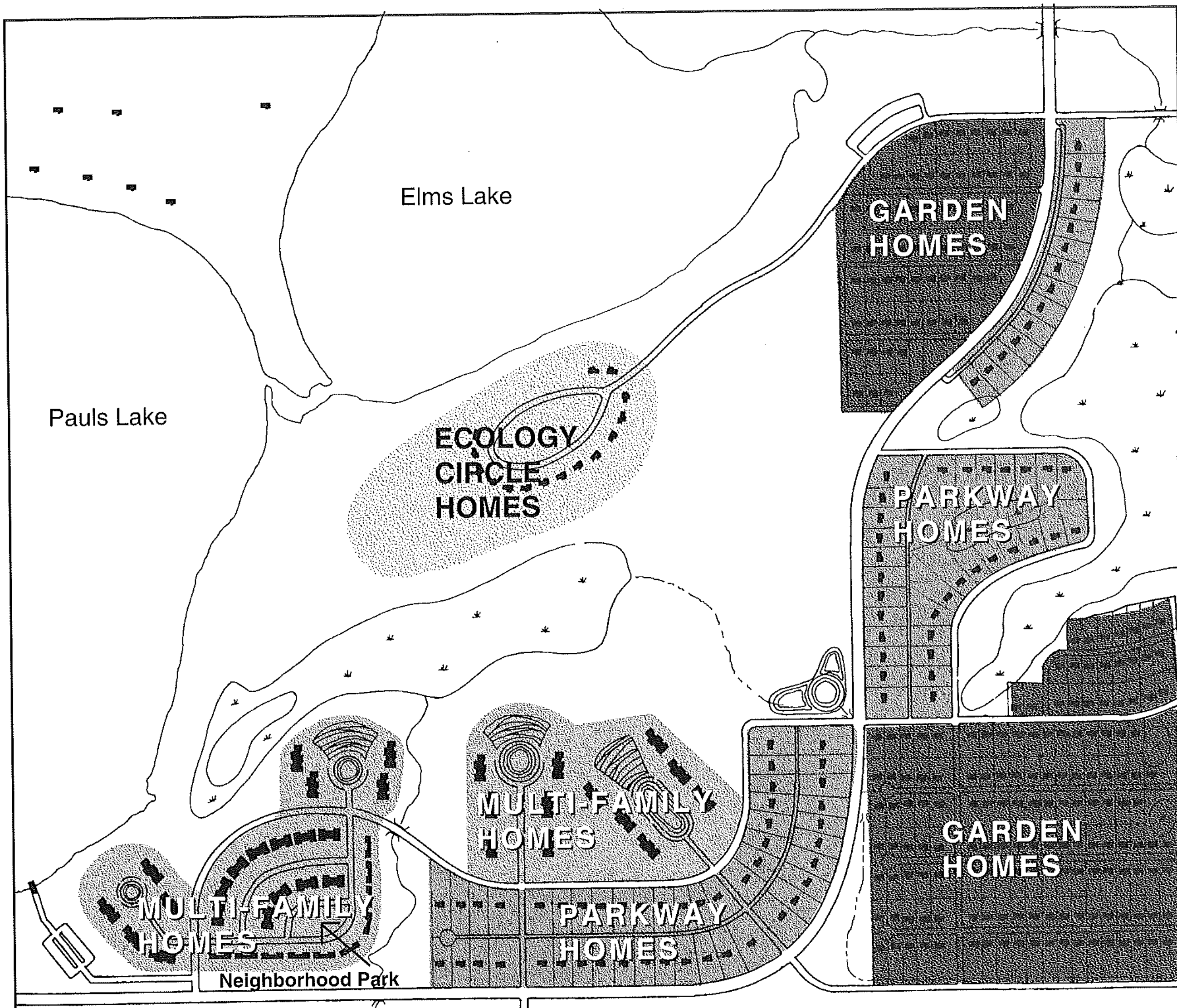
The ecology circle homes are planned to be more costly single family homes. In addition to providing very attractive home sites to buyers who can afford costly homes, the ecology circle homes positively contribute to the tax base of the city and provide a fiscally desirable substitute for large lot development outside the city. Like the multi-family homes, they have a very high amenity location with views of the large wetland and the lake. They have the greatest privacy of any of the home sites. The land on which the ecology circle homes are built will be held in a common homeowners association to allow overall site planning to maximize the privacy and amenity value of each home in a way that uses land and services efficiently.



Plan view of a neighborhood block with backyard garden swale and rain water garden at the end of the block.



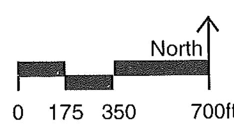
Rain water garden view from above.



Gross Density (whole neignborhood) = 2.28 DU per Acre
Net Density (whole neighborhood excluding wetlands and existing woodlands) = 2.90 DU per Acre

Net Density of Individual Home Site Types:

- Multi-Family = 10.5 DU per Acre
- Garden Homes = 3.7 DU per Acre
- Parkway Homes = 2.0 DU per Acre
- Ecology Circle Homes = .75 DU per Acre



Home Site Types

Building Ecological Stewardship into Land Ownership

One of the policy and management dilemmas for ecologically rich landscapes is the question of who will care for native ecosystems and restorations over time. In the context of settled landscapes, few native ecosystems are sufficiently enormous to exhibit the inherent balance and resilience that kept them vital before settlement by Europeans. The public has a limited interest and a limited capability to pay for the care of all potentially valuable ecosystems, many of which seem small and insignificant. Yet local people benefit and global ecological health is enhanced by small areas that contribute to cumulative gains in biodiversity and water quality. Who will care for ecosystems that do not fall into the public realm? Building ecological stewardship into land ownership provides part of the answer.

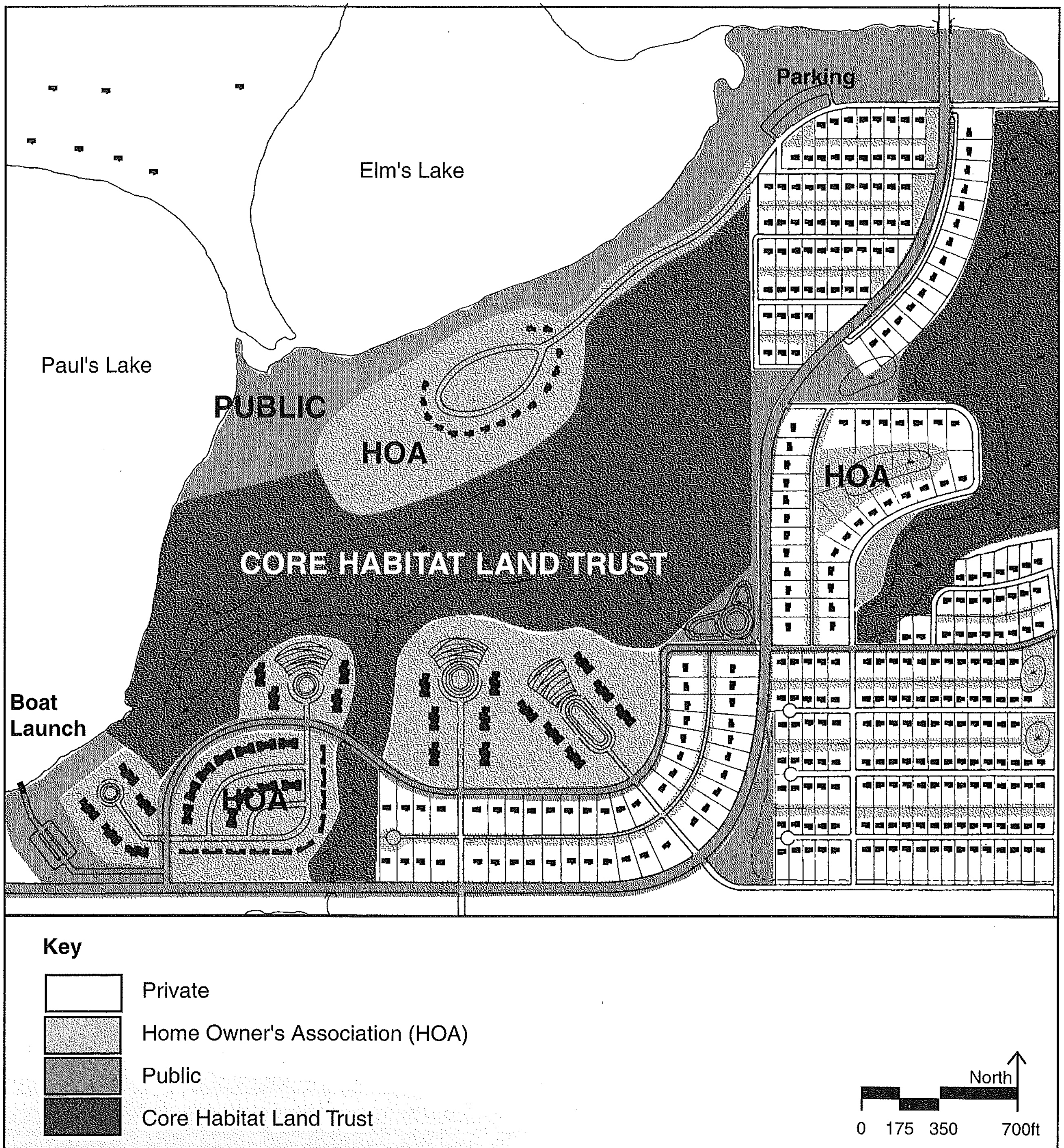
Forms of land ownership that place legal obligations on land owners, or convey some ecological ownership rights and responsibilities to other parties, can help to assure stewardship over the long term. The map on the opposite page shows that most of the single family homes in the Ecological Corridor Neighborhood have individual lots that are owned fee simple. However, the individual homeowners would be members of a homeowners association that would maintain the ecological capacity of the garden swale and rain water garden network that runs along the backyard or alley spine of each block.

Owners of both the multi-family homes and the Ecology Circle homes would also belong to homeowners associations. These home types would be privately owned houses and intimate private gardens, with the larger surroundings being homeowners association land maintained by the association. This strategy will allow all homeowners to enjoy maximum aesthetic benefit from these beautiful sites, it will assure wise stewardship of ecosystems on the sites, and it will minimize homeowners' responsibilities to care for large yards.

The enduring value of the focal amenity and core habitat of the entire neighborhood would be assured because development rights on the land would be owned by a land trust. This trust could be one established when the development plat is with its own board of directors or it could be part of a larger, known land trust, like the Minnesota Land Trust. Ownership of remaining rights in the core habitat could be shared by the homeowners associations or remaining rights could be held by the land trust as well. In either case, the trust would assure the long term ecological stewardship of the land without additional public cost. It would also assure that the privacy of the core habitat area for wildlife and as a focal amenity would be maintained. For detailed descriptions of innovative land ownership types, see Allman, L. 1996, Land Protection Options.

Finally, the 30 acres of the 306 acre site that have the highest amenity value have been dedicated to public use. A boat launch defines the southwest boundary of the neighborhood. It is an amenity for the neighborhood, and it is convenient for all citizens, located immediately off the arterial parkway. The main public access to the lakeshore park is from the north-south arterial parkway. Here citizens can park their cars and walk along the entire shore of Elms Lake to Paul's Lake for picnicking and contemplative recreation. The recreational trail system is also linked to the new public park, a good place to pause for picnics and restrooms.(see map on page 33)

A land trust should provide stewardship of core habitat wetlands.



Innovative Land Ownership Types

The Cambridge Ecological Corridor Neighborhood

Site Context Issues and Opportunities

An Integral Part of the Ecological Corridor

This project is a demonstration of how to design development in response to its ecological context. The chain of lakes watershed and habitat connections were used to define an Ecological Corridor overlay district,(page 10) in which future development is designed to enhance flows within the connected hydrological and biological system. The entire watershed is important to surface and groundwater quality. The Cambridge Ecological Corridor Neighborhood shows how the combination of city sanitary sewer and water with overland storm water drainage systems can protect water quality. Related projects (Nassauer, et al., 1997) have demonstrated the economic advantages of an overland storm water drainage approach.

The neighborhood design also connects different native ecosystem types in ecosystem complexes that compliment essential habitat characteristics, and the suggested land ownership types indicate how stewardship of those ecosystems could be culturally sustainable. Finally, the compact development pattern of the neighborhood has larger implications for protecting agriculture in the entire Ecological Corridor. If development is accommodated in relatively dense patterns and designed to have high natural amenity value, the demand to expand development to expensive, ecologically questionable large lots is reduced.

If the development characteristics that are exemplified in the Ecological Corridor Neighborhood are adopted throughout sewered areas of the Ecological Corridor, and if residential development that is not part of agriculture is effectively discouraged where no city sewer services exist, the Ecological Corridor can become an amenity that rationally defines the southern edge of growth in Cambridge. Ecologically, the corridor will be broad enough to support hydrological and biological flows to the Rum River. It will connect ecosystem complexes into a more complete network of habitat connections. And overlay performance standards (like the Design Principles on pages 34-35) that extend beyond areas of the corridor that are habitat connections, will actually enhance overall ecological quality of the region.

Development, Edges, and Boundaries in the Ecological Corridor

The Ecological Corridor Neighborhood exemplifies several characteristics of boundaries and edges that could be used throughout the Corridor. Most importantly, development was sited within an area proposed for city sewer and annexation. The area will be annexed within the municipal boundary and sewered to improve water quality, which has suffered from failing septic systems, and to create the critical mass of development required to economically support a new sewer main.

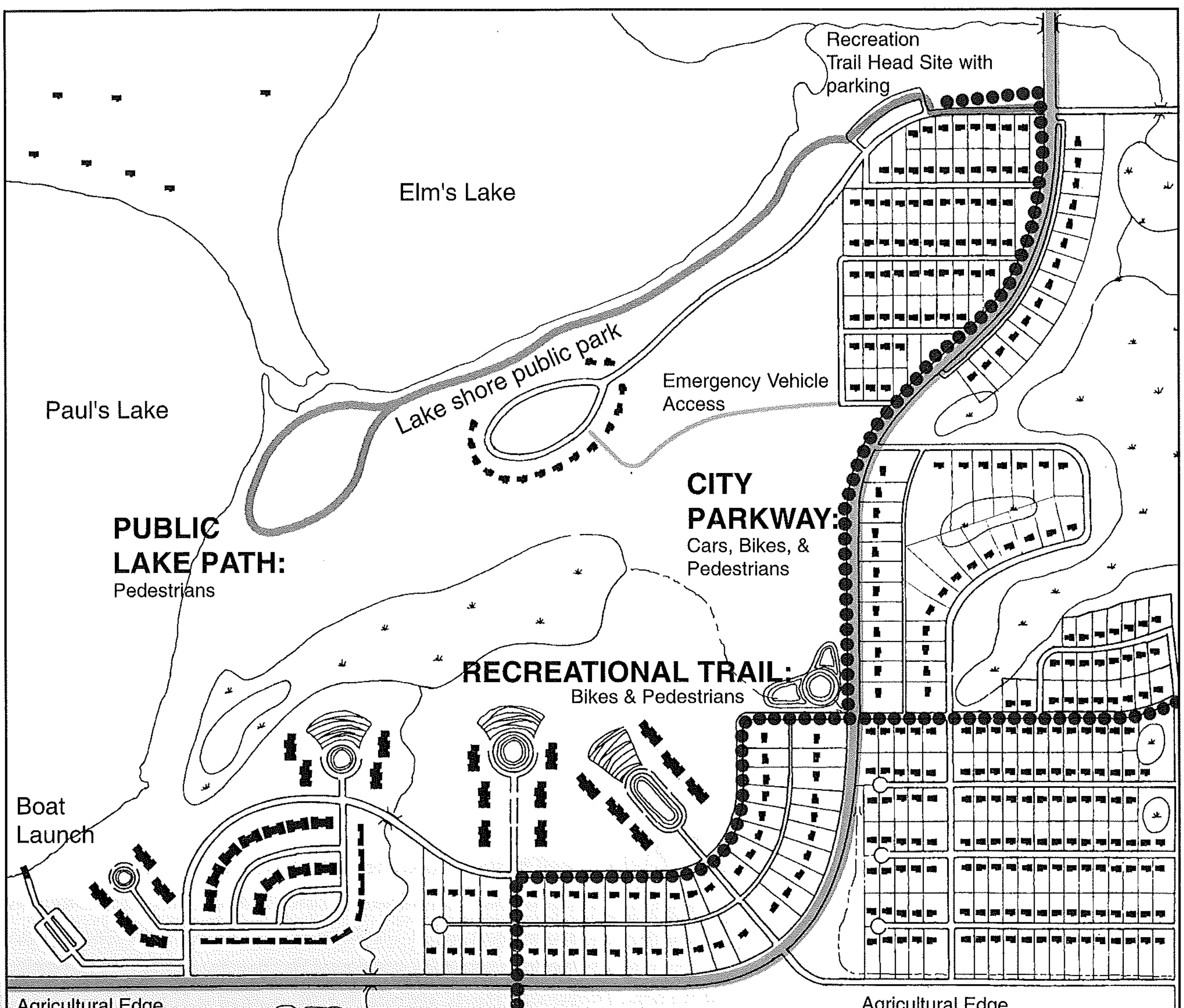
The neighborhood also was sited to efficiently use the planned city infrastructure of a new north-south arterial in the location of County Road 45. Development stays relatively close to this main road to keep city service and infrastructure costs down. The neighborhood was also sited to create vital connections between traditional west Cambridge and new east Cambridge at the three critical controlled crossings of Highway 65, as shown on page13.

The edge between agriculture and residential development was carefully designed within the parkway section and along the south and east boundary of the neighborhood. Key views out to the beautiful rural landscape and cultural landmarks, like the church, are emphasized, along an edge that generally creates a buffer to wind and sound. In addition, none of the roads in the new neighborhood exit on to township or rural roads that would be used for moving agricultural equipment. This careful design of edge between agriculture and residential development minimizes conflicts between the two land uses.

Finally, the Ecological Corridor creates a bold edge of the city, a landscape of lakes, wetlands, and woodlands, where natural amenities dominate. As citizens become accustomed to enjoying the natural amenity qualities of the Ecological Corridor, public perception will support the Corridor as an edge to growth.

An Integral Part of the City of Cambridge

Much of the success of the design lies in the way it contributes to the overall character and function of the city - as an amenity, as a part of the parkway system, and as the site of a lakeshore public park and recreational trail head site, shown on the map below. Every new development in the city should be evaluated for the particular design characteristics that contribute to the overall pattern of the city. Compared with standard local governments' requirements for development to allocate a given proportion of land to open space, this standard emphasizes qualitative public benefits. It allows the city to accomplish recreational, ecological, and infrastructure goals with one strategically designed public land pattern.



Cambridge Community Circulation System

The Cambridge Ecological Corridor Neighborhood

Design Principles

Overall, the design principles that are demonstrated by the Cambridge Ecological Corridor Neighborhood grow from six overarching ideas that will be useful to other cities as they consider all the ways that wetland construction or restoration can contribute to their quality of life.

Overarching Design Principles

1. Design overland storm water drainage systems to function as networks that operate from very small scales to very large scales. Urban wetland amenities should begin at the smallest scale - the individual home or commercial site - to treat storm water and also build biodiversity. Small scale rain water gardens should be connected into a hierarchical system of garden swales, urban run-off wetlands, and biodiversity wetlands to make an overall landscape structure of amenity and biodiversity. An overland storm water drainage network will not only infiltrate or detain storm water economically, it also can build a network of biodiversity, and legible urban amenity form.

2. Build biodiversity within and around wetlands. Plant wetlands with native plants, and have a planting and maintenance plan to control invasion by exotic plants like reed canary grass and lythrum. Minimize rapid changes in wetland water level (bounce) by minimizing the amount of storm water that flows directly into wetlands. Grade new or restored wetlands to have long, shallow slopes along the edge. Each of these objectives will help to build biodiversity by encouraging all the wetland vegetation zones to be restored.

3. Connect wetlands to other native vegetation ecosystems: woodlands, stream corridors, lakes, or other wetlands. The larger and wider the continuous area of native vegetation ecosystems, the greater its habitat potential. The more different types of native ecosystems that are connected, the greater its habitat potential.

4. Connect wetland open spaces to park and circulation systems throughout the city, and to appropriate cultural institutions: schools, homeowners associations, citizens groups. Wetlands that are part of the daily experience and part of larger infrastructure or cultural systems have more people who understand their value and care about their stewardship.

5. Involve people in the development process and in the care of local landscapes. The more people are involved in development decisions, the more they will contribute to, understand, and support innovations in local design and planning. The more people are involved in nature, the better they will understand, enjoy and take care of the landscape.

6. Design restored and constructed wetlands and other indigenous ecosystems so that they are recognizable amenties. The appearance of new open spaces and of new garden types that knit together ecological neighborhoods should meet cultural expectations for attractive landscapes. While people may not immediately recognize wetlands, prairies or understory habitat as beautiful, design that pairs these ecosystems with recognizable characteristics of well-cared for residential or park landscapes can help people appreciate the beauty of native ecosystems. In amenity open space, wetlands should be edged with landscape elements that show that people are taking care of the landscape (cues to care), or wetlands should be placed in a larger, traditionally picturesque landscape setting.

Ecological Corridors and Growth Management: Design Principles

Some of the design principles demonstrated in Cambridge are particularly germane to situations where metropolitan growth is approaching areas that could be defined as ecological corridors. They are summarized on this page.

The conceptual definition of the ecological corridor can lead to mapping the corridor as an overlay for planning performance standards, as shown on pages 6 - 10. These standards should protect flows of species and water and across the corridor and they should build greater ecological health when new development occurs.

Within the Corridor, growth should be supported as part of a rational, economic extension of city services. New development should be dense, comparable to the traditional core of the city, and it should be strongly connected to the existing city. Where city services will not be extended, residential growth should be strongly discouraged - to reduce public costs, protect ecological health, and protect agriculture.

To help keep public costs in check and to allow for sensitive ecosystems to be managed primarily for their ecological health with minimum human disturbance, a range of land ownership types should be used within the development. New public land should include landscape types that are widely appreciated for their beauty and relatively less vulnerable to human disturbance, for example, lakeshore. Innovative forms of land ownership, like home owners associations or land trusts, may be more appropriate for other open space types, ecosystems where human disturbance or wide public use is not desirable.

New development should include small areas to hold rain water and build biodiversity.

CAMBRIDGE DESIGN PRINCIPLES

- **Ecological corridors should encompass habitat connections and watersheds.**
- **New development should not fragment water or species flows across the corridor.**
- **New development should bring ecological quality to a finer scale: building small areas to hold rain water and build biodiversity within development.**
- **New municipal boundaries should correspond with areas that must be sewered for ecological and economic reasons.**
- **New development patterns should have a net density similar to that of the traditional core of Cambridge.**
- **New development should include public land in the areas of highest perceived amenity and where ecological function is not vulnerable to human disturbance.**
- **Long term cultural sustainability of ecosystems in the development should be supported by innovative land ownership types.**

Conclusion

This project, the Cambridge Ecological Corridor Neighborhood, is part of a set of five projects, each of which demonstrate a different aspect of the potential for wetlands to be community amenities. The Bassett Creek project in Minneapolis shows how the existing fabric of the city can be retrofit to include a new wetland park. The Cambridge project shows how ecological patterns can help to define the edge of urban growth. The Crystal project shows how existing industrial sites can be renewed to make a new, more complete mix of land uses and contribute to ecological patterns. The Marshall project shows how a hierarchy of areas - from the size of a home garden to the size of a city park - can contribute to managing storm water across a watershed. The North St. Paul project shows how constructed wetlands and their surroundings can teach us about urban ecology, even where nature is not pristine.

Each of these projects is informed by the overarching design principles above, and many evolved from common opportunities in the engineering and planning processes of local governments. For example, each project involves a wetland that is part of an overland storm water drainage system. Wetland location in all of the projects is determined largely by the pattern of soils and underlying bedrock geology. Each of the projects showed how ecological patterns suggest solutions to decisive questions about the future land use pattern of the city: how to grow, how to plan for economic redevelopment, how prevent to flooding. Finally, each of the projects is designed to have an effect on its surrounding neighborhood, as a model or as a source of ideas.

While wetlands are the focus of these five projects, other native ecosystems also can be amenities that build habitat and contribute to immediate human health. Constructing or restoring wetlands should be augmented by protecting, restoring, or constructing woodlands, savanna, prairies, and stream corridors. Together these ecosystems inject amenity and biodiversity into the fabric of urban life. We cannot know the full range of values that wetlands and other native ecosystems produce, but we can know that retaining the full spectrum of environments indigenous to our region by making native ecosystems part of settled landscapes simply makes conservative good sense. Designing wetlands to help define the amenity character of our towns and cities is one way to make ecological health part of a regular habit for planning and development.

The Cambridge project shows how wetlands can help to define the edge of development.

Further Reading

Allman, Laurie. 1996. **Land Protection Options**. The Nature Conservancy, Mpls, MN.

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Nassauer, Joan Iverson and Andrew Caddock. 1996. **Cottage Grove and Denmark Township Case Studies**, MN Agricultural Experiment Station #39-077, Department of Landscape Architecture, University of Minnesota.

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Nassauer, Joan Iverson, Brady Halverson, and Steven Roos. 1997. **Bringing Garden Amenities into your Neighborhood as Infrastructure for Ecological Quality: A Guidebook for Cities and Citizens.** City of Maplewood.