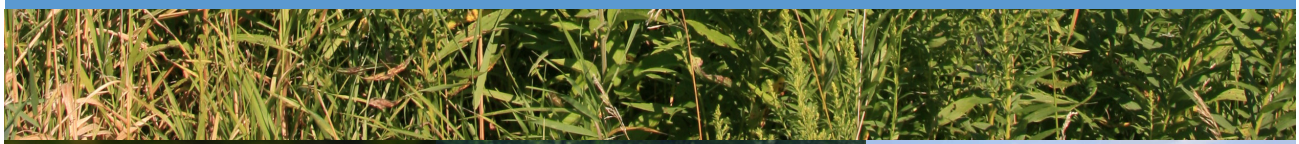
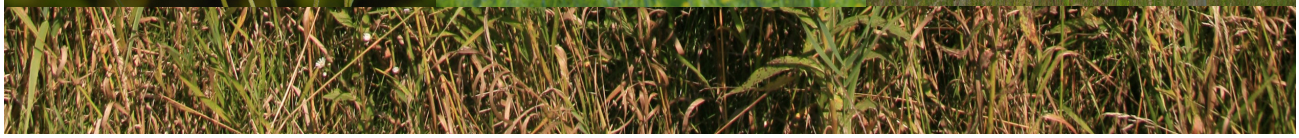
Natural Resources





Introduction

The City of Fitchburg geography was formed by the last of the glaciers, with the Milton Moraine generally dividing the City from southeast to northwest. The City has land in two of the major drainage basins of Dane County, each with two main watersheds within Fitchburg. A few large areas of sediment deposits form areas of little topographic variation, which provide good farmland, but also lead to pockets of closed basins. City water supply is dependant upon public wells into the deep Mount Simon and Eau Claire sandstones, making recharge of groundwater important to the long term viability of the community's water supply. Woodlands are prevalent in parts of the City, particularly in areas of steeper topography.

Physical Setting

Physiography of Southern Wisconsin

Soils

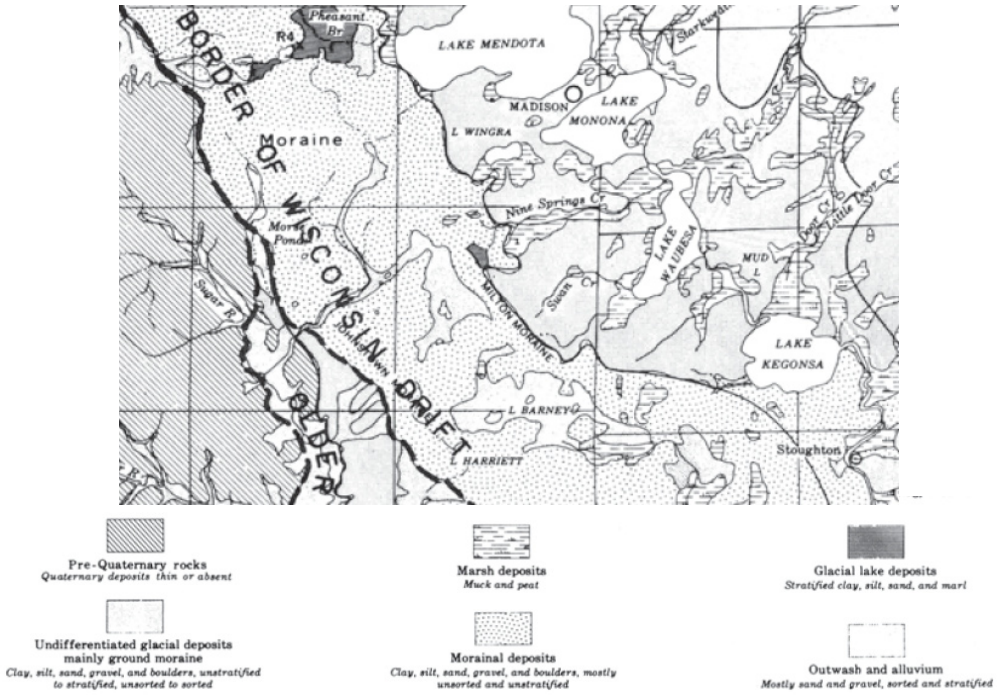
The last Continental Glacier covered most of Wisconsin until 12,000 to 15,000 years ago. Fitchburg is between two distinct physical landscapes, the glaciated and driftless (unglaciated) areas. The glaciated area was covered with layers of sand, clay, and gravel left by the series of glacial advances. The driftless area shows no evidence of glaciers. The soils are typically well-drained. According to the Town of Fitchburg Development Plan (1978), "as a result of this location, the most dominant glacial features are two terminal moraines deposited by the Green Bay Lobe of the Continental Glacier."

Terminal moraines formed at the outer edge of the maximum extent of a glacier or glacial lobe when the ice melted and deposited the debris carried by the glacier. Two terminal moraines can be found within the City of Fitchburg. The first extends across the southwest part of the City. It is part of the Johnstown moraine which marks the furthest extent of the Wisconsin glacier. The second runs in a northwest to southeast line through central Fitchburg and known as the Milton Moraine (Figure 5 - 1). The driftless area is just beyond Fitchburg's southwest corner.

In addition to moraines, drumlins were created when moving glaciers hit an object resulting in a slow down of the glacier. At this location, additional deposition of debris occurred forming elongated, teardrop-shaped hills. They often occur in groups, and are common in and near the northeast quarter of the City. Another glacial feature found within Fitchburg is Lake Barney. It was formed by either a landlocked drift basin or a melted iceberg chip held in by a topographical depression.

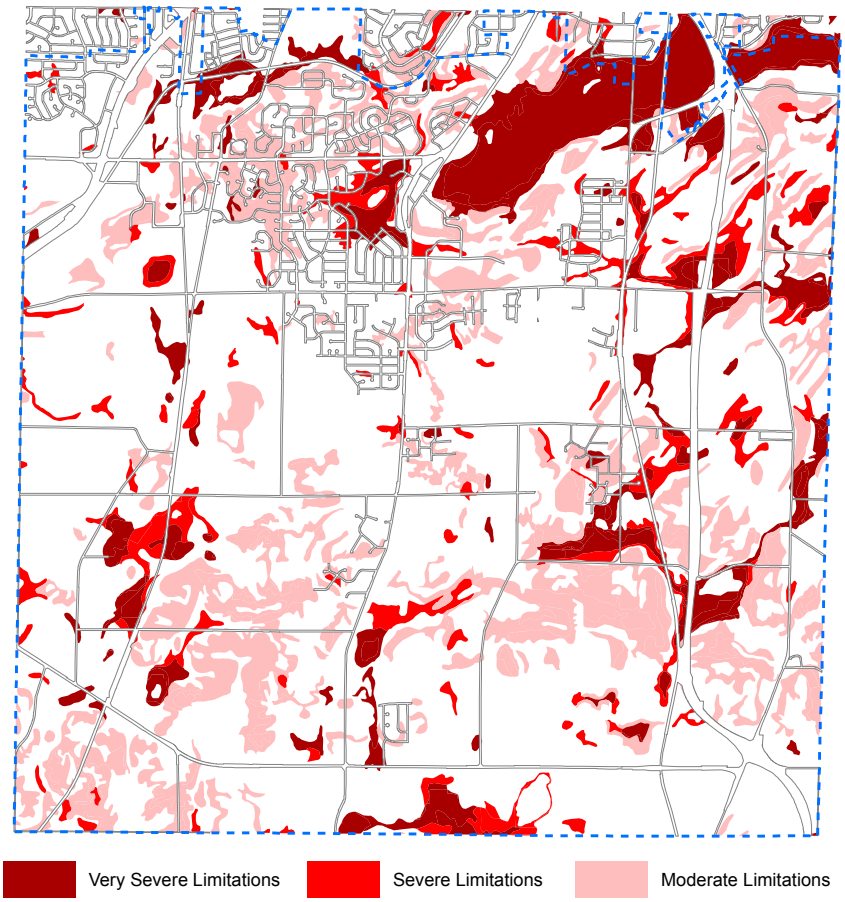
The City of Fitchburg contains primarily silt loam soils, including Dresden, Dodge, St. Charles Grays, Plano, and Ringwood. These soils tend to be prime agricultural soils. Additionally, these soils are generally suitable for development and have two- to- six percent slopes.

Figure 5 - 1: Physiographic Area of Central Soils



Source: 2004 Dane County Water Plan Summary. USGS Water Supply Paper 1779 - U (plat 2) 1965
Modified from Alden (1918)

Figure 5 - 2: Soils Development Limitations



Source: City of Fitchburg & Dane County LIO, 2006

Soils in steep slope areas include Kidder, Griswold, Military, and Whalan loams; McHenry, Rockton, Sogn, and Dunbarton silt loams; and Rodman sandy loam. Soil types with 6 to 12% slopes have moderate limitations to development, whereas soil types with 12 to 20% slopes have severe limitations to development due to high erodibility.

Soils within the floodplains of Nine Springs, Swan or Murphy's Creek include alluvial land, marsh, mucks (Houghton and Palms), silty clay loams (Wacousta and Sable) and silt loams (Colwood, Orion, and Radford). All of these soil types have very severe limitations to development due to high compressibility, very low bearing capacity, a seasonal high water table, and occasional flooding (Figure 5 - 2). Development is usually unsuitable in areas of very severe limitations. Elburn, Marshan, Troxel, and Virgin silt loams are located near the creeks and along the City's major drainage ways. These soil types also have severe limitations to development due to occasional flooding. In areas with severe limitations due to occasional flooding or steep slopes, proper development can occur only if the design of the development takes into account these site limitations.

Climate

The climate in Fitchburg is humid continental typical of mid-continent climates in the middle latitudes. The prevailing weather and wind direction is from the west, and produces four distinct seasons, with the season distinction often marked by storms that accompany the changes in air mass. Average monthly temperatures vary from 16.7 degrees F in January to 71.4 degrees F in July. The average annual precipitation is 31 inches, with the six month period of May through October receiving 55% of the average annual precipitation. Thunderstorms are erratic and unreliable in producing moisture, but the likelihood of one inch of rain in a seven day period is greatest for the first, second and fourth weeks of June than at any other time of the year. Chances for a trace of rain or less are greatest in the second half of August than for any other time of summer. Snowfall seasonally averages 37 inches. Frost generally lasts from early December through early April, with an average maximum depth of 18—30 inches.

Geology and Mining

The City of Fitchburg has significant quarry activity in its north western quadrant. This quarry activity predominantly occurs in the Platteville dolomite layer, but some quarries also move into the sandstone layer below. Sand and gravel pits appear to have been mainly associated with land areas in the eastern portion of the City. Some former borrow pits are being filled with "clean" fill material. Most notable is the site west of CTH MM south of McCoy Road., a former borrow pit for US Highway 14 construction.

The Wingra quarry south of McKee, and the Hammersly quarry north of Lacy Road are both in their final stages of material removal and, with both in the urban service area, redevelopment can be expected. Payne and Dolan have quarry permits for land just north of Lacy Road that will last until 2018. The Fitchburg Mineral holdings south of Lacy Road may be an expansion of the current Hammersley quarry on the south side of Lacy Road.

Features and Resources

Air Resource

Outdoor air quality in the Madison area currently meets all National Ambient Air Quality Standards (NAAQS); however, ozone levels are just below these standards. Because emissions from transportation sources are important in the generation of ozone, the continuing increase in vehicle traffic may eventually result in ozone levels greater than the ozone standard. Indoor air quality is less easily monitored. Both indoor and outdoor air quality have been linked to asthma and other respiratory diseases. Increases in asthma and other respiratory diseases in the Madison area have been identified. While the direct cause of this increase is unclear, efforts to maintain and improve air quality are needed. The Wisconsin Department of Natural Resources is the agency responsible for monitoring and responding to outdoor air complaints. Nationally, the Center for Enterprise Development (CFED) has indicated that Wisconsin ranks 25th of the 50 states in greenhouse gas emissions; by comparison Wisconsin in 2000 ranked 20th in population of the 50 states.

Health Impact

- Scientific research continues to identify indoor and outdoor air contaminants as contributing causes of asthma, other respiratory illnesses, and cardiovascular disease.

- The incidence of asthma in young people continues to rise as shown by the data collected by Madison Metropolitan School District (MMSD). Similar increases are also observed in many other communities around the country.

- Older adults are also at greater risk for experiencing health effects due to poor air quality. Hospitalization data for Dane County shows an increasing trend for older adults to be hospitalized for chronic obstructive pulmonary disease which includes bronchitis and asthma. Most of these hospitalizations result from smoking-related diseases.

Environmental Impact

- Madison area outdoor air quality currently meets all National Ambient Air Quality Standards (NAAQS), including the new, long-term ozone standard.

- Ozone levels continue to remain steady, just below both the short- and long-term ozone standards.

Environmental Impact Sources

- Traffic densities on highway and arterial roads in Madison continue to increase and are a significant source of air pollutants, including airborne particulates.

- Outdoor air monitoring of common air pollutants in the area is performed by the DNR. Measurement of hazardous air pollutants is not performed consistently.

- Regional surface ozone continues to be a threat to Madison's air quality. Transportation sources of ozone precursors continue to increase as Madison and the surrounding communities grow.

Energy Resources

Data on local level energy use is difficult to obtain or to develop, and therefore, national and statewide data, and variable actors (such as cost) are being used to provide information on energy use. The statewide data, of course, makes the assumption that Dane County, and Fitchburg in particular, are representative of the statewide average. Most important, however, may not so much be the specific data of usage, but the trends that are provided by the data. The popular press has been providing information on how increases in energy costs reduce disposable income and therefore affect the ability of the population to purchase non-essential goods or services.

According to Corporation for Enterprise Development's (CFED) economic report card for the state of Wisconsin (www.cfed.org), Wisconsin ranked 25th out of the 50 states in energy costs and in greenhouse gas emissions, and 26th in per capita energy consumption. However, the group indicated that the state ranked 16th in renewable energy and eighth in change in renewable energy. While there were some high rankings, the state ranked low, 44 out of 50 states, in changes in energy costs.

Oil Consumption

U.S. Energy consumption continues to increase as does the amount of foreign oil imported to meet the increasing demand (Figure 5 - 3). In his 2006 State of the Union address, President George W. Bush noted that the United States "is addicted to oil".

Figure 5 - 3: US Oil Consumption (in 1,000 barrels per day)

Year	Total US Petroleum Use	% of Use Imported
1975	16,322	37.1
1980	17,506	39.5
1990	16,988	47.5
2000	19,701	58.2
2004	20,731	63.4
2006	20,687	66.3
2007	20,698	64.9

Source: Wisconsin Department of Administration - Division on Energy, 2008.

Gas and Electric

In addition, the monthly Madison Gas and Electric electricity bill for an average residential user has increased over 39% in the past five years (January 2002 – January 2007). Increases for residential electricity users in the Wisconsin Power and Light service territory have been similar (Figure 5 - 4). In comparison, the Consumer Price Index has increased approximately 14% from 2002 to 2007.

Figure 5 - 4: Average Monthly Electric Bill

Date	MGE	WPL
January 2001	$53.16	$44.05
January 2002	$56.16	$47.09
January 2005	$71.03	$58.19
January 2006	$81.03	$66.46
January 2007	$78.25	$64.11

Source: Public Service Commission of Wisconsin, 2007.

Natural Gas

Natural gas prices have increased over 106% from 1990 to 2005 in Wisconsin (Figure 5 - 5).

Figure 5 - 5: Natural Gas Prices

Year	$ per million Btu
1990	5.69
2000	7.49
2004	10.09
2006	11.83
2007	12.28

Source: Wisconsin Department of Administration - Division on Energy, 2008.

Gasoline

Prices of gasoline reached record high levels above $4.00 per gallon for much of the state in the summer of 2008, but dropped below $2.00 in the winter of 2008 (Figure 5 - 6).

Figure 5 - 6: Gasoline Prices - Regular Unleaded

Year	Price/ gallon	Notes
1990	$1.139	Average annual price
2000	$1.532	Average annual price
2004	$1.901	Average annual price
2006	$2.626	Average annual price
2007	$2.866	Average annual price
2008	$3.29	Fitchburg daily price
2009	$1.92	Fitchburg daily price

Source: Wisconsin Department of Administration - Division on Energy, 2008 and MadisonGasPrices.com, 2009

Peter Tertzakian, a former geophysicist with Chevron Corporation, indicated in an interview with US News and World Report (February 13, 2006) that in regard to oil usage in the United States the "core issue is the way we live." He further noted that "the most problematic trend for oil consumption to emerge in the past 20 years has been the continued migration to the American suburbs. Twenty years ago, the

average American vehicle traveled 10,000 miles per year. Today, it travels 12,000 miles. That's a 20 percent increase, right there." The increase in the number of vehicles on the road and an increase in average vehicle-miles traveled creates an ever-increasing demand for oil and gasoline.

Energy costs continue to increase forming an upward trend. Construction of new power plants and transmission lines is expected to further add to electric costs, although greater reliability should result. Energy costs are increasing at a rate greater than inflation as a whole. As energy costs continue to well outpace the cost of goods as a whole, the concern is such costs will continue to drive inflation upward. The popular press has reported over the course of the past few years (2006 - 2008) the effects of energy cost increases and how they are affecting disposable income, which in turn affects the overall health of a spending based economy.

Wooded Areas

Forest land covers 15.7 million acres in Wisconsin and approximately 1,490 acres in Fitchburg. Private landowners of Wisconsin hold the largest portion of the woodland at 57 % or 9.7 million acres. Since over half of forest land is owned by private landowners, the Wisconsin Department of Natural Resources provides personalized services and administers a number of planning, property tax incentive and cost-sharing programs. Department foresters can help inventory, analyze, and evaluate the potentials of a sustainable forest.

The department offers several federal, state, and local cost share conservation programs in Wisconsin. While financial assistance to plan and implement forestry practices on private lands is never guaranteed, each year the federal government offers some incentive programs. The programs vary in eligibility requirements and the specific types of practices encouraged. Currently six programs are available to private landowners; they include the Wisconsin Forest Landowner Grant Program (WFLGP), Forest Health Stewardship Incentives Program (SIP), Conservation Reserve Program (CRP), Forest Landowner Enhancement Program (FLEP), Wildlife Habitat Incentives Program (WHIP), and Environmental Quality Incentives Program (EQIP).

Prairies

Prairies are grassland-dominated communities that occurred throughout the southern half of Wisconsin. Prairies consist of a vast number of specialized plants that interact with the soil, wildlife, insects, and each other. The organisms form a complex and diverse relationship. Unfortunately, these prairie habitats were nearly eradicated because their rich soils were valuable to farmers. Many of the distinct prairie species have been wiped out, due to agriculture and urbanization. They were maintained by periodic natural (or human-caused) fires that reduced encroaching woody vegetation. The few that remain are often restricted to linear strips along railroads where woody vegetation is periodically controlled. Prairie subtypes range from Wet Prairie to Dry Prairie, according to soil moisture content. "The prairies of Wisconsin include some of the most interesting though least widely known of any of our plant communities" (Curtis 1959).

Oak Savannahs

Savannah has a relatively narrow definition in the Midwest. It is generally used to describe an ecosystem that was historically part of a larger complex bordered by the prairies of the west and the deciduous forests of the east. There were a variety of plant community types that represented a continuum from prairies to forests. Savannahs were the communities in the middle of the continuum between the prairies of the west and the deciduous forests of the east; a plant community with scattered 'open-grown' oaks. In contrast to an oak forest, which has a closed canopy (approaching 100%); the savanna canopy ranges from about 10% to 50%.

In the 1800s, oak savannah once covered more than 5,000,000 acres in Wisconsin. Oak savannah was one of the most common vegetation types in southern Wisconsin and throughout the Midwest, today it is exceedingly rare. Researchers at the Wisconsin Department of Natural Resources (WDNR) estimate that only 0.01% of the original oak savannah still remains (WDNR, 1997). Probably the most common reason why the oak savannah has disappeared, other than conversion to agricultural use, is because of lack of fire. This is fire-controlled vegetation. The oaks themselves are fire-resistant, whereas weedy trees such as walnut, elm, maple, and ash are not. According to the U.S. Forest Service, as well as the Wisconsin Conservation Commission no uncontrolled fire should be allowed on any land in the state. However, the forests that were being cut were the northern coniferous forests, not the southern oaks. Although fire is a real danger in the forests of northern Wisconsin, little danger is present for the scattered southern oaks woods present in this area. Oaks do not suffer from the disastrous crown fires that rage through the coniferous forest. Fire in an oak wood is usually confined to the ground, to the leaf litter. Oak leaves are unusually susceptible to fire. When oak savannahs burn, weedy, woody vegetation such as prickly ash, buckthorn, and honeysuckle is killed, thus keeping the woods open. An open wood encourages the growth of grasses and flowering plants. Without the presence of fire, the ground vegetation would fill in and more competitive species and the oaks will be crowded out.

Wildlife

A variety of wildlife can be found within Wisconsin. According to the Wisconsin Department of Natural Resources (WDNR), 72 species of mammals are known from Wisconsin, including 69 native species; 408 species of birds are known from Wisconsin, including 400 native species; 35 species of reptiles and 19 species of amphibians native to Wisconsin; and 159 species of fish are known from Wisconsin, including 145 native species. For more specific information, the DNR has wildlife inventories available on various small game, big game, waterfowl, furbearers, and non-game species.

Hunting Regulations

City of Fitchburg
Firearms may be discharged for hunting purposes during lawful hunting seasons and within the provisions and rules of the Wisconsin Department of Natural Resources and with written permission of the land owner.

Wisconsin Department of Natural Resources (WDNR) Owned Land

The WDNR owns the Nevin Springs Fish and Wildlife area. Public hunting is allowed on this property. Regulations are those required by the state and a few additional regulations agreed upon by the WDNR and the City of Fitchburg. Types of hunting allowed for deer seasons are muzzle loaders and archery. Small game seasons allow shot guns with fine shot, muzzle loaders, archery, and falconry to be used.

U.S. Fish and Wildlife Owned Land

The U.S. Fish and Wildlife owns Waterfowl Production Areas (WPAs) which are purchased with proceeds from the sales of Federal Duck Stamps and are owned by the Federal government. WPAs are open to hunting, trapping, and fishing subject to all applicable Federal and State laws, except where posted with "Closed to Public Hunting" signs. Additional requirements include (but are not limited to): 1) blinds and tree stands must be removed daily, 2) firearms are permitted only while engaged in hunting during established open seasons with the appropriate hunting and firearm permits, 3) no motorized equipment, 4) no target shooting, 5) no placement or hunting over bait, and 6) nontoxic shot is required for all hunting - except for wild turkey.

Natural Areas

Additionally, the City of Fitchburg also has several stormwater facilities, natural and other areas available for public use. There are currently 22 natural areas and stormwater facilities, with approximately 175 acres of land. There is no set standard on how much natural area is needed by a population. Some of the other areas that are used by various City departments are open as public land. Some examples are City Hall/Community Center, Fitchburg Maintenance Facility, Goodland Park Road Lands, Gorman Wayside and surrounding land, and Fitchburg Safety Buildings.

Resource Conservation Commission

According to Chapter 1 of the Municipal Code, the Resource Conservation Commission shall recommend policy, enforcement, and information programs that will implement and carry out the findings and provisions of Section 14.06 - Solid Waste and Recycling of Chapter 14, Chapter 27 - Erosion Control and Stormwater Management, and Chapter 35 - Stormwater Utility of the Fitchburg Ordinances. The Resource Conservation Commission shall also recommend policy, enforcement, and information programs that serve to promote the general preservation and improvement of the environment, including but not limited to groundwater, stormwater, waste material, energy efficiency, and climate protection.

Other Government Agencies

Capital Area Regional Planning Commission

The Capital Area Regional Planning Commission (CARPC), formerly known as Dane County Regional Planning Commission, was formed through an intergovernmental agreement between Dane County and the County's local units of government. The CARPC is not a county agency, but an independent agency created by state statute and by agreement of Dane County communities. CARPC regulations in local government mainly come from its role in water quality.

Fitchburg deals with the CARPC in regard to environmental corridors, sanitary sewers, and urban service area extensions. Environmental corridors are continuous systems of open space in urban and urbanizing areas. They are used in community and regional plans to address the multiple concerns of drainage, water quality, recreation, open space, and wildlife habitat. Environmental corridors cannot be found outside Fitchburg's urban service area.

Dane County Human Services - Division of Public Health
The Dane County Division of Public Health is the official public health agency serving Dane County residents living outside the City of Madison. The mission of the Public Health Division is to: promote health, prevent disease and lessen the impact of illness in the community as a whole; prevent premature morbidity and mortality in the population at large; and promote and protect public health through environmental health and public health nursing activities.

Fitchburg deals mostly with the Groundwater Protection Program where the Environmental Health staff conducts on site evaluations of proposed on-site sanitary sewage systems and related soil analysis. Plans for the sewage system must be reviewed and approved by a county sanitarian prior to the issuance of a sanitary permit. Once a system is in place, a final inspection is conducted. The Division administers the Wisconsin Fund grant program, which provides eligible residents funds for replacing or repairing a failing septic system.

University of Wisconsin - Arboretum
The mission of the U.W. Arboretum is to conserve and restore Arboretum lands, advance restoration ecology and foster the land ethic. The Arboretum is composed of 1,260 acres which includes an extensive collection of restored ecological communities, including tallgrass prairies, savannas, several forest types and wetlands. It also contains 1,266 acres in outlying properties.

Wisconsin Department of Natural Resources (WDNR)
The WDNR is dedicated to the preservation, protection, effective management, and maintenance of Wisconsin's natural resources. It is responsible for implementing the laws of the state and, where applicable, the laws of the federal government that protect and enhance the natural resources of our state.

NHI Program

Wisconsin's Natural Heritage Inventory (NHI), established in 1985 by the Wisconsin Legislature, is maintained by the Wisconsin Department of Natural Resources' (WDNR) Bureau of Endangered Resources. The NHI program is responsible for maintaining data on the locations and status of rare species, natural communities, and natural features in Wisconsin. The Wisconsin NHI program is part of an international network of inventory programs that collect, process, and manage data on the occurrences of natural biological diversity using standard methodology. This network was established by The Nature Conservancy (TNC), and is currently coordinated by the Nature Serve. The network now includes natural heritage inventory programs in all 50 states, most provinces in Canada, and many countries in Central and South America.

Wisconsin's Natural Heritage Inventory program's three objectives are to: 1) collect information on occurrences of rare plants and animals, high-quality natural communities, and significant natural features in Wisconsin; standardize this information; 2) enter it into an electronic database and mark locations on base maps for the state; and 3) use this information to further the protection and management of rare species, natural communities, and natural features.

The elements tracked by the NHI program are compiled on a Working List of rare plants, animals, and natural communities. The Working List is dynamic, with species added and deleted as determined by NHI staff. Wisconsin's NHI program tracks the following element types: plant and animal species considered endangered or threatened by the U.S. Fish and Wildlife Service (USFWS) and/or the WDNR; plant and animal species considered by the USFWS and/or the WDNR as a species of special concern (a species whose numbers are thought to be low but has not yet been proven); natural communities as classified and described by the program ecologist and in John Curtis' Vegetation of Wisconsin; unique geological features and animal aggregation sites.

There exist two areas of statewide interest that could effect land use development decisions in Fitchburg. First is the 372 acres Waubesa Wetlands State Natural Area (SNA) at the southwestern edge of Lake Waubesa. This wetland complex contains sedge meadow, fen, and shrub-carr habitat. Nine Springs and its two inflowing creeks, Swan & Murphy, supply freshwater to the lake. The Nature Conservancy has established a 194 acre preserve adjacent to this area. This preserve is composed of the southern sedge meadow and a groundwater fed fen, which are two rare habitats. This area supports a northern pike spawning area, sandhill cranes, and is also home to the state threatened Blanding's Turtle (Mesbah & Kakuska 2007, p. 5).

The second area of statewide significance was noted by the WI DNR in 2006. The Wisconsin Land Legacy Report (WIDNR 2006) has proposed preservation of the Dunn-Rultand savannah and potholes located in the southern portion of the Town of Dunn and the northern portion of the Town of Rutland.

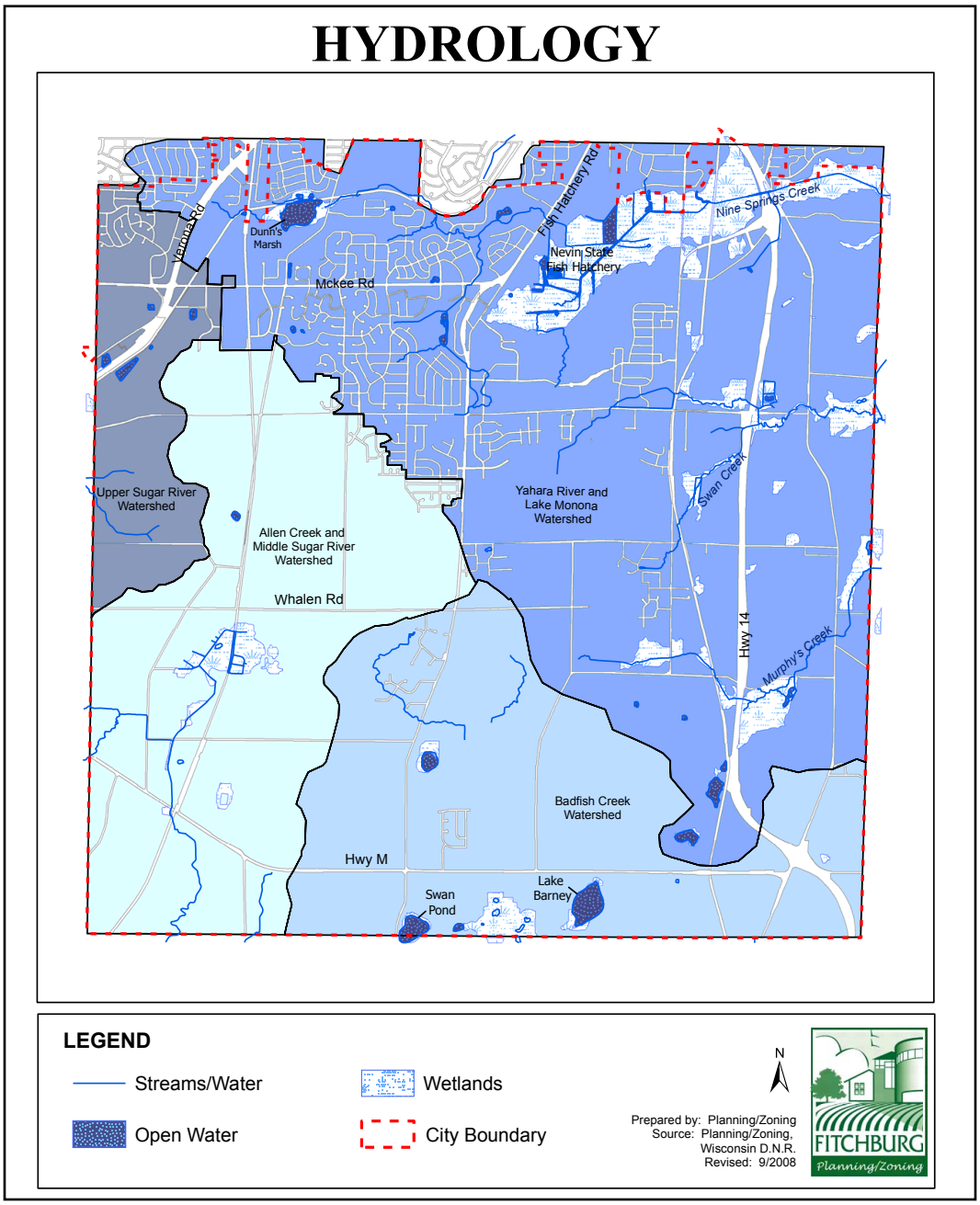
Information in the NHI is sensitive because rare species are very vulnerable to collection as well as destruction. Publication of exact locations may threaten their continued existence. It is for this reason that the NHI data are exempt from the Wisconsin Open Records Law. DNR does allow data sharing with outside groups, although a data license agreement is required and in most cases a user fee is charged. "Absence of evidence is not evidence of absence," nor does the presence of one element imply that other elements were surveyed for but not found. Despite these limitations, the NHI is the state's most comprehensive database on biodiversity and is widely used. More detailed information and recommendations for protection can be obtained from the DNR Bureau of Endangered Resources.

Hydrology

Watersheds

The City of Fitchburg is composed of four main watersheds (Figure 5 - 7). Each watershed has its own unique set of characteristics. A watershed can be defined as an interconnected area of land draining from surrounding ridgetops to a common point such as a lake or stream confluence with a neighboring watershed. The Yahara River/Lake Monona Watershed and the Badfish Creek Watershed are both part of the Lower Rock River basin. The Allen Creek--Middle Sugar River Watershed, and the Upper Sugar River Watershed are both part of the same larger watershed known as the Sugar—Pecatonica River basin. Also present within some of the watersheds

Figure 5 - 7



are areas of closed basins. Closed basins pose major issues with development, since there is no system of stream outfall for the storm water. Additionally, a few locations have topography so level that drainage is difficult.

Yahara River/Lake Monona Watershed

The Yahara River/Lake Monona watershed has a total of 85 square miles in its varied jurisdictions, and 70 % is considered urban. The water quality of its lakes and streams reflects this with corresponding urban runoff. Major goals of the watershed are to reduce heavy metal loading to surface waters; reduce suspended solids loads to reduce sedimentation in streams and lakes; and reduce phosphorus loading to Lake Monona and Waubesa.

Lake Monona drains a highly urbanized area and much of the shoreline has been developed. Water quality is affected by urban polluted runoff as well as the nutrient loading from Lake Mendota and its watershed. The lake has a diverse fishery of perch, panfish, largemouth bass, northern pike, walleye and muskellunge. However, a fish consumption advisory exists for certain fish in the lake.

Lake Waubesa is the shallowest of the Yahara Lakes. The watershed surrounding Lake Waubesa is a combination of urban, industrial, and rural lands. There are also extensive wetlands at the north and south ends of the lake. Water quality of the lake has improved since 1926 when Madison Metropolitan Sewer District (MMSD) diverted its treated wastewater effluent away from the lake. The lake still receives large nutrient loads primarily from upstream. Lake Waubesa supports a productive and diverse warm water fishery of muskellunge, northern pike, walleye, bass and panfish.

Streams

Murphy's Creek is a three-mile long spring-fed creek that is a tributary for Lake Waubesa at its southwestern shore. Flow in the creek is generally low. Water quality and habitat are limited in the upper reaches by low flow, as is the creek's fishery; the creek is considered a warm water forage fishery due to the low flows. Murphy's Creek does not have a stream water assessment rating.

Swan Creek is rated high on the 1990—2003 stream water assessment. The assessment is based on the Hilsenhoff Biotic Index (HBI) (RPC 2004). Swan Creek has been studied as part of the McGaw Neighborhood Plan. In its evaluation of the South Branch of Swan Creek in 2008, Montgomery Associates: Resource Solutions (MARS) found signs of a healthy headwater stream, even though there appeared to be high levels of siltation. The main section of Swan Creek has a warmer summer temperature than the South Branch, according to MARS, lately due to the detention basin for Swan Creek of Nine Springs Subdivision. This section also appears more degraded.

Murphy and Swan Creeks, both of which have their headwaters in Fitchburg, flow through a large 700 acre wetland complex at the southwestern edge of Lake Waubesa. This wetland includes fens, sedge meadows, shallow marsh and shrub carr all of which lie on a deep bed of peat (Town of Dunn, 1998). Between where

Murphy Creek and Swan Creek flow into Lake Waubesa is a short creek termed Deep Spring Creek, this stream is fed by a highly productive deep spring that is purported to be lined with at least seven different species of Purple Sulfur Bacteria (DeWitt et al, 2006). The great fen is located south of Deep Spring Creek, and is known to contain the rare and endangered calcareous fens. The Dane County Parks & Open Space Plan recommends expanding the Natural Resource Area for the South Waubesa Marsh along Swan Creek & Murphy's Creek to USH 14 (Dane County 2006, p. 53).

Nine Springs Creek is six miles long and intermittent until just east of Fish Hatchery Road where it picks up flow from the springs that give the stream its name. The creek empties into the Yahara River just above Upper Mud Lake. Portions of the stream have been ditched and straightened, and the stream runs through an urbanizing area. Channelization has increased summer water temperatures, reduced habitat, and increased sedimentation and excessive growth of aquatic plants. Urban storm water from the cities of Fitchburg and Madison also delivers pollutants to the creek. The creek could function as a warm water sport fishery. According to the WDNR, Nine Springs Creek is impaired water, with its major pollutants being sediment and phosphorus, and its specific impairments being dissolved oxygen levels and temperature. Nine Springs Creek is rated fair using the Hilsenhoff Biotic Index (HBI) (RPC 2004).

Swanson and Bahr (2004) found that the springs feeding Nine Springs Creek produce a consistent flow and concluded that this flow is due to a "layered aquifer system that includes high permeability features" (p.756). They also concluded that the "steady nature of spring flow would suggest that the effective aquifer, or flow path, length is rather long" (p. 754). Upon modeling the spring flow they noted that the actual flow conditions were only met in models with high permeability zones, however, the length of the flow paths is unknown. The principal groundwater concern is the decrease in groundwater levels due to urban pumping and increasing numbers of impervious surfaces that limit surface water infiltration. Both of these changes affect base flow and thus water temperature and quality. In addition, elevated chloride and sodium levels in surface water and groundwater exist due to winter road and street salting.

Wetlands

Dunn's Marsh is an isolated 30-acre, deep water marsh surrounded by a narrow strip of disturbed sedge meadow. Dunn's Marsh receives stormwater runoff from developed areas in Fitchburg and Madison to the north and west of the marsh, as well as from developed and developing areas in Fitchburg south of the marsh. A shorter time of concentration of stormwater runoff due to impervious surfaces in the watershed, has led to water quality and ecosystem degradation due to unnaturally high water levels and deposition of sediments and other pollutants. This wetland is a Class II wetland as reported by Mesbah and Kakuska, 2007, using a 1974 study by Bedford and Zimmerman.

Nine Springs Wetland and E-Way Complex are located in the Nine Springs valley, which extends from Lake Waubesa on the east to Dunn's Marsh on the west. This massive wetland complex is primarily Class III, but some significant Class II areas

are noted through the 1974 Bedford & Zimmerman study noted by Mesbah and Kakuska, 2007. A number of springs and seeps in the valley, for which the area is named, feed the wetlands. Springs found in the former lake beds, a situation present with Nine Springs Creek, are known to provide a consistent source of mineralized water needed to sustain threatened wetland plant communities (Swanson and Bahr, 2004). The extensive Nine Springs wetland complex has been altered over the years by attempts to drain portions and by channelization of the stream and some of its spring-fed tributaries. The most significant features of the wetland complex are the springs and groundwater seeps. Some of the original springs in the area no longer exist due to the effects of development. Further urbanization without consideration of the recharge areas for these springs could reduce spring flows. This could have a serious impact on WDNR's Nevin Fish Hatchery, which relies on spring flow in its operation.

Mesbah & Kakuska noted that, while the Bedford and Zimmerman study is dated, it represents the only systematic qualitative evaluation of wetlands in Dane County. The South Waubesa wetlands, which Swan and Murphy Creeks flow into, is a Class I wetland. These Class I wetlands approximate original eco-systems in the functioning and it is noted that "every effort should be made to protect them" (Mesbah & Kakuska, 2007). The Swan Creek wetland complex along Lacy Road is categorized primarily as Class III wetlands (Mesbah & Kakuska, 2007).

Badfish Creek Watershed

The Badfish Creek Watershed lies in south central Dane County and in the northwest corner of Rock County and encompasses 85.5 square miles. Wastewater from the City of Madison, treated by the Madison Metropolitan Sewerage District (MMSD), affects the watershed's water quantity and quality via discharge through an effluent ditch that joins the Oregon Branch of Badfish Creek.

Streams

Badfish Creek is formed by the confluence of its Oregon and Rutland Branches. Nearly 100 percent of the creek's entire length in Dane County has been ditched, straightened and widened. In contrast, in Rock County, the stream's natural morphology has been preserved. Badfish Creek, for at least part of its length, has impaired water polluted with PCB and a fish consumption advisory. Above the Oregon Branch the stream has limited aquatic life, and downstream of the Oregon Branch is a limited forage fishery. The portion of Badfish Creek rated on the stream assessment, which is the Oregon Branch and downstream, is rated fairly poor on the Hilsenhoff Biotic Index (HBI) (RPC 2004).

Wetlands

Lake Barney Wetlands Complex is a fresh meadow and marsh complex that stretches a little more than one mile south of Dane County Highway M. Polluted runoff, grazing and cultivation have degraded water quality and habitat over the years. Development in the area remains the greatest threat to the wetlands. Much of this wetland complex has a Class I rating (Mesbah & Kakuska, 2007).

Groundwater

This watershed has high susceptibility for groundwater contamination based on WDNR groundwater susceptibility mapping.

Rock River Coalition

The Rock River Basin contains two watersheds that affect Fitchburg, Yahara River/ Lake Monona and Badfish Creek Watersheds. The Rock River Coalition (RRC) is a basin-wide nonprofit volunteer organization founded in 1994. The mission of the RRC is to educate and provide opportunities for people of diverse interests to work together to improve the environmental, recreational, cultural and economic resources of the Rock River Basin.

Allen Creek and Middle Sugar River Watershed

The Allen Creek and Middle Sugar River watershed is in northeast Green County, northwest Rock County and south-central Dane County. The dominant land use in the watershed is agriculture, though some low intensity urban development exists in the upper reaches of the watershed. Municipal wastewater treatment plant discharges to surface water in the watershed from Belleville, Brooklyn and Evansville. Little is known about existing water quality of streams in this watershed.

An unnamed creek begins in section 20 of Fitchburg, just south of Whalen Road near the former Illinois Central Rail line (now Badger Trail). This unnamed creek flows to Lake Harriett in the Town of Oregon. Lake Harriett lacks an outfall, and water level would need to rise about ten feet before overflowing and water draining to either Story Creek to the south, and perhaps even to Lake Barney to the northeast.

Upper Sugar River Watershed

The Upper Sugar River Watershed lies in southwestern Dane County. The area around Verona and Madison is experiencing rapid urban development. This puts pressure on both surface water and groundwater resources in the watershed. A major water resource concern is the diversion of groundwater from the Sugar River basin to the Lower Rock River basin. Continued or increased groundwater diversions may lead to the reduction of base flow in the Sugar River and Badger Mill Creek, affecting water quality and in-stream habitats.

Goose Lake is a glacial lake located in the Town of Verona just west of Fitchrona Road and south of USH 151. This lake, which is referred to as Goose Pond in the Dane County Planning literature, has, according to observations by long time area residents, seen increases in water level and a reduction of water clarity, amphibians, and aquatic invertebrates and water fowl since the development levels in its basin occurred. The drainage basin for this body of water is 500 acres in size, with about 80 percent of the drainage area located in the City of Fitchburg. Higher water levels have affected the shoreline, and trees have been lost.

Streams

Badger Mill Creek is a tributary to the Sugar River near Verona. At one time, water quality in the creek was rated poor due to inadequately treated municipal (City of Verona) and industrial wastewater discharged to it. These discharges have been eliminated or diverted; City of Verona waste is now treated at the Nine Springs Sewage Treatment plant. As a result, water quality and in-stream habitat have improved. The creek's drainage area includes much of the southwest side of Madison as well as most of Verona. Urban runoff poses a significant threat to Badger Mill Creek. Badger Mill Creek is a warm water fishery, but it drains to the Sugar River which is a cold water fishery, and therefore, care must be utilized in any additional water effects for this stream. Goose Lake is a closed basin, and overflows of Goose Lake may eventually drain toward and into Badger Mill Creek. Badger Mill Creek has a very good Hilsenhoff Biotic Index (HBI) rating (RPC 2004).

The Madison Metropolitan Sewerage District (MMSD) has installed an effluent outfall at Badger Mill Creek. This effluent return line was to help off set the inter-basin transfer of water. The Dane County Water Quality Plan (RPC 2004) notes that return of effluent, along with other practices, shows some promise in mitigating the impacts of the inter-basin transfer.

Nationwide riparian areas comprise a small proportion of the landscape, less than 1%, but they are critical in their support of not only a disproportionately high number of wildlife species, but also a wide array of ecological functions and values. Agriculture and development increases light, temperature, sedimentation, pollutant loading and erosion which then degrades water quality and diminishes suitable aquatic habitat (Environmental Law Institute 2003, p. 19).

Wetlands

Large wetland complexes exist adjacent to the Sugar River. Other wetland areas have been drained and put into agricultural production. Wetland drainage and stream straightening in some locations have also degraded habitat and water quality.

Groundwater

Urban sources of polluted runoff do not yet appear to be harming water quality or in-stream habitats of the Sugar River. But threats to water quality increases with continued urban growth in the Madison-Verona area. Long-term, cumulative effects of urbanization on water quality and in-stream habitats of the upper reaches of the Sugar River are a major concern of DNR staff. The tools and responsibility for addressing long-term management of Sugar River water quality rest with Dane County and the municipalities in the watershed. It is conceivable that if the present rapid urban growth in this area continues unchecked, water quality, fisheries and in-stream habitats may be significantly degraded as a result of lowered groundwater base flow to the river.

Upper Sugar River Watershed Association

Upper Sugar River Watershed Association (USRWA) came into existence because

of the Upper Sugar River Initiative (WDNR). Through a grant from the US Environmental Protection Agency, the Upper Sugar River Initiative was formed, joining local government, natural resource agencies, private organizations, community groups, and volunteers. The Initiative effort evolved from a Madison Metropolitan Sewerage District (MMSD) creating a return line discharging water to Badger Mill Creek in the Upper Sugar River Watershed to address the issue of water diversions. A stakeholder group has formed to investigate wastewater discharge issues.

In collaboration with many partners, the Department needs to continue planning and implementing programs to protect stream health in the Upper Sugar River. The Upper Sugar River Watershed is threatened by urbanization and farming. Stormwater runoff, groundwater depletion, wastewater discharges and habitat destruction are ongoing threats to the aquatic environment's health.

The goals set forth by the Association are to protect the Upper Sugar River water quality through innovative strategies that capitalize on existing stakeholder involvement; improve habitat for terrestrial and aquatic life; increase water based recreational activities; investigate methods of improving groundwater infiltration to protect base flows in Badger Mill Creek; and educate students about local water resource issues.

Lake and Stream Morphology

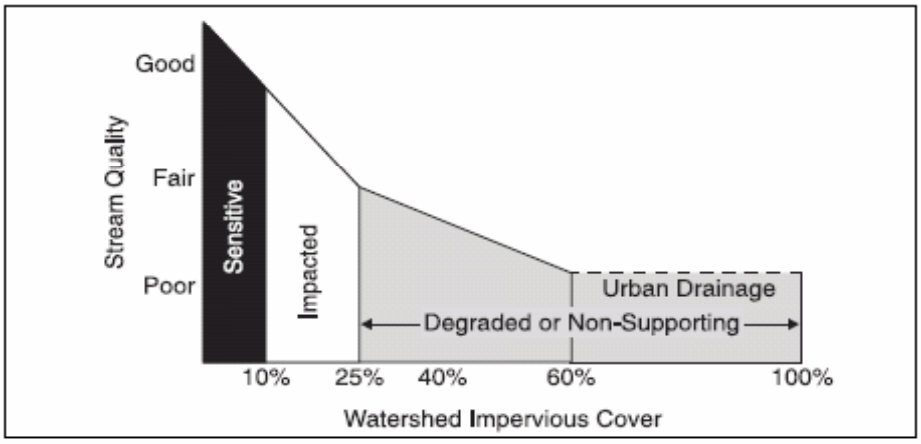
In 2005, Dane County adopted a classification system for the water bodies and streams in the County. This system is used to "identify and target management strategies and techniques where they are needed most and have the greatest beneficial effect" (RPC 2005, Executive Summary). Fitchburg streams in the Yahara Basin flow to Upper Mud Lake (Nine Springs Creek) and into Lake Waubesa (Swan Creek and Murphy's Creek). It is also important to focus on the smaller water body systems that are also sensitive, and more directly affected by development within the City of Fitchburg.

Various studies (see reference information in RPC 2004, and RPC 2005) point out the effects of impervious area as an environmental indicator (Figures 5 - 8, 5 - 9, 5 - 10). "As the natural landscape is paved over a chain of events is initiated that typically results in degraded water resources" (RPC 2005, p. 5). As the amount of impervious surface area increases so does the velocity and volume of stormwater. While detention ponds may function to reduce the peak discharge to predevelopment levels, the amount of storm water is greater, and the duration of the discharge is also much greater. The longer discharge, it is now thought, alters stream morphology since runoff velocity is above the critical erosive level (APWA 2006). Beyond increased runoff, velocity, and higher peak flow caused by a higher impervious surface ratio, the following may also occur:

- Water level fluctuations are greater
- Increase in erosion
- More sediment and pollutants
- Degradation of habitat (sedimentation, loss of vegetation)
- Water temperature increase

- Decline in aquatic diversity
- Decline in fish diversity
- Reduction in fish species and natural reproduction
- Inhibits groundwater recharge through the soil and subsequent discharge of groundwater to surface water, affecting surface water base flow
- Physical filtration and natural biologic processes that remove pollutants and nutrients is prevented
- Reduced base flow in streams and wetlands during dry weather conditions

Figure 5 - 8: Stream Sensitivity



Source: Dane County Water Body Classification Study Phase 1, 2005

Sediments and nutrients washed from the land surface are the primary cause of accelerated eutrophication, weed and algae problems of the lakes in the Yahara River watershed. Not surprisingly, nutrient concentrations of urban runoff are much higher than natural background levels (RPC 2004). The largest source of sediment to lakes and streams is from soil erosion of agricultural lands, although one has to keep in mind the significant amount of acreage under agricultural production. However, soil erosion from non-agricultural activities, primarily construction sites and surface mining, are one of the most significant localized sources of sediment and nutrients to receiving waters (RPC 2004). The 1997 Lake Mendota Priority Watershed Plan noted that while urban growth accounted for 0.3 % of the total land area in the watershed, it contributed 23 % of the sediment loading, and 19 % of the phosphorus loading. However, it has been noted that surface water quality in Dane County streams is generally not declining; this is thought to be attributed to the sewage treatment plan upgrades (RPC 2004). Sedimentation and over fertilization of the lakes from urban and rural non-point source pollution is a continued problem.

Vegetated buffers appear to help reduce some effects of urbanization on lakes and streams. Buffers of 75' to 100' can provide some mitigation of pollutants. After 100 feet, the point of diminishing return is reached for pollutant control. However, the upper end of the recommended ranges in Figure 5 - 9 is generally thought necessary to maintain the biological components of many streams, lakes and wetlands (RPC 2005).

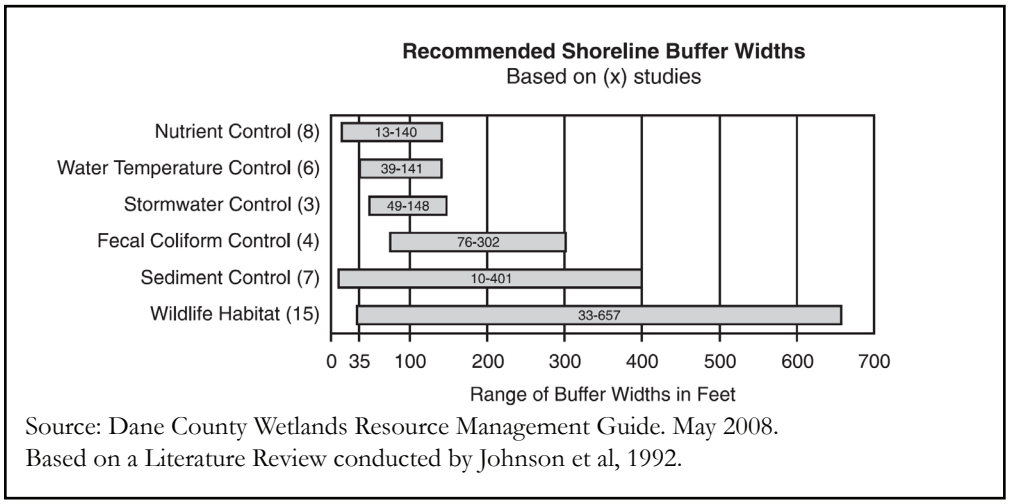
The Environmental Law Institute (2003) indicates that buffers of at least 100 meters are required to provide water quality and wildlife protection (p.20). Vegetated buffers

may also slow habitat fragmentation or perhaps even allow for re-establishment of a connected natural landscape. "A common consequence of land development is the fragmentation of an originally connected landscape into a mosaic of disconnected habitat patches (ELI 2003, p. 7). Habitat fragmentation is a serious threat to ecosystem functioning and biodiversity as humans dominate the landscape. The negative effects of habitat fragmentation can effect more than bio-diversity and species habitat. Land conservation and transformation can cause major alterations in hydrologic regimes, mineral and nutrient cycles, radiation balance and soil stability (ELI 2003, p. 5). Buffers are best vegetated with a diversity of nature species well adapted to the locale (ELI 2003, p. 20).

The 2005 RPC study further notes that, while wetlands perform important water quality functions, they can also be overwhelmed and degraded, reducing their quality and effectiveness in the important roles they serve to overall water system. The study recommends that wetlands be afforded the same level of protection as streams and lakes. For the most part, the current minimum environmental corridor surrounding a stream or wetland is 75 feet from the edge. Most environmental corridors established in the City have been at the 75 foot minimum.

The most cost effective wetland buffer would be a diverse mix of trees, shrubs, and groundcover in order to maximize infiltration and nutrient uptake (Mesbah & Kakuska, 2007, p. 2). Mesbah and Kakuska also note that unless larger buffers are dictated by special resource needs, most "resource management objectives can be accomplished using a buffer width of 300 feet" (2007, p.2).

Figure 5 - 9: Shoreline Buffer Widths



Source: Dane County Wetlands Resource Management Guide. May 2008.
Based on a Literature Review conducted by Johnson et al, 1992.

A typical low density suburban subdivision has an impervious surface ratio of greater than 30% (Figures 5 - 10 and 5 - 11). Little development takes place at levels below the minimum 25%, and certainly much less at the 10% level at which a water body changes from sensitive to impacted. Comprehensive planned development can be approached in such a manner so as to not only provide a suitable pattern of development that may assist in mitigating impacts, but to also provide efforts crucial to addressing the management of the water resource.

Figure 5 - 10: Lake and Pond Classifications

Name of Lake or Pond	Class	Management	2000 ISR (%) *	Sensitivity	Development
Barney Lake	I	Protect	.48	A	A
Harriet Lake	I	Protect	5.57	A	A
Goose Pond	II	Protect/Restore	27.06	A	C

Class Rating:
I = Protection measures preferred
II = Combined Protection and restoration

Sensitivity Rating:
A = High Sensitivity, with shallow seepage/spring fed pond or lake.
B = Medium Sensitivity, with deep seepage/spring pond or lake, or shallow drainage
C = Low Sensitivity, deep drainage lakes

Development Rating:
A = Low development level
B = Medium development level
C = High development level

*Impervious Surface Ratio (ISR)
Source: Dane County Water Body Classification Study, Phase 1, 2005

Figure 5 - 11: Stream and Creek Classifications

Name of Stream or Creek	Class	Management	2000 ISR (%) *
Badfish	I	Protect	4.87
Murphys	II	Protect/Restore	8.07
Swan	II	Protect/Restore	9.27
Badger Mill	III	Protect/Enhance	19.58
Nine Springs	III	Protect/Enhance	28.83

Class Rating:
I = Sensitive
II = Impacted
III = Degraded

*Impervious Surface Ratio (ISR)
Source: Dane County Water Body Classification Study, Phase 1, 2005

Groundwater Hydrology

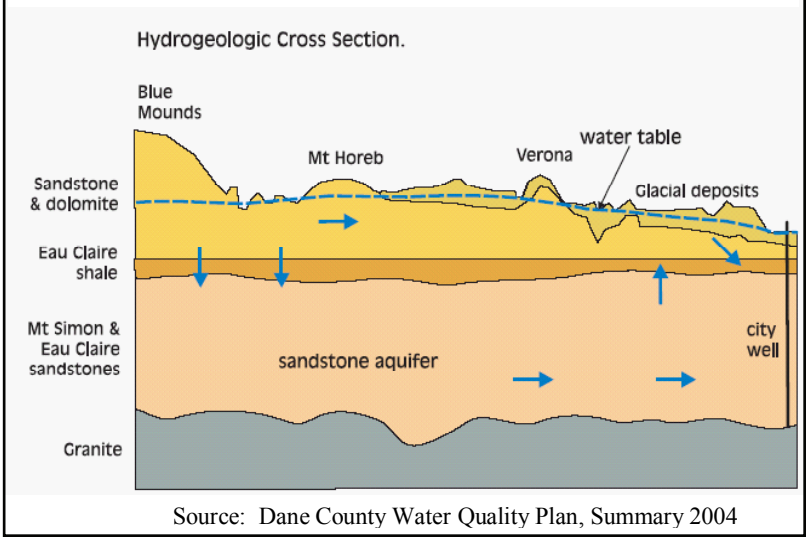
Groundwater is one of the City's most important resources as it provides the base flow to the streams and wetlands that are a valuable natural resource in the City, and provides from the deeper sandstone aquifer the required life sustaining water for the community. On average, a county resident uses approximately 140 gallons of water each day (RPC 2004). Municipal wells are located in the deep Mount Simon aquifer, while rural homes and uses obtain water from the shallow aquifers. Protection of the groundwater resource is important to the ability of the community to function in a sustainable manner. The Dane County Water Quality Plan (2004) indicates that "the surface water, shallow groundwater and deep ground water are intimately

connected in Dane County" (p.31). The plan further notes, that the recharge areas for most all groundwater in the county is in the county, therefore, the level of development in the county will affect the groundwater levels of the county. A shale layer exists between the lower sandstone (Mount Simon and Wonewoc formation) and the upper sandstone and dolomite layers. However, gaps or cracks occur in this aquitard providing a connection between the two groundwater tables. As the Water Quality Plan (RPC 2004) notes, the groundwater in the deep sandstone aquifer (Mount Simon) is replaced by percolation from the overlaying aquifers. The Eau Claire shale layer, based on well records, is 15—20 feet thick in the central and eastern part of the City, while the far western part has a thicker layer estimated at 20—50 feet.

Swanson et al (2006) indicate that the bedrock geology of South Central Wisconsin is deeply dissected by pre-glacial erosional bedrock valleys filled with unlithified glacial deposits. The bedrock ridges between the valleys are also overlain by glacial materials. The Tunnel City sandstone group is part of the upper sandstone and dolomite layer (Figure 5 - 12). Swanson et al (2006) determined that there is evidence for high permeability in the Tunnel City group in its contact with the underlying Wonewoc and overlying St. Lawrence formations.

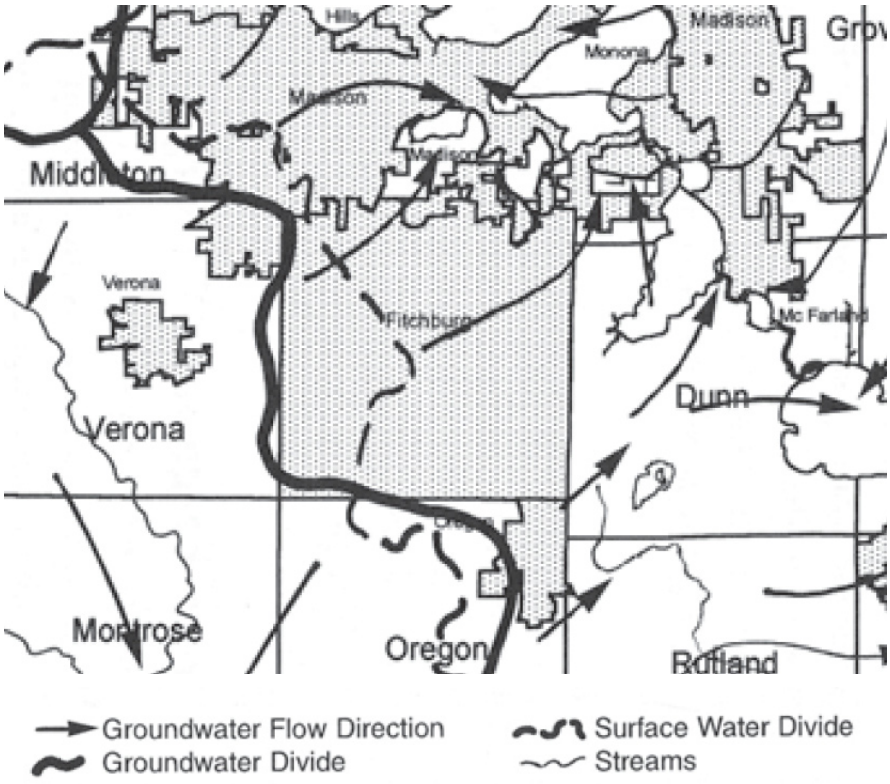
The Mount Simon, Eau Claire shale and the Wonewoc sandstone formations were formed during the Cambrian period of the Paleozoic era and are known as the Elk Mound group (Clayton and Attig, 1997). The Tunnel City formation, which is glauconite sandstone, exists directly above the Wonewoc formation. Above the Tunnel City group, various formations were placed by different geologic activities. Cross sections produced by Clayton and Attig (1997) indicate that the glacial till overlay valleys and ridges in existence prior to glaciation [Please refer to Clayton and Attig (1997) for the stratigraphic column of Dane County and more information]. A conceptual groundwater model to study Nine Spring Creek stream flow produced by Swanson and Bahr (2006) indicates that glacial materials filled valleys as deep as the Wonewoc formation. It appears reasonable to discern that significant groundwater recharge occurs to lower stratigraphic formation, such as Tunnel City, and perhaps Wonewoc, in valleys of the pre-glacial landscape. This could be of particular importance in areas where glacial melt water stream sediments were deposited since

Figure 5 - 12: Hydrogeologic Cross Section



Source: Dane County Water Quality Plan, Summary 2004

Figure 5 - 13: Groundwater Flow in the Upper Aquifer



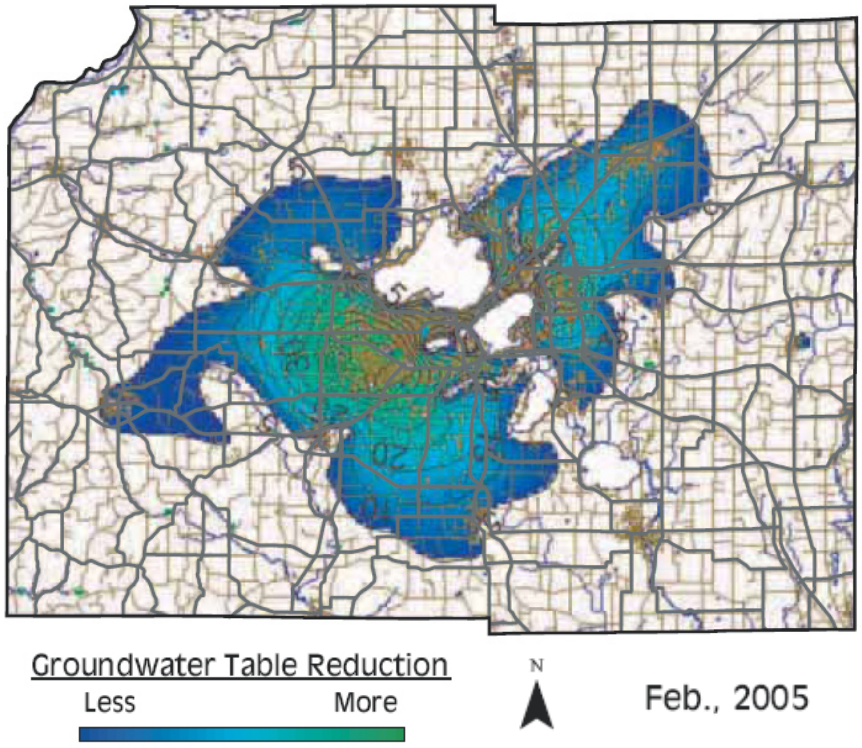
Source: Dane County Water Quality Plan Summary, 2004: Wisconsin Geological Natural History Survey, 1995

such sediments tend to be sand and gravel depositions, and in some cases were differentiated by glacial meltwaters.

Available information indicates that most all of Fitchburg, with the exception of the extreme southwest corner is in the same upper level ground water shed, and within this system there is a ground water movement to the northeast (Figure 5 - 13). This groundwater would feed the streams, creeks and wetlands that are part of the Yahara River Basin. The deep sandstone aquifers have a similar, although less easterly flow direction as can be seen by the following map. City well protection zones are set up with an off set to the south, in recognition of a general groundwater movement to the north.

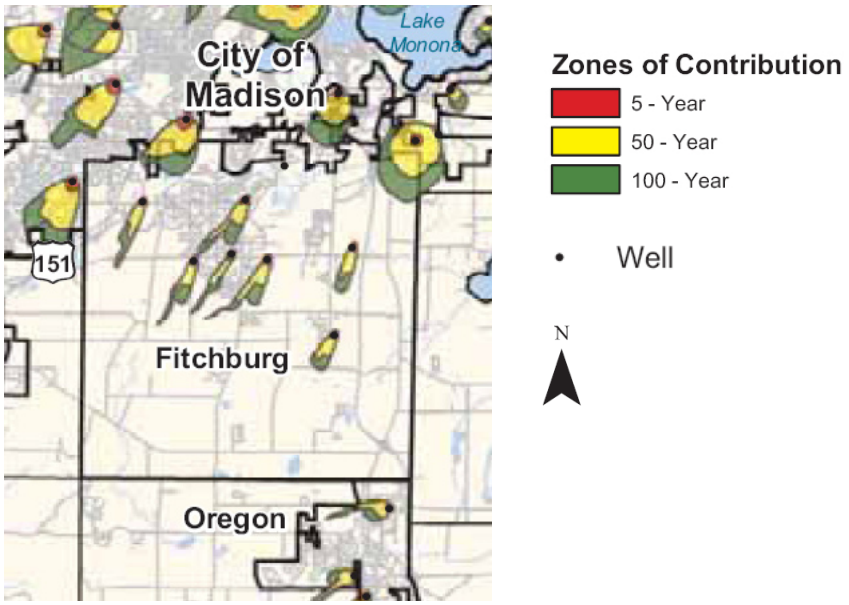
Alterations in the groundwater table by development can have serious consequences to the natural systems. Pumping of ground water for the Madison central urban service area has formed significant cones of depression in the lower water table (Figures 5 - 14 and 5 - 15). Comparison of groundwater levels of today, to that in the early 1900's (considered predevelopment) show that groundwater elevations southwest of Madison have declined over 60 feet, while elevations northeast of Madison have declined 50 feet. An additional decline of over 20 feet is expected due to additional pumping and development on the metropolitan fringe areas (RPC 2004). This causes a further reduction in the water table already beset by issues relating to impervious surfaces and a lack of storm water infiltration. Evaluations associated with the Dane County Hydrologic study noted decreased base flow in streams and lakes, as well as dewatered wetlands from the draw down of the water

Figure 5 - 14: Cones of Depression (2000), Dane County



Source: Dane County Water Quality Plan Summary, 2004

Figure 5 - 15: Zones of Contribution for Municipal Wells, Projected 2030 pumping rates



Source: Dane County Water Quality Plan Summary, 2004

table. The draw down also induces more rapid movement of contaminants to ground water and municipal water supplies (RPC 2004).

Pumping of groundwater and the related cones of depression may be causing a shift in the regional groundwater divide. It appears the pumping has led to a groundwater movement from adjacent basins, particularly the Sugar River basin, into the Yahara River basin, mainly due to the large and expanding cone of depression and vertical flow gradient created by the concentrated pumping within the central urban service area. The Madison lakes use to be groundwater discharge points, but with the cones of depression, they have now become a groundwater recharge area. As noted, Swanson et al (2006) determined that high permeability zones exist in the upper aquifer, particularly in the Tunnel City group. They note that the existence of the high permeability zones suggests that sandstones should be subjected to detailed hydrogeologic channelization in, for example, aquifer contamination susceptibility and/or well-head protection studies where preferential ground water flow can have major implications.

Groundwater withdrawal by municipal wells with diversion of waste water to the Madison Metropolitan Sewerage District (MMSD) treatment plant, which is in the Yahara—Monona watershed, were shown to result in a complete loss of base flow in Badger Mill Creek. MMSD constructed an effluent return line to the creek, to provide, by mechanical pumping, highly treated effluent to restore water flow to this creek (RPC 2004). However, return of such effluent only helps to reduce the impact of the loss of natural base flow, and impacts still likely remain.

As noted earlier, increasing urbanization leads to higher impervious surface ratios, and a loss of recharge areas. The amount of recharge areas to be lost within the central area by 2020 is greater than 4,000 acres, or the equivalent of 7.0 mgd of groundwater recharge lost due to impervious development and surface water runoff (Dane County Regional Planning Commission, 1997). A larger or compounded impact occurs when urban development is provided from wells and water that is diverted out of the watershed rather than being returned to groundwater at the same location. Therefore, NR151, which now requires some infiltration for new projects, is helpful, but does not address the full impact of pumpage and diversion. Additional strategies to promote more aggressive recharge measures need to be implemented, particularly in sensitive watersheds (RPC 2004).

The Water Quality Plan (RPC 2004) states that groundwater quality "indicates worsening trends, especially increasing nitrate levels from over use of fertilizers and increasing salt concentrations." Certain areas of the City also provide greater risk to ground water contamination either from surface activities, or subsurface activities.

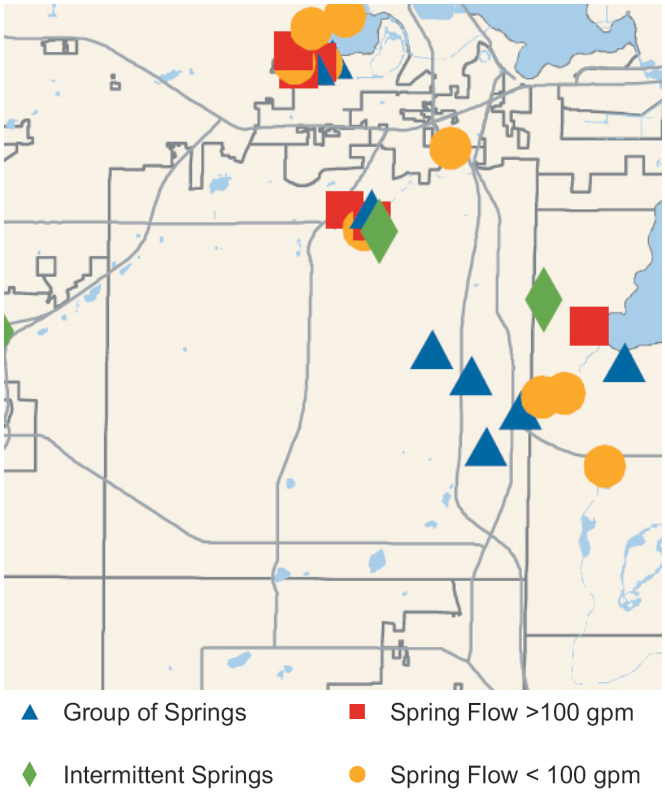
The City of Fitchburg has several springs in association with the Nine Springs Creek, Murphy's Creek and Swan Creek. The springs feeding Nine Springs Creek have been studied and located, but less activity has been shown in regard to the other springs within the community.

A University of Wisconsin student group undertook a study of the Nine Springs E-Way and noted that fifteen springs in Fitchburg provide a water source to Nine Springs Creek. Most of the springs are concentrated near the Nevin Fish Hatchery

(Figure 5 - 16). The groundwater flow is restricted to weaknesses in a lacustrine clay layer, and where weakness or the lacustrine clay layer is thin outfall of ground water occurs and a spring develops. The Nine Springs E-Way report (1998 Fitchburg Citizen's E-Way advisory Committee) indicated that it is difficult to determine source areas for springs, but that all source areas would have the ability to easily allow water to seep into the ground, in other words have a high infiltration capacity. The springs associated with Nine Springs Creek are generally served by a ground watershed that is narrower than that of the surface watershed, but which extends westerly more than does the surface watershed (1996 Water Resources Practicum, Nine Springs Watershed and Environmental Corridor). However, further evaluation of ground watersheds was also occurring at the time of that study.

The principal groundwater concern is the decrease in groundwater levels due to urban pumping and increasing acres of impervious surfaces that limit surface water infiltration. Both of these changes affect base flow from springs into rivers and streams and thus also affect water temperature and quality (Figure 5 - 16). In addition, elevated chloride and sodium levels in surface water and groundwater exist due to winter road and street salting.

Figure 5 - 16: Location of Springs



Source: Dane County Water Quality Plan Summary, 2004

Groundwater Recharge

Groundwater is the primary source of water for all users within Fitchburg and Dane County. Earlier information noted that there exists a shallow aquifer and a deep aquifer with the shallow aquifer providing rural uses with water, and the deep aquifer

being the location for most municipal wells. The two aquifers are separated by a shale layer, but information also notes that cracks or gaps in the shale layer must occur, as the groundwater in the lower aquifer is replaced by percolation from the overlying or shallow aquifer. Water is used locally and water is recharged locally.

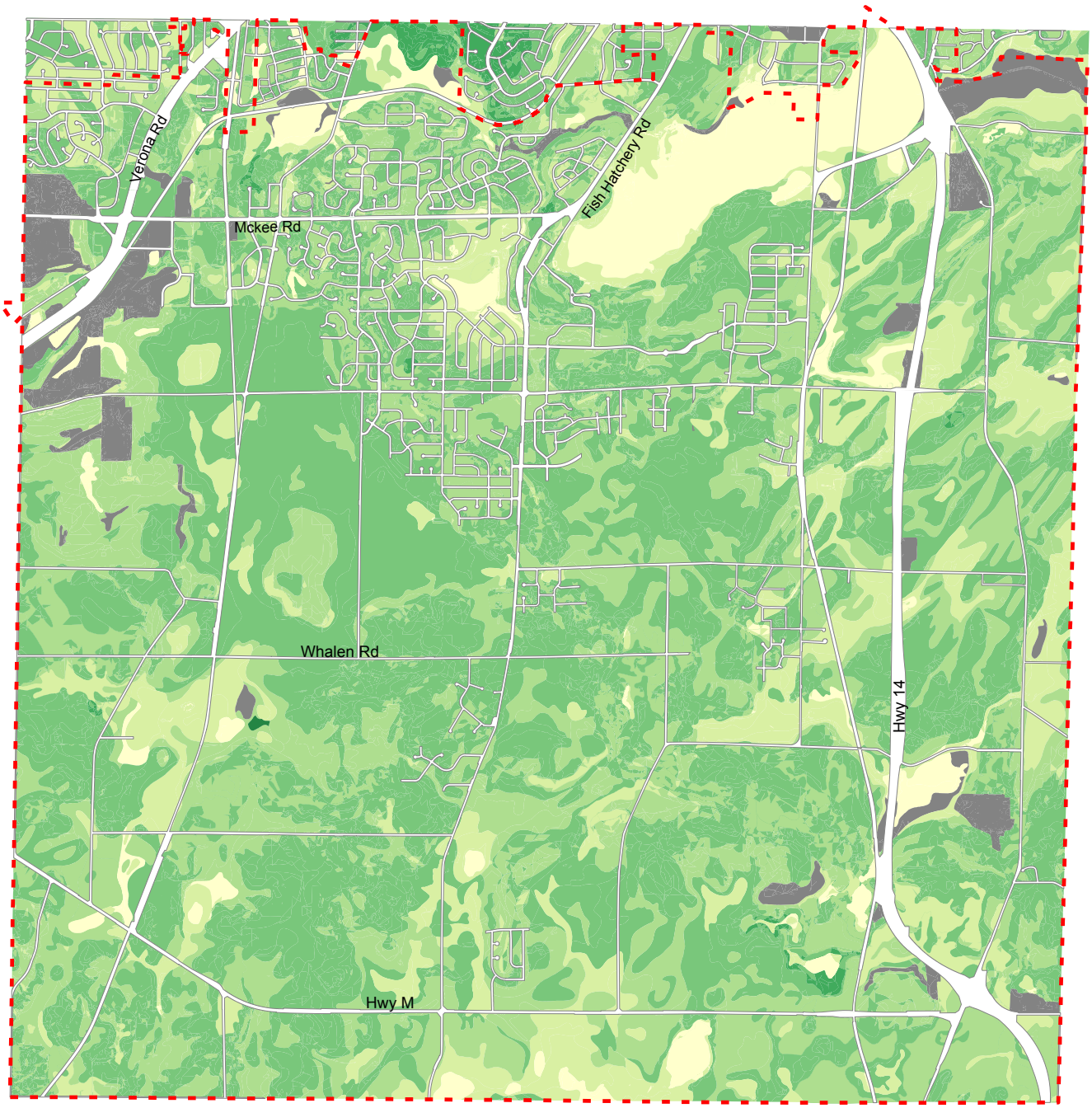
Groundwater pumping has caused cones of depression altering base flow in streams and lakes, and now causing the Madison lakes to be suppliers to the groundwater system, rather than the earlier conditions of the lakes being fed by groundwater. Groundwater withdrawals also may induce pollutants to the wells. Pollutants reach the groundwater from either above surface or below surface activities. Groundwater flow from the upper aquifer is generally in a northeasterly direction. The deeper aquifer has a similar northeasterly flow pattern, although possibly less pronounced easterly and more northerly flow than the upper aquifer flow pattern. Based on the above information it becomes clear that it is important to maintain and protect proper groundwater infiltration areas. However, underground hydrologic studies and information is rather recent; nonetheless, information on where recharge occurs will become present as these studies advance. The Dane County Water Quality Plan (2004) noted that the shallow (upper) aquifer recharge is in upland and hillside areas and the water flows to discharging points such as streams and wetlands. More recently, it is becoming apparent that general areas with high infiltration potential are upland areas that tend to be rather level. Logically, this makes sense, since storm water has a tendency to have more runoff on hill sides than it would on level areas, where precipitation would not runoff at near the velocity as on a hillside and then be able to infiltrate. Geologically, these areas appear associated with either deposits by glacial lakes, or deposits occurring from meltwater stream sediments.

Glacial lake deposits are typically plane-bedded or cross-bedded silt and clay, but includes off-shore gravel that may be from one meter to over tens of meters thick. Glacial lake beds most present in Fitchburg are classed as og, which is mostly uncollapsed, with flat topography, with some deposited on glacial ice resulting in a slightly hummocky topography. The meltwater stream sediments are considered to be sand and gravel typically at least several meters thick and deposited by braided streams that carried glacial meltwater during the Wisconsin Glaciation. Unit su is the most common unit present in Fitchburg and is classified as uncollapsed meltwater-stream sediment overlain by post organic sediment (Clayton and Attig 1997). (Og and su are common soil classifications.)

Based on those geologic characteristics, the geology of Fitchburg would present two significant sized areas and a few lesser sized areas with a high potential for recharge of groundwater. The first is a large area in southern Fitchburg from the eastern border running westerly along both sides of County M to near the Oak Hall cemetery, which is sometimes referred to as Prairie View (after a former school that served the area). The second major area is the Stoner Prairie area and then stretching southerly, generally along the former rail corridor to just south of County M. Isolated pockets of other areas exist such as McKee Farms Park locality, and a narrow ribbon along USH 151. Smaller, less distinguishable and more isolated areas exist from Irish Lane south to County B along the rail corridor. The level topography of these areas, combined with the top organic layer, also indicate a high quality agricultural resource.

Figure 5 - 17

NATURAL INFILTRATION MAP



High — Medium — Low

City Boundary

Undetermined -- Highly Variable

N

The data was derived from NRCS soil information using relative cumulative scores based on soil permeability, depth to water table, depth to bedrock, and slope (Table 1). Depth to bedrock and slope were considered less important and weighted accordingly. (Capital Area Regional Planning Commission).

Prepared by: Planning/Zoning
Source: Planning/Zoning, Dane County LIO & CARPC
Revised: 7/2008

FITCHBURG Planning/Zoning

Infiltration maps produced by the Capital Area Regional Planning Commission in late 2006 (Figure 5 - 17) confirm the above logic, but also point out that there are many other areas important for infiltration within the City. The Natural Infiltration map was derived from NRCS soil information using relative cumulative scores based on a variety of factors such as soil permeability, depth to water table, depth to bedrock and slope.