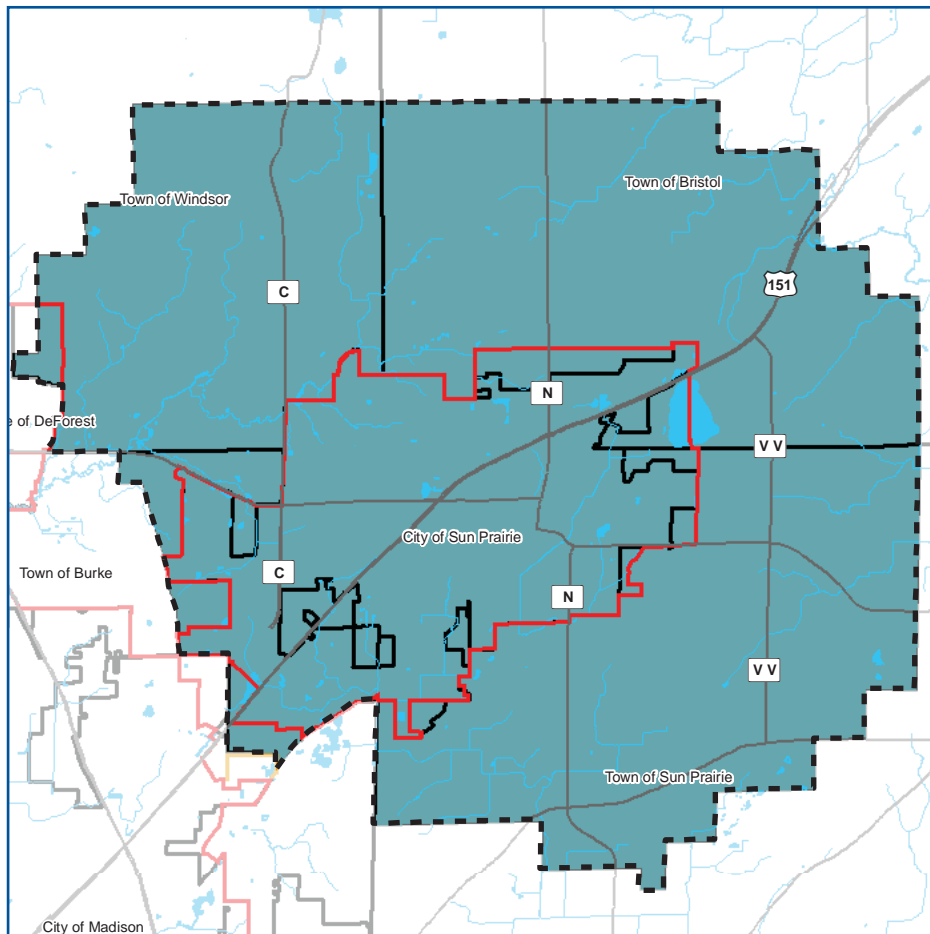




City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



January 2014

Adopting Resolutions

City of Sun Prairie Future Urban Development Area (FUDA) Planning

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City of Sun Prairie Environmental Conditions Report

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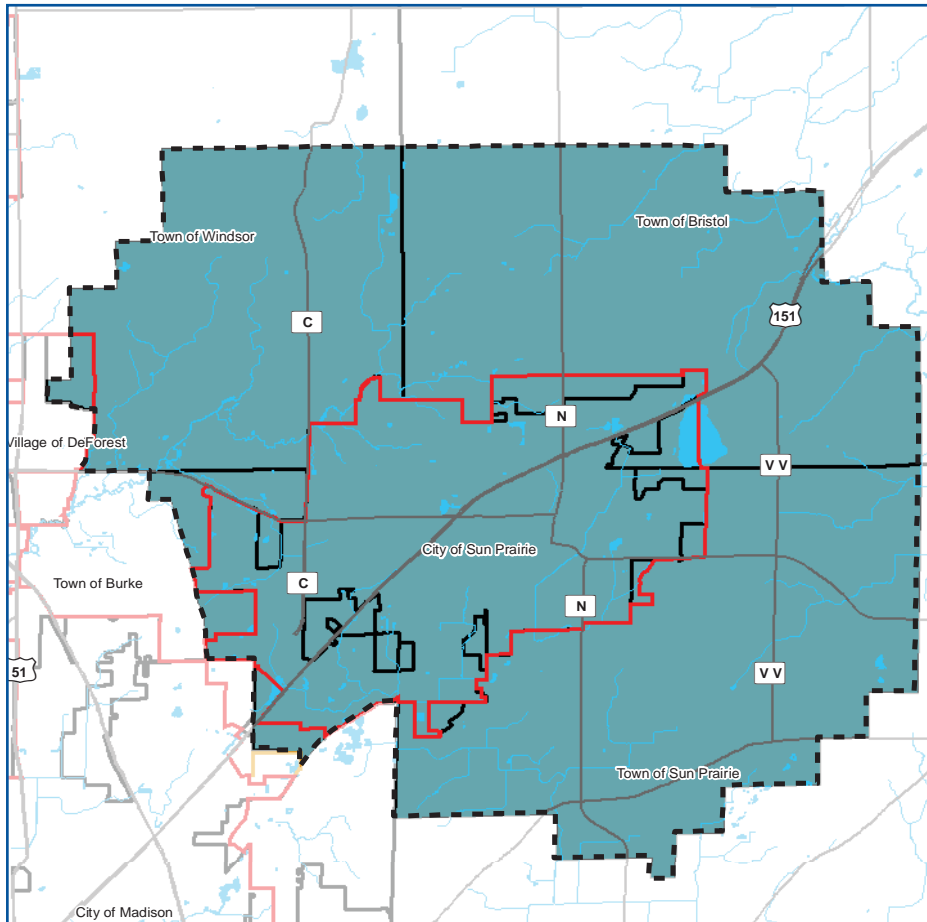
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City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



January 2014

Summary

Introduction

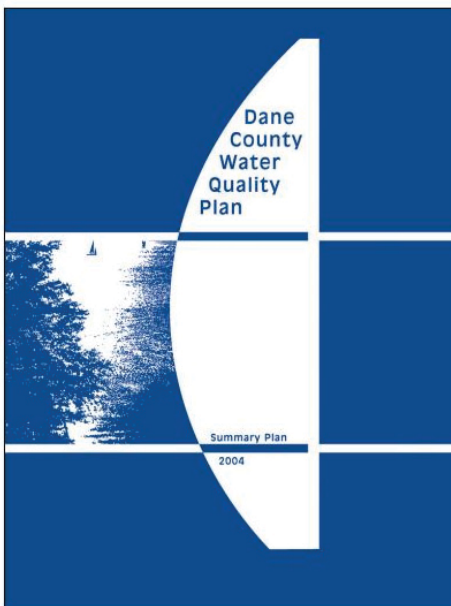
Future Urban Development Area (FUDA) Planning was charged to the Capital Area Regional Planning Commission (CARPC) and local communities with urban service areas (USAs) when the Commission was restored in 2007. Local communities use the USA amendment process to seek CARPC and Department of Natural Resources approval to expand urban development on a full range of services, including public sewer and water. The Sun Prairie USA is participating in this FUDA project and includes the City of Sun Prairie, City of Madison, Towns of Sun Prairie, Bristol, Burke, and Windsor with assistance from the Capital Area Regional Planning Commission.

Future Urban Development Area (FUDA) Planning is an intergovernmental proactive long-range planning process that was first named in local resolutions petitioning the Governor to establish CARPC in 2006. Item 7 in the resolution regarding updating the *Dane County Water Quality Plan* reads,

“The Plan shall also define a 25-year Future Urban Development Area with 5-year updates. The Plan shall be developed in cooperation with area communities, including towns, and shall consider adopted comprehensive plans and intergovernmental agreements. The Plan shall be developed as follows:

- a. CARPC staff shall provide communities with **environmental condition reports** consisting of maps, text, and information identifying environmental issues that should be addressed.
- b. [omitted]
- c. The Plan, which will identify the 25 Future Urban Development Area, shall be **based on the requirements of NR 121** and shall also consider other factors including the impacts on **natural and built systems, the efficient use of land including urban densities, and the ability to efficiently provide services to support the development and farmland preservation planning.**
- d. There shall be separate rules and policies for limited service areas.”

This document fulfills part “a. CARPC staff shall provide communities with environmental condition reports consisting of maps, text, and information identifying environmental issues that should be addressed.” This report is organized into four principle sections (1) Community Development, (2) Natural Resources, (3) Agricultural Resources, and (4) Other Resources. In addition to these, RPC staff have provided a sustainability audit of the existing built environment and a completed Comprehensive Plan Health Assessment Checklist. This Environmental Conditions Report (ECR) provides information for these communities to evaluate where development could occur, where resources should be protected and where both can occur together when they fulfill the resolution reading “the Plan, which will identify the 25 Future Urban Development Area, shall be based on the requirements of NR 121 and shall also consider other factors including the impacts on natural and built systems, the efficient use of land including urban densities, and the ability to efficiently provide services to support the development and farmland preservation planning.” A staff team and other local stakeholders from each jurisdiction met over one year to complete this report.



Relevant Governing Documents

City of Sun Prairie Comprehensive Plan
Burke, DeForest, Madison & Sun Prairie Cooperative Plan
City of Sun Prairie Zoning Ordinance
Sun Prairie West Main Street Corridor Plan
Sun Prairie Westside Plan
Town of Burke Land Use Plan
Town of Bristol Land Use Plan
Windsor Comprehensive Plan: 2025
Town of Sun Prairie Comprehensive Plan: 2003-2023
Sun Prairie-Bristol Intergovernmental Agreement (2005)
Sun Prairie-Windsor Cooperative Plan (2012)
Dane County Parks and Open Space Plan
Dane County Water Quality Plan
Dane County Land Use and Transportation Plan: Vision 2020

More information on this project is available at www.capitalarearpc.org/Madison-SunPrairie_FUDA.html

Funding for this project comes from CARPC operating budget and grant funds from the Sustainable Communities Regional Planning Grant Program sponsored by US Department of Housing Urban Development. The communities participating in this grant are also members of the Capital Region Sustainable Communities Partnership. To learn more about the grant and the Partnership visit: www.capitalarearpc.org/grant.html

Purpose

Many communities across the U.S. are discovering the need for an integrated approach to planning for growth and development. Fiscal efficiency and economic sustainability require an approach that minimizes the waste of natural and financial resources. Experience shows that inefficient and uncoordinated approaches to resource use result in wasted economic opportunity, increased financial burden on municipalities and taxpayers, and eroded community well-being, economic competitiveness, and quality of life. The primary natural resources objective of this approach is to maintain and, where possible, enhance the quality of our natural environment and the associated resource functions and values. However, this needs to dovetail with related growth and development strategies related to local community needs and aspirations, infrastructure planning, community economic development, long-term development visioning and planning, maintaining agricultural production of food and fiber, and reserving open spaces for cultural, recreational, aesthetic, and ecosystem functions.

The purpose of the FUDA process is to empower local decision-making with information and evidence that provide a regional perspective of vulnerabilities and opportunities. The regional impact of local actions can thereby be considered as part of the decision-making along with the local implications of regional trends and concerns.

The purpose of the ECR is to provide an inventory and assessment of the natural, agricultural, and community resources related to the study area based on the best available information. This information provides technical data and analysis that can be used by local communities in land use decisions. The natural, agricultural, and community data provide a foundation for local communities to evaluate where development can occur most efficiently, where resources need to be protected, and identify opportunities where development and conservation can occur together.

The information presented in the ECR is by necessity comprehensive, voluminous, and technical. The ECR is intended to be used by a diverse audience including community decision makers, technical staff, land owners, preparers of development proposals, and interested individuals and entities. Therefore, the report is designed with elements that target various audiences, allowing selective reading for specific purpose and content based on the following layered approach:

- The Executive Summary is aimed at providing a *report in brief* on issues, findings, and recommendations targeted for decision-making. References to specific maps and resources are included in the Executive Summary.
- More detailed information and justifications for the Executive Summary findings and recommendations are found in the technical body of the ECR. The ECR also includes technical *considerations* that can be used for detailed planning, design, and engineering work by various staff and consultants. This portion can be used as a *technical resource* for the communities in the study area, and a *reference* for consultants and technical professional working in the study area.
- Links to more detailed technical analysis and research references are included in the report.

- o CARPC staff are available to work with communities, community leaders, and their consultants to provide further content and technical expertise.

The ECR contains *existing* natural resource, agricultural, and land demand and supply data and analysis as outlined in the formation resolution quoted above. *“Environmental Conditions” are defined comprehensively to include various physical systems in the study area.* The ECR provides the data and analysis to inform local planning processes. This ECR is organized into four principle chapters:

- I. Community Development
- II. Natural Resources
- III. Agricultural Resources
- IV. Other Resources

The community development section is an assessment of demographic, land development, and density trends, and projections of population growth and land demand. This population growth and related demographic shifts must be effectively managed to protect the natural and agricultural resources identified in this report. The natural and agricultural resources sections are an assessment of assets in the study area. The natural resources section details the vulnerabilities of each natural resource, the potential for restoration for each, and specific recommendations for protecting these resources as valuable assets that add to the quality of life of the community and reduce infrastructure, maintenance, and environmental costs. The aim of the agricultural resources section is to provide more information about the potential agricultural assets in the area to help guide development and preservation decisions. The sustainability audit applies LEED for Neighborhood Development criteria to Sun Prairie’s existing urban fabric and highlights areas in policy and implementation that can improve the city’s sustainability performance. Finally, the ECR provides additional supplements including a Healthy Communities Comprehensive Plan Checklist and additional research explaining selected environmental factors.

Hierarchy of Scale in Analysis

*The challenge of viewing local actions in the context of their regional impacts is typically one of scale and our ability to evaluate and detect these impacts. We typically have limited understanding of the consequences of our actions. However, even the consequences that we know about can go undetected if we are not looking at the right geographic area or time-frame. This ECR looks at the geographic area based on areas of impact, starting with the regional scale. This is like the point-of-view of a skydiver at 30,000 feet, where he or she can see the interconnectedness of the streams, roads, landscapes, and other features and systems in the region. As the skydiver gets closer to the ground, the viewpoint becomes smaller and the focus more local and more detailed. Both viewpoints are relevant depending on the scale of analysis and impact. With respect to time frame, *water quality planning requires a 20-year planning horizon and is based on population growth projections for the region.* Most impacts are best analyzed in the context of “build-out,” or an analysis of a potential end result.*

These hierarchies of scale have the following implications:

- Regional vulnerabilities apply to all communities within the study area. These vulnerabilities characterize potential “downstream” effects of local actions.
- Sub-regional vulnerabilities apply to specific areas within the study area. The ECR outlines areas that influence these sub-regions. For example, sub-watershed boundaries are shown to indicate the areas where increased sediment in stormwater can exacerbate the health of a stream section.
- Local vulnerabilities apply to the small areas with defined impact on the local resource. For example, an isolated wetland is impacted by stormwater runoff from the relatively small land area that drains to it.
- Numerous networks and systems exist that need to be considered in combination as part of planning. The transportation network has different areas and scales of analysis compared to the surface water (rivers and streams) network or the school system. The ECR process attempts to include as many of these network and systems as is practicable. The participating communities are encouraged to include additional systems and networks in their deliberations and discussions as part of the local planning process. The local planning process would ideally facilitate an integrated, inter-related, and comprehensive inclusion for all the systems.

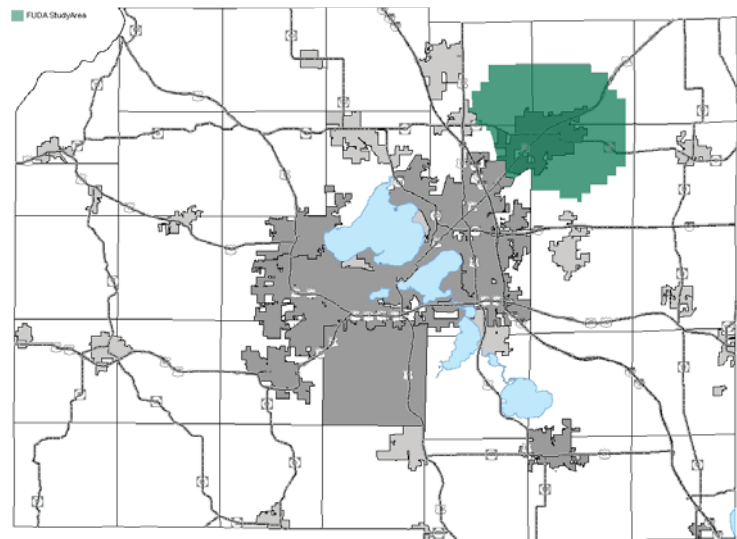
Defining the Study Area

Each FUDA project defines a *study area* to establish the outer limits of lands included in the analysis. The lands within the study area are those most likely to request USA amendments within the next 25 years. As noted in **Map 1**, there are 35,862 acres in the study area and includes the City of Sun Prairie and portions of the Towns of Bristol, Burke, Sun Prairie, and Windsor.

*Sun Prairie and these towns can integrate planning considerations (highlighted in **blue bold** text) and information contained in this ECR into their comprehensive plan and other governing document updates that could fulfill the Future Urban Development Planning Process outlined in the resolution. Once local actions are taken, these changes will update regional plans including the Dane County Water Quality Plan and the Land Use and Transportation Plan.*

For more information please visit:
www.capitalarearpc.org/madison_sunprairie_fuda.html

Map 1. City of Sun Prairie USA Study Area



Acres by jurisdiction:

City of Sun Prairie	9,290
Town of Bristol	9,508
Town of Burke	1,244
Town of Sun Prairie	9,246
Town of Windsor	6,575
Total Area	35,862

Community Development Summary

The Community Development chapter provides historic trends and the estimated future growth that will require management to protect natural and agricultural assets discussed in the other two chapters. This section focuses on urban development in the City of Sun Prairie Urban Service Area and potential future urban growth areas. Data is primarily from the 2010 Census and the 2009-2011 American Community Survey.

A. Population and Demographics

The City of Sun Prairie grew from 10,000 people in 1970 to 30,000 residents in 2010 at a consistently high growth rate of 30% per decade, with the last decade being the fastest at 45%. Across the county, Sun Prairie had one of the fastest growth rates in the 2000-2010 interval.

Urban: served by public sewer and water and other services, allowing higher density than in rural areas.

Rural: served by private on-site waste treatment (septic) systems and private wells, requiring lower density development than urban areas.

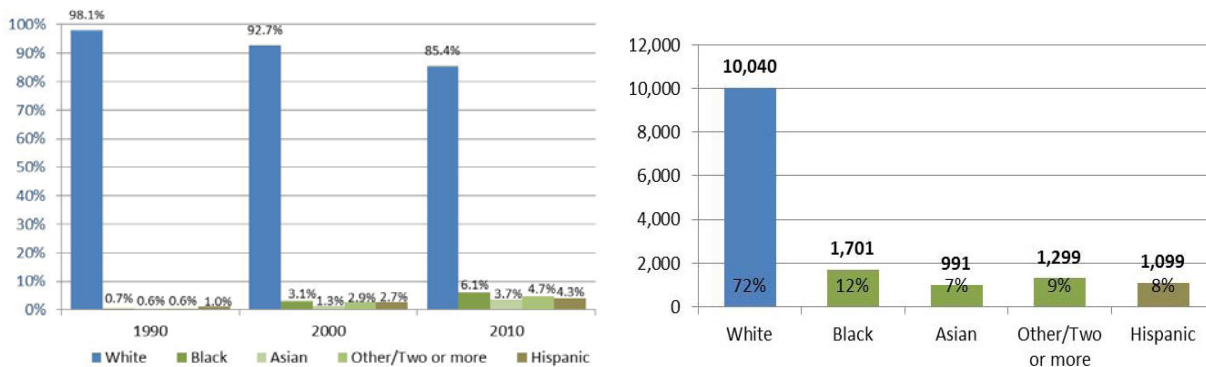
Sun Prairie's population has diversified since 1990, when 98% of the population was white. Since then, approximately 30% of the growth occurred in minority population groups, now representing approximately 17% of the population.¹ Based on this trend, Sun Prairie's population will likely continue to diversify in the future.

The parallel increase in population between 0-15 and 25-45 suggests many new families have moved into the city in recent years. This group likely impacted the large increase in children in the city. The most pronounced increase is between 50 and 69. However, compared to other small cities in Dane County, Sun Prairie has one of the lowest rates of population above 50. In contrast, the city has one of the highest rates of persons under 20.

The 2011 median household income² was \$66,395, about 7% higher than Dane County. Sun Prairie and Dane County have a similar distribution of household income, with few households below \$25,000 and many household incomes between \$50,000 and \$100,000.

As plans are made, Sun Prairie should consider how land use, transportation and other decisions impact the equity of outcomes for all current and future residents.

Population Diversity and Growth by Racial/Ethnic Group



¹ Sun Prairie has 24,362 White non-Hispanic residents, out of a population of 29,364 (83%) Note: Percentages do not add up to 100% because Hispanic is an ethnicity and counted independent of race.
² 5-year American Community Survey (ACS)

B. Housing and Land Use Trends

In all decades, housing units grew faster than population due to shrinking household sizes. The housing mix features a higher concentration of multifamily than most Dane County jurisdictions, accounting for 50% of the housing stock in 2010. Over the last 20 years town-homes doubled to 16%, as did small multifamily buildings (5 to 19 units), while larger buildings (20 or more units) grew to 10% of all housing units. The owner occupancy rate in Sun Prairie was steady at 62% in 2010. This information, combined with housing mix data, suggests a growing number of owner-occupied multifamily units.

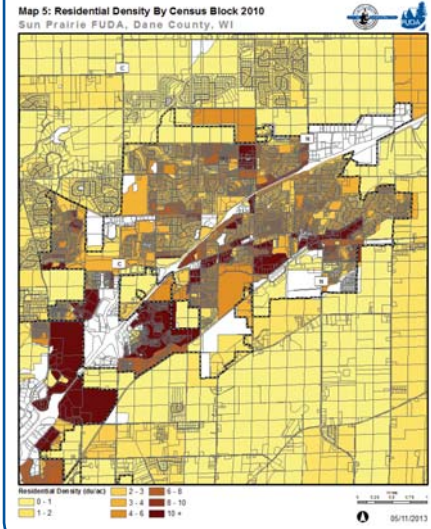
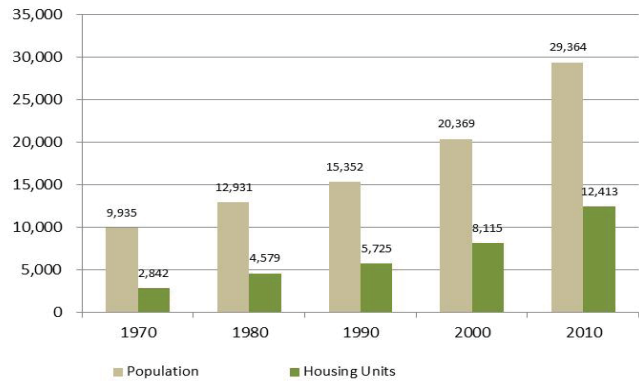
Compared to small cities and villages, Sun Prairie has more housing between \$150,000 and \$250,000, and slightly lower levels of homes priced at \$400,000 and above. In contrast, rent distribution in Sun Prairie is more variable and hosts more moderately priced and high-end rentals compared to other communities.

Between 1970 and 2010, developed land area grew from about 1,500 acres to 6,400 acres, with 2,400³ acres in the last decade. Residential development is approximately 36% of land in the urban service area, and is growing at a slower rate than in the past. Commercial land grew from 7% to 10% often replacing industrial uses.

Overall, residential density is 5.5 units per acre, increasing 14% since 1990 largely because of increases in the multifamily units built. In comparison, Sun Prairie has one of the highest residential densities outside Madison in Dane County, at nearly 10% more dense than the small city average and 20% more dense than the village average. The single family home density in 2010 was 3.6 units per acre, however single family homes built between 2000 and 2010 averaged 4.9 unit per acre. Average multifamily home density was 11 units per acre.

Sun Prairie saw robust commercial development over the past 20 years, increasing from 13 to 22.4 acres per 1,000 residents. Industrial growth increased briefly after 1990 and decreased over the last decade. Sun Prairie's commercial density, as measured by Floor Area Ratio,⁴ is 0.23 indicating mostly one-story buildings or multiple story buildings with large parking lots.

Population and Housing Growth 1990-2010



See page 48

³ 2010 Land Use values are taken from CARPC's county-wide land use survey. Differences in methodology may produce some differences between local land use calculations.

⁴ Floor Area Ratio (FAR) is a measure of building intensity: the ratio between the total square foot of a building and the total square feet of the site. For example, a 100,000 square foot site with a 20,000 square foot, single-story building would have a FAR of 0.2. A FAR of less than 0.2 can be an indicator that a site is underutilized. FAR is one indicator that must be combined with other indicators and observations before conclusions can be drawn.

Transportation

Over the past 30 years, researchers studied the links between vehicle miles traveled (VMT) per person and the built environment with the goal to reduce traffic, air pollution and expense to travelers. A 2012 study⁵ recommends four strategies communities can influence including, increasing residential and employment densities, mixing uses within the community and creating smaller block sizes. ***Enabling and implementing increased development densities, mixing uses and creating smaller block sizes could allow more local trips, some potentially without a car.***

Map 6. Proposed Bus Rapid Transit Route



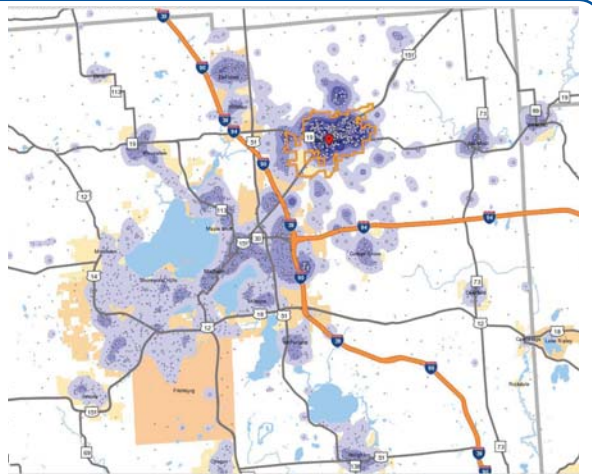
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Because the study area is home to a robust employment base commuting to and from Sun Prairie to and from the greater area can impact local and regional roadways. As of 2010, 16% of the Sun Prairie workforce worked in the city. Half of the workforce is employed in Madison, with major concentrations near the Capitol, Truax Airport, the American Center and Highways 30 and 51. Of employees who work in Sun Prairie, 23.5% live in Sun Prairie. This is a significantly higher rate than peer communities.

Sun Prairie has a well-developed bike network that connects most neighborhoods, schools, parks, commercial, and employment centers within the city and connects to nearby employment centers in Madison. Sun Prairie's Official Map for Bicycle Routes identifies many local streets as future routes.

Study Area Workers' Residences

Sun Prairie	2,112	24%
Madison	1,354	15%
DeForest	163	2%
Columbus	143	2%
Marshall	124	1%
Wausaukee	109	1%
Stoughton	108	1%
Fitchburg	98	1%
Beaver Dam	91	1%
McFarland	82	1%
All Other	4,615	51%



See page 50

⁵ <https://www.jtlu.org/index.php/jtlu/article/view/266/268>

Sidewalks are present on many though not all streets in Sun Prairie. Sun Prairie's Comprehensive Plan identifies gaps in the pedestrian network to be filled.

Sun Prairie does not have its own municipal transit system at this time. The city has worked with a private company to provide a shared-ride taxi service, and a private transportation service provides shuttles to and from East Towne Mall with connections to Madison Metro service. The closest Madison Metro stop is at the American Center. Looking to the future, regional transit options including Bus Rapid Transit with a possible extension to Sun Prairie and two potential express bus routes were studied and may be implemented.

Infill and Redevelopment⁶

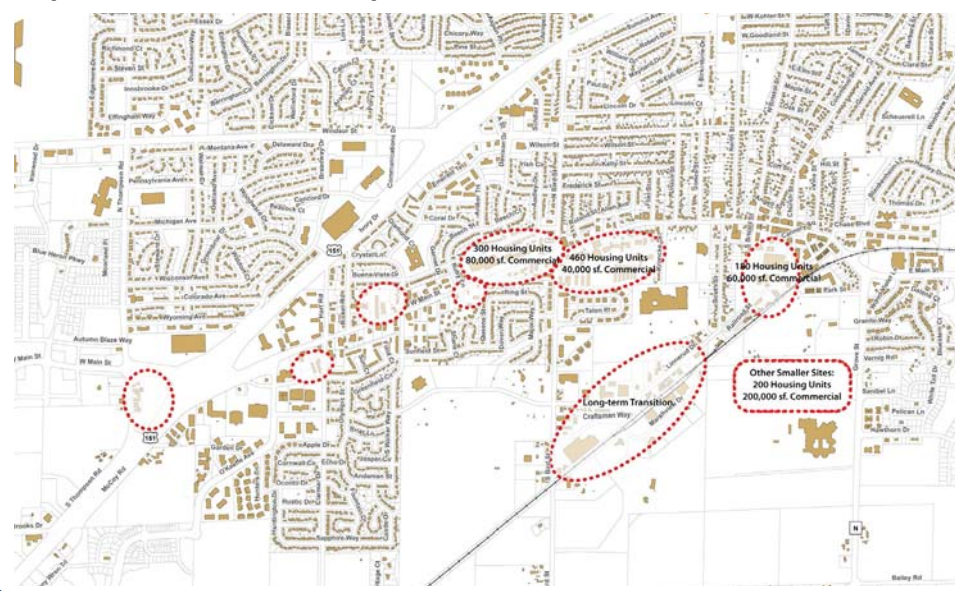
Sun Prairie has actively encouraged redevelopment. The city has three Tax Increment Financing (TIF) districts to spur more redevelopment and most recently completed the West Main Street Corridor Plan and the Downtown Phase II plan.

The Downtown Phase II master plan outlines the redevelopment vision for the area generally bounded by Main Street, the rail corridor and South Street. Redevelopment on these sites would be anticipated to be residential and potentially office development.

Several sites are identified in the West Main Street Corridors Plan. For example, the plan recommends commercial buildings at Main Street, transitioning to apartments, townhomes and continued retail with mixed use buildings (residential over ground floor retail) at Bird Street and Ruby Lane.

Redevelopment is challenging to predict and these estimates are one potential outcome. Of the identified sites, redevelopment could accommodate 450 residential units and 55,000 square feet of commercial space. All residential units would be multifamily apartment-style units and townhomes. This is roughly 40 less acres of greenfield development.

Map 10. Hanson Road Development Plan



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⁶ Because of the uncertainty, costs and challenges that redevelopment poses, it will not impact land demand for this FUDA study and is presented for informational purposes.

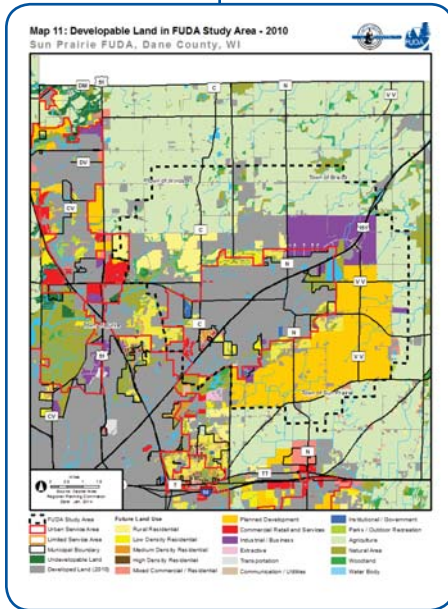
Long-Term Growth Projection

County population projections from the State⁷ are allocated among urban service areas.⁸ Using the projected increase of 18,449 people, 13,237 housing units could be required by 2035.

Using trends data, the projection estimates 45% of units will be single family at an average of 3.9 units per acre, and 55% multi-family were at 12 units per acre.

Overall future growth is projected to require 5,071 acres of development. According to Sun Prairie, as of 2010, 3,652 housing units were approved for development that were not built yet. This reduces demand by nearly 1,000 acres to 4,071 acres in unmet demand. Several other factors could increase or reduce this number, including changes in density, housing mix, household sizes, redevelopment, and unforeseen growth.⁹

Open land is considered developable if it does not qualify as an environmental corridor (floodplains, wetlands or slopes greater than 20 percent). The analysis indicates 917 developable acres (as of 2010) are available inside the current Sun Prairie urban service area. Compared to an adjusted land demand, the unmet demand for urban service area to accommodate the 2035 population is approximately 3,602 acres.



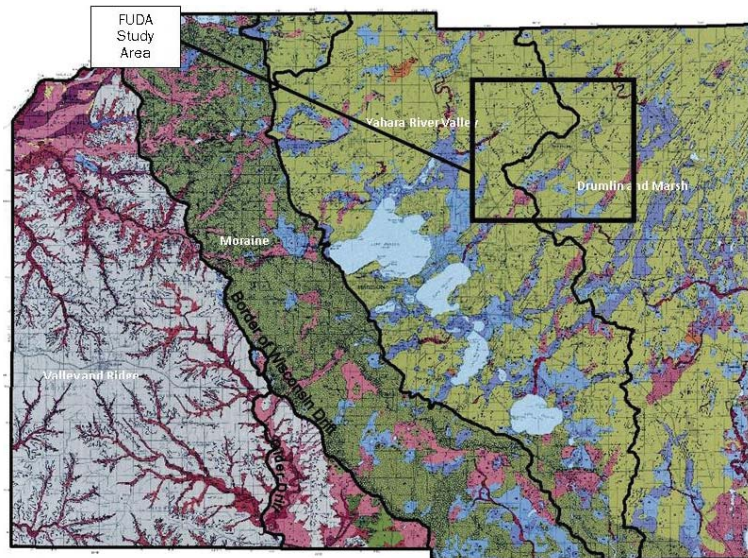
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Natural Resources Summary

The three purposes of the Natural Resources chapter are:

1. Provide a natural resource inventory and assessment based on local and regional considerations.
2. Outline considerations for land use planning and decision-making that protect and enhance the integrity of natural areas, both locally and regionally.
3. Outline opportunities for incorporating environmental features in local urban design to enhance the quality of life of local residents and to reduce costs for maintenance and infrastructure locally and regionally.

Map 12. Physiographic Areas and Deposits of Pleistocene Age



Derived from USGS Water-Supply Paper 1779-U (plate 2) 1965. For more detailed information see Pleistocene Geology of Dane County, WI. (WGNHS Bull. 95, 1997)

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Physical Geography and Surface Geology

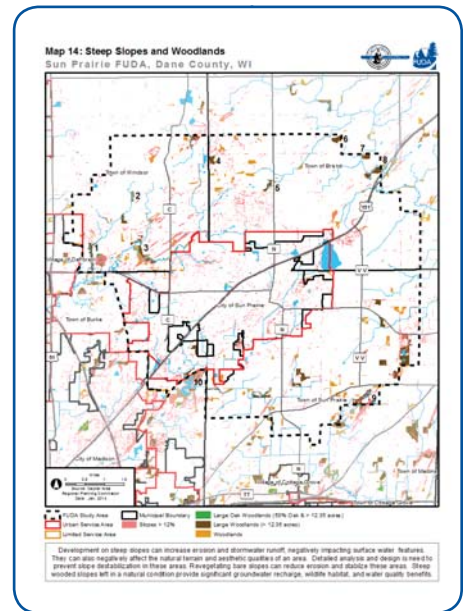
The Sun Prairie study area is located in the northeast part of the county, in the Yahara River Valley and Drumlin

⁷ The Wisconsin Department of Administration (DOA) provides 25-year population and housing projections for counties based on historic population growth and demographic factors.

⁸ According to a state approved methodology.

⁹ For example, the Comprehensive Plan has a policy to reduce approvals of multifamily and increase approvals of single family to attain higher proportions of single family housing.

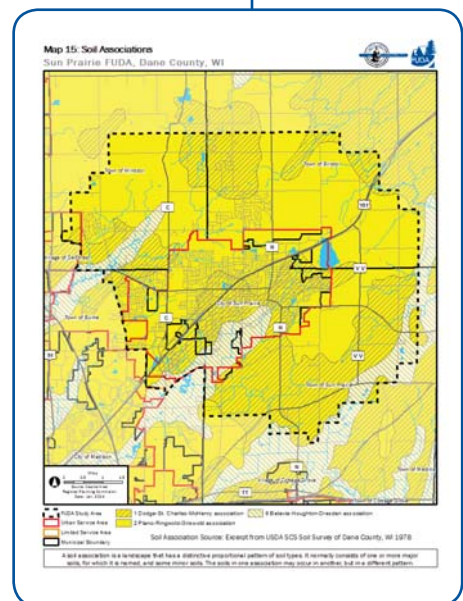
and Marsh Physiographic Areas (**Map 12**). The Yahara River Valley consists primarily of glacial ground moraine with extensive areas of peat and marsh deposits. The Yahara River Valley has an irregular topography, ranging from flat and rolling to hummocky and hilly. Here deep glacial deposits up to 350 feet dammed up a large preglacial valley, forming a chain of large lakes and wetlands. Lowlands along the Yahara River are generally marshy, whereas uplands are well drained. Streams in this physiographic area are generally flatter and more sluggish than those in the unglaciated driftless area to the west, and fewer are spring fed. The eastern portion of the study area is located in the Drumlin and Marsh Physiographic Area. This area includes many small drumlin hills interspersed with shallow glacial deposits that create an extensive system of interconnected wetlands. The only lakes in this area are small stream impoundments or shallow marshy lakes. Concerns associated with shallow depth to water table, wetlands, and floodplains are described more fully in subsequent sections of this report.



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Map 13 shows potential mineral resource extraction sites throughout the study area. *High Potential* sites offer an economically viable source of high quality aggregate. **These areas should be considered for protection from development until after the mineral resources are utilized and the site reclaimed.**

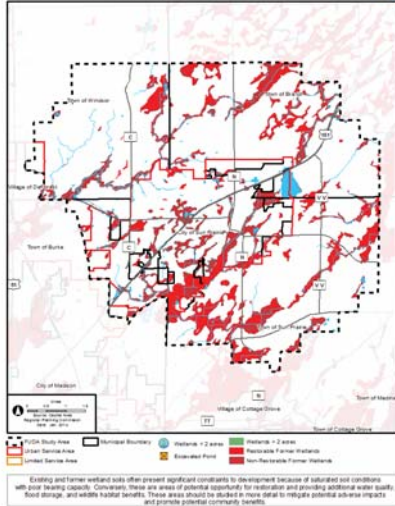
Developments on steep slopes can increase erosion and stormwater runoff. Some areas with slopes greater than 12% exist in the Sun Prairie FUDA study area (**Map 14**). **Slopes steeper than 20% should be protected from disturbance and maintain permanent vegetation to prevent destabilization. Municipal engineers should review and approve all slope disturbance and stabilization measures for slopes with gradient between 12% and 20%. Broadly, areas identified as having slopes in excess of 12% should be avoided for development, and within 75 feet of a water body, should be included as open space amenities or in Environmental Corridors for protection.** A detailed evaluation of steep slopes is presented on page 66. Woodlands are important biological resources critical for maintaining surface and water quality and quantity, and improving air quality. A detailed evaluation of the woodlands and several restoration opportunities is on page 66.



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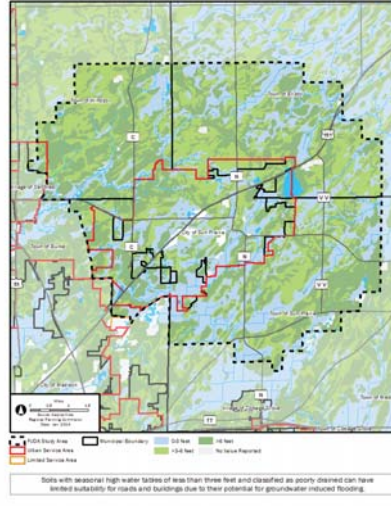
Soil type is an important indicator of structural difficulties for development. The soils found in the study area range from slightly to moderately limiting for farming and urban development without drainage measures. The study area also includes small areas with hydric soils, soils with shallow depth to water table, indicating existing and former wetlands that can be a barrier to development (see **Map 16**). In the study area, depth to bedrock generally exceeds 5 feet and is more than 50 feet in several areas and is not a limitation to development (see **Map 18**). Soil infiltration potential in the study area is generally moderate, and can be enhanced with engineered soils and tapping into deeper sand and gravel deposits. The last impediment for development is floodplains. **Map 22** shows 100-year floodplain boundaries for the areas most susceptible to flooding.

Map 16: Existing and Former Wetlands
Sun Prairie FUDA, Dane County, WI



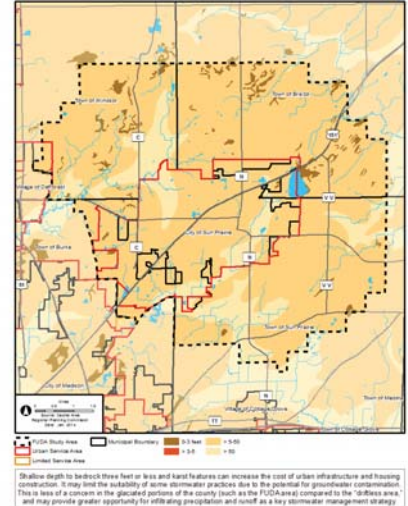
See page 74

Map 17: Depth to Water Table
Sun Prairie FUDA, Dane County, WI



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Map 18: Depth to Bedrock
Sun Prairie FUDA, Dane County, WI



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Table 11 WDNR Fish and Aquatic Life Uses

The Department has classified all surface waters into one of the fish and other aquatic life subcategories described below. Only those use subcategories identified in pars. (a) to (c) shall be considered suitable for the protection and propagation of a balanced fish and other aquatic life community as provided in federal water pollution control act amendments of 1972.

<p>(a) Cold Water Communities. This subcategory includes surface waters capable of supporting a community of cold water fish and other aquatic life, or serving as spawning area for cold water fish species.</p>	
<p>(b) Warm Water Sport Fish Communities. This subcategory includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.</p>	
<p>(c) Warm Water Forage Fish Communities. This subcategory includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life.</p>	
<p>(d) Limited Forage Fish Communities. (Intermediate surface waters). This subcategory includes surface waters of limited capacity and naturally poor water quality or habitat. These surface waters are capable of supporting only a limited community of forage fish and other aquatic life.</p>	
<p>(e) Limited Aquatic Life. (Marginal surface waters). This subcategory includes surface waters of severely limited capacity and naturally poor water quality or habitat. These surface waters are capable of supporting only a limited community of aquatic life.</p>	

Surface Water

The basic structural element of water resources protection is the watershed. A watershed is defined as the land area that drains to a specific body of surface water (river, lake, or wetland). *Carefully considering development plans in the context of the watershed is very important.*

Principal waters include Token Creek and the Yahara Lake Chain watershed, the headwaters of Koshkonong Creek, and the Mauneshia River. Lake Mendota is the major Yahara lake downstream of Sun Prairie, via Token Creek. Large portions of wetlands throughout the area were drained for agriculture or filled for development.

The WDNR established **water quality standards** consistent with the Federal Clean Water Act (Public Law 92-500) through Chapter 281 of the Wisconsin Statutes. These standards are shown in Table 11 and determinations for the study area are shown in detail on **Map 23b**. **Map 21** shows the streams and wa-

watersheds of the region and provides context for the streams and subwatersheds, shown on [Map 20](#).

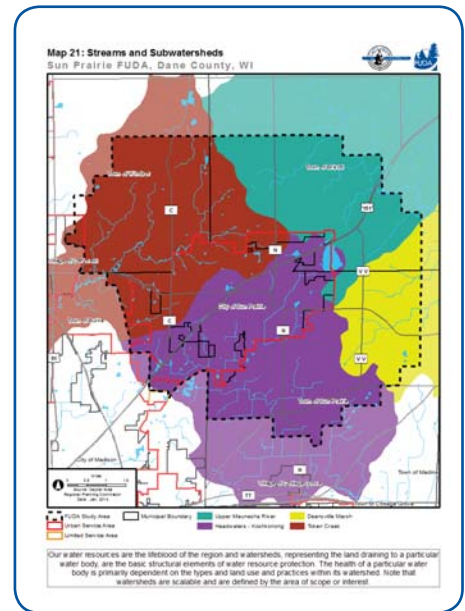
Stream restoration opportunities exist throughout the study area. These include Token Creek, and the various intermittent and ephemeral headwater streams that occur across watersheds, and the smaller intermittent and ephemeral streams. Recreating natural stream channel meanders is an important first step, followed by riparian restoration using native plant species. Restoration projects should follow five criteria:¹⁰

1. A goal that describes an ecologically healthy state that maintains dynamic properties within its regional context,
2. Reference undisturbed or recovered streams when historical data is lacking,
3. Use a design approach that uses empirical models focusing on ecological processes,
4. Use regional stream classification systems to guide restoration goals, and
5. Use common sense to notice site details and remove obvious stressors (lack of riparian vegetation, unrestricted livestock, etc.).

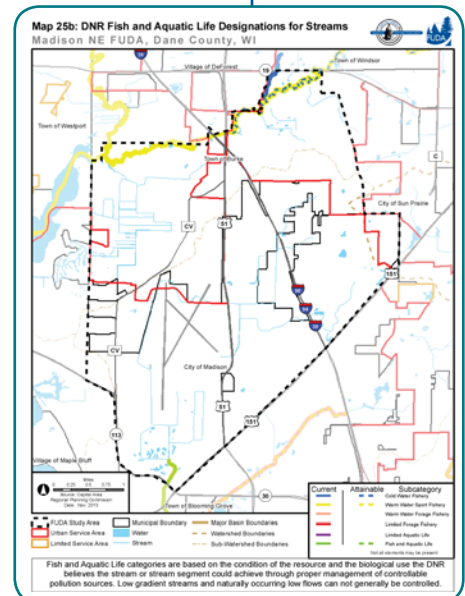
In general, there are two categories of techniques used in stream restoration: non-structural or structural techniques. Non-structural techniques use passive restoration and structural techniques use active restoration. The extent of a stream restoration in urbanizing environments will be ultimately determined by social values. Restoring a stream to pre-settlement conditions may not be possible.

Token Creek is the most prominent surface water feature that could be impacted from activities in the study area and is a major contributor of flow to Lake Mendota. Token Creek was placed on the State's 303(d) list of impaired waters in 1998. Combined, Token Creek and the Yahara River contribute nearly half (41%) of the flow to the Yahara Chain of Lakes. The study area encompasses about 24% of the watershed.

One of the principal water quality concerns for the Yahara Lakes is excessive phosphorus. All of the lakes in the Yahara chain are eutrophic, leading to multiple problems such as blue-green algae (cyanobacteria), nuisance aquatic plant species, low dissolved oxygen, and changes toward warmwater fish communities. The lakes are also impacted by aquatic invasive species, including eurasian water milfoil, often dominant in eutrophic lakes. The vast majority of phosphorus entering the Yahara Lakes comes from the surrounding land area and is carried to the lakes by tributary streams and upstream lake discharge.



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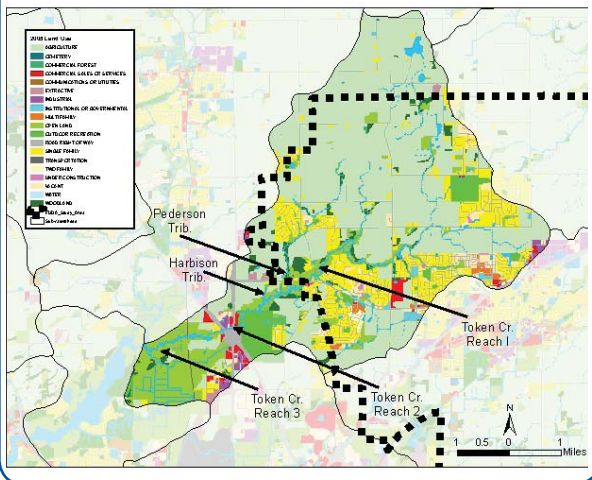
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10 Palmer et al. 2005

The Yahara CLEAN¹¹ partners developed the 50% phosphorus reduction goals for Lake Mendota, Monona, Waubesa, and Kegonsa in the Yahara Lake system. To meet these goals the Yahara CLEAN Strategic Action Plan includes actions to reduce the phosphorus loads delivered to the lakes. Present value cost is estimated to be \$76.5 million over 20 years.

The City of Sun Prairie installed several stormwater measures in developing areas near the Creek to minimize pollutants reaching the stream and minimize adverse thermal impacts from urban runoff. In addition, more effort will be needed to address historic impacts from urban areas predating these measures.

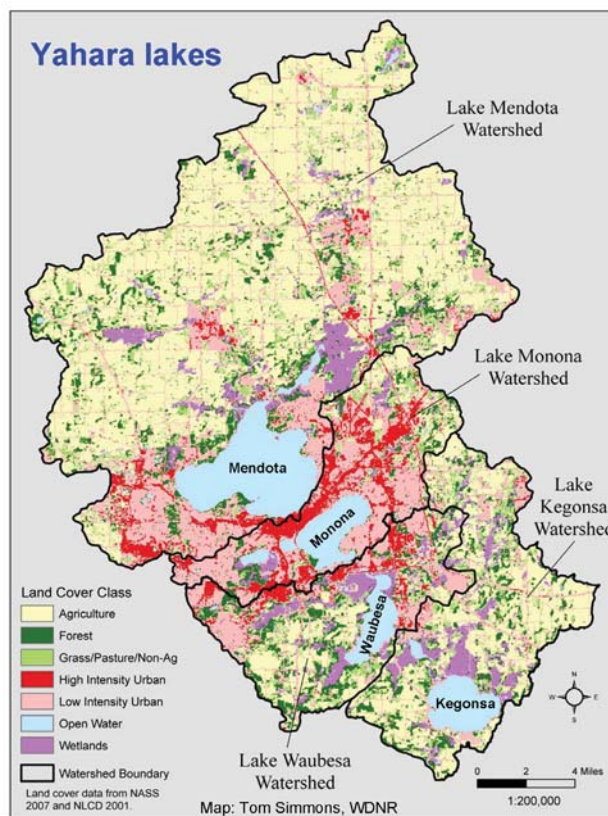
Map 24. Token Creek Subwatershed



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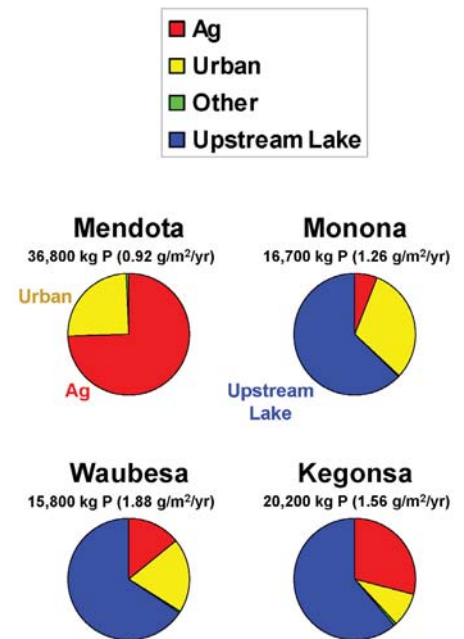
Sun Prairie features Harbison and Pederson Tributaries. Harbison Tributary is a valuable resource as a cold water source for Token Creek and a nursery source for reproduction of brown trout, and recruits fish for Token Creek. Pederson Tributary offers good water quality, high groundwater discharge and habitat, and could benefit from restoration.

The Yahara Lakes system is included in the Rock River Total Maximum Daily Load (TMDL) project establishing necessary reductions in discharge of sediment and phosphorus. Implementation measures and opportunities are expected to be shared among the various agricultural and urban



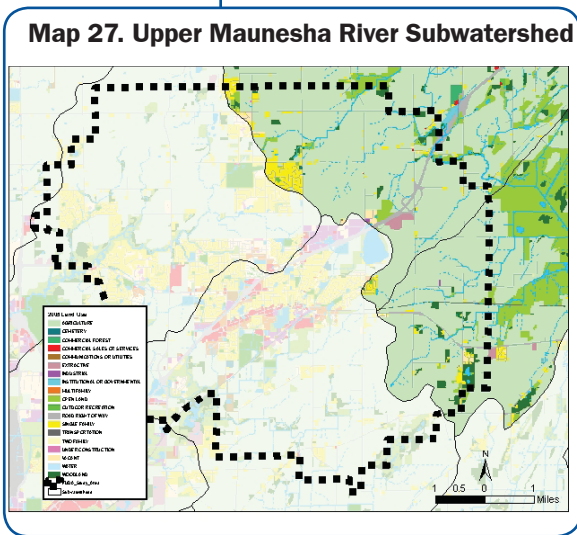
P Loading Sources:

SWAT 2000 modeling estimates for land uses; 1980-2007 monitoring data for lake outlets



Source: R. Lathrop & K. Kirsch, WDNR

11. Converse, D. 2012. Yahara CLEAN Strategic Action Plan for Phosphorus Reduction – Draft. Prepared for the Clean Lakes Alliance



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control, cleansing surface water of contaminants including sediment, heavy metals and pesticides, and providing important wildlife habitat, food-web support, movement corridors, and scenic qualities. **As the City of Sun Prairie FUDA study area continues to transform from agricultural to urban land uses, retaining these wetland functions and values is important.**

Wetlands and former wetlands pose significant constraints to development such as high water table levels, potential flooding, and poor soils. Former wetlands with hydric soils are a strong indicator of potentially restorable wetlands and **whenever possible, degraded wetlands should be enhanced** to create a self-sustaining, self-organizing ecosystem with ecological functions similar to historic or reference areas.

Three general approaches for wetland restoration are re-establishing hydrology consistent with historic patterns, controlling contaminants from entering into the wetland, and promoting native species while controlling invasive species. **Restoring wetlands should be considered in a cumulative context, whereby if more wetlands within a watershed are restored, the greater the improvements in water quality. Ensuring landscape connectivity between wetlands is also important** for animal movement and dispersal, and controlling invasive species, such as reed canary grass, hybrid cattails, and willows. For more information and strategies for restoration see the Natural Resources chapter. The following restoration sites in the study area were identified by the RPC Restoration Ecologist in 2013:

- **Patrick Marsh** is identified as a Natural Resource Area in the Dane County Parks and open Space Plan. Wise stormwater management (both quality and quantity) in areas draining to the marsh is crucial to retain this resource and passive recreation area.
- **Along Token Creek as the stream drains into Cherokee Marsh.** This wetland serves as a major habitat resource for the western most section of the study area. Restoration efforts should prioritize restoring this riparian wetland nearest the Token Creek Preserve Park.
- **Other valuable wetlands** were identified by the RPC Restoration Ecologist in 2012 and are on Map 28.

The majority of wetlands in the Sun Prairie FUDA study area are severely degraded reflecting the historic agricultural influence in the area. More detailed wetland evaluations and restoration plans are needed to enhance the potential functions and values associated with these areas. **Existing wetlands should incorporate a buffer of 75-100 feet for water quality protection and be included in park and open space areas as Environmental Corridors. The best strategy is to avoid these areas completely and direct future development to better suited areas.**

Wetlands of the greatest quality, such as Cherokee Marsh, should have at least a 700 foot buffer. Moderately disturbed wetlands should have at least a 300 foot buffer to prevent fur-

ther degradation. County and municipal zoning prohibits development in wetland areas of 2 acres or greater. Wetlands, regardless of size, are also regulated by other state and federal laws. Existing laws and regulations, however, do not always provide adequate protection.

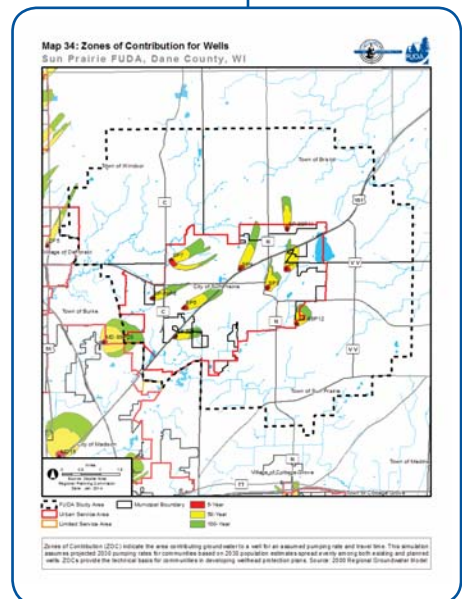
Groundwater

Surface water, shallow groundwater, and deep groundwater are closely interconnected. Precipitation that infiltrates into the soil enters the groundwater system to provide our drinking water and fill our streams, lakes, and wetlands. The geologic layer that separates the shallow groundwater and the deep groundwater is absent in the study area. This means that deep groundwater depends on the shallow groundwater for recharge (see [Map 30](#)) and can be more susceptible to contamination from surface activities.

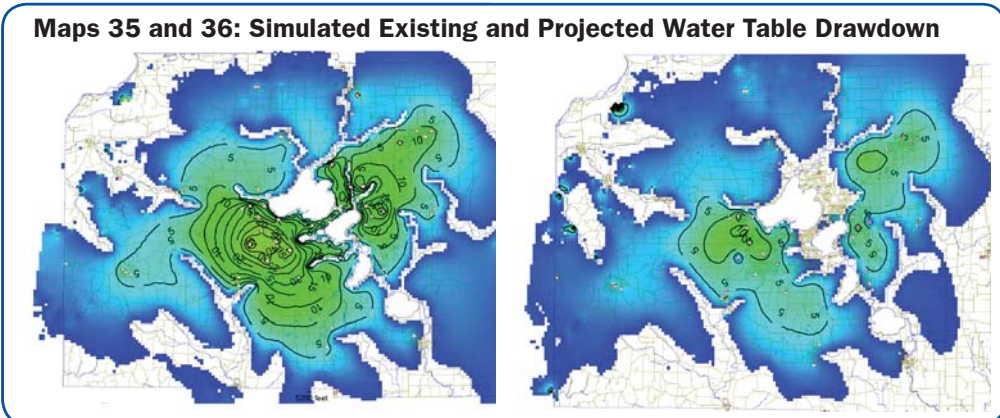
The groundwater/surface water balance can be upset by human activities. Almost all groundwater in Dane County originates as local recharge (Bradbury 1999). Moreover, activities that alter groundwater quality can make water unsuitable for domestic and industrial uses, and can have adverse impact on aquatic habitats. *High capacity municipal wells capture water from the deep aquifer often at the expense of smaller streams such as Upper Koshkonong, Starkweather, and Token Creeks.*

Rural private wells generally draw from the shallow groundwater table. This shallow aquifer is more susceptible to contamination from activities on the land surface. Research indicates that over-applying nitrogen fertilizer is elevating nitrate levels in the shallow groundwater. Elevated salt levels stemming from winter salt use on roads in both the shallow and the deep groundwater is another emerging concern. Once groundwater becomes contaminated it is expensive and difficult to restore its original condition.

[Map 34](#) shows the 5-, 50-, and 100-year water contribution zones for municipal wells pumping at 2030 rates in the FUDA study area. These provide the technical basis for community Wellhead Protection Plans. [Maps 35 and 36](#) show historic and projected lowering of the water table due to the cumulative withdrawals across Dane County. The following planning considerations can minimize the adverse impacts of development in the FUDA study area:



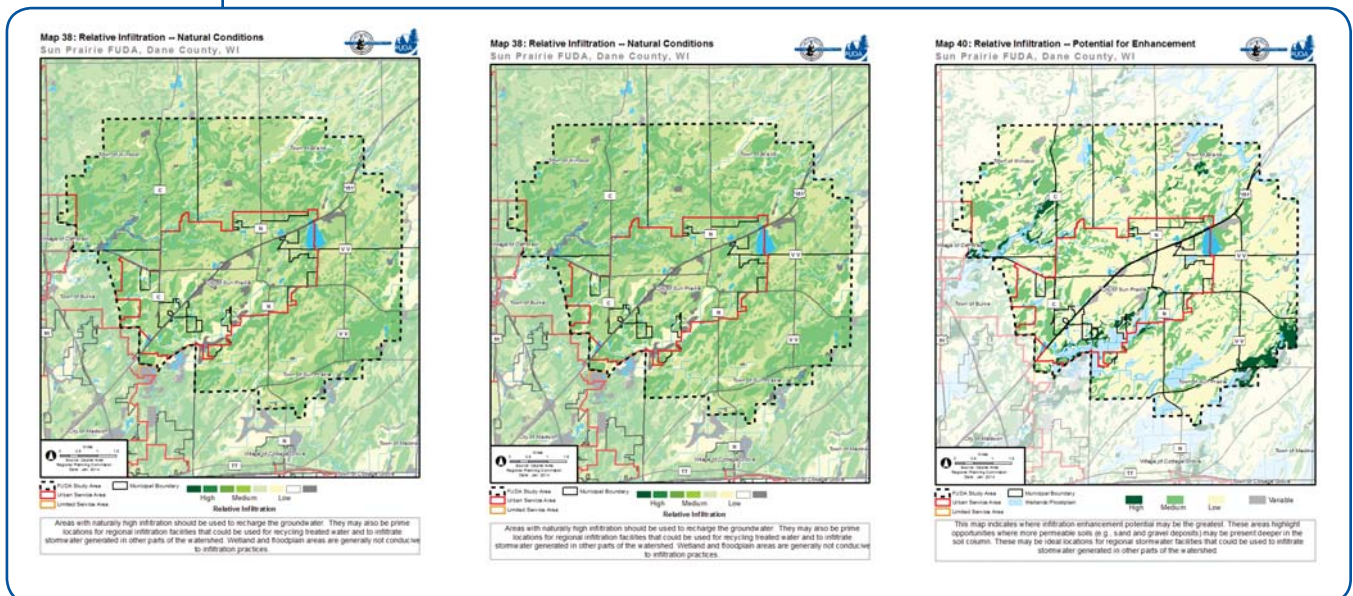
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- **Preserve areas suited for active and passive recharge.**
- **Locate future municipal wells outside capture zones for springs.**
- **Increase water conservation with low flow fixtures and rainwater harvesting for irrigation purposes.**
- **Enhance stormwater infiltration by directing downspouts to vegetated areas and lawns, installing rain gardens, and constructing active infiltration basins.**

Maps 38, 39, and 40 show various infiltration opportunities that can minimize future negative impacts and retrofit previously developed areas when opportunities permit.



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Open Space Corridors

Open space corridors promote important values for protecting water quality and habitat for fish and wildlife, and for recreational pursuits. An open space corridor is defined as a water feature and the riparian land that contacts the water, and can include upland areas (see [Map 41](#)). Open space corridors are a required under the federal Clean Water Act and Wisconsin state administrative codes (identified as environmentally sensitive areas, or ESAs, in NR 121). Open space corridors provide the network of a continuous open space system amongst communities, to be expanded upon where opportunities exist and to provide additional recreational easements and open space areas. **The 75-100-foot Environmental Corridor buffer is generally inadequate for protecting habitat, biodiversity, and ecosystem sustainability, which require 150 to 250 foot buffers.**

There are two opportunities to create long continuous open space corridors within the study area. The first will be along the upper reaches of Token Creek to connect the Token Creek Preserve Park, southwest to Token Creek County Park. The second is southwest and con-

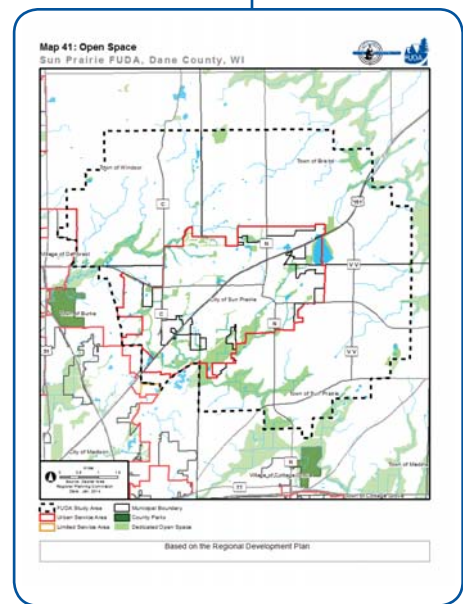


sists of several open water features associated with gravel operations. The Sun Prairie FUDA study area does not have many opportunities to create continuous open space corridors that will link large and important habitats to one another. Most of the natural resources here are severely degraded by agriculture. The three ecosystems of moderate quality; Token Creek, Patrick Marsh, and a large prairie resource in the northern half of the study area, are all very distant from one another and lack natural cover or landform that could link them.

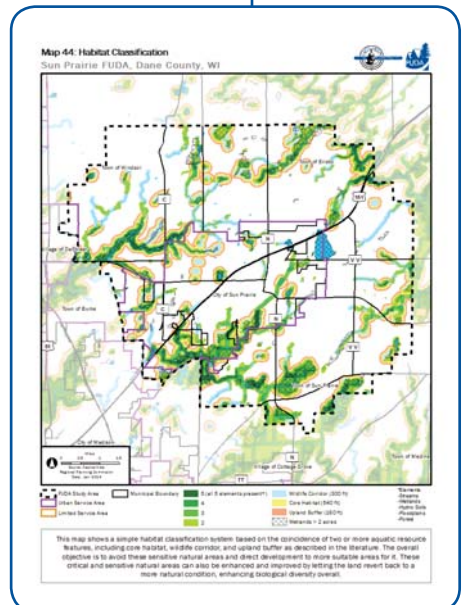
Riparian land adjacent to streams and rivers provides vegetation that is essential to stream ecosystem function at both reach and watershed scales. These areas provide water quality, channel stability, overflow areas, sediment retention functions, and habitat. Organisms living within the stream are critically dependent upon shade, woody debris and leaf litter from the terrestrial environment. Conserving riparian vegetation is important for controlling sediment loss. In riparian restoration planning, remember to accommodate the shifts and changes in area as streams meander throughout time. Remember to consider future climate change stressors also. ***When possible, expand buffers beyond 100 feet to increase resilience and redundancy in riparian ecosystems.***

Restoration across public and private lands is important for maintaining connectivity, size, and quality of riparian habitat (see [Map 45](#)). Riparian vegetation around Token Creek has the potential to be the most valuable resource for wildlife outside of Cherokee Marsh. Another riparian area resides within the Cherokee Marsh featuring a series of parallel drainage channels with invasive species. The following are recommended for riparian restoration:

- ***Riparian re-establishment and restoration requires public-private collaboration.***
- ***Riparian areas can be designed to reduce stormwater runoff and sediment input into water bodies from immediately adjacent land areas.***



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- *Riparian areas provide natural landscape breaks in densely developed urban environments, providing relief from perceived crowding.*
- *Riparian areas need to be maintained to prevent invasive plants from establishing themselves.*
- *Public funding may be available for establishing riparian areas as part of wetland restoration and stream restoration funding.*
- *Riparian restoration benefits can be maximized by including watershed and habitat connectivity.*

Endangered Resources

The City of Sun Prairie FUDA study area contains a diverse array of streams, wetlands, woodlands, and grassland habitats that support numerous wildlife species, and some are threatened or endangered (**Table 14 Map 45**). Finding a threatened or endangered species does not indicate that development cannot occur. Rather, prescribed management practices can be used to avoid impact.

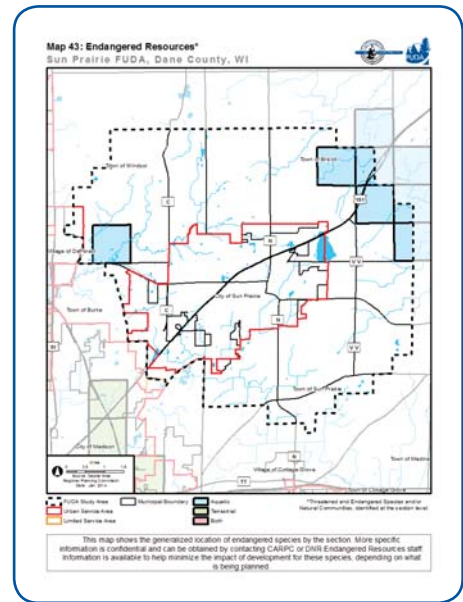
The WDNR Bureau of Endangered Resources (BER) maintains a statewide database representing the known occurrences of rare species and natural communities. Where there is the possibility or likelihood that an endangered resource may be present, an Endangered Resources Review by WDNR may be necessary. The RPC Restoration Ecologist can provide more current assessment, recommendation, and assistance especially during the more detailed and technical design work associated with development scenarios, plans, or projects. Since occurrences are generally site specific, ***suitable habitat should undergo a detailed professional review and, depending on the occurrence, BER staff should be consulted for specific actions.*** Details can be found at <http://dnr.wi.gov/topic/endangeredresources/biodiversity.html>.

While protecting water resources from human activities such as agriculture and urban development is obvious, it is often less apparent that the terrestrial areas surrounding our surface waters also serve as “core habitat” for many semi-aquatic species (amphibians and reptiles). According to the BER, *90% of the occurrences of threatened and endangered species in Dane County are located within 300 feet of streams and 700 feet of wetlands or small ponds.* Scientists identify “umbrella species” in the hopes of saving a whole range of animals and plants to maintain overall biologic health and biodiversity. In studies from the early 2000s, Semlitsch proposed stratified criteria that would include terrestrial zones adjacent to wetland habitats. Core Habitat areas are not intended to be restrictive to development or represent “no-build” zones. Instead, these areas highlight ecological connectivity and open space amenities (e.g., open space and wildlife movement corridors, biofuels, community supported agriculture, etc.).

In general, most natural resource objectives can be accomplished within ***a corridor 300 feet from the edge of a stream or wetland, and 700 feet from the edge of an exceptional wetland or pond greater than two acres with quality upland habitat nearby.*** The overall conservation objective should be to ***direct development away from sensitive and critical resource***

areas. If that is not possible, it is incumbent on planners and engineers to design developments to provide equal or greater natural resource protection. This can be accomplished through advanced conservation design techniques, restoration of other areas, and more based on the type of development, site characteristics, and options available.

Prairie restoration (Map 46) is site specific and the few remaining prairies in southern Wisconsin likely remain because depth to bedrock is too shallow for farming. Three prairies of interest exist within the Sun Prairie FUDA study. They are found along the northern half of Token Creek Preserve Park, along the edge of Patrick Marsh, and northwest of the intersection between Happy Valley Road and CO HWY N. The latter has ample space (58 acres) to support several area dependent songbird species, and appears to have different management regimes, allowing for greater biological diversity, and coexists well with the adjacent to existing development. Restoring prairies will benefit habitat for wildlife, promote rainwater infiltration, reduce overland runoff, and help to recharge groundwater. As with other restoration projects, a guiding image or ideal target community structure is important for defining the restoration goal.



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Table 14. Endangered Resources in the City of Sun Prairie FUDA Study Area

Endangered	Threatened	Special Concern	Natural Communities
None	Plants	Fish	Calcareous Fen
	Prairie Parsley	Least Darter	Southern Sedge Meadow
	Small White Lady's Slipper	Mammals	Wet-Mesic Prairie
	Tufted Bulrush	Western Harvest Mouse	

Source: WDNR Natural Heritage Inventory Database (11/2012)

Parks and Open Space

The *Dane County Parks and Open Space Plan* indicates various existing and proposed Natural Resource Areas, land and water trails, recreational parks, and forests, (see **Maps 47a and b**), including, include the Token Creek, Koshkonong Creek, Patrick Marsh, and Mauneha River Natural Resource Areas and three proposed trails. **Local future land use maps and plans should incorporate these regional elements into development designs. Dane County Parks staff should be consulted early in development planning.**

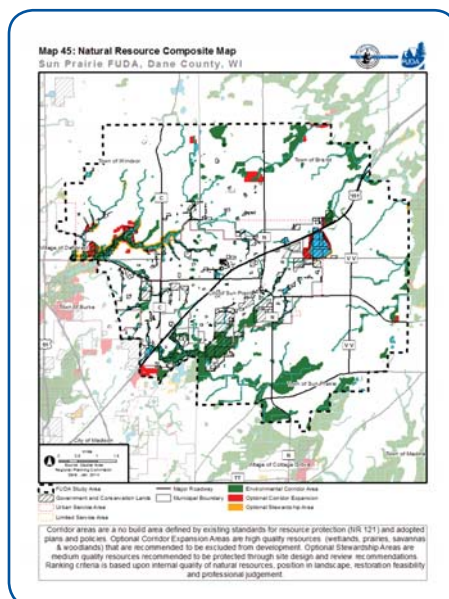
Urban Development Impacts on Natural Resources

By year 2030, almost 580,000 people are anticipated to reside in Dane County – an increase of almost 36% over the 2010 population. **This urban growth and development must be properly planned and managed to mitigate the adverse impacts and protect groundwater and surface water quality, the wildlife communities they support, and our quality of life.** The impacts of urban development on natural resources comes from interruptions in several natural processes:

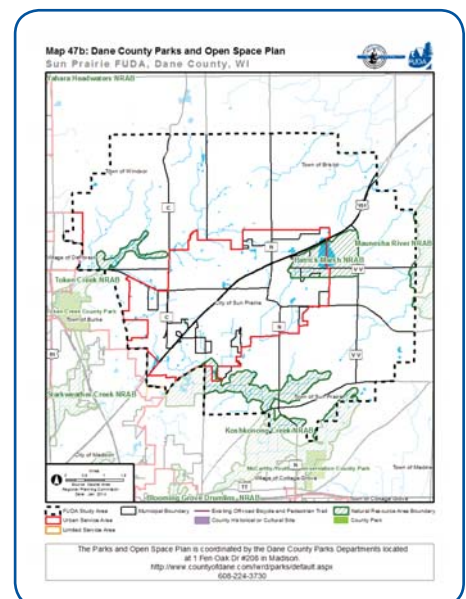
- Increased volumes and peak discharges of stormwater runoff from impervious surfaces in the absence of stormwater management facilities. This changes the width, depth, vegetation, and bed material of receiving streams and adversely impacts stream habitat health. See **Table 16** in the Natural Resources Chapter.
- Pollution from urban activities are carried in stormwater runoff in the absence of stormwater treatment facilities. In this region, due to the dominance of agricultural land uses, pollution loads change from agricultural pollution to urban pollution.
- Loss of habitat and connectivity due to development creates isolated habitat that cannot support wildlife (**Figures 34 and 35**). In the study area, *there is limited potential to increase habitat connectivity through contiguous corridors or stepping stones.*

Efforts focused on maintaining pre-development hydrologic characteristics, water quality, and habitat quality can help mitigate or offset the negative effects. Use these strategies to maintain and improve the integrity of natural resources through proactive planning:

- **Approach local issues from a regional watershed perspective.**
- **Direct development away from sensitive natural resources to more suitable areas.**
- **Increase land use efficiency through compact development patterns and infill and redevelopment.**
- **Allow land use density transfers (e.g., Transferable Development Rights) away from sensitive natural areas to areas with lower natural resource risk.**
- **Incorporate and integrate natural features into development design and applying conservation design principles.**
- **Consider the long-term impacts when selecting a site location, especially the soil and water resource constraints and opportunities.**
- **Minimize impervious areas in design.**



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- *Reduce pollution sources on all land surfaces.*
- *Look at collaborative interjurisdictional solutions with broader effectiveness.*
- *Tailor stormwater management measures and strategies to the susceptibilities and protection needs of the environment instead of generalized adopted minimum stormwater standards.*

Agricultural Resources Summary

Agricultural Land Use Trends

As populations increase, communities will need to provide land for development both within the existing urban area through infill and redevelopment and in new areas adjacent to existing developed areas. Urban development can incorporate urban agriculture, such as community gardens, community supported farms, or an agrarian community.¹⁶

The northeastern quadrant of Dane County contains some of the region's most productive and economically valuable agricultural land and includes the City of Sun Prairie and Towns of Bristol, Burke, Sun Prairie and Windsor. Moreover, Sun Prairie continues to experience significant population growth and agricultural land is often developed to accommodate this growth. *Agricultural land's important functions and benefits must be weighed when considering development, preservation and other land use decisions that may impact the agricultural sector.*

As of 2010, 18,820 acres of agriculture¹⁷ were in the study area, over 4,000 less acres than were considered agriculture in 2000. Development acreage across urban and rural areas increased about 1,000 more acres than this amount.¹⁸ The City of Sun Prairie had 1,470 acres of agricultural lands in 2000 and 524 acres in 2010 (500 in existing USA). Sun Prairie development increased several times this amount indicating that a significant development also occurred on lands that were not agriculture or already converted from agriculture before 2000.

Agricultural Parcels, Base Farm Tracts, and Contiguous Blocks

Agricultural land is divided into parcels and often these parcels host other land uses, such as woodlands or water. Parcels are important to examine because agricultural land is sold and regulated in parcels. Consequently, *preservation recommendations must be useful at the parcel level.* Burke and Bristol experienced parcel losses due to conversion and/or assembly, as supported by the increasing maximum, while the towns of Sun Prairie and Windsor saw an increase in parcels, potentially due to rural splits. Windsor has urban service area and planned development that could also account for many of the splits. Parcel size distribution in the study area shows parcels 35 acres (the typical zoning standard) or less account for the most parcels, while accounting for 45% of the land area.

¹⁶ Duany, Andres and Duany Plater-Zyberk & Company Garden Cities: Theory & Practice of Agrarian Urbanism. The Prince's Foundation for the Built Environment. 2011.

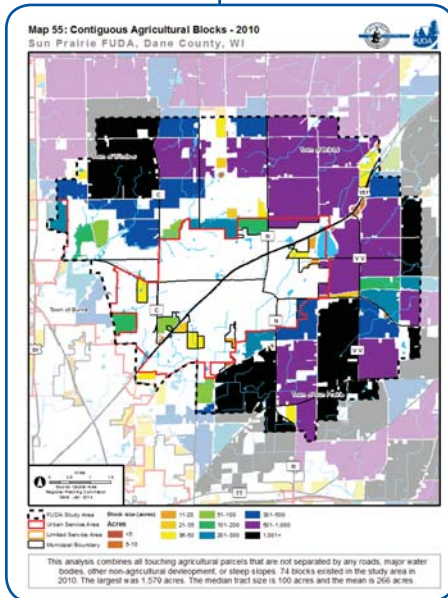
¹⁷ A portion of the agricultural land that converted out of agricultural land use category were recategorized under their true land use as data collection advanced and became more refined. For example, farm ponds went from this category to the "water" category, or woodlands were delineated separately in 2010 accounting for a large increase in woodlands and a loss in agriculture. This may result in a decrease in agricultural land use acreage, yet the actual cultivated or pastured acreage may not change.

¹⁸ Farmland Loss Mitigation Issue Paper 1: Farmland Loss in Dane County. The Capital Area RPC. 2008.

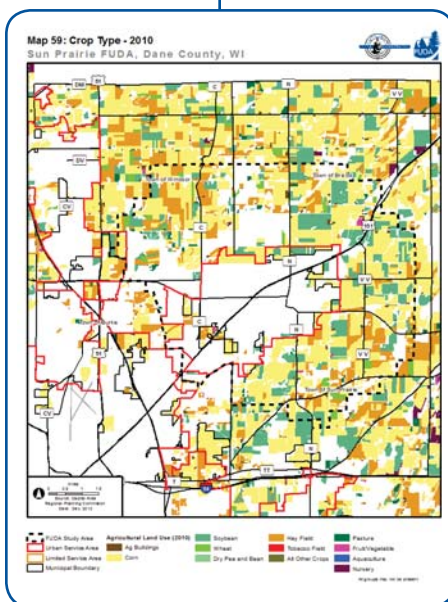
2010 Ag Parcel Facts:
890 parcels
30 acre average
17 acre median
Largest parcel 53

2010 Ag Tract Facts:
329 base farm tracts
60 acre average
38 acre median
Largest tract 586

2010 Ag Block Facts:
74 contiguous blocks
266 acre average
100 acre median
Largest block 1,579 Windsor



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The approximate number of base farm tracts, joined bordering parcels under the same landowner, reveals that the typical land owner holds 3 neighboring parcels on average,¹⁹ and the largest land area contributions are from tracts 101-200 acres.

Contiguous agricultural blocks measure agricultural parcel masses regardless of owner. The contiguous blocks in **Map 58** within, near, or bordering urban jurisdictions, rural subdivisions and highways in the study area show increased fragmentation. A large number of block between 500 and 1,000 acres exist throughout, especially in central Windsor, Bristol south of Highway 151 and the Town of Sun Prairie directly south of the city and at the south eastern corner. This last block is adjacent to the first, second and ninth largest blocks in the County. The size distribution breakdown for study area blocks shows that blocks over three hundred acres account for 84% of the area. These **larger contiguous blocks near developing areas could be incorporated into development design and provide urban agriculture and community separation amenities to future residents.** Smaller blocks, especially near developing areas, might infer where long-term farming may not be as viable. **If smaller blocks or blocks in near-term growth areas are considered valuable for agricultural use, these areas may require special efforts to preserve, or to adopt practices to reduce the burden from expanding urban development.**

The agricultural concentration in Burke is under 50% agriculture, while the Towns of Sun Prairie, Windsor, Bristol and as far as York reach the highest agricultural concentration in the county, ranging from 75% to 90% of all land uses. Areas exist outside the study area at over 50%, including the interface of Madison CUSA and Sun Prairie USA. Where agricultural concentration is declining due to encroaching urban and rural development, and landowners and the municipality want to preserve agriculture, a strategic approach to preserving existing agriculture or employing innovations in agricultural ventures and practice could help to ensure viable farmland and operations.

¹⁹ The true number of farm operations may be less than tracts because an owner may lease out his or her land to another for farming.

Operation Types

The study area and these jurisdictions support livestock production and row crop operations (Map 59 and Map 60). According to the 2010 Land Use Inventory, the livestock operations are primarily beef cattle and dairy cattle. The most dominant crops are row crops including corn, soy, hay (includes alfalfa). Of note, Bristol hosts 36 acres of nursery/ floriculture sites, Burke hosts 14 fruit tree acres, the Town of Sun Prairie has an apple orchard, 83 nursery/greenhouses acres and 2 acres of polyculture/ Community Supported Agriculture (CSA), and Windsor hosts 37 acres of nursery greenhouse and 8 acres with food trees. Of these, 63 acres of tree/nursery, all vegetables (including the polyculture/CSA) are located in the study area.

Soils and Support Services

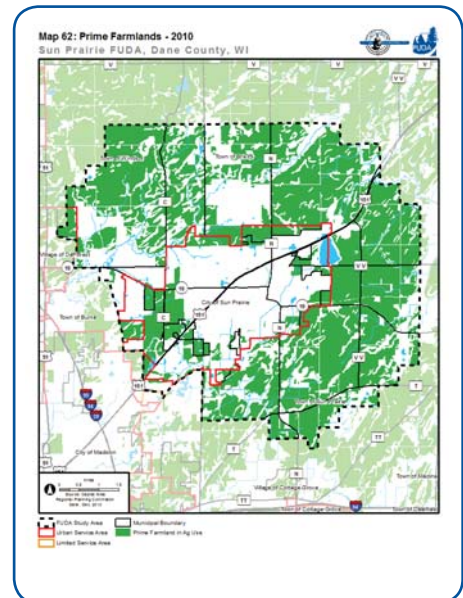
Successful agricultural operations depend on several inputs including quality soil, labor, and access to support services. Soil characteristics associated with productive agriculture are also ideal for development. Soil quality is high near Madison's planned Northeast neighborhood, in Windsor away from Token Creek, in Bristol directly bordering the city boundary to the north and east, and in the Town of Sun Prairie hugging the city's eastern border with scattered quality soils to the south.

These areas could be maintained as community separation and urban agriculture.

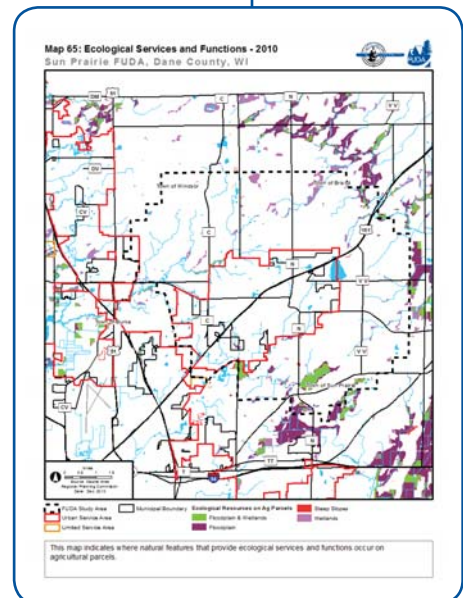
Determining where support services are located can indicate areas that are well suited for continued farming, and reveal where additional services may be warranted. such as dairy plants are generally concentrated in urban areas, highlighting the important interdependence between rural and urban areas. For example, the City of Sun Prairie hosts food warehouses, processing facilities and several dairy plants. ***As the rural areas in the study area urbanize, consider targeting the areas near major highways for expanding processing, other value-added facilities, warehouse and distribution centers that serve the surrounding agricultural sector.***

Agriculture and Other Land Uses

Agricultural land often interfaces with other land uses. For example, parcels hosting agricultural land and natural resources play a significant role in maintaining a certain level of environmental quality. In addition, agricultural land located adjacent to open space corridors may be eligible and targeted for natural resource conservation easement funds. Conservation easements allow a small proportion of land for agriculture. Typically, agricultural lands in these areas are well-suited for restoration or stewardship practices that improve the integrity and health of the neighboring natural communities and resources. ***Conservation efforts should be pursued with the idea that conservation areas would not produce losses for the land owner. Restoration projects could be completed through pollutant trading opportunities in the Rock River TMDL project discussed in the Natural Resources chapter.***



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Farmland Preservation Planning

All town jurisdictions have some form of agriculture conservation and some have agricultural preservation. All except for Burke participate in Agricultural Exclusive Zoning at the 1/35 acre standard. In addition, Windsor has a Purchase of Development Rights Program and a designated Agricultural Enterprise Area. In addition, the City of Sun Prairie has cooperative or boundary agreements with both Windsor and Bristol, and is party to (with Madison and DeForest) a cooperative plan for the dissolution of Burke over the next 20-25 years. These boundaries and preservation efforts are on *Map 66. Sun Prairie could establish a boundary agreement with the Town of Sun Prairie also.*

Each participating community has an adopted Comprehensive Plan and/or is part of the Dane County Farmland Preservation Plan that presents background, goal, objective, policy and program information. Local communities must determine how to best use this information in decision-making processes that impact agricultural land within the larger context of regional preservation and development.

Additional ECR Resources

In addition to these chapters, a Sustainability Audit and Healthy Community Planning Checklist provide additional analysis on the state of the community. As with many communities, the older areas of the community are often more compact and laid out on an efficient grid pattern. Over time, development has separated and isolated housing and jobs on larger blocks with wider less connected streets. These two tools offer specific recommendations for adjusted zoning codes and other ordinances to enable the community to attain its goals for a livable healthy community. Sun Prairie can work with the RPC and its public health partners to perform a Health Impact Analysis on proposed plan updates and development proposals.

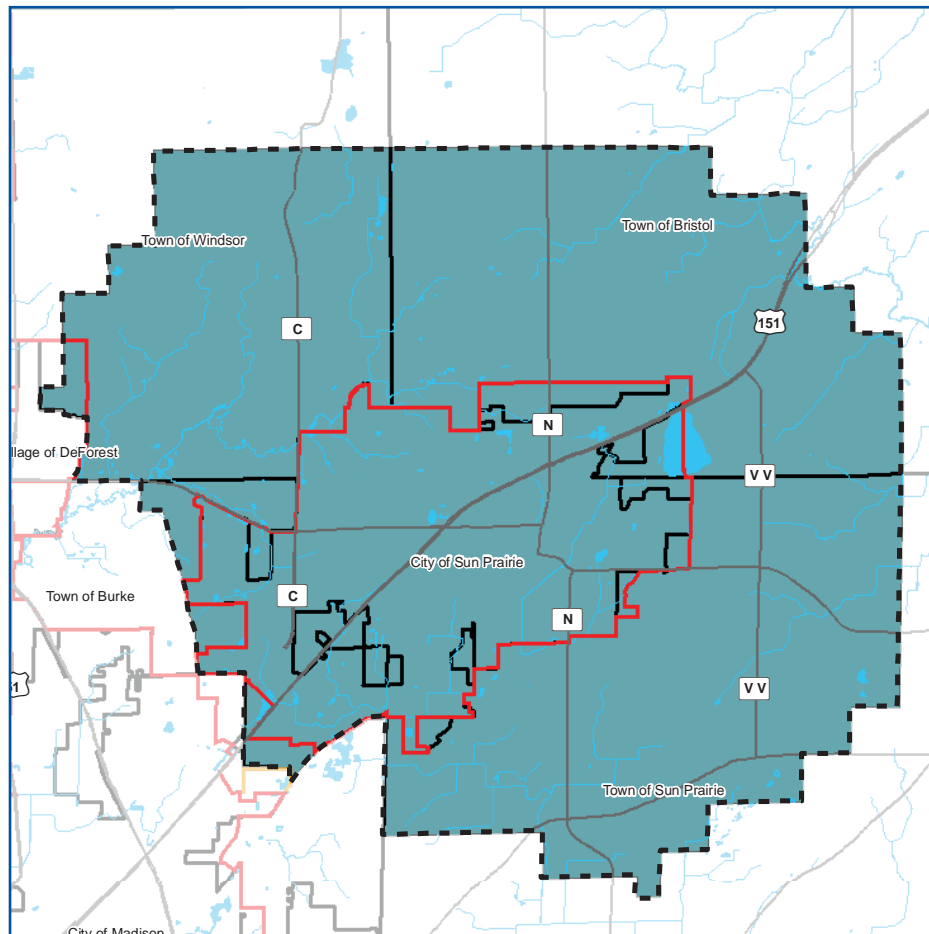
Conclusion

The City of Sun Prairie shows a commitment to cooperative intergovernmental planning and growing efficiently so as not to compromise the integrity of natural and agricultural resources as they move forward. As populations grow and urban areas accommodate these new residents, communities must consider the demographic, environmental and agricultural realities that will shape their future and the livelihoods of their residents. The Environmental Conditions Report offers several variables and analysis to help communities make regionally and locally informed decisions as they build-out their communities. This tool can assist communities as they work with developers, community residents, CARPC and other governments that have a role in Sun Prairie's peripheral development and preservation decisions and similar decisions made in the surrounding towns.



City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



Introduction

Introduction

Future Urban Development Area (FUDA) Planning was charged to the Capital Area Regional Planning Commission (CARPC) and local communities with urban service areas (USAs) when the Commission was restored in 2007. Local communities use the USA amendment process to seek CARPC and Department of Natural Resources approval to expand urban development on a full range of services, including public sewer and water. The USA included in this project is the northeastern portion of the Central USA in Madison and the Town of Burke, and invited the Towns of Sun Prairie and Westport, City of Sun Prairie, and Village of Waunakee, with assistance from the Capital Area Regional Planning Commission.

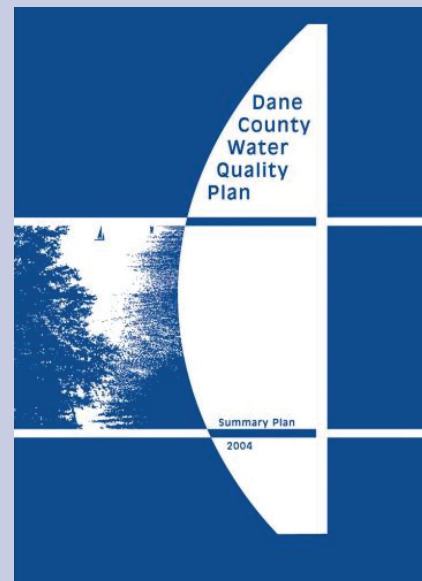
Future Urban Development Area (FUDA) Planning is an intergovernmental proactive long-range planning process that was first named in local resolutions petitioning the Governor to establish the RPC in 2006. Item 7 in the resolution regarding updating the *Dane County Water Quality Plan* reads,

“The Plan shall also define a 25-year Future Urban Development Area with 5-year updates. The Plan shall be developed in cooperation with area communities, including towns, and shall consider adopted comprehensive plans and intergovernmental agreements. The Plan shall be developed as follows:

- a. CARPC staff shall provide communities with **environmental condition reports** consisting of maps, text, and information identifying environmental issues that should be addressed.
- b. [omitted]
- c. The Plan, which will identify the 25 Future Urban Development Area, shall be **based on the requirements of NR 121** and

Relevant Governing Documents

City of Sun Prairie Comprehensive Plan
Burke, DeForest, Madison & Sun Prairie Cooperative Plan
City of Sun Prairie Zoning Ordinance
Sun Prairie West Main Street Corridor Plan
Sun Prairie Westside Plan
Town of Burke Land Use Plan
Town of Bristol Land Use Plan
Windsor Comprehensive Plan: 2025
Town of Sun Prairie Comprehensive Plan: 2003-2023
Sun Prairie-Bristol Intergovernmental Agreement (2005)
Sun Prairie-Windsor Cooperative Plan (2012)
Dane County Parks and Open Space Plan
Dane County Water Quality Plan
Dane County Land Use and Transportation Plan: Vision 2020



shall also consider other factors including the impacts on **natural and built systems, the efficient use of land including urban densities, and the ability to efficiently provide services to support the development and farmland preservation planning.**

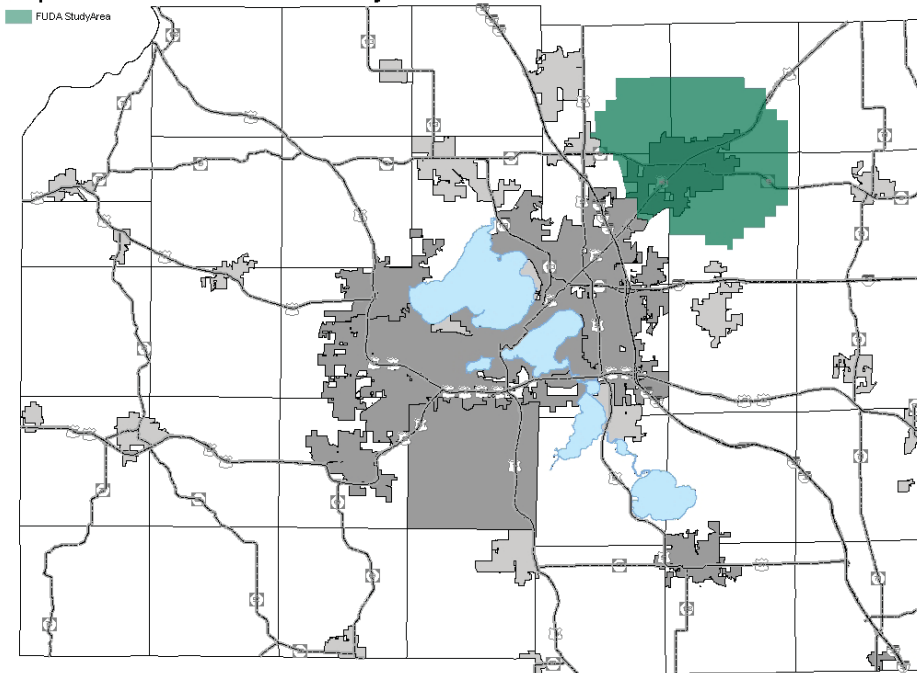
- d. There shall be separate rules and policies for limited service areas.”

This Report fulfills “a. CARPC staff shall provide communities with environmental condition reports consisting of maps, text, and information identifying environmental issues that should be addressed.” This report is organized into three principle sections (1) Community Development, (2) Natural Resources, (3) Agricultural Resources, and (4) Other Resources based on the best information available. The natural and agricultural resources sections are assets assessments. The community resources section assesses population and demographic trends, land development trends, projected future population, and the land supply and demand that could result. Finally, the ECR provides additional supplements including a Healthy Community Planning Checklist and additional research explaining selected environmental factors.

The ECR provides information for these communities to evaluate where development could occur, where resources should be protected and where both can occur together when they fulfill the resolution reading “the Plan, which will identify the 25 Future Urban Development Area, shall be based on the requirements of NR 121 and shall also consider other factors including the impacts on natural and built systems, the efficient use of land including urban densities, and the ability to efficiently provide services to support the development and farmland preservation planning.”

Each FUDA project defines a *study area* to establish the outer limits of lands included in the analysis. The lands within the study area are

Map 1: Sun Prairie USA FUDA Study Area



Acres by jurisdiction:

C. Sun Prairie	9,290
T. Bristol	9,508
T. Burke	1,244
T. Sun Prairie	9,246
T. Windsor	6,575
Total Area	35,862

most likely to request USA amendments within the next 25 years. As noted in Map 1, there are 35,862 acres in the study area and includes the City of Sun Prairie and portions of the Towns of Bristol, Burke, Sun Prairie, and Windsor.

Map 2 provides a closer look at the study area.

Sun Prairie and the surrounding towns can integrate this information and planning considerations (highlighted in **blue bold text**) contained in this ECR into their comprehensive and neighborhood plans, and other governing document updates that could fulfill the Future Urban Development Planning Process outlined in the resolution. Once local actions are taken, these changes will update regional plans including the Dane County Water Quality Plan and the Land Use and Transportation Plan.

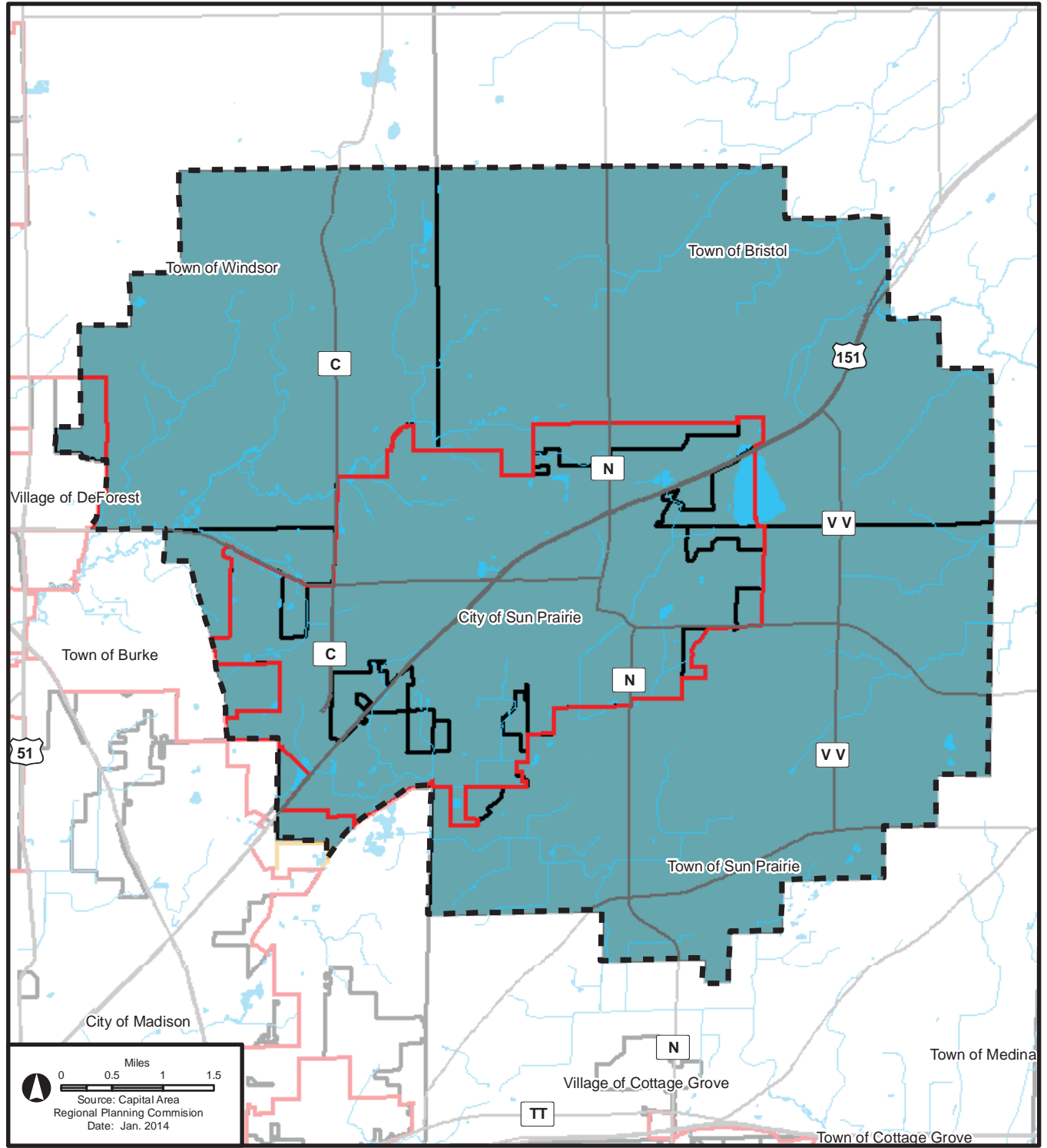
For more information please visit: www.capitalarearpc.org/Madison-SunPrairie_FUDA.html

To help advance these goals in Sun Prairie can work in collaboration with other local jurisdictions, other government agencies, non-profits, and businesses. The City of Sun Prairie and the towns of Bristol and Burke are encouraged to join the Capital Region Sustainable Communities Partnership.

Funding for this project comes from CARPC operating budget and grant funds from the Sustainable Communities Regional Planning Grant Program sponsored by US Department of Housing Urban Development . The communities participating in this grant are also members of the Capital Region Sustainable Communities Partnership. To learn more about the grant and the Partnership visit: <http://www.capitalarearpc.org/grant.html>

Map 2: Sun Prairie USA Study Area

Sun Prairie FUDA, Dane County, WI



0 0.5 1 1.5 Miles
 Source: Capital Area Regional Planning Commission
 Date: Jan. 2014

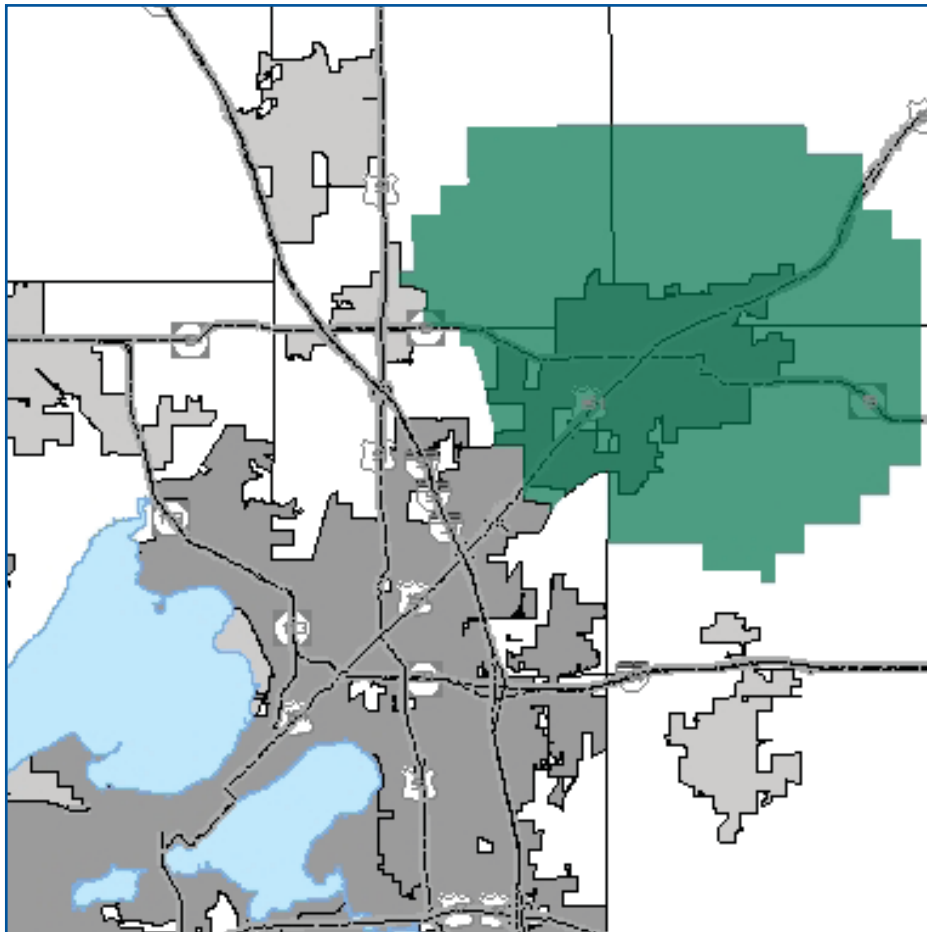
- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.



City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



Community Development

Introduction

The Community Development chapter provides historic population trends and estimated population growth for urban development. This chapter includes these major components:

- Community demographics,
- Housing and land use trends,
- Transportation,
- Redevelopment opportunities, and
- Estimate of future growth.

Urban: Served by public sewer and water and other services, allowing higher density than in rural areas.

Rural: Served by private on-site waste treatment (septic) systems and private wells, requiring lower density development than urban areas.

The Natural Resources and Agricultural Resources chapters that follow provide inventories and assessments of natural and agricultural assets to guide preservation decisions as development continues.

A. Community Demographics

Understanding how the makeup of the community’s population has changed over time is as important as understanding how the physical form of the community has changed. Sun Prairie demographic information offers insight into who lives in the community, what trends exist, and what the population may be like in the future.

1. Population and Diversity

The City of Sun Prairie grew from approximately 10,000 people in 1970 to nearly 30,000 residents in 2010. Sun Prairie had high growth rates averaging around 30% per decade during this period. Growth over the last decade, 2000-2010, was the fastest rate, at 45%. Across the county, Sun Prairie had one of the fastest growth rates in the 2000-2010 interval

Sun Prairie’s growth was rapid over the past 10 years, more than double the small city and villages rate and more than triple Dane County—only Verona had a similar growth rate during this decade. Growth in the 1990’s was generally consistent with the

Figure 1. Population Growth 1980-2010

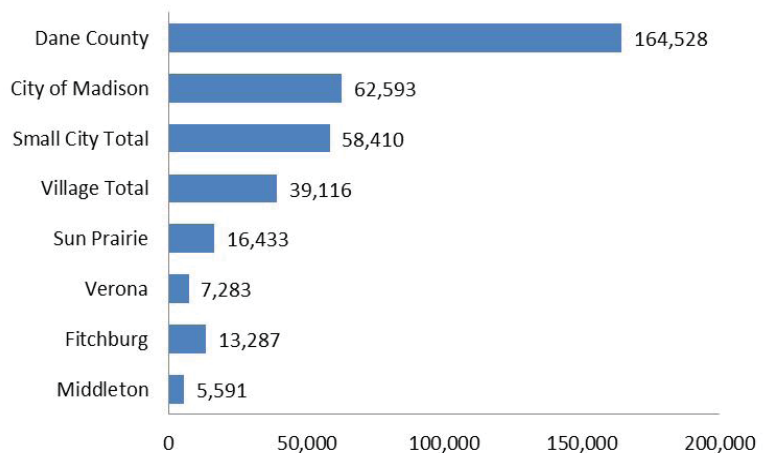


Figure 2. Growth Rates 1980-2010

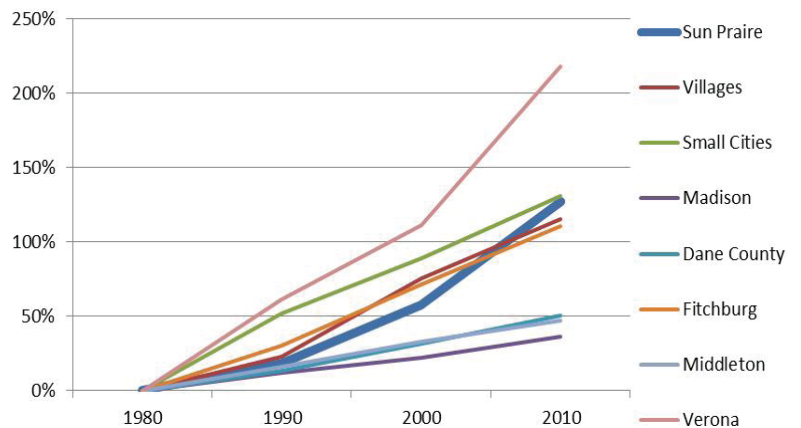


Figure 3. Racial and Ethnic Composition 1980-2010

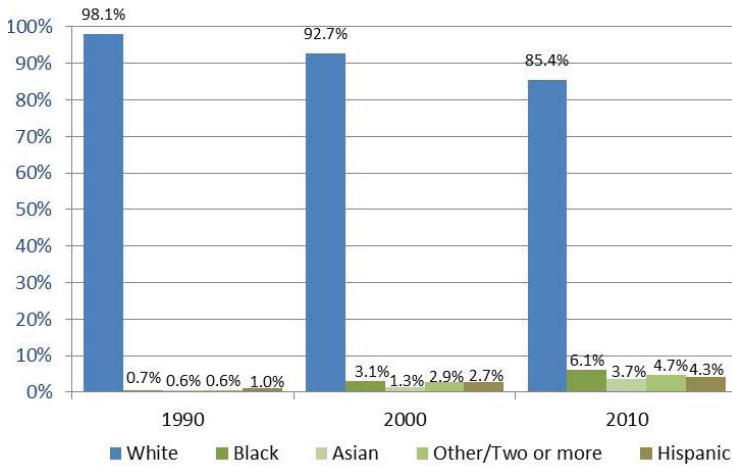


Figure 4. Growth by Race/Ethnicity 1980-2010

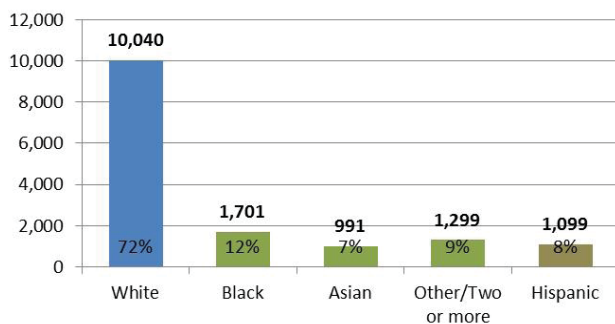
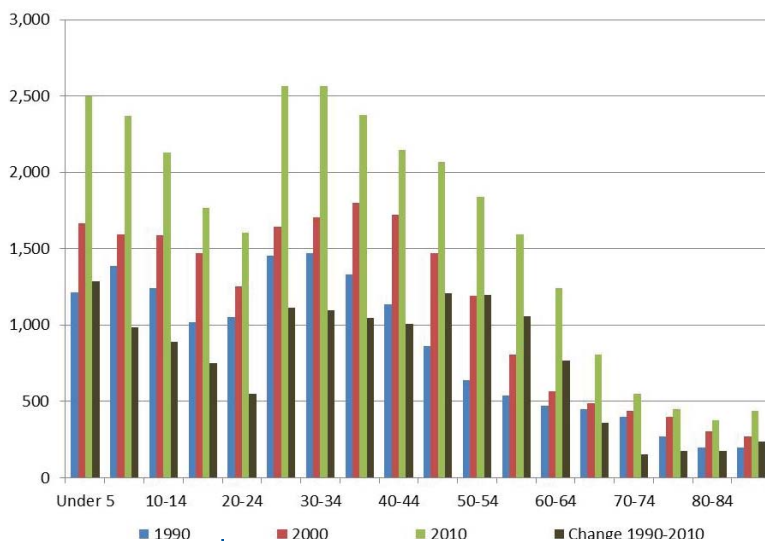


Figure 5. Age Distribution 1990-2010



²⁰ Sun Prairie has 24,362 White non-Hispanic residents, out of a population of 29,364 (83%) Note: Percentages do not add up to 100% because Hispanic is an ethnicity and counted independent of race.

small city and village average despite trailing these communities in the 1980's. Keep in mind that growth rates are relative to the population of that community. While Madison has observed a lower growth rate than small cities and villages over the past thirty years, in absolute numbers it has grown by more than 60,000 people, compared to nearly 100,000 in all small cities and villages combined. This is also important when comparing Sun Prairie's growth to Verona over the past 10 years; while Verona's rate was comparable to Sun Prairies, the actual population added in Verona was 40% of that added in Sun Prairie.

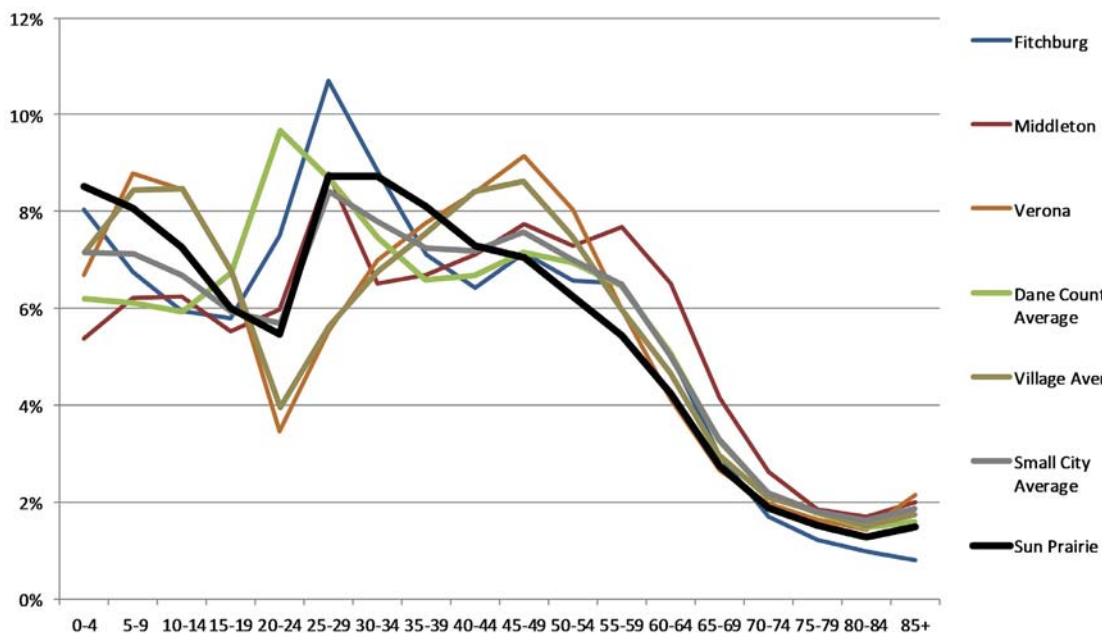
Sun Prairie's population has diversified since 1990, when 98% of the population was white. Since then, approximately 30% of the growth occurred in minority population groups, now representing approximately 17% of the population, while whites represent 83%.²⁰ This is slightly more than in Dane County (except Madison) with an increase between 1990 and 2010 of 25%. This suggests Sun Prairie's population, will continue to diversify in the future, similar to regional and national trends.

2. Age

Sun Prairie has experienced growth in every age group since 1990. The largest growth was in the 0-5 age group with nearly 1,300 total people, and is twice 1990 figure. The age cohort 25 to 60 grew at least 1,000 people with much of the growth in the lower age ranges occurring within the last 10 years. This may be attributable to easier access to credit for first time homebuyers prior to the recession beginning in 2008. The parallel increase in population between 0-15 and 25-45 suggests many new families have moved into the city in recent years.

Compared locally and nationally, Sun Prairie, like many other areas, shows some signs of aging, though not to the extent of other small cities in the County. The most pronounced increase in Sun Prairie is between 50 and 69. However, compared to other small cities in Dane County, Sun Prairie has one of the lowest rates of population above 50. In contrast, Sun Prairie has one of the highest rates of population below 20.

Figure 6. Age Distribution Comparison 2010



3. Income

The 2011 5-year American Community Survey (ACS) estimates indicate the median household income in the City of Sun Prairie was \$66,395. This median household income is about 7% higher for Sun Prairie households than Dane County households overall. Compared to other communities in the county, Sun Prairie generally has fewer households with incomes below \$25,000 and more households with incomes between \$50,000 and \$100,000.

These variables reveal the growing diversity of people living in Sun Prairie. This diversity of people expands across age, ethnic background, culture, physical ability, income and more. *As development is pursued, communities need to consider how land use, transportation, and other decision impact the equity of outcomes for all residents.*

Table 1: Median Household Incomes

Median Income	1990	2000	2010
Sun Prairie	\$35,301	\$51,345	\$66,395
Dane County	\$32,703	\$49,223	\$61,913
% of Dane County	107.9%	104.3%	107.2%

Figure 7. Income Distribution

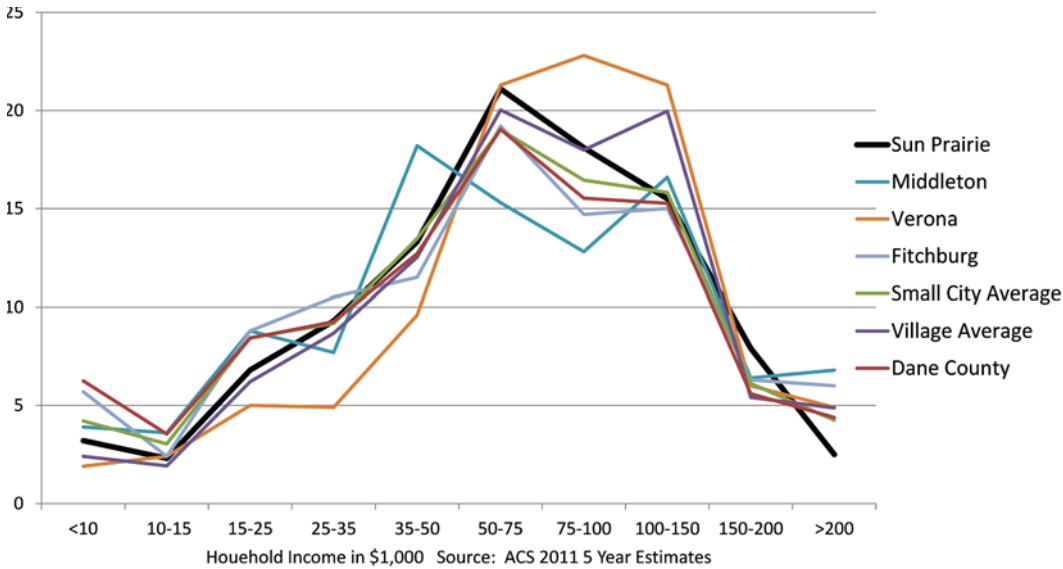


Figure 8. Population and Housing Growth 1970-2010

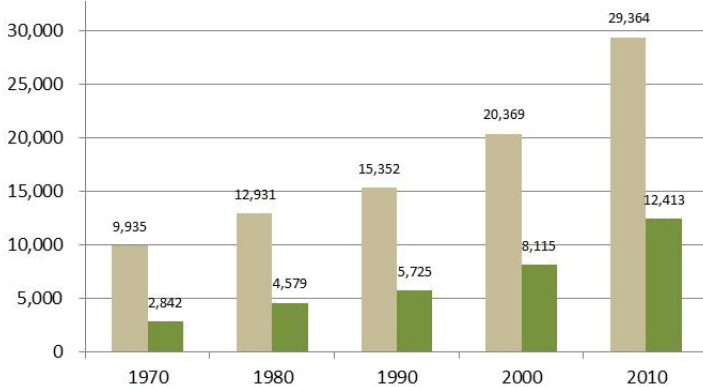
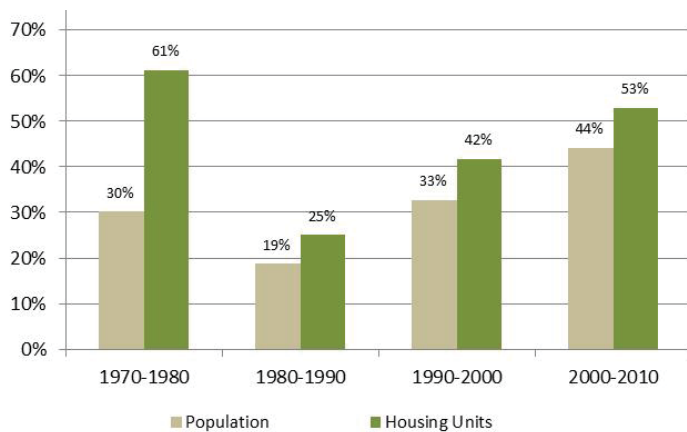


Figure 9. Population and Housing Growth Rates 1970-2010



B. Housing and Land Use Trends

1. Housing Growth

The rate of residential development (housing units) exceeded the rate of population growth over the past 40 years due to shrinking household sizes. In 1970, the average household size was 3.49 persons, dropping to 2.36 by 2010, more than a full person per household difference. This pattern of shrinking household size is not unique to Sun Prairie and has occurred throughout the country.

2. Housing Mix

Sun Prairie's housing mix changed significantly over the past 40 years.²¹ In 1970, 72% of Sun Prairie's 2,800 housing units were single family homes. Over the subsequent decades, an increasing percentage of multifamily units were built. By 1990, single family accounted for 56% of homes, and as of 2010 the number of single family and multifamily homes were approximately even. The overall single family rate for

²¹ CARPC land use inventory classifies duplexes as multifamily, which accounts for the large difference between Sun Prairie's land use residential land acres and that of CARPC. Additionally, residential buildings that were under construction at the time of the survey were not classified as residential.

small cities is approximately the same as Sun Prairie. Among peer communities, Middleton and Fitchburg have rates around 42% while Verona more closely resembles a village mix at 64% single family.

This decreasing rate of single family homes is shared by most other small cities in Dane County, with most communities having decreasing rate of single family between 0.5% and 7% occur from 1990 to the present. Fitchburg was the only community to increase its single family rate during this time. Looking further reveals some trends in building over the past 20 years:

- Townhomes doubled as a percent of the total units to 16%.
- Duplexes, three, and four unit buildings remained steady at 13%.
- Small multifamily buildings with 5 to 19 units declined relative to other housing, while larger buildings with 20 or more units grew to 10% of all housing units.

3. Owner Occupancy

In contrast to the changes in housing mix, Sun Prairie's owner occupancy rate was generally steady and in 2010 was 62%, slightly above the small city average of 60%. This information, combined with housing mix data suggests a growing number of owner-occupied multifamily units, likely condominiums, townhomes, and duplexes. Predicting what ownership occupant levels will be in the future is difficult given the current market trends shifting towards rental. As the same time, it is unknown if this is a trend or a fundamental shift in the housing preference. Note that these figure differ from housing unit figures because vacant properties are not counted.

4. Housing Value Distribution

Housing in Sun Prairie has a similar value distribution compared to other areas in Dane County. Compared to small cities and villages, Sun Prairie has greater levels of housing

Table 2. Housing Mix 1990-2010

# of Units	1990		2000		2009-2011	
1- detached	3,065	54%	4,371	54%	6,276	51%
1- attached	478	8%	782	10%	1,944	16%
2	432	8%	463	6%	765	6%
3-4	324	6%	643	8%	848	7%
5-9	631	11%	525	6%	602	5%
10-19	522	9%	653	8%	867	7%
20-49	120	2%	525	6%	776	6%
50+	98	2%	143	2%	338	3%

Source: American Community Survey

Figure 10. Housing Mix 1990-2010

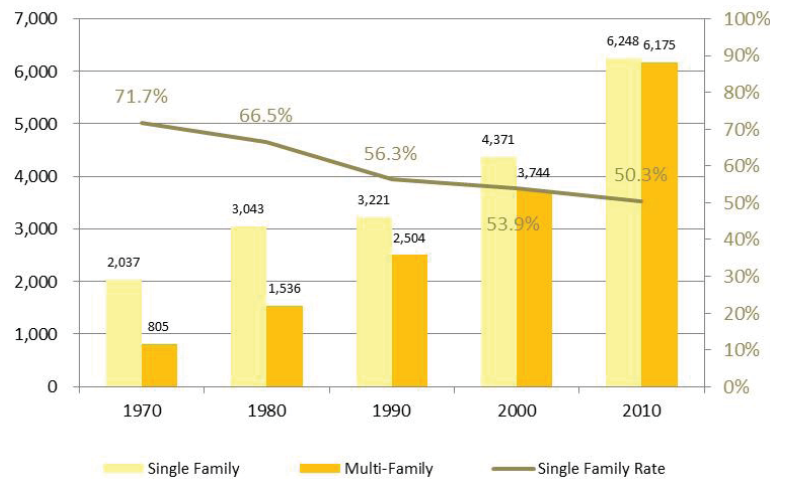
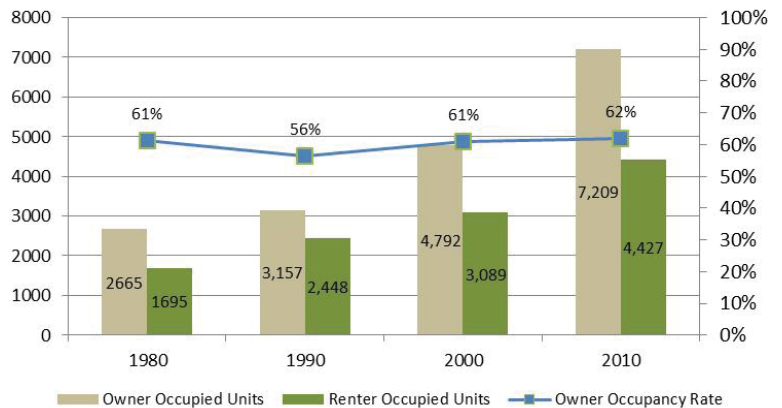
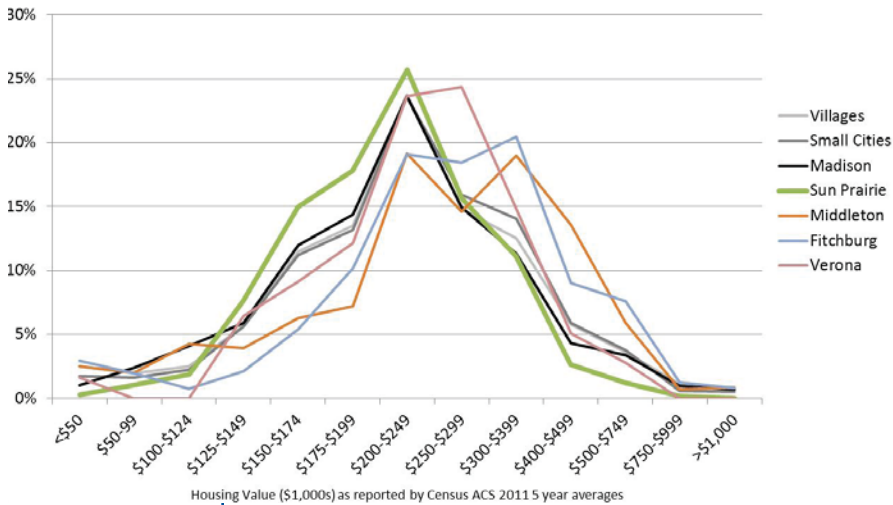


Figure 11. Owner Occupancy 1980-2010



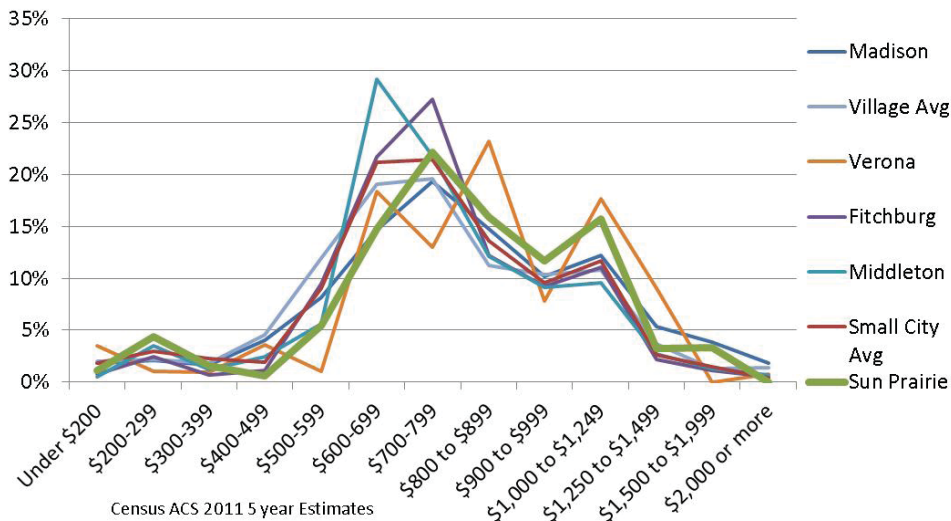
between \$150,000 and \$250,000 and slightly lower levels of homes assessed at \$400,000 and above. Specifically looking at housing in Middleton, Fitchburg and Verona, housing in Sun Prairie would be considered more affordable, with greater rates of homes below \$250,000. While this distribution provides more homes at an affordable level, the lack of high end homes can be a concern for municipal budgeting.

Figure 12. Housing Value Distribution



Rent distribution in Sun Prairie is more variable. Overall, rental options offer more moderate and high-end homes compared to other communities. These differences between Sun Prairie and other communities are most noticeable in Figure 13 for rentals at \$700 and \$1,250 price points.

Figure 13. Rental Value Distribution



5. Land Use

Since 1970, developed land area in Sun Prairie grew from just under 1,500 acres to almost 6,400 acres, including 2,400 acres in the last decade.²² Residential development is the most prevalent land use, occupying approximately 36% (2,277 acres in 2010) of land in the urban service area. This figure represents a slightly declining share of all land uses since 1980, likely do to increases in recreational land overall.²³

Table 3. City of Sun Prairie Land Uses (acres/% of total)

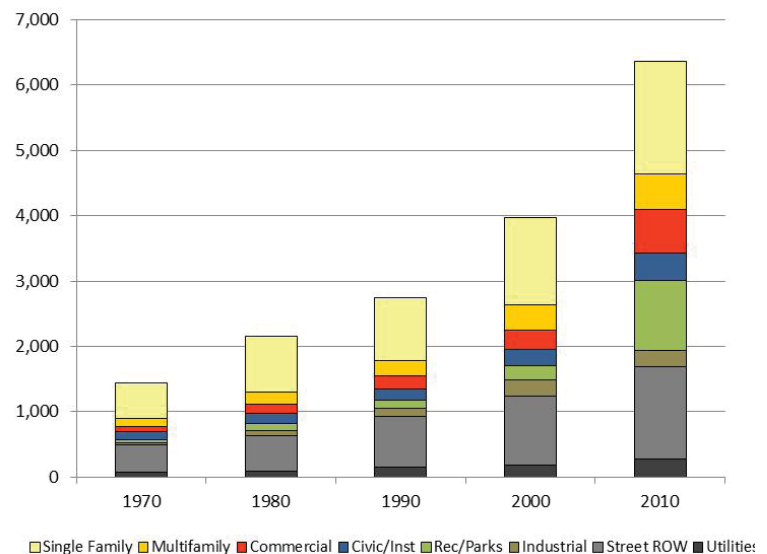
Land Use	1970	1980	1990	2000	2010
Residential	675/47%	1,055/49%	1,195/44%	1,513/43%	2,277/36%
Commercial	79/5%	126/6%	199/7%	296/7%	663/10%
Industrial	26/2%	78/4%	121/4%	251/6%	247/4%
Street ROW	430/30%	538/25%	771/28%	1,058/27%	1,422/22%
Transport/Utilities	66/5%	92/4%	153/6%	179/5%	274/4%
Institutional	119/8%	156/7%	170/6%	260/7%	424/7%
Recreation	53/4%	117/5%	129/5%	209/5%	1,060/17%
Total	1,447	2,161	2,738	3,966	6,367

Commercial growth is another significant driver of developed areas. Commercial land uses grew from 7% to 10% of developed area over the past decade. However, a portion of growth in commercial areas is offset by losses in industrial uses, in both absolute acres and percent of developed area. Note that commercial and industrial classifications are based on the specific use of a building under the North American Industrial Classification System (NAICS). As a result a property could change classification from industrial to commercial with no visible change to the building.

The percentage of right of way (ROW) decreased somewhat since 1970. One potential cause is that newer street standards do not designate as much right-of-way as was designated in older development areas and are thereby offsetting the impact of the large amount of right of way inside the city limits designated for Hwy 151 and older streets.

In 2010, CARPC's land use survey methodology changed with respect to how recreational land was accounted for. As a result, most communities' recreational land acreage increased dramatically compared to previous surveys. While this change increased the accuracy of the measure, it makes time series

Figure 14. Land Use Changes 1970-2010

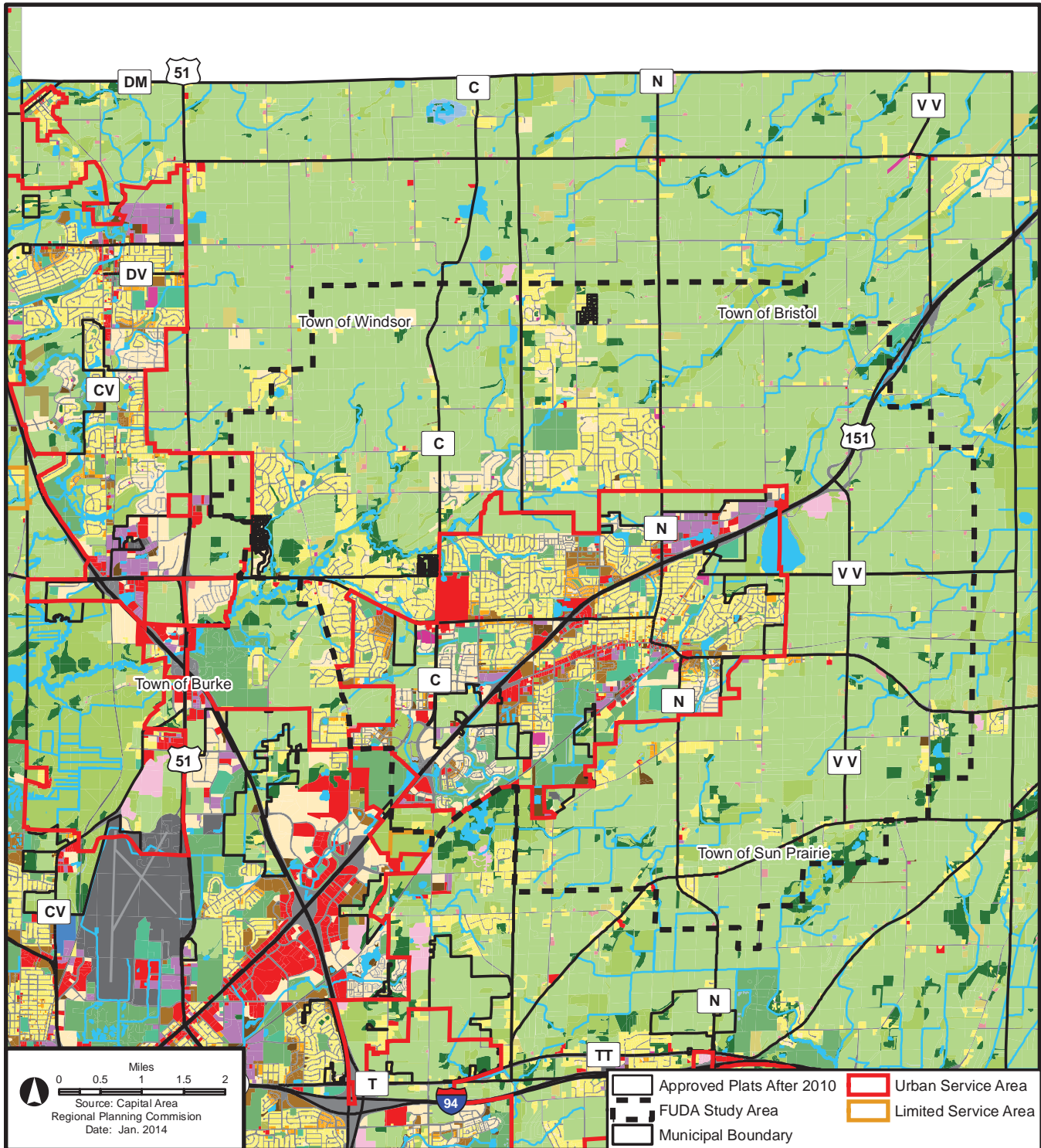


²² 2010 Land Use values are taken from CARPC's county-wide land use survey. Differences in methodology may produce some differences between local land use calculations.

²³ CARPC's land use inventory classifies duplexes as multifamily, which accounts for the large difference between Sun Prairie's land use residential land acres and that of CARPC. Additionally, residential buildings that were under construction at the time of the survey were not classified as residential.

Map 3: Land Use 2010

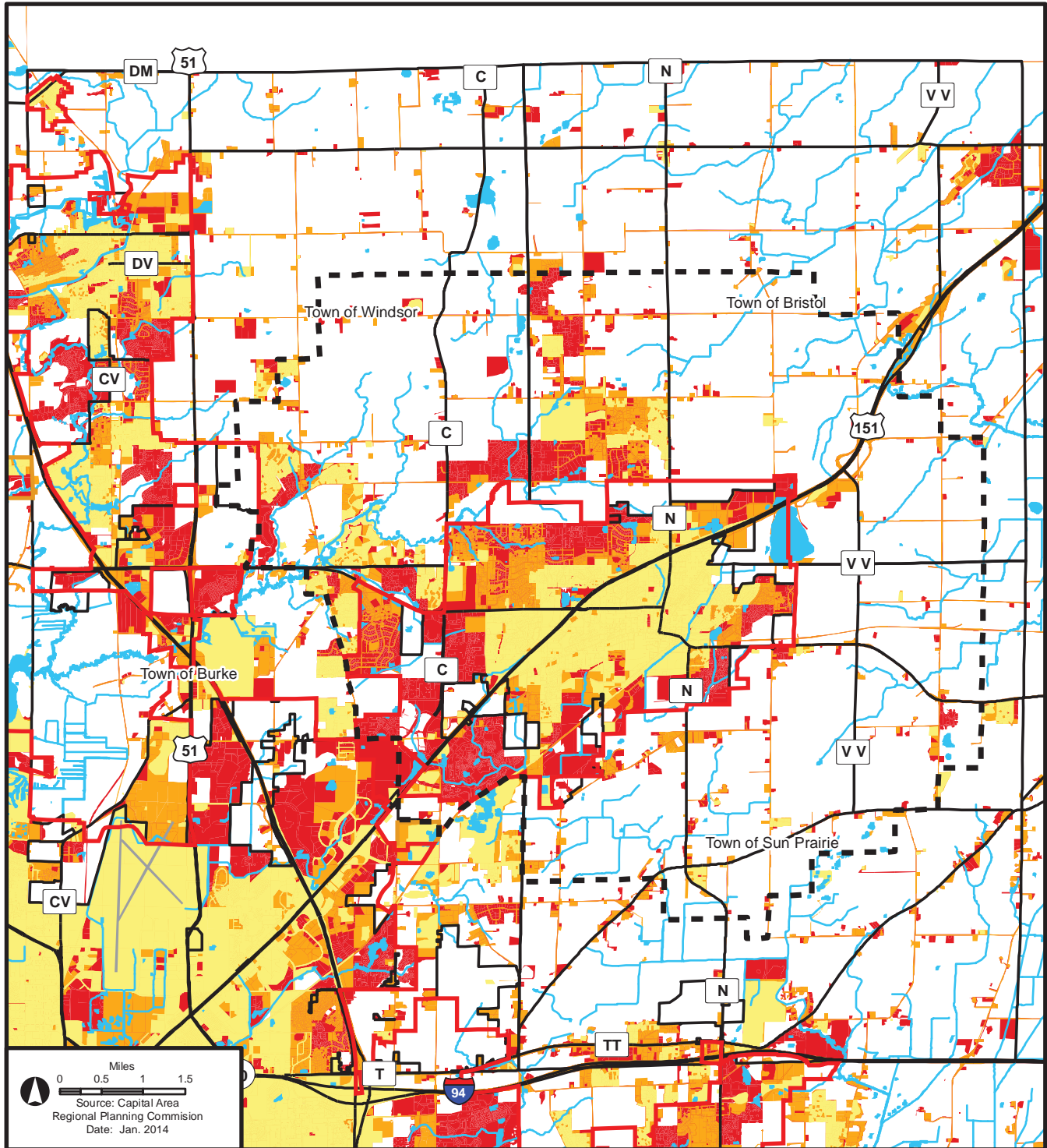
Sun Prairie FUDA, Dane County, WI



- | | | | |
|-----------------------------|---------------------------------|----------------------|-------------------------|
| OPEN WATER | INDUSTRIAL | OUTDOOR RECREATION | MINERAL EXTRACTION |
| ONE FAMILY UNIT RESIDENTIAL | TRANSPORTATION RELATED | FARM RESIDENCE | VACANT LANDS SUBDIVIDED |
| TWO FAMILY UNIT RESIDENTIAL | ROAD RIGHT OF WAY | AGRICULTURE | WOODLANDS |
| MULTI FAMILY RESIDENTIAL | ROAD RIGHT OF WAY NOT YET BUILT | PASTURE | OTHER OPEN LANDS |
| GROUP RESIDENTIAL | COMMUNICATIONS AND UTILITIES | AQUACULTURE - PLANTS | UNDER CONSTRUCTION |
| MOBIL HOME PARKS OR COURTS | CEMETERY | AQUACULTURE - FISH | |
| COMMERCIAL | PUBLIC SERVICE | AG RELATED SERVICES | |

Map 4: Land Use Changes: 1990-2010

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Developed Land (1990)
- Developed Land (2000)
- Developed Land (2010)
- Urban Service Area
- Limited Service Area

Parcel based land use inventories for Dane County for the years 1990, 2000 and 2010.

comparisons challenging. Prior to this change, recreational land, including parks, increased significantly since 1990. The total acreage more than doubled in a decade and continued to increase through 2010. Currently, recreational land occupies 17% of all developed land, an increase from 5% in 2000.²⁴ Sun Prairie's park dedication ordinance requires one acre per 23 dwelling units, or approximately 1,900 square feet per unit.²⁵ Sun Prairies parkland dedication requirements also specify a minimum park frontage onto public streets to ensure the park is perceived as public and not an extension of residential backyards.

The Development Progression **Map 4** is useful in showing the direction and pace or recent growth relative to established neighborhoods. The maps shows most of the growth between 1990 and 2000 occurred north of Hwy 151 between Windsor Street and Egre Road. In the subsequent 10 years, development shifted toward the west, after the completion of the West Side Plan in 2004.

For the purposes of the land use survey, a parcel is considered developed if it has been plat- ted, and is classified as vacant. Additionally, changes in land classification can impact the map. For example, when the recreational land use category was revised for 2010, it included land that was previously considered not developed. This is the case with the land surround- ing Botts Pond.

6. Residential Density

In most communities, residential land is the single largest use (by acreage). Consequently, residential density is an important metric for community growth and expansion.²⁶

The overall single family home density in 2010 was 3.6 units per acre, slightly above the small cities average of 3.5 units per acre. Comparable communities' single family densities range from 3.5 (Verona) to 4.4 (Middleton). From 1970 to 2000, single family densities de- clined from 3.7 to 3.3 before rebounding to 3.6 in 2010. Single family homes built between 2000 and 2010 averaged 4.9 unit per acre, more dense than the community average.

Sun Prairie's average for multifamily development was 11 units per acre, similar to the small city average. Peer communities multifamily densities were 10.5 (Middleton), 11 (Verona) and 13.4 units per acre (Fitchburg). Unlike many other communities, multifamily density consistently increased in Sun Prairie since 1970. Many small cities and villages experienced decreasing density in multifamily residential in this time. Like single family, multifamily units built in Sun Prairie between 2000 and 2010 were at a higher density than the community av- erage (13.7 units per acre), likely attributable to new traditional neighborhood developments (TNDs) and residential redevelopment near the downtown. Between increases in single fam- ily and multifamily, the overall density of residential development built in Sun Prairie was 7.6 units per acre.

Sun Prairie's overall residential density was 5.5 units per acre in 2010, increasing 14% since 1990. One major factor in this increase was the housing shift toward multifamily units. Compared to other communities, Sun Prairie has one of the higher residential densities in

²⁴ Note 2010 recreational land use category was redefined are resulted in a number much larger than anticipated. This number is under review and until it is confirmed, it has been replaced with one more consistent with past rates.

²⁵ Or fee in lieu of, at the discretion of the Plan Commission

²⁶ Unless otherwise noted, all densities are net density (area in residential use excluding streets, open space, etc.)

Dane County (except Madison), and is nearly 10% more dense than the small city average and 20% more dense than the village average. Peer cities had densities of 6.2 (Middleton) and 4.7 units per acre (Verona).

Using a per capita metric, Sun Prairie has fewer acres of residential per 1,000 residents (higher density) than many small cities and villages. While household sizes have declined over the past 20 years, increases in residential density (units per acre) in Sun Prairie during this time offset this change. In contrast, many communities have seen a slight increase residential land area per 1,000 residents over the past 20 years.

In addition to overall community density, it is useful to understand where higher and lower density areas exist within the city. Areas of highest density exist surrounding the downtown and continue west on Main Street. New areas developing on the west side have greater densities than most of the community. To some extent, the map of residential density (calculated by total residential acres and total housing units within census blocks) is what would be expected based on the time of land development and overall community density patterns discussed in the previous paragraphs.

7. Commercial Density

Commercial density, like residential density, impacts the amount of land anticipated for future development. Commercial densities are a product of parking, stormwater and open space requirements. Aside from parking, these regulatory standards are created outside the local control. Moreover, additional costs, such as structured parking, are often associated with increasing commercial density.

Analyzing Sun Prairie’s commercial development shows a 0.23 average commercial density (as measured by Floor Area Ratio²⁷). This information is provided for reference and information only and does not impact land demand calculations discussed in the following sections. Because of the challenges of obtaining this data, it is not possible to compare this figure to other communities.

²⁷ Floor Area Ratio (FAR) is a measure of building intensity: the ratio between the total square foot of a building and the total square feet of the site. For example, a 100,000 square foot site with a 20,000 square foot, single-story building would have a FAR of 0.2. A FAR of less than 0.2 can be an indicator that a site is underutilized. FAR is one indicator that must be combined with other indicators and observations before conclusions can be drawn.

Table 4. Residential Density Comparison

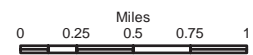
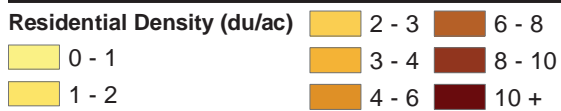
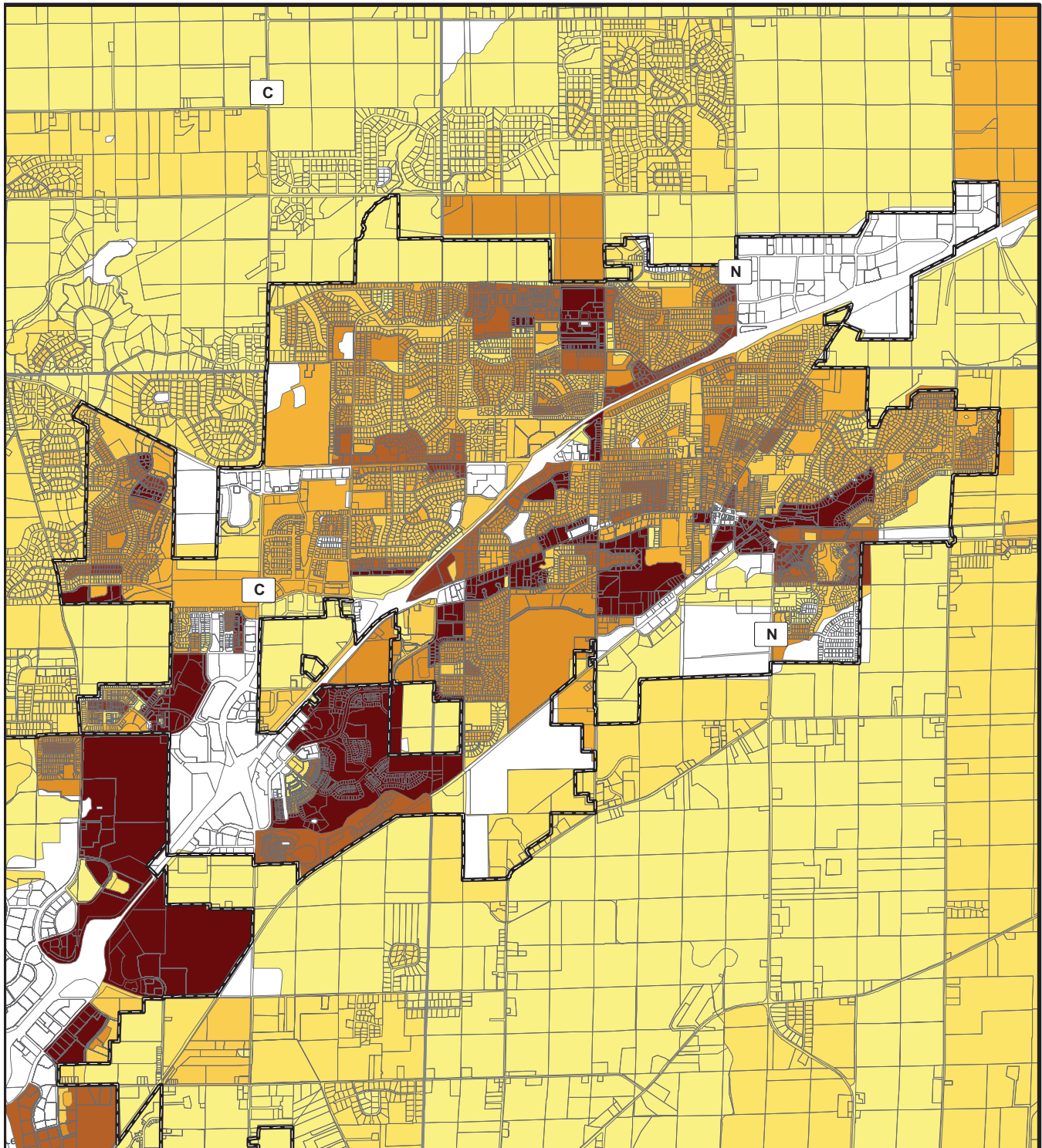
	Single Family	Multifamily	Combined
City of Sun Prairie			
2010	3.62	11.16	5.5
1990	3.38	10.29	4.8
Change	7%	8%	14%
Madison			
2010	4.83	17.29	7.9
1990	4.43	16.31	7.1
Change	9%	6%	11%
Small Cities			
2010	3.46	11.43	5.0
1990	3.20	11.48	4.6
Change	8%	0%	9%
Villages			
2010	3.27	7.96	3.9
1990	3.13	9.27	3.8
Change	4%	-14%	4%
Dane County			
2010	2.24	13.97	3.5
1990	2.61	13.06	3.9
Change	-14%	7%	-10%

Table 5. Common Commercial Building Densities

Building Type	FAR
Sun Prairie Average	0.23
1 story building, surface parking	0.2
2 story building, surface parking	0.35
3 story building, surface parking	0.5
4 story building, mixed parking	0.7
4 story building, structured parking	1.4

Map 5: Residential Density By Census Block 2010

Sun Prairie FUDA, Dane County, WI



05/11/2013

However, Table 5 provides comparative FAR values for common commercial building types.²⁸

8. Other Land Uses²⁹

Sun Prairie experienced robust commercial development over the past 20 years, increasing from 13 to 22.4 acres per 1,000 residents. This growth is consistent with trends in other small cities in Dane County.

Industrial land use increased somewhat after 1990 and decreased over the last decade (potentially due to the reclassification of uses). While Sun Prairie has fewer industrial acres per resident than the small city average, small city industrial is decreasing rapidly.

The amount of area required by streets (ROW) per 1,000 residents declined, possibly as a result of changes in residential development patterns. Compact development and efficient street systems use less land for roads per person, costing communities less in maintenance and creating lower volumes of stormwater. Decreases in residential densities between 1990 and 2000 and subsequent increases between 2000 and 2010 are reflected in acres of street right of way per person values.

Table 6. Land Use Comparison 1990-2010

	Residential	Commercial	Industrial	Street ROW	Trans/Com/Util	Gov/Inst	Recreation	Total
City of Sun Prairie								
2010	78	23	8	48	9	14	36	217
1990	78	13	8	50	10	11	8	178
Change	0%	74%	7%	-4%	-6%	31%	330%	22%
Madison								
2010	59	17	6	36	11	8	39	175
1990	59	12	6	32	14	11	20	153
Change	0%	36%	10%	11%	-19%	-29%	96	14
Small Cities								
2010	88	24	14	54	13	12	45	250
1990	91	13	23	45	8	12	9	197
Change	-3%	84%	-39%	21%	59%	1%	389%	27%
Villages								
2010	101	12	14	47	12	15	43	243
1990	99	11	14	46	8	16	15	206
Change	2%	15%	1%	1%	37%	-7%	185%	18%
Dane County								
2010	126	19	14	86	15	10	62	331
1990	131	13	14	92	14	13	30	277
Change	-4%	44%	1%	-7%	4%	-20%	105%	19%

C. Transportation

1. Vehicle Miles Traveled and Community Design

Over the past 30 years, researchers studied the links between vehicle miles traveled (VMT) per person and the built environment to better understand the relationship between travel and developing strategies to reduce VMT and its travel impacts. Reducing VMT can result in less traffic, air pollution, and cost savings to travelers. A 2012 study published in the Journal of Transport and Land Use³⁰ pointed to four factors a community can influence including increasing residential and employment densities, mixing uses within the community and creating smaller block sizes. Smaller block sizes generally create more direct paths between

²⁸ Source: Sun Prairie assessment data, comparative building densities from Capital Area RPC's Infill and Redevelopment Assessment.

²⁹ For uses other than residential, CARPC uses a determined acreage per 1,000 residents to project the land demand for commercial, industrial, civic, recreational and other common land uses. This measure allows for comparison between different communities and is used in CARPC's land demand methodology.

³⁰ <https://www.jtlu.org/index.php/jtlu/article/view/266/268>

Figure 15. Residents' Work Place

Madison	5,990	45%
Sun Prairie	2,112	16%
Middleton	399	3%
Monona	219	2%
Milwaukee	261	2%
DeForest	256	2%
Waunakee	228	2%
Fitchburg	136	1%
Janesville	105	1%
Windsor	142	1%

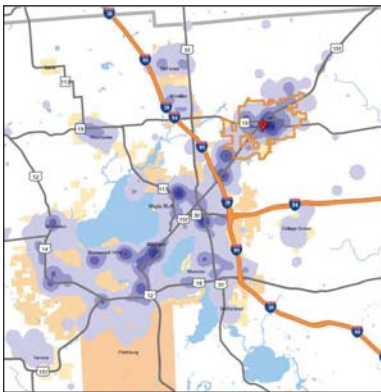
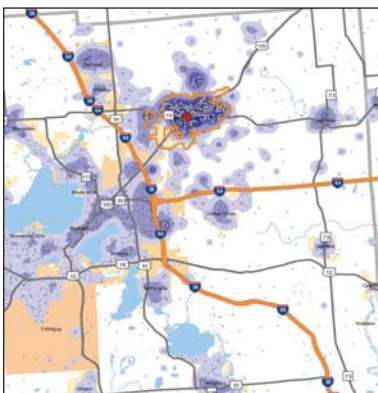


Figure 16. Workers' Residence

Sun Prairie	2,112	24%
Madison	1,354	15%
DeForest	163	2%
Columbus	143	2%
Marshall	124	1%
Waunakee	109	1%
Stoughton	108	1%
Fitchburg	98	1%
Beaver Dam	91	1%
McFarland	82	1%
All Other	4,615	51%



origins and destinations, further reducing trip length and encouraging walking and cycling. The study suggests *employing all four strategies would support shorter trips and some potentially without a car.*

Sun Prairie has adjusted policies and budgets to incorporate pedestrian and bicycle accommodations over the past 10-15 years. This includes a Safe-Routes-To-School program and a “Complete Streets” policy that aims to consider the multiple functions streets can provide for travelers, business, and stormwater infrastructure. Many variables that could be considered under this topic are presented in greater detail in the Sustainability Audit accompanying this report.

2. Commuting Patterns

As of 2010, 2,116 residents, or 16% of the local workforce, worked in the Sun Prairie (Figure 15). Given Sun Prairie’s close proximity to Madison, half of the Sun Prairie’s workforce is employed there. Major concentrations are near the Capitol, Dane County Regional Airport, the American Center and Highway’s 30 and 51. These commute values and patterns are consistent with peer communities.

Of employees who work in Sun Prairie (Figure 16), 24% live in Sun Prairie. This is a significantly higher rate than peer communities with approximately 10% of local employees live in that community. Madison residents comprise 15%, with concentrations on the east side. Additional employees travel from DeForest, Marshall and Waunakee.

The two sets of data also reveal that peer communities Middleton and Verona have a greater number of jobs per residents in the workforce, at 1.96 and 1.28 jobs per resident respectively, compared to Sun Prairie’s 0.57 jobs per resident, indicating that a significant portion of the population find work out of Sun Prairie.

3. Transit Service Potential

Sun Prairie does not have a municipal transit system. The closest Madison Metro Transit stop is at the American Center. The city worked with a private cab company to provide a shared-ride taxi service. In addition, a private transportation service shuttles between Sun Prairie and East Towne Mall at three scheduled times on weekdays, allowing users to connect with Metro Service at this location. Other private efforts exist that aim at assisting rural and senior citizen residents transportation to major destinations.

The Madison Area Transportation Board (MATB or MPO) researched several regional transit options including the Bus Rapid Transit (BRT) with a possible extension toward Sun Prairie. The study also discussed express bus, and showed two potential routes. Rail transit is likely a

long-term project region-wide, including Sun Prairie. Sun Prairie has expressed interest in locating a major transit stop downtown when transit options are pursued.

4. Bike and Sidewalk Network

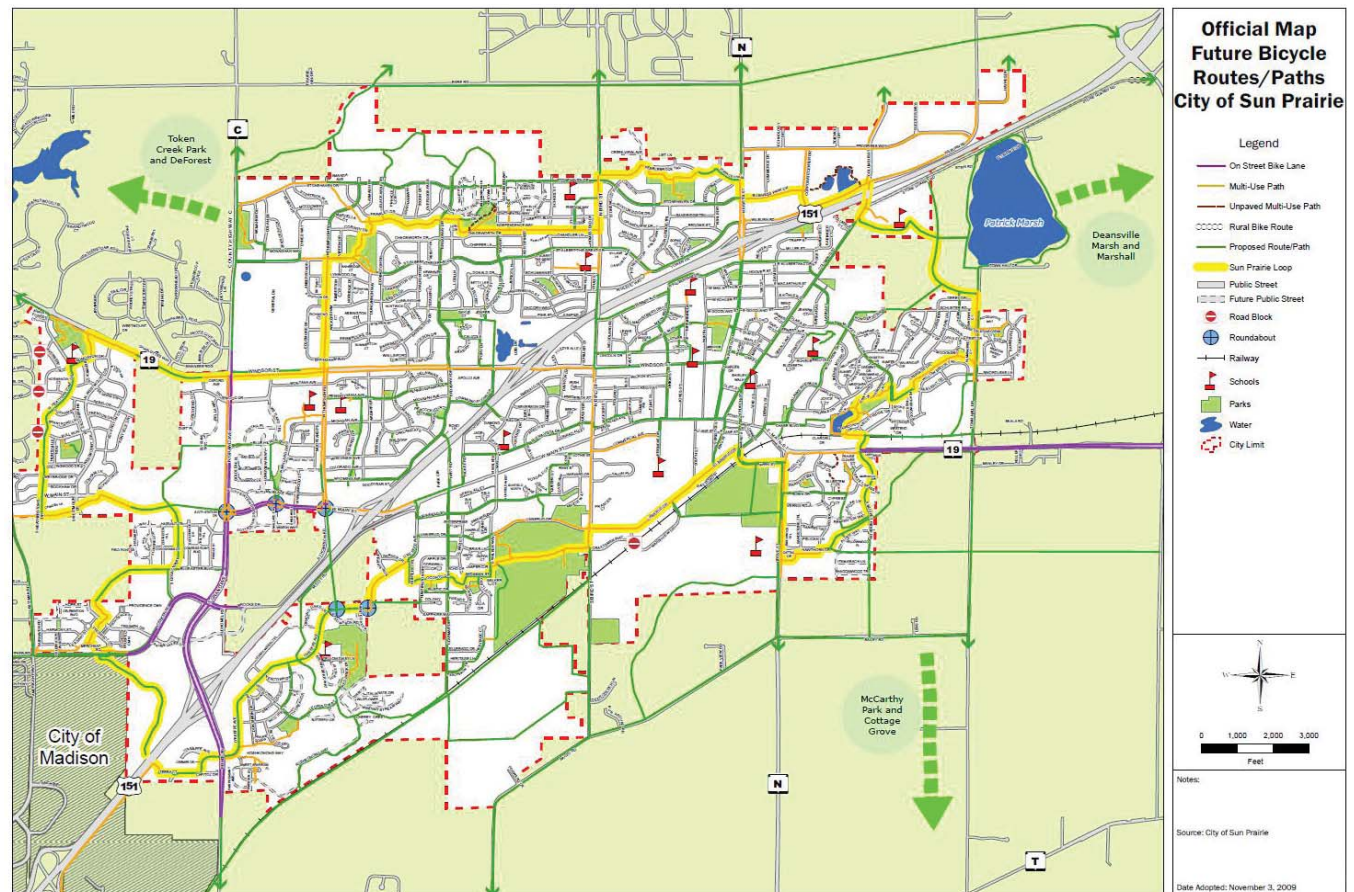
Sun Prairie has a well developed bike network of off-street paths and on-street routes on collector or arterial streets. The network effectively connects most neighborhoods, schools, parks, and commercial/employment centers within the city, and provides connections to nearby employment centers in Madison. Sun Prairie’s Official Map for Bicycle Routes identified many local streets as future routes. If all proposed routes are completed, most areas of Sun Prairie would be within a quarter mile of a designated route or path.

Sidewalks are present on many, though not all streets, in Sun Prairie. However, sidewalks are required on both sides of new streets and are installed on both sides of streets when reconstructed. Sun Prairie’s Comprehensive

Map 6. Proposed Bus Rapid Transit Routing



Map 7. Bike Routes



Plan identifies gaps in the pedestrian network to be addressed when fiscally and politically feasible. Developers are also required to install sidewalks on existing arterial frontages abutting the parcel.

D. Infill and Redevelopment

Infill and redevelopment can create a host of benefits for communities that encourage the intensification of under-utilized land. These benefits can include removal of blighting influences, improved property value, increased activity and destinations, greater support for local businesses, and more efficient use of land and infrastructure. While the benefits of redevelopment are many, so are the challenges that can come with its implementation, including property assemblage, increased development costs (compared to greenfield sites) environmental contamination, and citizen opposition.

Sun Prairie has actively encouraged redevelopment in the past, with Cannery Square and surrounding redevelopment in the downtown as prime examples. The city has five active TIF districts in and around these areas to spur redevelopment and has continued with the Downtown Phase II Plan and the West Main Street Corridor Plan. These plans present or refine a redevelopment vision, and stop short of saying how much development could actually occur. As part of the FUDA process, staff examined these previously-studied sites to gain a understanding of how much redevelopment could occur, and what that could mean in the context of 25 years' worth of growth.³¹

Map 8. Downtown Phase II Plan



1. Downtown

The Downtown Phase II master plan outlines the redevelopment vision for the area generally bound by Main Street, the rail corridor and South Street. Most remaining sites are in the Washington Mills/City Garage Sites sub-area. Redevelopment is anticipated to be predominantly residential. Office development and limited commercial could be a potential on parcels facing Linnerud Drive.

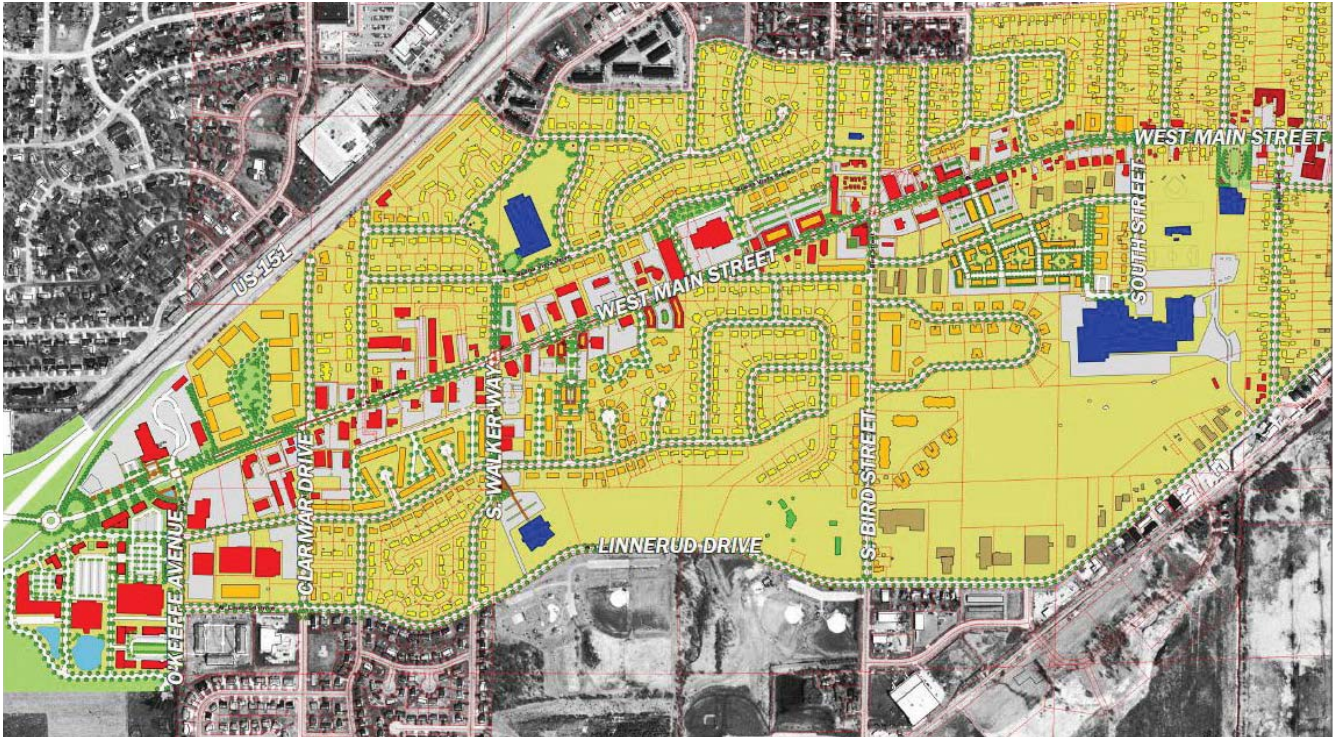
2. West Main Street

Several sites further west on Main Street were identified in the West Main Street Corridor Plan. The first major site is between Kronke Drive and Bird Street south of Main Street and surrounding Commercial Avenue, including the former Hanley site. Much of this area is older and under-utilized industrial land, with several storage facilities. The plan recommends commercial buildings at Main Street, transitioning to residential (apartments and townhomes), with upgrade industrial/intensive commercial use along Commercial Avenue.

The next series of sites is between Bird Street and Ruby Lane, home to aging strip retail building (which is 40% vacant), and the vacant former Heckel's Marine and Sentry Foods sites. Because

31. Because of the uncertainty, costs and challenges that redevelopment poses, it will not impact land demand for this FUDA study and is presented for informational purposes.

Map 9. West Main Street Concept Plan



two newer grocery stores are nearby, it is unlikely a grocery will re-open at this location. Moreover, this anchor vacancy could lead to increased vacancy in the adjacent strip retail building. However the site could remain a retail node with the addition of mixed use buildings with residential units over ground floor retail.

Further west, though land uses become more auto-oriented, redevelopment has improved the appearance and walkability of these areas. While some sites exist in this area, they tend to be smaller and more scattered. One redevelopment project underway is the Walmart property, where a new store will replace the existing store.

3. Infill and Redevelopment Potential

Based on the above assumptions, it is possible that redevelopment could accommodate 1,160 housing units and 380,000 square feet of commercial space. However, it is unknown if all assumed redevelopment would or could occurring during the 25 year timeframe for land demand projections.

Redevelopment is challenging to predict and these estimates are only one potential redevelopment outcome. In a strong market, redevelopment can occur where it is not predicted. Conversely, without market support, redevelopment may not occur at all despite plans. Redevelopment often requires municipal expenditure, such as TIF funds, to address infrastructure improvements, remediate contaminated properties, potentially acquire land, etc. In addition, without

Figure 17. Infill and Redevelopment Assessment Methodology

Identified sites are assigned building types. Each building type has an associated residential density and/or commercial density based comparable existing buildings. For example, a three story mixed use building averages 40 housing units per acre and a 0.25 FAR commercial density.²⁰

Summing the sites yields the total estimate of residential units and commercial square footage that is converted to acres (based on existing development).

²⁰ The overall FAR of a three story mixed use building will be greater than the number given for commercial density, which only addresses the amount of commercial space relative to the site size.

Map 10. Redevelopment and Infill Sites and Estimates

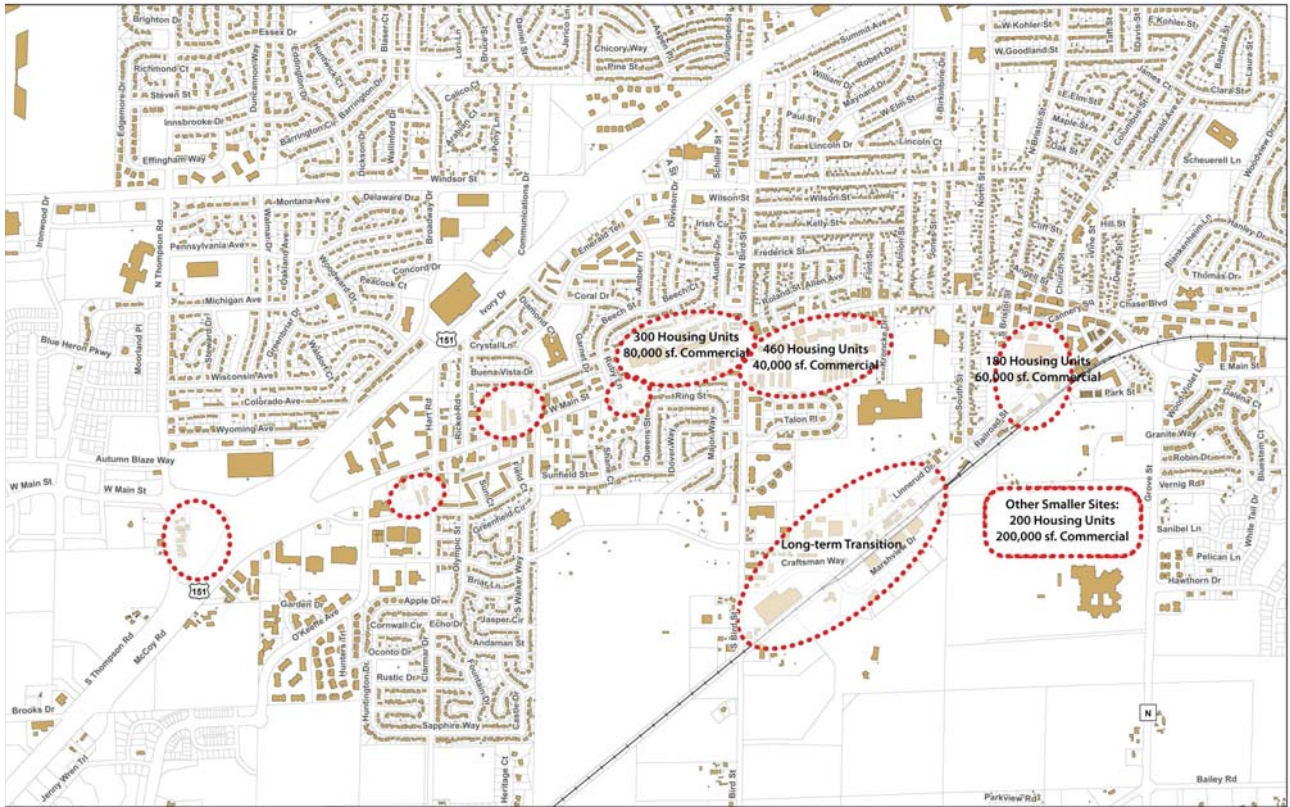


Table 7: Redevelopment and Infill Housing and Commercial Space Estimates

Site	Estimated Housing Units	Estimated Commercial Space
Downtown South	180	60,000 sf
West Main Street: Bird to Kroncke	460	40,000 sf
West Main Street: Bird to Ruby	300	80,000 sf
Other Sites	200	200,000 sf
Total	1,160	380,000 sf

the benefit of a public process, it is uncertain if the redevelopment would have community support. For these reasons, the projected estimates presented should not be relied upon when future Urban Service Area or wastewater facility decisions are made.

E. Estimate of Long-Term Growth

1. Land Demand Estimate

The Wisconsin Department of Administration (DOA) provides 25-year population and housing projections for counties based on historic population growth and demographic factors including age distribution and household composition. CARPC’s state-approved methodology uses county projections as a basis for estimating future growth in urban service areas. The DOA also created 2030 municipal-level projections in 2008, and are provided for reference only. These projections occurred prior to the 2010 Census counts and do not take into account recent trends.

Sun Prairie’s recent growth illustrates the need for more up-to-date projections than the 2008 DOA municipal projections. That projection estimates population growth of 11,584 people in the 20 year period between the 2010 Census count and 2030, a projected growth of only 2,589 more than was observed in the previous decade.

Table 8 shows the most recent population projections by municipality created by the DOA (2008) and the CAPRC’s 2035 projection for the Sun Prairie USA (2012).

Table 8. Population Projections

Municipalities	Census 2000	Census 2010	2030 Projection	2035 Projection
C. Sun Prairie	20,369	29,593	40,948	48,042
T. Bristol	2,698	3,765	5,661	
T. Burke	2,990	3,284	3,546	
T. Sun Prairie	2,308	2,326	2,961	
T. Windsor	5,286	6,345	7,739	

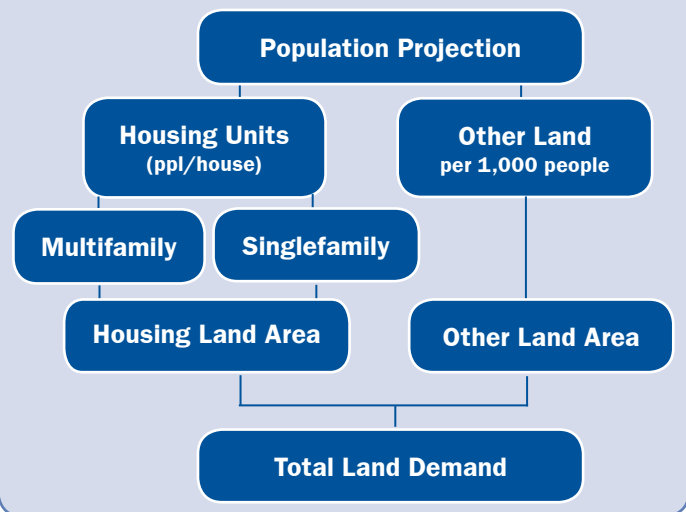
This analysis uses these estimates as the basis for future growth projections as required by Wisconsin Administrative Code (NR 121). CARPC intends to update estimates of growth every five years as new data becomes available.

Table 9 shows the projected urban land demand for the Sun Prairie Urban Service Area.³² Using the projected increase of 18,449 people, 13,237 additional housing units could be required by 2035. The projection estimates 45% of units will be single family. Note the 30 year average shown in Table 9 is lower at 40%. Densities for singlefamily and multifamily were estimated at 3.9 and 12 units per acre, based on trends, recent developments, and existing plans discussed earlier.

Non-residential land use projections are based on trends in developed acres per 1,000 residents for each category. These typically used similar acres per 1,000 rate to those observed between 1980 and 2010, with some variations. The recreation category uses Sun Prairie’s park land dedication requirement of 1 acre per 23 dwelling units, resulting in about 31 acres per 1,000 residents.³³

Figure 18. Land Demand Methodology

Population is translated into housing units based on persons per housing unit data. Housing units are divided into single-family and multi-family following the observed trends. Single and multifamily units are converted into land area with a units per acre residential density estimation. Density values used to project land area demand for future single and multifamily residential are based on trends, existing plans, recent developments and discussions with local officials. Demand for non-residential land uses per capita estimates are based on 30 year trends.



³² This projection is created specifically for the FUDA process and is not identical to the RPC’s USA land demand calculations that are used to determine maximum USA size. Projection values, including density, have been modified based on data analyzed during the FUDA study process.

³³ As previously mentioned, the classification or recreational land changed for the 2010 land use survey, which explains the large difference between the 2000 and 2010 acres per 1,000 people.

Table 9. Sun Prairie Urban Service Area Projections

	Census		Forecast	Change
	1980	2010	2035	2010-2035
Total Population	12,931	29,593	48,042	18,449
HH Population		29,262		
Persons/housing unit	2.8	2.36	2.25	
Total Housing Units	4,579	12,413	21,352	13,237
Single Family Units	3,043	6,248	10,362	5,991
% of housing	66.5%	50.3%		45.3%
Multifamily Units	1,536	6,175	11,010	7,266
% of housing	33.5%	49.7%		54.9%
Single Family Acres	868	1,724	2,873	1536
Density (units/ac.)	3.5	3.6		3.9
Multifamily Acres	187	553	982	605
Density (units/ac.)	8.2	11.2		12.0
Commercial Acres	126	663	890	594
Ac./1,000 persons	9.7	22.4		32.2
Industrial Acres	78	247	439	188
Ac./1,000 persons	6.0	8.4		10.2
Street ROW Acres	538	1,422	2,398	1,340
% of above acreages	42.7%	44.6%		45.8%
Trans/Comm/Util Acres	92	274	380	201
Ac./1,000 persons	7.1	9.2		10.9
Institutional Acres	156	424	589	329
Ac./1,000 persons	12.0	14.3		17.8
Recreation Acres	117	1,060	485	277
Ac./1,000 persons*	9.0			15.0
Total Developed Acres	2,161	6,367	9,037	5,071

Overall future growth is projected to require 5,071 acres of land. Several factors could increase or reduce this number, including changes in density, housing mix, household sizes (persons per household), redevelopment and unforeseen growth.

Some of the “future” growth already accounted for because approved platted developments are considered developed (vacant) even if not built upon. According to Sun Prairie, as of 2010, 3,652 housing units were approved that were not built yet (less than 3,000 as of 2013). Using densities for single family and multifamily previously discussed, these not built approved developments would reduce the residential land demand by 590 acres, and accompanying recreational land (park dedication) and right of way demand is 160 and 250 acres less respectively. As a result of these approved units, the total land demand is reduced by 1,000 acres, bringing the total to 4,071 acres.

2. Land Supply Estimate

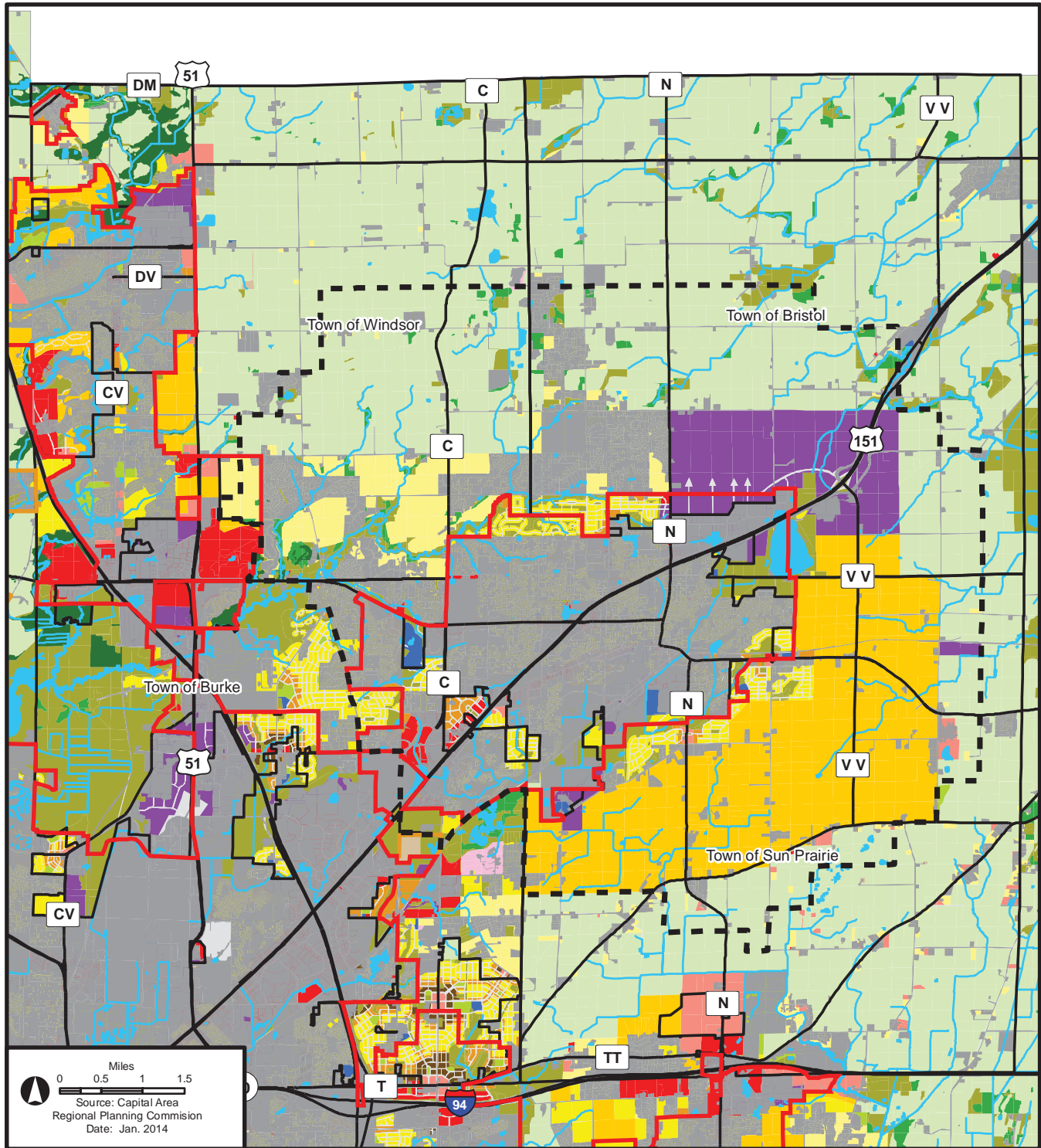
To plan for this projected 4,071 acre land demand, development potential inside the current urban service area was evaluated.³⁴ This follows the idea that land inside the urban service area boundaries is generally prioritized for future development. However, new USA expansions are often requested prior to developing all the land within the service area due to limiting and uncontrollable factors, such as unwilling landowners.

Land was considered developable if it was not yet developed and is not considered environmental corridor (floodplains, wetlands or slopes greater than 20 percent). Once developable areas were identified, they were compared to a future land use plan to quantify the potential for each use.

³⁴ More or less land may actually be required, based on the uncertainties associated with projections and a variety of other factors FUDA planning focuses on urban development that will take place within an urban service area (existing or future). Rural development that occurs outside of USAs is not the focus of FUDA planning.

Map 11: Developable Land in FUDA Study Area - 2010

Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Future Land Use	Planned Development	Institutional / Government
Urban Service Area	Rural Residential	Commercial Retail and Services	Parks / Outdoor Recreation
Limited Service Area	Low Density Residential	Industrial / Business	Agriculture
Municipal Boundary	Medium Density Residential	Extractive	Natural Area
Undevelopable Land	High Density Residential	Transportation	Woodland
Developed Land (2010)	Mixed Commercial / Residential	Communication / Utilities	Water Body

Table 10. Developable Land in Sun Prairie USA 2010

Land Uses	2010-3035 Demand	Adjusted 2010-3035 Demand	Supply	Unmet Demand
Residential	1,551	2,538	385	2,154
Commercial	594	867	57	810
Industrial	188	274	201	72
Street ROW	1,340	0	-	-
Trans/Comm/Util	201	201	0	201
Institutional	329	329	69	260
Parks/Rec	277	0	206	-
Total	4,480	4,209	917	3,498

Source: Capital Area RPC, Madison Area Transportation Planning Board
 Adjusted demand based on approved/not built units 1/1/2010. Adjusted land demand includes ROW and park dedication acreages. Mixed Commercial Residential areas are 25%:75%.

Because most land use plans do not allocate land to uses such as roads, the previous values were adjusted after deducting land for the homes approved and yet to be built. This process shifts parks and recreation land demand into the residential category, since most park development occurs with residential development and associated park land dedication requirements. It also shifts the right of way acreage proportionally into each of the land use categories.

The analysis indicates 917 developable acres of land (as of 2010) were inside the current boundaries of the Sun Prairie urban service area. Compared to the adjusted land demand, this reveals an unmet demand beyond the existing USA of 3,602 acres.

F. Public Water and Sewer Capacity

1. Wastewater

The City of Sun Prairie generated wastewater at an average of 3.1 million gallons per day (mgd) in 2011 and 2012. This is about 70% of the Sun Prairie Wastewater Treatment Facility average daily capacity of 4.4 mgd. Over 130 miles of sanitary sewer and force main are used for wastewater collection within this community. The wastewater received at the treatment plant in 2011-2012 was significantly higher than (about 26%) the City's water distribution. If this difference cannot be accounted for by wastewater treatment plant customers that are not served by the public water supply system, then it indicates a significant amount of infiltration and inflow into the City's wastewater collection system. The 2035 forecasted population for the City of Sun Prairie could increase wastewater generation to 4.85 mgd. The projected wastewater generation could use 113 gallons per capita per day (gpcpd) for the existing system and 81 gpcpd for population growth base increases. The wastewater generation assigned to population growth was assumed to have no inflow and infiltration contribution. In addition to wastewater flows generated by population growth, 10% was added to account for unplanned industrial growth. The current wastewater treatment facility is not projected to have sufficient capacity to serve the 2035 population. Assuming no significant increase in large commercial or industrial wastewater generators, plant capacity is estimated to be reached during 2027.

2. Public Water

The City of Sun Prairie operates a public water supply system including seven wells, six reservoirs/tanks with 2.85 million gallons of storage capacity, and 141 miles of water main. In 2012, 29,840 people were supplied with 2.5 mgd with a maximum supply of day distributing 5.3 million gallons. The average is expected to increase to 4.1 mgd in 2035 (based on current use rates).

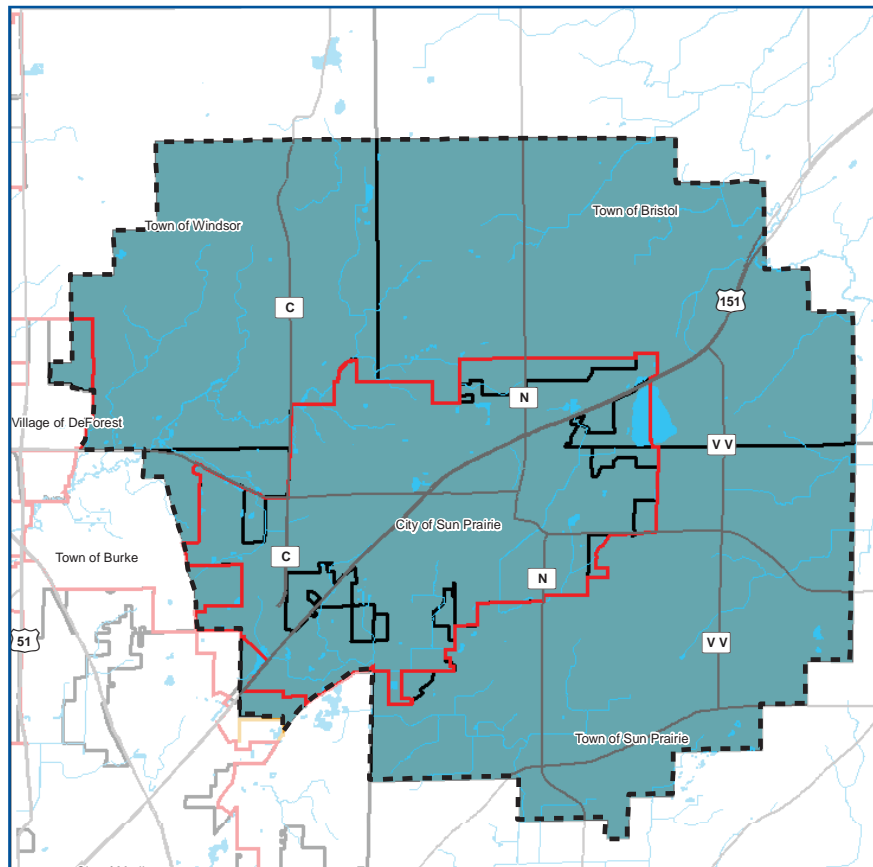
G. Conclusion

The land demands presented represent the current trends that can be used or baseline scenario for land use planning and comprehensive plan updates. This projection shows what could happen if development continues at a pace similar to recent trends. However, just as past decades were not continuations of earlier periods, future decades may not be either. The purpose of extrapolating current trends is to inform future choices. In comparing alternative scenarios to current trends, communities can make informed choices regarding plans and policies that best advance community goals.



City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



Natural Resources

Introduction

This chapter of the Environmental Conditions Report has three main purposes:

- Provide a natural resource inventory and assessment based on local and regional considerations.
- Outline considerations for land use planning and decision-making that protect and enhance the integrity of natural areas, both locally and regionally.
- Outline opportunities for incorporating environmental features in urban design to enhance the quality of life of local residents and to reduce costs for maintenance and infrastructure locally and regionally.

Conserving and restoring local natural resources improves the quality of life of residents and enhances beauty of our cities and villages. Connecting these regional and local features within environmental corridors helps protect water quality, sustain wildlife and plant habitat, and provides valuable opportunities for recreation and education. Assessing this natural resources information along with agricultural, economic, and community information, provides a foundation for local communities to evaluate where development should be encouraged, where resources should be protected, and where both can occur in harmony.

The present condition of the region's natural resources is dramatically different from pre-European settlement times and continues to be altered for agriculture and development. Agricultural land use dominates where prairies and scattered oak savanna once flourished. Many wetland acres that once filled the river bottoms and other low lying areas were ditched and drained. Stream channels were dredged and straightened. Development increased as populations in urban and rural communities grew, often fragmenting natural communities and ecological systems. Urban development in the 19th and 20th centuries produced uncontrolled runoff from streets and parking lots, and erosion from construction sites and stream banks that degraded water quality and wildlife habitat. With thoughtful planning, development, and management practices, these resources can be protected from such impacts, and degraded resources can be restored.

Impacts from development are, for most individual sites, relatively small. When considered on a regional basis, however, their cumulative impact can have substantial consequences. To manage these impacts, it is critical to understand them on a regional basis, and collectively address them at the site level. Ultimately, the site level is where the physical changes to the environment are being made and mitigation measures are easier to implement.

Many communities across the U.S. are discovering that a natural resource-based development strategy is a much better alternative to conventional urban design and development. The primary objective is relatively straight forward. The quality of our natural environment and the associated resource functions and values should be maintained and, where possible, enhanced. This dovetails with a host of related growth and development strategies related to infrastructure planning, community development, agriculture, and open space. A resource-based development approach has several characteristics:

- Tangible, measurable, and readily understood by the participants in the local development review process.
- Directly linked to the local development review process by making natural resources protection a priority during all stages of the development process – from the conception of how the landscape is to be altered through the planning, design, and construction of individual projects, to the maintenance of the necessary infrastructure such as stormwater management facilities after it is completed. Each step of the development process should only proceed when it can be reliably determined that the impacts of the development will be mitigated or minimized.
- Clear and practical management approaches towards local development by explicitly directing development away from environmentally sensitive areas along with other necessary protections and safeguards.

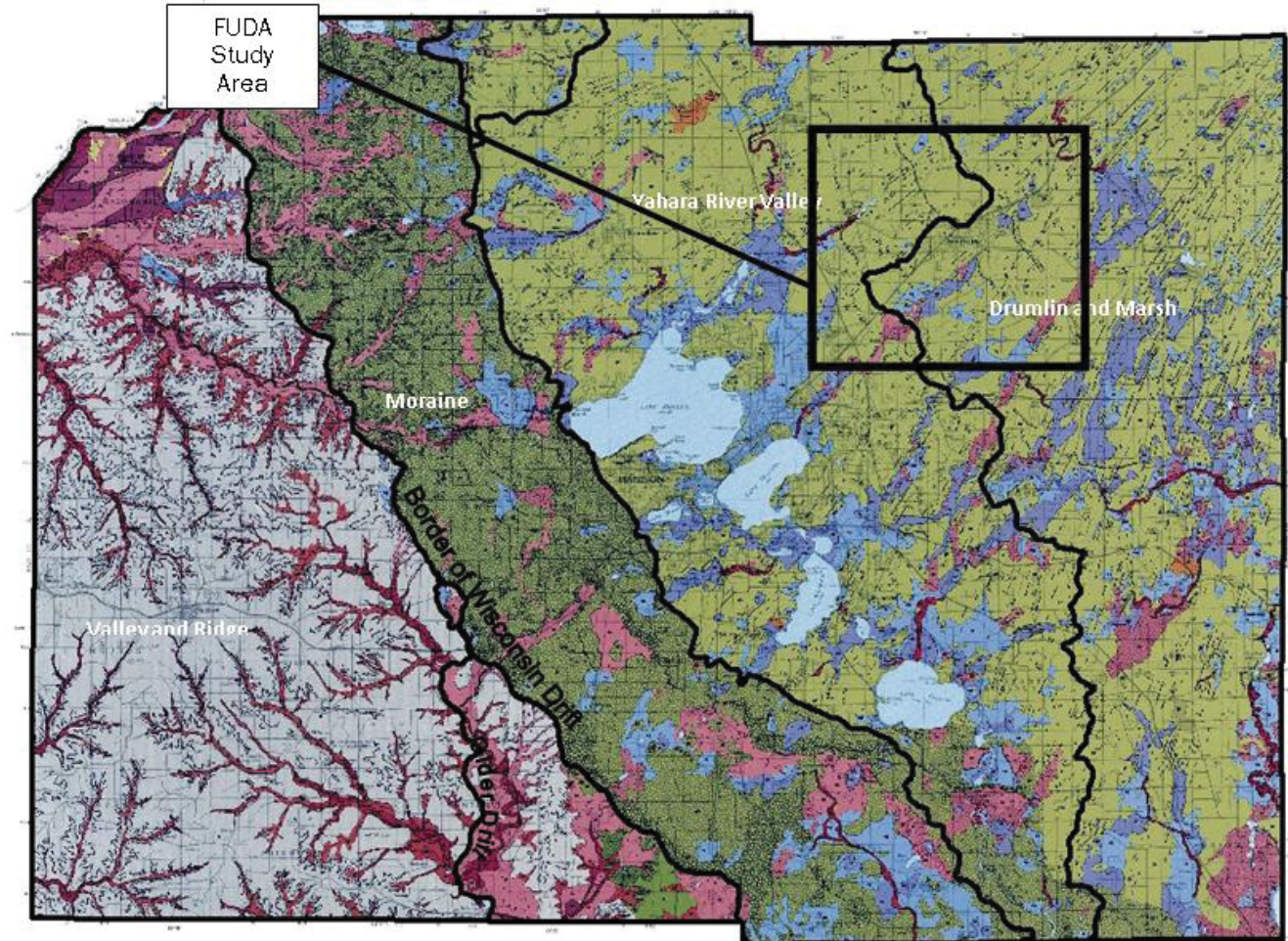
A resource-based strategy should streamline the local review process, reduce administrative burdens on local government, and be fully responsive to the needs of the development community for clear direction, timely review, and reduce uncertainty and mitigation costs.

The physiography of Dane County explains the surface and near-surface resources that characterize the landscape of the region. These include land forms, geology, soil and subsoil characteristics, vegetative cover, drainage and surface- and ground-water resources, and associated habitats. Information in this section is organized based on a layered approach and starts with large-scale characteristics followed by characterization at successively smaller scales of analysis. Planning and design implications of these features and characteristics are discussed and highlighted at each step. Information concerning past and current actions and efforts to address problems and issues have also been included to provide the pertinent context for future decision-making.

A. Physical Geography and Surface Geology

The Sun Prairie study area is located in the northeast part of the county, in the Yahara River Valley and Drumlin and Marsh Physiographic Areas (*Map 12*). The Yahara River Valley consists primarily of glacial ground moraine with extensive areas of peat and marsh deposits. The Yahara River Valley has an irregular topography, ranging from flat and rolling to hummocky and hilly. Slopes are relatively gentle. Here deep glacial deposits up to 350 feet dammed up a large pre-glacial valley, forming a chain of large lakes and wetlands. Lakes Mendota, Monona, Waubesa, and Kegonsa dominate the valley. Lowlands along the Yahara River are generally marshy, whereas uplands are well drained. Streams in this physiographic area are generally flatter and more sluggish than those in the unglaciated driftless area to the west, and fewer are spring fed. The eastern portion of the study area is located in the Drumlin and Marsh Physiographic Area. This area includes many small drumlin hills interspersed with shallow glacial deposits that create an extensive system of interconnected wetlands with poorly defined drainage and few springs. The only lakes in this area are small stream impoundments or shallow marshy lakes. Concerns associated with shallow depth to water table, wetlands, and floodplains are detailed in subsequent sections of this report.

Map 12. Physiographic Areas and Deposits of Pleistocene Age in Dane County, WI



Derived from USGS Water-Supply Paper 1779-U (plate 2) 1965. For more detailed information see Pleistocene Geology of Dane County, WI. (WGNHS Bull. 95, 1997).

1. Mineral Resources

Map 13 shows potential mineral extraction sites throughout the study area. *High Potential* mineral extraction sites have deposits of either ice contact stratified glacial material or coarse outwash, providing the best potential for an economically viable source of high quality aggregate. *Low Potential* sites have deposits of either pitted outwash or finer outwash and are less likely to be an economically viable source of high quality aggregate.

Mineral extraction operations are eligible uses under the Dane County Zoning Ordinance as a conditional use in agricultural zoning. Section 10.191 establishes procedures and standards of operation for mineral extraction operations. ***Mineral resources are important economic and environmental assets. These areas should be protected from development until after the mineral resources have been utilized and the site reclaimed.*** These areas also provide significant opportunities for large-scale infiltration and groundwater

Planning Considerations

- Preserve mineral resource areas until after the resources are used.
- Preserve mineral resource areas until their value and usefulness as regional infiltration and groundwater recharge is investigated and ruled out.

recharge to maintain the hydrologic regime of area waters. This strategy needs to include stringent measures to protect groundwater quality, and is covered more fully on [page 122](#).

2. Steep Slopes and Woodlands

Typical definitions for steep slopes in Wisconsin vary from 12% to greater gradients. Steep slopes pose a number of development concerns and constraints. A significant concern is that developments on steep slopes increase erosion and stormwater runoff. This is problematic since it can adversely affect water quality as debris and excess sediment is washed into surface waters. A scattering of areas with slopes greater than 12% exist in the Sun Prairie FUDA study area ([Map 14](#)). The following standards are recommended:

- *Slopes steeper than 20% should be protected from disturbance and planted with permanent vegetation to prevent destabilization.*
- *Municipal engineers should review and approve all slope disturbance and stabilization measures for steep slopes with gradient between 12% and 20%.*
- *Broadly, areas identified as having slopes in excess of 12% should be avoided for development and included in open space amenities or in Environmental Corridors.*

Woodland Restoration

Before European settlement, southern Wisconsin was a complex mosaic of prairie, savanna, and forest. Fire was the major driver for the distribution of these ecosystems. Where fires burned most frequently and intensely, prairies were found. Where fires were less prevalent, savannas, woodlands, then forests grew. Most of the natural forests of Dane County can be found in the Valley and Ridge sub-region. In the east, woodlands were less frequent because the glaciers left wide flat areas enabling prairie fires to sweep the landscape. European settlers suppressed fires and plowed native prairies. The remaining prairies transitioned to savannas and then to woodlands, and some finally into forests. Woodlands and forests were favored by settlers as they provided firewood, timber, and game leading to their preservation. Most of the woodlands in this study area are the product of this transition and do not represent the historical land cover.

The remaining woodlands in this area only cover 4% of the total landscape. Many exhibit irregular, unnatural, and small patch shape, are distant from each other, bisected by roads, have abrupt transitions at the woodland edge, and have existing developments and infrastructure nearby. Landcover attributes of habitat size, shape, and relative position in the landscape strongly influence biodiversity on a site and regional scale. Small areas tend to have low species diversity (raw number of species), and is associated with low functional diversity (number of different ecological jobs performed by species). Low biodiversity impairs two important ecosystem functions needed for sustainability, ecological resistance and resilience. Ecological resistance is the capacity of an ecosystem to arrest change, and ecological resilience, the ability to recover after stress.

Planning Considerations

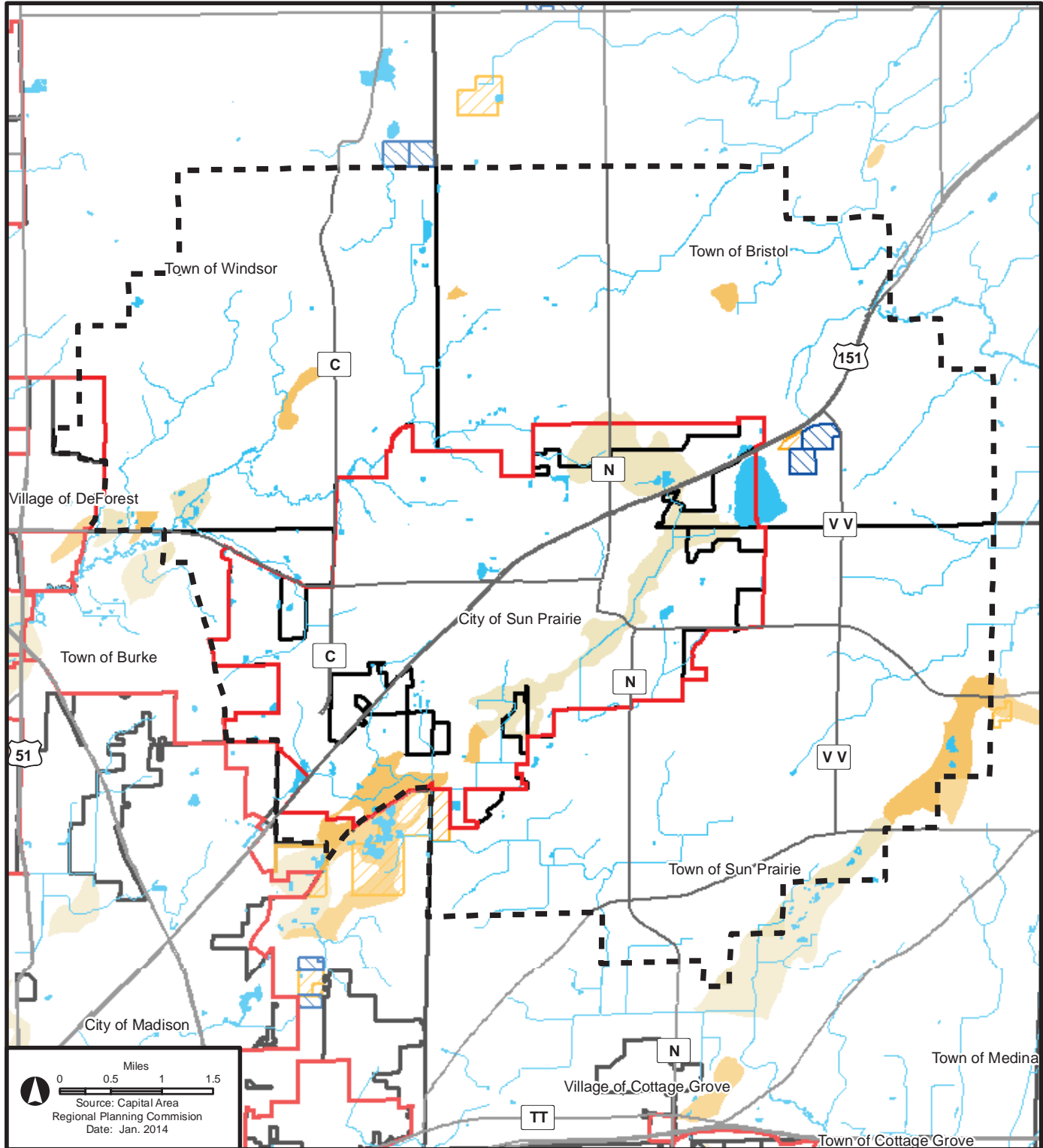
Protect, preserve, or restore perennial vegetation on slopes greater than 20% to protect against development and slope destabilization.

Limit development on slopes greater than 12%. Preserve or restore them in perennial vegetation wherever possible.

All slope disturbance and stabilization measures should be reviewed and approved by municipal engineers.

Map 13: Mineral Resources

Sun Prairie FUDA, Dane County, WI

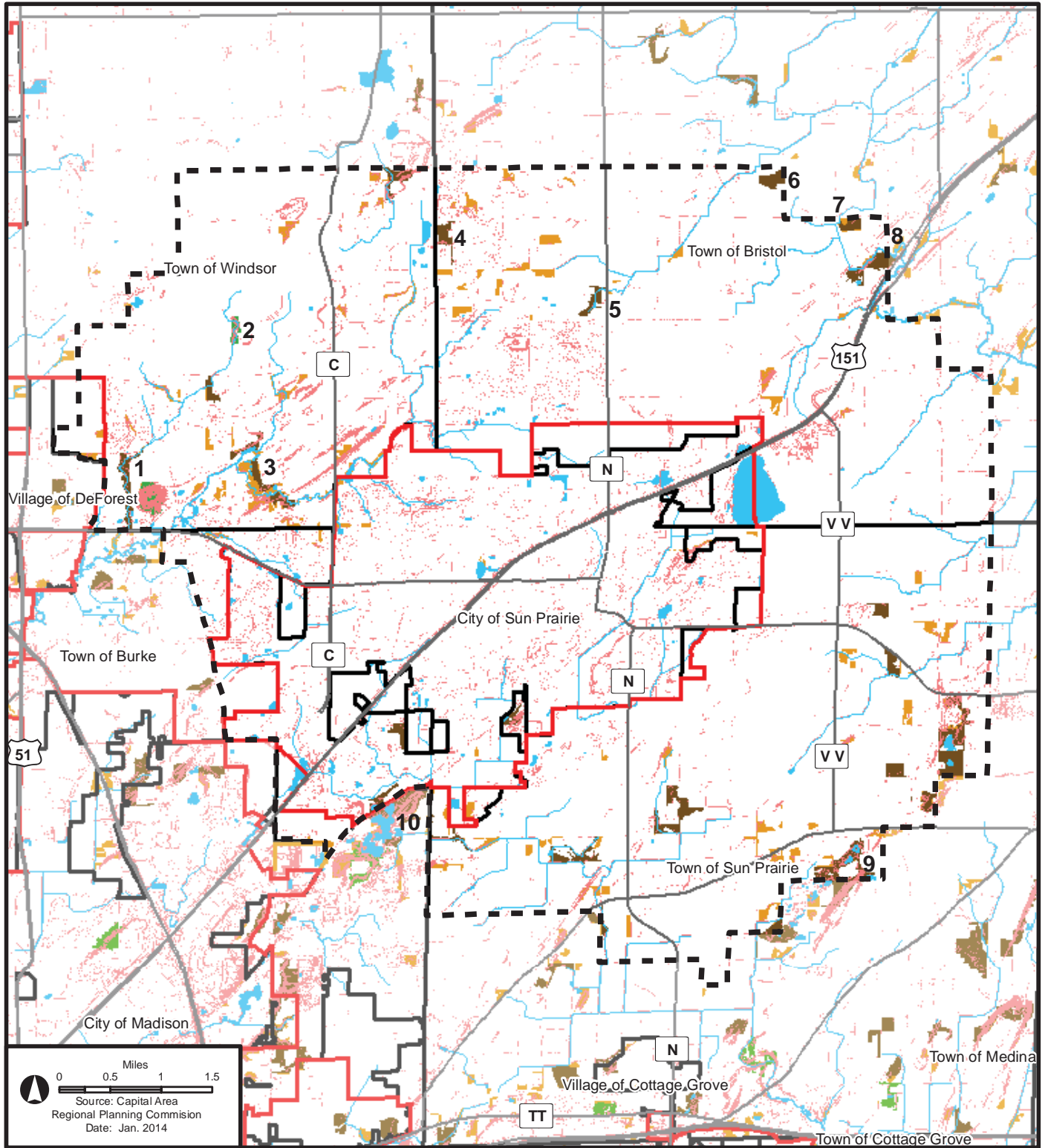


- FUDA Study Area
- Municipal Boundary
- High Potential Sand & Gravel
- Conforming Site (CUP)
- Urban Service Area
- Low Potential Sand & Gravel
- Non-Conforming Site
- Limited Service Area

Mineral resources are important economic assets. These areas provide significant opportunities for regional infiltration practices to replenish the groundwater. Non-Conforming Sites are referred to as Unregulated Mineral Extraction Sites.

Map 14: Steep Slopes and Woodlands

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Slopes > 12%
- Large Woodlands (> 12.35 acres)
- Woodlands
- Large Oak Woodlands (50% Oak & > 12.35 acres)

Development on steep slopes can increase erosion and stormwater runoff, negatively impacting surface water features. They can also negatively affect the natural terrain and aesthetic qualities of an area. Detailed analysis and design is need to prevent slope destabilization in these areas. Revegetating bare slopes can reduce erosion and stabilize these areas. Steep wooded slopes left in a natural condition provide significant groundwater recharge, wildlife habitat, and water quality benefits.

In woodlands, small patches with irregular edges are detrimental to the microclimate along woodland boundaries and enables invasive species colonization. Invasive Cottonwood trees (*Populus deltoides*) are problematic in riparian areas because they grow quickly and are prone to breaking. When near streams, their excessive woody debris alters stream width leading to a variety of ecological problems, and when near development, their root system threaten underground utilities.

The canopy and understory species of woodlands in Southern Wisconsin have changed over the past 50 years.³⁵ The predominant red and white oaks are being replaced by more fire intolerant species, such as sugar and red maple, elms, black cherry, green ash, box elder, and hackberry.³⁶ Oak replacement is facilitated by shrub species and suppressed fire regimes. Shrubs create strong shade and higher soil moisture. This creates a positive feedback loop that accelerates plant community transition from oak dominated woodlands towards moisture favoring tree species. Excessive shrubs reduce plant diversity in the forb layer and have contributed to ecological homogenization. Invasive shrubs have removed habitat for ground species and changed nesting patterns for birds making them more susceptible to predation.

Despite this overall change in vegetation from pre-settlement conditions and habitat fragmentation, there are some woodlands that represent the historic conditions with native plant species. Sites classified as 12.35 acres (5 ha) or greater, and are 50% or greater oak content, help provide the minimum conditions needed for oak habitat. This acreage allows for population dynamics needed to promote long term persistence. Additionally, sites with mature oak stands should be preserved, as oaks take several decades to reach reproductive maturity. Analysis of vegetation cover from satellite data (LANDFIRE³⁷) indicates there are two locations (**Map 14**) that meet the above criteria: site 1, located north of Token Creek at the intersection between STH 19 and Portage Road, and site 2, west of CTH C and bounded between Windsor Road and Egge Road. With the exception of a few residences along the periphery, Site 1 remains largely intact because of its steep topography and is owned by the town. Site 2 is mostly a riparian area that follows an intermittent stream and is near the lower end of the conservation threshold for size. However, most of its area is protected by streambank regulations. ***CARPC recommends that these sites be preserved in its entirety. Long-term conservation of these areas will require thinning of the canopy and understory to remove excessive brush and competitor tress, as their presence will hinder oak sapling establishment.***

Additional non-oak woodlands within the study area should be preserved due to their larger size. Woodlands that are 12.35 acres (5 ha) or greater provide cover for some area sensitive organisms, can facilitate ecological connectivity, and provide ecosystem services to their watersheds. Sites 3 through 9 are larger woodlands. Site 3 forms the eastern edge of Token Creek Preserve Park. This woodland serves as a natural buffer to the adjacent wetland, and cover and nesting opportunities for wildlife that use the wetland. Pine trees are dominant along the western edge, and mixed deciduous trees occur along the eastern edge. Stands of pine trees are not typically found in southern Wisconsin unless they were planted intention-

³⁵ Curtis, J. T. 1959. The Vegetation of Wisconsin: An Ordination of Plant Communities. The University of Wisconsin Press. Madison.

³⁶ Rogers, D., T. P. Rooney, and R. Henderson. 2008. From the Prairie-Forest Mosaic to the Forest: Dynamic of Southern Wisconsin Woodland. In: D. M. Waller and T. P. Rooney (Eds). The Vanishing Present: Wisconsin's Changing Lands, Waters, and Wildlife. The University of Chicago Press. Chicago.

³⁷ <http://www.landfire.gov/>

ally as ornamentals or tree plantations. Pine stands tend toward lower biological diversity when they grow to high densities.

Site 3 has a well developed understory, with a variety of shrub and forb species to provide adequate cover. ***For this site, it is recommended that any sapling or juvenile pines be removed.*** This will prevent additional recruitment of pines, allow deciduous trees to colonize, and eventually the pine stand will thin as trees reach senescence and die. Sites 4 through 8, in the northern half of the study area, tend to be isolated within the study area and have limited potential to contribute to the regions ecosystems. Site 5 will likely be retained, in its entirety, because its riparian function. Sites 6, 7, & 8 occur on the north eastern corner of the study area, nearest Deansville State Wildlife Area. They form a tenuous link of stepping stones connecting a degraded wetland to the state natural area. Their utility and importance as habitat connectors will improve, if the aforementioned wetland were to be restored. Site 9 occurs at the southeastern corner of the study area, south of the T-intersection between CTH T and CTH VV. This site is a cluster of smaller woodlands surrounding wetlands, prairies, and open water features. This site has sufficient size and habitat variety to serve as a minor wildlife area. Site 10 is adjacent to the study area towards the southwest. This site was once a gravel excavation site and the depressions have since filled with water. The surrounding woodland features could serve as community separation between the Cities of Sun Prairie and Madison.

Many woodlands exist within the study area that are not oak dominated or are large enough. Small patches often have irregular edges and have high perimeter to area ratios caused by habitat fragmentation. Ecological processes within the woodland can be altered when adjacent to agriculture or urban land use. This phenomenon is called edge effect. Edge effects include drier microclimates along woodland boundaries and can lead to detrimental changes in plant composition and greater colonization by invasive species. Invasives decrease native plant diversity throughout woodland canopy, shrub, and forb layers. Woodland edges are more susceptible to colonization by invasive species, particularly local invasives including buckthorns, Russian olive, and Japanese honeysuckle. Additionally, edge effects influence habitat suitability by animal species. Smaller, less motile species, including insects and herptiles are more severely affected by edge effects. Bird species have a higher susceptibility to nest parasitism by the Brown-headed Cowbird (*Molothrus ater*), where woodland edge effects are more prevalent. Smaller woodlands should be evaluated for retention on a case-by-case basis. If desired, communities can incorporate them into their urban designs if feasible.

Planning Considerations

Identify local stressor causing ecosystem degradation.

Eliminating invasive species.

Restore connectivity within the landscape for organism movement.

An entire landscape does not need to be replanted back into woodlands.

Woodlands meriting the greatest protection and should remain intact are those located near Token Creek. This includes the woodland sites 1, 2, and 3 above, and any additional woodlands that are border on the riparian wetlands regardless of size. These woodlands are important for four reasons: they provide additional habitat variety, woody debris, leaf litter, and will be necessary for organisms with complex life history traits. Habitat variety is a driver in maintaining biodiversity, allowing multiple organisms, with varying life history requirements, to co-exist in the same area. Large woody debris is a major driver in stream ecology and impacts chan-

nel morphology, sediment accumulation, and in-stream habitat for aquatic invertebrates and fish. Streams that lack large woody debris tend to be wide and have increased downcutting erosion. Leaf litter is an essential component to food webs in smaller order streams and is used by several different taxonomic groups of aquatic macroinvertebrates that either feed on the litter itself, or graze on biofilms that grow upon the leaf. These macroinvertebrates are then prey for higher organisms. Finally, many organisms require multiple ecosystems to fulfill their life history requirements. This will be important to retain woodlands near Token Creek as degradation by reed canary grass (*Phalaris arundinacea*) has reduced riparian plant diversity and no longer provides adequate nesting sites for birds in the area. Local birds were seen foraging for insects along the stream channel and returning to nest in the nearby trees.

The potential benefits of restoring many of these small woodlands should be a lowered priority given limited resources. However, there are instances where woodland restoration is recommended, identifying and removing the factor(s) that caused ecosystem degradation is important. If not, they will eventually fail. Restoration plans for these areas should include the removal of invasive species, opening the canopy, clearing excessive brush, and planting native oak species. Sites that currently border on agriculture should be planted with woodland transition species to create softer edge effects. Greater conservation gains for this area will be achieved by pursuing greater woodland functionality rather than expanding woodland cover.

Other woodlands, in the study area could be considered as natural resource amenities for communities. They may have greater societal value than ecological value. These areas may serve as visual breaks in the urban fabric, separators between different land uses, or retained as community parks. The quality, size, and position of woodlands that are further south in the study area, will not require additional connectivity measures. Continuous environmental corridors for ecological stepping stones will not be needed. Connectivity measures should be implemented to connect large, high value conservation areas to each other.

3. Soils

The geologic history of Dane County is responsible for the productive soils found in the area. Clay and silt loams are found primarily in the glaciated portion of the county. Soil type is an important indicator of structural difficulties posed for development. The following characterizes the soils found in the Sun Prairie FUDA study area (*Map 15*):

Soils Underlain by Sandy Loam Glacial Till

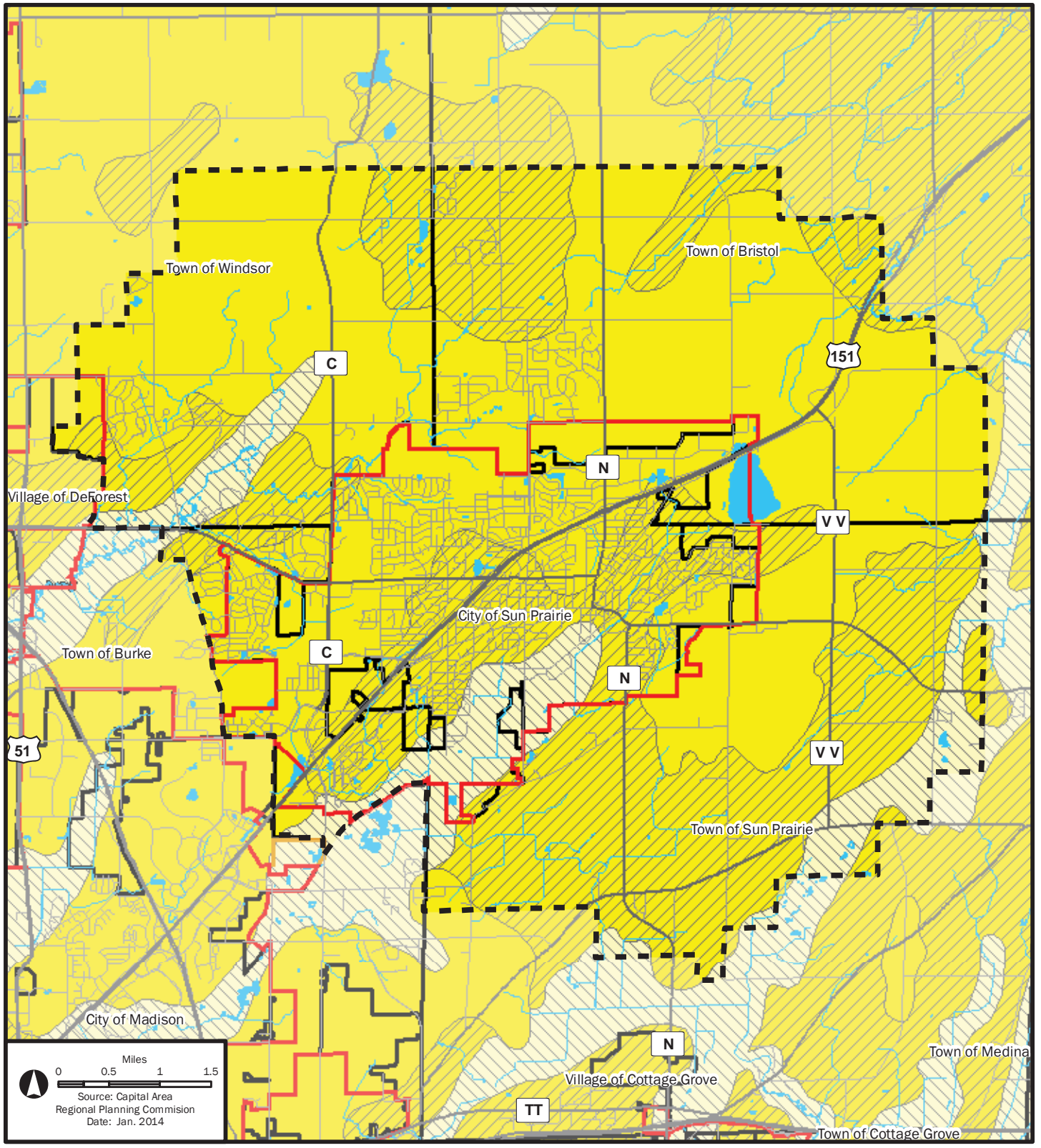
The soils in this group formed mainly by wind born deposits of silt loam underlain by sandy loam glacial till. Most of these soils have moderate permeability and high available water capacity. *These soils pose slight to moderate limitations for farming and for urban use.*

Dodge-Street Charles-McHenry Association

This association has a varied landscape characterized by ground, end, and recessional moraines. The landscape is mostly gently sloping to sloping. Some areas on benches and in depressions and drainageways can be nearly level, and small areas of moderately steep to steep slopes can also be present. *Except for small areas in drainageways and steep slopes, this association poses slight limitation for development.*

Map 15: Soil Associations

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
 - Urban Service Area
 - Limited Service Area
 - Municipal Boundary
 - 1 Dodge-St. Charles-McHenry association
 - 2 Plano-Ringwold-Griswold association
 - 8 Batavia-Houghton-Dresden association
- Soil Association Source: Excerpt from USDA SCS Soil Survey of Dane County, WI 1978

A soil association is a landscape that has a distinctive proportional pattern of soil types. It normally consists of one or more major soils, for which it is named, and some minor soils. The soils in one association may occur in another, but in a different pattern.

Plano-Ringwood-Griswold Association

This association consists mainly of gently sloping areas on glacial uplands. Some areas on uplands are nearly level to sloping. A small area of moderately steep rises or ridges also exists. *Except for small areas of steep slopes, this association poses slight limitation for development.*

Soils Formed in Outwash Material

The soils in this group consist of associations formed mainly in outwash material near streams or adjacent to glacial moraines. These soils are generally loamy and underlain by sand, gravel, or both. These soils have moderate permeability and available water capacity. Many of them are good sources of sand and gravel. *Where these soils are well drained and gently sloping to sloping, they have slight to moderate limitations for most urban uses.*

Batavia-Houghton-Dresden Association

This association has a landscape that consists of outwash plains with depressions and old lake beds. The soil material was deposited by wind and by water from melting glaciers. The texture of the material is variable, though predominantly silt, sand, or gravel. *Areas with poor drainage (silt and finer soils located in old lake beds) can pose limitations to development from induced flooding.*

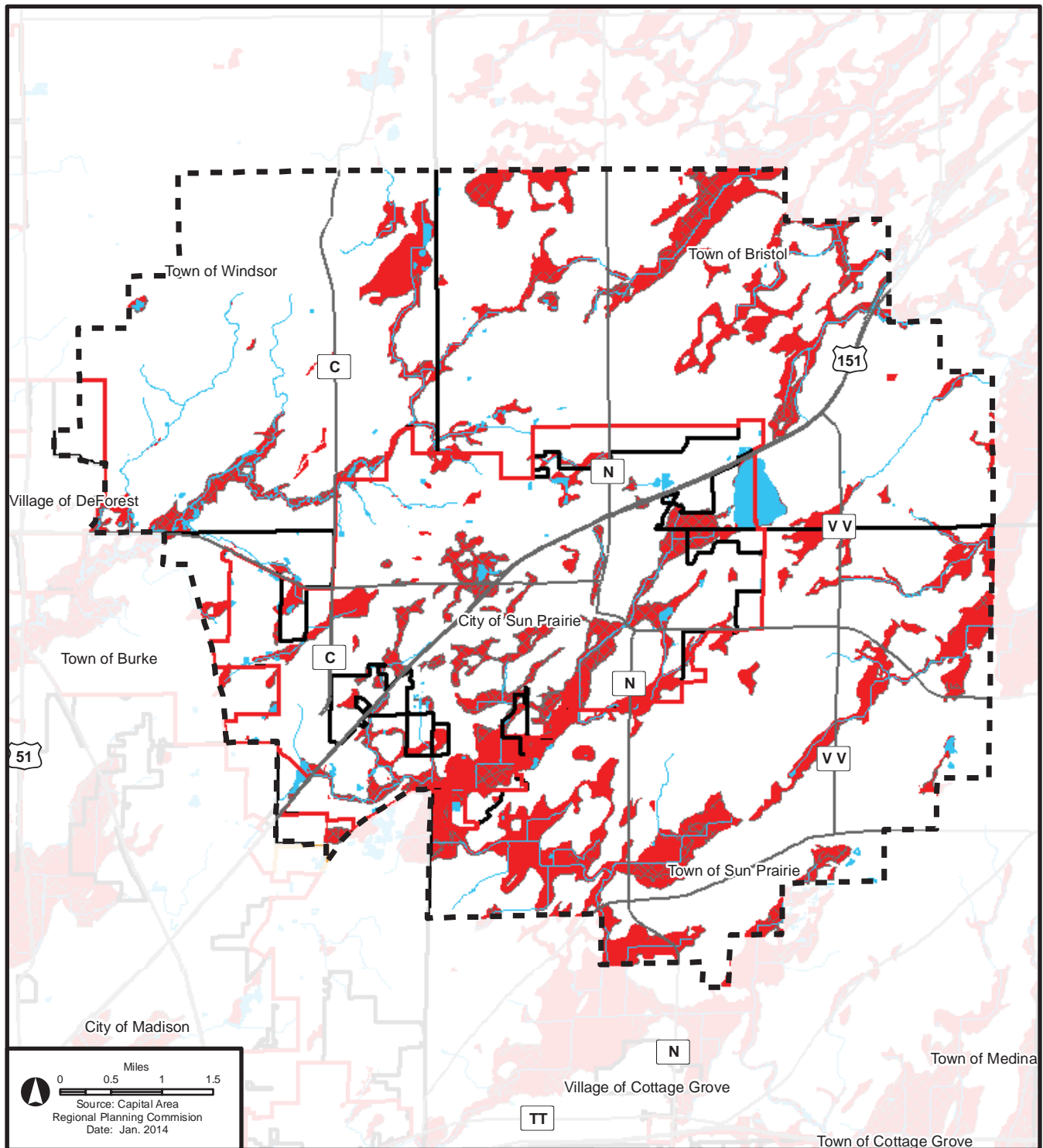
Hydric Soils

These soil associations contain soils that are “hydric,” and are associated with prolonged periods of wetness or saturation. Hydric soils are good indicators of existing and former (drained) wetlands (see [Map 16](#)). Potentially restorable wetlands are indicated based on WDNR modeled data. Hydric soils with potential for wetland restoration lie along the streams in this area. These include Colwood (Co), Houghton (Ho), Orion (Or), Otter (Ot), Sable (Sa), and Wacousta (Wa) soils.

Depth to water table in hydric areas is generally 0 to 3 feet (see [Map 17](#)). *Soils with seasonal high water tables of less than 3 feet and classified as poorly drained may not be suitable for infrastructure due to potential groundwater induced flooding. These areas are well suited for park and open space areas. If these areas are developed, on-site soils investigations are recommended to determine the actual extent of seasonal high groundwater areas and potential increases in groundwater levels from stormwater management practices and in-*



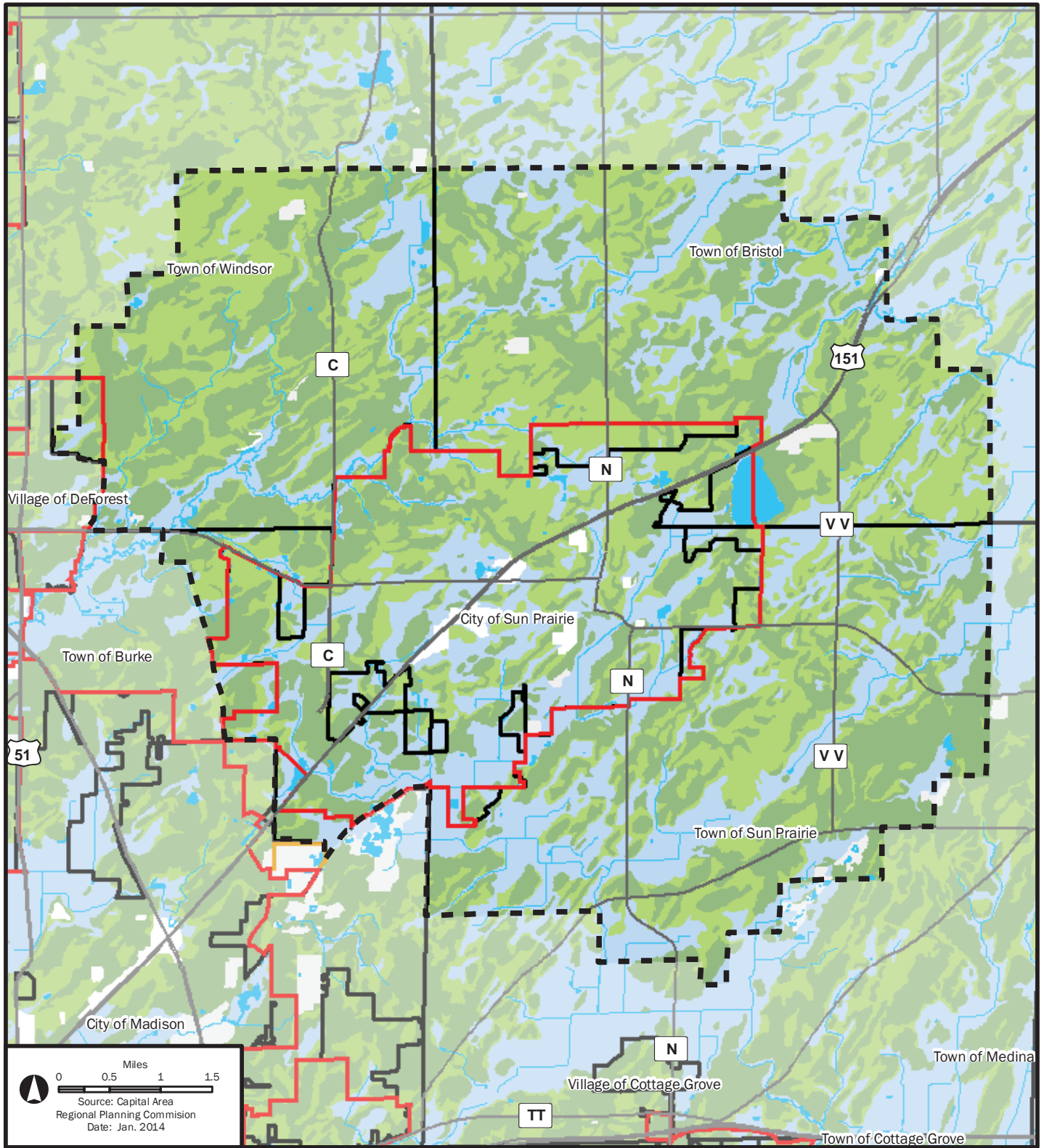
Map 16: Existing and Former Wetlands Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Wetlands < 2 acres
- Wetlands > 2 acres
- Urban Service Area
- Limited Service Area
- Excavated Pond
- Restorable Former Wetlands
- Non-Restorable Former Wetlands

Existing and former wetland soils often present significant constraints to development because of saturated soil conditions with poor bearing capacity. Conversely, these are areas of potential opportunity for restoration and providing additional water quality, flood storage, and wildlife habitat benefits. These areas should be studied in more detail to mitigate potential adverse impacts and promote potential community benefits.

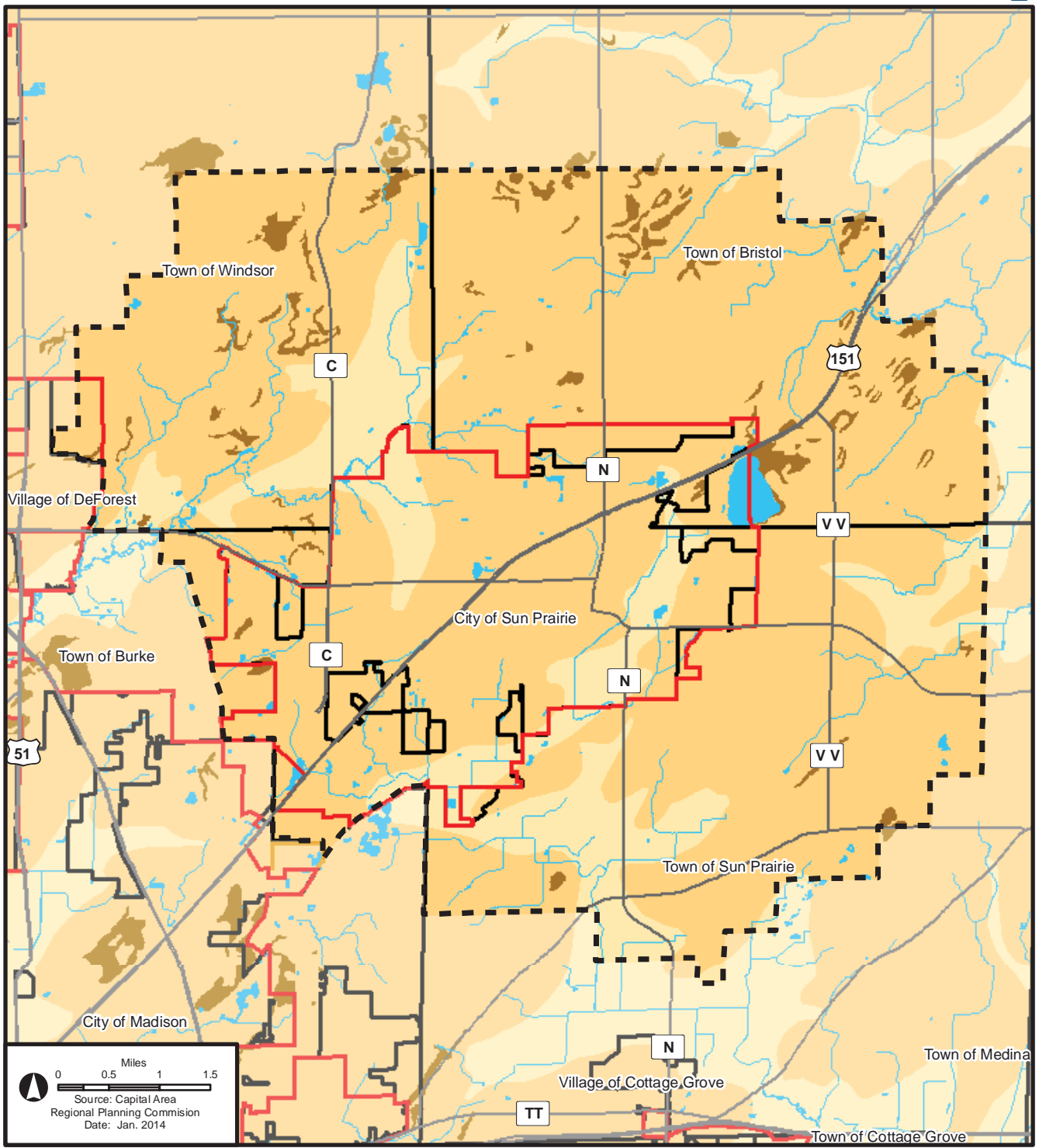
Map 17: Depth to Water Table
Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- 0-3 feet
- >3-6 feet
- >6 feet
- No Value Reported

Soils with seasonal high water tables of less than three feet and classified as poorly drained can have limited suitability for roads and buildings due to their potential for groundwater induced flooding.

Map 18: Depth to Bedrock Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	0-3 feet	> 5-50
Urban Service Area		> 3-5	> 50
Limited Service Area			

Shallow depth to bedrock three feet or less and karst features can increase the cost of urban infrastructure and housing construction. It may limit the suitability of some stormwater practices due to the potential for groundwater contamination. This is less of a concern in the glaciated portions of the county (such as the FUDA area) compared to the "driftless area," and may provide greater opportunity for infiltrating precipitation and runoff as a key stormwater management strategy.

creased precipitation. Restrictions are recommended in confirmed problem areas to establish the lowest allowable level of any structure so that it is situated well above the high water table to reduce the potential for groundwater induced flooding. **These soil conditions may also limit the suitability of some stormwater infiltration practices due to the potential for groundwater pollution.** More detailed information is provided on [page 129](#).

Depth to Bedrock

Excavating bedrock can increase construction costs. Bedrock at a depth of 3 feet or less and karst features may also limit the suitability of some stormwater infiltration practices due to potential groundwater pollution. Shallow depth to bedrock is less of a concern in the glaciated part of the county. This is because of the significant amount of till left behind by the retreating glacier. This is an opportunity for development because deep soils generally provide greater pollutant removal and easier stormwater management. *In the Sun Prairie study area depth to bedrock generally exceeds 5 feet and is more than 50 feet in many areas (see [Map 18](#)).*

Development Site Analysis

While the USDA Natural Resources Conservation Service (NRCS) Soil Survey for Dane County is a valuable planning tool, soil borings or other onsite soils investigation are necessary for detailed engineering analysis and site design. For example, [Map 19](#) shows building site potential for dwelling units with basements based on soil characteristics. Each situation will be different depending on the intended or anticipated land use, existing or potential soil limitations, and any special planning, design, or implementation that may be needed to minimize or overcome the limitations encountered.

Relative Infiltration

CARPC staff, with cooperation from the Dane County Land and Water Resources Department, conducted an analysis of the stormwater infiltration potential of soils in this area. This analysis uses existing topography and soils data (slope, soil permeability, depth to the water table, and depth to bedrock) to infer infiltration potential. Infiltration potential in the Sun Prairie FUDA study area is generally medium, **with the potential for enhancement with engineered soils and tapping into deeper sand and gravel deposits.** More detailed information on infiltration and groundwater recharge areas is provided on [page 129](#).

B. Surface Water

Agricultural practices and urban development have either threatened or degraded receiving waters. As natural areas are converted to agriculture or urban development, unless mitigate, the ground/surface water balance shifts from a groundwater-dominated system to surface

Planning Considerations

Soils with seasonal high water tables of less than 3 feet and classified as poorly drained have limited infrastructure suitability due to groundwater induced flooding.

Hydric soils are good indicators of existing and former (potentially restorable) wetlands.

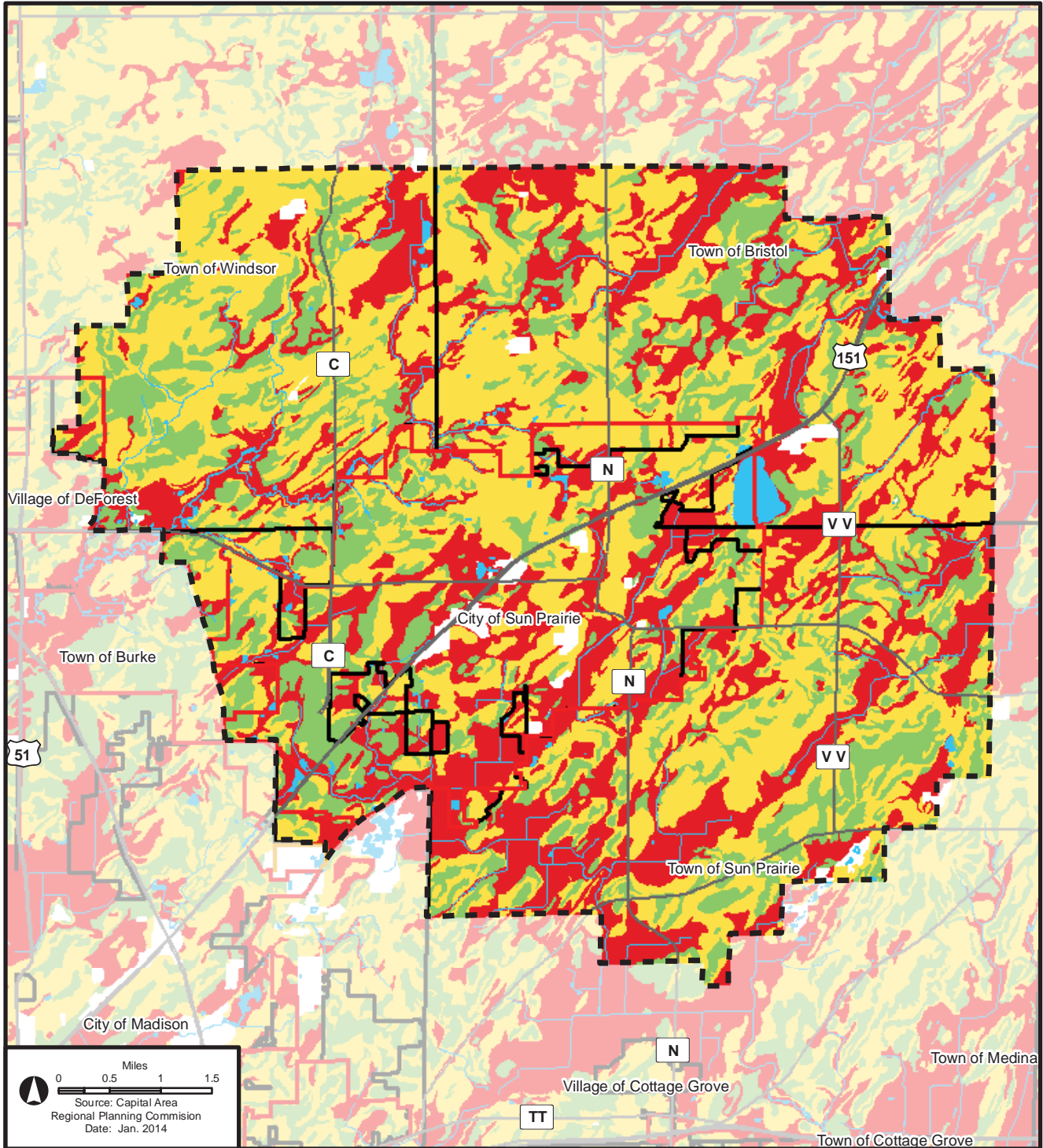
Consider areas with high infiltration potential for enhanced infiltration and groundwater recharge.

Planning Considerations

Bedrock excavation can increase the cost of infrastructure and construction.

Bedrock at a depth of 3 feet or less and karst features may limit the suitability of some stormwater infiltration practices due to potential groundwater pollution.

Map 19: Building Site Potential for Dwellings with Basements Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Very Limited
- Not Limited
- Urban Service Area
- Somewhat Limited
- Not rated
- Limited Service Area

The ratings for dwellings are based on the soil properties that affect the load-bearing capacity and the ease and amount of excavation needed.
Source: USDA Natural Resource Conservation Service Soil Survey for Dane County.

water runoff dominated system. This reduces in stream quality and promotes transitions to more tolerant biological communities.

Since these impacts can be gradual and cumulative, it is important to minimize them in all cases where possible. One strategy promoted by CARPC for new development in the region since the mid-90s is to **employ stormwater control measures and practices that maintain or otherwise mimic pre-development hydrologic conditions** (i.e., the pre-development ground/surface water balance). For example, in addition to maintaining groundwater resources, stormwater management controls and practices that maintain pre-development infiltration and groundwater recharge also help reduce peak flow rates and volumes of stormwater runoff. This results in less stream bank erosion, channel cutting and widening, and less pollutants transported to surface waters. In the Token Creek watershed, the Village of DeForest and Town of Windsor adopted a stormwater ordinances requiring such practices for new development in their urban service areas. Suitable **buffers are also needed** to protect our waters from surrounding land uses, in addition to providing necessary food, cover, and movement corridors for wildlife. **More effort is needed to avoid impacts to these sensitive resources and instead direct future development to more suitable areas.** These strategies are described in detail in *Technical Appendix D* of the *Dane County Water Quality Plan*.



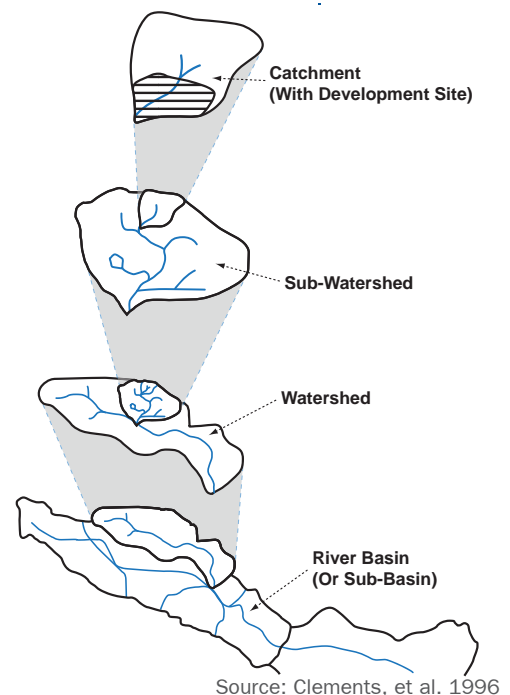
1. Watersheds and Drainage

The basic structural element of natural resources protection is the watershed. A watershed is defined as the land area that drains to a specific body of water (river, lake, or wetland) and can be compared to a topographic bowl, bathtub, or basin separated from neighboring watersheds by ridgelines.

Watersheds are scalable. Like nested Russian dolls they flow into successively larger versions of themselves (see **Figure 19**). While similar in form and function, for purposes of clarity, watersheds are often given more descriptive names depending on the scale being used. For example, a particular *catchment area* for a neighborhood in the City of Sun Prairie might drain to Token Creek *subwatershed*, then to Yahara River watershed, Lower Rock River basin, Mississippi River basin, and ultimately the Gulf of Mexico. See **Map 20** and **Map 21**.

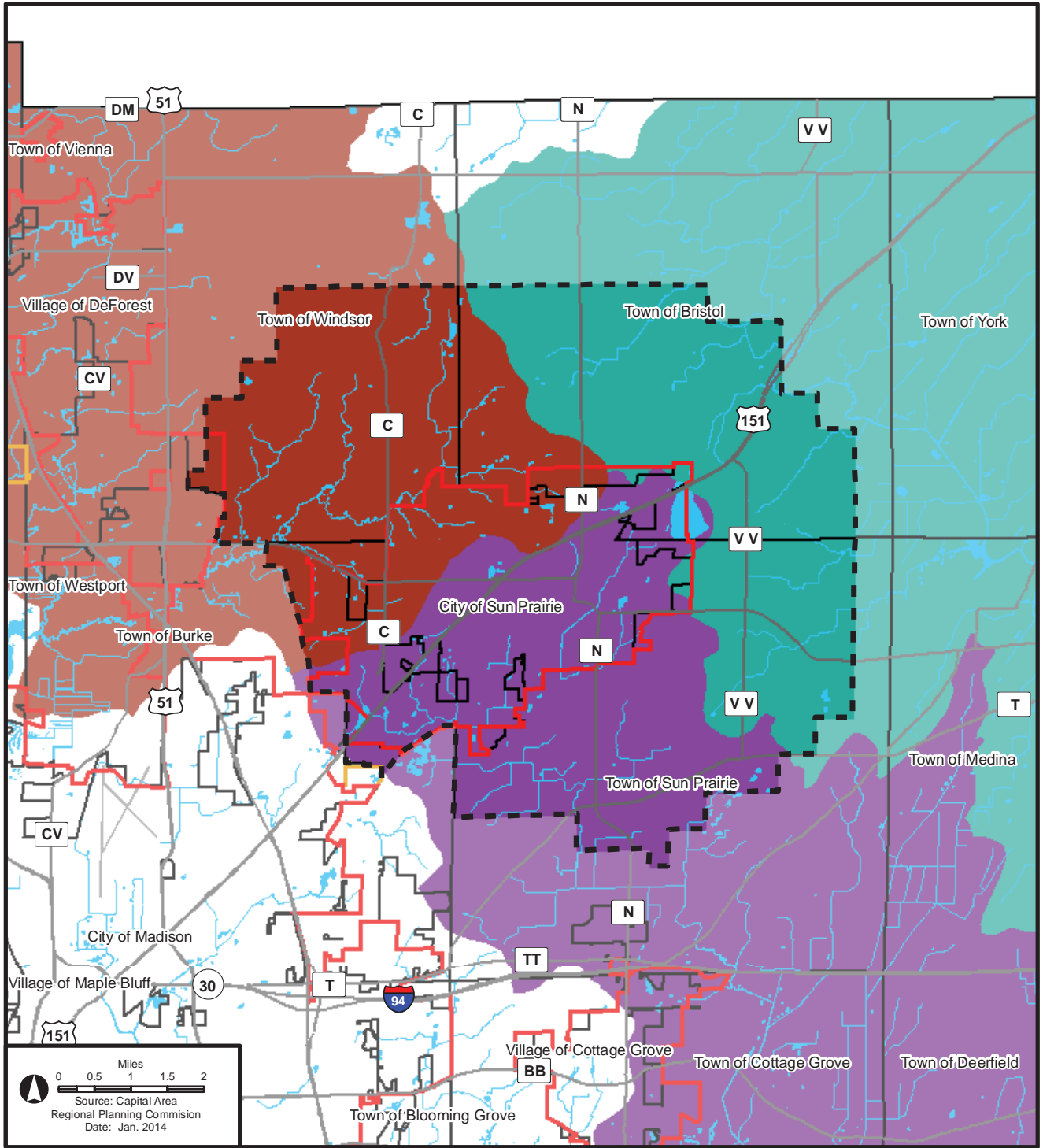
All organisms, whether aquatic and terrestrial, are dependent on water and shaped by watershed dynamics. Many conservation and natural resource management plans use the watershed concept as a means of organization. Careful consideration of development plans in the context of the watershed concept is very important

Figure 19. Watershed Management Units



Map 20: Subregional Watersheds

Sun Prairie FUDA, Dane County, WI

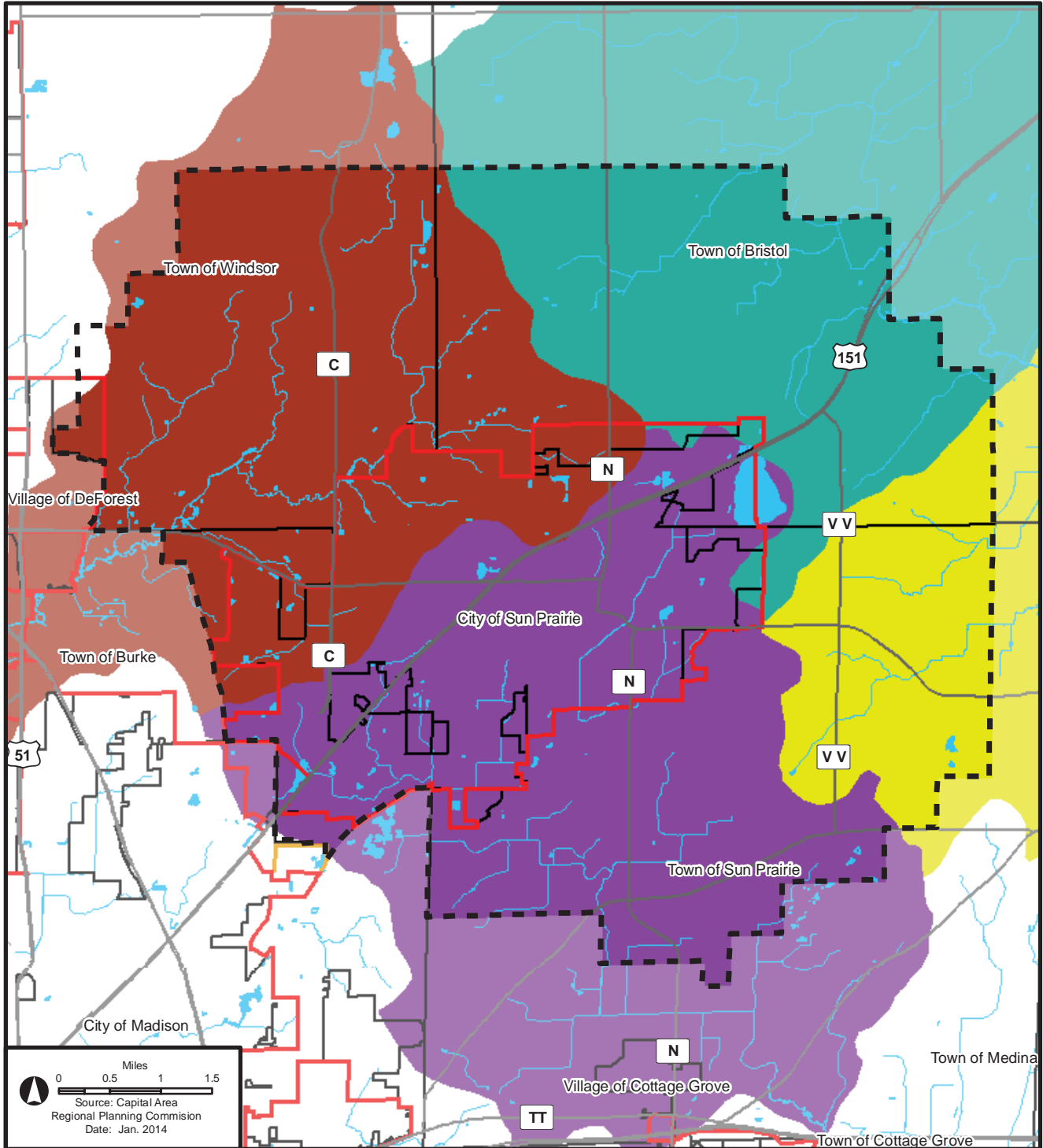


- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Maunesha River
- Upper Koshkonong Creek
- Upper Yahara River

Our water resources are the lifeblood of the region and watersheds, representing the land draining to a particular water body, are the basic structural elements of water resource protection. The health of a particular water body is primarily dependent on the types and land use and practices within its watershed. Note that watersheds are scalable and are defined by the area of scope or interest.

Map 21: Streams and Subwatersheds

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Urban Service Area
- Limited Service Area
- Upper Maunasha River
- Token Creek
- Headwaters - Koshkonong
- Deansville Marsh

Our water resources are the lifeblood of the region and watersheds, representing the land draining to a particular water body, are the basic structural elements of water resource protection. The health of a particular water body is primarily dependent on the types and land use and practices within its watershed. Note that watersheds are scalable and are defined by the area of scope or interest.

Planning Considerations

- Approach issues from a watershed scale.
- Consider the cumulative and long-term impacts.
- Direct development away from sensitive areas.
- Use compact development styles.
- Incorporate natural features into development designs.
- Apply conservation design principles.
- Minimize impervious areas.
- Slow stormwater runoff and encourage infiltration.
- Reduce pollution sources from all surfaces.

given that local actions have implications downstream far beyond their point of origin. Therefore, it is critical to **consider potential downstream impacts of changes to land cover and land use as part of the planning or conceptualization of such changes.**

Hydrology and drainage are highly dependent on climate and climate variability. The climate of Dane County is typical of the Great Lakes states. Winters tend to be long, cold and snowy, while summers are short and some times humid. Average annual precipitation is about 33 inches, with 67 percent falling from April through September. Average groundwater recharge in Dane County is estimated to be 7.6 in/yr; however, this varies by location. Most recharge occurs in late fall, winter, and early spring when vegetation is dormant and evapotranspiration is minimal. Runoff and evapotranspiration vary widely due to seasonal conditions and land use. August is the wettest month with 4.3 inches of precipitation (1971-2000), and January is the driest with about 1.2 inches. About 84% of the precipitation events are half an inch or less. Snowfall averages 50 inches per year. The ground usually begins to freeze at the end of November and thaws in mid-April. The potential for runoff and severe erosion is often highest in March and

early April when heavy rainstorms and snowmelt occur on ground sparsely covered by dead vegetation. Climate change studies and predictions suggest changes in intensity and timing of precipitation have already occurred in our region, and additional changes are expected. The subject of climate variation is covered in more detail in *Technical Appendix D of the Dane County Water Quality Plan.*

Floodplains

A survey of 100-year floodplain boundaries offers insights into the areas most susceptible to flooding (see **Map 22**). These are areas that have a 1% chance of being inundated in any single year. Floodplains are designated by the Federal Emergency Management Agency (FEMA) and present significant limitations to development. It is important to note that floodplains are mapped using historic data. Floodplain boundaries can change over time with changes in precipitation and land use. A problem with high water levels has repeatedly occurred in the Yahara Lakes over the last several decades. While measures have been taken in recent years to control the timing and volume of stormwater runoff from new urban development in the watershed, **the impacts associated with historic land cover changes from their natural pre-settlement state to agricultural and urban land uses will need to be addressed to ameliorate high water levels in the Yahara system.**

Planning Considerations

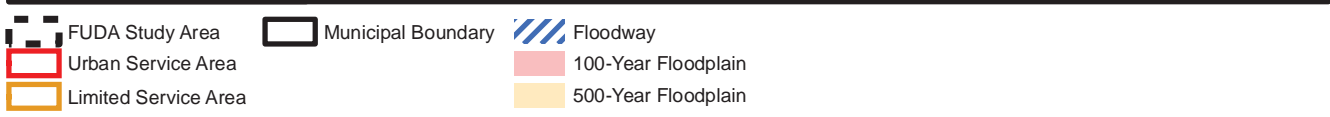
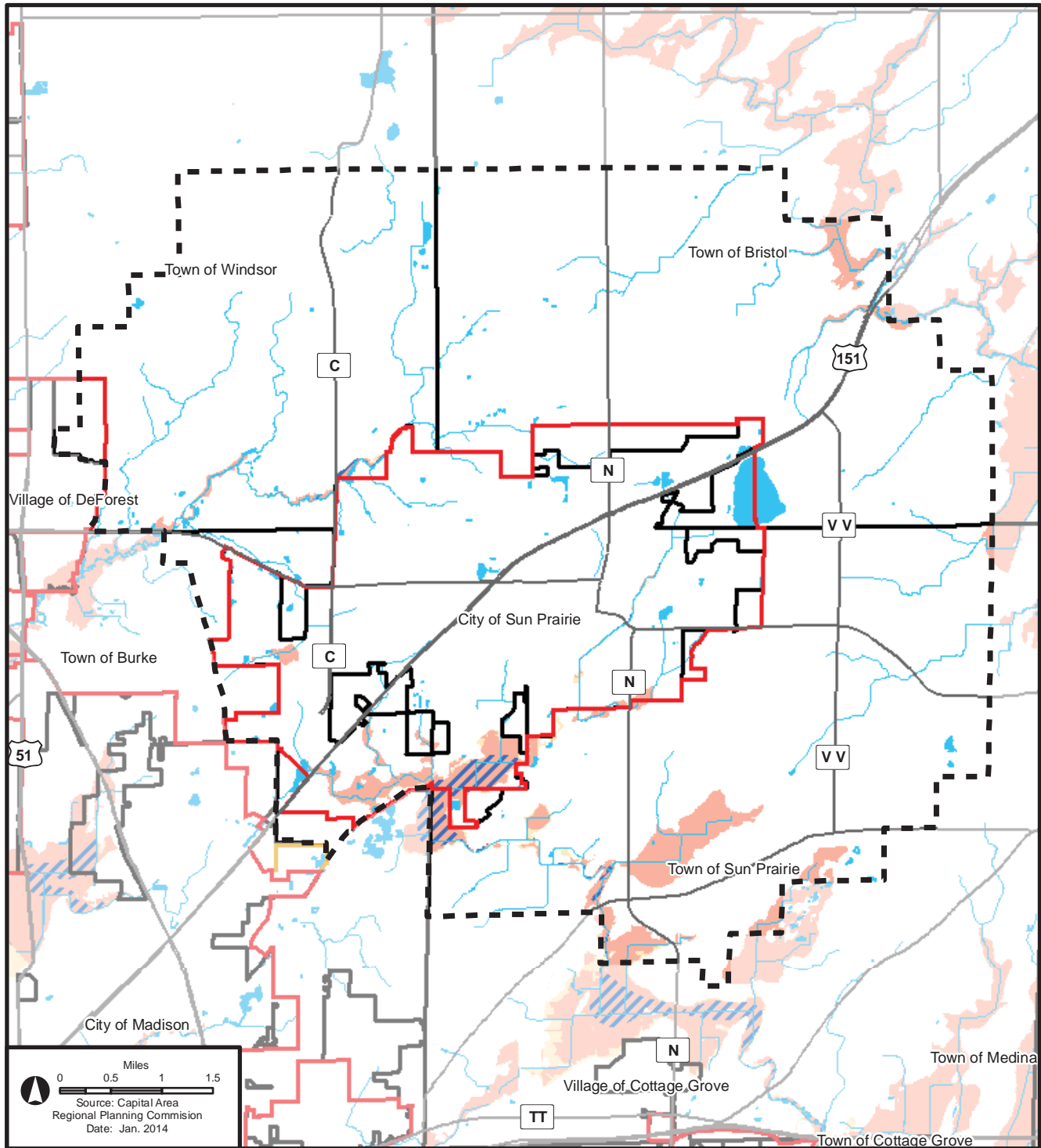
- Keep infrastructure that can be damaged by flooding out of the 100-yr floodplain.
- Include additional buffer around floodplains to account for changes in floodplain boundaries over time.

2. Stream Classifications and Biological Indicators

The WDNR is authorized to establish water quality standards that are consistent with the Federal Clean Water Act (Public Law 92-500) through Chapter 281 of the Wisconsin Statutes. Water quality standards are the foundation of Wisconsin's water quality management program. They serve to define the goals for a water body by

Map 22: Floodplains

Sun Prairie FUDA, Dane County, WI



Floodplains present significant limitations to development. Development should be avoided in floodplain areas. These areas represent current conditions. Increased development in the watershed along with accompanying increases in volumes of stormwater runoff can expand the delineated areas.

designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants. These water quality standards are explained in detail in Chapters NR 102, NR 103, NR 104, NR 105, and NR 207 of the Wisconsin Administrative Code. These water quality standards rely on three elements to collectively meet the goal of protecting and enhancing surface waters. They include designated uses, water quality criteria, and anti-degradation provisions.

Designated Uses

Designated uses are goals or intended uses for surface water bodies in Wisconsin, and are classified into the following categories (Chapter NR 102):





Recreational Use: All surface waters are considered appropriate for recreational use unless a sanitary survey shows that humans are unlikely to participate in activities requiring full body immersion.

Public Health and Welfare: All surface waters are considered appropriate to protect for incidental contact and ingestion by humans.

Wildlife: All surface waters are considered appropriate for the protection of wildlife that relies directly on the water to exist or rely on it to provide food for existence.

Fish and Aquatic Life: All surface waters are considered appropriate for the protection

Table 11. WDNR Fish and Aquatic Life Uses

<p>The Department has classified all surface waters into one of the fish and other aquatic life subcategories described below. Only those use subcategories identified in pars. (a) to (c) shall be considered suitable for the protection and propagation of a balanced fish and other aquatic life community as provided in federal water pollution control act amendments of 1972.</p>	
<p>(a) Cold Water Communities. This subcategory includes surface waters capable of supporting a community of cold water fish and other aquatic life, or serving as spawning area for cold water fish species.</p>	
<p>(b) Warm Water Sport Fish Communities. This subcategory includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.</p>	
<p>(c) Warm Water Forage Fish Communities. This subcategory includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life.</p>	
<p>(d) Limited Forage Fish Communities. (Intermediate surface waters). This subcategory includes surface waters of limited capacity and naturally poor water quality or habitat. These surface waters are capable of supporting only a limited community of forage fish and other aquatic life.</p>	
<p>(e) Limited Aquatic Life. (Marginal surface waters). This subcategory includes surface waters of severely limited capacity and naturally poor water quality or habitat. These surface waters are capable of supporting only a limited community of aquatic life.</p>	

of fish and other aquatic life. Surface waters vary naturally with respect to factors like temperature, flow, habitat, and water chemistry. This variation allows different types of fish and aquatic life communities to be supported. Wisconsin recognizes Fish and Aquatic Life subcategories (**Table 11**) based on the water body's capacity to support a diverse and healthy fish community.

A Fish and Aquatic Life Use Designation is legally recognized in Wisconsin Administrative Code. This designation is used to determine water quality criteria and effluent limits. A stream can obtain a codified designated use by applying formal stream classification procedures. The current codified uses and water body details for individual Dane County streams can be found on the WDNR Water Basin website.³⁸

Assigning designated uses to protect fish and aquatic life is an iterative process dating back to the late 1960s.

³⁸ <http://dnr.wi.gov/water/basin/>

While the WDNR strives to maintain a contemporary list of designated uses, it cannot visit each stream, river, or lake very often. In fact, many of the designated uses in the Wisconsin Administrative Code date back to the 1980s.

Determining a Fish and Aquatic Life subcategory is one of the first steps in managing water quality. The WDNR published updated guidance in 2004 to facilitate determining a designated use to reflect the most current understanding of stream/river ecology. The informal guidance provides biologists a framework for collecting and assessing field data to recommend the best fit Fish and Aquatic Life subcategory a particular water or segment.

Current and Attainable Uses

The *current use* is the fish and aquatic life community the WDNR biologists believe the water currently supports. Current Fish and Aquatic Life Use determinations for Dane County streams are shown on [Map 23a](#), and the determinations for the FUDA study area streams are shown in more detail on [Map 23b](#).

The *attainable use* is the use the WDNR biologists believe the stream could attain if “controllable” sources of impairment are managed. These actions include effluent requirements for point sources, and cost-effective and reasonable best management practices for non-point source pollution control. Beaver dams, low gradient streams, naturally occurring low flows, and land cover and land use are generally considered “uncontrollable” natural or cultural factors. The *attainable use* may be the same as the *current use* or it may be higher.

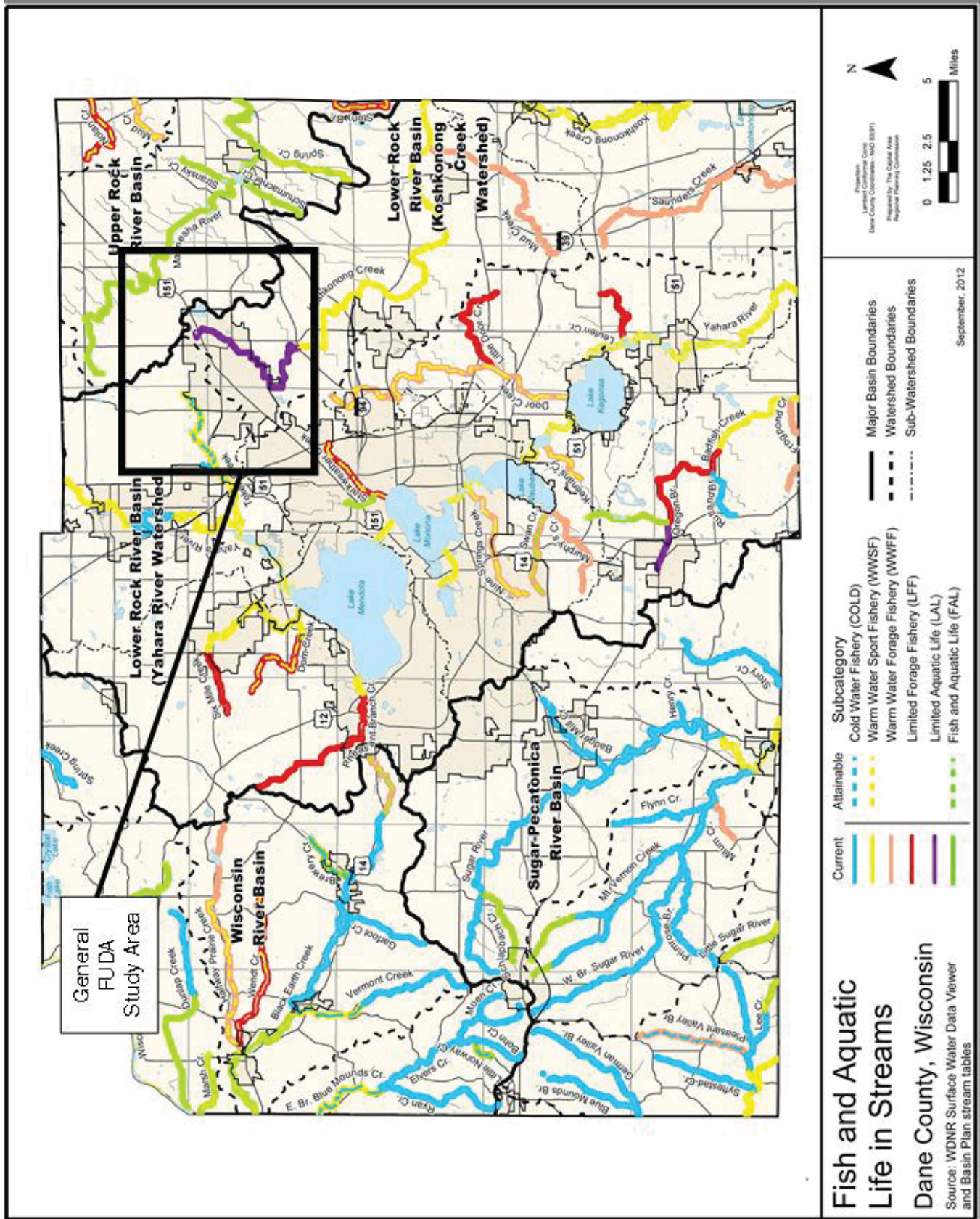
Current and Attainable Uses are not formal designations. They are based on the current condition of the water or the condition that could be achieved through management plans or activities. Note that the current and attainable use determinations may be different than the codified Fish and Aquatic Life use designations for some streams. This is because the current/attainable use determinations are used for more informal fisheries management purposes, activities, and guidance; whereas the Codified Use designations are used for more formal or regulatory pollution control and permitting activities where there may be more significant legal and financial considerations.

One indicator of stream water quality condition is the type of insects found living on rocks and other stream bottom materials. Certain species of insects will tolerate only undisturbed conditions with limited organic material, while others are able to survive in various types of habitat and water quality conditions. The Macroinvertebrate Index of Biotic Integrity is used as an indicator of biotic health of a stream by the types of insects living there ([see Table 12a](#)). The WDNR also uses the Hilsenhoff Biotic Index as an indicator of low dissolved oxygen concentrations resulting from organic pollution ([see Table 12b](#)). Tolerance values are assigned to various species of insects and an overall score is calculated for the water body. The Fish Index of Biotic Integrity (IBI) is another widely applied and effective tool using fish community data to assess the environmental quality of aquatic habitats.

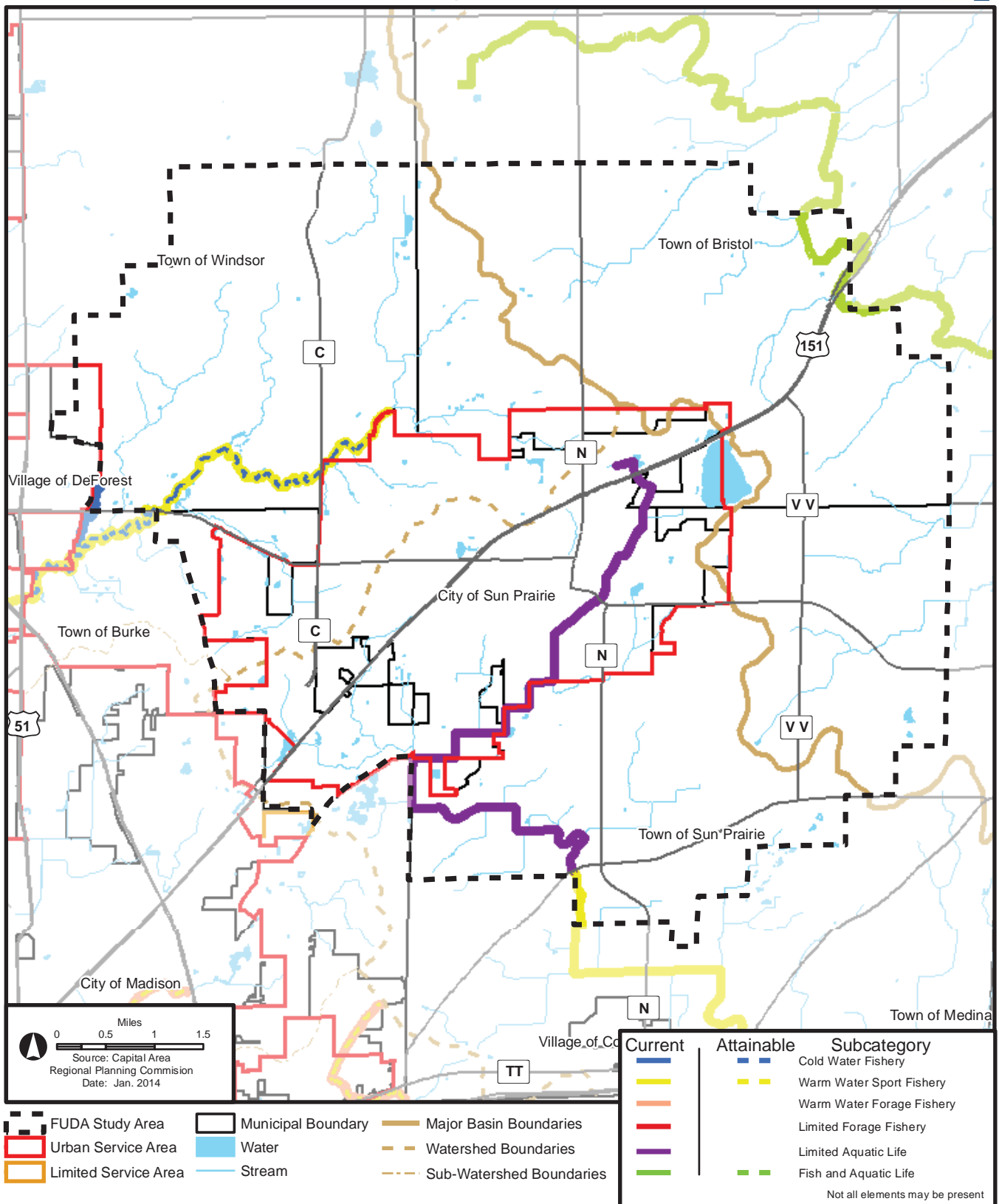
3. Surface Water Features

Surface waterbody health and quality is a reflection of the land use and practices in the watershed. [Map 20](#) presented earlier shows the streams and watersheds of the region and provides the regional context for the streams and subwatersheds of the Sun Prairie study

Map 23a: Fish and Aquatic Life Designations (Dane County)



Map 23B: DNR Fish and Aquatic Life Designations for Streams Sun Prairie FUDA, Dane County, WI



Fish and Aquatic Life categories are based on the condition of the resource and the biological use the DNR believes the stream or stream segment could achieve through proper management of controllable pollution sources. Low gradient streams and naturally occurring low flows can not generally be controlled.

Table 12a. Fish and Aquatic Life Stream and River General Assessment Thresholds

Designated Use	Condition Category	Management Recommendation	Fish IBI	Macroinvertebrate IBI
Cold Stream: Stream supports coldwater fish and macroinvertebrate species	Excellent	Consider O/ERW Listing	Cold IBI 90-100	7.5-10
	Good	Maintain Condition	Cold IBI 60-80	5.0-7.4
	Fair	Restoration	Cold IBI 30-50	2.6-4.9
	Poor	Consider 303(d) Listing	Cold IBI 0-20	0-2.5
Small Cold Stream: Trout absent, but other coldwater fishes/inverts self-sustaining	Excellent	Consider O/ERW Listing	Cold IBI 50-60	7.5-10
	Good	Maintain Condition	Cold IBI 30-40	5.0-7.4
	Fair	Restoration	Cold IBI 10-20	2.6-4.9
	Poor	Consider 303(d) Listing	Cold IBI 0-10	0-2.5
Warm Water Sport Fish (WWSF): River	Excellent	Consider O/ERW Listing	Large River IBI 80-100	-
	Good	Maintain Condition	Large River IBI 60-79	-
	Fair	Restoration	Large River IBI 40-59	-
	Poor	Consider 303(d) Listing	Large River IBI 0-39	-
Warm Water Sport Fish (WWSF): Wadeable Stream	Excellent	Consider O/ERW Listing	Warm IBI 65-100	7.5-10
	Good	Maintain Condition	Warm IBI 50-64	5.0-7.4
	Fair	Restoration	Warm IBI 30-49	2.6-4.9
	Poor	Consider 303(d) Listing	Warm IBI 0-29	0-2.5
Warm Water Forage Fish (WWFF): Stream	Excellent	Consider O/ERW Listing	Small Stream IBI 100	7.5-10
	Good	Maintain Condition	Small Stream IBI 70-90	5.0-7.4
	Fair	Restoration	Small Stream IBI 40-60	2.6-4.9
	Poor	Consider 303(d) Listing	Small Stream IBI 0-30	0-2.5
Limited Forage Fish (LFF): Stream	Attaining	Maintain Condition	Small Stream IBI 40-100	2.6-10
	Non-Attaining	Consider 303(d) Listing	Small Stream IBI 0-30	0-2.5
Limited Aquatic Life (LAL): Stream	Attaining	Maintain Condition	-	2.6-10
	Non-Attaining	Consider 303(d) Listing	-	0-2.5

Source: WDNR, 2012

Table 12b. Hilsenhoff Biotic Index (HBI) Water Quality Scale

Hilsenhoff Biotic Index	Water Quality Scale	Degree of Organic Pollution
0.00 - 3.50	Excellent	Organic Pollution Unlikely
3.51 - 4.50	Very Good	Possible Slight Organic Pollution
4.51 - 5.50	Good	Some Organic Pollution Probable
5.51 - 6.50	Fair	Fairly Substantial Pollution Likely
6.51 - 7.50	Fairly Poor	Substantial Pollution Likely
7.51 - 8.50	Poor	Very Substantial Pollution Likely
8.51 - 10.00	Very Poor	Severe Organic Pollution Likely

Source: Hilsenhoff, 1987

area, shown on [Map 21](#) (shown previously). The principal streams include Token Creek and the Yahara Lake Chain, the Headwaters of Koshkonong Creek, and the Mauneshia River. The Starkweather Creek watershed borders the southwestern boundary of the study area and flows through the City of Madison to Lake Monona. Lake Mendota is the major Yahara lake downstream of Sun Prairie, via Token Creek. Large portions of wetlands throughout the area have been drained for agriculture or filled for development.

Token Creek

Token Creek is the most prominent surface water feature that would be impacted from activities in the study area. Token Creek is a spring-fed tributary to the Yahara River that originates in the Town of Windsor (T9N, R10E, Section 24). Token Creek is 10 miles long and drains 27.4 square miles located between the City of Sun Prairie and the Village of DeForest. Token Creek has a moderate gradient of 8.7 ft/mile. Token Creek has a diverse fishery containing warmwater, coldwater, forage fish, and rough fish species. This small watershed was probably a native brook trout fishery prior to European settlement. The construction of a dam, since removed, and 44 acre millpond in the center of the watershed about 150 years ago limited the resource. *Token Creek is a major contributor of flow to Lake Mendota*, with flow of about 19 cubic feet per second (cfs) under baseflow conditions, representing over a quarter of the flow in the Yahara Chain of Lakes. *Combined, Token Creek and the Yahara River contribute nearly half (41%) of the flow to the Yahara Chain of Lakes.*

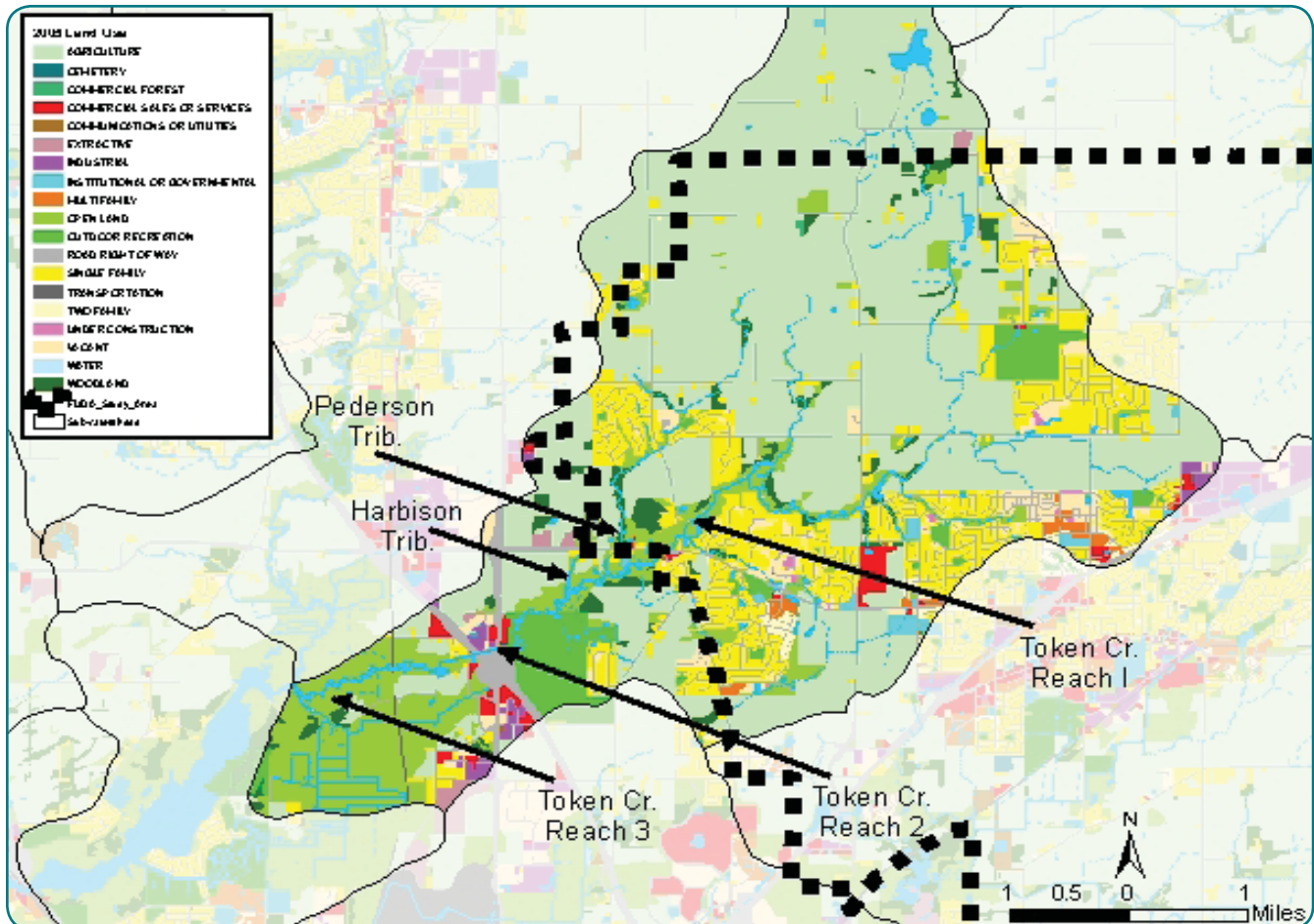
The WDNR identifies the first three miles upstream of the Yahara River as a Warmwater Sport Fishery, with the potential of becoming a class III (i.e., stocked) trout stream. The segment of stream from approximately USH 51 to Culver Springs is identified as a class III trout stream with class II potential (exhibiting some natural reproduction). The remaining stream segment is identified as being a warmwater sport fishery with the potential of becoming an unspecified coldwater community. Land use is primarily agriculture (73%), followed by residential and transportation (11%), and wetlands (4%). The FUDA study area encompasses about 24% of the land area in the watershed.

Problems impacting the water quality of Token Creek include:

- Sediment and nutrient loading from agricultural fields and barnyards,
- Historic hydrologic modification and destruction of wetlands,
- Historic urban stormwater runoff from older urban areas,
- Heavy instream aquatic plant growth,
- Elevated temperatures and periods of low dissolved oxygen,
- Sediment suspension by common carp,
- Lack of suitable habitat for aquatic organisms due to heavy sedimentation, and
- Reduction in baseflow due to high capacity municipal well withdrawals.

Token Creek was placed on Wisconsin's 303(d) list of impaired waters in 1998 because of excessive sediment and suspended solids loading, and also because of the partially failed Token Creek millpond dam, since removed, obstructed fish passage.

Map 24. Token Creek Subwatershed



In 2002, the EPA approved a *Total Maximum Daily Load (TMDL)* plan for Token Creek. Project goals included:

- *Restoring morphology and habitat,*
- *Managing and reducing sediment and other pollutant loading from agricultural land through the Lake Mendota Priority Watershed Plan, and*
- *Managing stormwater discharges through the Lake Mendota Priority Watershed Plan and WDNR's stormwater discharge permit program.*

The WDNR has added the goal of *restoring a native brook trout fishery in the reach downstream of the Culver Springs*. Brook trout are very pollution intolerant coldwater sport fish. Restoration work on Token Creek to improve habitat and hydrologic functions include:

- *Removing the berm at Culver Springs (completed) allowing fish to flow freely,*

- **Stabilizing stream banks,**
- **Removing pond sediment above the former dam location, and**
- **Restoring natural vegetation in riparian areas to improve in stream habitat.**

Additional recommendations from the RPC staff include **flood bank reconnection and bank regrading**. Restore in stream habitat complexity through the use of introduced large woody debris, and developing riparian vegetation to allow for future woody debris and consistent leaf litter inputs. These terrestrial inputs are needed for macroinvertebrate and fish survival.

The Creek total sediment load capacity is no greater than 746 tons per year. Projected 2020 annual loads are estimated to be over double that amount or 1,560 tons per year (estimated 1,416 tons in 1996). Reductions in loading are specified in the TMDL and implemented through agricultural and urban best management practices. Token Creek is also included in the Rock River Basin TMDL project for required reductions in sediment and phosphorus. These efforts are just beginning. Implementation measures among agricultural and urban sources have not been defined. There may also be opportunities for **“nutrient trading”** or pollutant reduction credits that could be bartered among the various sources. Such trading opportunities are expected to result in more efficient and cost-effective pollutant reduction and remediation efforts overall.

Relative to its drainage area, Token Creek has significantly more baseflow than most other streams in southern Wisconsin. Whereas the Yahara River watershed is about three times the size of the Token Creek watershed above USH 51, Token Creek has about twice the baseflow of the Yahara River (**Figure 19**). About half of the baseflow in Token Creek comes from a number of springs in the area of the former mill pond. The fact that baseflow in Token Creek is high compared to its drainage area suggests that groundwater flows into Token Creek from adjacent watersheds, such as the Yahara River, Maunasha River, Koshkonong Creek, and Starkweather Creek watersheds. Compared to the surface watershed, the groundwater basin is believed to be considerably larger (**Map 25**). This helps explain the relatively large amount of baseflow in Token Creek.

Issue: Excess Nutrients, Sediment, and Temperature

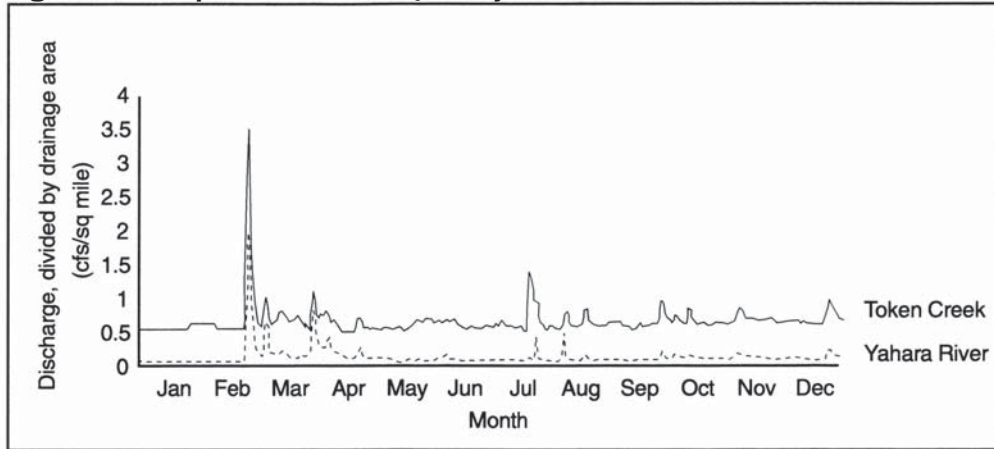
Measures taken since 1990s:

Implemented agricultural best management practices (BMPs).
 Implemented urban BMPs in areas of new development.
 Adopted stormwater volume control standards (100% stay-on) as part of the Village of DeForest stormwater ordinance.
 Adopted volume control by the City of Sun Prairie and Town of Windsor for recent development areas in the watershed.
 Adopted groundwater withdrawal mitigation measures by the City of Sun Prairie, Village of DeForest, and Town of Windsor for recent development areas in the watershed.

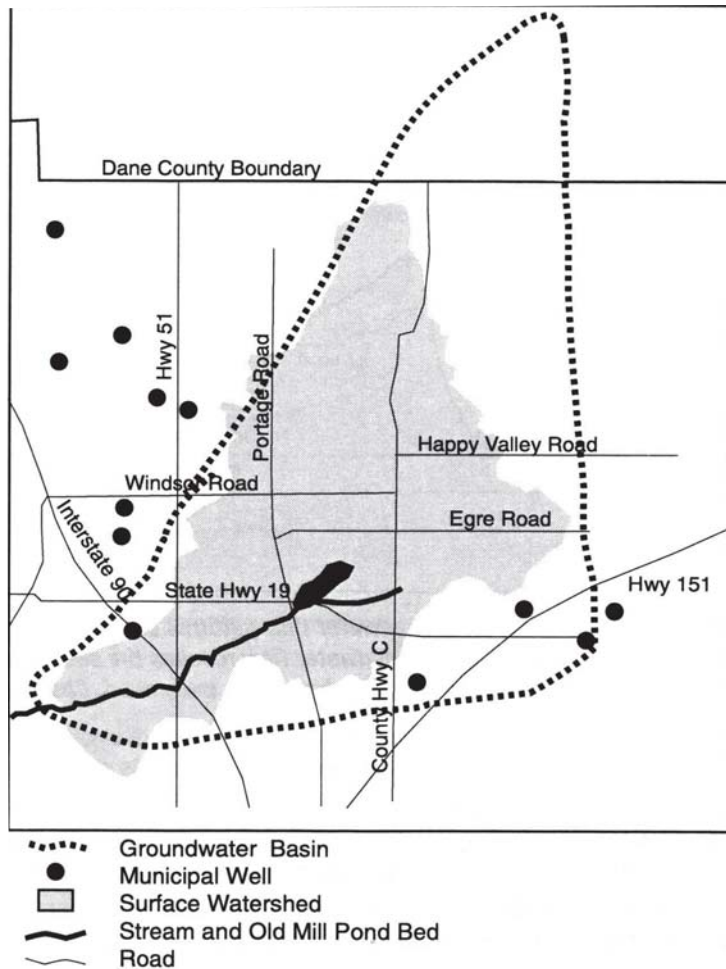
Recommended additional measures:

Increase financial resources for broader implementation of agricultural best management practices for water quality and runoff volume reduction.
 Increase financial resources for broader implementation of retrofit urban best management practices in older urban areas for water quality and runoff volume reduction .
 Restore wetlands, woodlands, prairies, and pastures in select areas for water quality improvement, runoff volume reduction, and wildlife habitat.
 Promote opportunities for capturing phosphorus within the watershed and exporting it (e.g., manure digesters).
 Explore nutrient trading opportunities/partnerships to promote synergies and cost efficiencies associated with required TMDL sediment and phosphorus reductions.
 Adopt broader protective local stormwater standards for urban and agricultural areas.

Figure 20. Comparison of Water Quantity in Token Creek and Yahara River



Map 25. Token Creek Watershed Relative to the Groundwater Basin



Source: Water Resources Atlas for Token Creek, 1997

In 1992, the Token Creek dam partially failed and the drained millpond became a marsh. At least two significant springs became evident, Culver and Trout Pond Springs, as the two major tributaries rising to form clearly defined wetland/stream tracks leading to the Creek. The former millpond absorbed the coldwater springs, heating the water and degrading the Creek’s fishery and water quality. The WDNR is working with the Town of Windsor, Dane County, local conservation groups, and residents to remove the dam and restore a high quality coldwater sport fishery here.

The natural springs in the Token Creek watershed are a unique resource, and one of the largest complexes in southern Wisconsin according to WDNR. The springs contribute water at a near constant volume and at uniform water quality and temperature supporting a class III coldwater fishery. According to WDNR fishery biologists, the stream has the potential to support a naturally reproducing class II coldwater fishery – including brook trout, a highly sensitive species.

Trout streams are rare in the glaciated portions of Dane County. The quality of the fishery here is attributed to the relatively large baseflow discharges of groundwater to the stream. Because trout and other aquatic organisms typical in coldwater ecosystems are intolerant to

wide variations in their environment, the qualities that the springs provide are vital for cold-water ecosystem function and productivity. In addition to serving as a source of water, the springs bring up clean sand and prevent accumulation of silt – critically important for trout reproduction.

Token Creek has received significant public and private funding and volunteer effort directed at protecting and restoring this unique resource. In 1998, the WDNR and the Town of Windsor acquired the Token Creek dam and surrounding reservoir for \$1,400,000. This acquisition and subsequent dam removal is expected to enable the restoration of five to seven miles of brook trout stream in eastern Dane County. Because of its status as a trout stream, Token Creek is identified by WDNR as an Area of Special Natural Resources Interest. One of the things that make this project unique is that it is situated between the communities of Sun Prairie, DeForest, Windsor, Burke, and Madison. Conversely, if adequate measures are not taken these same communities' growth could limit restoration efforts by altering both surface and groundwater flow patterns (see pages 155) of this report describing the natural resource impacts of urban development).

Extraordinary stormwater management measures are needed and are being implemented to maintain or improve the hydroecology of the Creek. Maximizing stormwater infiltration opportunities in new developments and retrofitting existing development (where opportunities permit) will be needed to maintain and improve existing baseflow and thermal conditions in the Creek.

Maintaining existing hydrologic conditions will reduce the impacts of proposed development and should address the potential impacts on the receiving waters. The City of Sun Prairie installed several stormwater measures in developing areas near the Creek to minimize pollutants reaching the stream and minimize adverse thermal impacts from urban runoff. In addition to these measures, more effort will be needed to address impacts from older areas not covered by these measures. The City of Madison has not expanded into this watershed.

Three different reaches of Token Creek are described below.

Reach 1 – Headwaters to Culver Springs

Land use in this part of the watershed is dominated by agriculture, both cash cropping and dairy farming, and residential development. Housing development is occurring extensively in this area. Problems impacting water quality in this reach include sediment and nutrient loading from agricultural fields and barnyards, loss of habitat due to excessive sedimentation, historic loss of infiltration areas, and impacts to both water quality and water quantity resulting from historic stormwater runoff from older urban areas and municipal well water withdrawals.

This section of stream is identified as being a warmwater sport fishery with the potential of becoming a coldwater fishery. Priority watershed HBI appraisal monitoring in 1994 and 1995 at four sites indicated a range of water quality conditions from very good (HBI = 4.30) to fairly poor (HBI = 7.49). The HBI score at CTH C in 1994 was 7.49 (fairly poor water quality conditions), while the HBI score at the same site in 2008 was 4.92 indicating good water quality. Coldwater IBI monitoring upstream of the millpond and Culver Springs at CTH

Issue: Excess Nutrients

Measures taken since 1990s:

Implemented agricultural best management practices to provide the following:

- Reduced soil erosion,
- Utilized nutrient management to optimize the use of fertilizers,
- Reduced the transport of manure by stormwater into streams,
- Prevented livestock from getting into streams, and
- Manure digester installations to reduce phosphorus in manure.

Implemented urban best management practices to provide the following:

- Controlled construction erosion,
- Controlled peak stormwater rates at predevelopment levels in new development,
- Maintained runoff volumes to predevelopment levels in new development areas by including infiltration requirements in stormwater ordinances,
- Provided stormwater treatment in new development areas,
- Required exclusion of phosphorus from lawn fertilizers sold in the region,
- Implemented retrofit sediment reduction measures in existing urban areas.

Recommended additional measures:

- Increase financial resources for broader implementation of agricultural best management practices for water quality and runoff volume reduction.
- Increase financial resources for broader implementation of retrofit urban best management practices in older urban areas for water quality and runoff volume reduction .
- Restore wetlands, woodlands, prairies, and pastures in select areas for water quality improvement, runoff volume reduction, and wildlife habitat.
- Promote opportunities for capturing phosphorus within the watershed and exporting it (e.g., manure digesters).
- Explore nutrient trading opportunities/partnerships to promote synergies and cost efficiencies associated with required TMDL sediment and phosphorus reductions.

quality. However, the available instream habitat is low, and a poor environment for aquatic organisms. In many areas, most of the desirable substrate is covered with over three feet of fine sediment.

C in 1998 and 2000 indicated very poor biotic integrity conditions (prior to the dam removal in 2005). Macroinvertebrate IBI data indicated fair biotic integrity in 2008.

Reach 2 – Culver Springs to USH 51

The primary land use in this part of the watershed is very similar to that of the first reach, being dominated by agriculture and residential development. This segment has a large rural development component surrounding it. Factors that impair water quality include sediment and nutrient loading from agricultural and barnyard runoff, historic urban stormwater runoff from older urban areas, lack of habitat, suspension of sediment due to high common carp populations, turbidity, hydrologic modification, and wetland destruction.

The fish community is composed of a greater abundance and diversity including common carp, white sucker, green sunfish, bluegill, and a few brown and brook trout. This is an unusual fish assemblage given that trout, particularly brook trout, are an intolerant species, while all other species found are highly tolerant. Notes from site managers opine that the trout are non-native and likely escapees from trout ponds. The high volume of cold spring water in the former millpond area permits these fish to survive. Noted that the former mill pond and immediately downstream is the only section of stream with suitable substrate and gradient to allow natural trout reproduction.

Macroinvertebrate samples indicate fair water quality (HBI = 5.7) in 1995 (taken below the spillway of the former millpond). The millpond dam was found to be unsafe and was removed in 2005. Thus the area directly above the dam is existing as a shallow wetland, with a stream channel meandering through the former millpond. The aquatic life present below the millpond reflects an improvement in water

Results of coldwater IBI monitoring in 2000 and 2001 upstream of Token Creek County Park indicated fair biotic integrity conditions for both years. Coldwater IBIs at STH 19 indicated poor biotic integrity conditions in 2000 and fair biotic integrity conditions in 2001. Coldwater IBI monitoring beginning just downstream of the dam site and continuing upstream to the Culver Springs in 2006 showed a good biotic integrity rating. ***These data coupled with ongoing channel and habitat improvement indicate that Token Creek can sustain a viable coldwater fishery.***

Reach 3 – USH 51 to the Confluence with the Yahara River

The primary land use in this part of the watershed is agricultural, followed by residential development and wetlands. Wetlands play a larger role in this reach, particularly closer to Cherokee Marsh and Lake Mendota. Problems associated with degradation of water quality include sediment and nutrient loading from agricultural fields, nutrient loading from Cherokee Marsh, historic stormwater runoff from older urban areas, turbidity, high populations of common carp, and heavy instream sedimentation. Aquatic macrophytes (larger plants) are common and overly abundant in some places.

The current biological use of the fishery is Warmwater Sport Fishery consisting of bluegill, largemouth bass, walleye, green sunfish, and some rough fish species (common carp and freshwater drum). Although the Yahara River and Lake Mendota serve as a reservoir for upstream migration of warmwater fishes, biologists assert that warmwater species are self-sustaining and that it has the potential to support coldwater species. The factors impairing the fisheries in this stretch include low gradient and high sediment/nutrient loading, extensive channel incising and channel widening, high turbidity, low quality instream habitat, and temperature increases from proximity to Cherokee Marsh.

Temperature Impacts

Because Token Creek is a coldwater resource, water temperatures are a particular concern. ***In Dane County coldwater systems are protected by thermal performance standards, Chapter 14.53(2)(f).*** Token Creek and its tributaries show significant temperature change due to daily and seasonal variations. Seasonal fluctuations can be as high as 45°F. Daily fluctuations can also be significant with fluctuations as great as 23°F. Fluctuations are much smaller in areas close to springs, which maintain a temperature of about 50°F. The upper reaches of Token Creek and its tributaries east of CTH C are not fed by large springs so they are characterized by low flow volumes and low flow rates. The middle portion of Token Creek between CTH C and I-90/94 contains many springs flowing into Token Creek. The significant volume of water coming from these springs tends to lessen the degree of warming in the summer and cooling in the winter. Water temperatures in this portion of the stream range from 68°F in the summer to 46°F in late winter. In designating Fish and Aquatic Life Uses for Wisconsin Surface Waters (WDNR 2004), WDNR defines temperature as the maximum temperature during any year, usually in July or August. ***For Coldwater streams the maximum is 77°F. The Impairment Threshold is 73°F*** (WDNR, 2010) (no minimum temperature threshold).

In general, lower temperature surface waters tend to support sensitive plants and animals, with most trout species needing temperatures between 40°F to 70°F. Higher temperature

surface waters leads to changes in animal behavior, increasing feeding and aggressiveness. It also drives off intolerant species favoring invasive carp and anaerobic bacteria. The relationship of temperature to dissolved oxygen is also very much related to the kinds of organisms living there. Oxygen is more soluble in lower temperature water. At 50°F water saturated with oxygen contains about 12 mg/L, while at 86°F water is saturated at only about 7 mg/L. Organisms that require high levels of oxygen are usually restricted to colder waters.

One major concern for retaining lower temperatures in trout streams is maintaining consistent hyporheic, or interstitial, flow. This phenomenon occurs when shallow groundwater percolates through sediment as it passes into the active stream channel. It is an important mechanism responsible for buffering stream temperature. Hyporheic flows are colder than surface flows because they are not exposed to solar radiation. The contributions of hyporheic flows to streams can be reduced by finer sediment particles that impede water movement, reductions in the groundwater table reduces total hyporheic volume, stream riffle sequences that reduce interactions between the hyporheic zone and the stream, and increase channelization, incision, and widening that disconnects streams from groundwater. ***Stream restoration projects should explore methods to reduce the existing fine sediment particles within the stream, usually accomplished by temporarily changing flows to flush sediments. Riparian areas should also be restored to limit additional fine sediment inputs.***

In addition, bacterial decomposition of excessive amounts of organic matter from stormwater runoff can depress oxygen levels further. The WDNR has established 6 mg/L dissolved oxygen as the minimum water quality criteria level for coldwater streams. Dissolved oxygen levels in Token Creek measured at USH 51 average 10 mg/L, with minimum levels averaging 9 mg/L.

Stream Channels and Habitat Loss

The historic conversion of the Token Creek watershed from natural prairie and savanna vegetation to agricultural and urban land uses has altered the original stream channels. Comparisons between early surveyor's notes and present-day channel widths indicate that below the former Token Creek dam, the main branch of Token Creek has widened significantly (IES, 1997). This increase shows that the channel cross sections have compensated to carry the increased water volumes. In addition to the widening trend, deep deposits of fine sediment across the stream bottoms indicate that the stream channel is also more shallow.

The Pederson and Harbison tributaries do not show this widening trend, however, their channels appear to have adapted to increased water volumes by cutting down vertically. These types of changes are expected in developed watersheds where width, depth, or both, increase as a result of increased flood magnitude, frequency, and sediment load carried by the stream. These ***impacts can be mitigated or offset for new development through stormwater management practices*** that maintain pre-development hydrologic characteristics in streams. Previous development without adequate stormwater management practices would require retro-fitting to correct existing impacts. Restoration of incised streams will require regrading of the streambank in some areas. Regrading the stream channel will be needed to return the stream evolution to historical norms.

The shape and size of a stream cross section are a function of the streamflow, sediment load, and channel erosion potential. At higher flows the river has more energy, and thus

is able to erode more sediment from its banks and bed. At lower flows the river has less energy causing sediment to fall out of suspension and be deposited on the banks and bed. Thus, higher flows associated with storms and spring snowmelt are responsible for shaping the channel. Large floods move more sediment and large woody debris, push large cobbles and boulders, and widen the channel more than small floods and are less frequent than smaller floods that occur every one to three years and fill the channel determining the channel size, or the bankfull capacity.

In the Token Creek watershed, surveyed stream sections have a relatively high width-to-depth ratio, confirming that their channels are wide, shallow and subject to bank erosion and water temperature variations. Although gravel streambeds have been observed in a few areas, the primary materials on stream banks and beds are fine-grained sediments. Silt deposit depths range from a few inches to several feet thick over sand and gravel. This information indicates that topsoil has eroded from uplands and washed down into the streams over time. The small particles in these channels now make the streams highly sensitive to erosion and prone to high turbidity during flows.

Harbison Tributary

Harbison Tributary joins Token Creek approximately one mile east of the USH 51/STH 19 interchange. Baseflow is estimated to be approximately 2.0 cfs. The stream has a large spring complex (Pederson Springs >200 gallons per minute [gpm]) on the north side of STH 19 on property owned by Dane County. According to WDNR fisheries biologists, the stream contains natural populations of brown trout and likely brook trout.

Four coldwater IBIs done in 2000 and 2001 all indicated good biotic integrity. This is consistent with the watershed HBI assessment monitoring of 1994 and 1995. WDNR is completing habitat improvements, including removal of a rough fish holding pond and stream bank work to improve in-stream and riparian habitat. A fish survey conducted in 2004 found good numbers of young-of-year brown trout (indicating natural reproduction) upstream of STH 19 and good nursery habitat. Downstream of STH 19 has more adult brown trout from 7-14 inches.

This tributary is a valuable resource as both a source of cold water for Token Creek and a nursery source for reproduction of brown trout, and recruits fish for Token Creek.

Pederson Tributary

Pederson Tributary originates in the Town of Windsor section 34 and flows south before entering Token Creek in the Town of Burke. The land use in this area is dominated by agriculture, residential development, and wetlands. Factors that impair water quality of this tributary include sediment and nutrient loading from agricultural fields, historic stormwater runoff from older urban areas and highways. The current biological use of the fishery is coldwater. Fish species found in this tributary include brown trout, white sucker, and mottled sculpin. Macroinvertebrate samples indicate good water quality (HBI = 4.75). Watercress (*Nasturtium spp.*) was also present indicating good water quality and high groundwater discharge. The tributary has woodlands along the majority of its length, and ***efforts to remove cottonwood trees should be a priority.*** Further, there are three small ponds that occur north of STH 19. The two ponds found to the east of the stream have great potential as amphibian breeding sites. ***These ponds should be retained and surrounding vegetation restored.***

Yahara Chain of Lakes

The Sun Prairie study area drains to Lake Mendota and the Yahara Chain of Lakes via Token Creek. The Lake Mendota watershed is largely rural and covers 232 square miles. Approximately 20% of the watershed land area is urban or urbanizing.³⁹ Approximately 12% is open water or wetland.

Water Quality

One of the principal water quality concerns for the Yahara Lakes is excessive phosphorus. All of the lakes in the Yahara chain are classified as eutrophic, being defined as high fertility caused by excessive nutrient loading. Eutrophication leads to multiple problems: an overabundance of blue-green algae (cyanobacteria) and nuisance aquatic plant species, low dissolved oxygen, and changes toward warm water fish communities. High algal concentrations limit water chemistry, clarity, and color. When at higher concentrations, algae demand more oxygen from the water as they die and decompose. During decomposition, bacteria consume dissolved oxygen, causing oxygen concentrations to decline. When living algal concentrations are high enough, they reduce the light that reaches submerged aquatic vegetation. This vegetation is an important habitat for forming organisms needed for multiple aquatic invertebrates, refuge for fish species, and other ecosystem functions. If invasive vegetation is present, abundant phosphorus can accelerate their growth and provide them a competitive advantage over native plants. The lakes are also impacted by the aquatic invasive species Eurasian water milfoil, commonly dominant in eutrophic lakes.

The **water quality goal** for Lake Mendota is to reduce the spring total phosphorus to less than 0.074 mg/L. Models indicate this concentration will result in a decrease in blue-green algae to less than 2 mg/L during the summer months. This concentration represents the threshold for algal blooms, identified by green water and surface scum.

Given current annual phosphorus loading, the likelihood on any given summer day of a nuisance algae bloom occurring is 50%. With a 50% reduction in annual phosphorus loads to the lake, the likelihood of a nuisance algae bloom occurring is reduced to 20%. In years with high precipitation, and resulting high runoff into the lake occurs, summer nuisance algal blooms would be more likely. This could occur even when best management practice (BMP) recommendations are implemented.

The vast majority of the phosphorus entering the Yahara Lakes comes from the surrounding land area and is carried to the lakes by tributary streams and upstream lake discharge. The land use practices in the Lakes' tributary drainage area greatly influence the amount of phosphorus washed into the lake. Phosphorus arrives mostly bound to sediments, but also dissolved in water. Once arriving to the lakes, phosphorus remains high due to internal recycling within buried lake sediments. Increased sediment load is also detrimental to lake ecology. *Suspended sediments reduce light penetration, inhibit photosynthesis for aquatic vegetation, impair fish reproduction and feeding, and destroy wildlife habitat.*

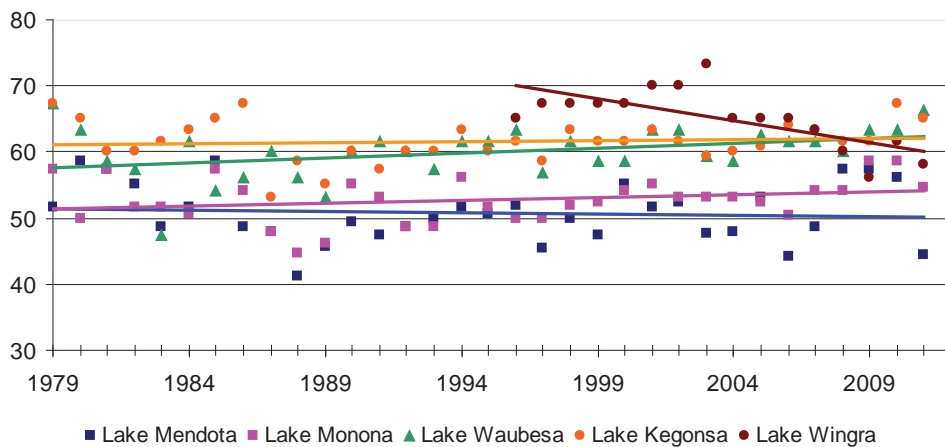
Records of algae blooms date back to before the first limnological studies were conducted in the 1890s. Nutrient levels and water quality conditions in the Yahara Lakes have improved since municipal and industrial wastewater stopped being discharged to them. In 1971, this wastewater was diverted around the Yahara Lakes to Badfish Creek – effectively bypassing the lakes. Efforts are now being directed towards reducing “nonpoint” or diffuse nutrients sources washing off the land and into surface waters. Various regulatory and voluntary measures have been, and are being pursued to improve the water quality of stormwater runoff from both agricultural and urban sources.

³⁹ Lake Mendota Priority Watershed Plan 2000

Low phosphorus concentrations in the lakes are correlated with years of low precipitation and runoff. In general, low flows to the lakes result in lower phosphorus concentrations, followed by lower chlorophyll, and improved water clarity. Lake Mendota dropped into the mesotrophic (moderately fertile) category in the drought year of 1988. *This indicates that water quality improvements can be realized through nonpoint source reductions and controls.*

While highly variable, water clarity data since 1979 has shown slight improvement in Lake Mendota (i.e., lower Trophic State Index [TSI] values, see trendline in [Figure 21](#)). Water clarity has declined in downstream lakes. Lake Wingra has improved due to a carp removal project conducted there. Projects to reduce the nonpoint sources of pollution have been conducted since the 1980s with cost-sharing monies available to install BMPs under the state’s Nonpoint Source Pollution Abatement “Priority Watershed” Program. However, the projects were voluntary, many of the BMPs were untested, and participants were too few to result in significant reductions in phosphorus loadings to the Yahara Lakes.⁴⁰

Figure 21. Median Summer Trophic State Index (TSI) Values Based on Secchi Disk Results



TSI	Description
TSI > 80	Algal scums, summer fishkills, few plants rough fish dominant. Very poor water quality
TSI 70-80	Becoming very eutrophic: Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen -depleted bottom waters during the summer, plant overgrowth evident warm water fisheries (pike, perch, bass, etc.) only.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen depleted during the summer.
TSI < 30	Classical oligotrophy; clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.

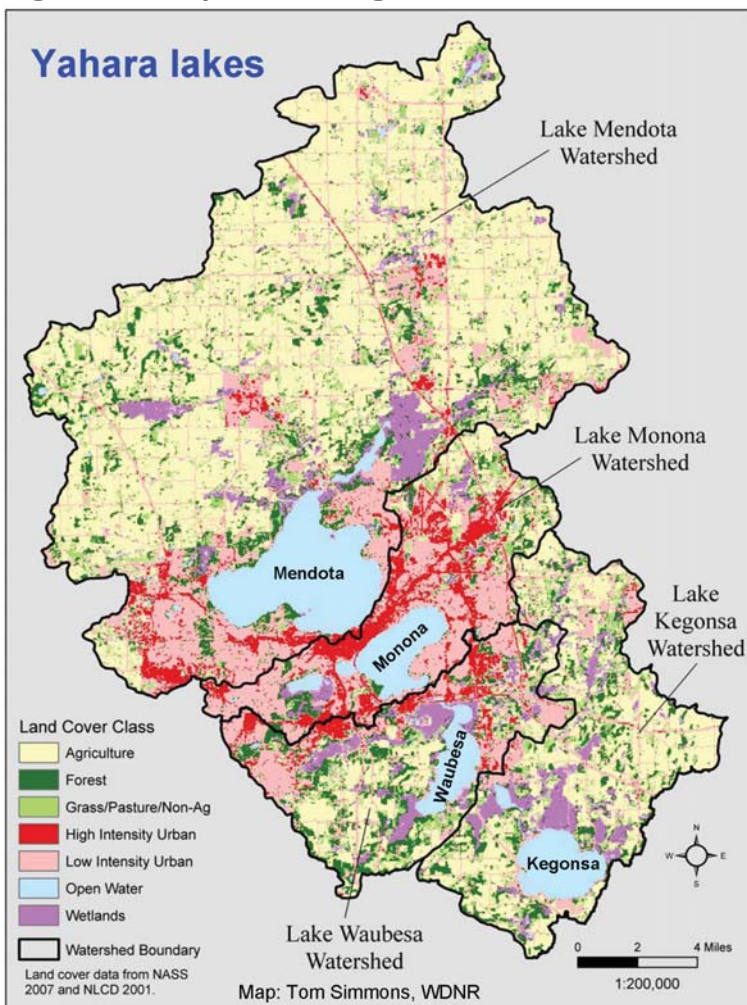
Source Wisconsin DNR

⁴⁰ Lathrop, R. 2007. *Perspectives on the Eutrophication of the Yahara Lakes*. *Lake and Reservoir Management* 23: 345-365.

According to Lathrop and Carpenter (2010), an estimated 81,000 pounds (36,800 kg) of phosphorus enter Lake Mendota annually (see **Figure 22**). *Three-quarters of the phosphorus load originates from agricultural lands in the watershed.* This has a cascading effect, since two-thirds of the phosphorus load to the downstream Yahara Lakes comes from the upstream lakes (indicated in blue).⁴¹ This means that *phosphorus load reductions to Lake Mendota (both agricultural and urban) could produce cascading water quality improvements in the downstream Yahara Chain of Lakes too.* And, as evidenced during dry/low-load years, water quality could improve relatively quickly if the amount of phosphorus flowing into the lakes is significantly reduced.⁴² Based on these findings, the Yahara CLEAN partners have developed the following goals for reducing phosphorus in the Yahara Lake Chain System:⁴³

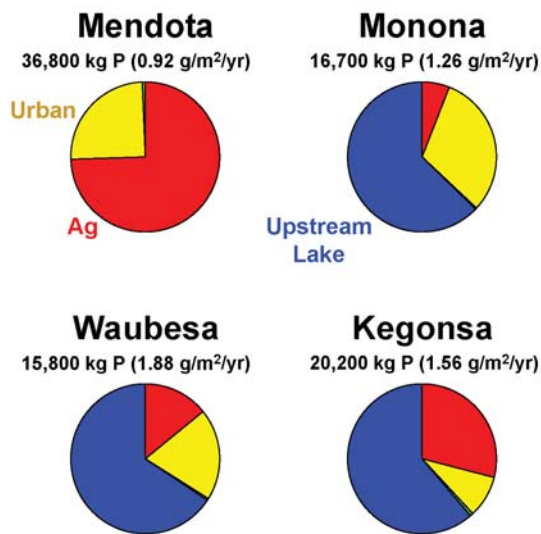
- **Lake Mendota: Reduce the average annual phosphorus load to Lake Mendota by at least 50%.**

Figure 22. Phosphorus Loading Sources to the Yahara Chain of Lakes



P Loading Sources:

SWAT 2000 modeling estimates for land uses; 1980-2007 monitoring data for lake outlets



Source: R. Lathrop & K. Kirsch, WDNR

41 Lathrop, R. and S. Carpenter. 2010. *Response to Phosphorus Loading in the Yahara Lakes Preliminary Finding*. UW Nelson Institute Community Environmental Forum on the Yahara Lakes, Madison, WI., February 23, 2010.

42 Lathrop, R. and S. Carpenter. 2011. *Phosphorus Loading and Lake Response Analyses for the Yahara Lakes*. Unpublished report for the Yahara CLEAN Project.

43 Converse, D. 2012. *Yahara CLEAN Strategic Action Plan for Phosphorus Reduction – Draft*. Prepared for the Clean Lakes Alliance

- ***Lake Monona: Reduce the average annual phosphorus loads by 50% from the direct drainage basin to Lake Monona.***
- ***Lakes Waubesa and Kegonsa: Reduce the average annual phosphorus loads from direct drainage sources to Lakes Waubesa and Kegonsa by 50%.***

To meet these goals the Yahara CLEAN Strategic Action Plan includes recommended actions estimated to cost \$76.5 million over 20 years including:

Urban Actions

- Improve leaf management,
- Control construction erosion,
- Maintain permitted stormwater facilities,
- Stabilize urban waterway banks, and
- Reduce suspended solids in stormwater.

Agricultural Actions

- Improve cropping, tillage, and in-field practices,
- Build community digesters,
- Recover phosphorus at digesters,
- Manage manure and nutrients,
- Dredge drainage ditches,
- Stabilize rural waterway banks,
- Relocate or cover livestock facilities,
- Harvest wetland plants, and
- Promote wetlands restoration.

The Yahara Lakes system is also included in the Rock River Total Maximum Daily Load (TMDL) project establishing necessary reductions in discharge of sediment and phosphorus. Implementation measures and opportunities are expected to be shared among the various agricultural and urban sources as parties to the Yahara CLEAN Strategic Action Plan and the Yahara WINS pilot project coordinated by Madison Metropolitan Sewer District.⁴⁴

Note that some sediment and nutrient load reductions to surface waters and the Yahara Lakes could be negated if with increases in the frequency and intensity of spring and summer storms as projected by climatologic models. Data from the Wisconsin Initiative on Climate Change Impacts (WICCI) show average annual precipitation increased 4.5 to 7 inches in Dane County between 1950 and 2006. Projections suggest the average annual rainfall from 1980 to 2055 will increase an additional 1.5 inches. The frequency of 3-inch rainfall events has increased over the last 10 years. The WICCI projection is for 2 to 2.5 more rainfall events of 2 inches or greater per decade in Dane County from 1980 to 2055 (from 12 times per decade to 14 or 14.5 times per decade).

Because most of the sediment and phosphorus discharged to Lake Mendota comes from agricultural land uses, the timing of the rainfall significantly influences phosphorus load-

⁴⁴ http://danedocs.countyofdane.com/webdocs/pdf/press/6_-_11_Final_Press_Event_Handout.pdf



ing. August 2007, the wettest August on record with 15 inches of precipitation, resulted in about 6,100 pounds of phosphorus at the USGS station at the Yahara River in Windsor. In comparison, June 2008, the wettest June on record with nearly 11 inches of precipitation, resulted a phosphorus loading of about 22,100 pounds. Higher phosphorus loading with less precipitation is likely due to the timing of manure spreading and/or the changes in crop cover during the growing season. **Additional urban and rural runoff management practices may be needed to improve water quality of Lake Mendota and the downstream Yahara Lakes.**

The National Oceanic and Atmospheric Administration's National Weather Service updated rainfall frequency data for Midwestern states, including Wisconsin in 2013 and this data will be used to adjust stormwater modeling as necessary.

Water Quantity

Large areas of former wetlands in the Yahara River Valley were ditched, drained, and converted to agriculture, in many cases resulting in less storage and flashier runoff transported downstream. Likewise, many urban areas are paved with efficient storm sewers directing precipitation more quickly downstream. Agricultural operations with inadequate runoff control and older urban areas with inadequate stormwater management have increased the volumes of stormwater runoff directed to the lakes resulting in more frequent high lake levels and increased flooding.

The lake levels for the Yahara Chain of Lakes are managed by Dane County according to the lake level orders established by the WDNR in 1979. The orders require lake level coordination of the entire chain of lakes as an interconnected system. Note that this is a difficult balancing act considering the vagaries of weather, a very large and slowly responsive system, and often conflicting resource management goals and objectives among multiple user groups.

Issue: High Lake Levels

Measure already taken:

- Peak rate control in urban areas since late 1990s.
- Runoff volume control in urban areas since 2004.

Recommended additional actions:

- Retrofit BMPs in older urban areas to reduce runoff volumes.
- Restore wetlands, woodlands, and prairies in strategic agricultural areas.

Persistent problematic high water levels on Lake Mendota is evidenced by the 2,905 days (25%) the lake levels exceeded the target maximum water level between 1980 and 2011 (**Figure 23**). In Lake Monona, the water levels exceeded the target maximum 3,688 days (32%) (**Figure 24**). The exceedances often last for months at a time. **Since upstream communities contribute additional volumes of stormwater to the lakes, stormwater volume controls are a critical strategy in successfully addressing this problem – both for new and existing development. One promising strategy is to restore prior-converted wetlands, prairies, or woodlands in select areas of the watershed.** Refer to page 110 for a more detailed discussion of wetland resources and opportunities in the study area.

Figure 23. Historic Lake Mendota Water Levels and DNR Lake Level Limits

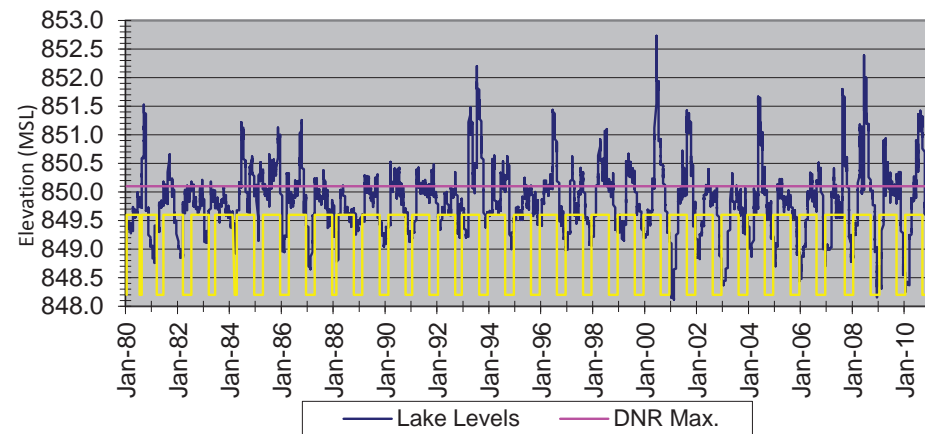
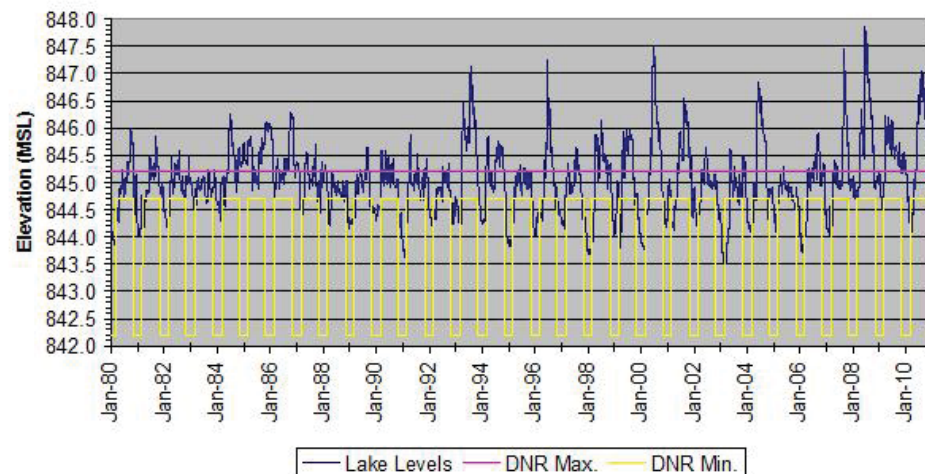


Figure 24. Historic Lake Monona Water Levels and DNR Lake Level Limits

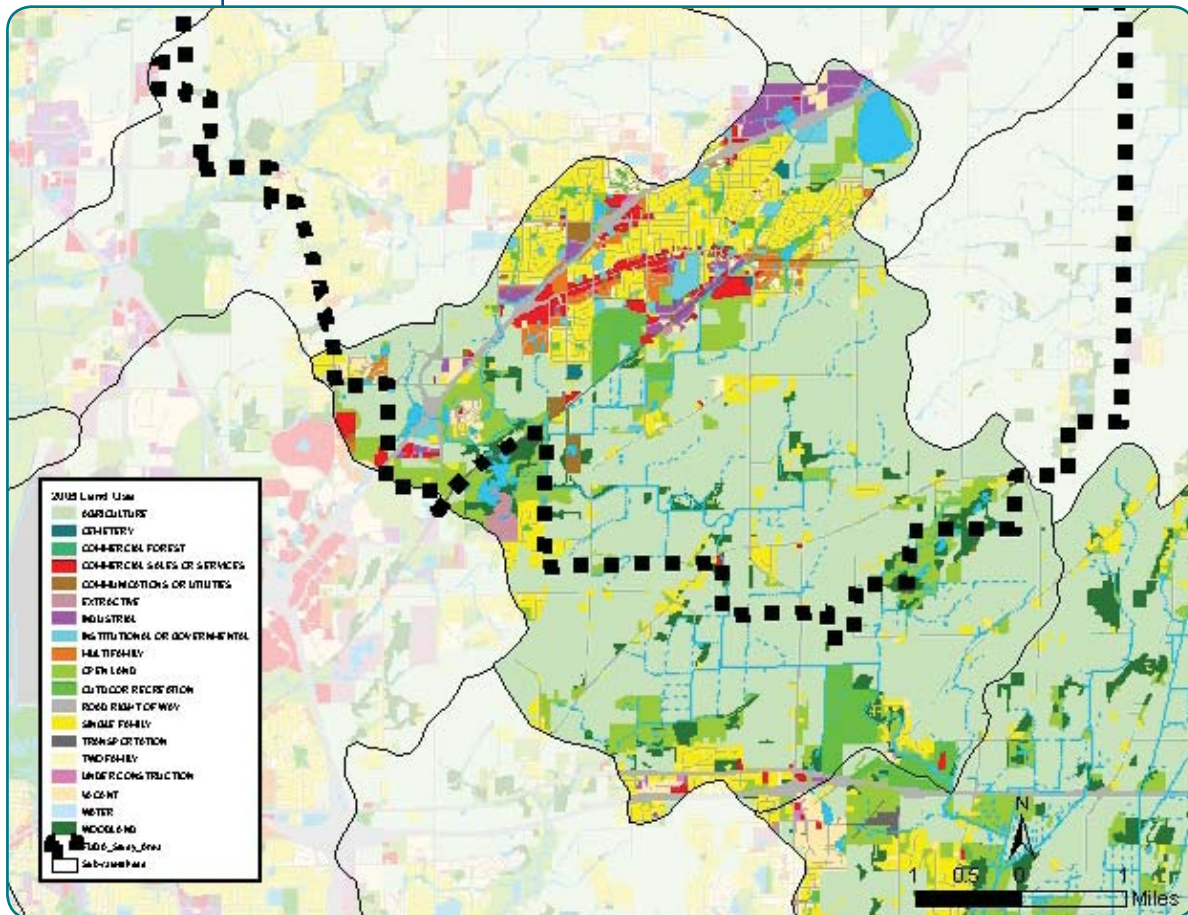


Upper Koshkonong Creek

Koshkonong Creek rises on the southeast side of the City of Sun Prairie and flows southerly 55 miles, draining about 174 square miles in eastern Dane County before joining the Rock River at Lake Koshkonong in Jefferson County. The creek has a very low gradient (3.8 feet/mile) and is mostly channelized above the Village of Cambridge with minimal stream buffers. Below Cambridge the stream is flatter (1.9 feet/mile) and flows in its natural channel. Stream baseflows are generally low with warm water temperatures due to low groundwater inputs. The WDNR designates this section of the creek as being Limited Aquatic Life associated with the Sun Prairie wastewater plant discharges near Bailey Road.

The creek was extensively modified to improve drainage for crop production. A large percentage of original wetlands were drained for this purpose. There are several active agricultural drainage districts in the Koshkonong Creek watershed. This wetland loss, coupled with stream ditching and widespread use of drainage tiles, allows significant nutrient loadings to reach the creek and downstream receiving waters. Stormwater runoff and nonpoint source pollutant loading from urban parts of the watershed also continues to be a problem. The

Map 26. Upper Koshkonong Creek Subwatershed



Sun Prairie and Cottage Grove areas have seen rapid urbanization in the past twenty years. The increase in impervious surfaces has historically resulted in increased runoff to receiving waters. New development in Dane County must now meet stringent erosion control and stormwater management requirements including, more recently, infiltration controls. Additional efforts are needed to control runoff from pre-existing urban areas in addition to ongoing agricultural production activities.

The first six miles of Koshkonong Creek are designated a Limited Aquatic Life (LAL) stream. It is effluent dominated from the Sun Prairie wastewater treatment plant near Bailey Road to CTH T where the classification changes to a warmwater sport fishery (WWSF). Flow is intermittent in its headwaters with stormwater and meltwater runoff contributing the only flow above the treatment plant. The stream has naturally limiting conditions such as a flat gradient, low baseflow, and warm temperatures.

DNR rotational monitoring done in 2009 just east of the Dane-Jefferson county line showed an NR 217 rolling median total phosphorus value of 0.259 mg/L. This is considerably above the target established in the Rock River TMDL of 0.075 mg/L. Average total suspended sediment reductions of 87 percent and 67 percent will be needed in the Upper and Lower Koshkonong Creek watersheds, respectively. The DNR is also proposing to add Koshkonong Creek to its 303(d) list of impaired waters due to high phosphorus levels.

The headwaters reach of Koshkonong Creek does not exhibit good water quality. Fish-IBI and HBI monitoring done in 2000 at Bailey Road downstream of the Sun Prairie waste water treatment plant indicated poor water quality conditions due to very significant organic pollution. HBI monitoring at CTH TT (WWSF reach) in 1997 and 2003 indicated fair water quality with significant organic pollution (HBI = 5.39 and 6.08, respectively). M-IBI scores at the same sites and dates indicated fair biotic integrity (M-IBI = 2.79 and 4.01, respectively).

Overall, water quality conditions in Koshkonong Creek have remained steady or improved over the past 30 years. USGS water chemistry data indicate considerable improvements in some conventional water quality parameters due to wastewater treatment plant upgrades and both urban and agricultural conservation practices. For example, instream ammonia levels have declined significantly. Total phosphorus and suspended sediment have also declined, although these are still above the Rock River TMDL targets. Soil loss in the towns of Sun Prairie, Medina, and Deerfield have also declined significantly. Additional improvements could occur with more aggressive stormwater management measures in and around the City of Sun Prairie and Village of Cottage Grove, and implementation of more conservation practices such as no-till farming and nutrient management planning.

Wetland restoration and increased buffer widths, particularly along ditched sections and tributaries, can also help reduce sediment and nutrient loading. Facility and operational improvements at the Sun Prairie wastewater treatment plant can also improve water quality conditions, especially for phosphorus. DNR has developed a nutrient trading framework that encourages water quality trading that maximizes environmental benefits in a more efficient and cost-effective manner than in the past. For example, water quality trading allows wastewater dischargers to take advantage of economies of scale and treatment efficiencies that may be better and more economically realized in the agricultural sector, thereby reducing the overall costs of achieving water quality objectives in the watershed. The City should therefore continue to explore nutrient trading opportunities and reduction strategies with agricultural and community partners in the watershed to more effectively and efficiently meet the Rock River TMDL targets.

The area of Koshkonong Creek stretching from the south edge of the City of Sun Prairie south to Interstate 94 is identified as a Natural Resource Area in the Dane County Parks and Open Space Plan. The purpose is to promote flood mitigation, wetland restoration potential, and future recreational opportunities. A 2001 floodplain management study evaluating non-structural alternatives to reduce flood damages in the watershed recommends wetland restoration, vegetative buffers, and floodplain easements be investigated and promoted.⁴⁵

⁴⁵ Dane County. 2001. Koshkonong Creek Floodplain Management Study. Dane County, WI.

Issue: Excess Nutrients and Sediment

Measures taken since 1990s:

- Implemented agricultural best management practices (BMPs).
- Implemented urban BMPs.
- Adopted stormwater volume control standards in areas of new development.

Recommended additional measures:

- Increase financial resources for broader implementation of agricultural best management practices for water quality and runoff volume reduction.
- Increase financial resources for broader implementation of retrofit urban best management practices in older urban areas for water quality and runoff volume reduction.
- Restore wetlands, woodlands, prairies, and pastures in select areas for water quality improvement, runoff volume reduction, and wildlife habitat.
- Increase buffer widths, particularly along ditched sections and tributaries, and floodplain easements on flood prone areas.
- Explore nutrient trading opportunities/partnerships to promote synergies and cost efficiencies associated with required TMDL sediment and phosphorus reductions.

The primary flood problem is damage to agricultural crops. According to the study, enrolling lands in the Conservation Reserve Program (CRP) could provide a rental payment to producers and take the most frequently flooded land out of production. The Wetlands Restoration Program (WRP) also provides funding to landowners to restore wetlands on their property. Landowners could also put flood prone land into floodplain easements. To maximize the positive impacts, easements would need to be acquired on significant reaches of contiguous land. Koshkonong Creek could be reconfigured to keep much of the floodwaters off the farm fields and restore the creek so that it is stable. However, this would require excavating quantities significantly greater than a sediment cleanout and brush removal alternative, which was found economically infeasible (i.e., the costs exceeded the potential crop benefits).

Upper Mauneshia River

The Mauneshia River rises along the Dane-Columbia county line in northeastern Dane County, and flows southeasterly through the Towns of Bristol, York and Medina into Jefferson County, eventually emptying into the Crawfish River. The Mauneshia River watershed drains about 88 square miles of primarily agricultural land in Dane County. Each of the three towns the Mauneshia flows through show reductions in erosion and soil loss since 1988.⁴⁶ However, cropland soil erosion resulting in nutrient loading to the river and downstream waters is still a significant problem.

The Mauneshia is a shallow gradient meandering river. Much of its length west of USH 151 was ditched and straightened to facilitate and improve drainage for agriculture. The river has several unnamed channelized tributaries draining to it. The river channel is natural and the gradient increases with occasional riffles between USH 151 and the Deansville Marsh State Wildlife Area. The Mauneshia was ditched and straightened through the Deansville Marsh. The river meanders from Deansville Marsh to the Dane-Jefferson county line, passing through the Marshall Millpond. A portion of the watershed from Deansville Marsh downstream is in the proposed DNR Glacial Heritage Area, extending just west of the Deansville Wildlife Area to the Kettle Moraine State Forest in Jefferson County. In Dane County, the area is identified as a Natural Resource Area in the Parks and Open Space Plan.

The WDNR considers the Mauneshia River as being a warmwater sport fishery stream that was not supporting its existing or potential use. In 1998, the DNR placed the Mauneshia River on the state's list of impaired waters. Phosphorus and sediment pollutants were thought to be causing low dissolved oxygen (DO) and degraded habitat impairments in the river. The DNR developed a Total Maximum Daily Load (TMDL) instream phosphorus level of 0.075 mg/L for the Mauneshia River and for other larger, low gradient streams in the Rock River basin. This level is significantly above the reference background value for streams recommended by Robertson et.al. of 0.03-0.04 mg/L for wadeable streams,⁴⁷ though reflects the realities of such low gradient streams in agricultural areas. The Rock River TMDL recommends an average percent reduction of total P loading to the Mauneshia of between 31-37 percent in Dane County.

In 1992, water quality was considered to be generally good, although concern was ex-

⁴⁶ Dane County LWRD, 2008.

⁴⁷ Robertson, 2006. A stream or other water body reflecting natural conditions with few impacts from human activities and which is representative of the highest level of support attainable in the basin or ecoregion.

Issue: Excess Nutrients and Sediments

Measures taken since 1990s:

Implemented agricultural best management practices (BMPs)

Recommended additional measures:

Increase financial resources for broader implementation of agricultural best management practices for water quality and runoff volume reduction.

Increase financial resources for broader implementation of retrofit urban best management practices in older urban areas for water quality and runoff volume reduction.

Restore wetlands, woodlands, prairies, and pastures in select areas for water quality improvement, runoff volume reduction, and wildlife habitat.

Increase buffer widths, particularly along ditched sections and tributaries.

Explore nutrient trading opportunities/partnerships to promote synergies and cost efficiencies associated with required TMDL sediment and phosphorus reductions.

below the Village of Marshall between 2001-03 also indicated fair biotic integrity.

Water quality conditions in the Maunsha River watershed appear to be holding steady and improving slightly. **Increasing buffer widths, particularly along ditched sections and tributaries, may help reduce sediment and nutrient loading, although significant additional water quality and instream habitat improvements may be difficult to achieve. Maintaining a 120-foot continuous stream buffer, natural vegetation, or a combination of natural vegetation and forage or biomass crops can improve water quality and instream aquatic communities.^{50,51} Buffers may also increase stormwater infiltration, especially if planted with deep-rooting native prairie vegetation. Planting native trees on drumlin slopes may also encourage more infiltration needed to maintain stream baseflow.**

Stream Restoration

Successful stream restoration projects require both scientific understanding and participant cooperation. A fine balance must be struck between the promotion of stream health and the desires and attitudes of landowners. Symptoms of poorly functioning streams are steep bank erosion, high sediment loading, lack of pools and riffles, and flooding. Modifications to streams such as riprap, channelization, bank armoring, levees, and other flood and velocity control engineering only correct in-stream problems and do not address large scale systemic problems. Stream restoration should focus on restoring the dynamic equilibrium of the stream in addition to site engineering to stabilize banks or channels. Maximum stream restoration benefits occur when the watershed level

is considered. This is accomplished through land management practices that hold water and slowly release water into streams.

One challenge is to encourage landowners with properties in stream headwaters to participate in stream restoration. Upstream landowners often do not see the negative impacts of stream degradation, as compared to landowners downstream who most experience increased erosion and flooding. Granting incentives will be useful to promote landowner participation. Once a landowner buys-in, **stream restoration projects should follow the five criteria:⁵²**

- 1. A restoration goal that describes an ecologically healthy state that maintains dynamic properties within its regional context,**
- 2. Undisturbed or recovered streams serve as restoration reference sites, specifically when historical data is lacking,**

⁵⁰ Weigel, 2005.

⁵¹ Weigel, 2003.

⁵² Palmer et al. 2005

3. *Use a design approach which uses empirical models that focus on ecological processes,*
4. *Use regional stream classification systems to guide restoration goals, and*
5. *Use common sense to notice site details and remove obvious stressors (lack of riparian vegetation, unrestricted livestock, etc.).*

Successful stream restoration requires dynamic qualities, not excessively imposed control leading to static conditions. River dynamics are often described as reaching an equilibrium that describes natural fluctuation around a character state. Alterations in flow regimes have devastating impacts within riverine ecosystems. River flows regimes are considered to be the master variable for stream ecosystems. Flow regimes determine flooding patterns and shape the physical habitats within river and floodplain. Changes in flow negatively affects the distribution of organisms, impairs reproductive strategies of aquatic organisms, impairs habitat utilization, and in-stream connectivity. With these environmental changes, native organisms are quickly displaced by invasive species that cause additional alterations.

In general, there are two types of techniques: (1) non-structural and (2) structural techniques. *Non-structural techniques* use passive restoration, or any restoration method that does not involve an engineered alteration of the environment. Passive restoration is accomplished with landscape oriented methods, which change land use through administrative or legislative means. Streams tend to be resilient ecosystems. If environmental stressors are identified and eliminated, streams can recover without active human intervention. Methods for non-structural stream restoration use fencing to exclude livestock and establishing greenways and conservation easements.

Structural techniques use active restoration to modify the environment directly. Structural techniques are divided again into two categories, those that use “soft engineering,” which uses on site natural materials such as alluvium, woody debris, or other bioengineering, and those that use “hard engineering,” which uses artificial materials like concrete, sheet piling, rock gabions, and rip rap. These physical manipulations can change stream sinuosity, gradient, substrate, sediment loading, bank profile, and floodplain connectivity. They are most often used to lock stream morphology to preserve property and infrastructure. Although it is desirable for stakeholders to control erosion within a reach, the process comes at a cost. As the amount of active intervention in stream restoration increases, the cost, difficulty, possibility for failure, and immediate disruption to stream ecosystem could follow. However, physical manipulations may have more immediate results.

Stream restoration approaches within the FUDA study will vary by stream order ranking. First order streams do not have other streams leading into them, and are headwaters of a larger stream. A second order stream is the confluence of two first order streams, and a third order stream is a confluence of two second order streams. Headwater streams in agricultural or urbanizing areas, though often ignored for conservation, are critical as refuge for aquatic organisms in disturbed higher order streams. The surrounding riparian

Issue: Stream Restoration

Maximize stream restoration benefits by considering watershed.

Unify landowners to help.

Streams need to remain dynamic.

Stream restoration methods:

- Modify land use (soft)
- Modify stream itself (hard)

vegetation of headwater streams is a major contributor to food web dynamics, helps regulate sediment inputs, and reduces the severity of flooding events, all of which propagate downstream. Headwater streams and low discharge first order streams will benefit most from soft engineering and restoration of riparian buffers (discussed on [page 136](#)).

As stream order increases, total discharge also increases enabling streams to carry and deposit more sediment. Higher order streams also have higher sinuosity and well defined pool and riffle sequences. Bends and curves in higher order streams are sites for additional erosion and deposition, while pools and riffles provide habitat heterogeneity. Under normal conditions, erosion and deposition sites change, with new bends appearing and vanishing throughout time. When stream flows increase due to human activity, these two processes are amplified. Greater erosion and deposition occur at bends in the stream, while pool and riffle sequences are lost leading to a uniform stream bed. Middle order streams are most conducive to using hard engineering techniques.

The extent of stream restoration in urbanizing environments will be ultimately determined by social values. Restoring a stream to pre-settlement conditions may not be possible. ***Stream restorations in this context should be guided by determining what can be done to promote a dynamically variable environment, but constrained by site history and the need to protect property.***

Stream restoration opportunities exist throughout the study area. These include Token Creek, and the various intermittent and ephemeral headwater streams that occur across watersheds. Riparian restoration with native tree species will partially help stabilize banks from downcutting erosion, and the inputs of woody debris and leaf litter will help improve in-stream habitat variety and trophic support to aquatic food webs. To improve the bank stability, structural restoration will be needed, as major changes to bank morphology caused by erosion cannot be repaired naturally by the stream in a regulatory time frame. Structural restoration techniques may be best used when protecting infrastructure from changes in stream meander. The erosion potential of Token Creek may increase if global climate change creates higher and more frequent storm flow events.

The smaller intermittent and ephemeral streams within the study area will also benefit from structural and non-structural restoration. The agricultural landscape has channelized many of the streams to some extent. Recreating natural stream channel meanders is an important first step, followed by riparian restoration using native plant species.

Wetlands

Over half of the wetlands in Dane County and the U.S. were lost over the last century, including those in the Sun Prairie USA FUDA study area. Many of the wetlands that remain are degraded. This has resulted in the loss of important wetland ecological functions and values, and also incurs socioeconomic costs. It has become increasingly recognized that all wetlands have value – particularly since there are fewer of them remaining. Significant advances have also been made in the science of wetland restoration, and public opinion and policies for protecting and restoring wetlands.

*Wetlands play a critical role in the hydrology of river basins. Wetlands are valuable for flood control, cleansing surface water of contaminants including sediment, heavy metals and pesticides, the organic peat permanently locking many chemicals, and providing important wildlife habitat, trophic support, movement corridors, and scenic qualities. **As the City of Sun Prairie study area transforms from agricultural to urban land uses, retaining these wetland functions and values will remain important.***

The Wisconsin Wetland Inventory (WWI) indicates that wetlands exist along streams and marshy areas in the study area. Based on the hydrologic modifier codes for the WWI Map units, most of these wetlands appear similar from a hydrologic standpoint, with a modifier of “K” indicating wet soil during much of the growing season. Wetlands in the study area include shallow marsh, sedge meadow, shrub carr, and occasionally forested wetlands.

Patrick Marsh

Patrick Marsh has become an area of increasing public and private interest in recent years, and is identified as a Natural Resource Area in the Dane County Parks and Open Space Plan. The name “Old Lake” is thought to have been used in its early history because the lake disappeared from time to time; drying up to become a marsh. The lake was renamed Patrick Marsh for William Patrick who settled on the west shore in 1841 and was the first Chairman for the Town of Bristol in 1846. The widely fluctuating water of Patrick Marsh led to its demise in 1965 when landowners began draining the marsh. For nearly three decades, the marsh ceased to exist, as tiling kept the soil dry.

The expansion of USH 151 from Sun Prairie to Columbus in the early 1990s enabled cooperative marsh restoration as part of the wetland mitigation agreement between the Department of Transportation (DOT) and the Department of Natural Resources (DNR). DOT purchased the drained farmland and adjacent uplands to mitigate the loss of 26 acres of wetlands the DOT destroyed by widening USH 151. Because DOT restored more wetland acres than were lost during the project, the balance of those wetland acres were “banked” as credits to mitigate other wetland losses due to highway projects in the district. This “wetland bank” at Patrick Marsh was the first of its kind in the state. In 1991, 225 acres including the basin and surrounding lands south of USH 151 were acquired. In 1992 DOT transferred the property to the DNR fulfilling their wetland mitigation requirements. Without the banking concept, the willingness of DOT to purchase the land, and most importantly the cooperation of landowners that were willing to sell, Patrick Marsh would not have been restored. With abundant rainfall in the Spring of 1993, the marsh filled to its full pool level of about 160 acres, with an average depth of almost five feet and a maximum depth of nearly eight feet. In the Fall of 1993, an outlet structure was installed on the marsh’s northeastern corner to control the water level and direct overflow to the Maunasha River watershed.

The character of the marsh has changed little since 1993. Water levels have remained high and aquatic plant diversity has actually decreased with the high water levels. Very little emergent vegetation appears along the shoreline. In 1994, the wetland was dedicated as the Patrick Marsh Wildlife Area. It consists of prairie and oak opening restoration efforts, a deep-water marsh and small woodlots. Hydric soils outside of the DNR property southwest and southeast of the marsh offer potential for future shallow marsh restoration efforts that could provide flood storage, phosphorus reduction, and wildlife habitat. Several forms of

passive recreation currently take place at the marsh including walking, cross-country skiing, and fishing. The area also offers outstanding bird watching opportunities.

In 2003, Dane County Parks Department completed a Patrick Marsh Project Plan. The plan provides guidance to Dane County, stakeholder units of government, and other conservation organizations regarding lands that may be considered for future preservation efforts. These lands may then be eligible for Wisconsin Stewardship or Dane County Conservation Fund dollars. Preservation of land is entirely dependent on the willingness of property owners to sell their property or easements for conservation purposes, and the local government or conservation's ability to procure funds for acquisition. Plan objectives include:

- Preserve lands surrounding the existing Patrick Marsh Wildlife Area to provide continuous and expanded public ownership for future passive recreation, education, and trail linkage opportunities.
- Preserve adjacent hydric soil areas for future shallow marsh restoration efforts that will provide expanded wildlife habitat, flood storage, and water quality benefits.
- Preserve upland buffer areas adjacent to the resource area and maintain open viewsheds into the marsh.

Wise stormwater management (both quality and quantity) in areas draining to the marsh have also been identified as being particularly crucial to the future of this valuable natural resource and community area site.



Token Creek Wetlands

One of the higher quality and ecologically supporting wetlands within the study area follows along Token Creek as the stream drains into Cherokee Marsh. This wetland serves as a major habitat resource for the western most section of the study area. Most of the wetland vegetation along Token Creek is now invasive reed canary grass. This plant severely limits habitat quality and ecosystem function. However, there are sections of wetland riparia where this invasive is not as prevalent. Restoration efforts should be prioritized to restoring this riparian wetland nearest the Token Creek Preserve Park. This will grant the greatest gains due to the size and ecological structure of the site, limited human activity, and quality upland habitat nearby. Token Creek Preserve Park has additional qualities that make it more conducive for biological diversity, including the presence of small pools along the eastern edge. These water bodies, and their proximity to upland habitat make them useful as amphibian breeding sites, and feeding sites for other vertebrates.

The overall quality of the wetland changes as the stream approaches Token Creek Park. Outside the park boundaries, the quality of the wetland is highly degraded, owing to management practices by multiple landowners. Wetland quality is more variable within the park, as some areas are subject to conservation while others appear unmanaged. Wetland diversity is lowest near the highway interchange, and improves once inside Cherokee Marsh.

Other Wetlands

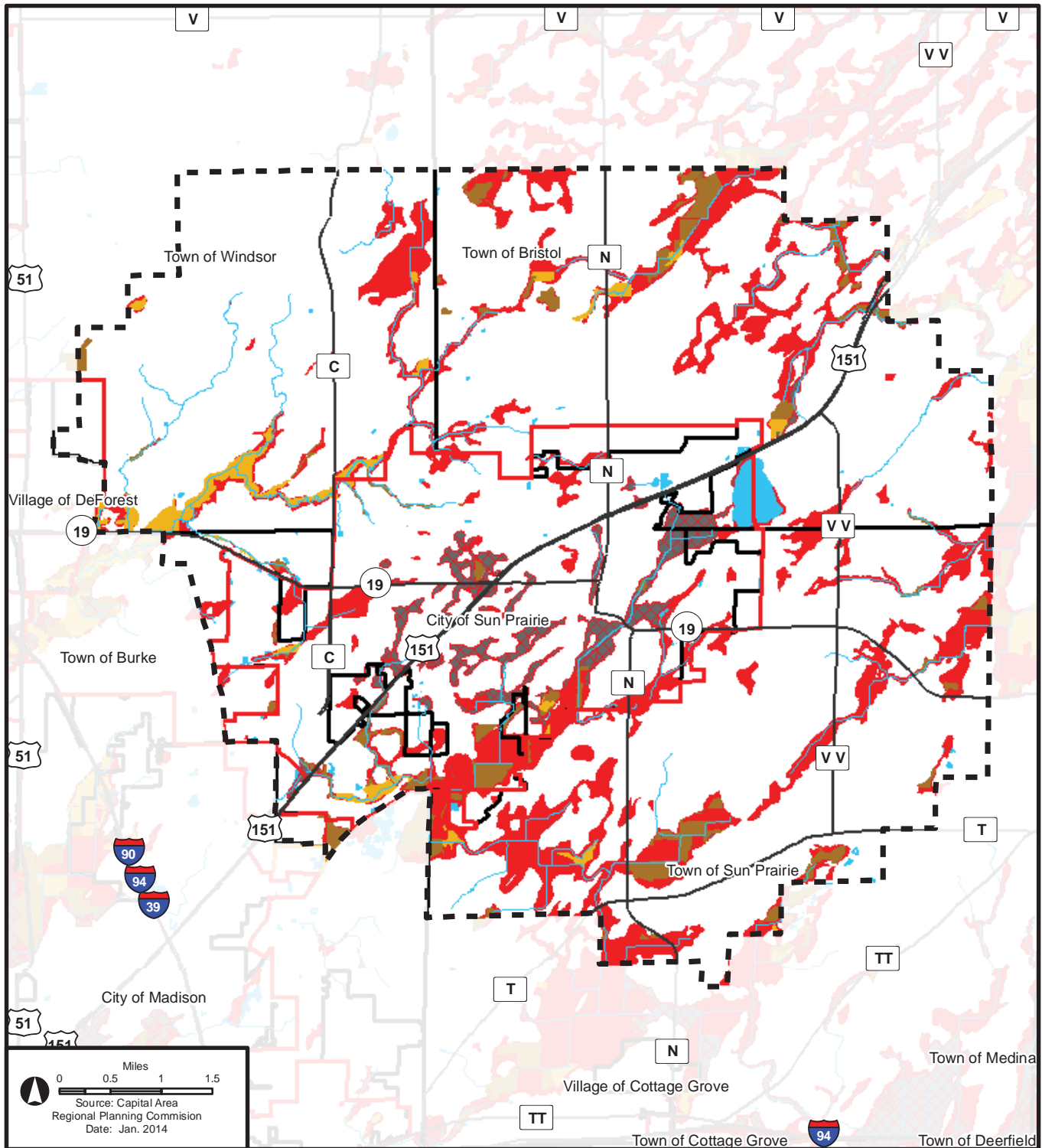
Limited surveys were conducted to assess the health and quality of other wetlands in the area. Overall, there is a broad range of biological quality among the wetland sites depending on site specific factors. Generally, the quality of these wetlands depends on nearby land use, such as the intensity of agricultural activity (i.e. pasture, cultivated or mowed land, or those that have been ditched or drained), or urban development (such as polluted runoff or filled wetlands). Low disturbance wetlands feature native wet prairie and sedge meadow species. Medium and high disturbance wetlands are characterized by an abundance of reed canary grass or woody shrubs resulting from varying degrees of ditching or hydrologic alteration. Some are affected by nutrient enrichment or sedimentation and invasive plant species.

As part of the natural resource inventory for the Dane County Water Quality Plan, a study of wetlands in Dane County was conducted by Bedford et al. in 1974. This study provided information for planning, decision-making, and strategies for managing wetland resources. The most valuable wetlands were identified by the RPC Restoration Ecologist in 2012 and are included on Map 30. Whereas some of the information contained in the Wetlands of Dane County is dated and needs to be re-visited, it provides valuable information, especially when combined with the significant progress in our understanding, appreciation, and management of these critical resources over the last 35 years.

Higher quality wetlands include the upper reaches of Token Creek and Patrick Marsh. There are few wetlands of moderate quality within the study area. These are limited to wooded wetlands scattered throughout the landscape, or small cattail dominated shallow marshes encircled by urban development. The wooded wetlands that remain have reduced wetland boundaries and generally occur as treelines along topographic depressions. The cattail marshes appear to be in areas that are permanently or frequently inundated. These wetlands have limited open water features, making them less attractive to wildlife.

Map 28: Wetland Groups

Sun Prairie FUDA, Dane County, WI



- | | | | |
|----------------------|--------------------------|---------------------------------------|---------------------------------|
| FUDA Study Area | Municipal Boundary | Group I (Protect) | Group IV (Enhance, Restore) |
| Urban Service Area | Wetlands not Inventoried | Group II (Protect & Enhance) | Group V (Restorable Former) |
| Limited Service Area | | Group III (Protect, Enhance, Restore) | Group V (Non-Restorable Former) |

All wetland groups may not be present or wetlands may not be classified. Consult Map 5 for wetland boundaries.

Wetlands are grouped by their present or potential biological condition, scientific value, public use, extent of degradation, and immediate or long-range threats. While all wetlands have value, decisions must sometimes be made as to where specific approaches and efforts are best tailored or targeted.

Wetland Groups

The information collected during the 1974 study was used to group wetlands into five categories (**Map 28**) based on their present or potential biological condition, scientific value, public use, extent of degradation, and immediate or long-range threats. The majority of wetlands in the Sun Prairie study area are severely degraded and appear to be Group IV or Group V wetlands, reflecting the significant historical agricultural influence in the area.

Group I Wetlands are the best and, in some cases, among the most valuable in southern Wisconsin. Cherokee Marsh is a good example near the study area. Although showing signs of disturbance they remain virtually intact. In addition to their wildlife value, water quality, and flood protection benefits, these sites also provide important reference sites for designing restoration projects in other areas. Every effort should be taken to protect them.

Group II Wetlands include many of the large peat deposits, that are particularly valuable for protecting the Yahara River and its chain of lakes. Examples in neighboring areas include Waunakee and Deansville Marshes. While the survey information may be somewhat dated, these wetlands still remain in very good condition. Most of the wetlands in this group are large or deep enough to be resilient. Alterations have not had a profound effect. These wetlands should receive the same protection as those in Group I, and it is certainly possible to improve or enhance their condition.

Group III Wetlands, although substantially altered, do in fact provide wildlife habitat and open space, and enhance the environment overall. While all reasonable efforts should be made to ensure their protection, **enhancement may be especially important to improve one or more degraded function such as flood protection, water quality, and wildlife habitat.**

Group IV Wetlands maintain some function or exist for temporary periods of time (such as protection from flooding or for migratory waterfowl use). Many of the Group IV Wetlands could not be surveyed during the original study because of limited resources. The fact that they can still be considered wetlands many decades after drainage indicates that they are not well suited for agriculture. **Their best use appears, then, to be enhanced or restored for one or more wetland values or functions, rather than continued attempts at drainage.** The wetland east of the Dane County Airport is a good example.

Group V Wetlands no longer exist or function as a wetland ecosystem. Ditching, draining, or filling has destroyed all functions and values. It may be possible, however, to restore them by reversing the action(s) that destroyed them in the first place. Potentially restorable wetlands are indicated based on WDNR modeled data accounting for land use and land cover constraints. **These areas present significant opportunities to restore wetland acreage lost over the last century.**

Many degraded wetlands provide important flood protection benefits and open space corridors. Many sites, particularly those where native species remnants exist, have a high potential for restoration or enhancement. So too do those that have been ditched or drained, since it is often possible to restore their natural hydrology by plugging ditches or breaking drainage tile lines. In the end, the management strategy for each wetland will be as unique as the wetland itself. Because of the scarcity of remnant aquatic habitat, both aquatic and

terrestrial endangered species are often found associated with wetland areas. Likewise, many ephemeral wetlands provide important breeding habitat for amphibians that serve as food for other wildlife. Therefore, enhancing the quality and extent of wetland habitat in an area helps support and promote natural food webs, biotic health, and overall species diversity. This topic is discussed more fully in later sections.

Wetlands and former or converted wetlands pose significant constraints to development. County and municipal zoning prohibits development in wetland areas of 2 acres or greater. Wetlands, regardless of size, are also regulated by other state and federal laws. Existing laws and regulations, however, do not always provide adequate protection. **The best strategy is to avoid these areas completely and direct future development to better suited areas.** In addition, existing laws and regulations largely ignore opportunities to restore some of the large wetland acreages (and associated functions and benefits) that have been lost over the last century. These remnant wetland acres should provide the basis or framework for carrying out an effective wetland resources protection and restoration strategy here, as in other watersheds throughout the county. Note that property tax law disincentivizes restoring wetlands by valuing wetlands higher than cropped farmland. Therefore, farmers have to be prepared to pay higher property tax and lose income from reduced crop yields when restoring prior converted wetlands.

The Bedford et al. study (1974) is a particularly useful reference for those in the early stage of designing their own wetland restoration or enhancement projects. *Each wetland is unique and the management strategy must be tailored for each.* Wetland protection and restoration plans are routinely developed by consulting firms on behalf of their clients. Federal, state, and local funding is available to promote these projects. The *Dane County Wetlands Resource Management Guide* (CARPC 2008) outlines a process and framework for developing successful wetland restoration and protection plans and projects in collaboration with public and private partners. In uninventoried areas or where information is significantly out of date, the CARPC restoration ecologist/biologist can provide more current assessment, recommendations, and assistance.

Existing wetlands should include a minimum buffer of 75-100 feet for water quality protection, and also be included in park and open space areas as Environmental Corridors. Group I and II wetlands should be granted 700 foot buffers to protect their intrinsic resource qualities and to protect habitat. Group III wetlands should have at least a 300 foot buffer. For Group IV wetlands, if communities are unwilling or unable to restore the wetlands to a state where it may be functional habitat, then it should have at least a 75-100 foot buffer.

Wetland Restoration

As with all restoration activities, the goal is to create a self-sustaining, self-organizing ecosystem with similar ecological functions relative to historical or reference communities. **For successful restoration, the ecological community will need to remain persistent, maintain ecological function after disturbances (ecological resistance), and have the ability to return to its previous state after disturbance (ecological resilience).** There are three general approaches for wetland restoration. These are re-establishing hydrology consistent with historical patterns, control contaminants from entering the wetland, and promoting native species while controlling invasive species. Like stream restoration, wetland restoration can

be divided into two general categories, passive and active restoration. Passive techniques include eliminating grazing and mowing allowing native vegetation to return. Active restoration techniques for wetlands include removing fill, changing site hydrology through changes in geomorphology (channel redirection), and replacing invasive plants with native species.

Wetland restoration occurs on a site by site basis. The potential role for wetland restoration within the watershed-scale approach is usually not considered. This is largely due to limited resources and finding willing landowners who wish to participate. ***Restoring wetlands should be considered in a cumulative context, whereby when more wetlands within a watershed are restored, the greater the influence on improving water quality. Considering landscape connectivity between wetlands is also important*** for animal movement and dispersal and controlling invasive species.

Multiple invasive species are found in these wetlands. The two most prolific invasive species of major concern are reed canary grass and hybrid cattails. Willows can also be problematic as high density bush stands. Invasive species are problematic because they form high density monotypic stands within the ecosystem causing decreased species diversity, impairing food web interactions, and removing habitat. Invasive species affect ecosystem and watershed processes by altering erosion, runoff and depositional processes. Where smaller patches exist, herbicide application and manual removal can be effective. When the invasive species forms large, monotypic stands, heavy machinery, and controlled fires will be needed. Invasive species control must be performed on adjacent sites, otherwise the invasive species will settle and colonize the site again. If urban development includes construction in areas with restorable wetland sites, it may be beneficial to use heavy equipment to remove extensive patches of invasive species (after receiving permission from WDNR).

Several restoration opportunities exist throughout the Sun Prairie study area. These wetlands include the riparian areas around Token Creek, a small wet prairie northeast of Patrick Marsh, and Patrick Marsh itself. The first major wetland restoration opportunity is Token Creek. As previously mentioned, Token Creek is one of the larger conservation areas within the Sun Prairie study area. Restoring Token Creek wetlands coincides with restoring its riparian area. The condition of this wetland riparian zone will influence ecosystem processes and habitat functions within the stream. The main conservation issue will be to control the extent of reed canary grass along the length of the stream. This grass is a pernicious species that is difficult to eradicate, and will require several years of commitment and continuous effort. Alternate wetland restoration scenarios may involve creating smaller patches of dense canopy herbaceous wetland vegetation, including riparian trees. These sites will create additional habitat variety, provide localized woody debris inputs directly into the stream, and may be easier to establish as

Issue: Wetland Restoration

Three means:

Re-establishing hydrology,
Contaminant control, and
Invasive species control.

Promote connectivity & consider the watershed.

Wetland restoration methods:

Modify land use (soft) and
Modify wetland itself (hard).

Seek governmental assistance for wetland restoration funding.

Alter land-use practices in adjacent agriculture can improve wetlands by reducing fertilizer inputs.

Planning Considerations

Consider opportunities to connect valuable natural resource areas into E-Ways for recreational, educational, and environmental benefits.

For example, the Environmental Corridors for Token Creek, Koshkonong Creek, Patrick Marsh, and the Mauneshia River could be expanded upon to showcase these significant natural resource features.

compartmentalized units. Restoration planning should include an adaptive management component that allows for experimentation in treatment options, timing, and deployment. Removing this invasive can coincide with restoration of the stream bank itself. Excavation of the steep banks can also be used to remove the standing reed canary grass and remove the underground rhizomes. Riparian restoration, like stream restoration, will need cooperation and consensus among landowners along the length of Token Creek.

The second wetland restoration site is found north-east of Patrick Marsh, on the northern side of US 151. This is a small wet prairie that contains a variety of herbaceous wildflowers. However, the site appears to be heavily colonized by fescues. Management for northern sections of the site could include prescribed burning and mowing, combined with adding more local species to augment the plant community. This wet prairie could be managed similarly to drier prairies, and should be granted a 100 to 120 foot buffer if management plans include prescribed burning.

The third site, Patrick Marsh will be a challenging restoration if the intent is greater use by wildlife. Patrick Marsh, in its current state, is mostly open water and has limited emergent vegetation. Most of the natural communities for this site are prairies along the edge, with oak openings to the south. These communities are very narrow and form a ring around the waters edge. Recreational use has resulted in a trail network that cuts through this narrow band of vegetation. This has consequences for wildlife as frequent human activity disturbs wildlife, particularly in the northern section of the wildlife area. Future restoration goals for this site could include expanding the area for emergent wetland plants and creating conditions similar to the original restoration effort in 1992. Under present conditions, including the heat wave of 2012, there was minimal exposure of the mudflats and very little emergent vegetation along the shoreline. Lowering water levels and expanding the extent of emergent vegetation would be beneficial to aquatic wildlife in two ways: first, it would provide additional foraging opportunities to wildlife, beyond the upland prairies, and second, provide cover, visual occlusion, and distance for wildfowl in the open water away from human activity along the nature trails.

Restoring the hydrology could be accomplished by changing the height of the outlet, to allow for natural variability in water levels. However, this option may be less feasible if it creates a greater risk for downstream flooding. Approximately 100 acres of the Sun Prairie business park north of USH 151 collects runoff to a wet detention pond before releasing it under the highway through a culvert discharging to the north side of Patrick Marsh. There were discussions of re-routing this stormwater to the state-owned wetlands on the east instead of Patrick Marsh. This alternative should be looked at closely as it would allow stormwater to be diverted away from Patrick Marsh and would also allow more time for the water to be filtered by overland flow and infiltrate into the ground. The reduced water levels would also allow additional wetland vegetation to establish.

If Patrick Marsh were to be further restored, allowing for conditions that are conducive for waterfowl breeding, then a 300 foot buffer should be enacted. This will protect the resource both during and after restoration. If restoration is not feasible, then retaining a 100 foot buffer around the water's edge and 120 buffer around the adjacent prairies is recommended.

Several minor wetland restoration opportunities exist throughout the Sun Prairie study area. First, generally dispersed throughout the study area in agricultural areas that are poorly drained and have hydric soils, that persistently fail to produce cash crops. There are government programs designed to assist landowners in becoming natural resources stewards. Some of these programs include the Wildlife Habitat Incentive Program (WHIP), the Wetlands Reserve Program (WRP), and the Conservation Reserve and Conservation Reserve Enhancement Programs. If there are restorable wetlands within these agricultural areas that are not profitable for farmers, participation with these programs may give farmers the financial incentive to participate. Second, thin tracks of hydric soils parallel most of the streams in this region. If the areas around these streams are urbanized, it could be possible to create riparian areas with additional wetland functions. However, the feasibility of such restorations will need to be evaluated case-by-case.

Multiple observations were made of vast expanses of reed canary grass beyond the bounds of wooded riparian zones and ending before a corridor of upland trees or adjacent agriculture. In these locations, the native wetland community is displaced by this species. These expansive areas result in lowered plant community diversity and negative impacts on invertebrate diversity. These two factors may negatively influence organisms higher in the food web, yet current studies are inconsistent.

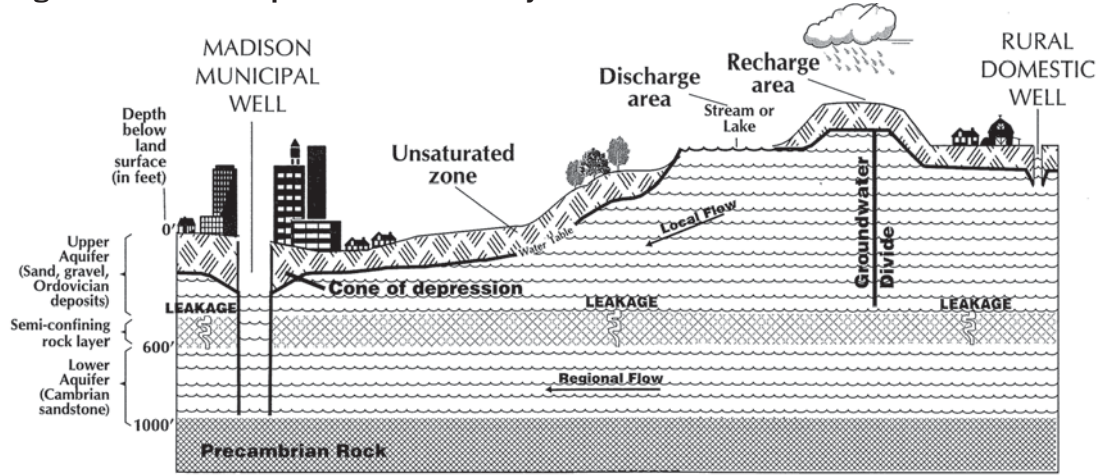
Wetland restoration should be considered on the landscape level. Interconnectivity between wetlands is important for animal movement between patches and the dispersal of plant propagules.

C. Groundwater

Precipitation that infiltrates into the ground enters the groundwater system to provide our drinking water and baseflow for streams, lakes, and wetlands. Surface water, shallow groundwater, and deep groundwater are closely interconnected. This groundwater/surface water balance can be upset by human activities. Almost all groundwater in Dane County originates as recharge occurring locally (Bradbury 1999). *We are therefore directly responsible for the health of our ground and surface water resources.*

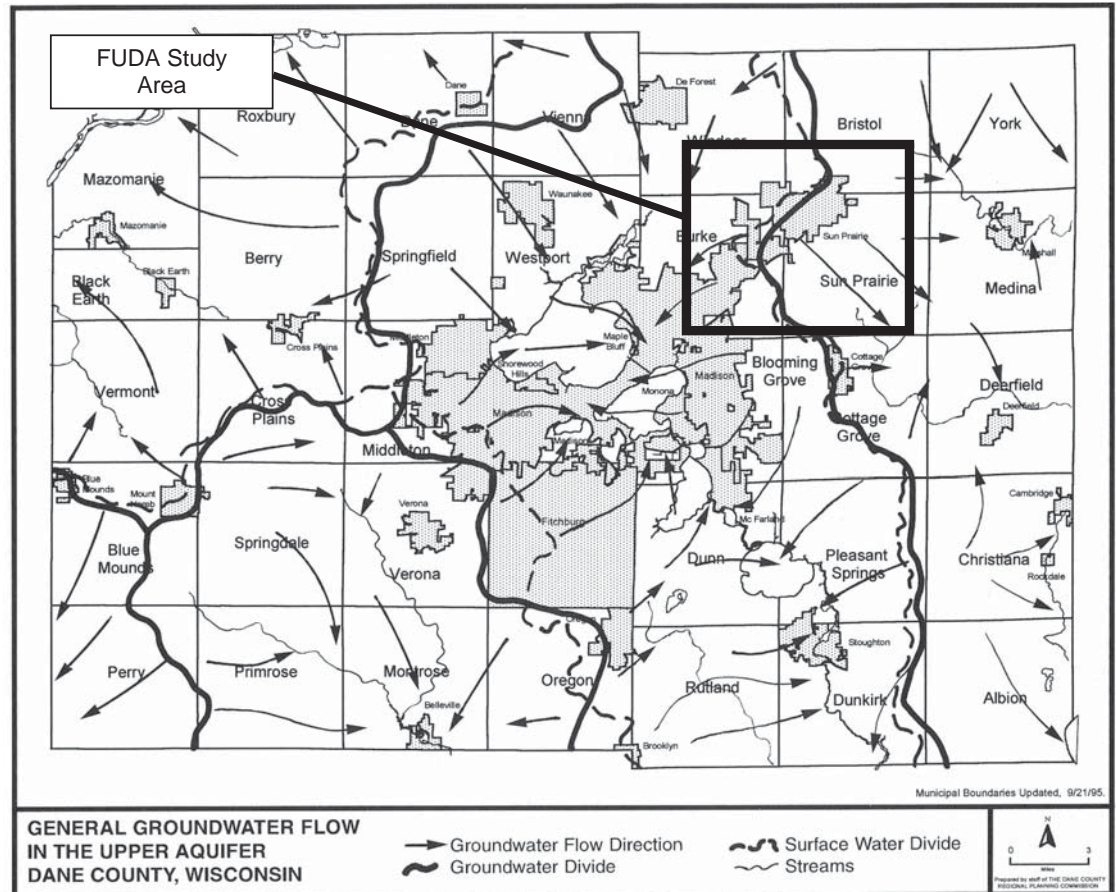
Most lakes and streams are discharge points for groundwater where the water table intersects the land surface. In general, the water table is a subdued reflection of the land topography (see [Figure 25](#)). The depth to groundwater ranges from zero at the fringes of lakes, streams, and wetlands to over 200 feet beneath the ridges in the driftless area. The shallow groundwater in Dane County forms several naturally occurring basins that either moves away from groundwater divides or flows towards these surface water bodies (see [Map 29](#)). Note that groundwater and surface water boundaries do not necessarily coincide. There are various places in the county where shallow groundwater can move horizontally beneath topographic divides and opposite surface water flow. This is particularly evident where pumping from the Madison metropolitan area has expanded the groundwater divides, thereby capturing more water from the Sugar River watershed in the southwest and the Maunasha and

Figure 25. General Aquifers in Dane County



Source: The Hydrogeology of Dane County, Bradbury, et al., 1999

Map 29. General Groundwater Flow



Source: Wisconsin Geological and Natural History Survey, 1995.

Koshkonong watersheds in the northeast. *High capacity municipal wells capture water from the deep aquifer often at the expense of smaller streams such as the Upper Yahara River, Starkweather, and Token Creeks.*

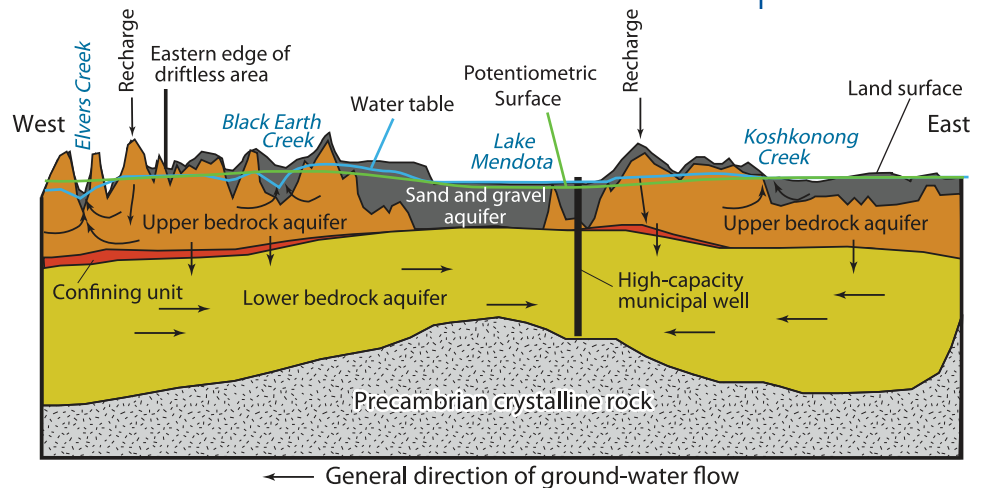
Groundwater in Dane County occurs in **three aquifers** (see **Figure 26**):

1. *Sand and gravel aquifer* that fills the buried bedrock valleys of major rivers and streams in the glaciated central and eastern parts of the county,
2. *Shallow sandstone and dolomite bedrock upper aquifer*, and
3. Deep Mt. Simon sandstone lower bedrock aquifer, underlying the Eau Claire shale aquitard confining layer.

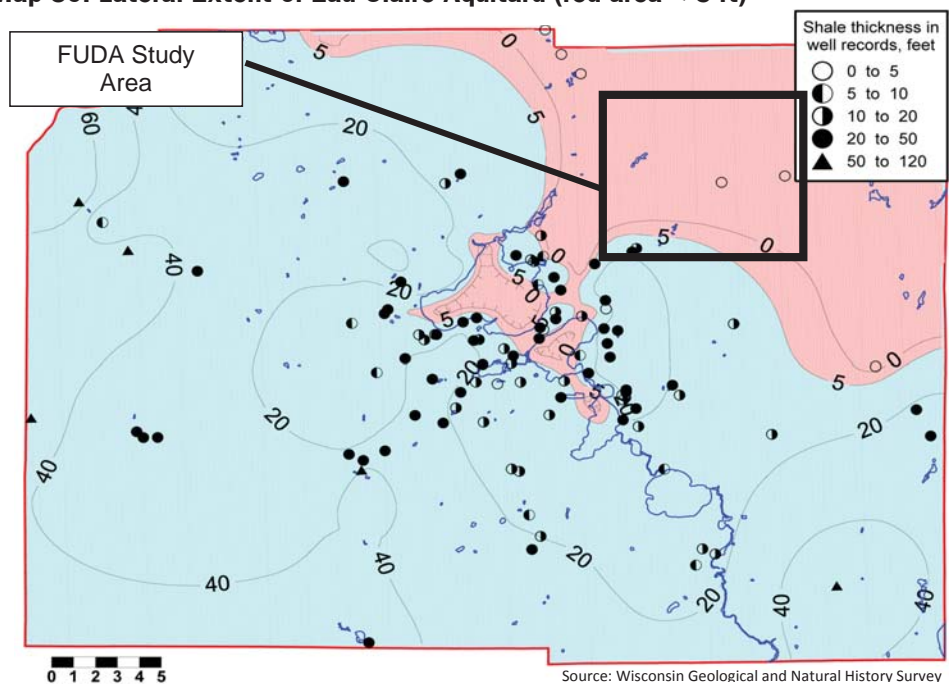
Unlike much of the county, the Eau Claire aquitard separating the shallow and deep aquifer systems is largely absent beneath the Yahara Lakes and in the northeast portion of Dane County (see **Map 30**). *This implies that shallow and deep aquifer systems are more directly connected where the confining layer is absent, and that the effects of high capacity municipal well water withdrawals can more easily propagate to the surface water systems.* These effects include declines in water table levels and reductions in stream baseflow.

Groundwater modeling and field studies by researchers suggests that streams and springs in the area are fed by both the shallow and deep aquifer systems with contributing areas in the uplands. **Map 31** and **Map 32** show the upper and lower groundwater flow patterns separately to better distinguish these two aquifers. Note that termination of up-

Figure 26. Groundwater Aquifers in Dane County



Map 30. Lateral Extent of Eau Claire Aquitard (red area < 5 ft)



per aquifer flow lines in the uplands in [Map 31](#) indicate recharge to the lower aquifer in [Map 32](#). Deep aquifer discharge to the upper aquifer near water bodies is not as apparent. With regard to the latter, general movement is southeast and east toward Lake Mendota. The Wisconsin Geological and Natural History Survey (WGNHS) has mapped several major springs in the Token Creek watershed (see [Map 33](#)):

- Culver Springs (2,700 gpm), Trout Springs (785 gpm), and unnamed springs (425 gpm) near the former millpond,
- Pederson Springs (>200 gallons per minute [gpm]) on Harbison Tributary,
- Big Hill Springs at the mouth of Pederson Tributary (10 gpm) and an unnamed spring on Token Creek east of USH 51 (50 gpm), and
- An unnamed spring on the East Branch of Starkweather Creek (500 gpm).

Other springs in the area are either less than 10 gpm or have gone dry.

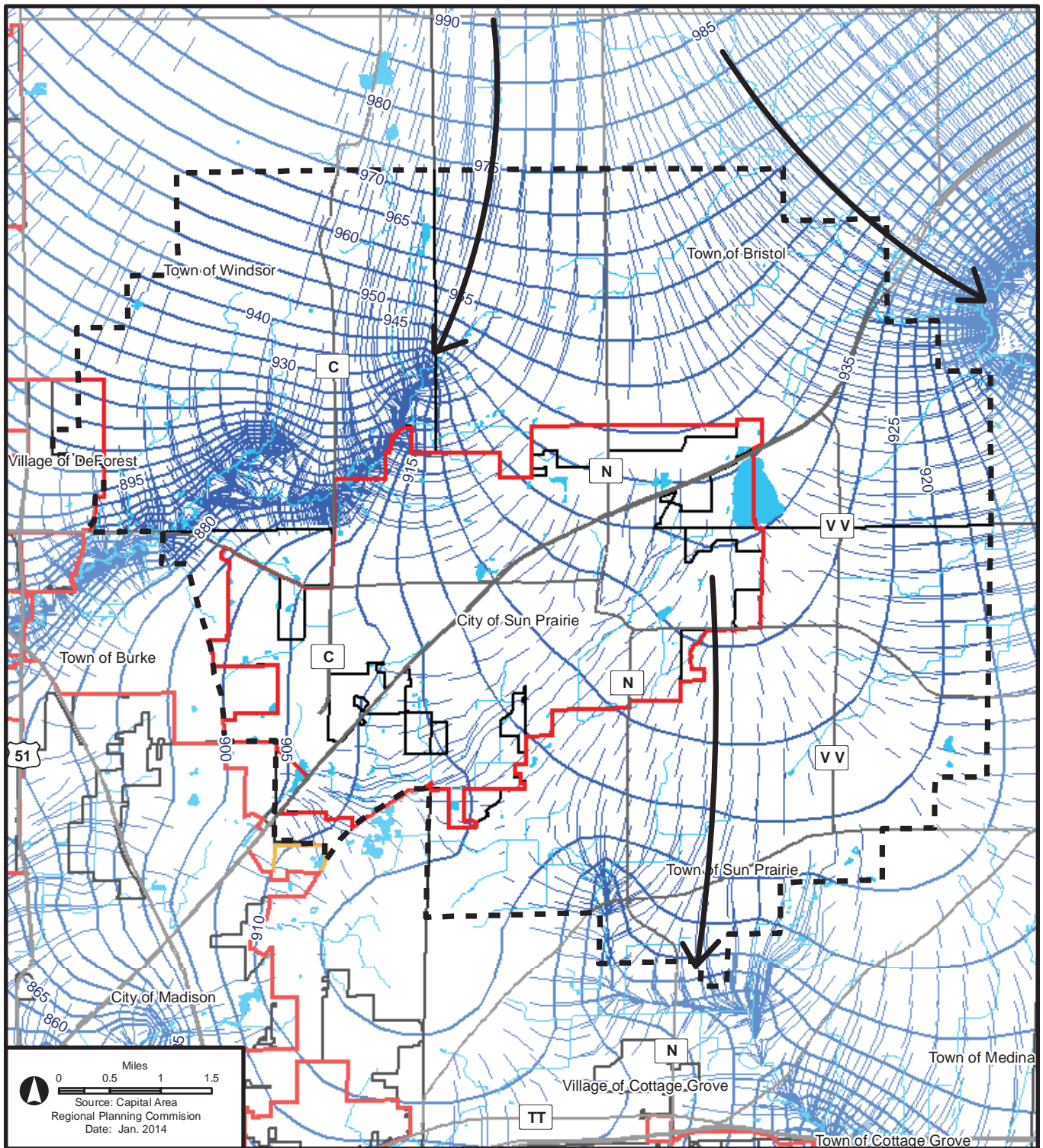
1. Groundwater Quality

Groundwater supplies nearly all of the water for our domestic, commercial and industrial uses in the Sun Prairie FUDA study area and Dane County overall. Once groundwater becomes contaminated it is very expensive and difficult to return it back to its original condition. Groundwater is also very important for providing baseflow discharge to wetlands and streams, especially during periods of dry weather. *Groundwater that is withdrawn and used in the Sun Prairie FUDA study area is, for the most part, recharged locally from infiltration of precipitation in the immediate area, thus it is especially important to protect groundwater quality.*

In rural areas, domestic water supplies are drawn from the upper sandstone and unconsolidated (glacial) aquifers (recall [Figure 20](#)). In urban areas, deep municipal wells draw water from the deep Mt. Simon aquifer. Shallow rural wells are at greater risk, compared to deeper municipal wells drilled hundreds of feet deep. Municipal wells are also tested often. While groundwater quality is generally good, there have been localized instances of contamination from nearby pollution sources, particularly in the upper or shallow aquifer affecting shallow rural wells. Water quality concerns include increases in nitrates, dissolved salts, and volatile organic compounds (VOCs). These also could affect the deep aquifer most municipal water supplies withdraw from, though the quality is generally quite high and safe for use. Urban residents receive annual Consumer Confidence Reports from their municipal suppliers required by the Federal Safe Drinking Water Act and U.S. EPA. The reports provide consumers with clear, concise, and accurate information about the quality of their drinking water. The City of Sun Prairie's most recent annual report do not show water quality violations.

Water supply concerns relate to potential increases in nitrates, pesticides, dissolved salts, and volatile organic compounds (VOCs), which could affect the deep aquifer from which most municipal water supplies are withdrawn. [Map 34](#) shows the 5, 50, and 100-year zones of contribution for Sun Prairie wells pumping at 2030 rates. These provide the technical basis for community Wellhead Protection Plans. Sun Prairie has developed a wellhead protection plan to guide development and prevent contamination of municipal wells.

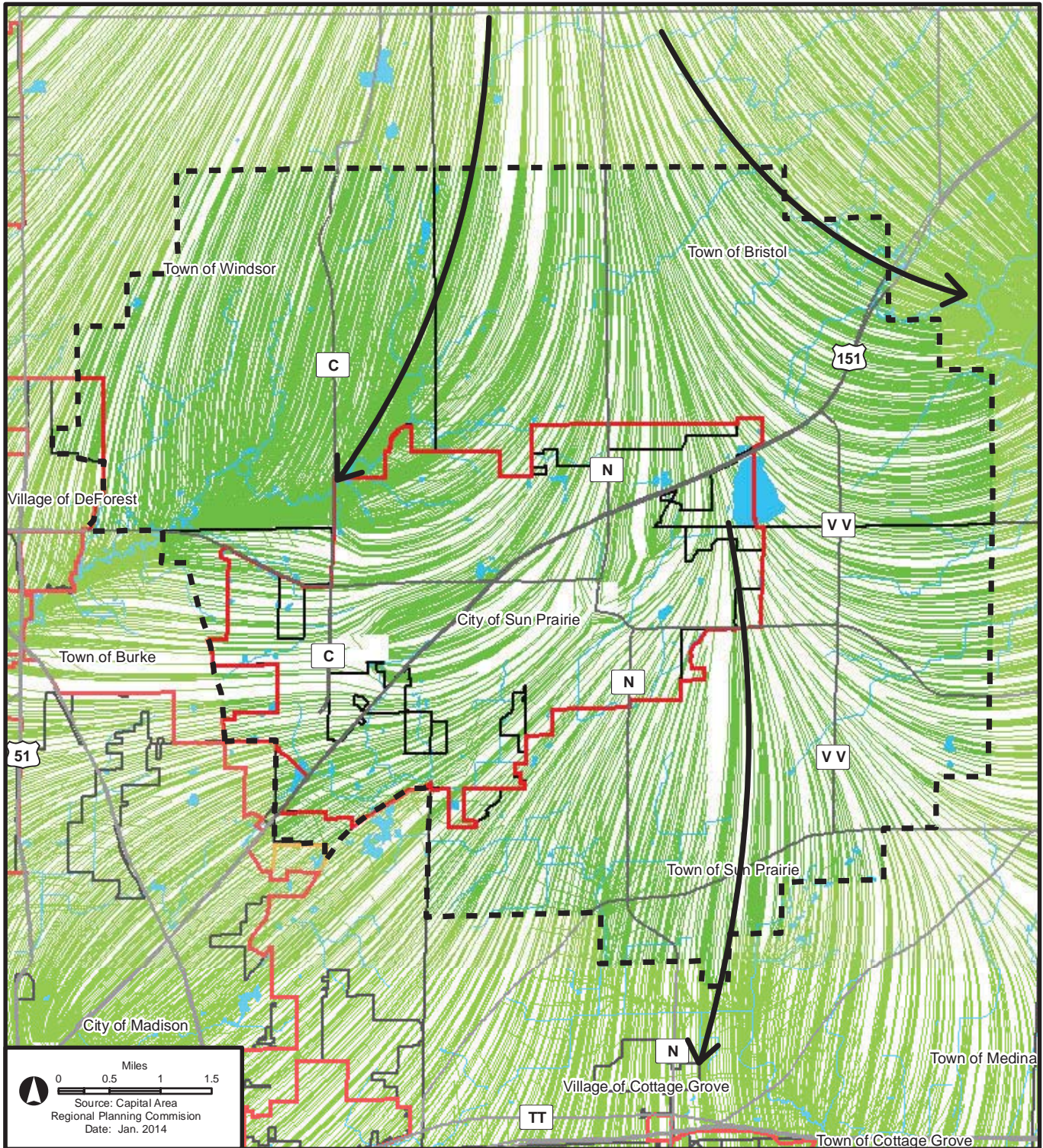
Map 31: Simulated Groundwater Flow (Upper Aquifer) Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Modeled Hydraulic Head (feet)
- Upper Aquifer Flow
- General Groundwater Movement

Similar to topographic contours, groundwater flows downhill or perpendicular to hydraulic head contours. Abbreviated flow lines indicate groundwater recharge/discharge to/from the deeper Mt. Simon aquifer. (Source: 2000 Regional Groundwater Model)

Map 32: Simulated Groundwater Flow (Mt. Simon) Sun Prairie FUDA, Dane County, WI

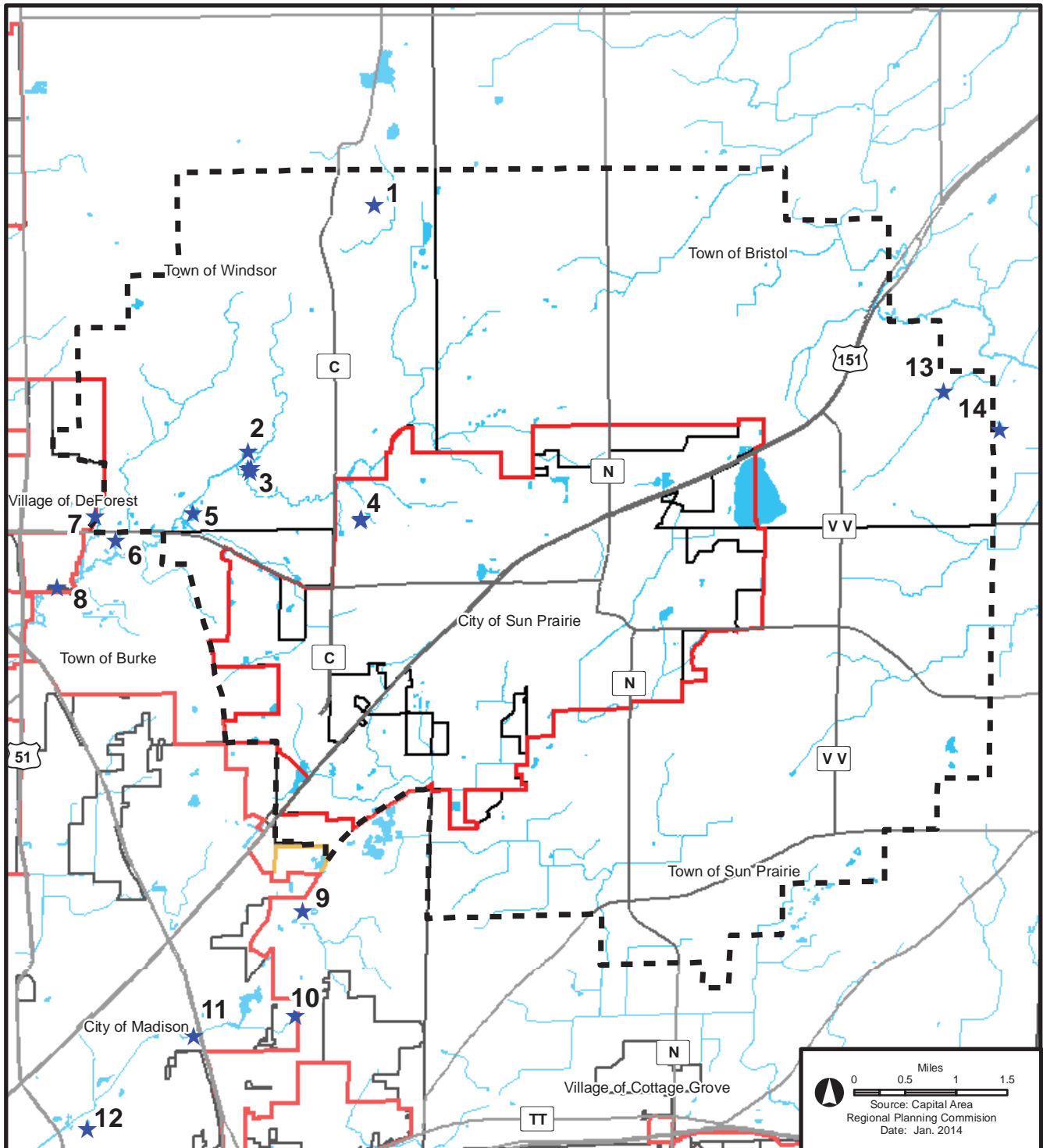


- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Mt. Simon Aquifer Flow
- General Groundwater Flow

Deeper Mt. Simon aquifer flow indicates more regional groundwater movement, often drawn to high capacity municipal wells (represented by white cells). (Source: 2000 Regional Groundwater Model)

Map 33: Springs

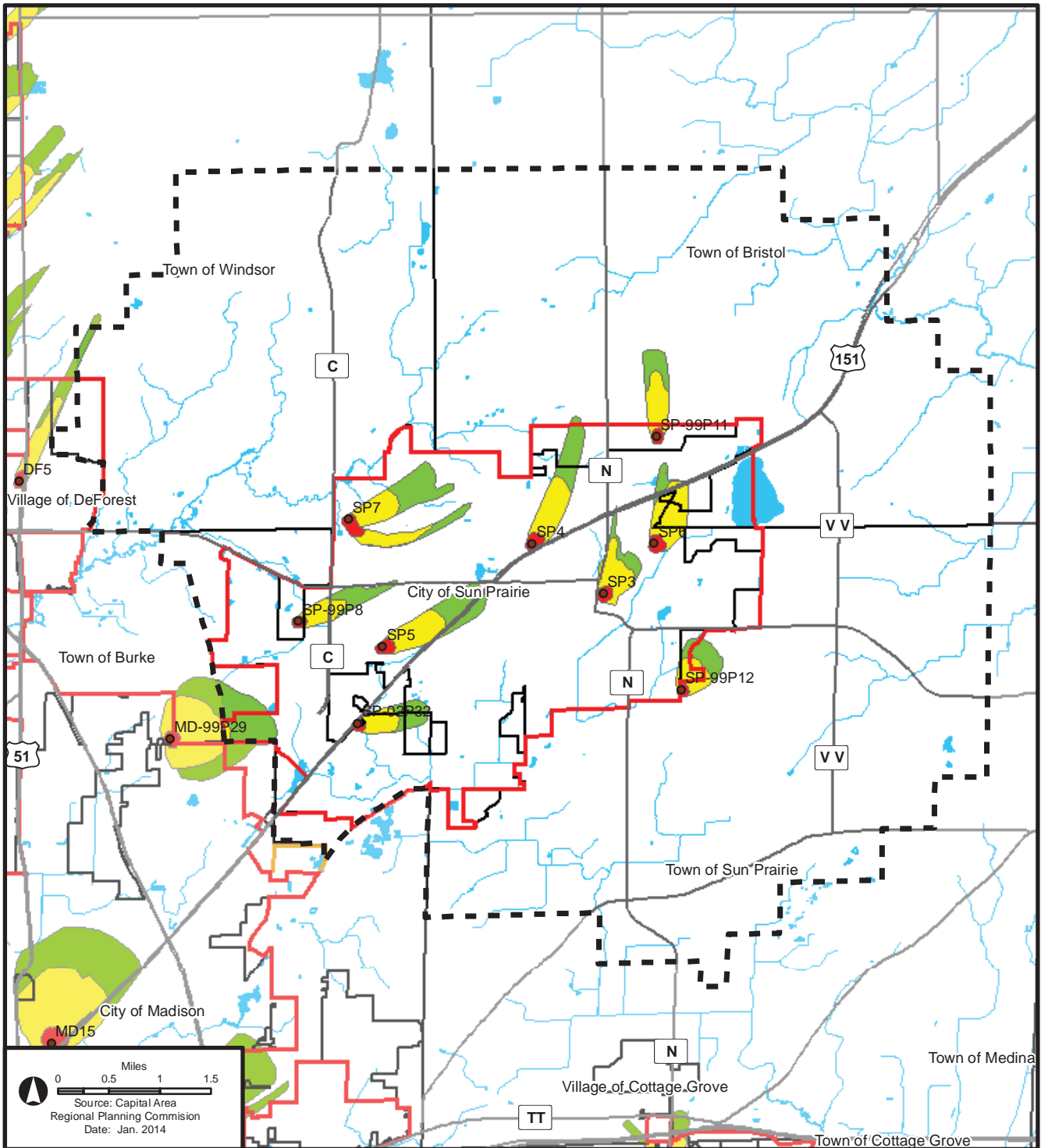
Sun Prairie FUDA, Dane County, WI



Urban Service Area	Municipal Boundary	1 - dry	5 - 785	9 - dry	13 - dry
Limited Service Area	Springs	2 - 2,700 gpm	6 - 10	10 - 5	14 - dry
		3 - 425	7 - >200	11 - 500	
		4 - dry	8 - 50	12 - 10	

Springs indicate areas of visible groundwater flow to surface water features. Groundwater discharge to a stream along its length may not be as readily apparent except by measuring its baseflow (i.e., streamflow during prolonged dry-weather periods). (Source: Wisconsin Geological and Natural History Survey)

Map 34: Zones of Contribution for Wells Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- 5-Year
- 50-Year
- Limited Service Area
- 100-Year

Zones of Contribution (ZOC) indicate the area contributing groundwater to a well for an assumed pumping rate and travel time. This simulation assumes projected 2030 pumping rates for communities based on 2030 population estimates spread evenly among both existing and planned wells. ZOCs provide the technical basis for communities in developing wellhead protection plans. Source: 2000 Regional Groundwater Model

2. Groundwater Quantity

Pumping and Diversion

Pumping or withdrawing groundwater from one location and then discharging it to another location can significantly alter the local ground and surface water balance. For example, MMSD diverts wastewater to Badfish Creek, short-circuiting the Yahara River system. A similar (although less extreme) diversion occurs when municipal well water is withdrawn from the Token Creek watershed in the City of Sun Prairie and subsequently treated and discharged to Koshkonong Creek.

As part of the Dane County Regional Hydrologic Study (DCRPC, 2004) groundwater modeling was conducted to estimate the impacts of high capacity municipal well water withdrawals. *These impacts can be particularly pronounced in urban areas where concentrated pumping of groundwater lowers the water table, reducing base flow contributions to streams and lakes.* **Map 35** shows declines from year 2000 pumping by 45 feet on the east side of the Madison metropolitan area. **Map 36** shows the projected 2030 water table declines.

According to modeling, baseflows are 13% lower in Token Creek, and 45% lower in the Yahara River compared to pre-development conditions (no pumping) (see **Table 13**). Baseflow is expected to fall to zero in the East Branch Starkweather Creek and Upper Koshkonong Creek due to future well withdrawals. **CARPC recommendations for new Urban Service Areas encourage water conservation and infiltration measures to mitigate these reductions.**

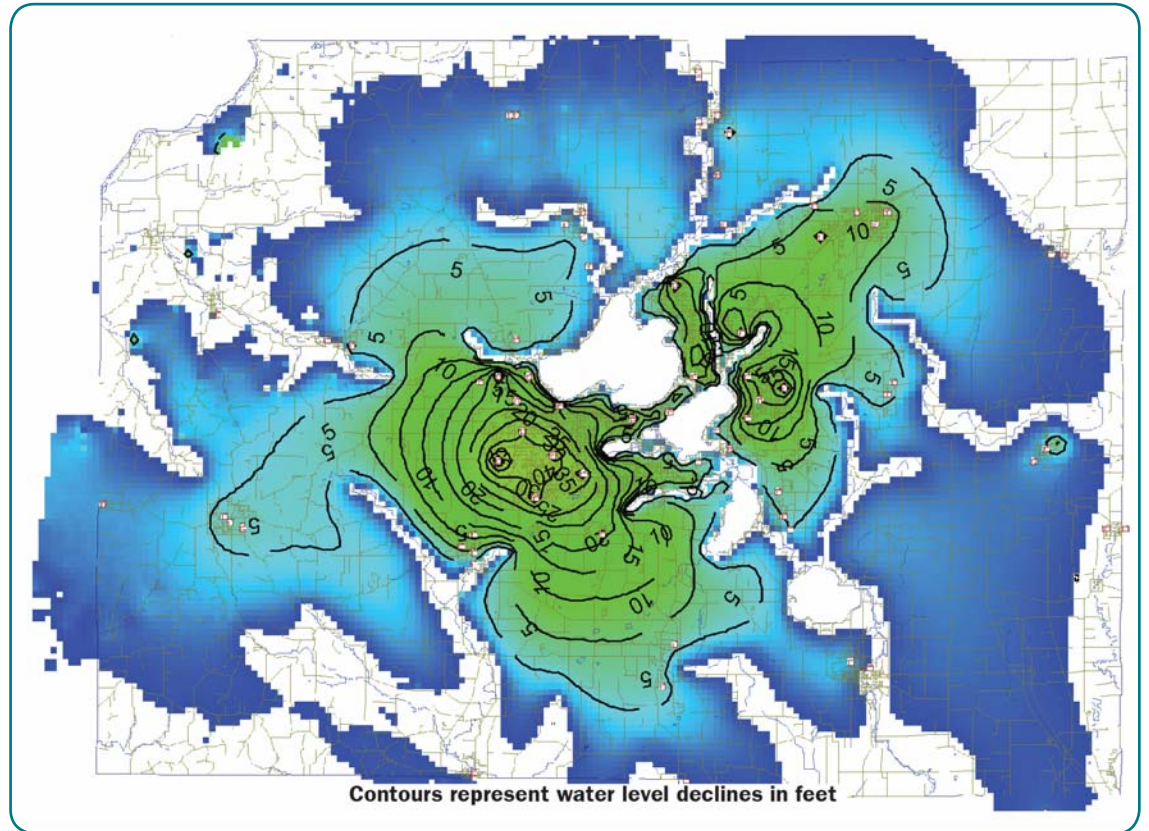
Table 13. Simulated Stream Baseflows for Selected Streams in Dane County (cfs)

Station	Pre-Development Cfs	2000 cfs (% reduction)	2030 cfs (% reduction)
Token Creek	23.09	20.11 (13%)	17.94 (22%)
West Br. Starkweather Creek	5.44	0.60 (89%)	0.57 (90%)
East Br. Starkweather Creek	2.10	0.30 (86%)	0 (100%)
Koshkonong Creek @ Bailey Rd	0.95	0.24 (25%)	0 (100%)
Mauneshia River @ USH 151	2.48	2.10 (15%)	1.68 (32%)
Yahara River at McFarland	127.28	70.00 (45%)	54.21 (57%)

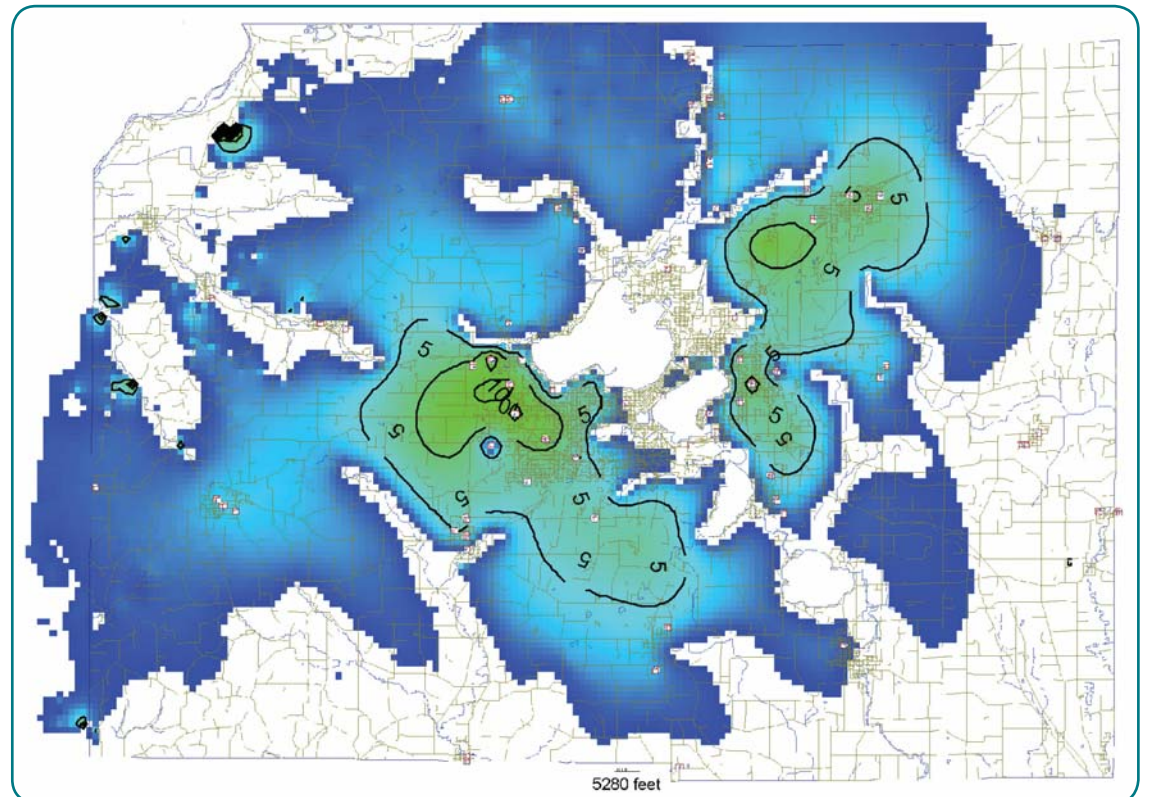
Source: DCRPC 2004

Recognizing the cumulative impacts of well withdrawals on sensitive water resources, the Village of DeForest and the WDNR entered into a *Memorandum of Understanding (MOU) in 2004 "Regarding the Use of New and Existing Wells and Their Impact on Token Creek and Other Area Surface Waters."* In the MOU the Village agrees to take all reasonable management steps to limit the impacts of their well system on Token Creek. For example in accordance with the MOU, DeForest Well No. 5 will be used minimally on a daily basis and as needed for fire emergencies or system maintenance. Token Creek Well 1, in the south side supply area, would be pumped 0.144 mgd. Total projected 2035 withdrawal from the south supply area is estimated to be 0.414 mgd. **Likewise, the City of Sun Prairie should investigate and take all reasonable management steps to limit the impacts of municipal well withdrawals on Token Creek.**

Map 35. Simulated Water Table Drawdown, 1990-2000



Map 36. Simulated Water Table Drawdown, 2000-2030



Groundwater Recharge Loss

With the expansion of urban areas typically comes an increase in impervious areas covered by roads, roofs, and parking lots. *The increase in impervious surfaces in the absence of active stormwater infiltration practices can substantially reduce natural groundwater recharge through the ground.* While there is no critical shortage of groundwater available for future supply needs, this clear and cold groundwater flowing from numerous springs, seeps, and baseflow discharge does provide an extremely important source of water for maintaining the health and well-being of our surface water resources. **Map 37** shows natural groundwater recharge rates for the study area.

Precipitation that soaks into the ground recharges groundwater supplies and discharges to streams keeping water temperatures low, and enhancing water oxygen levels. This favors habitat for fish and other sensitive aquatic species. Alternatively, precipitation that typically runs off the land surface picks up pollutants along the way, requiring extensive stormwater quality treatment. **Additional runoff volumes, if not controlled, can also result in higher stream flows, and if allowed to continue and accumulate, can cause extensive stream bed and bank erosion and contribute to habitat damage.**

Relative Infiltration

A key modern stormwater management strategy is to infiltrate as much rainfall and snow-melt into the ground as possible to reduce overland runoff and replenishing groundwater supplies. Maps 38, 39, and 40 show various opportunities for minimizing impacts from future development and retrofit previously developed areas where opportunities permit.

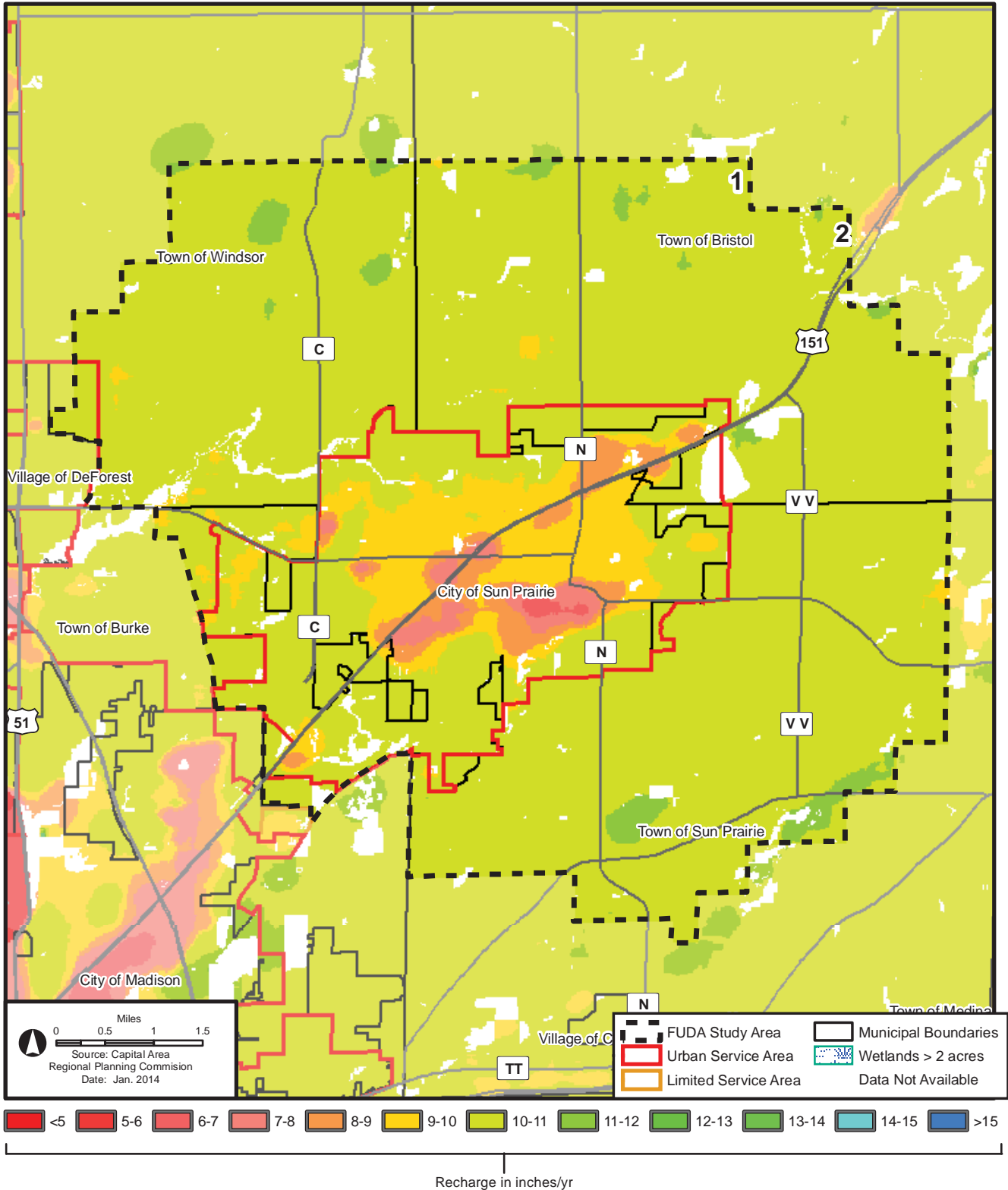
The distinction between infiltration and recharge should be clarified. Whereas all precipitation that reaches groundwater is infiltrated into the soil, not all infiltrated precipitation actually makes it all the way to recharging groundwater supplies. Some of it may be captured by plants and evaporated or transpired back into the atmosphere. **Areas with naturally high infiltration should be used to recharge groundwater to the greatest extent practicable.**

Map 38 indicates medium infiltration areas within the study area. Runoff generated in these areas could be reduced through rain gardens and low impact design. Modeling by Dr. Kenneth Potter at UW-Madison provides important insight into the beneficial aspects of rain gardens. He theorized that over 90% of the annual runoff can be infiltrated into the ground by using a rain garden sized only 10% of the impervious area draining to it (see **Figure 27**). The optimum area ratio is between 10%-15% before experiencing a rate of diminishing return. In this manner, infiltration rates in rain gardens can be designed to exceed natural infiltration rates, helping to make up lost infiltration caused by development and groundwater depression caused by well withdrawals. Stormwater runoff rates and volumes are lowered through infiltration practices. Reducing runoff prevents damage to streams and reduces pollutant loads into area waters. Rain gardens are one of many options available for increasing infiltration.

Planning Considerations

- Investigate and take all reasonable management steps to limit municipal well withdrawal impacts on Token Creek and Cherokee Marsh.
- Identify locations best suited for preservation for active and passive groundwater recharge.
- Use every opportunity to infiltrate rainfall runoff to recharge the groundwater.
- Increase water conservation with low flow fixtures and rainwater harvesting.

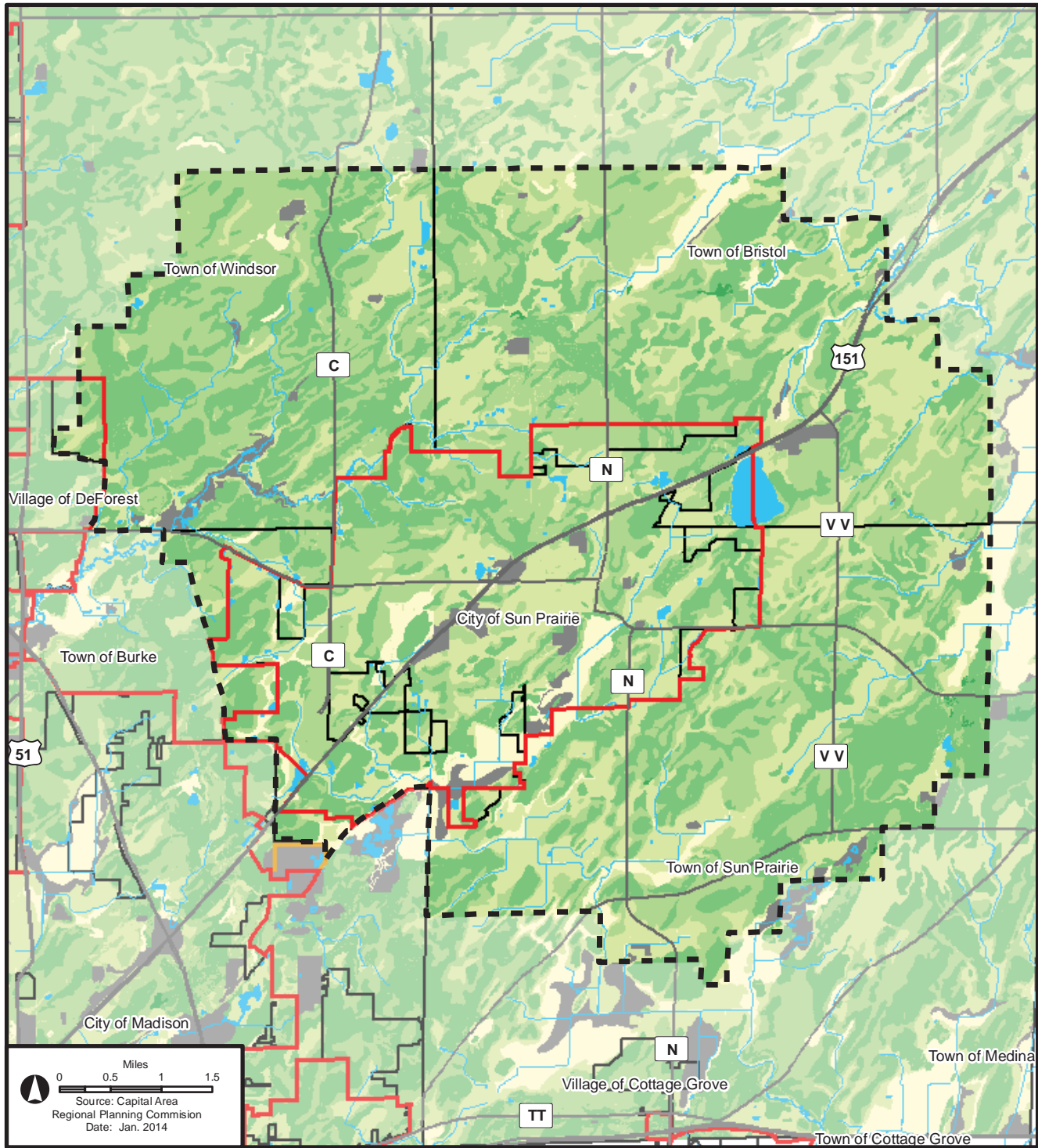
Map 37: Groundwater Recharge Sun Prairie FUDA, Dane County, WI



Precipitation that soaks into the ground and recharges the groundwater, eventually discharges to streams and other water bodies, helping keep water temperatures low and enhancing oxygen supplies. This favors habitat for fish and other sensitive aquatic species. Development without mitigation measures can disrupt the ground/surface water balance resulting in less recharge and more stormwater runoff.

Map 38: Relative Infiltration -- Natural Conditions

Sun Prairie FUDA, Dane County, WI

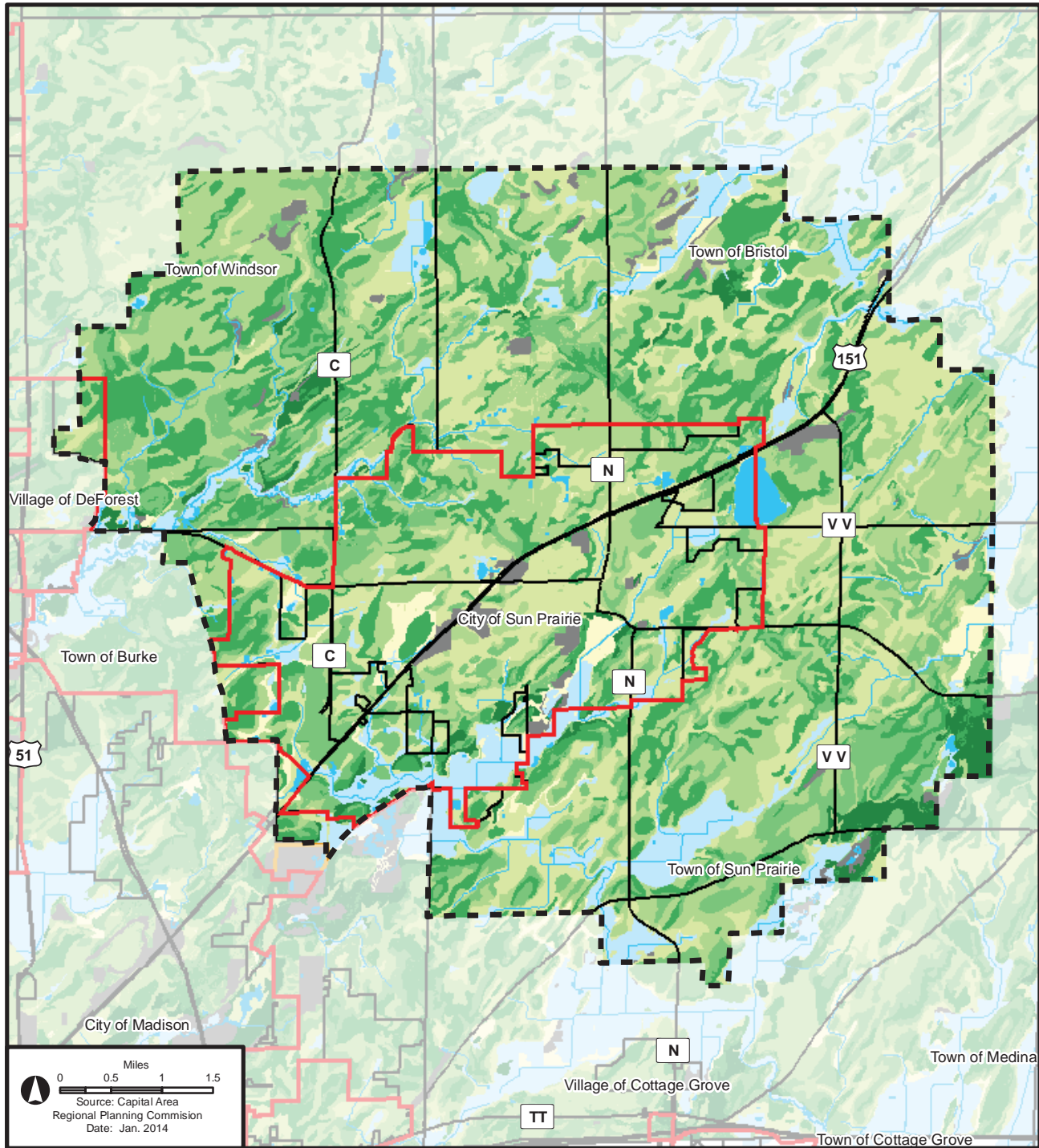


FUDA Study Area	Municipal Boundary	High	Medium	Low
Urban Service Area				
Limited Service Area				

Relative Infiltration

Areas with naturally high infiltration should be used to recharge the groundwater. They may also be prime locations for regional infiltration facilities that could be used for recycling treated water and to infiltrate stormwater generated in other parts of the watershed. Wetland and floodplain areas are generally not conducive to infiltration practices.

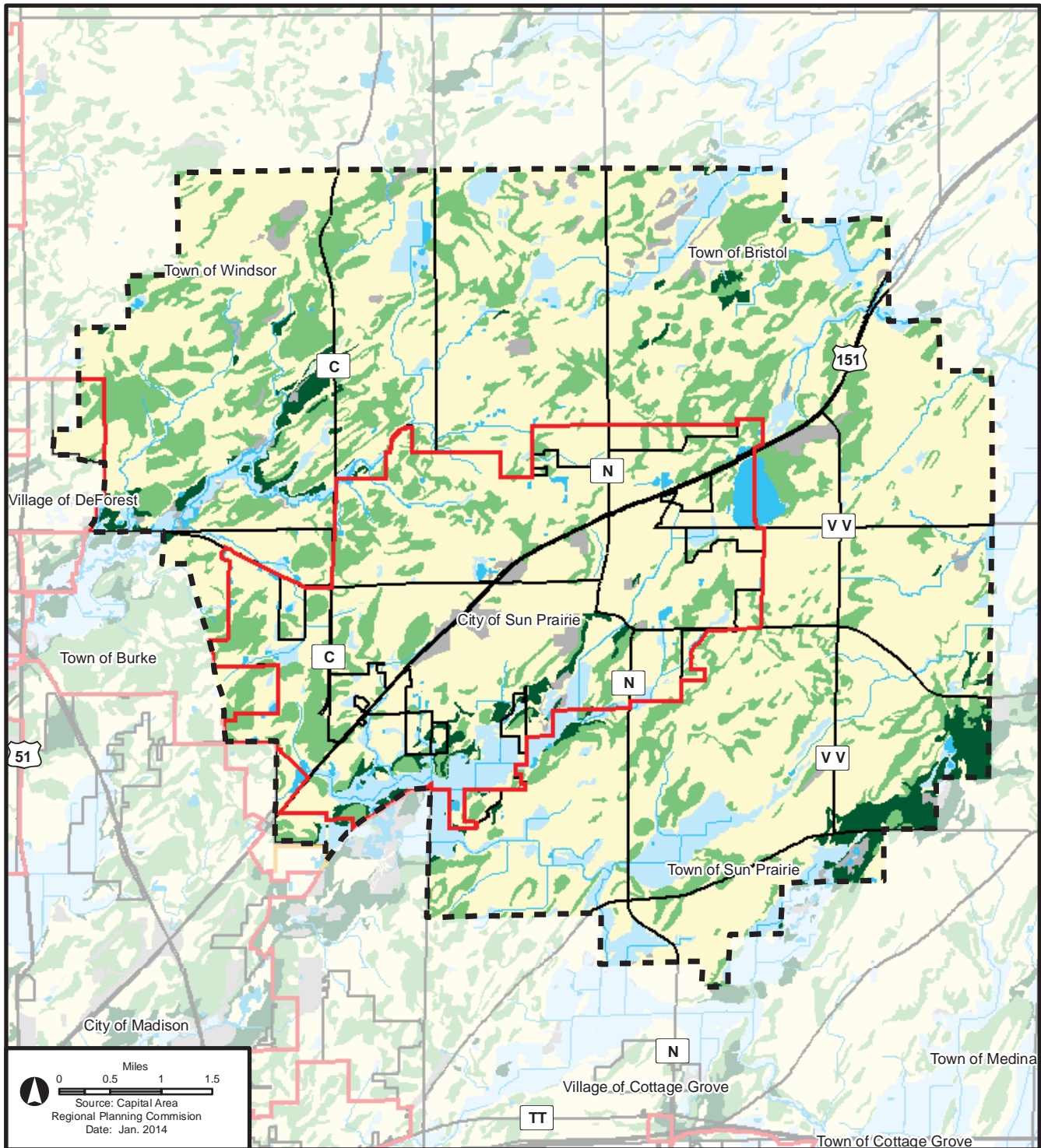
Map 39: Relative Infiltration -- Engineered Conditions Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary							Variable
Urban Service Area	Wetlands/Floodplain	High Medium Low						
Limited Service Area		Relative Infiltration						

Infiltration can be enhanced by removing shallow layers of low permeability soils and tapping into deeper sand and gravel deposits. The use of engineered soils can enhance natural infiltration and enhance the opportunities for infiltrating stormwater. There may also be enhanced opportunities or improvements that could be gained by retrofitting previously developed areas.

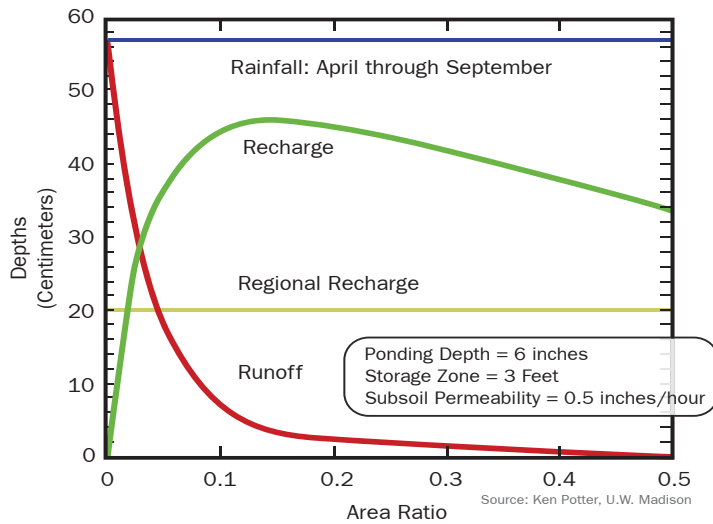
Map 40: Relative Infiltration -- Potential for Enhancement Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Urban Service Area
- Wetlands/Floodplain
- Limited Service Area
- High
- Medium
- Low
- Variable

This map indicates where infiltration enhancement potential may be the greatest. These areas highlight opportunities where more permeable soils (e.g., sand and gravel deposits) may be present deeper in the soil column. These may be ideal locations for regional stormwater facilities that could be used to infiltrate stormwater generated in other parts of the watershed.

Figure 27. Rain Garden Simulation



practices. There may also be opportunities for retrofitting previously developed or re-developing areas.

Map 40 shows where the potential for enhancing infiltration may be the greatest. These areas show the greatest improvement in infiltration capacity between the natural and engineered states. **Overall, there are many opportunities for enhancing infiltration throughout the study area.**

The purpose of these maps is to highlight these areas as important elements of site design, so that they may be more fully utilized for water quality protection and groundwater recharge, early in the planning process. While the maps do not replace the need for more in-depth analysis for a particular site, they are a useful planning tool for incorporating innovative stormwater management practices into development designs.

D. Open Space Corridors

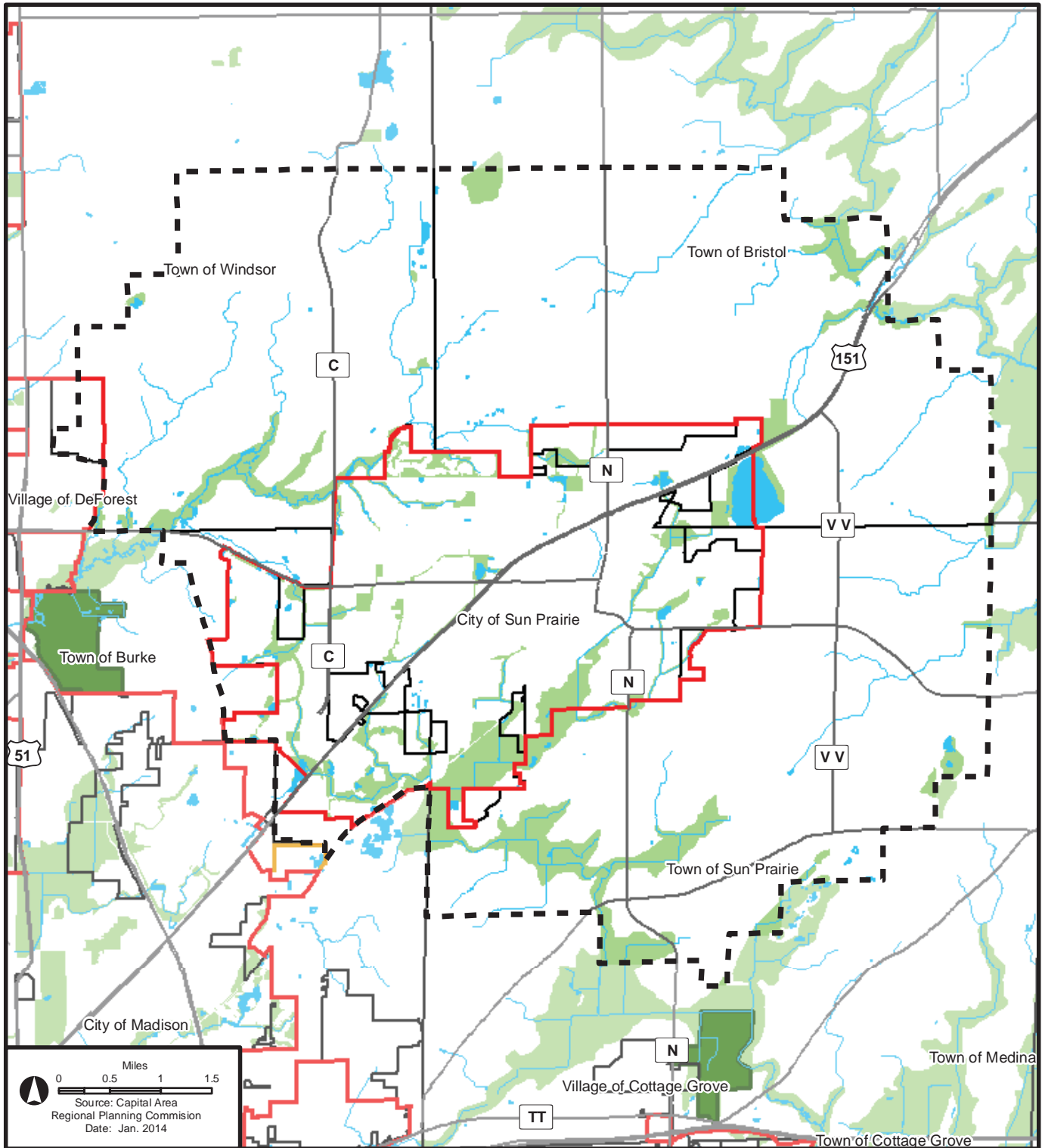
An *open space corridor* is defined as a water feature(s) and the riparian land that contacts with the water through flooding or soil saturation, and can include upland areas (see **Map 41**). Open space corridors promote protecting water quality and habitat for fish and wildlife, and recreational pursuits.

The Sun Prairie study area does not have many opportunities to create continuous open space corridors that will link large and important habitats to one another. Most of the natural resources within this range are severely degraded small and isolated habitat patches. The three ecosystems of quality, Token Creek, Patrick Marsh, and a large prairie resource in the northern study area, are distant from one another and lack natural cover or landform that could link them. Riparian areas link riverine and terrestrial systems and make each more ecologically productive. Riparian areas also serve as habitat for both terrestrial and aquatic species. Nutrients from aquatic areas help support vegetation in upland commu-

Map 39 presents enhanced infiltration that could result from engineering practices tapping into deeper sand and gravel deposits. Significant opportunities exist within the study area. **These may be prime locations for regional infiltration facilities** that could be used for water recycling and to infiltrate stormwater generated in other parts of the watershed. Groundwater quality protection measures should also be considered. For example, directing clean rooftop runoff to infiltration trenches and basins would be one way of dealing with this, and engineered soils (e.g., mixtures of sand, clay, and compost) to filter out pollutants, maintaining adequate separation distances to groundwater, along with a whole host of other engineering and conservation design

Map 41: Open Space

Sun Prairie FUDA, Dane County, WI



Based on the Regional Development Plan

nities, and this vegetation acts as a filter strip to help protect water quality and prevent upland sediment and associated pollutants from washing into streams.

The Open Space Corridors shown on the Regional Development Plan Map include two distinct components that provide a continuous countywide network of open spaces and environmental resources:

Environmental Corridors within urban and limited service areas, provide the basis for a continuous open space system based on natural features and environmentally important lands such as streams, lakes, shorelands, floodplains, wetlands, steep slopes, woodlands, parks, and other publicly owned lands.

Resource Protection Areas in rural areas (outside urban and limited service area boundaries) are based primarily on floodplains, wetlands, and shoreland areas, along with publicly owned lands. These areas face considerably less development pressure than their urban counterpart.

Environmental Corridors were originally developed to protect sensitive aquatic features from urban development activities that degrade water quality. They were intended to provide a basic skeleton network of connected natural areas that can be expanded through local initiative. The 75-100-foot vegetative buffers are generally inadequate for protecting habitat, biodiversity, and ecosystem sustainability, which require 150- to 250-foot buffers. These concerns have emerged more recently. This is not a significant problem inasmuch as more needs to be done. Intergovernmental, long-term planning offers the opportunity to capture and address these broader concerns. With this in mind, more information and discussion are provided in this section about natural resource impacts from urban development.

1. Riparian Areas and Their Restoration

The riparia is the land that is adjacent to streams and rivers. Riparian vegetation is essential to stream ecosystem function at both stream reach and watershed scales. These areas provide water quality, channel stability, sediment retention functions, and habitat to both aquatic and terrestrial organisms.

Although the amount of land in the riparian area constitutes only a small amount of the total land in the watershed, it has considerable value for both water quality and the overall life-cycle needs of organisms. For example, trees and shrubs along the river help shade the stream from the sun and keep water temperatures low. Logs and branches that fall into the stream provide a suitable place for insect larvae, an important food source for fish. These logs, along with the vegetation that overhangs the stream channel, provide hiding places and shelter. In addition, leaf litter from trees and shrubs in riparian areas provides nourishment for insects and other stream organisms. Vegetation also provides stabilization for stream banks with intermingling plant roots. Riparian trees dissipate the kinetic energy from floods and improve soil infiltration through increased soil porosity and improving capillary action.

Conserving riparian areas in upslope ecosystems, upstream systems in steep hills, is impor-

tant for controlling sediment. These areas never achieve static equilibrium and lose sediments in episodic events, mostly during precipitation. Maintaining wide riparian vegetation in these steep areas will be essential for two reasons. First, steeply sloped areas, particularly sites found on the outside bends of stream meanders, are not conducive to growing extensive vegetation, this suggests the importance of having wide riparian buffers to control flows through these areas, and second, precipitation increases due to global climate change will likely make these areas more prone to erosion in the future.

Throughout Dane County, there are three major invasive species that impair riparian function: reed canary grass, willows, and cottonwood trees. Reed canary grass constricts flow in watercourses and increases evapotranspiration. The invasive grass has a profound impact on habitat structure as it out competes native plant species and prevents regeneration of saplings that later contribute woody debris leaf litter inputs and shade for fish. When willows grow in high densities, they also produce monotypic stands and hamper species diversity. When this species propagates throughout riparian areas, it reduces stream discharge rates. In southern France, when these pioneer trees grew along the River Ouvèze, it caused the mean stream width to decrease by nearly half. This reduced the stream capacity and eventually lead to devastating floods in 1992. Cottonwood trees negatively impact woody debris budgets into streams. These trees grow faster than native trees, and have brittle wood and weaker root structures. These trees are more susceptible to falling from wind or storms. Excessive woody debris inputs into streams will cause it to widen, resulting in warmer streams and greater deposition of fine sediments. These fine sediments, in turn, remove the small interstitial spaces between river stones, that serve as macroinvertebrate refugia and reproductive sites for some fish.

When planning for riparian restoration it is important to consider that riparian areas shift and change as streams meander throughout time. ***Buffer widths should include this meandering and anticipate changes.***

Remember to consider future climate change stressors in riparian restoration. Global climate change models predict increased severity and frequency flooding and droughts. Considering ecological resilience, or the ability for an ecosystem to rebound after stress and remain adaptable to future change, is important for designing ecological restoration plans. With global climate change and expanding human populations, it will be necessary to consider if current standards for riparian protection will be sufficient in future years. Research indicates that riparian vegetation are well adapted to climate disturbances and may be more resilient than upland habitats. ***When possible, it may be prudent to expand buffers beyond 100 feet to increase resilience and redundancy in riparian ecosystems*** (for more detail on potential approaches see the concept of “core habitat” on page 144).

Riparian restoration, like wetland and stream restoration, need cooperation from multiple landowners to be effective. Restoration across private lands is important for maintaining connectivity, size, and quality of riparian habitat. There are governmental funds available for riparian restoration. Many of these riparian programs are also under the same granting agency as wetlands. Some of these include the Wildlife Habitat Incentive Program (WHIP), the Conservation Reserve Program (CRP), and the Environmental Quality Incentives Program (EQIP). Riparian restoration in agricultural settings may be less appealing to full time farm-

ers on larger plots than part time farmers with smaller plots. The Maryland Department of Natural Resources found higher landowner participation in the installation of forested buffers from small scale farmers who did not receive a majority of their income from horticulture. Farmers of larger tracts of land, who earned more of their income from agriculture than animal husbandry, were more likely to install grass buffers instead of forested buffers.

Ultimately, despite the ability of riparian areas to control overland flows to streams and rivers, *riparian conservation cannot be a substitute for good catchment management and land use practices. These areas can be further integrated into broader buffers for park and open space purposes to enhance wildlife habitat and support “core habitat” concepts outlined on page 144.*

The Sun Prairie study area has one major riparian area of interest, the riparia of Token Creek. Riparian vegetation around Token Creek has the potential to be the most valuable resource for wildlife outside of Cherokee Marsh. This location, and the wetlands connected to it, serve as a major natural corridor to Cherokee Marsh, and likely facilitates movement of some bird and small mammal species entering into Cherokee Marsh. This riparian/wetland complex and the woodland patches found along the edge, appear to be large enough habitat for resident bird and small mammal species. *It is recommended that all woodlands, adjacent to Token Creek be preserved from development in their entirety*, as they are the primary habitat for organisms that reside along Token Creek.

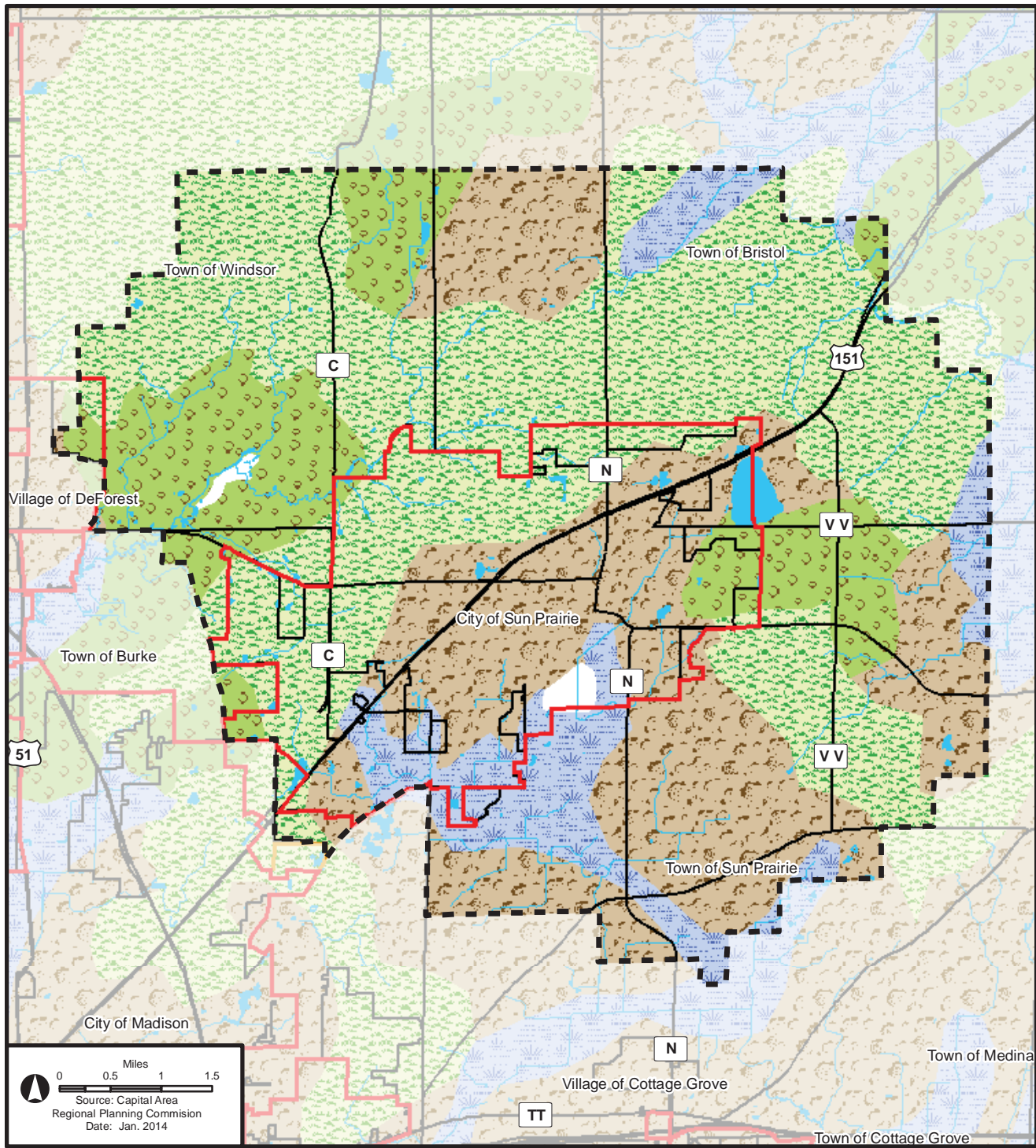
Despite its value, the Token Creek riparia does have some major conservation issues. Reed canary grass exists throughout its length and into the adjacent wetlands. As described previously, the presence of this invasive impairs multiple ecosystem functions by limiting leaf litter, woody debris, and habitat values. Although this invasive plant stabilizes the contours of the landscape, it makes streams more prone to downcutting bank erosion. This type of erosion changes the stream channel and reduces its floodplain connectivity leading to high discharges during storm events.

E. Endangered Resources

Before Europeans arrived, south central Wisconsin was mostly open country dominated by prairies and oak savannas (see [Map 42](#)). Grasses, wildflowers and widely scattered oaks were the principal vegetation. Low, poorly drained areas contained extensive marshes, sedge meadows, and wet prairies. For millennia, fire checked the growth of forests and kept the landscape open. Fires were probably ignited by native Americans or naturally occurring by lightning. Areas that burned often and contained few barriers to the spread of fire (such as lakes, rivers, and marshes) were usually treeless prairies, rich in grass and forb species. Areas that burned less frequently developed into oak savannas and woodlands. Like the prairie, these oak communities contained a high diversity of grass and forb species. Burr oaks and white oaks were the dominant trees since their thick bark protected them from fire. Areas protected from fire, usually on the leeward sides of lakes and major rivers, developed into sugar maple-basswood forests.

Following European settlement, wildfires sharply diminished and eventually halted. No longer suppressed by fire, oak seedling sprouts grew rapidly and formed closed-canopy oak for-

Map 42: Presettlement Vegetation Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Urban Service Area
- Limited Service Area
- Oak openings -- bur, white, black
- Oak -- white oak, black oak, bur oak
- Marsh and sedge meadow, wet prairie, lowland shrubs
- Prairie

The presettlement vegetation cover data was digitized from a 1976 map created by Professor Robert Finley from land survey notes written in the mid-1800s when Wisconsin was first surveyed. This vegetation cover map can be used to identify regional changes in land cover since the time when the state was first surveyed. This data is not intended for landscape-scale analysis.

ests within a generation. Eventually fire-sensitive hardwoods, like maples, ashes, elms, and hickories began spreading and displacing oak trees. Lands that were prairies or savannas are now mostly wooded, farmed, or built upon.

According to WDNR, only 0.5% of the original area covered by prairie and only 0.01% of the area covered by savanna in Wisconsin still exists (WDNR, 1995). Ecosystems originally rich in plant and animal species have degraded through structural changes to habitat and subsequent loss of plant and animal species. This is the result of widespread land clearing for agriculture and development, stormwater runoff, wetland drainage, river and stream channeling, invasive species, and extensive ecosystem fragmentation. Only relatively recently have serious efforts been taken to protect and restore these resources. The Sun Prairie FUDA study area contains a diverse array of streams, wetlands, woodlands, and grassland habitats that support numerous wildlife species, and some may be either threatened or endangered.

Plant community structure is the fundamental building blocks of ecological landscapes and determines zoological diversity and drives ecosystem function. Native communities are valuable and vital component of sustaining biodiversity. Undisturbed native communities allow for rare species needing specific habitats. Rare species and unique natural communities are often good biological indicators of significant areas and ecological functions.

Termed “Endangered Resources,” such resources indicate where significant or vulnerable ecological areas exist. The presence of one or more rare species and natural communities is an indication of ecosystem health and importance. **Such areas should prompt attention toward species conservation, management, and restoration needs.**

The WDNR Bureau of Endangered Resources (BER) maintains the Wisconsin Natural Heritage Inventory (NHI), a statewide database representing the known occurrences of rare species and natural communities. **Map 43** shows generalized occurrences of endangered resources in the Sun Prairie FUDA study area. This information is confidential and is not subject to Wisconsin’s open records law. While publication of the species’ locations cannot be made to resource managers, the NHI can determine the likely occurrence of rare species in areas affected by development or other land management activities. This information can be incorporated into development designs. Note the NHI is not a complete catalogue of the locations of the state’s rare species. Users must recognize that many areas of the state are not inventoried, thus making distribution maps incomplete. Thus an “absence of evidence is not evidence of absence,” nor does the presence of one occurrence imply that other occurrences have been surveyed for but not found.

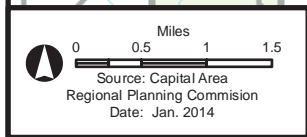
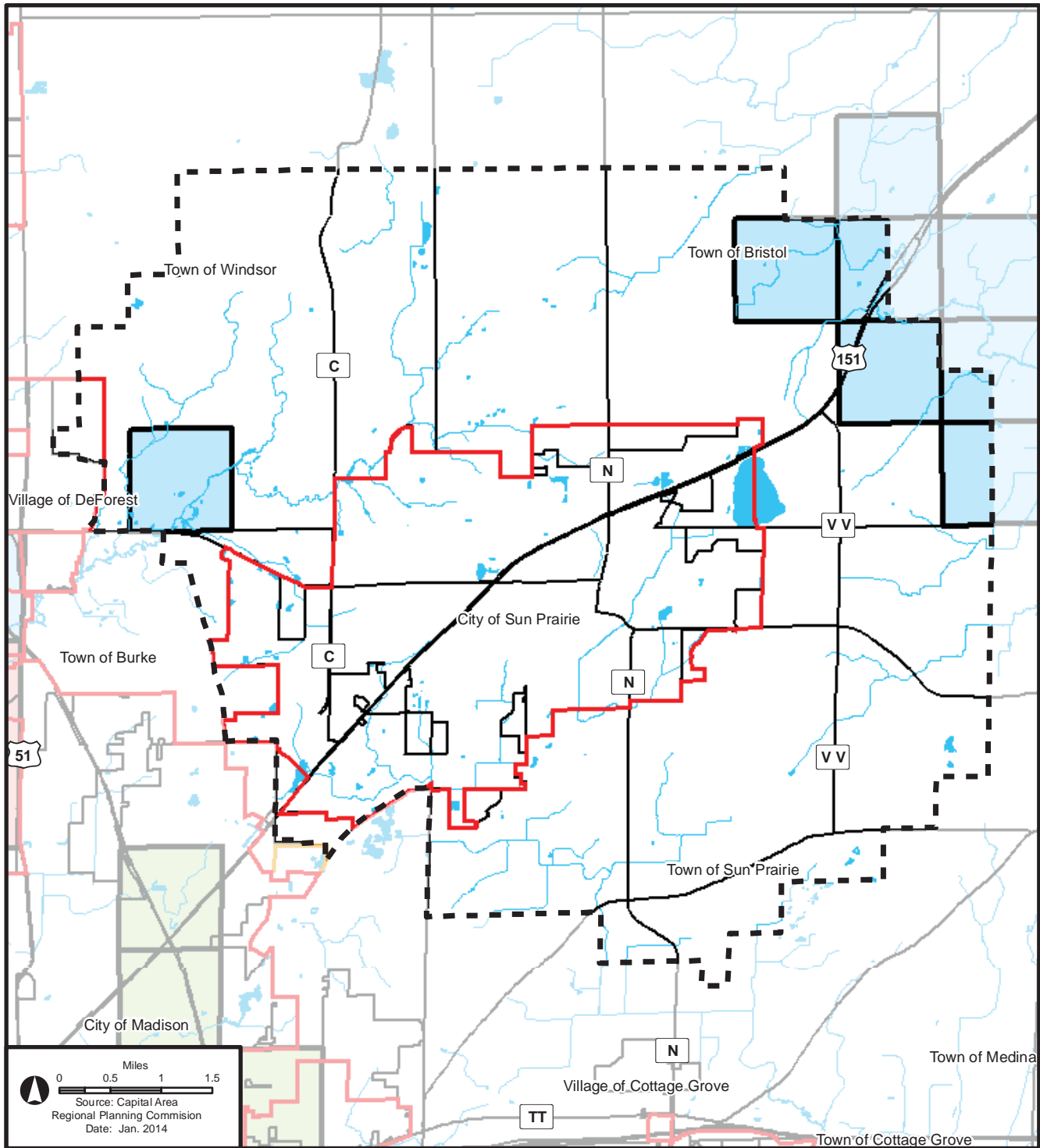
The typical screening review procedure entails querying the database for a particular area. The results list any known occurrences in the search area and one mile buffer (two miles for aquatic species). If a known occurrence is found within the search area or buffer, then the search area is evaluated for habitat representing that particular species or community. If absent, the species is not likely to exist. If present, a field survey may be warranted to assess the suitability of the habitat and whether or not individual species may be present.

Planning Considerations

Look for opportunities to protect habitat for threatened and endangered species in public parks and nature preserves.

Map 43: Endangered Resources*

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Aquatic
- Terrestrial
- Both

*Threatened and Endangered Species and/or Natural Communities, identified at the section level.

This map shows the generalized location of endangered species by the section. More specific information is confidential and can be obtained by contacting CARPC or DNR Endangered Resources staff. Information is available to help minimize the impact of development for these species, depending on what is being planned.

Since occurrences are generally site specific, the following information can be used as a guide in determining whether or not suitable habitat may exist in a particular area. *If so, a more detailed review should be conducted by knowledgeable professionals and, depending on the occurrence, BER staff should be consulted for any specific actions that should be taken.* Finding a threatened or endangered species doesn't necessarily mean that development cannot occur. Rather, prescribed management practices are needed to avoid impact. Note that destruction of habitat is not an illegal activity, only taking or otherwise killing individual Threatened or Endangered species. The preferred approach, however, is to avoid habitat loss altogether. Species listed in the NHI are categorized as one of the following:

1. *Threatened:* Any species which appears likely, within the foreseeable future, on the basis of scientific evidence to become "Endangered."
2. *Endangered:* Any species whose continued existence as a viable component of the state's wild animals or wild plants is determined by the WDNR to be in jeopardy on the basis of scientific evidence.
3. *Special Concern:* Any species whose population is suspected to be declining, though scientific evidence is insufficient to justify this assertion. Species of Special Concern could become threatened in time.
4. *Natural Community:* An identifiable assemblage of plant, fungal, and animal species living together in a particular area. The NHI Program tracks examples of Wisconsin's natural communities that are deemed significant because of their undisturbed condition, size, or for other reasons.

A screening conducted by CARPC staff identified endangered resource and species shown in **Table 14**. These species have the potential to occur in the study area if suitable habitat exists. More detailed information concerning these species can be obtained from the WDNR Bureau of Endangered Resources reference site at:

<http://dnr.wi.gov/topic/endangeredresources/biodiversity.html>.

F. Wildlife Resources and Biodiversity

Terrestrial areas surrounding surface waters serve as "core habitats" for many semi-aquatic species that depend on both aquatic and terrestrial environments to fulfill their life-cycle requirements (e.g., feeding, mating, nesting, and over-wintering). These species serve as food for higher level organisms and so on. Scientists identify certain species as *umbrella species* because by protecting an important umbrella species and preserving its habitat, various other species that depend on the same habitat will also be protected.

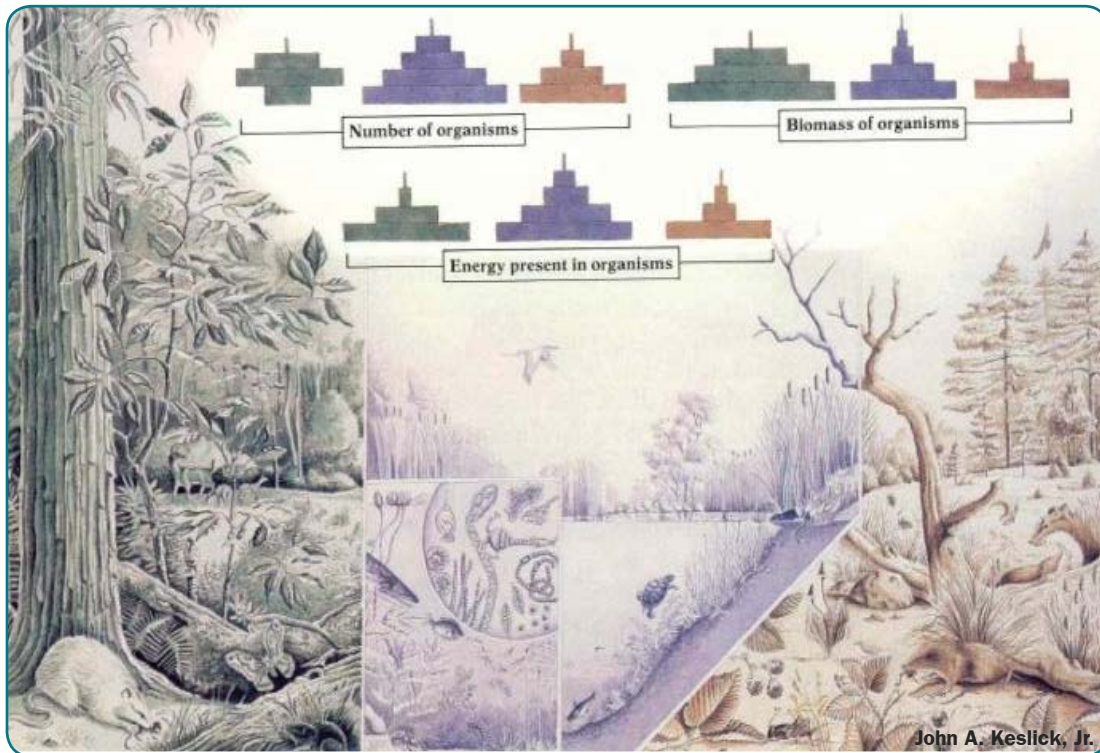
Table 14. Endangered Resources in the City of Sun Prairie FUDA Study Area

Endangered	Threatened	Special Concern	Natural Communities
None	Plants	Fish	Calcareous Fen
	Prairie Parsley	Least Darter	Southern Sedge Meadow
	Small White Lady's Slipper	Mammals	Wet-Mesic Prairie
	Tufted Bulrush	Western Harvest Mouse	

Source: WDNR Natural Heritage Inventory Database (11/2012)

Amphibians and reptiles, known as herptiles, for example, represent a crucial link between aquatic and land ecosystems. Herptiles play particularly important roles in food webs because they occupy a middle position as both predator and prey, and also because they constitute an enormous amount of the biomass in aquatic and riparian ecosystems (see [Figure 28](#)). Development activities that cut too deeply into the base of these trophic pyramids can destabilize these systems, rippling to higher predators, and leading to ecosystem collapse.

Figure 28. Trophic Pyramids of Numbers, Biomass, and Energy for a Forest, Shallow Pond, and “Old Field.”



Semlitsch and Bodie (2003) summarized literature on the use of core terrestrial habitats by amphibians and reptiles essential for carrying out their life-history functions. Using the minimum mean group (salamanders) provides a good reference point for establishing a minimum wildlife protection program. If the distances salamanders move from wetlands are assumed to be normally distributed, then by definition the mean for adults of all salamander species combined represents a distance encompassing 50% of the population. Furthermore, a core habitat encompassing the majority of the population (95% confidence limit) would encompass a terrestrial habitat of 540 ft from a wetland edge (Semlitsch 1997). This distance encompasses the minimum distances for nearly all herptile species in [Table 15](#), except snakes and frogs (specifically) which are typically more mobile.

Semlitsch proposed stratified criteria that would include at least three terrestrial zones adjacent to core aquatic wetland habitats (see [Figure 29](#)):

1. *Aquatic Buffer*. Starting from the wetland edge, a first terrestrial zone would be restricted from use and designed to buffer the core aquatic habitat and protect water resources (100-200 feet.).

2. *Core Habitat*: A second terrestrial zone, overlapping the first, would encompass the core terrestrial habitat defined by the semi-aquatic focal-group (e.g., 540 feet for salamanders, as above).
3. *Terrestrial Buffer*: A third zone, starting from the outward edge of the second zone, would buffer the core terrestrial habitat from edge effects and surrounding land use practices (e.g. 160 feet.).

Table 15. Core Herptile Habitat*

Species	Minimum (ft)	Maximum (ft)
Frogs	672	1,207
Salamanders	384	715
Amphibians	522	951
Snakes	551	997
Turtles	403	941
Reptiles	417	948
Herptiles	466	948

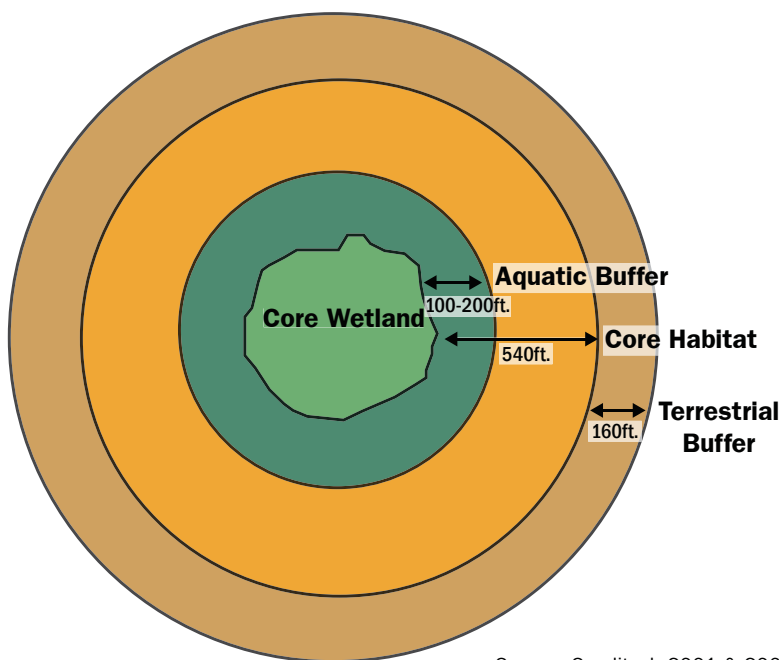
*Distance from wetland edges
Source: Semlitsch, Bodie 2003

Streams in Wisconsin are used less than ponds and wetlands for amphibian breeding, unless they feature quiet water outside the stream channel or quiet backwaters needed for breeding (Hay, 2008). **A 300-foot buffer on both sides of the stream is recommended.**

*These areas are not intended to be restrictive to development or represent “no-build” zones. Instead, these areas are intended to highlight ecological connectivity and amenity opportunities (e.g., open space and wildlife movement corridors, biofuels, community supported agriculture, etc.). **As such, these areas offer both unique constraints and opportunities that need to be considered early on in the community’s overall development and resource protection plans.***

Stream corridors provide extremely valuable habitat and critical connecting corridors for a wide variety of wildlife species. Areas surrounding wetlands and ponds are also rich habitat areas. According to the Wisconsin WDNR Bureau of Endangered Resources (BER), *90% of the occurrences of threatened and endangered species in Dane County are located within 300 feet of streams and 700 feet of wetlands or small ponds.*

Figure 29. Zones of Protection for Semi-Aquatic Species



Source: Semlitsch 2001 & 2003

Researchers have also reported positive correlations between forest cover and amphibian and reptile populations in wetlands. *These studies suggest the need to link terrestrial forest habitats adjacent to wetlands to sustain amphibian and reptile species. **Map 44** shows habitat classifications based on the coincidence of two or more resource features (streams, wetlands, hydric soils, floodplains, and forestlands), including core habitat and wildlife corridors described above. Core physical and biological components are mutually coincident. In many cases, these areas could be improved or enhanced by management activities that allow the land revert back to a more natural condition (passive restoration), or by more active restoration of farmed wetlands, prairies, and riparian areas.*

The overall conservation objective should be to direct development away from sensitive and critical resource areas. If this is not possible, it should be incumbent on planners and engineers to design developments to provide equal or greater natural resource protection. This may be accomplished by advanced conservation design techniques, restoration of other areas, or other means based on the type of development, site characteristics, opportunities, and options available.

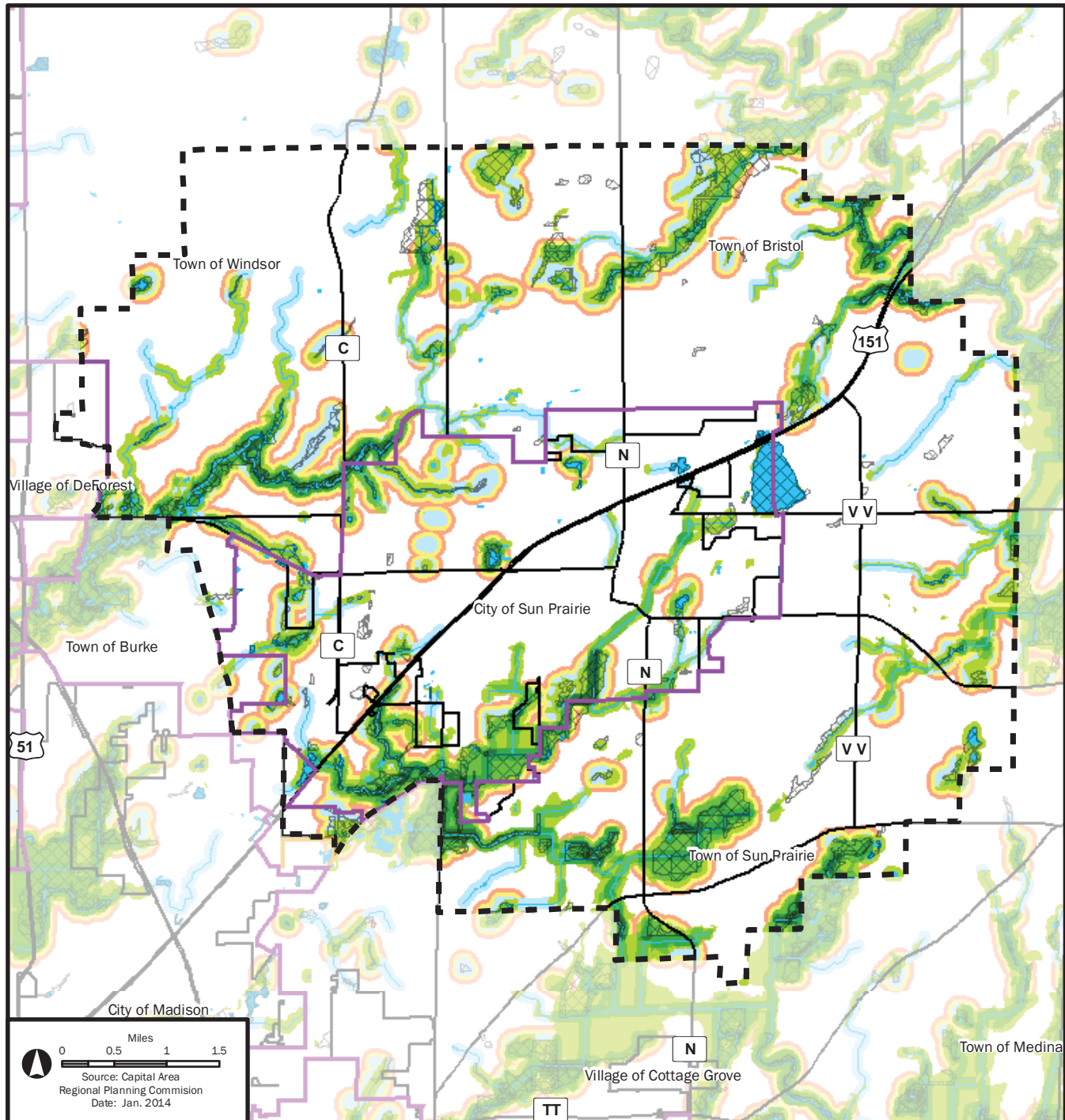
A resource based approach to ecosystem management has proven to be a successful and comprehensive approach to resource conservation. ***Human activities should strive to prevent isolating habitat and optimize connectivity to allow sensitive native species to disperse and re-colonize.*** This goal is attainable by establishing habitat corridors, maintaining landscape attributes (e.g., patch size, shape, edge, etc.), and connecting “stepping stone patches” where possible.

In general, most natural resource objectives can be accomplished within a corridor width of 300 feet from the edge of a stream or good quality wetland and 700 feet from the edge of an exceptional wetland or small pond greater than two acres with quality upland habitat nearby. Natural resources depicted in **Map 45** can have individually prescribed buffers in proportion to resource quality, habitat potential, position in the landscape, restoration feasibility, and professional judgment. This map shows three distinct scenarios of protection; (1) Environmental Corridor Area, (2) Optional Corridor Expansion, (3) Optional Stewardship Area. The Environmental Corridor Area is the “no build” area set forth by existing standards, laws and policies, for the protection of environmental resources. The Optional Corridor Expansion Area suggests widest buffer protection for the highest quality wetlands (700 foot red buffer); additional protection for larger higher quality wetlands that have some conservation issues (300 foot orange buffer), protection for large oak woodlands, higher quality prairies, and habitat patches that are important for habitat connectivity (drawn as red polygons). This scenario is generated from recommendations in the current scientific literature. The Optional Stewardship Area provides greater protection for higher quality wetlands (300 foot orange buffer). This distance is consistent with federal recommendations to protect important wetland habitats. However, this scenario does not include protection for woodlands or prairies, and does not consider other habitat or wildlife issues beyond the wetland boundary. If the Optional Stewardship Area scenario is used, then the 700 foot wetland buffer should be reduced to 300 feet. Where there are groups of small wetlands, they should also be considered together.

Where and when a 300 foot buffer is considered burdensome for a community, there are alternatives that will allow for natural resources protection, create habitat, and produce a tradable commodity. For example, research into biodiversity and ecosystem functioning theory developed by David Tilman of the University of Minnesota suggests that planting high diversity tallgrass prairies may be a source for biofuels. When compared to other biofuel sources, tallgrass prairies are a more efficient source than corn ethanol and soybean biodiesel. These prairies produce 51% more energy per acre than other crops. Planting tallgrass prairies for biofuels also serve as alternatives for low fertility soils than other crops intended for the same purpose, as they will have higher stand biomass. This resource may be collected using standard farming equipment and practices, and can regrow every year, leading to a renewable resource.

Map 44: Habitat Classification

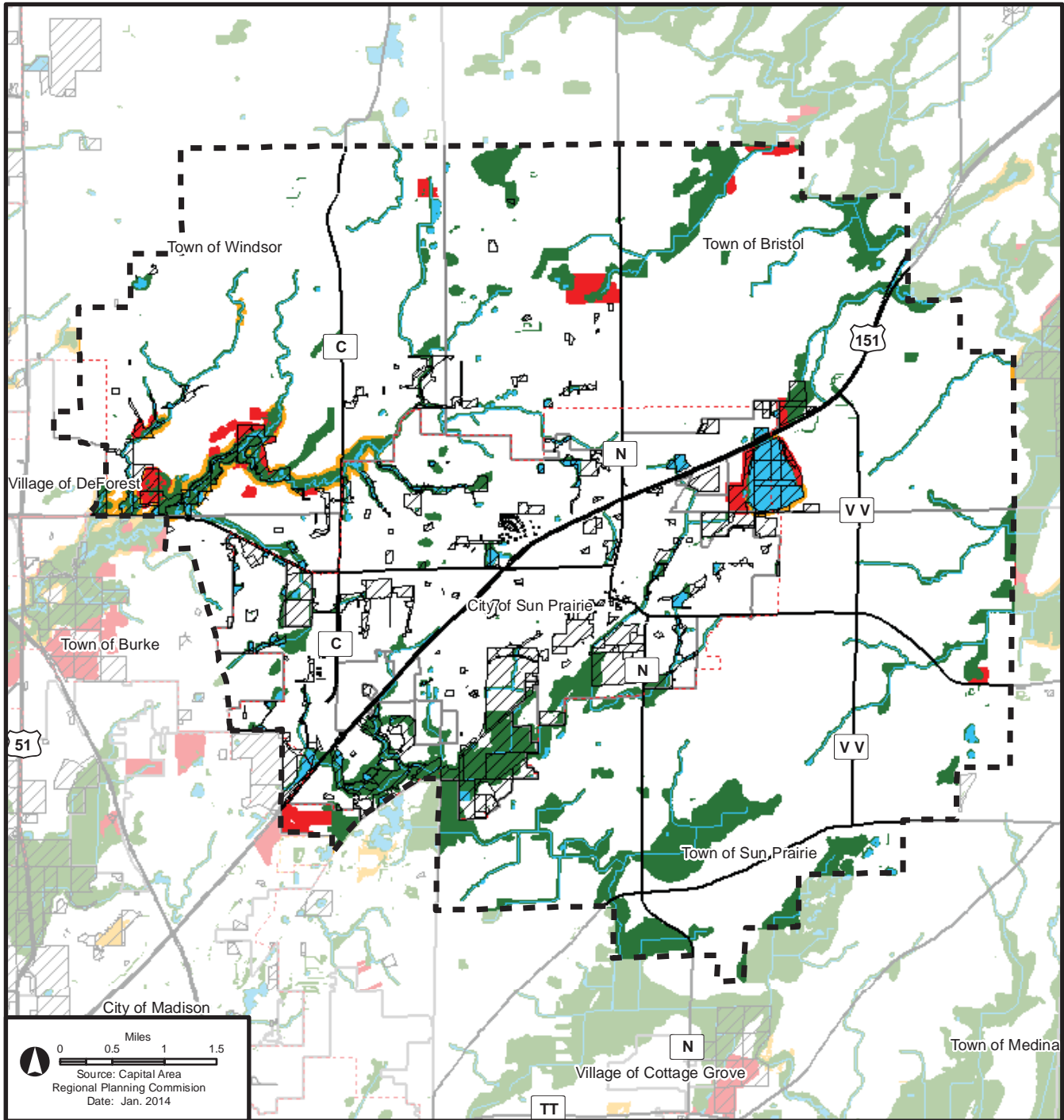
Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	5 (all 5 elements present*)	Wildlife Corridor (300 ft)	*Elements -Streams -Wetlands -Hydric Soils -Floodplains -Forest
Urban Service Area		4	Core Habitat (540 ft)	
Limited Service Area		3	Upland Buffer (160 ft)	
		2	Wetlands > 2 acres	

This map shows a simple habitat classification system based on the coincidence of two or more aquatic resource features, including core habitat, wildlife corridor, and upland buffer as described in the literature. The overall objective is to avoid these sensitive natural areas and direct development to more suitable areas for it. These critical and sensitive natural areas can also be enhanced and improved by letting the land revert back to a more natural condition, enhancing biological diversity overall.

Map 45: Natural Resource Composite Map Sun Prairie FUDA, Dane County, WI



Corridor areas are a no build area defined by existing standards for resource protection (NR 121) and adopted plans and policies. Optional Corridor Expansion Areas are high quality resources (wetlands, prairies, savannas & woodlands) that are recommended to be excluded from development. Optional Stewardship Areas are medium quality resources recommended to be protected through site design and review recommendations. Ranking criteria is based upon internal quality of natural resources, position in landscape, restoration feasibility and professional judgement.

By potentially changing wider riparian areas to biofuel producing tallgrass prairies, communities may be able to promote multi-resource objectives. The limitations of this method will be the size of the converted area, historical landscape coverage, ability to conduct controlled burns that will not endanger infrastructure, and the ability of heavy machinery to access these locations. If the converted area is too small, it may not be economically viable to extract this resource. An experiment funded by the State of Minnesota and the United States Geological Survey is near completion at the Cedar Creek Ecosystem Science Reserve testing the relationship between biofuel production and water quality. The results of this project will contribute greatly to implementation in local communities.

Biofuel production can also be derived from other species within protective buffers and highly degraded areas. There are many instances when invasive reed canary grass can be found in proposed buffer areas. When restoration of wetlands and riparia cannot be performed, it is possible to use this plant as a biofuel source. In a technical report, Dr. Gregory Zimmerman of Lake Superior State University performed an experiment to determine the caloric content of pelletized reed canary grass. He discovered that reed canary grass, when burned, has the energy content equal to other plant material (~ 8000 BTU/lb). He noted that a one acre stand of reed canary grass, once pelletized, has yields equivalent to 266 gallons of propane. In economic terms, if the same amount of propane was used for heating, it would cost approximately \$670. Dr. Gregory states these pellets contain 32 times the energy required to harvest and process this invasive, and the gains outweigh the cost to process. Pelletized reed canary grass may be a cost-sharing biofuel solution for local communities to help offset some heating costs.⁵³

1. Ecological Restoration

Ecological restoration may be necessary to maintain critical functions and the services they provide, and to maintain our natural heritage for future generations. *Designs for ecological restoration share the following general characteristics and guidelines:*

- Comparatively, conservation and management of natural resource areas are far less expensive than attempting ecological restoration.
- The causal factor leading to the ecosystem's degradation must be identified and removed or abated. If not, then a restoration project will not maintain cohesion after restoration activities.
- When performing restoration, it is often not possible to restore or create an ecosystem that is an exact copy of a natural or idealized ecosystem state.
- Restoration of physical attributes within an ecosystem will not always result in positive biotic responses or lead to the return of all species.
- Restoration will take time to mature. Depending upon the ecosystem, it may take a few years or several decades before restoration is mature. Successful restoration needs monitoring to determine if additional corrections are required.
- Restoration is complicated and not as easily manipulated as human engineered systems. It may not be possible to control for all aspects within a restoration project.

⁵³ Lake Superior University News Article: http://www.lssu.edu/whats_new/articles.php?articleid=1816

- Each restoration project will have its own unique challenges and specific approaches will be required to resolve those problems. Using a standard repeated approach is unlikely to be successful.
- The ultimate goal is to create a self-organizing and self-sustaining system that no longer requires active human intervention. Continually spending large sums of money, time and other resources will not solve ecological problems. Nor will waiting for advances in science and technology resolve degraded ecosystems. Application of current restoration methods is required now to preserve our quality of life and improve it for future generations.

2. Prairie Restoration

Prairie restoration is site specific. The few remaining prairies in southern Wisconsin have likely been preserved because soil depth to bedrock was too shallow and not conducive to farming. Restoring grasslands and prairies will benefit wildlife habitat, and reduce overland runoff and help to recharge groundwater.

As with other restoration projects, determining an ideal target community structure is important for developing a defined restoration goal. According to Packard (2005) there are *six restoration goals*: Restore (1) original vegetation, (2) the community now best expressed by the site, (3) the rarest or highest priority community that is practicable, (4) a variety of communities, (5) as large as possible given site limits, or (6) the highest priority, best and easiest mix of communities possible.

To preserve and restore these natural areas, the most important consideration is reintroducing fire regimes. Fire is a regulating event for grassland, prairie, and savanna ecosystems. The lack of fire in these ecosystems may be considered a disturbance. Without these events, grassland, prairie, and oak savanna communities will inevitably change in composition to include fire-intolerant (e.g., brush/woody) species. The application of fires will remove these intolerant species and allow these native plants a competitive advantage. As fire regimes cease, non-prairie species become established and displace native species.

With many ecosystems, maintaining large areas is preferential to having smaller patches. Larger prairies are ecologically important for larger species, including prairie chickens, and specific rare insects that require large areas, and consumable plants for their larval stages. On a practical perspective, it may not be possible to maintain large prairie areas given the economic interests of agriculture. Even with this condition, maintaining small prairies, wherever possible, will be beneficial. In some instances, maintaining prairies that are less than one thousand square feet may yield up to sixty different plant species and be habitat for countless insects and several bird species. It has been proposed that in an urban setting, that if one-tenth of lawns were to be replaced by “postage stamp” prairies, there would be a sizable reduction in the use of water, fertilizers, pesticides, and reduced need to use powered lawnmowers.

Five prairies of interest exist within the Sun Prairie study area ([Map 46](#)). They are found: (1) along the northern half of Token Creek Preserve Park, (2) along the edge of Patrick Marsh, (3) northwest of the intersection between Happy Valley Road and CO HWY N, (4) between US

151 and Reiner Road, and (5) northeast of the intersection between US 19 and Twin Lane Road.

The first two prairies are found within the Token Creek Preserve Park and Patrick Marsh, and are in good condition with each having a variety of hydric and mesic prairie plant species. These sites are both protected as within government owned conservation lands. The third prairie, north of Happy Valley Road, does not receive such protection. This site is quite substantial and covers approximately 58 acres. This site has ample space to support several area dependent songbird species, and appears to have different management regimes, which allows for greater biological diversity. Although adjacent to existing development, this prairie is a rare natural community, especially for Sun Prairie. The fourth prairie, found between US 151 and Reiner Road is also in private ownership. This site is transitioning away from an open prairie, and is being overtaken by woody species. There are some prairie gaps in the patch interior that are also showing signs of woody plant encroachment. However, this site has potential as greenspace and partial community separation between Madison and Sun Prairie. The fifth prairie is along the far eastern edge of the study area, northeast of the US 19 and Twin Lane Road intersection. This prairie is highly degraded with wide patches of reed canary grass and woody plant encroachment.

G. Parks as Natural Resource Areas

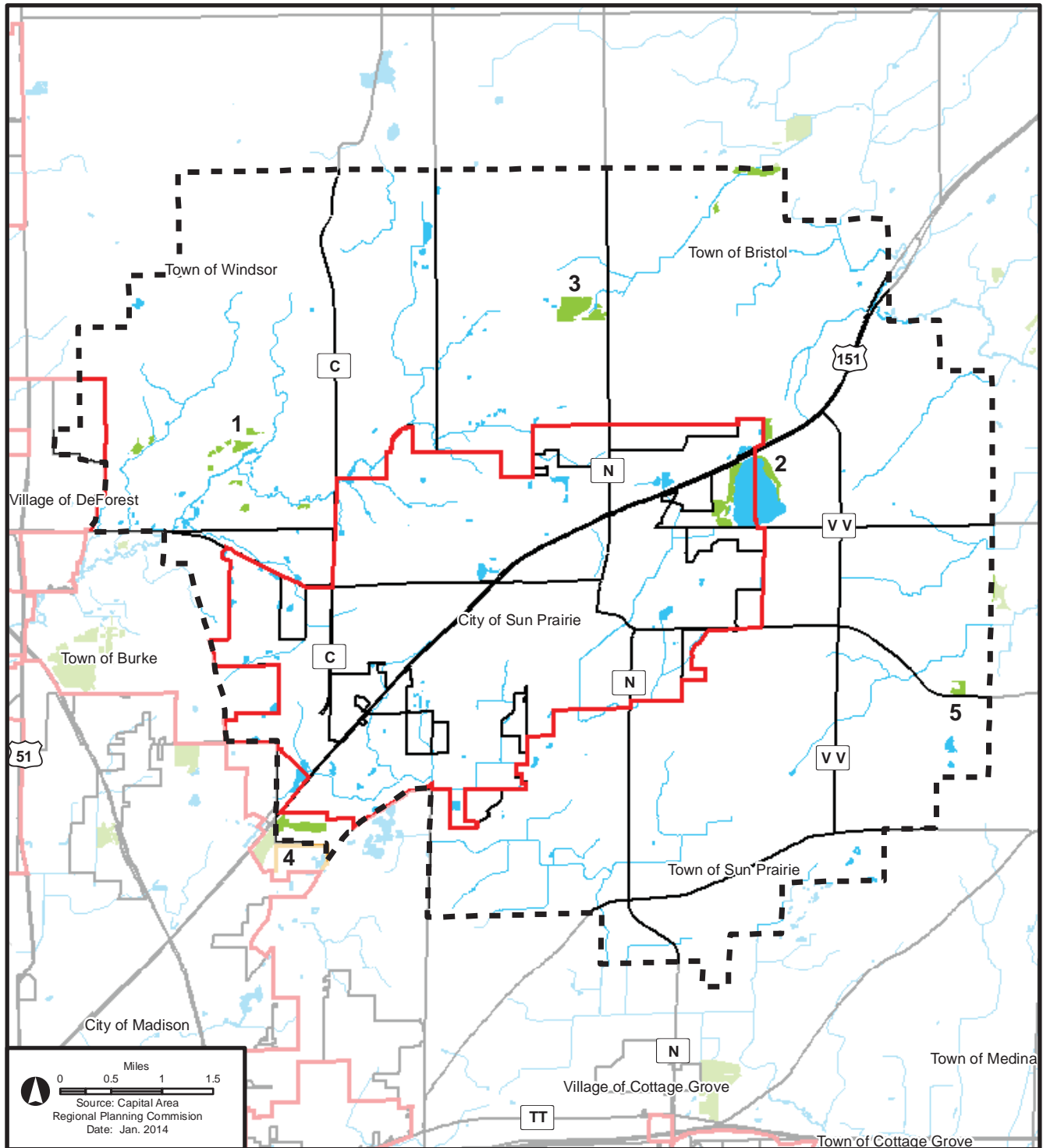
The *Dane County Parks and Open Space Plan* defines this role and recommends how Dane County can work as a partner with other governmental units and the private sector. Adopting the Plan and acceptance by WDNR enables the county to participate in state and federal outdoor recreation grant programs. The Plan indicates various Natural Resource Areas, existing and proposed land and water trails, recreational parks, and forests, as the focus of these efforts in the study area (see *Maps 47a and b, and 48*), including:

- Token Creek Natural Resource Area
- Koshkonong Creek Natural Resource Area
- Patrick Marsh Natural Resource Area
- Maunasha River Natural Resource Area
- Proposed Token Creek to Riley Deppe County Park Trail
- Proposed Georgia O'Keefe Trail
- Proposed DeForest to Sun Prairie Trail

Local future land use maps and plans must incorporate regional elements into resource and park areas. Dane County Parks staff should be consulted early on in development planning to promote opportunities, coordination and avoid incompatible or potentially conflicting proposals.

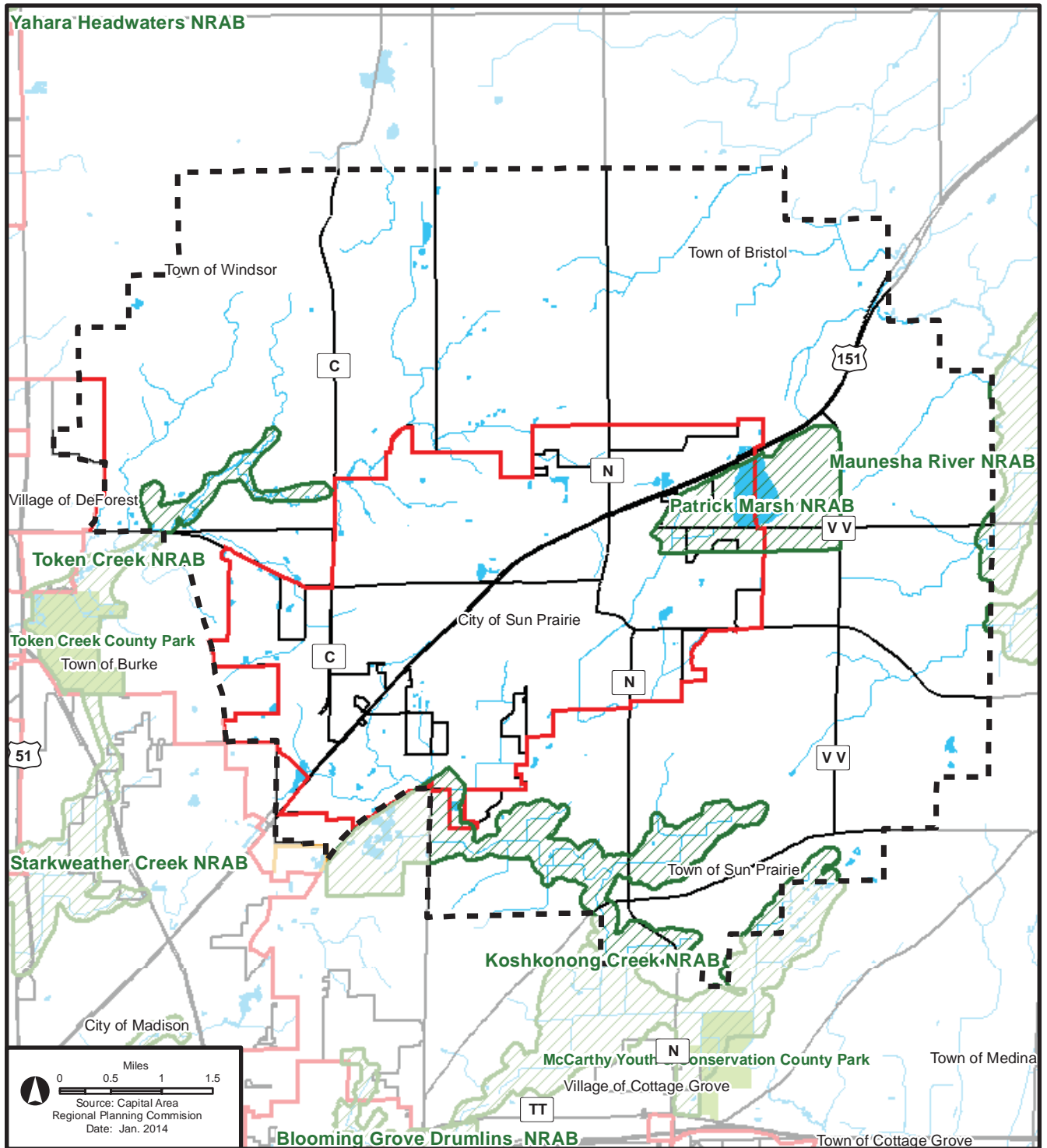
Note that park and purchased conservation areas adversely impact town property tax revenues and add to maintenance costs for the responsible entity. Acquisition considerations for these areas should include revenue sharing measures or approaches to compensate the affected town for this loss of revenue, and to create programs that allow private owner-

Map 46: Prairies and Grasslands Sun Prairie FUDA, Dane County, WI



Priority native prairie & savanna remnants and grassland/prairie management areas from Dane County Land and Water Resources Department

Map 47b: Dane County Parks and Open Space Plan Sun Prairie FUDA, Dane County, WI

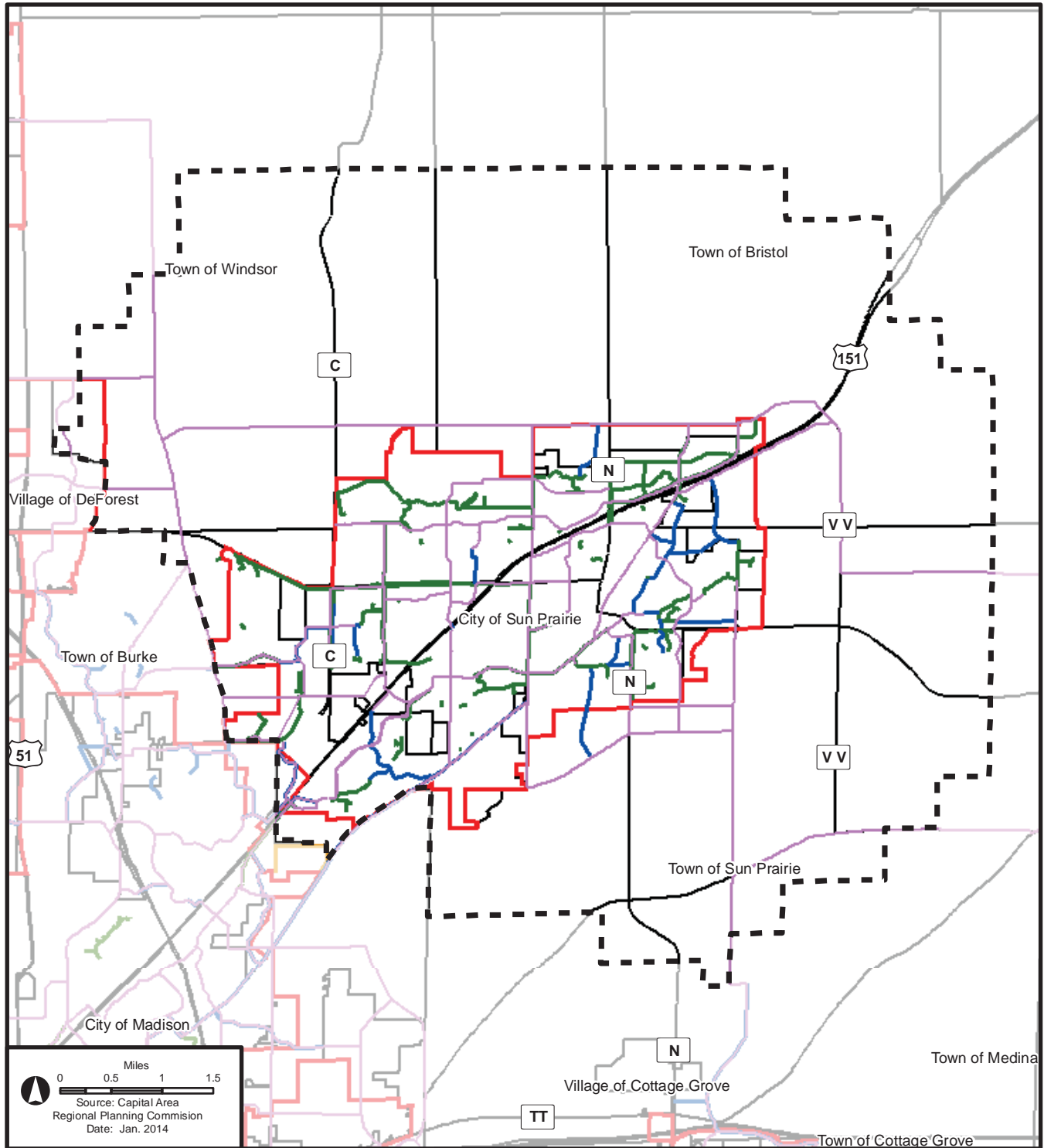


- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Existing Off-road Bicycle and Pedestrian Trail
- County Historical or Cultural Site
- Natural Resource Area Boundary
- County Park

The Parks and Open Space Plan is coordinated by the Dane County Parks Departments located at 1 Fen Oak Dr #208 in Madison.
<http://www.countyofdane.com/lwrp/parks/default.aspx>
 608-224-3730

Map 48: Bike Plan

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Bike Route
- Existing
- Proposed
- Hiking - No Bikes
- Under Construction

Bike routes and paths including proposed paths are shown.
Data comes from the Madison Area Transportation Planning Board.

ship of buffer areas for agricultural uses that produce income while maintaining ecosystem services of a more natural land cover.

H. Urban Development Impacts on Natural Resources

Dane County is the second-largest metropolitan area and one of the fastest-growing counties in the state. By year 2030, almost 580,000 people are expected to reside in Dane County – an increase of almost 36% over current population. *This urban growth and development must be properly planned and managed to mitigate the adverse impacts of urban development to protect the quality of our groundwater and surface water resources, the wildlife communities they support, and our everyday quality of life.*

1. Water Quantity and Quality Impacts

One of the most obvious manifestations of urban development is the *increase in impervious surfaces*. Hard surfaces, such as streets, rooftops, driveways, and parking lots changes in the hydrologic regime if development progresses without mitigation (*Figure 25*). Watershed impervious cover ranges between 0-40% in Dane County.⁵⁴ Because of compaction during the development process, turf and landscape areas can also affect the total runoff from built areas, unless mitigated with practices such as deep tilling and soil augmentation.

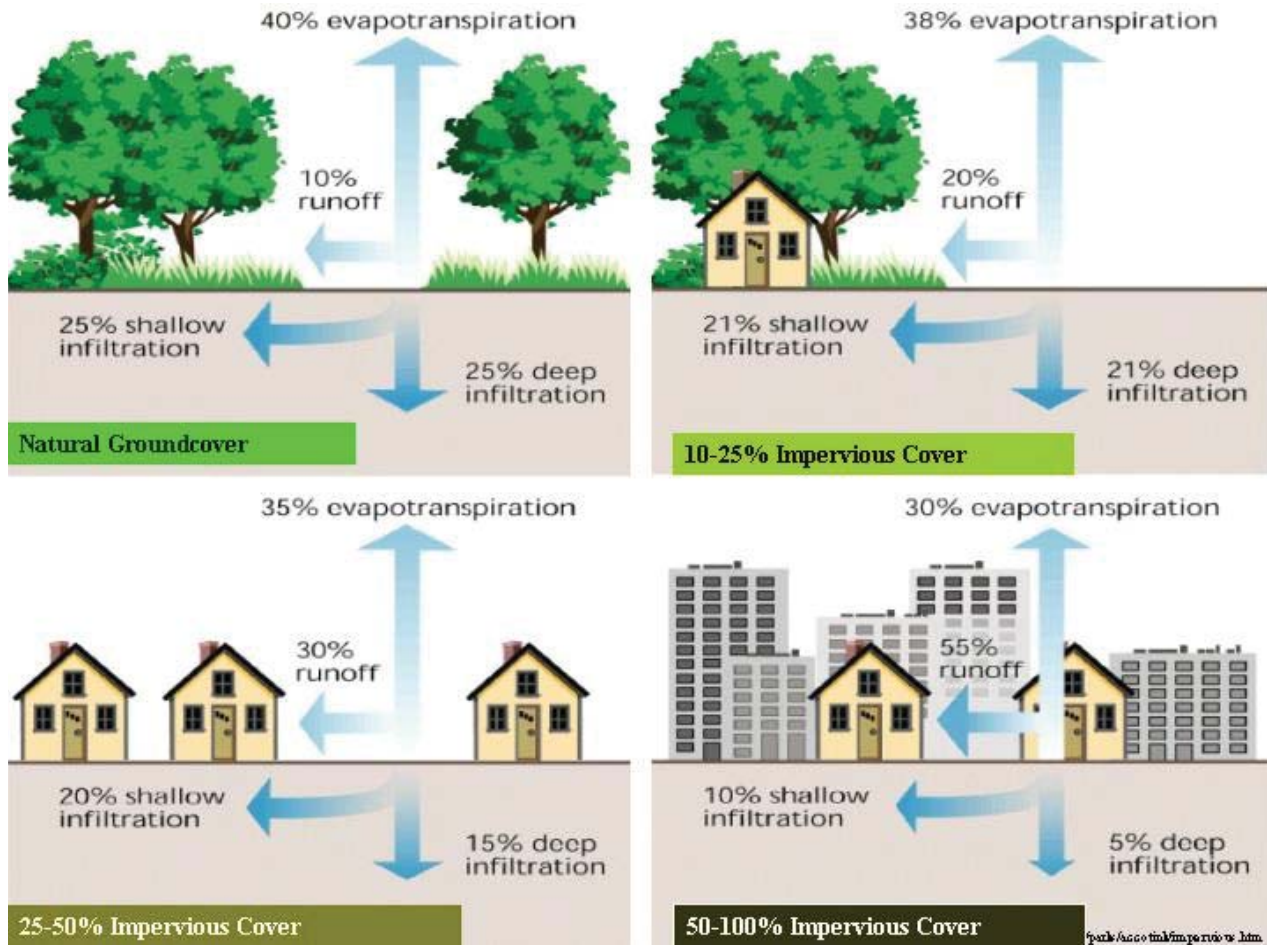
Figure 30 shows typical pre-development and post-development hydrographs for a watershed that is being developed for urban land uses without any mitigation practices. As development progresses the stream hydrology changes from a more gradual and subdued groundwater-dominated system (solid line) to one dominated more and more by flashier surface water impacts (dashed line). The area below the hydrographs represents the volume of rainfall runoff. The increased peak flow and runoff volume resulting from development is significant because of the increased pollutant loading it can carry, and potential flooding and channel erosion problems it can cause downstream. In addition, as infiltration of precipitation is reduced by increased impervious cover, the volume of water available for baseflow in streams is similarly reduced. Infiltration and groundwater recharge of precipitation and subsequent discharge to streams and wetlands is critical in sustaining them during dry weather periods.

Urban land use without appropriate management practices can severely degrade aquatic ecosystems (see Table 16). Increased peak flows and runoff volumes increase the erosive force of the channel flows and can significantly upset the streambed and bank stability and the sediment load equilibrium that has established itself over time. Increased volumes and rates of runoff overload natural drainage systems that have adapted themselves to pre-development conditions. As the frequency of bankfull events increases with urbanization, the stream attempts to enlarge its cross section to reach a new



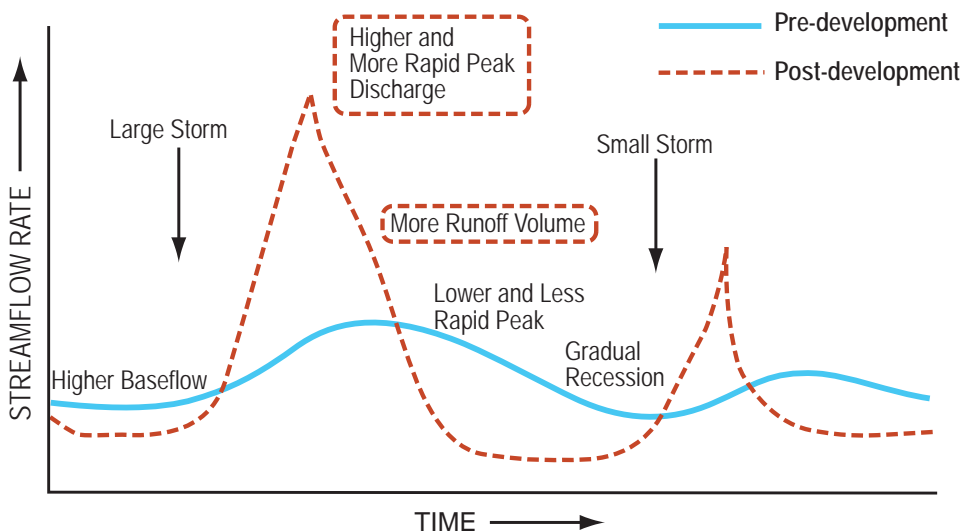
54 Dane County Regional Planning Commission. 2005. *Dane County Water Body Classification Study Phase I.*

Figure 30. Hydrologic Effects of Urban Development and Impervious Cover



Source: The Importance of Imperviousness (Schueler 1994)

Figure 31. Changes in Stream Hydrology as a Result of Urbanization



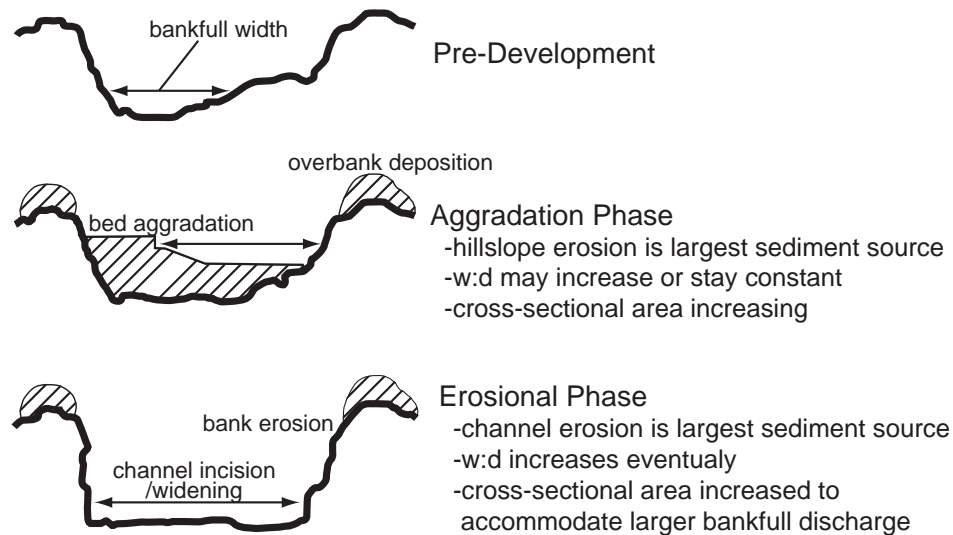
Source: Schueler, 1994

Table 16. Summary of the Potential Impacts of Urbanization on Aquatic Ecosystems

Environmental Concern	Potential Impact	Cause/Source
Increase in runoff-driven peak or bankfull stream flows	Degradation of aquatic habitat and/or loss of sensitive species	Increased stormwater runoff volume due to an increase in basin imperviousness
Increase in runoff-driven flooding frequency and duration	Degradation of aquatic habitat and/or loss of sensitive species	Increased stormwater runoff volume due to an increase in basin imperviousness
Increase in wetland water level fluctuations	Degradation of aquatic habitat and/or loss of sensitive species	Increased stormwater runoff due to an increase in basin imperviousness
Decrease in dry season baseflows	Reduced aquatic habitat and less water for human consumption, irrigation, or recreational use	Water withdrawals and/or less natural infiltration due to an increase in basin imperviousness
Streambank erosion and stream channel enlargement	Degradation of aquatic habitat and increased fine sediment production	Increase in stormwater runoff driven stream flow due to an increase in basin imperviousness
Stream channel modification due to hydrologic changes and human alteration	Degradation of aquatic habitat and increased fine sediment production	Increase in stormwater runoff driven stream flow and/or channel alterations such as levees and dikes
Streambed scour and incision	Degradation of aquatic habitat and loss of benthic organisms due to washout	Increase in stormwater runoff driven stream flow due to an increase in basin imperviousness
Excessive turbidity	Degradation of aquatic habitat and/or loss of sensitive species due to physiological and /or behavioral interference	Increase in stormwater runoff driven stream flow and subsequent streambank erosion due to an increase in basin imperviousness
Fine sediment deposition	Degradation of aquatic habitat and loss of benthic organisms due to fine sediment smothering	Increase in stormwater runoff driven stream flow and subsequent streambank erosion due to an increase in basin imperviousness
Sediment contamination	Degradation of aquatic habitat and/or loss of sensitive benthic species	Stormwater runoff pollutants
Loss of riparian integrity	Degradation of riparian habitat quality and quantity, as well as riparian corridor fragmentation	Human development encroachment and stream road crossings
Proliferation of exotic and invasive species	Displacement of natural species and degradation of aquatic habitat	Encroachment of urban development
Elevated water temperature	Lethal and non-lethal stress to aquatic organisms reduced DO levels	Loss of riparian forest shade and direct runoff of high temperature stormwater from impervious surfaces
Low dissolved oxygen (DD) Levels	Lethal and non-lethal stress to aquatic organisms	Stormwater runoff containing fertilizers and wastewater treatment system effluent
Lake and estuary nutrient eutrophication	Degradation of aquatic habitat and low DO levels	Stormwater runoff containing fertilizers and wastewater treatment system effluent
Bacterial pollution	Human health (contact recreation and drinking water) concerns, increases in diseases to aquatic organisms, and degradation of shellfish harvest beds	Stormwater runoff containing livestock manure, pet waste, and wastewater treatment system effluent
Toxic chemical water pollution	Human health (contact recreation and drinking water) concerns, as well as bioaccumulation and toxicity to aquatic organisms	Stormwater runoff containing toxic metals, pesticides, herbicides, and industrial chemical contaminants
Reduced organic matter (OM) and large woody debris (LWD)	Degradation of aquatic habitat and loss of sensitive species	Loss or degradation of riparian forest and floodplain due to development encroachment
Decline in aquatic plant diversity	Alteration of natural food web structure and function	Cumulative impacts of urbanization
Decline in aquatic invertebrate diversity	Alteration of natural food web structure and function	Cumulative impacts of urbanization
Decline in amphibian diversity	Loss of ecologically important species	Cumulative impacts of urbanization
Decline in fish diversity and abundance	Loss of ecologically important species	Cumulative impacts of urbanization

equilibrium associated with the increased flows. Greater frequencies and durations of high stormflows can result in channel incision, stream bank undercutting, increased stream bank erosion, and sediment loading and transport along the streambed (*Figure 32*).

Figure 32. Changes in Stream Channel Geomorphology due to Urbanization



Source: NALMS 2007

The results are wider, straighter, sediment-choked streams, greater water temperature fluctuations, and loss of riparian cover, shoreland, and aquatic habitat. The streambed is covered by sand and silt, and pollutant loading (e.g., toxic materials, metals, and organics) is also increased. *Research shows that by the time the water quality impacts become evident, the stream ecosystem is already damaged.*

The significance of hydrologic changes and pollutant loading associated with urban development that lacks mitigation practices is clear: ***strategies that maintain pre-development runoff volumes and mimic more natural flow conditions will reduce the frequencies of larger and more erosive flows resulting from that development.*** And, since pollutant loading is a function of flow, it stands to reason that reducing the volume of runoff will result in reduced pollutant loads as well. This is in addition to conventional practices that capture and treat the “first flush” of pollutants during runoff events. ***Overall, it is much easier to incorporate hydrologic protection measures early in the design before an area becomes developed than to address the problem after development.***

Communities in our region are working to mitigate these potential hydrologic impacts of urban development for over a decade. In the late 1980s, the then Dane County Regional Planning Commission began requiring new urban service area additions to provide peak runoff rate control to pre-development levels and to remove sediment from stormwater runoff. Similar standards were adopted by Dane County and the State of Wisconsin in 2002. Infiltration requirements and volume control conditions were pioneered by the Dane County Regional Planning Commission in the mid 1990s. Infiltration requirements and volume control standards were adopted as part of the county-wide stormwater ordinance in 2004, and the standards for commercial areas were improved in 2011.

The neighboring Village of DeForest adopted an ordinance requiring a *100% pre-development stormwater volume control and groundwater recharge standard* more stringent than NR 151 and Dane County Chapter 14. The challenge is in finding retrofit opportunities in existing development. The Village has spent substantial funds in recent years to upgrade and retrofit its stormwater management facilities and to improve water quality and has committed to fund future restoration and conservation activities. ***Municipalities in the Northeast FUDA are advised to follow DeForest's lead.***

When properly planned, designed, constructed, and maintained, these standards, and the management practices implemented to meet them, can effectively mitigate the potential hydrologic impacts of new urban development. The primary sources of impacts to our water resources are agricultural nonpoint source pollution and urban nonpoint source pollution from development that was constructed before these standards were put in place.

2. Habitat Loss and Landscape Connectivity

Habitat loss or fragmentation is the process whereby contiguous natural areas are reduced in size and separated into discrete parcels due to converting land for other uses, such as urban development or agricultural production. Because of the prime soils located here, agriculture has had a significant impact on wildlife habitat in Dane County. ***When habitat is destroyed, a patchwork of habitat fragments remains.*** Fragmented habitats become isolated from one another, impairing organism and energy flow among them, resulting in increased competition, susceptibility to invasive species, and higher local extinction rates. ***These remnant areas require protection, network re-connection, and enhancement where possible.***

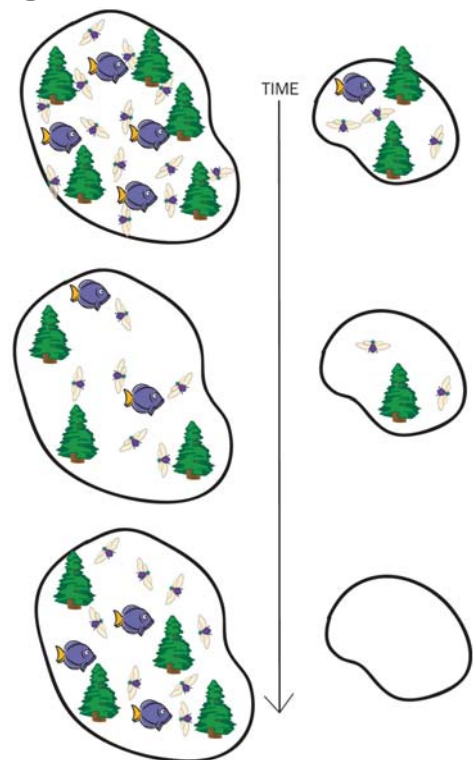
Figure 33 shows the probability of a local species population being extirpated increases as habitat patch size decreases (right side of the diagram). Conversely, a larger patch generally supports a larger population size for a given species, making it less likely that the species will go locally extinct (left side of the diagram).

Species viability and diversity are also enhanced by well-connected habitats. ***Wildlife corridors are therefore recommended*** as a conservation measure to help counter the negative effects on habitat loss and fragmentation, and patch isolation (see **Figure 34**).

According to Diamond (1975) and Noss (1997), ***landscape designs for maintaining habitat preserves should be based on the following principles (Figure 35):***

- Larger habitat patches with large populations are better than small patches with smaller populations,
- Contiguous patches are better than fragmented patches,
- Closer patches are better than distant patches,

Figure 33. Patch Size and Local Extinction

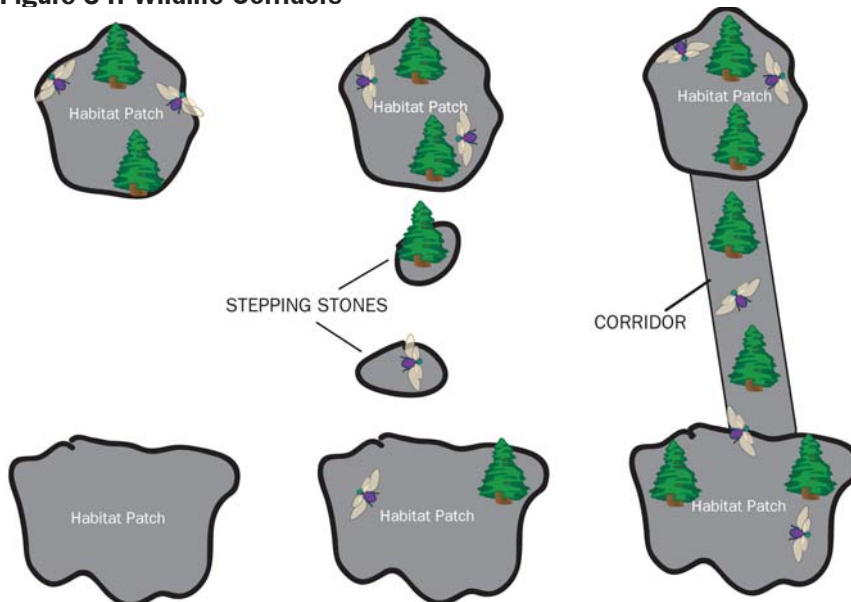


The probability of a local species going extinct increases with decreasing habitat patch size. A larger patch generally supports a larger population than a smaller patch, making it less likely that a species will go locally extinct.

Source: Environmental Law Institute 2003

- Patches that are mutually equidistant are better than those distributed linearly,
- Patches with higher area to perimeter ratios are better than long, thin patches,
- Species that are well distributed across a landscape have lower local extinction risk,
- Stable populations fare better than fluctuating populations, and
- Peripheral populations perform poorly relative to core populations.

Figure 34. Wildlife Corridors



Protecting stepping stone patches or establishing a corridor can increase habitat connectivity, and improve species migration into extirpated habitat areas.
Source: Environmental Law Institute 2003

Figure 35. Habitat Preserve Design

A. Size		D. Linearity	
Better	Worse	Better	Worse
B. Subdivision		E. Connection	
Better	Worse	Better	Worse
C. Separation		F. Edge / Interior Ratio	
Better	Worse	Better	Worse

Some "better-worse" comparisons of design of preservation systems as derived from island biogeographic theory. (Modified from Diamond 1975)

When the landscape is being preserved for habitat, it is important to note that not all patches are always occupied by regional species. Also, patches within the landscape vary in species content, with higher quality habitat likely containing sensitive species. Maintaining a series of patches within a landscape is necessary for prey species to elude predators, refuge from contagious diseases and parasites, and providing re-colonization opportunities.

In general, most natural resource objectives can be accomplished within a corridor of 300 feet from the edge of a stream and 700 feet from the edge of an exceptional wetland or small pond (shown on Map 45). This is the area where community stewardship activities will have the greatest beneficial effect. For example, this is the area suggested by leading ecologists for providing core habitat and a protective buffer for semi-aquatic amphibians and reptiles umbrella species.

In the Sun Prairie study area, there is limited potential to increase the habitat connectivity through the implementation of contiguous corridors or stepping stones. The major habitats of importance, as listed previously, are Token Creek, Patrick Marsh, and the large

prairie north of Happy Valley Road. These resources are mutually distant from each other and are separated by long distances filled with continuous agriculture, urbanization, and several major county highways. Additionally, these resources are not of extraordinarily high quality. The use of continuous corridors and stepping stones should be reserved for larger natural resource areas of higher quality.

Planning Considerations

Establish Environmental Corridor widths to provide habitat needs.

Provide continuous corridors for habitat connectivity whenever possible.

I. Conclusion

The strategies below can be implemented to minimize long-term impacts in a watershed undergoing urbanization.

Approach local projects from a regional watershed perspective.

Watersheds and other natural features are not defined by political boundaries. Development impacts in one jurisdiction often impact other jurisdictions in the watershed. Planning at a watershed level is essential for streams and water bodies. Assessing the local and cumulative impact of development on a watershed scale is essential. Criteria that balance high impact land uses such as residential, commercial, and industrial development with low impact land uses such as forests, wetlands, and grasslands are useful tools in the hands of regional and community land use planners and practitioners. Such criteria can be used to protect sensitive wetlands, floodplains, woodlands, and the wildlife that depend on them, while also accommodating economic development.

Direct development away from sensitive natural areas to better suited areas.

Large naturally vegetated buffers surrounding our valuable water resources improves water quality by absorbing and filtering out sediments from runoff that would otherwise enter these waters directly. Natural resource reserves are particularly important as core habitat for wildlife. They also add to the natural scenic beauty of the landscape and provide an open space balance for the developed areas, increasing property values, outdoor recreation opportunities, and quality of life for residents and visitors alike.

Increase land use efficiency through compact, infill and redevelopment.

Prematurely expanding urban uses onto rural and open areas is often inefficient and unnecessarily wasteful. Urban land uses moving out onto less-expensive land farther out from urban city centers do not typically account for the additional public costs or inefficiencies of providing the necessary infrastructure and services to serve that development (sewer, water, transportation, police, fire, etc.). After several decades of study in other areas around the country, it is apparent that unplanned or premature development imposes significant short-term and long-term costs on local governments, businesses, property owners, developers, and the environment.

Allow land use density transfers.

Density transfers allow developers and land owners to achieve the same overall density, therefore the same economic benefit, while concentrating development in less sensitive portions of the site or the area. Transfer of Development Rights programs provide a funding mechanism to compensate landowners located in sensitive “sending areas,” directing the

development potential of their land to more suitable “receiving areas.” Landowners, developers, and the public reap significant benefits with efficient economic development activity.

Use natural features and conservation design principles when developing.

Incorporating the existing natural features of the site into the design of a development, rather than clearing the site completely and starting anew, reduces the impact that the development has on the natural state of a watershed. Rather than the traditional individual plots and set back style, a clustered development with large passive open spaces is very effective. In many cases, clustered development leads to a dramatic cut in the cost of providing utilities and services – especially those related to transportation and imperviousness.

Consider the long-term impacts when selecting a site.

Because the amount of runoff generated by different land uses is a function of the hydrologic soil type and the land use, locating land uses based on the hydrologic soil type can significantly reduce the long-term impact of the development. For example, locating land uses that generate large amounts of clean rooftop runoff (e.g., commercial development) near soils that have naturally or potentially high infiltration rates can help reduce the hydrologic impact of the land use change.

Minimize impervious areas in design.

Limiting road widths, parking spaces and other impervious surfaces to a minimum reduces their water quality and quantity impacts. Using more permeable materials allows more water to seep into the ground. Implementing a compact development pattern can minimize overall disturbance to the natural features.

Slow stormwater run-off of impervious areas and encourage infiltration.

Stormwater basins and constructed wetlands reduce the risk of flooding. These basins retain stormwater and release it more gradually over a longer time period. Stormwater basins can be designed to be aesthetically pleasing and can potentially be used as the focus for open space or recreational facilities on a site. They can also be used for economic benefit by developers and realtors as many people enjoy living near water and are willing to pay higher prices for such plots. While stormwater basins are important for reducing peak flows, they do not solve the problem of increased runoff *volumes* due to development. An effective way to increase the amount of water that infiltrates into the ground is by implementing infiltration control measures.

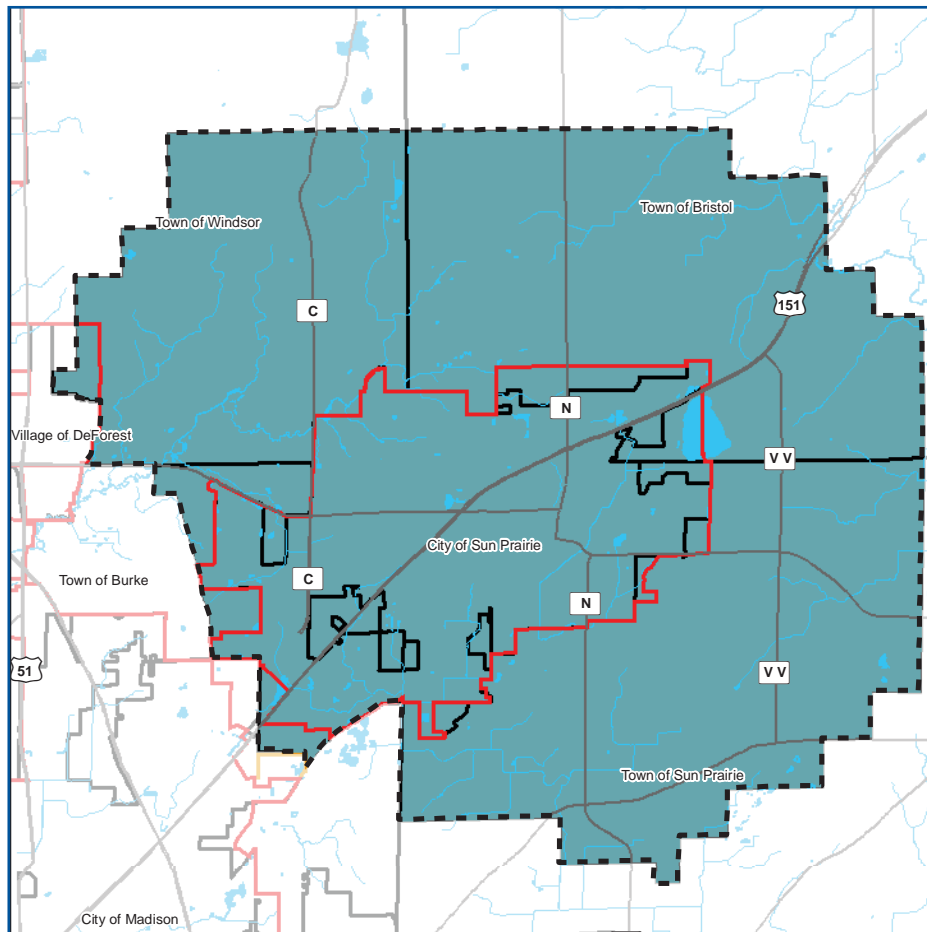
Reduce pollution sources on all surfaces.

The amount of pollutants that get into stormwater can be reduced or prevented through good management practices at the source. Proper disposal of pet waste and reducing the use of fertilizers and pesticides in lawns, gardens, and other good “housekeeping” practices can significantly reduce the nutrients and chemicals in runoff.



City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



Agricultural Resources

Introduction

The northeastern quadrant of Dane County contains some of the region's most productive and economically valuable agricultural land. Agricultural data in this chapter covers a large part of this quadrant including the City of Sun Prairie and Towns of Bristol, Burke, Sun Prairie and Windsor. This information, in combination with the information from the Natural Resources and Community Development Chapters, can guide decision-making in identifying agricultural lands that these communities may preserve, enhance or develop over the next several decades.

Agriculture serves three general purposes:

- Agricultural lands provide food, fiber and fuel for life's most basic needs, adequate space for rural facilities and an employment base for rural and urban areas.
- Agriculture provides a community aesthetic and sense of place built throughout history that can educate citizens and provide them with recreational lands.
- Properly managed agricultural lands can be used to recycle nutrients, form soil and provide wildlife habitat. Additionally, properly managed agricultural lands can provide pervious land for rainfall and snow melt infiltration, maintain water temperature and quality, recharge groundwater and buffer noise.

The agricultural land's important functions and benefits must be weighed when considering development, preservation and other land use decisions that may impact the agricultural sector.

This chapter of the ECR covers:

- Agricultural land area and land conversion
- Agricultural parcels
- Agricultural base farm tracts and ownership
- Agricultural contiguity and concentration
- Agricultural operation type (livestock, crop, and crop type)
- Tax value assessment (land and improvements)
- Soil quality (prime lands and Land Evaluation)
- Agricultural support services
- Agricultural relationship to other land uses

This chapter provides information for the 2000-2010 interval. Comparable geographic data is not available for earlier periods. The information is from county-wide data sources including the land use inventory, tax parcel assessments, and data from the Wisconsin Department of Agriculture, Trade, and Consumer Protection. Data are provided for the local communities, Yahara River Valley and Drumlin and Marsh sub-regions, and Dane County for regional comparison.

A. Agricultural Land Area and Land Conversion

Agricultural production is one of the most significant land uses across the State. Dane County is no different in this regard. Simultaneously, Dane County continues to experience one of the fastest population growth rates in the State. Agricultural land is often developed with buildings and infrastructure to accommodate this population growth.

In 2010, approximately 384,000 acres were categorized as agricultural land use in Dane County, over 165,500 acres fewer than categorized as agriculture in 1980 and approximately 67,000 acres fewer than in 2000.⁵⁵ Since 1980, 82,000 acres were converted to devel-

oped uses, representing 50% of the total area converted. Agricultural lands are generally in town jurisdictions with a few areas in cities and villages.

The City of Sun Prairie Urban Service Area borders four towns. Directly west is the Town of Burke, northwest is the Town of Windsor, northeast is the Town of Bristol and to the south is the Town of Sun Prairie. Burke has a significant amount of development and ecologically significant areas, and is located at the convergence of three urban communities of DeForest, Madison and Sun

Prairie. These communities agreed to a cooperative plan describing and illustrating how the Town of Burke divide amongst these jurisdictions by 2036. Windsor also hosts several types of development, including urban scale development inside the Central Urban Service Area. Bristol hosts a few rural subdivisions near the City. Like the Town of Sun Prairie, Windsor and Bristol are largely agriculture with farm residences and agricultural structures.

Table 17 and **Map 49** show agricultural and developed lands in the study area. As of 2010, 18,820 acres of agriculture were in the study area, over 4,000 less acres than were considered agriculture in 2000.⁵⁶ Development acreage increased about 1,000 more acres than this amount.

Burke saw a nearly 200 acres decrease in developed land over the time period due to annexation from DeForest, Madison and Sun Prairie. In 2010, 2,357 acres were agricultural, roughly 3,500 less than in 2000. Thus, of the 3,500 acres loss a significant portion was due to annexation, including 230 acres annexed to Madison. In addition, several other areas

Table 17. Agricultural and Developed Land Area (acres)

	Agricultural		Developed	
	2000	2010	2000	2010
Study Area	23,173	18,820	8,230	13,521
Town of Bristol	17,623	15,819	1,306	3,080
Town of Burke	5,705	2,329	3,699	3,519
Town of Sun Prairie	15,336	13,653	691	2,536
Town of Windsor	15,150	12,824	845	3,524
City of Sun Prairie	1,470	504	3,991	8,393
Drumlin and Marsh	163,960	163,265	26,592	38,507
Yahara River Valley	87,912	93,415	50,534	63,928
County	499,000	384,317	127,055	163,375

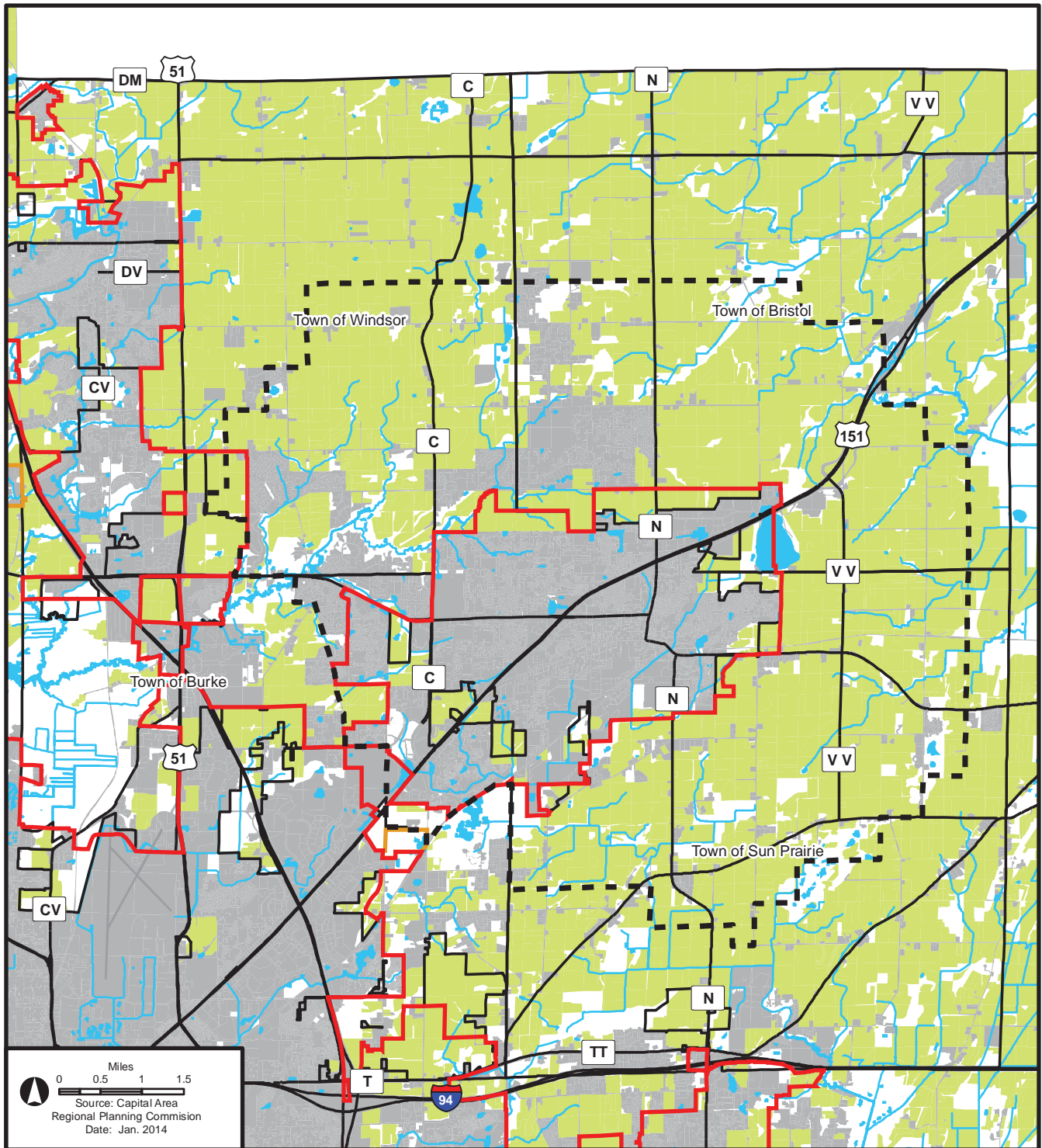
Source: CARPC Land Use Inventory

⁵⁵ At the county level, about 95,500 acres of crop and pasture lands were converted to other uses between 1980 and 2000. Less than half of all crop and pasture acreage losses can be attributed to development, with approximately 37,000 acres developed. Thus, significant agricultural acreage is being transferred to land uses such as vacant/unused, environmental corridors, wetland restoration, or open space. See FLM 1: Farmland Loss in Dane County, CAPITAL AREA RPC, 2010. (http://danedocs.countyofdane.com/webdocs/PDF/capd/2010_postings/FLM_1.pdf).

⁵⁶ A portion of the agricultural land that converted out of agricultural land use category were re-categorized under their true land use as data collection advanced and became more refined. For example, farm ponds went from this category to the "water" category, or woodlands were delineated separately in 2005 accounting for a large increase in woodlands and a loss in agriculture. This may result in a decrease in agricultural land use acreage, yet the actual cultivated or pastured acreage may not change.

Map 49: Agricultural and Developed Lands - 2010

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Developed Land Use 2010
- Agricultural Land Use 2010

Planning Considerations

Incorporate urban agriculture into developing neighborhoods where appropriate.

Remaining agricultural lands can serve as community separation between the Sun Prairie USA and neighboring USAs.

were platted for development in 2010 that were not in 2000. The Town of Sun Prairie saw 2,300 acres converted out of agriculture and developed land increased roughly 1,800 acres. Bristol saw approximately 2,000 less agricultural acres than in 2000, with an increase in developed acres only slightly less. This difference is either from town development or annexation. Windsor saw nearly twice as much development as was converted out of agriculture, likely due to the prevalence of urban development in the Windsor portion of the urban service area. This difference, where more

developed acres occurred than were converted out of agriculture, is from (1) developing non-agricultural lands (e.g. open lands) or (2) lands converted out of agriculture before 2000 that acted as holding lands until development became feasible in the 2000-2010 time period. Note that town lands are also counted as part of urban areas after annexation.

Agricultural land conversions are shown in magenta in [Map 50](#). Note that both urban and rural development contribute to this figure. These trends are in line with regional changes dating back to 1980.⁵⁷

The City of Sun Prairie had 1,470 acres of agricultural lands in 2000 and 504 acres in 2010. This decrease is likely due to developing agricultural lands being held for urban development. Sun Prairie development increased several times this amount indicating that a significant development occurred on lands that were not agriculture or already converted out of agriculture prior to 2000. According to [Map 51](#), 500 of the 504 acres were in the Service Area in 2010. This land typically remains agriculture until development occurs (often leased out to maintain lower agricultural use tax rates). ***Alternatively, community gardens, community based farms and other urban scale agriculture can be incorporated into urban developments. Urban agriculture can provide buffers between communities, land uses and natural resources, and greater food security*** (adequate food availability, access, and use⁵⁸).

B. Farmland and Farm Operation Characteristics

Variables characterizing agricultural acreages, concentration, land value, soil quality, and support services can be useful in planning for urban and rural development and agricultural preservation.

1. Agricultural Parcels

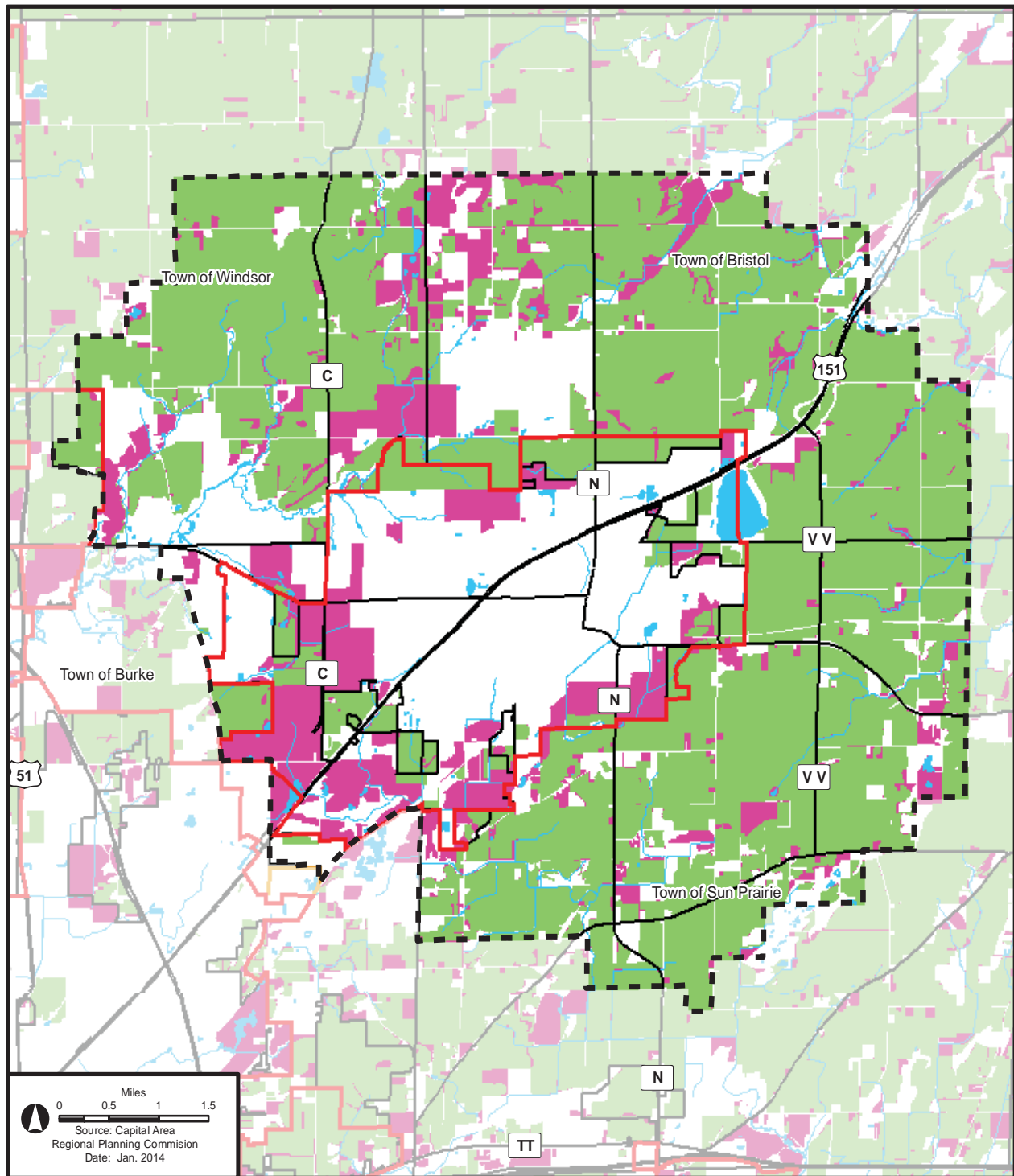
Agricultural land is divided into parcels and often these parcels host other land uses, such as woodlands or water. Thus, parcels are potentially larger than the actual area in agricultural production. Still, parcels are important to examine because agricultural land is sold by the parcel. ***Moreover, land use regulations occur at the parcel level and preservation recommendations must be useful at the parcel level.*** Finally, parcels are the base unit for determining base farm tracts (bordering parcels with the same owner) and contiguous blocks (bordering parcels) of agricultural land presented later. See [Map 52](#).

⁵⁷ A portion of the agricultural land that converted out of agricultural land use category were re-categorized under their true land use as data-collection advanced and became more refined. For example, farm ponds went from this category to the "water" category, or woodlands were delineated separately in 2005 accounting for a large increase in woodlands and a loss in agriculture. This may result in a decrease in agricultural land use acreage, yet the actual cultivated or pastured acreage may not change.

⁵⁸ World Health Organization

Map 50: Agricultural Land Conversion 2000-2010

Sun Prairie FUDA, Dane County, WI

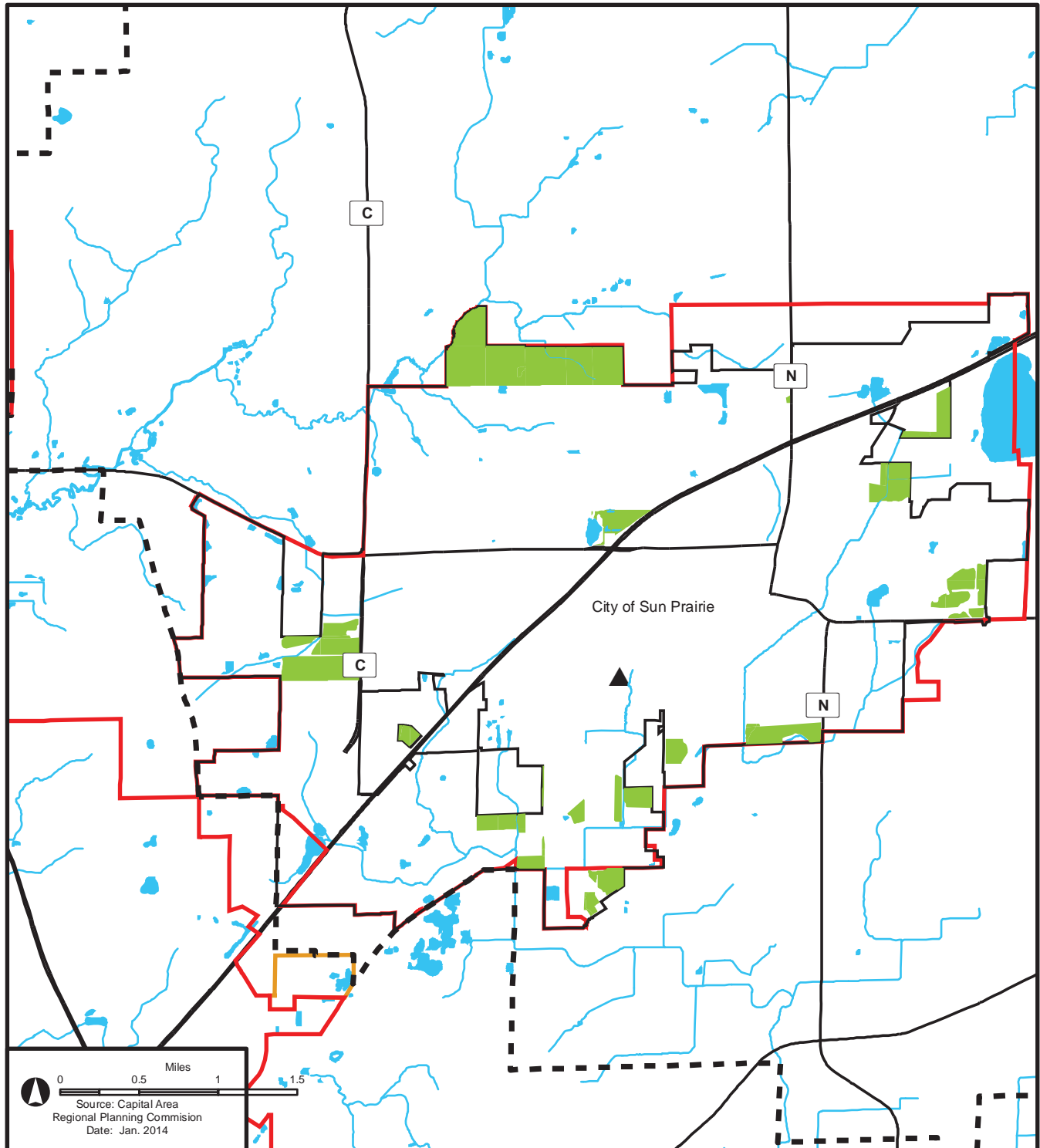


- FUDA Study Area
- Municipal Boundary
- 2010 Agriculture
- Urban Service Area
- Limited Service Area
- 2000 Agriculture

Lands converted out of agriculture maybe result from improved data collection and delination of open lands.

Map 51: City Lands in Cultivation - 2010

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundaries
- Community Gardens
- Sun Prairie Agriculture

Table 18. Parcels with Agricultural Land (acres)

	2000				2010			
	# Parcels	Median	Mean	Max.	# Parcels	Median	Mean	Max.
Study Area	920	25	24	51	890	30	27	96
Town of Bristol	722	22	25	43	680	32	26	77
Town of Burke	291	22	24	51	206	17	19	53
Town of Sun Prairie	692	22	24	42	738	20	21	96
Town of Windsor	572	25	25	41	668	33	27	81
Drumlin and Marsh	6,945	22	24	68	6,749	28	24	163
Yahara River Valley	3,516	25	25	59	3,562	28	26	261
County	21,309	23	24	68	20,302	29	25	518

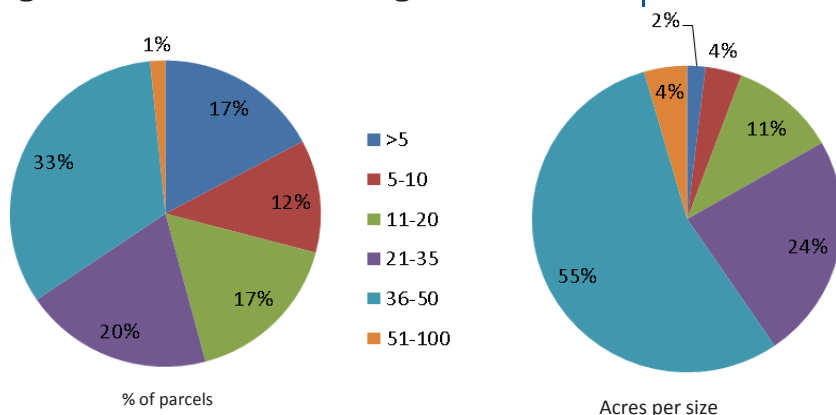
Source: CARPC Land Use Inventory

Table 18 shows that in 2010, the agricultural land in the study area was divided into 890 parcels a 30 parcel decrease since 2000.⁵⁹ This could signal that development occurred on these parcels or that parcels were assembled. The increased maximum size supports the latter, though a mix is likely. Burke and Bristol experienced this trend, while the towns of Sun Prairie and Windsor saw an increase in parcels, likely due to rural splits. Windsor has urban service area and planned development that could also account for many of the splits there. Additionally, an increase in development potential between 2000 and 2008, resulted in numerous parcel divisions, and with the collapse of the housing market thereafter, many of the parcels remained in agricultural use through 2010. In the Town of Sun Prairie, smaller parcels are along Highway 19 and along CTH N and CTH T. Similar to the other jurisdictions, these towns also saw an increase in the maximum parcels size, implying parcel assembly.

Countywide, parcel sizes typically follow agricultural zoning standards. The predominant standard is 1 split for 35 acres. Bristol does not use Exclusive Agricultural Zoning though still uses the 1 per 35 standard. Parcel figures here are slightly smaller than 35 acres, with a 27 acre mean and a 30 acre median. In all of towns except Burke, the mean and median stayed relatively the same or increased.

Study area parcel distribution in **Figure 36** reveals that the most common agricultural parcels are 36-50 acres in size, with 33% of parcels in this range, occupying 55% of the agricultural acreage in the study area. Combined, agricultural parcels 35 acres (the typical zoning standard) or less account for the most parcels, while accounting for 45% of the land area. Parcels over 500 acres can be found in Dane County and in the physiographic sub-regions.

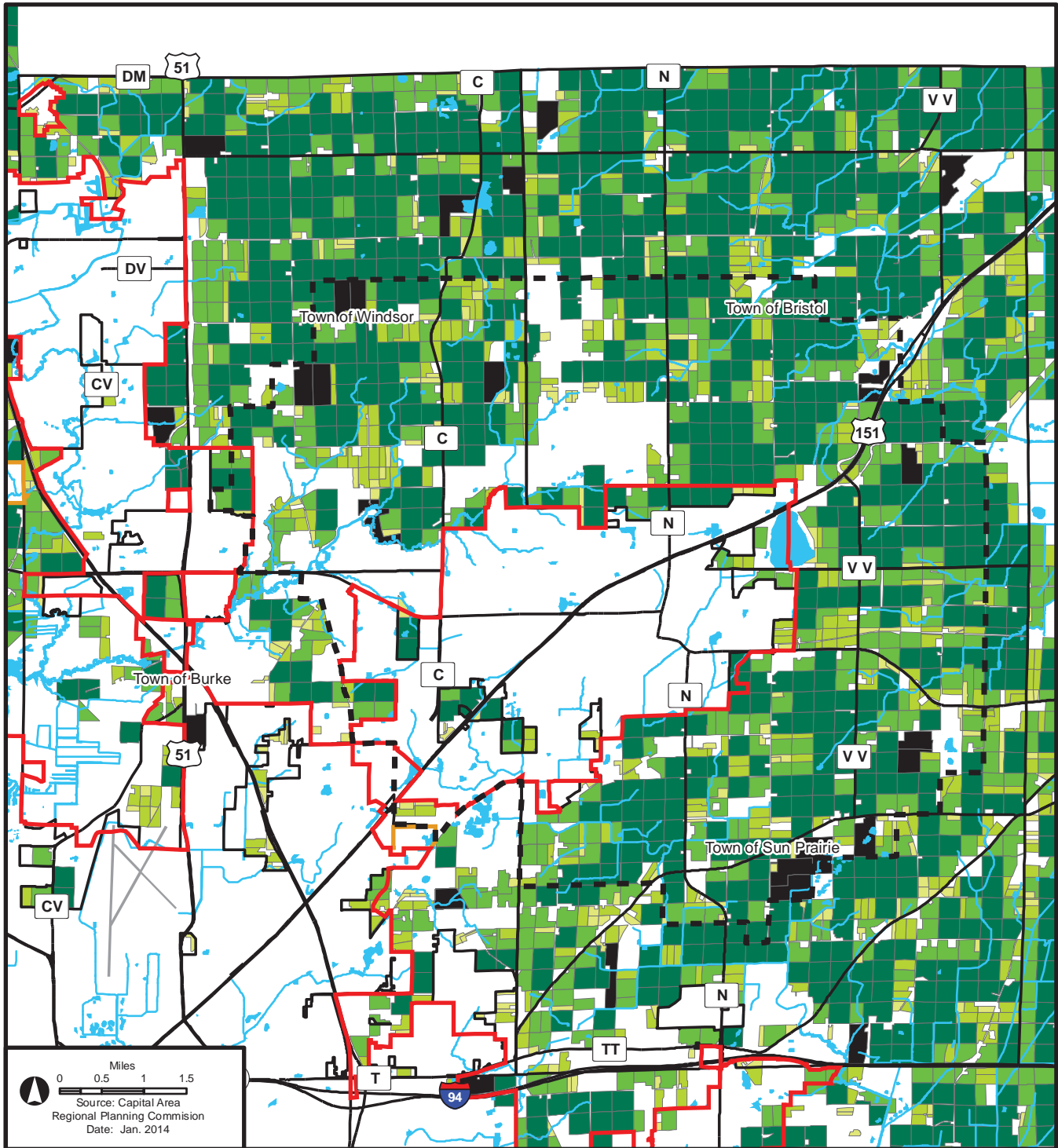
Figure 36. Parcel Size and Acreage Distribution



⁵⁹ Roads, water, parks, and other public lands are not counted in this figure.

Map 52: Agricultural Parcels - 2010

Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	5 - 10 acres	36 - 50
Urban Service Area		11 - 20	51 - 100
Limited Service Area		21 - 35	

2. Base Farm Tracts

To determine the approximate number of farm operations and estimate their size, bordering parcels owned by the same landowner were combined into one unit called a base farm tract, shown in *Map 53*. Within the study area, 329 base farm tracts existed in 2010, revealing that the average land owner holds 3 parcels.

The true number of farm operations may be less because an owner may lease out his or her land to another for farming. While specific data is not available for every parcel or operation (confidential records), the Department of Agriculture, Trade, and Consumer Protection (DATCP) provides summary information on owner-operators at the town level (*Map 54*). In Burke, less than 20% of farms are worked by owner operators, one of the lowest in the county. Towns like Burke, with a lower ratio of owner-operators, can indicate developing areas. In both the towns of Sun Prairie and Windsor, 50-79% of farms are worked by owner operators. The Town of Bristol ranks in the highest group for the County with 80% or higher. Rented farmland near developing areas could indicate that these lands may develop.

Table 19. Base Farm Tracts (acres)

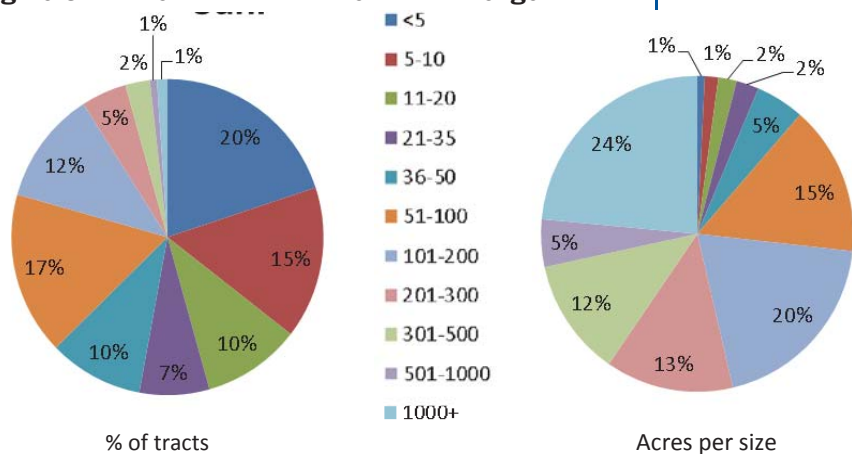
	2000				2010			
	# Tracts	Median	Mean	Max.	# Tracts	Median	Mean	Max.
Study Area	416	39	52	505	329	38	60	586
Town of Bristol	302	38	60	505	201	35	87	1,750
Town of Burke	156	39	37	179	100	38	33	237
Town of Sun Prairie	322	38	51	367	229	35	69	2,461
Town of Windsor	269	39	54	365	182	38	76	1,002
Drumlin and Marsh	2,206	48	74	1,722	2,388	35	68	1,501
Yahara River Valley	1,237	47	71	549	1,227	38	69	1,006
County	6,691	51	77	1,723	7,213	38	69	2,461

Source: CARPC Land Use Inventory

As seen in *Table 19*, the median tract size in the study area was 38 acres and the mean was 60 acres in 2010. This difference indicates that a few landowners own very large parcels. The largest base farm tract was 586 acres.

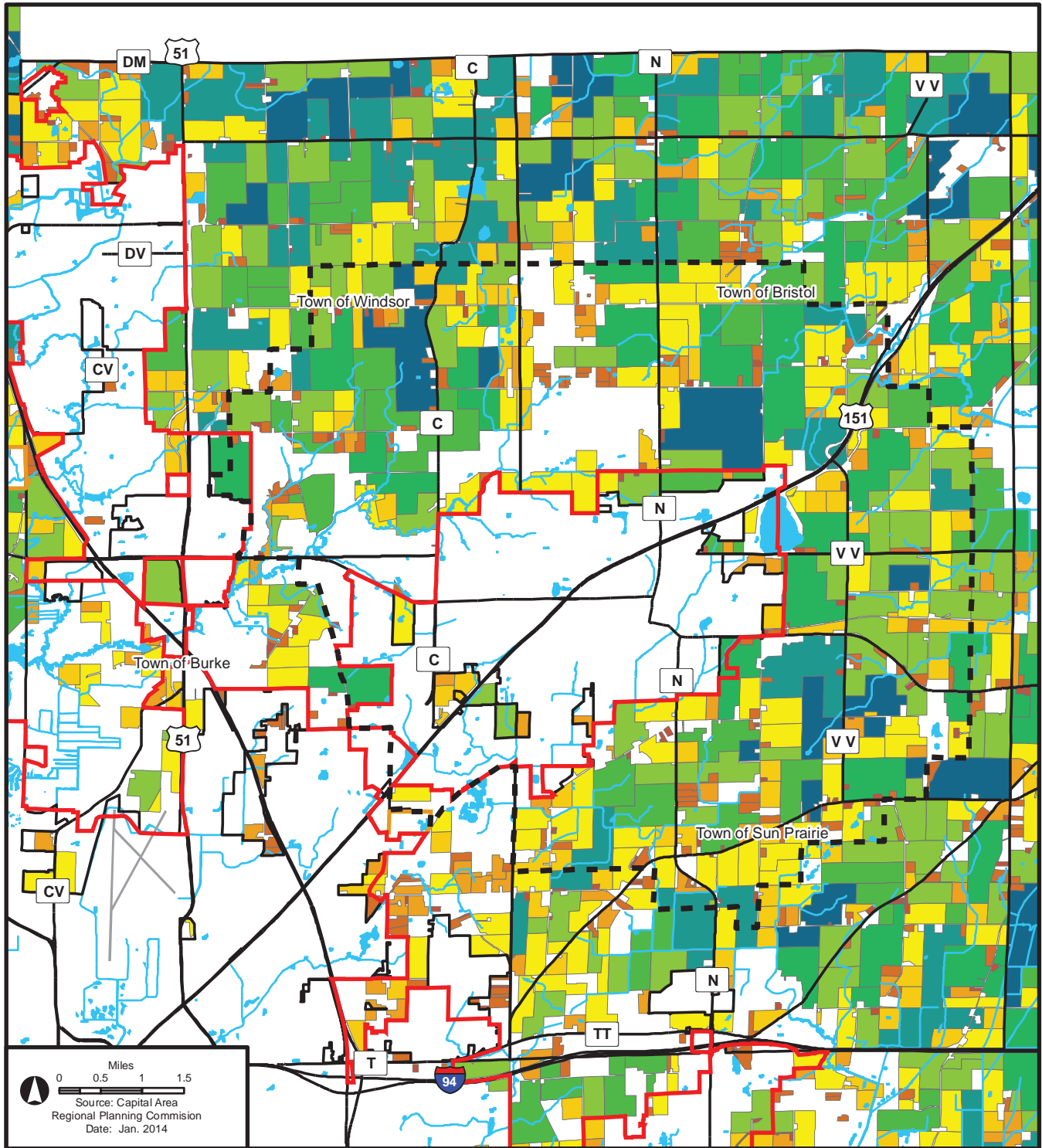
The size distribution breakdown (*Figure 37*) for all base farm tracts shows 42% of all tracts to be under 35 acres, with 35% of these being less than 10 acres. While many tracts are this size, tracts under 35 acres only comprise 6% of all agricultural land. The largest

Figure 37. Base Farm Tract Sizes and Acreage



Map 53: Base Farm Tract Size - 2010

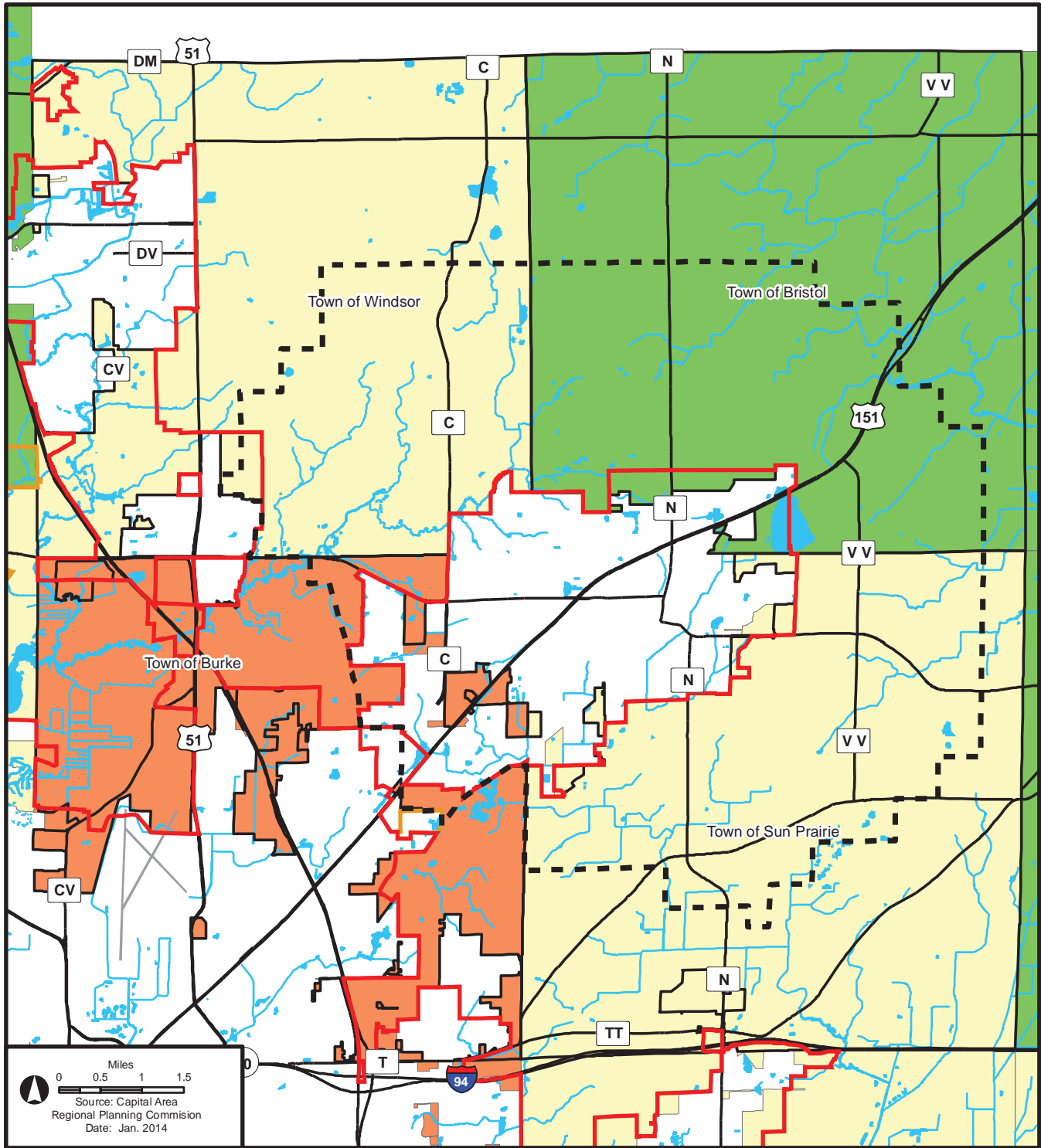
Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	Base Farm Tract Size	11-20	51-100	301-500
Urban Service Area		<5	21-35	101-200	501-1000
Limited Service Area		5-10	36-50	201-300	1001+

Map 54: Farmland Percent Owner-Operator (2008)

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- 20-49% Owner Operator
- 50-79% Owner Operator
- 80% and Higher Owner Operator

area contributions are from tracts 1,000+ acres and occupy 24% of agricultural land area, even though these blocks are 1% of the distribution. The second largest contribution is from tracts 101 to 200 acres at 20% of the land area. County-wide the breakdown of smaller sized tracts mirrors the study area.

3. Agricultural Land Contiguity and Concentration

For agricultural operations to remain viable, a critical mass of relatively uninterrupted agricultural land may be necessary. This creates efficiency for businesses providing resources and services to farmers, and prevents conflicts with surrounding residential. Potential issues include farm noise and odor, traffic conflicts with slow-moving farm vehicles, trespassing and soil erosion.

Contiguous agricultural blocks measure agricultural parcel masses. The study area has a few large contiguous blocks observable in [Map 55](#). [Table 20](#) presents data for the area. *In 2010, the study area had 74 contiguous blocks of parcels with agricultural land at an average of 226 acres and a median of 100 acres each. Within the study area the largest block is 1,579 acres and is in Windsor.*

The largest block was in the Windsor. The study area boasts large contiguous blocks of agricultural land and portions of large blocks primarily outside the study area, as shown. [Map Table 20. Contiguous Agricultural Blocks \(acres\)](#)

	2000				2010			
	# Blocks	Median	Mean	Max.	# Blocks	Median	Mean	Max.
Study Area	104	118	210	1,504	74	100	266	1,579
Town of Bristol	68	183	264	1,069	56	100	329	1,478
Town of Burke	65	78	88	691	61	100	56	361
Town of Sun Prairie	67	134	245	1,677	38	100	401	1,471
Town of Windsor	72	90	201	1,504	51	100	264	1,579
Drumlin and Marsh	673	78	244	3,759	653	45	254	3,573
Yahara River Valley	531	69	166	1,289	411	100	215	1,673
County	1,857	88	275	3,764	1,853	100	268	3,555

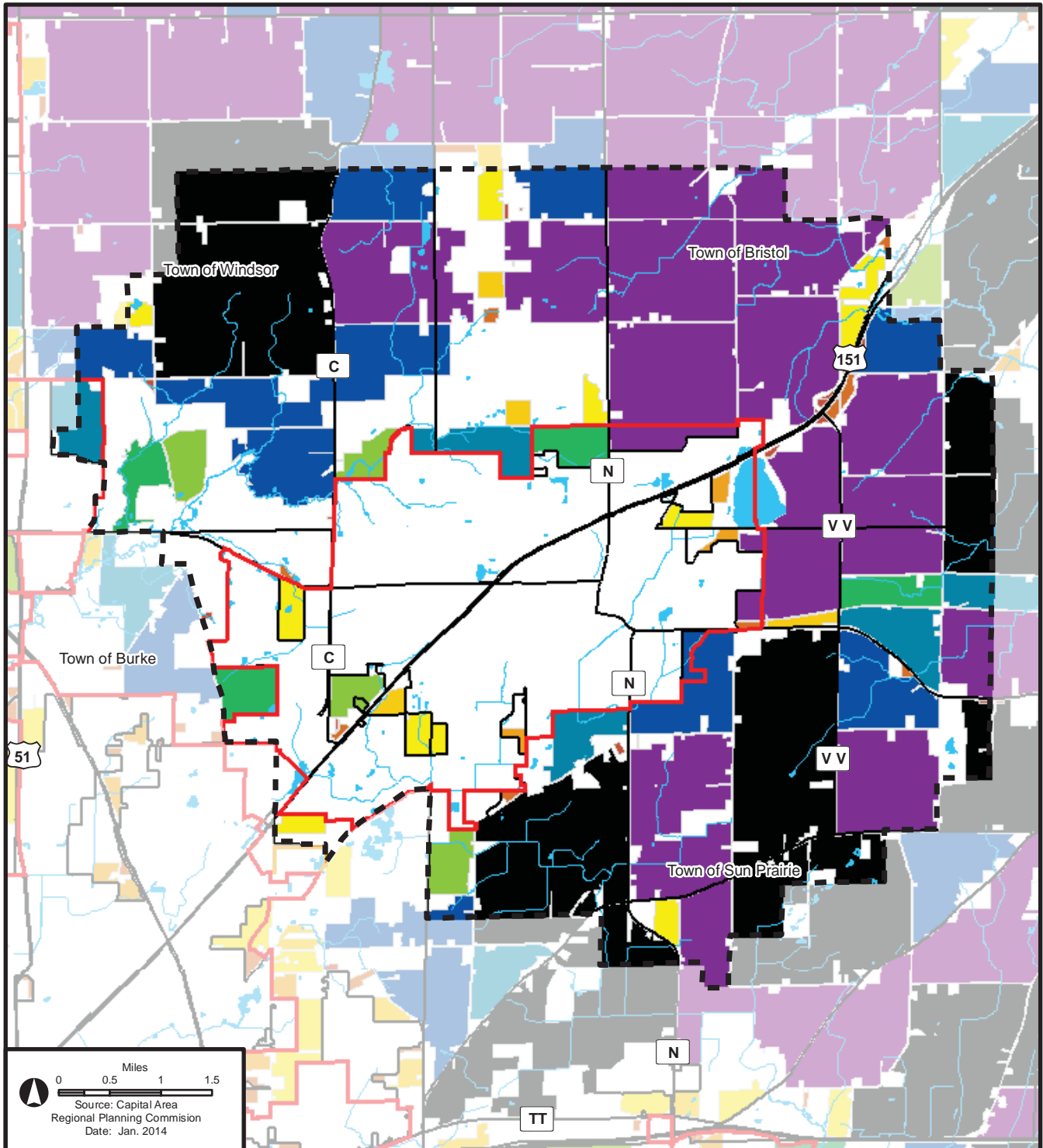
Source: CARPC Land Use Inventory

55 also indicates that agricultural lands within, near, or bordering urban jurisdictions, rural subdivisions and highways show increased fragmentation. A large number of blocks between 500 and 1,000 acres exist throughout the area, especially in central Windsor, south of Highway 151 in the Town of Bristol, in and the Town of Sun Prairie directly south of the city and at the south eastern corner. The latter, is adjacent to the first, second and ninth largest agricultural blocks in the County.

Size distribution ([Figure 38](#)) reveals that nearly 30% of the blocks are under 35 acres, many less than 5 acres along the highways. This mirrors the block distribution in the sub-region and county, although these larger territories have more 21-35 acres block relative to the study area. The next largest interval in the study area is 500-1,000 acres and accounts for nearly half of the land in the study area. Combined, blocks over 300 acres, while only 34%

Map 55: Contiguous Agricultural Blocks - 2010

Sun Prairie FUDA, Dane County, WI

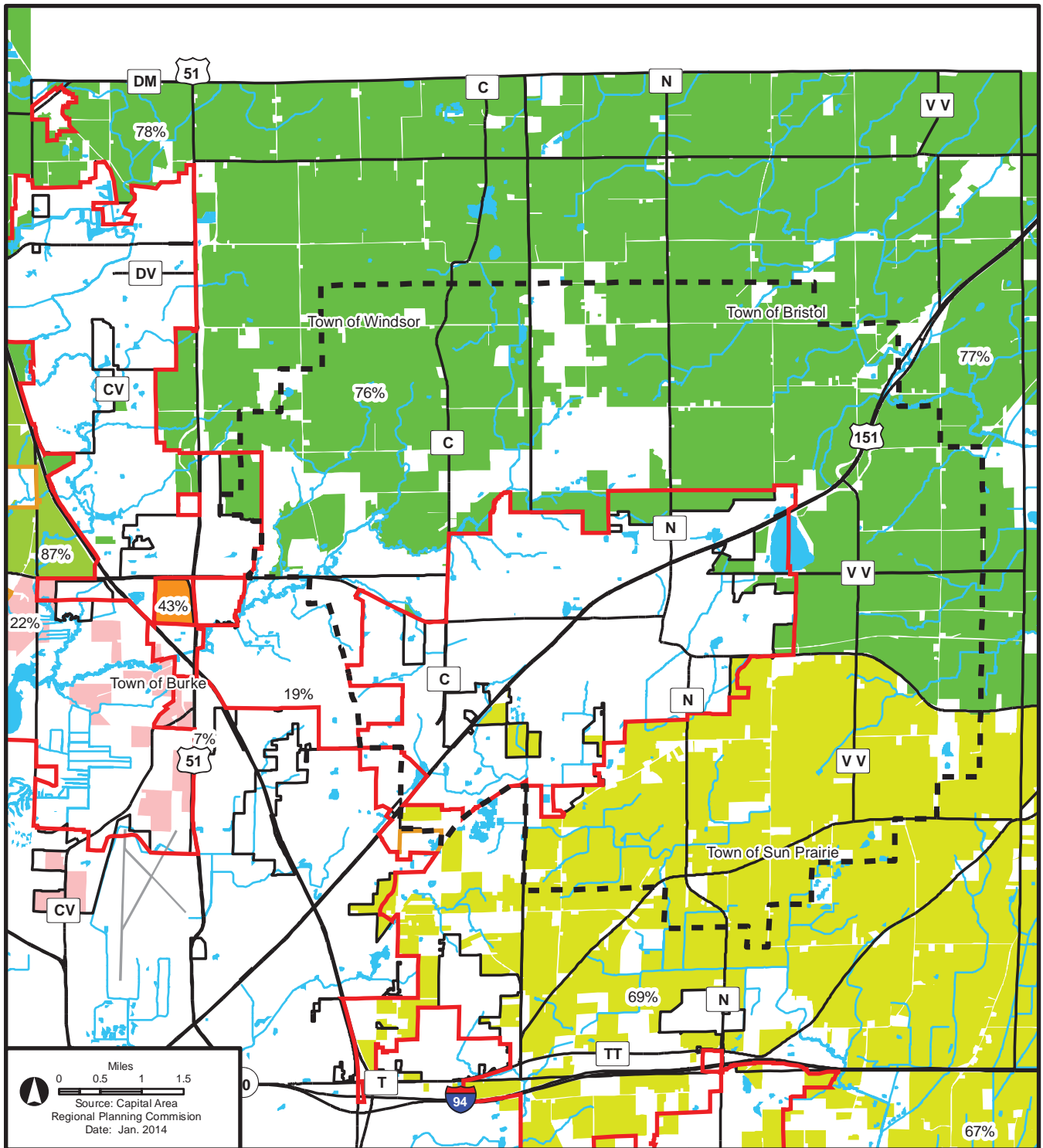


	FUDA Study Area	Block size (acres)		11-20		51-100		301-500
	Urban Service Area	Acres		21-35		101-200		501-1,000
	Limited Service Area		<5			201-300		1,001+
	Municipal Boundary		5-10					

This analysis combines all touching agricultural parcels that are not separated by any roads, major water bodies, other non-agricultural development, or steep slopes. 74 blocks existed in the study area in 2010. The largest was 1,579 acres. The median tract size is 100 acres and the mean is 266 acres.

Map 56: Agricultural Concentration Between Major Roads - 2010

Sun Prairie FUDA, Dane County, WI

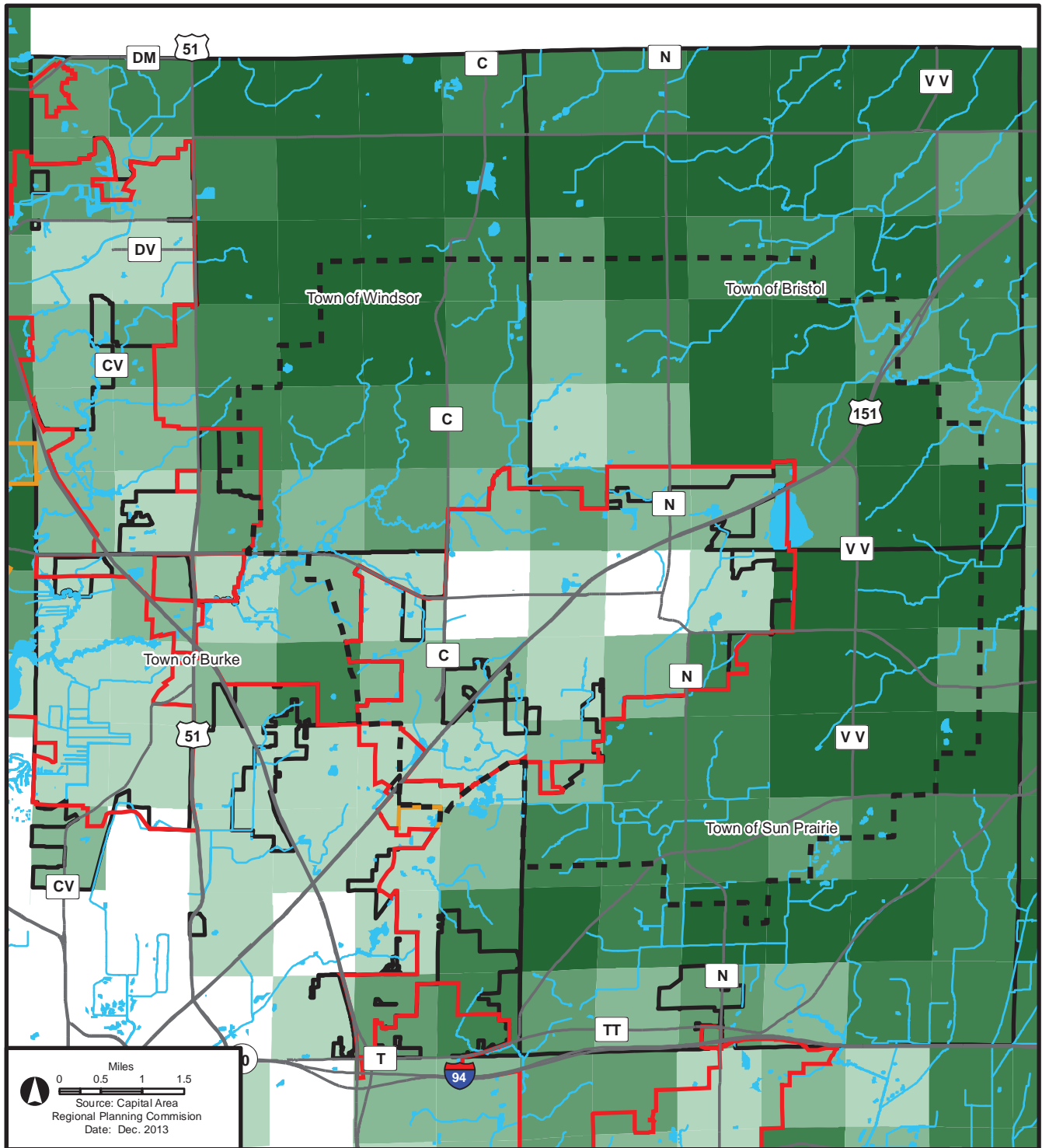


FUDA Study Area	Municipal Boundary	Agricultural Concentration (%)	40-49	60-69	70-79
Urban Service Area		20-29	50-59	80-89	90+
Limited Service Area		30-39			

This analysis combines all agricultural parcels bound by major roads and calculates the percentage of the land that is in agricultural use with that area. This analysis was conducted to show contiguous agriculture without considering local roads a barrier to agricultural vitality.

Map 57: Section Level Agriculture Percentage - 2010

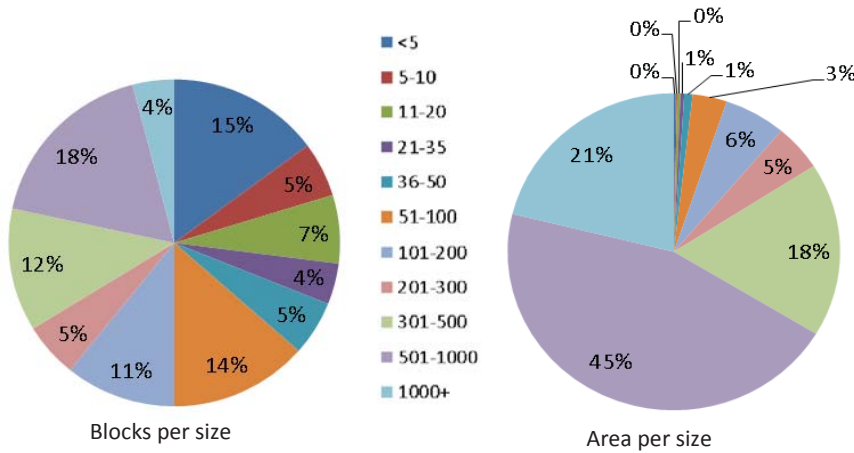
Sun Prairie FUDA, Dane County, WI



Urban Service Area
 Municipal Boundary
 Limited Service Area

Percentages were calculated by determining how much land was being used for agricultural purposes from the 2010 land use inventory for each section.

Figure 38. Contiguous Block Size Distribution and Acreage



of blocks, constitute 85% of the land area. *Larger contiguous agricultural blocks located outside near-term development areas could be well suited for preservation. Smaller blocks, especially near developing areas, might infer that long-term farming may not be as viable. If smaller blocks or blocks in near-term growth areas are considered valuable for agricultural use, these areas may require special efforts to preserve, or to adopt practices to reduce the burden from expanding urban development on nearby farm operations and maintain the economic viability of an isolated farm operation.*

Another useful measure is agricultural concentration shown in [Map 56](#). Because many local and rural roads benefit agricultural operations, they are removed from the analysis as barriers. Instead, only major roads are considered barriers to agricultural concentration. The agricultural concentration in Burke is under 50% agriculture, while the Towns of Sun Prairie, Windsor, Bristol and as far as York reach the highest agricultural concentration in the county at ranging from 75% to 90% of all land uses. [Map 57](#), Agricultural Concentration by Section, mirrors these results and highlights that the towns surrounding the City of Sun Prairie are some of the most concentrated areas for agricultural production in the county. A few areas exist outside the study area at over 50%, including at the interface of Madison CUSA and Sun Prairie USA.

Planning Considerations

Preserve large contiguous blocks of agriculture outside of immediate growth areas for rural production.

Blocks near developing areas may require special preservation efforts or changes in practices, if the area is desired for continued agricultural production.

Large contiguous blocks in areas with low agricultural concentration due to development may be more susceptible to development pressure. *Where agricultural concentration is declining due to increases in urban and rural development and landowners and the municipality want to preserve agriculture, a strategic approach to preserving existing agriculture or employing innovations in agricultural ventures and practices, such as agrarian urban developments, specialty cropping, poly-culture cropping, etc. could help to ensure viable farmland and operations.*

4. Agricultural Operation Types

The study area and these jurisdictions support livestock production and row crop operations. According to the 2010 Land Use Inventory, the livestock operations are primarily beef cattle and dairy cattle. Burke hosts nearly 20 distinct locations for pasture for beef production amounting to 38 acres. Windsor hosts 57 operations split between beef and dairy with 40 distinct pastures. Sun Prairie hosts 33 premises with twice as many dairy as beef operations and 53 designated pasture areas. Finally, Bristol hosts 40 with three times as many dairy than beef operations and 50 pasture areas. The higher prevalence in dairy in this area

of the county likely correlates with the presence of several active dairy plants in Sun Prairie and eastern Madison. [Map 58](#) shows the location of some of these operations by type in 2010. [Table 21](#) shows 204 acres were pasture for livestock in the study area.

The most dominant crops are row crops including corn, soy, hay (includes alfalfa) and others as shown on [Table 21](#) and [Map 59](#). These crops are typically dedicated to growing feed for livestock. Compared across the county, the study area hosts a greater proportion of row crops and a lesser proportion of pasture lands because the terrain allows more intensive agricultural practices than occur in the western Dane County.

Of note, Bristol hosts 36 acres of nursery/floriculture sites, Burke hosts 14 fruit tree acres, the Town of Sun Prairie has an apple orchard, 83 nursery/greenhouses acres and 2 acres of polyculture/Community Supported Agriculture (CSA), and Windsor hosts 37 acres of nursery greenhouse and 8 acres with food trees. Of these, 63 acres of tree/nursery and all vegetables (including the polyculture/CSA) are in the study area.

Table 21. Agricultural Land Cover 2010 (acres)

	Row Crops, Grains, Hay, or Seeds					Vegetable	Pasture	Fallow
	Hay/ Alfalfa	Grain	Wheat	Corn	Soybeans			
Study Area	3,223	0	429	10,715	3,629	10	204	38
Town of Bristol	2,075	0	283	9,645	3,095	0	206	54
Town of Burke	821	0	0	1,252	139	0	38	7
Town of Sun Prairie	2,476	0	270	7,738	2,696	2	150	51
Town of Windsor	3,051	0	476	7,250	1,413	6	139	84
City of Sun Prairie	82	0	0	356	65	2	0	0
Drumlin and Marsh	18,778	290	3,194	74,66	15,251	0	2,677	868
Yahara River Valley	15,096	10	1,520	41,361	11,012	3	1,857	443
County	59,109	1,151	7,710	194,263	70,344	46	15,611	2,271

Source: CARPC Land Use Inventory

5. Tax Value Assessment

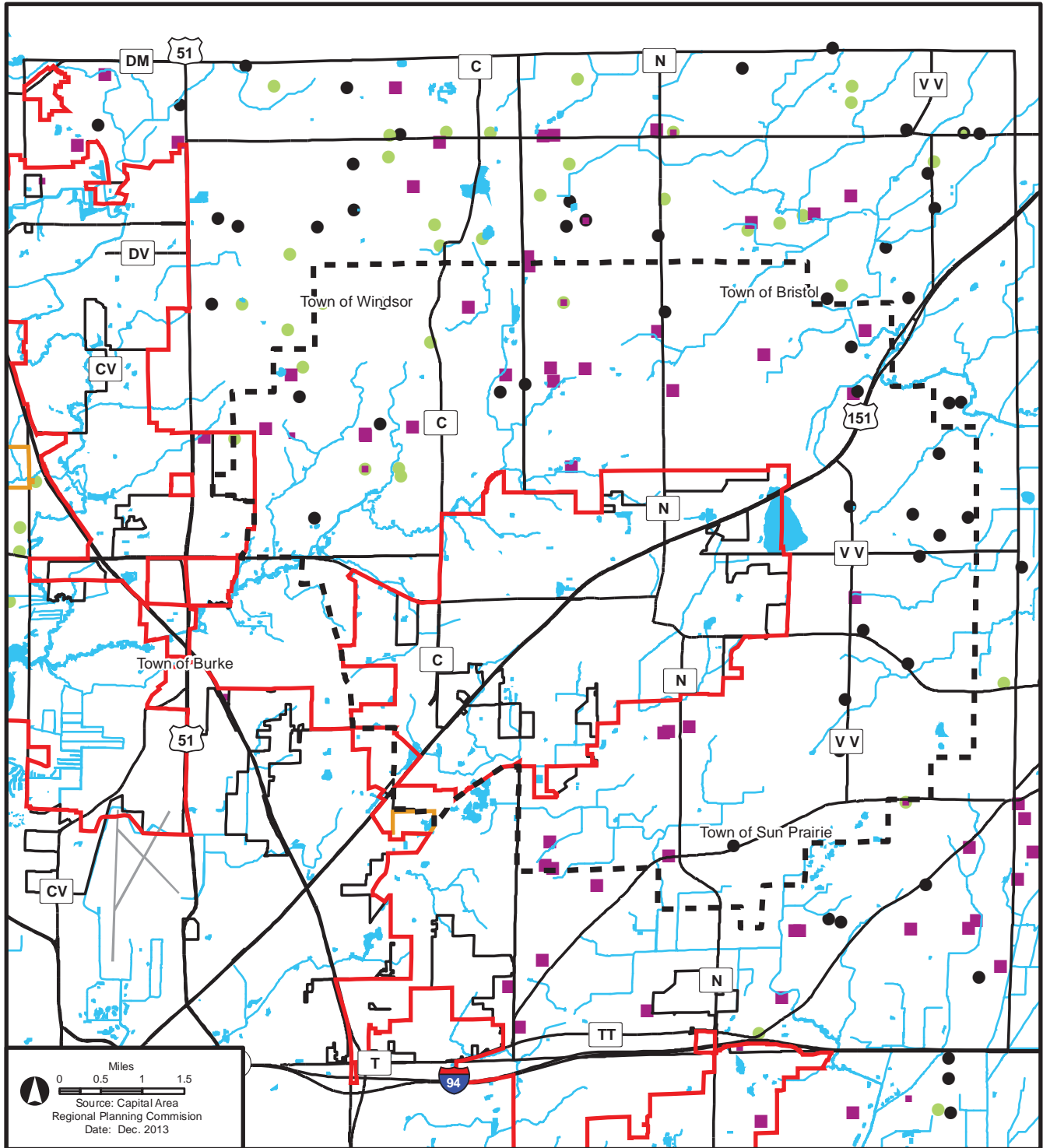
Supplementing these data with land and improvement assessment values may signify the intent to maintain agricultural use. Assessment figures are shown in [Table 22](#) and [Map 60](#) for land value and in [Table 23](#) and [Map 61](#) for improvement value.

Parcels with low land value assessment are typically dedicated to crop cultivation or pasture and are away from developing areas. These lands may not generate a profit significant enough to encourage selling the land for development and may not require preservation measures. Where development pressure is eminent, agricultural land linked to a high value improvement or facility could remain in agricultural production and may not require preservation measures.

Note that improvements are typically built structures that take arable land out of cultivation. Thus, preserving parcels with high value improvements alone is insufficient for food and fiber cultivation. Also note that some improvements on agricultural parcels may not be agricul-

Map 58: Livestock Operations- 2010

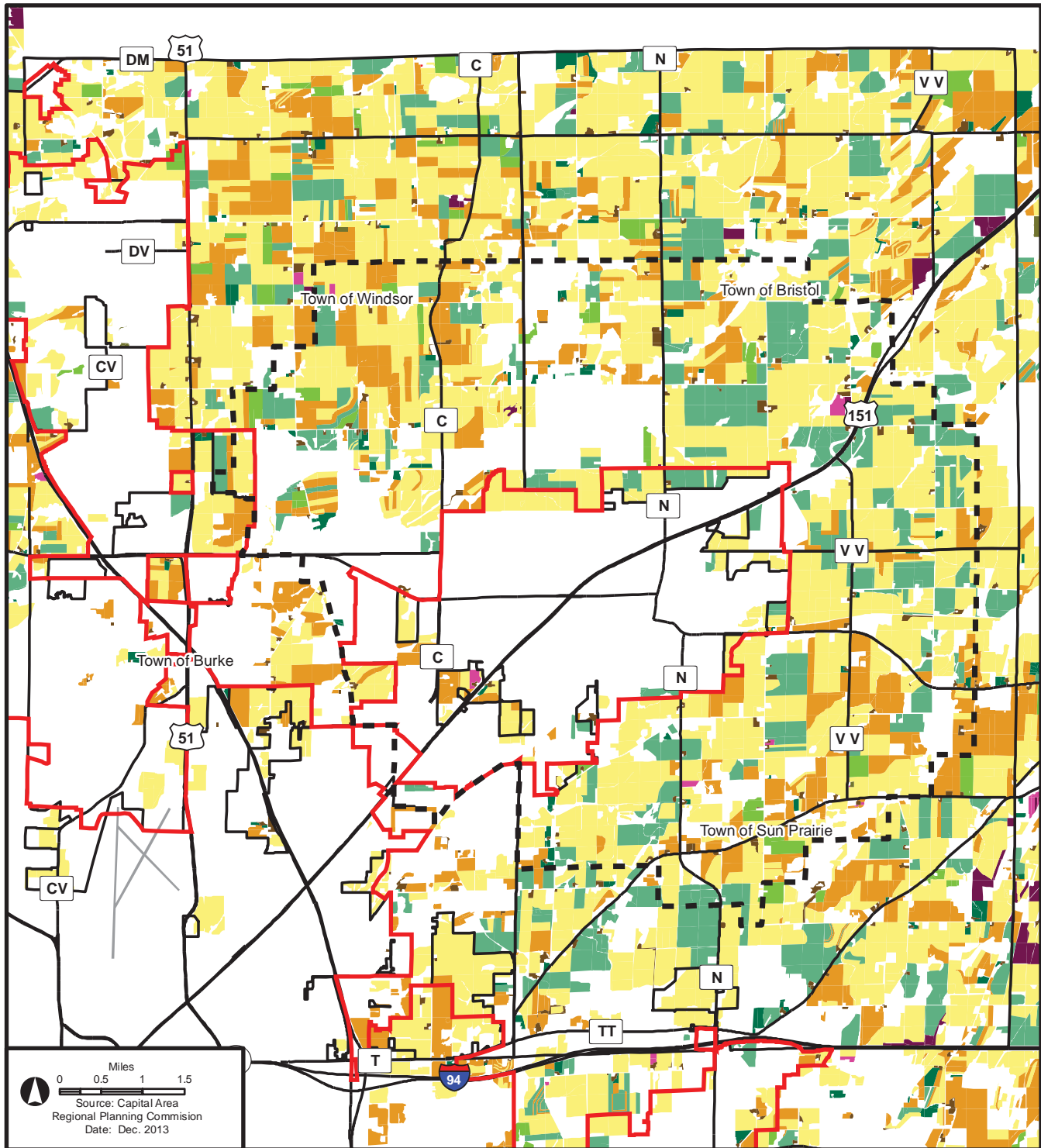
Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	Primary Livestock	Hog/Pig	Secondary Livestock	Hog/Pig
Urban Service Area		Dairy	Sheep	Dairy	Sheep
Limited Service Area		Beef	Other fur bearing	Beef	Other fur bearing
		Goats	Horses	Goats	Horses

Map 59: Crop Type - 2010

Sun Prairie FUDA, Dane County, WI



- | | | | | |
|----------------------|-------------------------------------|------------------|-----------------|-----------------|
| FUDA Study Area | Agricultural Land Use (2010) | Soybean | Hay Field | Pasture |
| Urban Service Area | Ag Buildings | Wheat | Tobacco Field | Fruit/Vegetable |
| Limited Service Area | Corn | Dry Pea and Bean | All Other Crops | Aquaculture |
| Municipal Boundary | | | | Nursery |

All groups may not be present

Table 22. Land Tax Assessment 2010 (\$/per acre)

	Total	Median	Mean	Max.
Study Area	29,830,100	11,600	5,268	190,909
Town of Bristol	17,793,600	11,400	2,679	90,000
Town of Burke	10,289,300	13,600	7,957	190,909
Town of Sun Prairie	24,784,300	11,950	6,267	189,825
Town of Windsor	20,661,300	10,900	3,778	83,171
Drumlin and Marsh	27,681,553	11,900	4,102	190,909
Yahara River Valley	135,382,200	11,100	4,294	359,898
County	804,741,400	21,800	4,224	403,846

Source: Dane County Tax Assessor

Table 23. Improvement Tax Assessment 2010 (\$/per acre)

	Total (\$)	Median	Mean	Max.
Study Area	8,622,509	0	9,688	484,364
Town of Bristol	3,439,231	0	5,058	470,263
Town of Burke	2,399,397	0	11,648	484,364
Town of Sun Prairie	7,642,255	0	10,355	304,623
Town of Windsor	4,467,185	0	6,687	184,419
Drumlin and Marsh	354,633,700	131,900	158,744	6,252,000
Yahara River Valley	25,652,065	0	7,202	479,875
County	140,169,990	12	6,904	1,634,615

Source: Dane County Tax Assessor

turally related. Closely examining improvements may be necessary to determine the likelihood of land converting from agricultural use to higher intensity development uses.

Some parcels have a very low assessment for both land and improvement values. For example, 21 parcels are assessed a zero dollars improvement value, The majority of parcels are at least \$1-1,350/acre at 600 parcels. The next largest categories with 44 parcels are \$3,251-5,950/acre and parcels over \$30,000/acre. The difference also reveals that a few very highly valued parcels raise the mean for the entire area.

6. Soil Quality

Successful crop cultivation depends significantly on soil quality. In Dane County, soil quality is referenced under two measures, prime farmland and land evaluation. Land evaluation (LE) factors in prime farmland to determine soil classes, where Class I is the most preferred, and Class VIII is the least preferred agricultural soil.

Soil characteristics associated with productive agriculture are often also ideal for development. *Special consideration is warranted when pursuing development in these areas to preserve high quality lands for food cultivation if desired by the land owners and community.* Table 24 provides summary information in Map 62 and Map 63.

Table 24. Prime Farmlands and Land Evaluation Classes 2010 (acres)

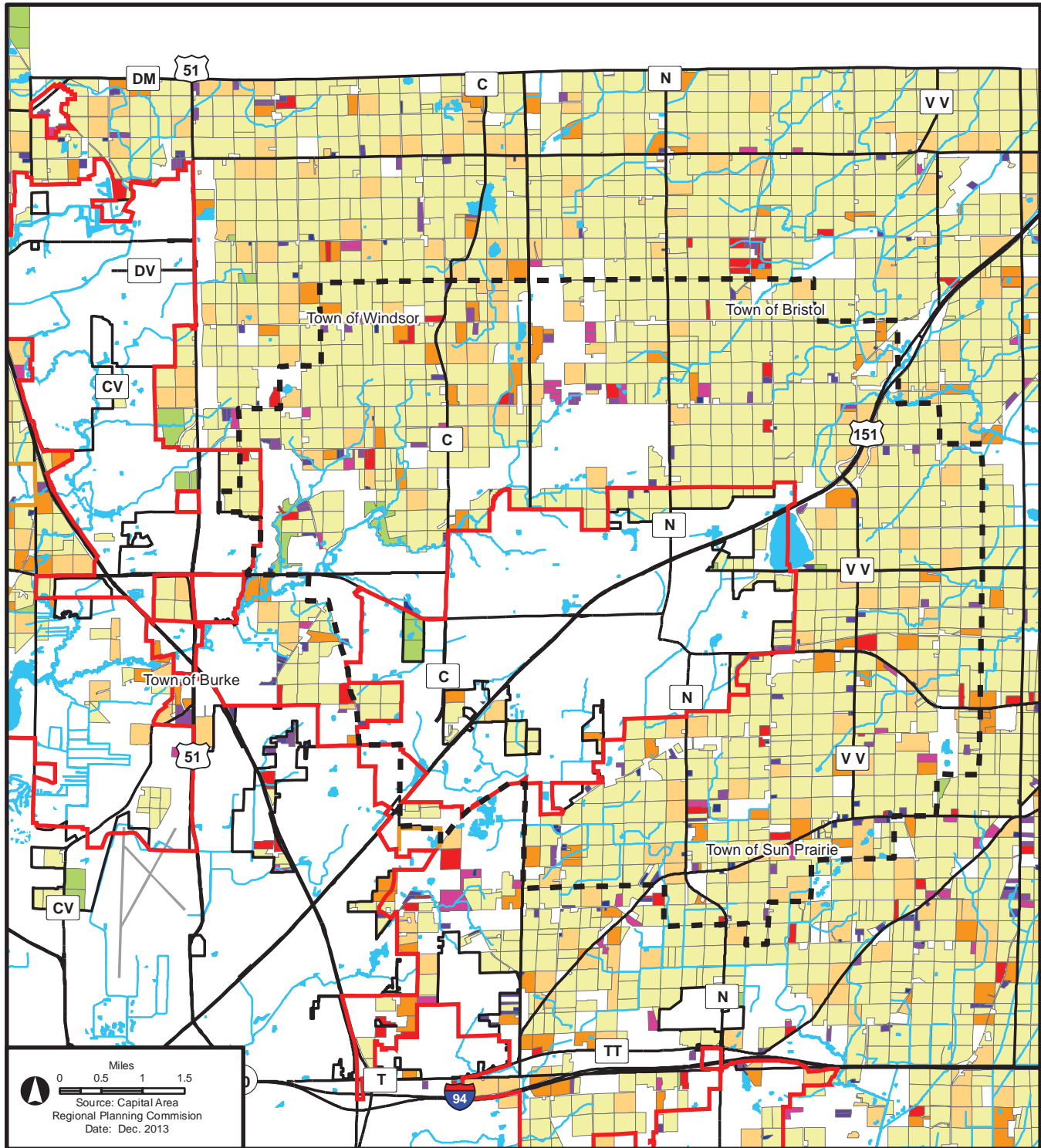
	Prime farmlands	LE Classes				
		I Best	II	III	IV	V-VIII
Study Area	15,577	14,521	7,891	988	3,915	6,356
Town of Bristol	14,971	10,025	3,235	564	10,025	7,592
Town of Burke	1,917	1,623	2,663	397	1,623	4,668
Town of Sun Prairie	11,221	6,291	4,759	504	6,291	7,349
Town of Windsor	10,403	8,488	4,261	611	8,488	4,771
City of Sun Prairie	404	3,091	1,774	210	3,091	2,373
Drumlin and Marsh	1,971	1,623	2,663	397	1,155	3,513
Yahara River Valley	43,675	51,303	33,626	7,799	27,203	46,584
County	243,732	171,266	121,846	57,111	117,128	280,361

Source: Dane County Conservation

In Burke, a relatively small amount of high quality soils are located east of Interstate 90/94. The portion of Burke immediately to the south of the City of Sun Prairie is not prime and has lower class soils likely due the mineral resources present there. Continuing south to-

Map 60: Value Assessment of Land - 2010

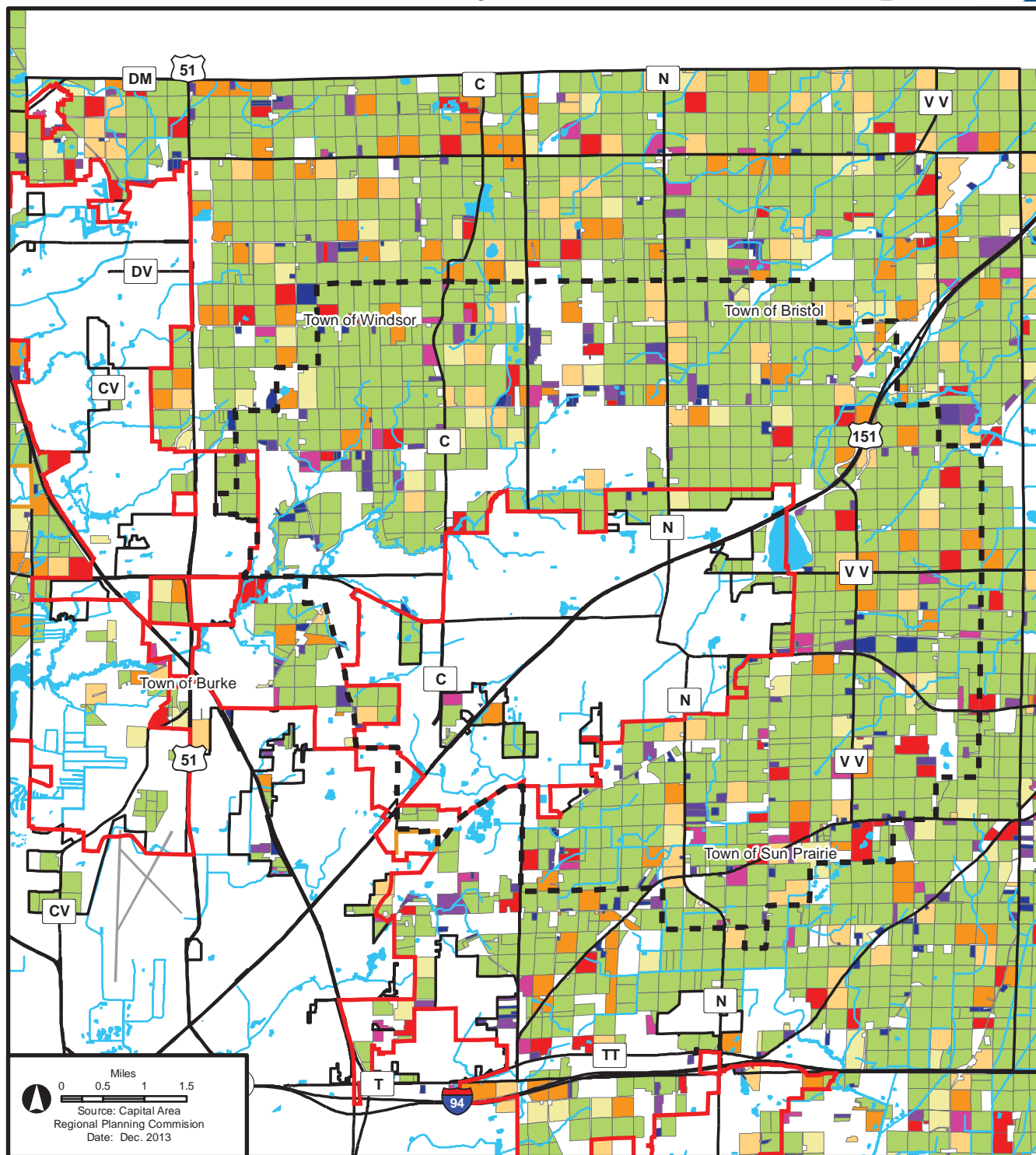
Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	Land Value (\$/acre)	\$,1351 - 3,250	\$9,351 - 13,300	\$30,000+
Urban Service Area		0	\$3,251 - 5,950	\$13,301 - 19,050	
Limited Service Area		\$1 - 1,350	\$5,951 - 9,350	\$19,051 - 30,000	

Map 61: Value Assessment of Improvements - 2010

Sun Prairie FUDA, Dane County, WI



FUDA Study Area	Municipal Boundary	Land Value (\$/acre)	\$1,351 - 3,250	\$9,351 - 13,300	\$30,000+
Urban Service Area		0	\$3,251 - 5,950	\$13,301 - 19,050	
Limited Service Area		\$1 - 1,350	\$5,951 - 9,350	\$19,051 - 30,000	

wards Madison’s planned Northeast neighborhood, soil quality significantly improves. The land west of the Interstate is significantly compromised for cropping due to poorly drained soils, high water table, and proximity to the Yahara River and Lake Mendota. This is also the case for a small land area in Windsor around Token Creek, while the remaining area hosts significant expanses of prime and high class soils when drained. While the Towns of Bristol and Sun Prairie face slightly more water related barriers (floodplains, wetlands), they also host a significant amount of prime soils when drained. In the Town of Bristol a good portion of the quality soils directly border the city boundary to the north and east. Prime and high class soils in the Town of Sun Prairie also hug the city’s eastern border, with more scattered to the south. Areas with high quality soils could be used for urban agriculture as an amenity to new residents and the community when they are taken into the urban service area.

7. Support Services

Agricultural operations need land, people and services to support agricultural functions and the livelihood of farmers. Determining where existing services are located and the services they provide can help to identify areas that are well supported for continued farming, and reveal where additional agricultural support services may be warranted. ***The farming sector needs more than just good land for its viability, farm operators and employees are needed to maintain productivity.*** The County has seen a decline in processing facilities over the past few decades as certain agricultural markets have declined or left the area. *The economic health of these businesses and services is a good indicator of the larger agricultural sector’s health.*

As seen in **Map 66**, several food processing facilities are located in or around Sun Prairie. For example, the City of Sun Prairie hosts food warehouses, processing facilities and dairy plants, such as Weyauwaga Cheese. The dairy plants are critical in ensuring the viability of the existing dairy operations.

Additional dairy plants exist in central and eastern Madison, with a few scattered in the west and over the county line. As the rural areas in the study area urbanize, ***consider targeting areas near support services and major roadways for expanding processing, other value-added facilities, warehouse and distribution centers that serve the greater surrounding agricultural sector.***

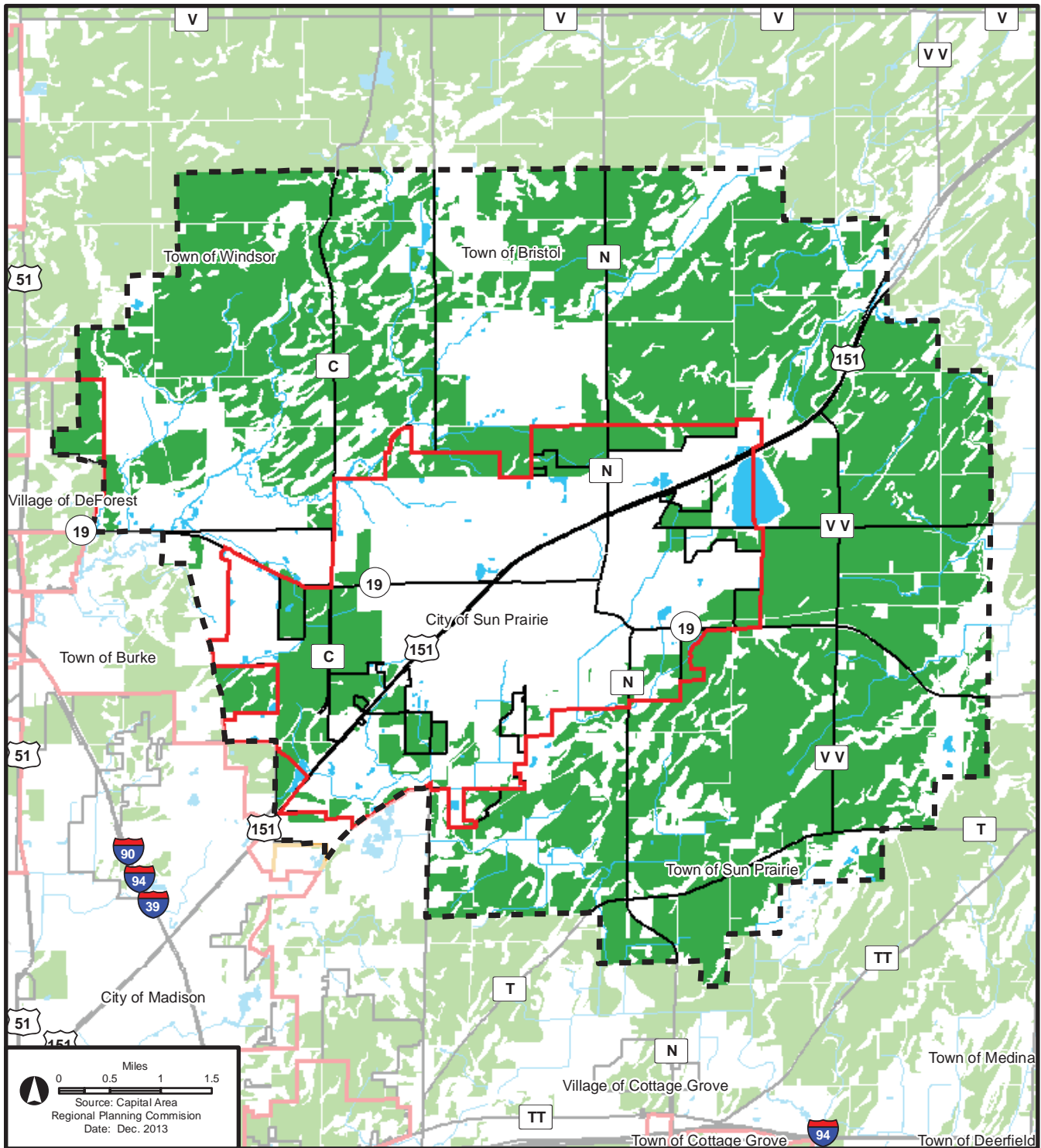
Overall, the greatest concentrations of processing and commercial services are generally concentrated in or on the periphery of urban areas. This highlights interdependence between rural and urban areas throughout the region and indicates the economic contribution rural agricultural activities provide cities and villages and vice versa. This data is not exhaustive and other service, such as veterinary and insemination, should be collected locally and incorporated into the existing data set.

Planning Considerations

Target areas near support services and major roadways for expanding processing, other value-added facilities, warehouse and distribution centers.

Map 62: Prime Farmlands - 2010

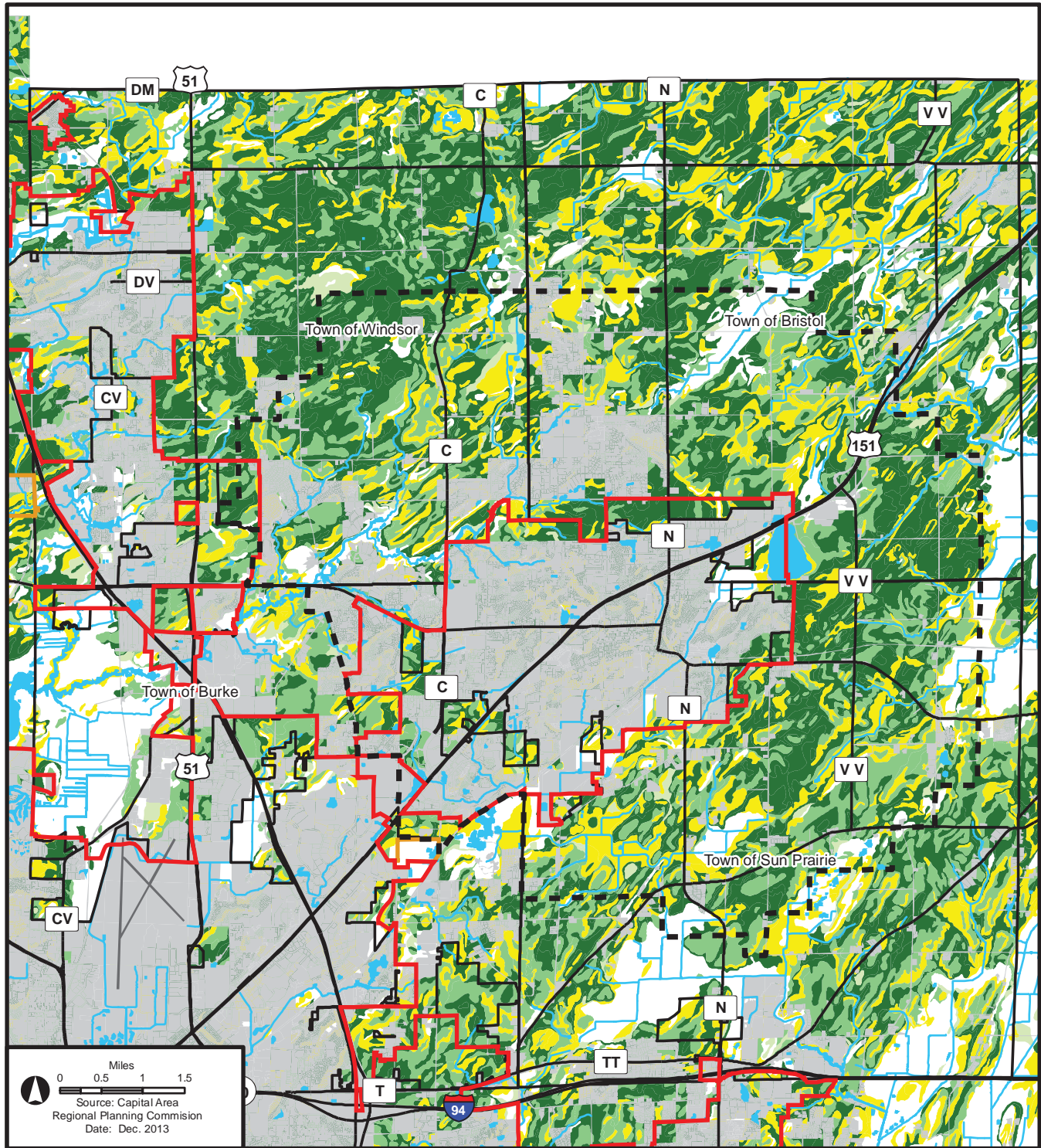
Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Municipal Boundary
- Urban Service Area
- Prime Farmland in Ag Use
- Limited Service Area

Map 63: Land Evaluation Classification - 2010

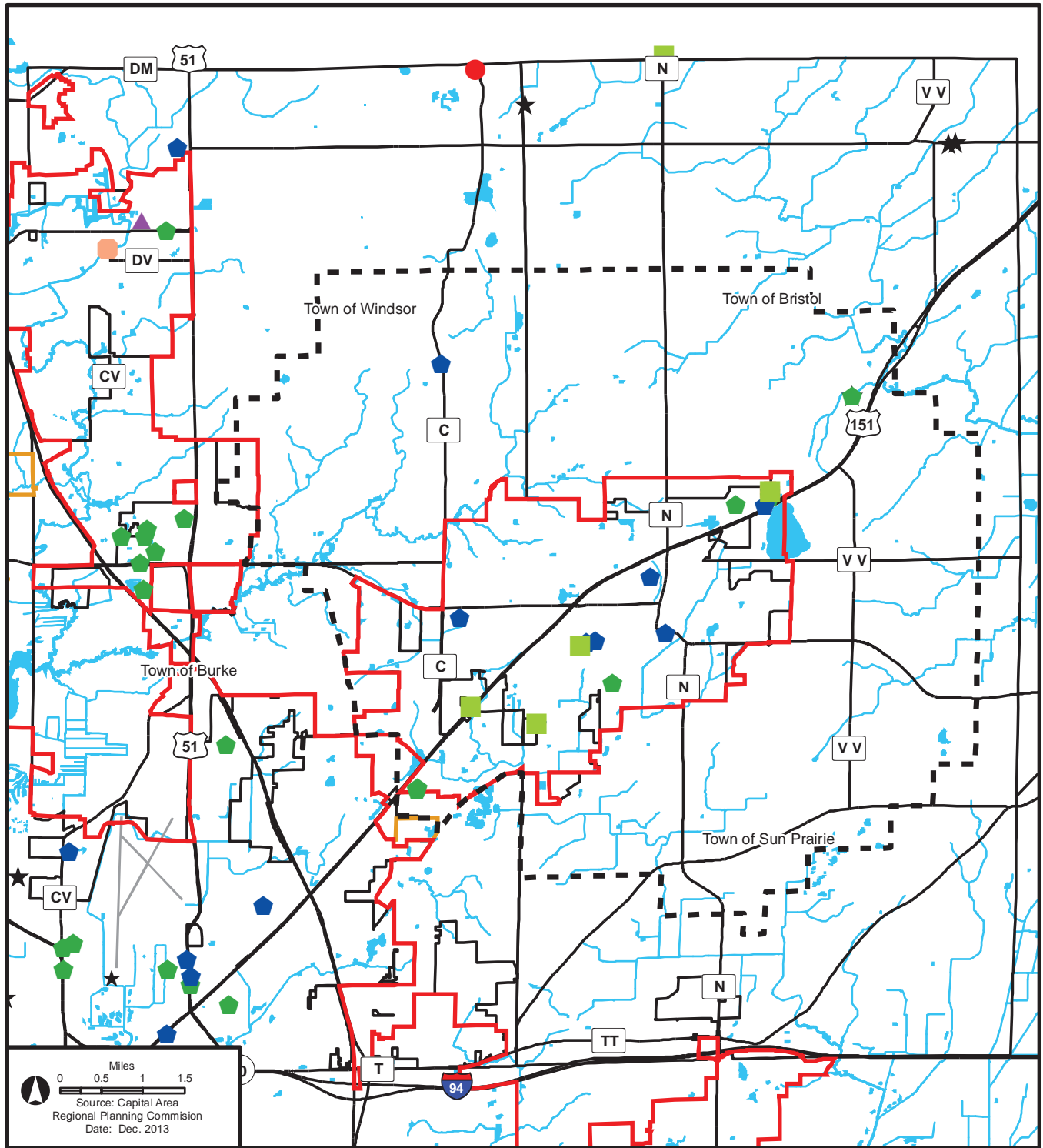
Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Developed Land Use (2010)
- I Best Class for Agriculture
- II
- III
- IV

Map 64: Agricultural Support Services - 2008

Sun Prairie FUDA, Dane County, WI



- | | | | |
|----------------------|----------------------|-----------------|----------------------|
| FUDA Study Area | Municipal Boundary | Food Processing | NOP Organic Products |
| Urban Service Area | Commercial | Meat Plant | Ethanol Facility |
| Limited Service Area | Dairy Plant | Food Warehouse | BioDiesel Facility |
| | NOP Organic Business | | |

Source: Department of Agriculture, Trade and Consumer Protection

C. Agricultural Relationship to Other Land Uses

1. Ecological Services and Functions on Agricultural Parcels

Parcels hosting agricultural land and natural resource features can play a significant role in maintaining environmental quality. This analysis uses widely accepted criteria for establishing open space corridors⁶⁰ including former wetlands drained for agriculture, to determine where natural features occur on agricultural land parcels. Regional open space corridors are continuous systems of drainage ways and stream channels, floodplains, wetlands, steep slopes, and other natural resource features. These corridors maintain and protect natural features essential for preserving the quality of life in the region. These functions are described in detail in the Natural Resources chapter of this report. Identifying open space corridor features on agricultural parcels reveals lands with critical roles in improving and restoring the ecological services and functions the land can provide.

Many high intensity agricultural practices can diminish the ecological services and functions these lands would otherwise provide. The Dane County Water Quality Plan inventories water quality degradation due to historic and current agricultural practices, such as stream channel straightening, draining pothole wetlands, and dewatering isolated wetlands using drain tiles. Over-applying fertilizer, spreading manure, and changing land cover from forest and prairie to agriculture, increase nutrient input into streams and lakes to unnaturally high levels. Excess phosphorus flows into surface water through overland flow or by shallow groundwater. Increased nitrogen levels are also present in the shallow groundwater from over applying nitrogen fertilizer that seeps into springs and streams. Additionally, livestock wading in waterways can cause bank erosion and degrade water quality and habitat health. Finally, low commodity pricing encourages production maximization and planting in areas prone to soil erosion.

Farmers are dependent on environmental functions and resources for their livelihood, and some implement conservation farming practices to reduce the adverse impacts of agricultural activities on these functions and resources. These practices include conservation tilling, improved nutrient management, and manure management. However, even with these practices, the historic impacts remain and inadvertent new impacts from current practices and products are discovered (such as atrazine contamination of the groundwater). Additionally, an emphasis on technology based remediation and mitigation typically increases production costs, and encourages overproduction and operation expansion to disperse costs, resulting in fewer small and medium sized farms.

Groundwater recharge is often mentioned as one of the ecosystem functions of open and agricultural land. The Natural Resources chapter outlines the regional groundwater susceptibilities. High infiltration areas and zones of contribution are identified on [Map 38, page 131](#), [Map 39, page 132](#), and [Map 40, page 133](#).

As illustrated in [Table 25](#) and [Map 67](#), the study area hosts agricultural lands that include ecologically significant lands. [Figure 39](#) illustrates the relative dominance of these ecological features across the study area, Drumlin and Marsh and Yahara River Valley sub-regions,

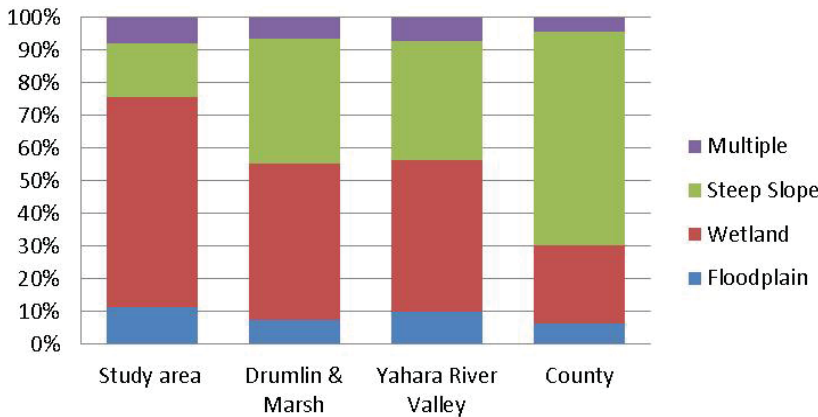
⁶⁰ Map 41, page 135 shows open space corridors in the FUDA study area.

Table 25. Ecological Services and Functions on Agricultural Parcels (acres)

	Floodplain	Wetland	Steep Slope	Multiple	Total
Study Area	258	1,637	1,391	129	3,415
Drumlin and Marsh	2,711	17,702	14,194	2,358	36,965
Yahara River Valley	4,134	19,506	15,288	2,989	50,972
County	13,601	51,723	140,839	9,100	215,263

Source: CARPC Land Use Inventory

Figure 39. Ecological Features on Parcels with Agriculture



practices, conservation, and restoration of former wetlands and riparian zones for various locations in the study area can be provided based on ecosystem requirements and opportunities. Other areas may be suited for integrated resource management, low-impact design, conservation design, agrarian urbanism and accommodating multiple land uses and ecological services simultaneously.

Planning Considerations

- Consider land management and the extent of the management practice together.
- Conservation efforts should not fiscally penalize land owners.
- Pollutant trading opportunities exist under the Rock River TMDL plan.

Land owners and the local jurisdictions can pursue conservation goals together. *Conservation efforts should be pursued with the idea that conservation areas would produce income for the land owner. Restoration projects could be completed through pollutant trading opportunities through the Rock River TMDL project discussed in the Natural Resources section.* Note that some downstream mitigation goals for water quality improvement and flood control might be possibly achieved more cost-effectively through upstream conservation measures. Such opportunities should be evaluated as part of plan conceptualization in downstream areas.

2. Existing Farmland Preservation

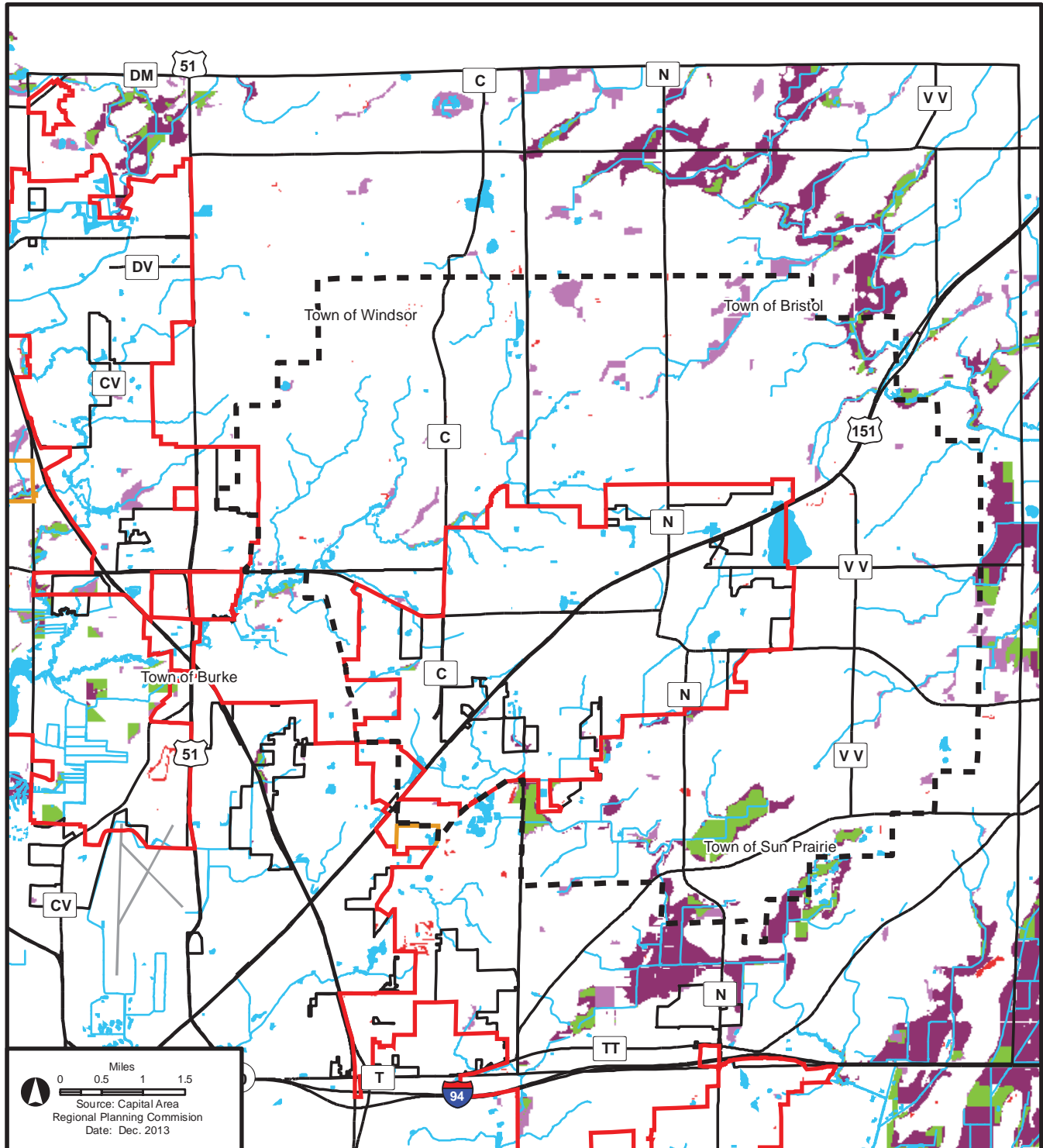
All town jurisdictions have some form of agriculture conservation and some have agricultural preservation. All the towns, except for Bristol, participate in Exclusive Agricultural Zoning at the 1 per 35 acre standard, though Bristol uses the same standard in its local zoning ordinance. In addition, Windsor has a Purchase of Development Rights Program and a designated Agricultural Enterprise Area. The City of Sun Prairie has cooperative or boundary agreements with both Windsor and Sun Prairie, and is party to (with Madison and DeForest)

and Dane County. The majority of these lands here are wetlands and floodplains. This differs greatly from the western territories of the county where steep slopes dominate the landscape.

To identify, enhance, and maintain ecological services and functions of agricultural land effectively, land management practices and the areal extent of these practices need to be considered together. This approach can integrate various programs and policies to create a network of permanent agricultural and open space conservation areas protected from development. Supporting recommendations for low impact agricultural

Map 65: Ecological Services and Functions - 2010

Sun Prairie FUDA, Dane County, WI



- FUDA Study Area
- Urban Service Area
- Limited Service Area
- Municipal Boundary
- Ecological Resources on Ag Parcels**
- Floodplain & Wetlands
- Floodplain
- Steep Slopes
- Wetlands

This map indicates where natural features that provide ecological services and functions occur on agricultural parcels.

a cooperative plan for the dissolution of Burke over the next 20-25 years. These boundaries and preservation efforts are shown on *Map 68*.

Two effective land management and planning tools for rural preservation are a cooperative agreement or a boundary agreement between two or more jurisdictions. Similar agreements were adopted as part of the Town of Burke, City of Madison, Village of DeForest and City of Sun Prairie Cooperative Plan. These agreements establish agricultural land preservation east of Highway 51 and north of Burke Road for the next 30 years. Sun Prairie also has boundary agreements with Windsor and Bristol. *Sun Prairie could also establish a boundary*

Planning Considerations

The City of Sun Prairie could establish a cooperative and/or boundary agreement with the Town of Sun Prairie.

agreement with the Town of Sun Prairie. Boundary agreements help to ease political tension, creates a more simple, predictable, and stable land management framework and helps to direct growth to more appropriate locations. In addition, town farmland preservation maps, in accordance with the State Farmland Preservation Act, designate lands as either “preservation,” “rural development,” or “transition areas.”

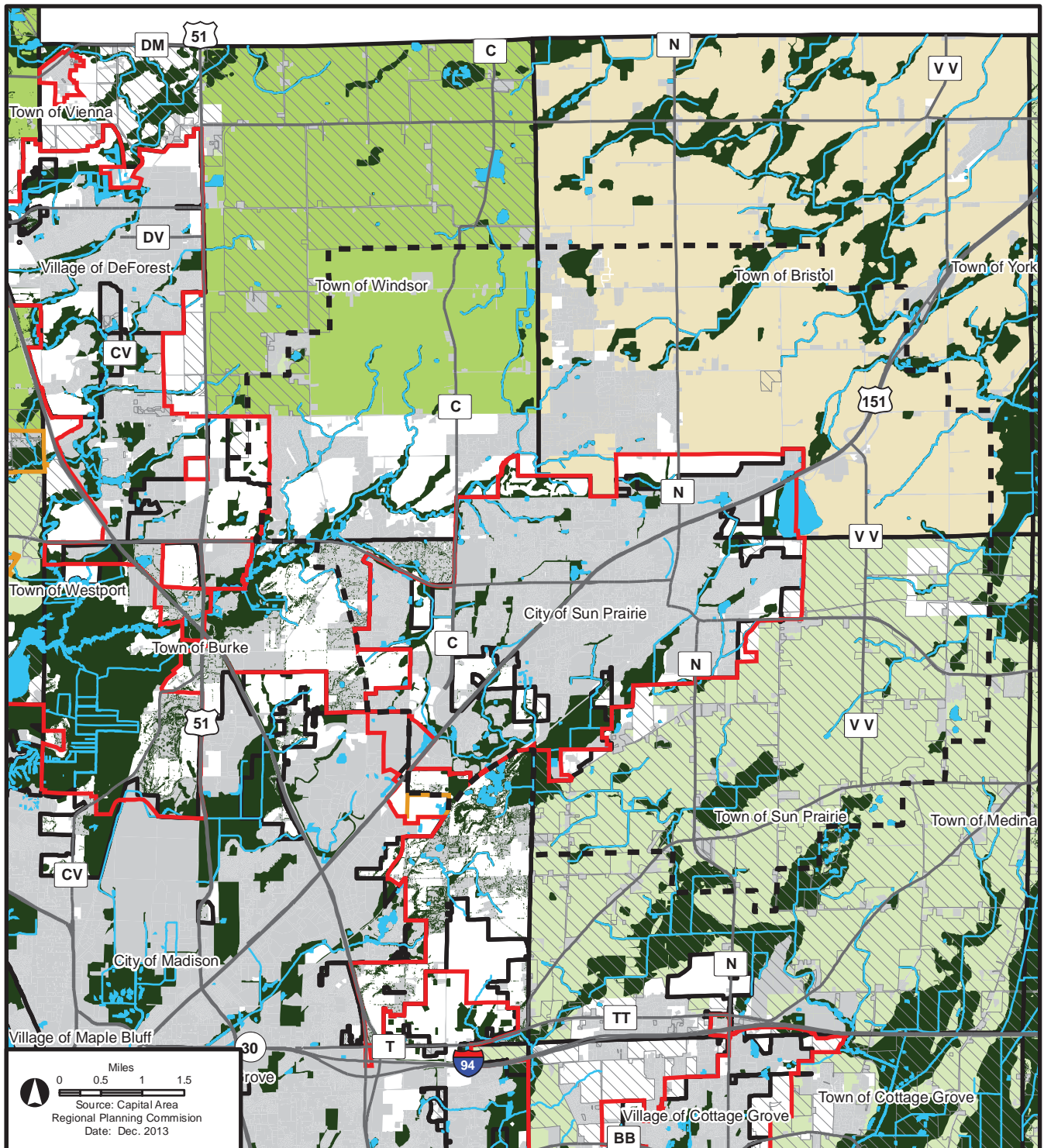
D. Conclusion

Each community in the study area has an adopted Comprehensive Plan and/or is part of the Dane County Farmland Preservation Plan that presents background, goal, objective, policy and program information. Communities can incorporate the information in this report into their plans and decision-making processes. Some factors or characteristics may be more important or useful than others to farmers and the local community. Local communities must determine how to best use this information in decision-making processes that impact agricultural land within the larger context of regional preservation and development. Here is a summary of the other considerations mentioned throughout this chapter:

- The important functions and benefits of agricultural lands must be weighed when considering development, preservation, and other land use decisions.
- Land use regulations occur at the parcel level and preservation recommendations must be useful at the parcel level.
- Diversity in size and operation type protects the regional agricultural sector from severe market changes in any one sector and will better support and encourage regional food systems.
- Land that is rented out and near developing areas could indicate that these lands could be desirable for development.
- Larger contiguous agricultural blocks located outside near-term development areas could be well suited for preservation. Direct urban growth away from contiguous blocks of agricultural land.
- Where agricultural concentration is declining due to increases in urban and rural development, and landowners and the municipality want to preserve agriculture, a strategic approach to preserving existing agriculture or employing innovations in agricultural ventures and practice, such as agrarian urbanism, specialty cropping, poly-culture cropping, etc. could help to ensure viable farmland and operation.
- Parcels with high value agricultural improvements, such as large infrastructure

Map 66: Farmland Preservation Policy

Sun Prairie FUDA, Dane County, WI



- | | | |
|----------------------|------------------------------------|----------------------------------|
| Urban Service Area | A-1(EX) Zoning | Agricultural Preservation Areas |
| Limited Service Area | Resource Protection Corridor | Rural Development / Transitional |
| Municipal Boundary | Agricultural Enterprise Area (AEA) | Bristol Ag. Preservation Areas |

Data comes for the Dane County Comprehensive Plan, Dane County Farmland Preservation Plan and local jurisdictions.

investments for agricultural use (milking parlors, processing facilities, etc.), are potentially more likely to remain in agricultural use. Closely examining improvements locally may be necessary to determine the likelihood of the surrounding land converting to developed.

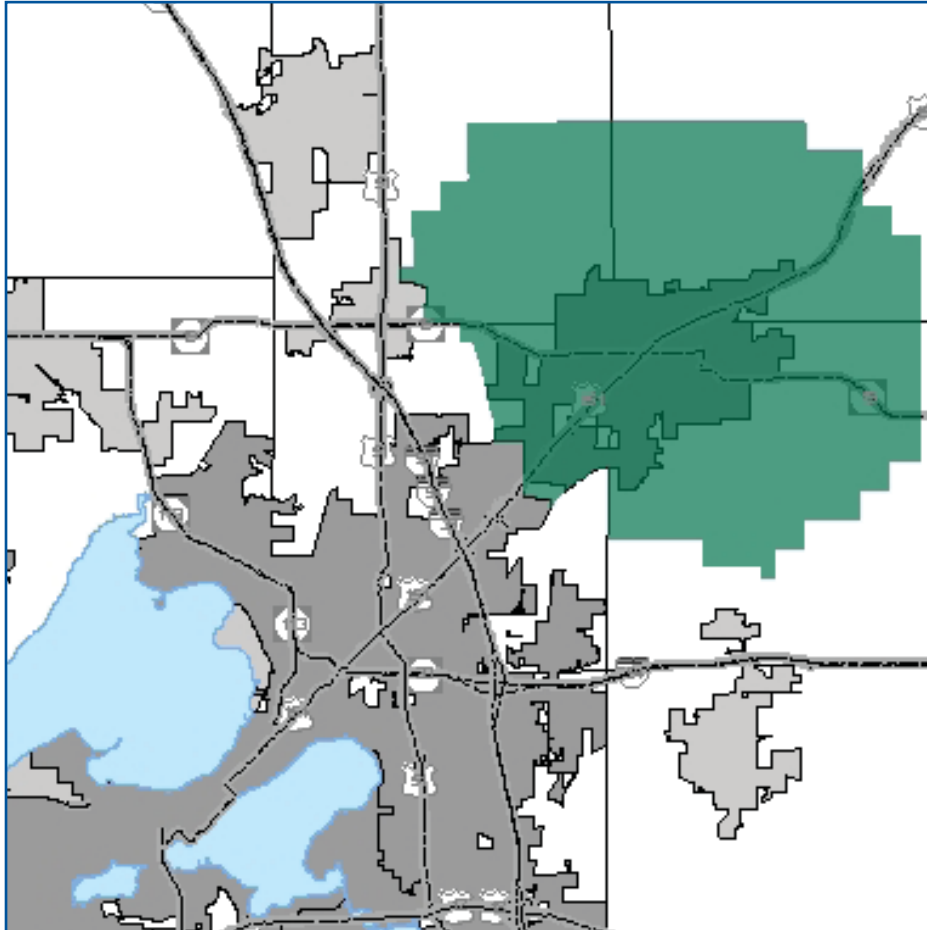
- Special consideration is warranted when pursuing development to preserve high quality lands for food cultivation.
- Within the urban service area and outside the city limits there are small areas with high quality soils that could be used for urban agriculture such as community supported agriculture, community gardens, food forests and other methods as an amenity to new residents and the community.
- The economic health of services is a good indicator of the larger agricultural sector's health.
- Across the region there is a strong agricultural interdependence and a mutually beneficial relationship between rural and urban areas throughout the region.
- Services, such as veterinary medicine, artificial insemination, and others are also important and could be collected locally and incorporated into the existing data set.
- Open space corridors define a network of sensitive natural resource areas that can be augmented with additional conservation areas and practices. This approach can integrate programs and policies to create a permanent network of agricultural and open space conservation areas. Supporting recommendations for low impact agricultural practices, conservation, and restoration of former wetlands and riparian zones for various locations in the study area can be provided based on ecosystem requirements and opportunities.
- Some areas may be suited for integrated resource management, low-impact design, conservation design, agrarian design, and accommodating multiple land uses and ecological services simultaneously.
- Any conservation efforts should be pursued with the idea that conservation areas would produce income for the land owner. Restoration projects could be completed through pollutant trading opportunities through the Rock River TMDL project discussed in the Natural Resources section.
- Some conservation practices would greatly benefit from changes in state law and taxing policy. For example, wetlands are typically assessed at higher land values than farmland due to the agricultural use value law (Tax 18). Consequently, farmers not only lose cropland and income by restoring former wetlands, they also pay higher property taxes under current tax policy.
- Establish a cooperative or boundary agreement with the Town of Sun Prairie.

The data in this section is provided to assist in decision-making processes to identify the agricultural lands that the community would preserve, maintain or develop. The data and subsequent decisions can be updated or incorporated into comprehensive and farmland preservation plans as the communities update them in the coming years. The variables with the most potential for making and measuring the impact of growth on farmland in the study area are contiguous blocks of agriculture and agricultural concentration. Other variable such as ecological services and functions, support services, land and improvement assessment values, and soil quality are best considered at the site level.



City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



Other Resources

Sustainability Audit
Healthy Community Planning Checklist

Sustainability Audit

Introduction

As part of the Sun Prairie Area Future Urban Development Area (FUDA) planning study, this sustainability audit was performed to help inform communities of growth options which lead to more sustainable outcomes. The audit use the Leadership in Energy and Environmental Design (or LEED®) Neighborhood Development framework. LEED® is an independent, third partying certification system that recognizes buildings and development that are energy and water efficient, have reduced waste and greenhouse gasses, and are healthier for occupants. The United States Green Building Council (USGBC) created this system and multiple others that address new construction, health care, homes and commercial interiors. LEED® for Neighborhood Development, or LEED® ND, measures large scale development projects such as master planned communities. This system recognizes certain development and infrastructure patterns and locations are inherently more sustainable than others.

All LEED® rating systems utilize a credit system. Credits are obtained by meeting a variety of criteria in different categories, such as energy efficiency. LEED® ND has 47 prerequisites and credits, some offering more than one credit. A total of 110 credits are possible, with 10 that recognize innovation in design and emphasize regional needs. Forty credits are required to be LEED® Certified, and achieving a greater number of credits can result in Silver, Gold and Platinum ratings.

Credits are obtained in following three categories:

- **Smart Location and Linkages:** Addresses the location of a development, encouraging development to avoid of sensitive areas (such as wetlands, floodplains, critical habitat, etc.) and focusing development in areas with water/sewer infrastructure, established and connected street and bicycle networks, employment, commercial and residential opportunities, and encouraging the redevelopment of infill and brownfield sites.
- **Neighborhood Pattern and Design:** Encourages a neighborhoods physical design to be walkable, with mixture of uses and densities with origins and destinations in close proximity, and an attractive and accessible neighborhood design.
- **Green Infrastructure and Buildings:** Investigates and encourages the reduction in total energy use in buildings and infrastructure, including energy used to make and transport materials. This section also looks at water usage.

The purpose of this audit is to identify strategies that communities can use to grow more sustainably in the future. Because LEED® certification is intended to reward the most sustainable development, the bar on many credits is set high. Because of this communities should not be viewed in a negative light if they currently do not meet the criteria of particular credits.

Note that LEED® targets developers, architects, building owners, and other parties that have complete control over all development decisions, and not the jurisdiction the project occurs in. Many of the credits are generally beyond the scope of local government regulation and as such, it was not intended as a metric to benchmark sustainability



of an entire city. However, this does not mean that municipalities cannot use the credits to better understand how they could grow more sustainably.

A. Summary of Credits

LEED® ND's citizens guide uses a framework to make understanding the relationship of the credits easier. The sustainability audit compared the 47 prerequisite and credits to the physical conditions, zoning and land division ordinances, and comprehensive plan. The following analysis slightly modifies this framework. A full description of each credit and the local conditions in the matrix that follows this summary.

Smart Location and Linkage

- SLL Prerequisite 1: Smart Location
- SLL Credit 1: Preferred Locations
- SLL Credit 2: Brownfields Redevelopment
- SLL Credit 5: Housing and Jobs Proximity

Sun Prairie generally achieves these criteria, by having all growth be contiguous and sewer-ed. Sun Prairie has a strong employment base and commercial options which provides residents the opportunity to work and shop in their community. Sun Prairie has made efforts to encourage redevelopment, including on brownfields, through various policies including Tax Incremental Districts (TIDs).

Design with Nature

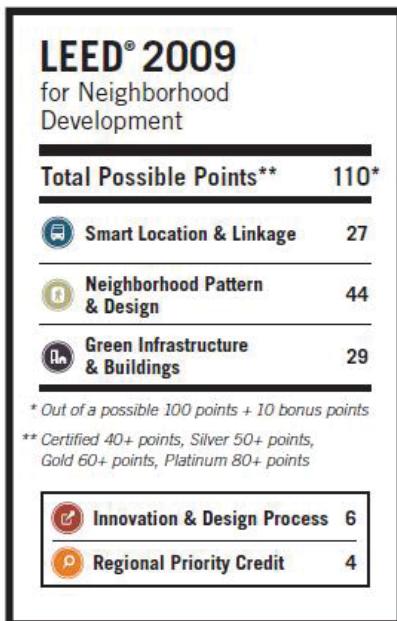
- SLL Prerequisite 2: Imperiled Species and Ecological Communities
- SLL Prerequisite 3: Wetland and Water Body Conservation
- SLL Prerequisite 4: Agricultural Land Conservation
- SLL Prerequisite 5: Floodplain Avoidance
- SLL Credit 6: Steep Slope Protection
- SLL Credits 7, 8, 9: Site Design for, Restoration of, or Long-Term Conservation Management of Habitat or Wetlands and Water Bodies
- GIB Credit 7: Minimized Site Disturbance

Most of these credits are met by policies at the state and county level that are implemented in Sun Prairie's zoning code. Many of the surrounding towns are actively working to conserve agricultural land, and Sun Prairie's policy of developing compactly to prevent premature farmland loss greatly assists agricultural preservation efforts.

Connected Neighborhoods

- NPD Prerequisite 3: Connected and Open Community
- NPD Credit 6: Street Network

These credits address the street and pedestrian connectivity of an area by measuring the intersections per square mile. Overall, Sun Prairie is slightly below the initial threshold of 140 intersections per square mile. However, there are areas that meet and exceed this level, including in and around



the downtown and most of the commercial and employment destinations.

Public Transit

- SLL Credit 3: Locations with Reduced Automobile Dependence
- NPD Credit 7: Transit Facilities
- NPD Credit 8: Transportation Demand Management

As discussed, Sun Prairie does not currently have transit. Identified options exist for future service via express bus.

Neighborhoods that Use Land Efficiently

- NPD Prerequisite 2: Compact Development
- NPD Credit 2: Compact Development

LEED® ND uses 7 units per acre as a baseline for compact development. Sun Prairie's overall density is 5.5 units per acre, though similarly to the street connectivity criteria, many areas in Sun Prairie do meet or exceed this density. In the context of Dane County, only Madison exceeds this density as a municipality at 7.9 units per acre. The credit also specifies higher density surrounding transit stops, which could be a consideration for future growth.

Walkable Streets

- NPD Prerequisite 1: Walkable Streets
- NPD Credit 1: Walkable Streets
- NPD Credit 14: Tree-Lined and Shaded Streets

This categories addresses many features that make streets more pedestrian friendly and walkable, including sidewalks, building height and setbacks, transparency and entry requirements and design speed of streets. Sun Prairie's development meet many of these. Sidewalks and street trees are required in all areas. With the exception of the downtown, setbacks are generally larger than those discussed in the criteria. Entries, transparency, and street speed are met in many areas of Sun Prairie. However, only limited areas, such as districts on Main Street, have design standards.

Reduced Parking and Transportation Demand

- NPD Credit 5: Reduced Parking Footprint
- NPD Credit 8: Transportation Demand Management

These credits discuss reducing the parking footprint and visual impact through actions such as, placing parking behind or adjacent to buildings, adding bike parking and preferential parking for car-share. In the downtown, parking is on the street or in the rear, while in other areas it is in front of commercial buildings. Sun Prairie does not have a requirement for bike parking. One criteria is to establish a maximum parking footprint, however this would only be feasible with structured parking.

Bicycle-Friendly Design

- SLL Credit 4: Bicycle Network and Storage

This credit address the prevalence of a bike network and Sun Prairie has a well-established network that connects residential areas with common destinations including the downtown, commercial and employment areas, parks, schools. and residential areas. Virtually every developed area in Sun Prairie is within ¼ mile of a bike route or trail.

Mixed Uses and Community Spaces

- NPD Credit 3: Mixed-Use Neighborhood Centers
- NPD Credit 9: Access to Civic and Public Spaces
- NPD Credit 10: Access to Recreation Facilities
- NPD Credit 12: Community Outreach and Involvement
- NPD Credit 13: Local Food Production
- NPD Credit 15: Neighborhood Schools

These credits discuss the prevalence of common destinations for residents, including commercial, employment, parks and schools. In general, Sun Prairie meets these criteria by having a high number of residential units in close proximity to the above mentioned spaces. Sun Prairie does have a farmers market that is operational in the summer and is in a central location. Schools are discussed in terms of the number of residences surrounding them and their size (acres).

Green Buildings

- GIB Prerequisite 1 and Credit 1: Certified Green Building(s)
- GIB Prerequisite 2 and Credit 2: Building Energy Efficiency
- GIB Prerequisite 3 and Credit 3: Building Water Efficiency
- GIB Credit 4: Water-Efficient Landscaping

The regulation of energy and water efficient buildings is challenging at the local level and is generally best done with state building codes.

Reusing Older Buildings

- GIB Credit 5: Existing Building Reuse
- GIB Credit 6: Historic Resource Preservation and Adaptive Use

Sun Prairie has comprehensive plan goals in historic preservation and building reuse and has listed buildings on the national register of historic places. The façade grant program could assist in the renovation of historic buildings.

Reducing Pollution

- GIB Prerequisite 4: Construction Activity Pollution Prevention
- GIB Credit 8: Stormwater Management
- GIB Credit 17: Light Pollution Reduction

Like some previous credits, stormwater and construction pollution controls are regulated by state and county entities. Sun Prairie does require new developments lighting to not be visible from adjacent areas to reduce sky glow in dark areas.

Keeping Things Cool

- GIB Credit 9: Heat Island Reduction

This credit addresses heat islands that can accompany dense urban development. This credit requires roof and hardscape surfaces to be light colored to reflect light and absorb a lesser amount of heat. This can be accomplished using concrete in place of asphalt in parking areas and a white roof membrane instead of a black one. Sun Prairie does not have a policy addressing this.

Neighborhood-Wide Energy Efficiency

- GIB Credit 10: Solar Orientation
- GIB Credit 11: On-Site Renewable Energy Sources
- GIB Credit 12: District Heating and Cooling
- GIB Credit 13: Infrastructure Energy Efficiency

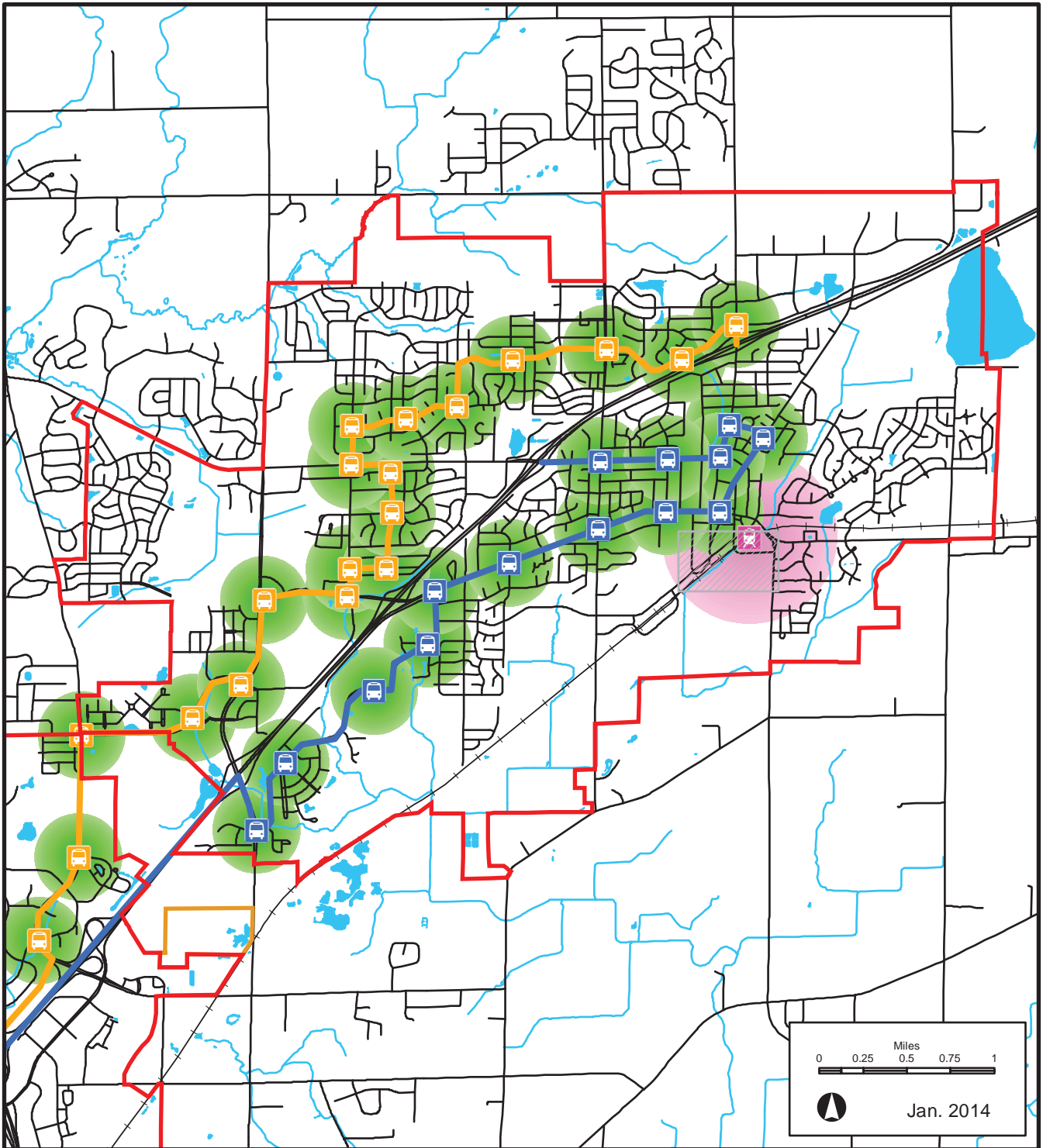
These credits address passive and active energy saving for larger areas. Solar orientation of buildings allows greater passive heating and day lighting to occur. This can be a consideration in the neighborhood design process. Sun Prairie does have some buildings with on-site renewable energy generation, such as solar panels. Some communities have updated their zoning ordinances to avoid any unforeseen impacts on surrounding properties. District heating and cooling is most appropriate for campus and is a decision best made by the end user. Infrastructure energy efficiency is currently being investigated via LED street lighting on Main Street, with possible expansion to other locations in the future.

Reuse and Recycling

- GIB Credit 14: Wastewater Management
- GIB Credit 15: Recycled Content in Infrastructure
- GIB Credit 16: Solid Waste Management Infrastructure

The wastewater facility collects and reuses methane gas for operations. Sun Prairie does have recycling collection service and nearby facilities for items not collected.

Map 67: Sustainability Audit Transportation Service Area Sun Prairie FUDA, Dane County, WI

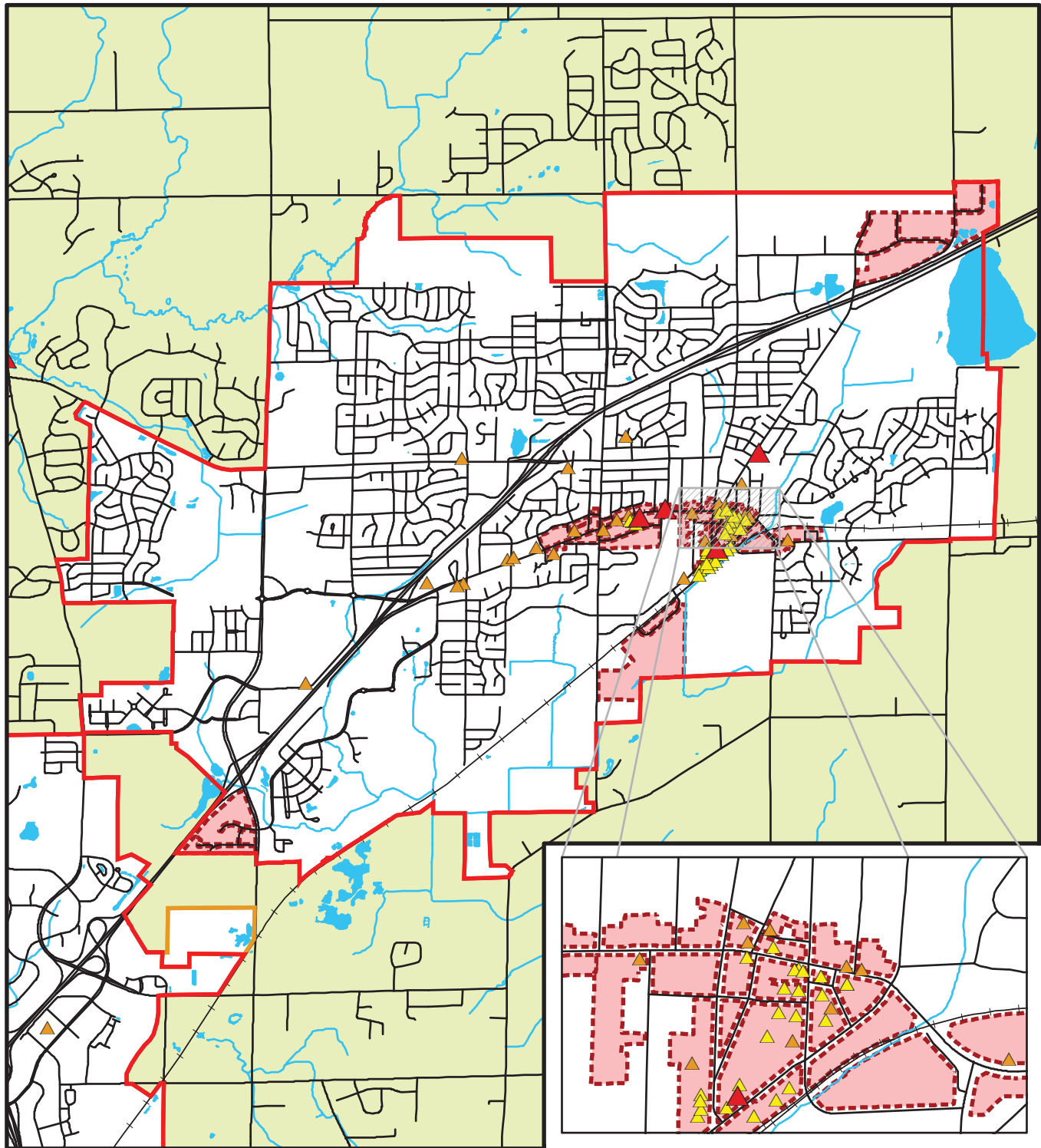


- | | | | | |
|----------------------|--------------------------------|------------------------------|------------------|------------------------------------|
| — Road Centerlines | Satellite Downtown 2012 | Transportation Depots | Sun Prairie West | Transportation Service Area |
| — Railroads | Sun Prairie East | Railroad Depot | Sun Prairie East | Railroad Depot |
| Urban Service Area | Sun Prairie West | | | Bus Stops |
| Limited Service Area | | | | |

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 68: Sustainability Audit TIF & Contamination Locations

Sun Prairie FUDA, Dane County, WI

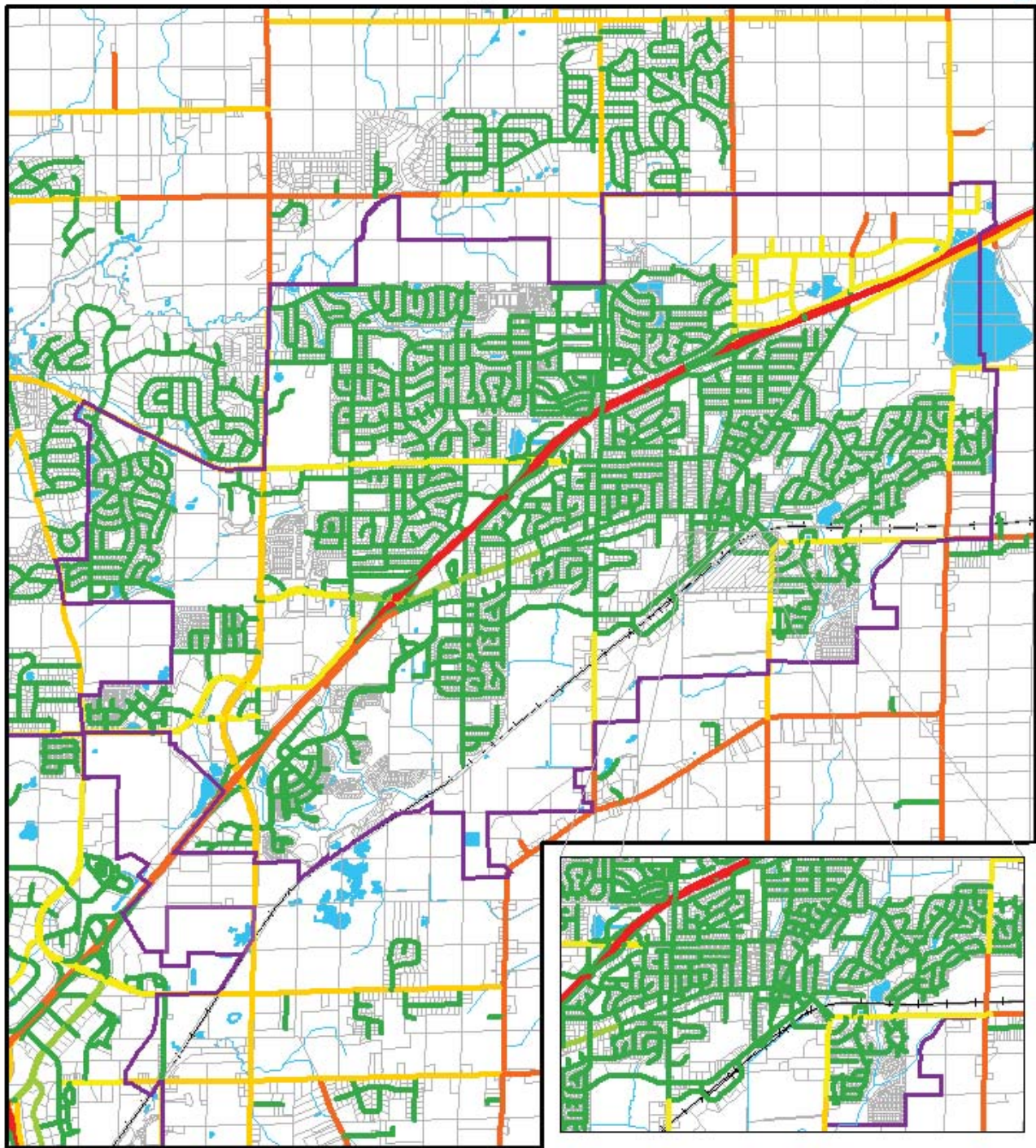


— Road Centerlines	Urban Service Area	▲ BRTS - Contaminated or Cleaned
— Railroads	Limited Service Area	▲ BRTS - Ongoing Responsibility
Water	TIF Districts Non-Madison	▲ BRTS - Ongoing Responsibility - Originating from other source

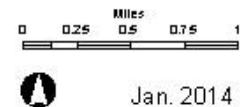
Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 69: Sustainability Audit Street Speed
Sun Prairie FUDA, Dane County, WI



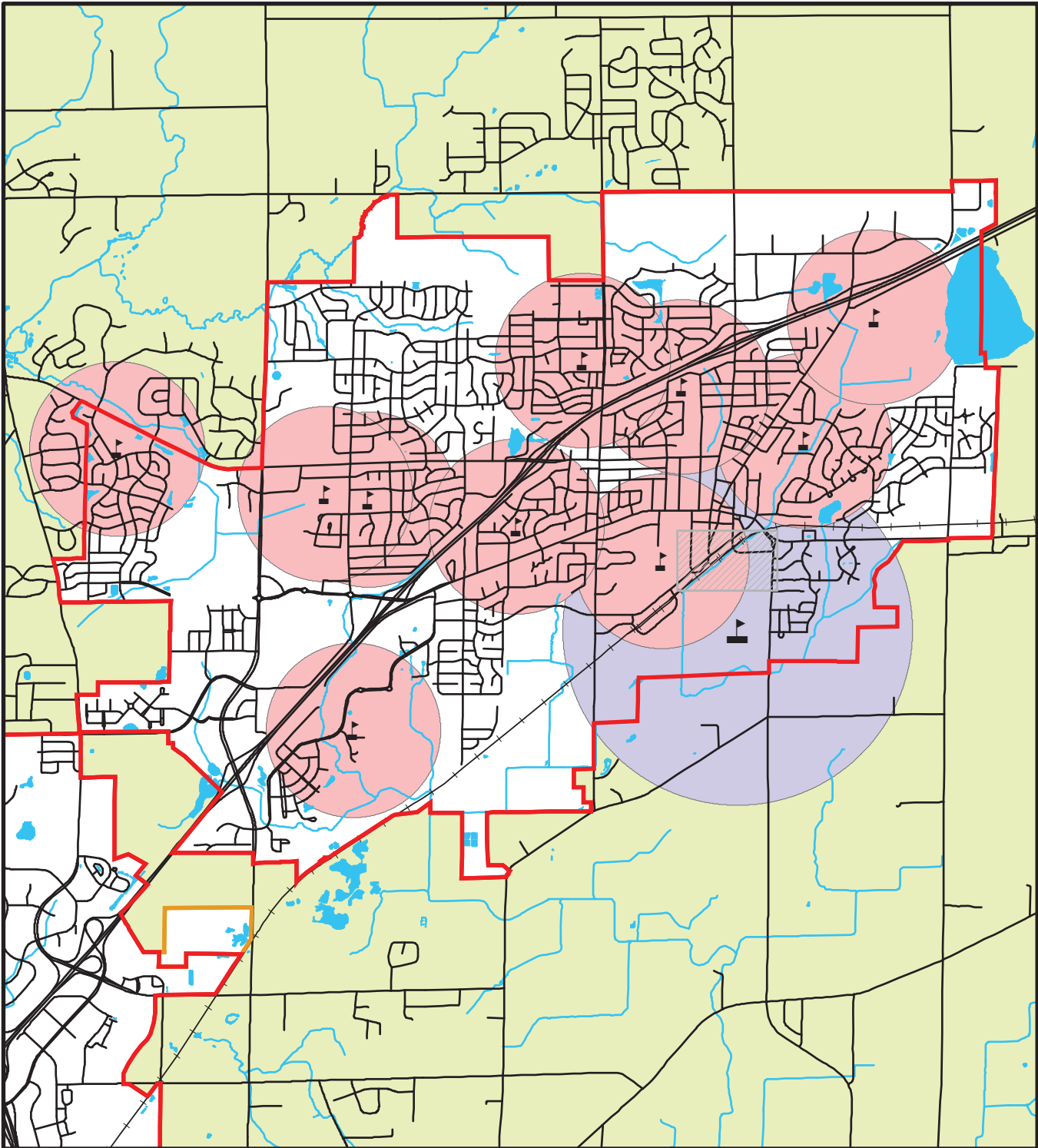
- | | | | | |
|-------------|---------|---------|------------------|----------------------|
| Speed Limit | 35 | 50 - 55 | Tax Parcels | Urban Service Area |
| <25 | 40 - 45 | 65 | Road Centerlines | Limited Service Area |
| 30 | | | Railroads | Water |



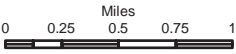
Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 70: Sustainability Audit School Service Area
Sun Prairie FUDA, Dane County, WI



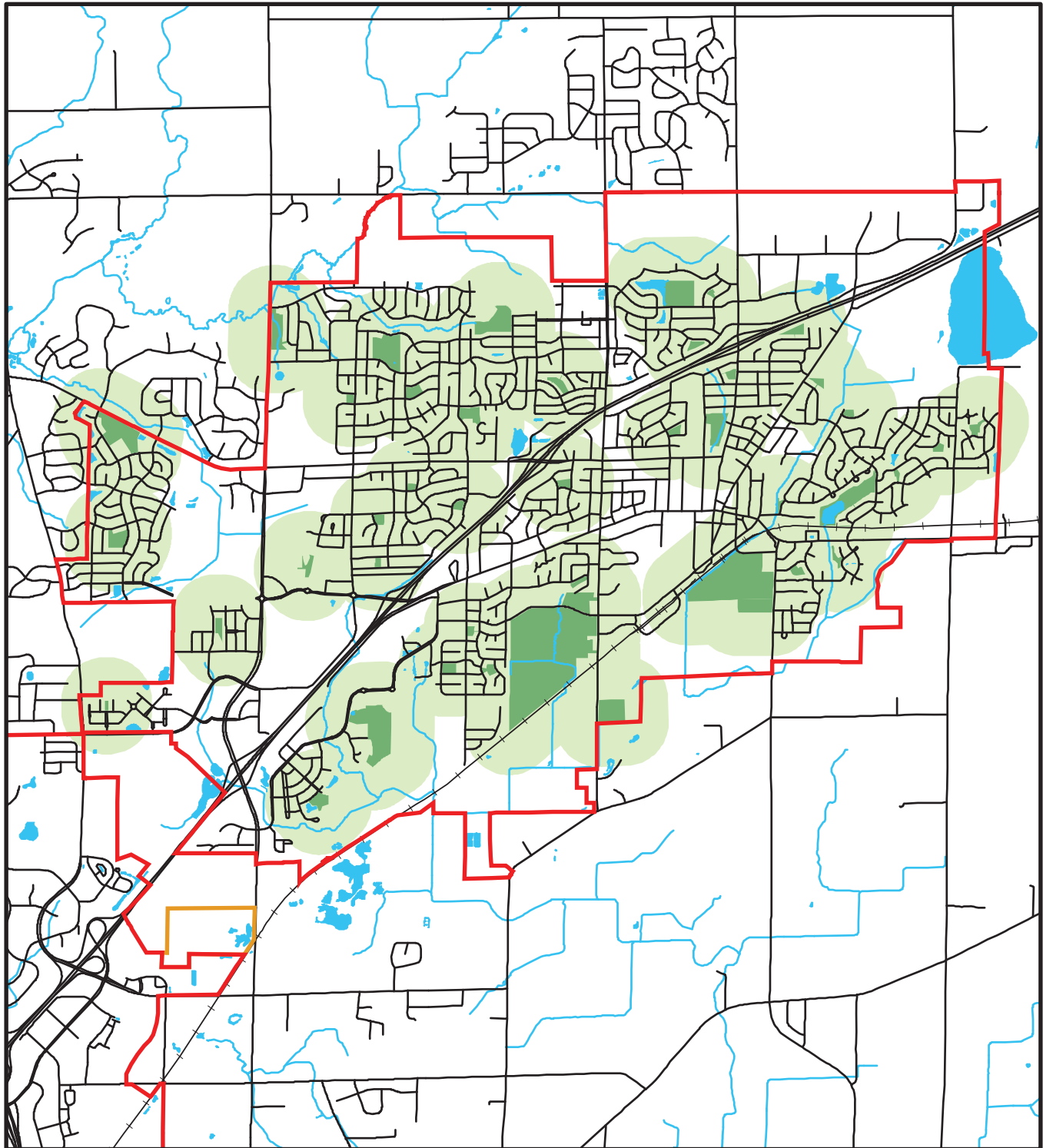
- Road Centerlines
- Railroads
- Water
- Urban Service Area
- Limited Service Area
- School_bufferMerge
- High School (1 mile)
- Middle & Elementary Schools (.5 mile)



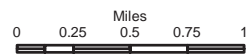
Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 71: Sustainability Audit Parks Service Area (.25 mile)
Sun Prairie FUDA, Dane County, WI



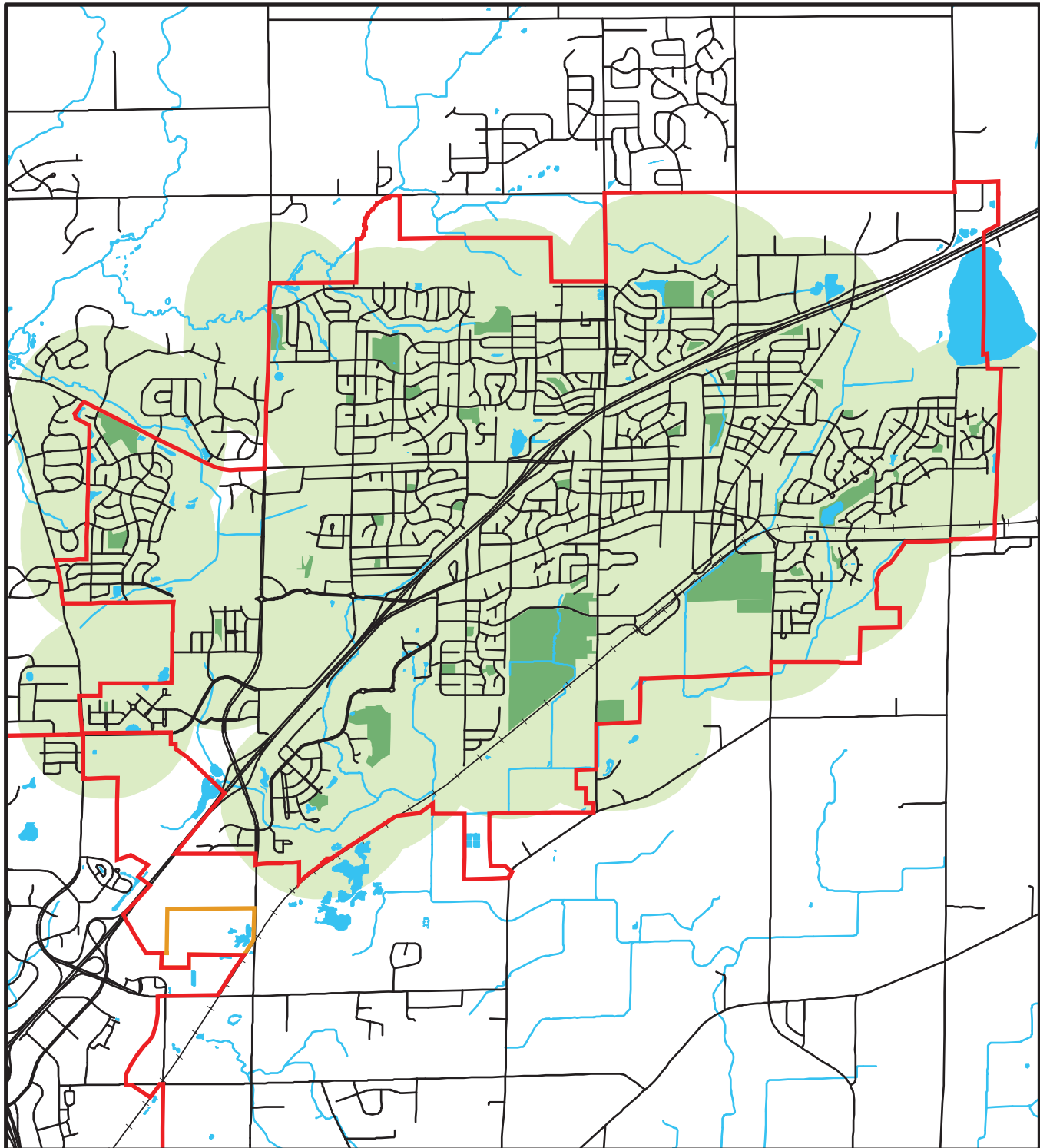
- Road Centerlines
- Railroads
- Water
- Urban Service Area
- Limited Service Area
- Sun Prairie Park (>.25 acres)
- Park layer .25 mile buffer



Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 72: Sustainability Audit Parks Service Area (.5 mile)
Sun Prairie FUDA, Dane County, WI



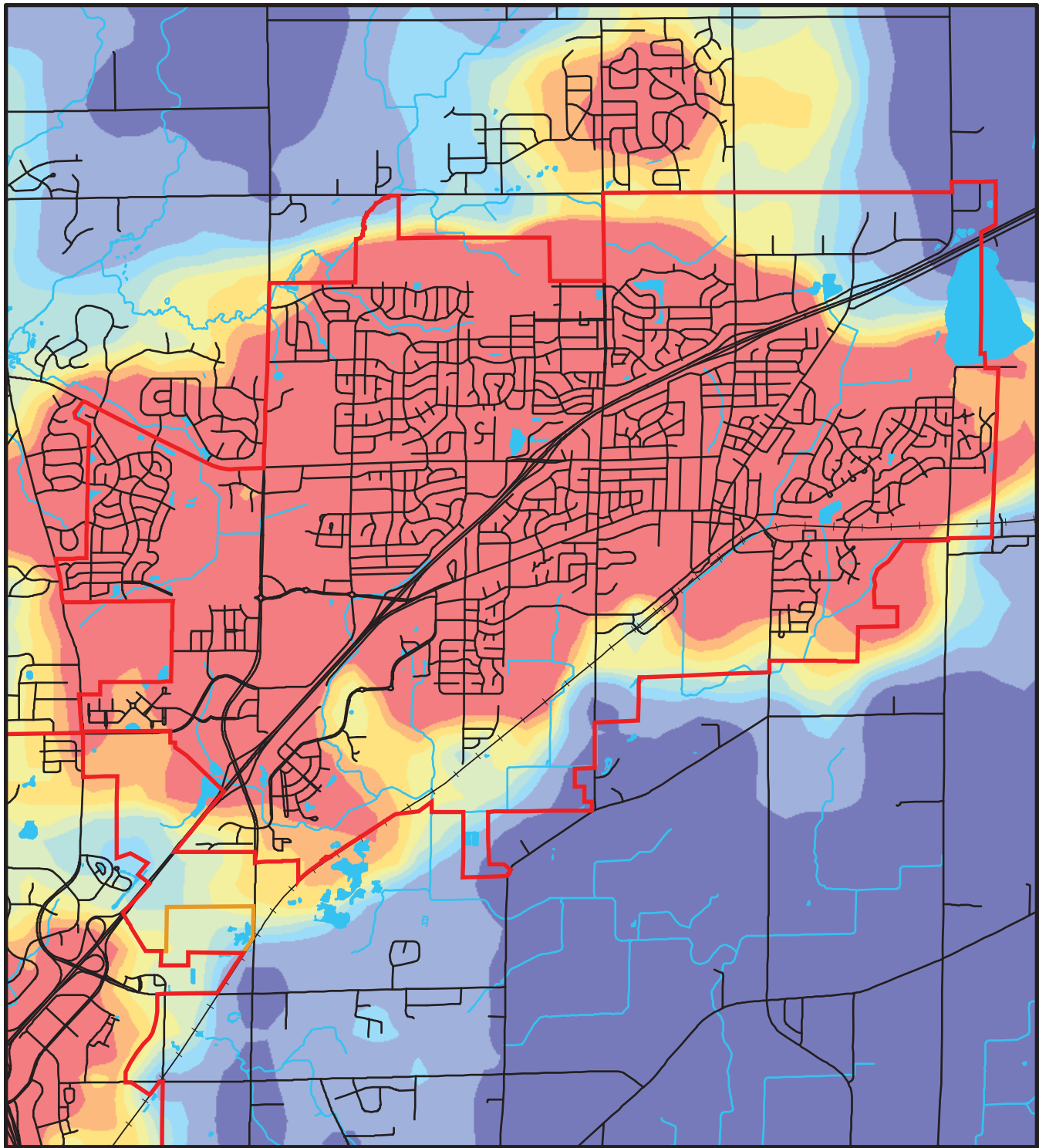
- Road Centerlines
- Railroads
- Water
- Urban Service Area
- Limited Service Area
- Sun Prairie Park (>.25 acres)
- Park layer .5 mile buffer



Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

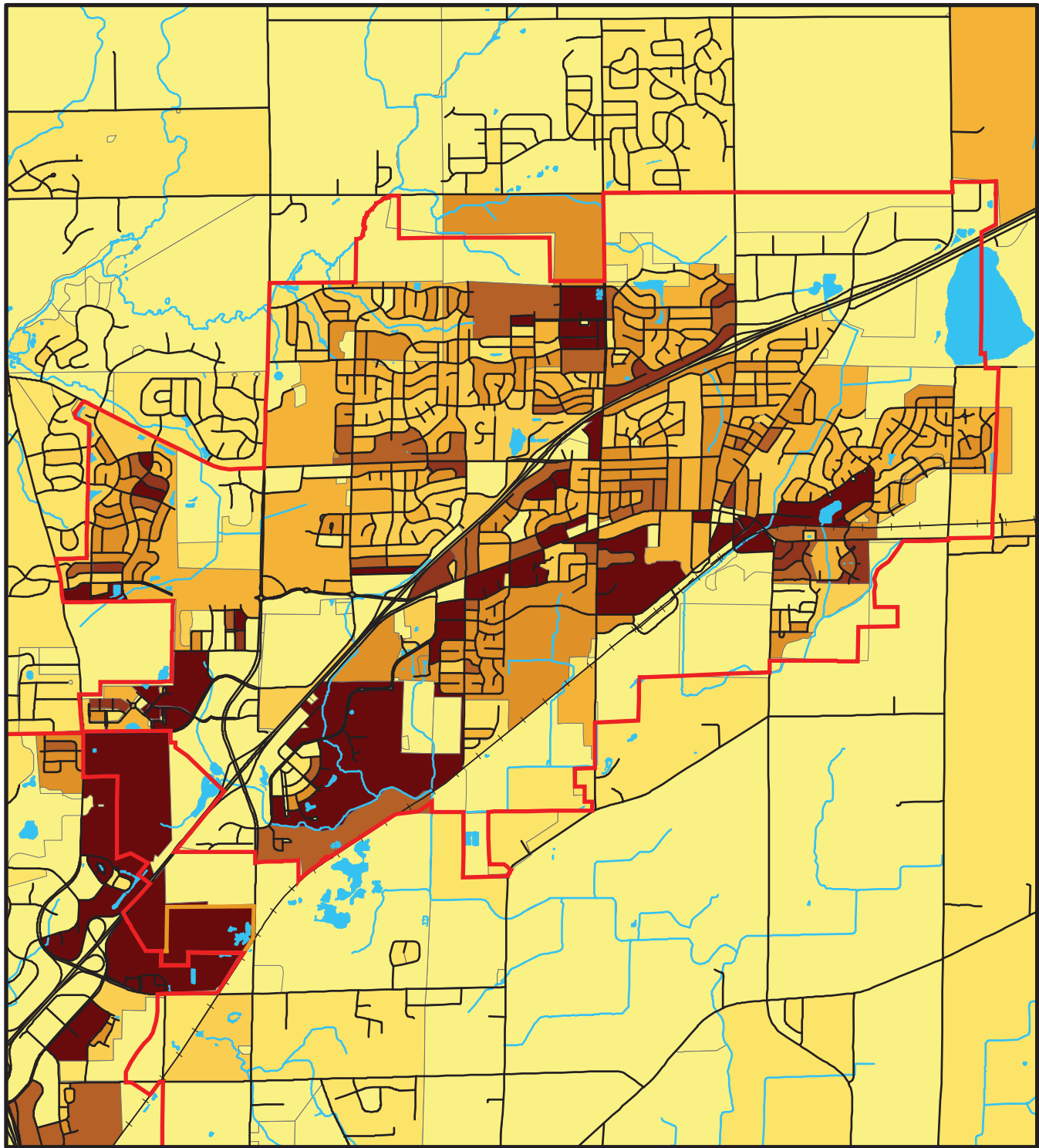
Map 73: Sustainability Audit Intersection Density Sun Prairie FUDA, Dane County, WI



— Road Centerlines	 Urban Service Area	Intersections/Sq. Mile	 40-80	 120-140	 180-200	Miles 0 0.25 0.5 0.75 1
— Railroads	 Limited Service Area	Intersection/Sq Mile	 80-100	 140-160	 200+	
 Water		 >40	 100-120	 160-180		Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 74: Sustainability Audit Residential Unit Density Sun Prairie FUDA, Dane County, WI



— Road Centerlines	 Urban Service Area	Housing Units/Residential Area	 2 - 3	 6 - 8
— Railroads	 Limited Service Area	 0 - 1	 3 - 4	 8 - 10
 Water		 1 - 2	 4 - 6	 10 +

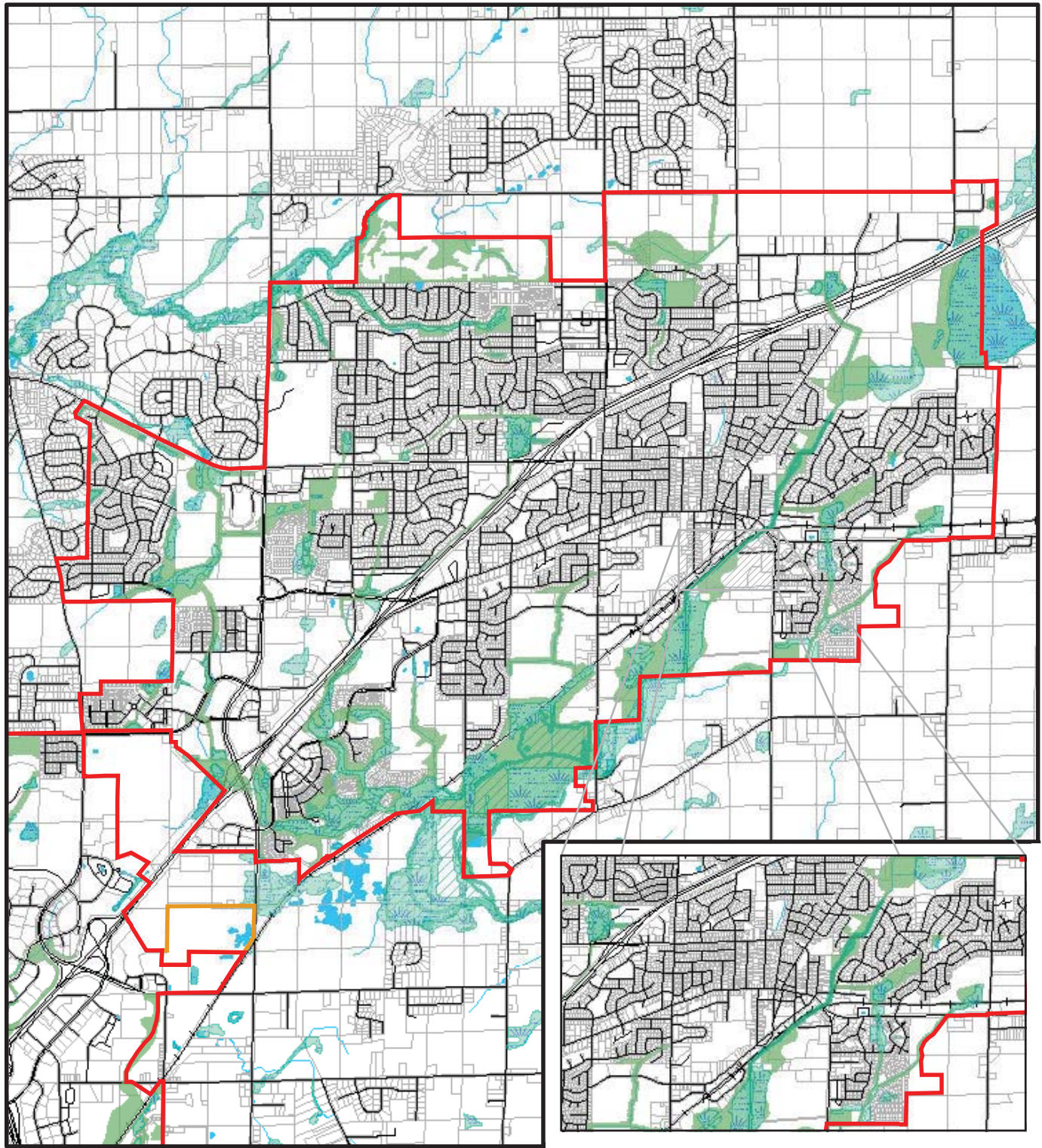
Miles
0 0.25 0.5 0.75 1

Jan. 2014

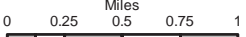
The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 75: Sustainability Audit Environmental Corridors

Sun Prairie FUDA, Dane County, WI



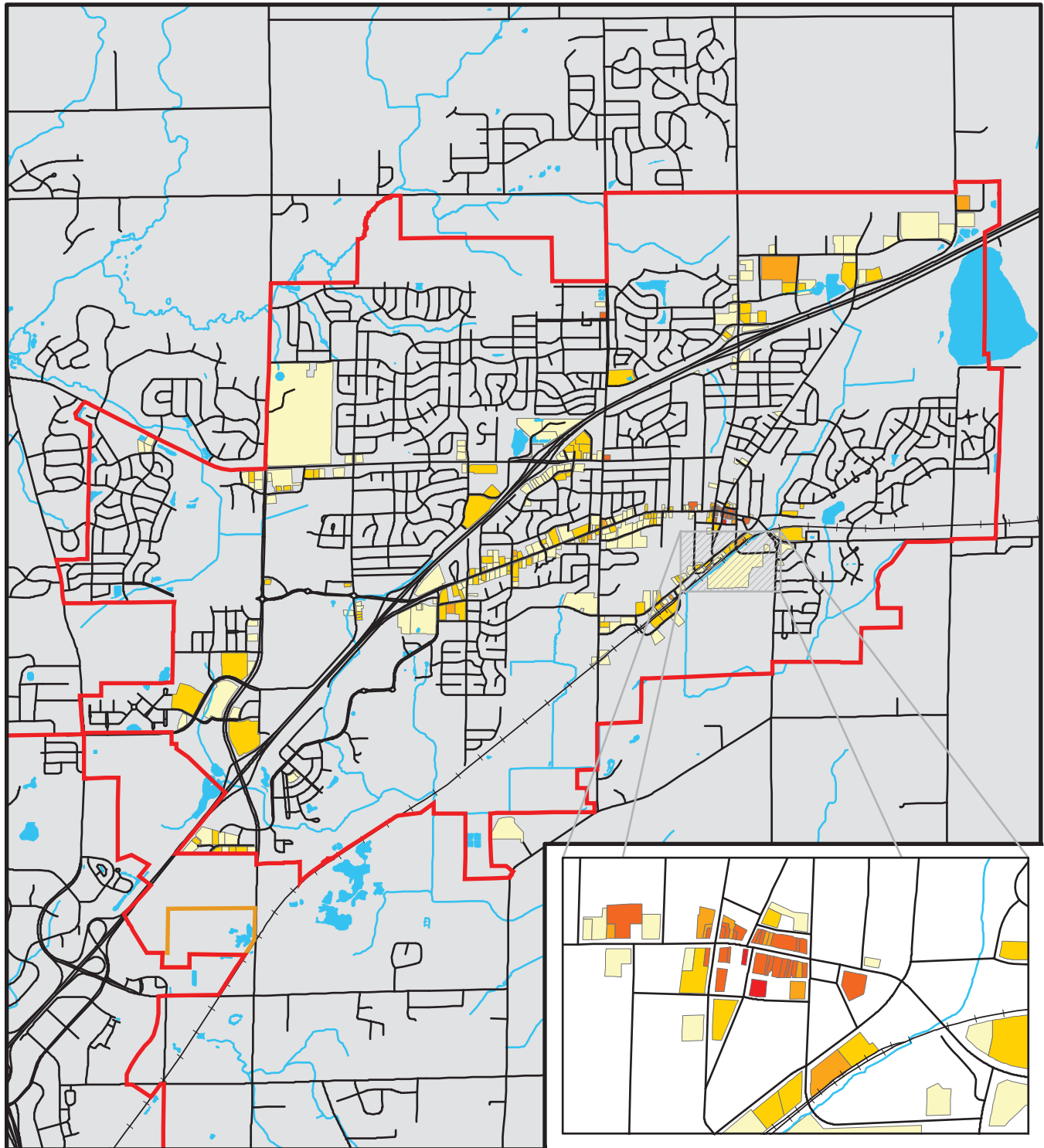
Tax Parcels	Urban Service Area	Wetlands > 2 acres	Flood Plain (1%)
Road Centerlines	Limited Service Area	Wetlands < 2 acres	Environmental Corridor
Railroads	Water		



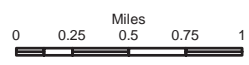
Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 76: Commercial Floor Area Ratio Sun Prairie FUDA, Dane County, WI



— Road Centerlines	Urban Service Area	Commercial FAR	0.4 - 0.8
— Railroads	Limited Service Area	0.0 - 0.2	0.8 - 2.0
Water		0.2 - 0.4	2.0+

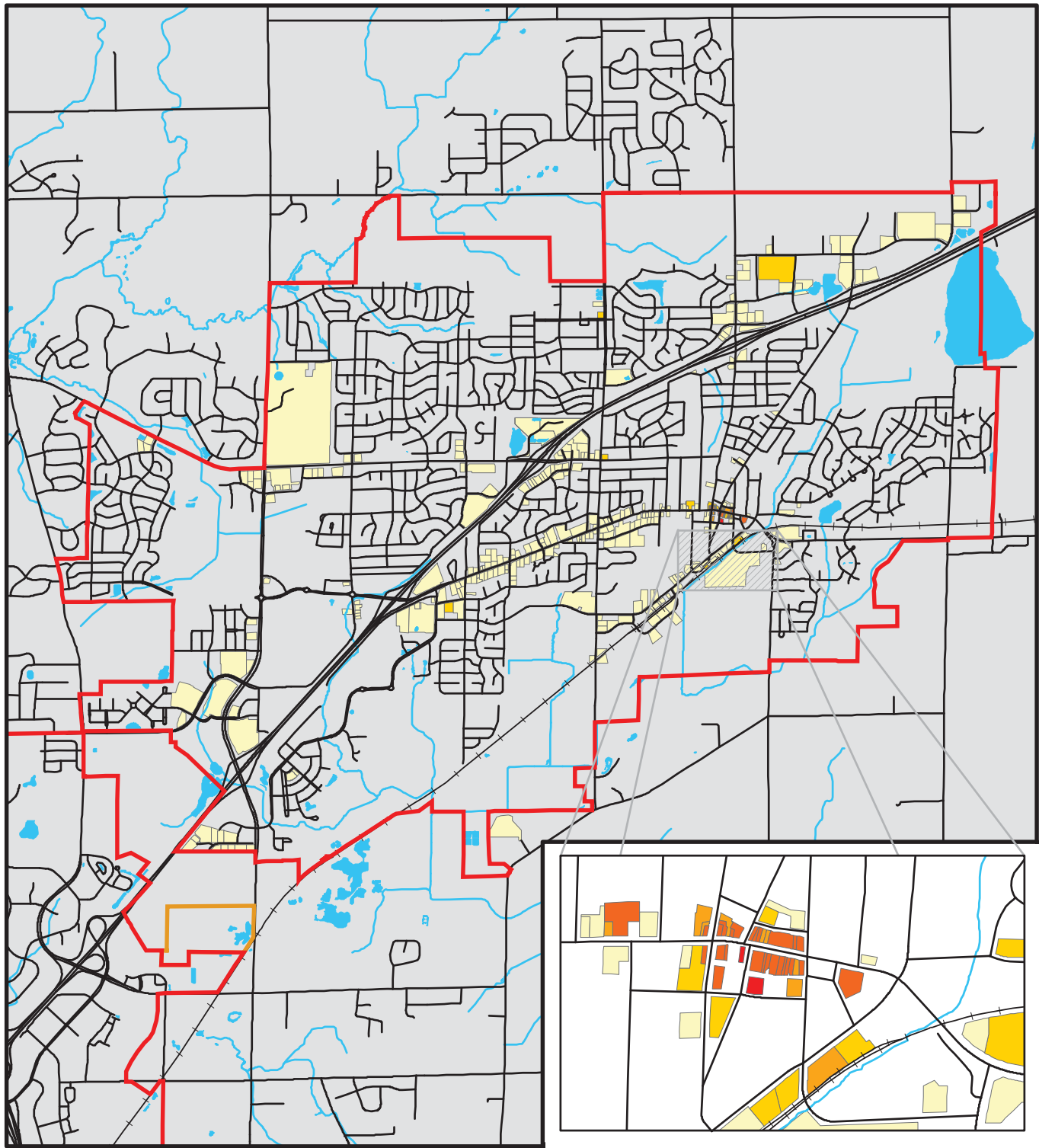


Jan. 2014

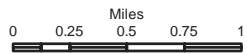
The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 77: Commercial Floor Area Ratio

Sun Prairie FUDA, Dane County, WI



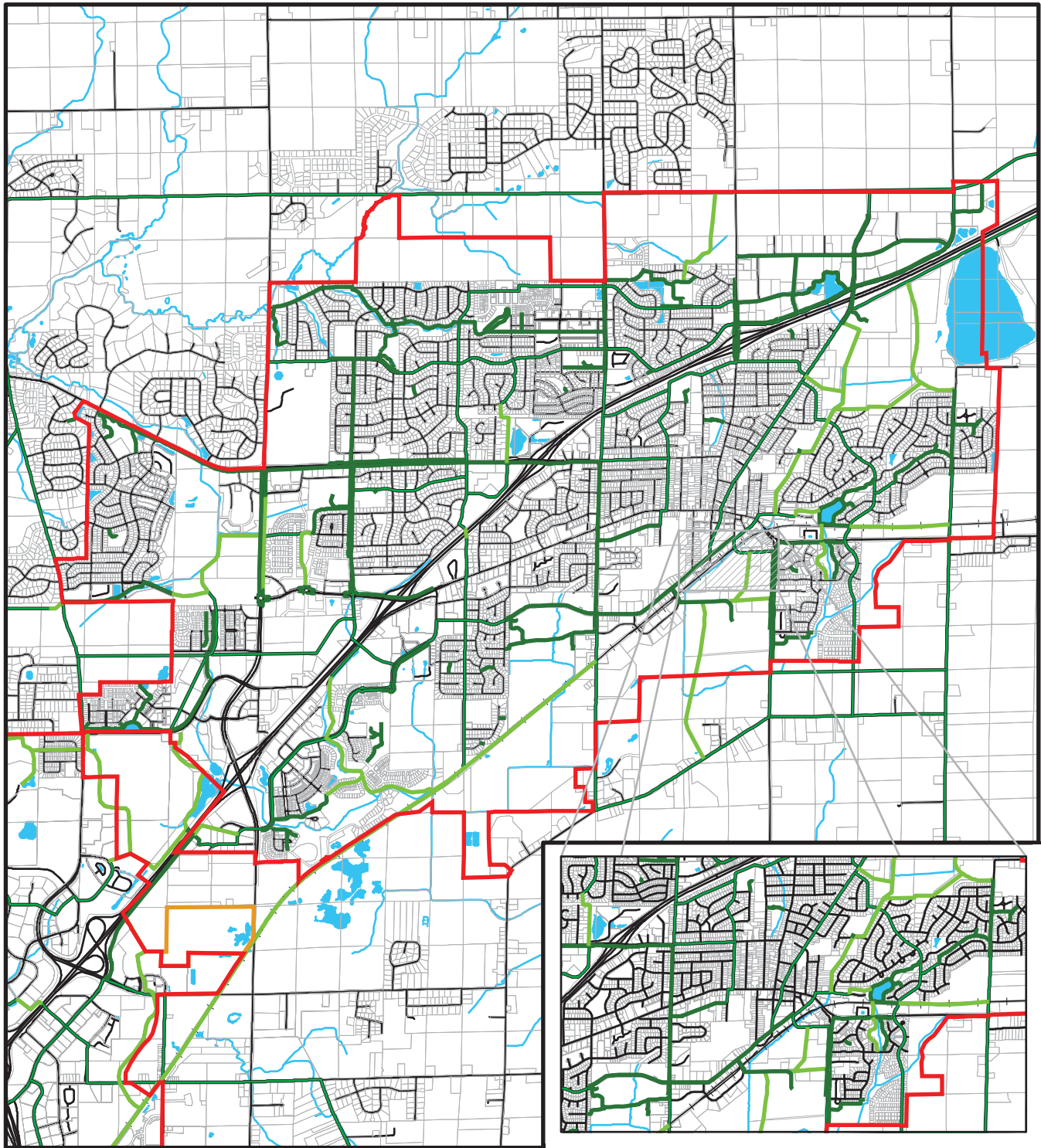
- Road Centerlines
- Railroads
- Water
- Urban Service Area
- Limited Service Area
- Commercial FAR**
- 0.0 - 0.5
- 0.5 - 1.0
- 1.1 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0



Jan. 2014

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

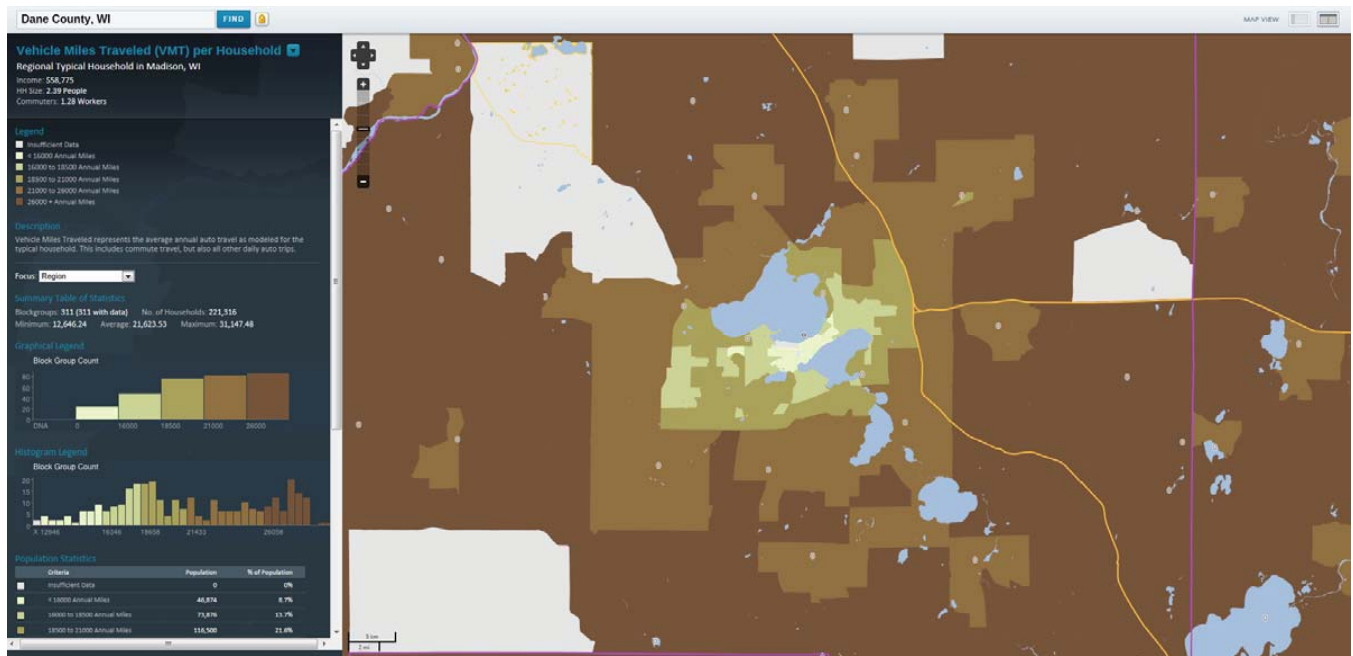
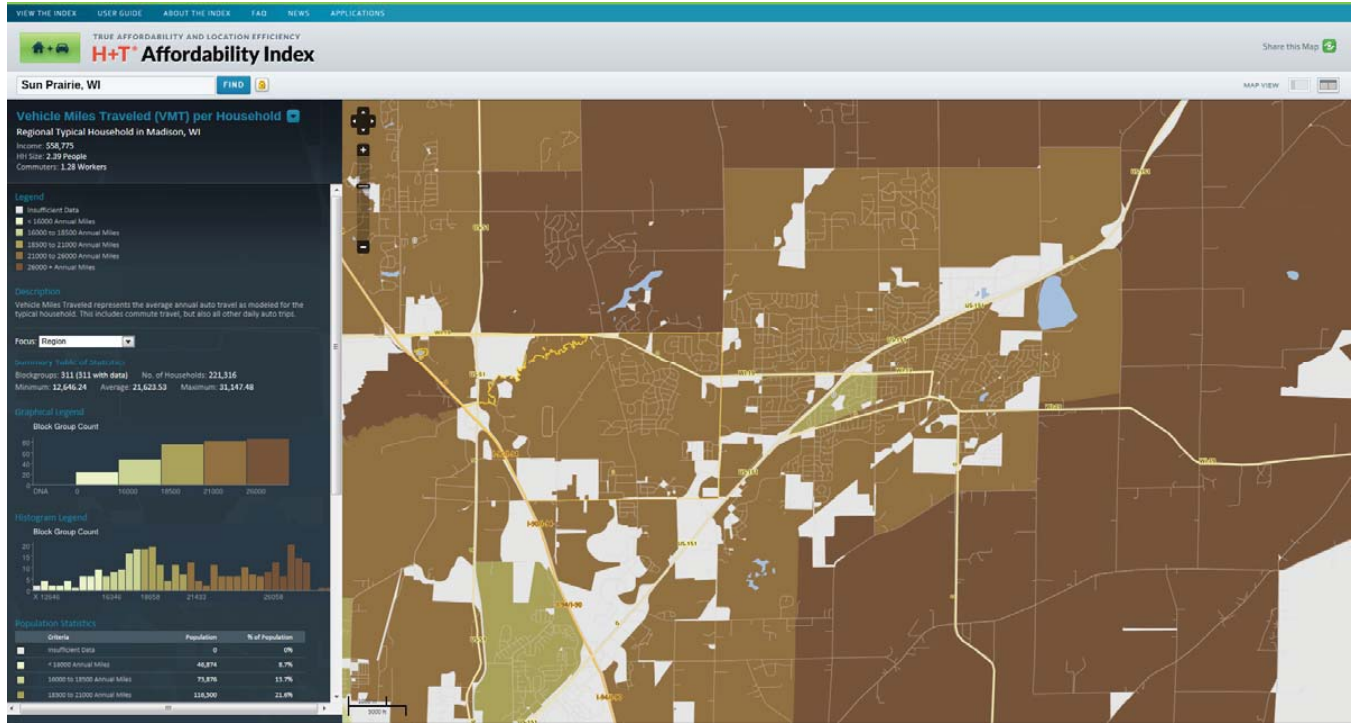
Map 78: Sustainability Audit Bicycle Infrastructure Sun Prairie FUDA, Dane County, WI



- | | | | | |
|------------------|----------------------|------------------|--------------------|------------|
| Tax Parcels | Urban Service Area | Bike Path | Hiking - No Bikes | Bike Route |
| Road Centerlines | Limited Service Area | Existing | Under Construction | |
| Railroads | Water | Proposed | | |

The study area was derived using the extra territorial jurisdictional boundaries of the City of Sun Prairie as the base area.

Map 79: Sustainability Audit Vehicle Miles Travelled Per Household Sun Prairie FUDA, Dane County, WI



Source: Center For Neighborhood Techology (CNT) H+T Index

Healthy Community Planning Checklist

This tool is adapted from Design for Health www.designforhealth.net (supported by Blue Cross and Blue Shield of Minnesota) and Minnesota Department of Health Metropolitan Common Council Comprehensive Plan Checklist.

The following tables compile criteria for healthy communities that were applied to the Sun Prairie Comprehensive Plan. Several components are applicable to many chapters however were not repeated for brevity. This is not an exhaustive list and could incorporate more variables. Additionally, Sun Prairie has several neighborhood and corridor plans that could provide more specifics in implementation and design in those areas. Ordinances, such as the zoning code, were consulted as needed. Sun Prairie can use this tool to determine any improvements or updates to existing plans, ordinances and programs. Note that Chapter 1 of the Sun Prairie Comprehensive Plan is the introduction and the plan has two volumes, 1 for exiting conditions and 2 for goals, objectives, policies etc.

Chapter 2: Issues and Opportunities

Is there explicit language connecting the plan element to human health?	No	Connection of the plan element to human health is mostly implied. More explicit language connecting the plan element's policies and recommendations to human health is needed.
What other health topics, if any, could be incorporated into this section?		

Chapter 3: Agricultural, Natural and Cultural Resources

Is there explicit language connecting the plan element to human health?	No	Connection of the plan element to human health is mostly implied. More explicit language connecting the plan element's policies and recommendations to human health is needed.
What other health topics, if any, could be incorporated into this section?		
Does the plan identify existing and plan for future opportunities for local food production (i.e. community gardens, protection of agricultural land)?	Yes	No official policy or program.
Has a community food security assessment (USDA ERS) been created to establish barriers to healthy food, income levels, lost farmland, community gardens and farmer's market availability within urbanized areas?	No	
Are there existing or planned vegetated buffers along all water bodies (preferably 20m to 50m) to prevent non-point pollution from impervious surfaces?	Yes	Referred to as environmental corridors.
Are there policies that encourage the inclusion and maintenance of the natural environment?	Yes	

Are there policies that require that all developments have views of greenery for mental health benefits?	No	
Are ground and surface water protected through tools like a wellhead protection overlay zone, prohibiting storage, treatment, production, or disposal of federally- recognized hazardous materials (excluding dry cleaning, photo processing, service stations, or junkyards)?	Yes	Wellhead protection ordinance (2010).
Is a tree canopy provided in parks, open space, and streetscapes to establish a 50% to 100% canopy coverage in the area?	No	Trees and street trees are addressed and regulated through Title 12 Streets, Sidewalks and Public Places, Chapter 12.40 Trees and Shrubs of the City of Sun Prairie's Code of Ordinances. The language does not include canopy coverage language explicitly. Certain woodlands are protected as part of Environmental Corridor regulations.
Is water quality connected to planning for industrial centers and roads in relation to well location?	Yes	
Are site development reviews provided for developments within 1000 feet of wells (site conditions, management practices, minimized grading/vegetation removal)?	Yes	As part of the Urban Service Area Amendment process with the Capital Area RPC.
Are greenways incorporated to provide natural, non-motorized open space corridors (often following roadways, ridge tops and waterways)?	Yes	
Are EPA ground- and surface-water protection overlay districts created using land use geographic zone categorizations (i.e. Zone 1 – within 1000 feet of the public well supply)?	Yes	Through Regional Planning Commission.
Are public education and incentive for water quality provided, such as recreational water resources guide, incentives and technical resources for rain gardens, and septic tank management program loans?	Yes	Public education and technical resources on improving water quality can be found on the City's engineering website at: http://www.cityofsunprairie.com/engineering . Incentive for specific water quality improvements exist at county level and locally, such as the Stormwater Utility Credits Program that went into effect in 2003 in the City of Sun Prairie.
Are parking lots and driveways required to use porous materials and containment strategies (avoid isolated permeable areas, grades of property to divert flow to permeable area, etc.)?	-	Yes though not porous pavements.
Is water quality integrated into planning tools like environmental resources and conservation, public infrastructure, parks and open space?	Yes	

Are there development and landscape design standards for water (i.e. green roofs, encouraging rain gardens, buffer thresholds, ordinances for pervious pavement)?	-	Buffer standards are identified in Title 17 Zoning, Chapter 17.28 Environmental Corridor: Natural Resource Protection Regulations of the City of Sun Prairie's Code of Ordinances, and ordinances for pervious pavement are identified in Title 15 Building and Construction, Chapter 15.30.070 Stormwater Management Plan Requirements. Other methods are not regulated.
Are educational programs such as the NEMO (Nonpoint Education for Municipal Officials) Program used?	No	
Does the plan provide for a variety of natural areas that can accommodate a variety of uses (parks, plazas, landscaped areas) ranging from highly maintained to more wild areas?	Yes	
Does the plan address severe rain events or increased precipitation?	Yes	The City is implementing a number of improvements to address drainage and flooding issues that may occur during heavy rain events. See Comp Plan Vol 2, Chapter 4 Utilities and Community Facilities, P. 4-4 to 4-5.
Does the plan address targets or strategies for GHG reductions community-wide?	-	No established targets, but strategies to reduce GHG emissions are identified in the plan, which include consideration of changing the City's purchasing policies to place a greater priority on buying local materials and supplies and selecting bid projects that are sustainable, as well as consideration of adopting a "no-idle" policy for City vehicles, and investing in vehicle operator education and idle reduction technology for City vehicles. Adoption of the City's Safe Routes to School Plan is also seen as a strategy to reduce auto-related emissions.
Has the plan considered climate change?	Yes	Goals and objectives for natural resources were developed with the consideration of climate change.
Does the plan address access to trails for all residential areas?	Yes	
Does the plan provide guidance on separating potentially contaminating land uses with residential areas and natural resources?	No	
Does the plan address extreme heat events?	No	

Chapter 4: Utilities and Community Facilities

Is there explicit language connecting the plan element to human health?	Yes	Included as access to health care facilities, parks and recreation. Health could be related more directly to the built environment in the right of way where private properties meet public property.
What other health topics, if any, could be incorporated into this section?		
Is a tree canopy provided in parks, open space, and streetscapes to establish a 50% shade cover?		
to 100% canopy coverage in the redevelopment area?	No	
Are there surface-runoff policies/plans that require diversion and collection of water to natural drainage and filtration areas (detention ponds, infiltration pits, swales berms, green strip filters, gravel beds and French drains)?	Yes	Stormwater Ordinance
Does the plan provide for a variety of natural areas that can accommodate a variety of uses (parks, plazas, landscaped areas) ranging from highly maintained to more wild areas?		
	Yes	V1-4-24, V2-4-13
Does the plan provide strategies to convert community facilities, fleets and operations to a carbon-neutral environment?	Yes	V1-4-14, V2-4-13. Fleets are discussed in Issues and Opportunities V2-2-17.
Does the plan address energy-efficient building codes (i.e. LEED)?	Yes	V1-4-14,15 and V2-4-13

Chapter 5: Intergovernmental Collaboration

Is there explicit language connecting the plan element to human health?	No	Collaborative efforts as they relate to health including transit, natural resource corridors and access to regional resources.
What other health topics, if any, could be incorporated into this section?		

Chapter 6: Economic Development

Is there explicit language connecting the plan element to human health?	Yes/Yes	Included as an economic sector, reclaimed sites. V2-6-7,
What other health topics, if any, could be incorporated into this section?		“The operations of businesses in this sector would not create hazards to public health or the environment.” Health could be related more directly to the built environment as an amenity to active living that attracts people to the area.
Are there plans to ensure that there are supermarkets/fruit and vegetable stores located throughout the municipality?	No	Sunshine Place is discussed in the utilities and Community Facilities chapter. Sunshine Place provides community meals on Mondays and has a food pantry.
Does the plan include “buy local” campaigns supported by marketing efforts, and local food distribution?	No	County “buy local” campaign exists.
Is public financing provided for infill development and alternative uses for contaminated sites?	Yes	Funding is available at state and federal levels through competitive grants and locally through TIF, Revolving Loan Fund.

Chapter 7: Housing

Is there explicit language connecting the plan element to human health?	-	As discussed related to assisted living facilities and access to emergency services and healthcare in Volume 1. Volumes 1 and 2 could include access to healthy environment, social places, access to light and air and neighborhood design to reduce auto dependence and enable auto-less travel.
What other health topics, if any, could be incorporated into this section?		
Are at least 50% of residential units affordable to persons at or below the medium household income, and/or is there at least a 20% ownership and 20% rental unit housing mix in a neighborhood or census tract?	No	
Are all residential areas planned for an average of 4 (preferably 7) units per gross acre?	No	Density is between 3 and 4 units per acre in single family areas in the North Side and Near East side Detailed Planning Areas. Taken with multi-family at an average of 13-15 units per acre, the planning areas attain 4-4.5 units per acre.

Are planned residential uses located in areas with existing water and sewer infrastructure or where it is planned to occur with development?	Yes	Local and regional policy.
Does the plan incorporate a variety of housing densities? Variety of housing cost?	Yes	V2-7-6 Goal 1. Goal 2 Objective 5 favors single-family housing at 65% of desired housing stock.
Are there existing or planned transit stops for all residential areas in urbanizing or redeveloping areas (ideally within 1200m)?	-	MPO Transportation Plans expresses the potential for an express bus stop for regional travel.
Does the plan address life-cycle housing?	Yes	V2-9-81 Policy 16, and in Issues and Opportunities.

Chapter 8: Transportation

Is there explicit language connecting the plan element to human health? What other health topics, if any, could be incorporated into this section?	Yes	V1 and V2: Included as safety amongst travelers, ability for walking and biking for public health, mobility as passive exercise versus active exercise on trails etc. Safe Routes to School Program.
Are there existing or planned transit stops for all residential areas in urbanizing or redeveloping areas (ideally within 1200m)?	Yes	Stops are planned in the long term as part of the Transport 2020: Transportation Alternatives Analysis.
Are complete street, shared street and traffic calming concepts incorporated into the future land use plan?	Yes	V2-8-23: Complete Streets Policy 10 and Traffic Calming Policy 11. Does not include social space in public right of way. Nothing on shared streets.
Is residential and commercial density discussed in this chapter to encourage walking, bicycling and transit?	Yes	V2-8-22: Public Transit Policy 7.
Is regular transit service planned for all residential and employment areas (preferably within 1200m of all residential areas)?	Yes	V2-7-6 Goal 1. Goal 2 Objective 5 favors single-family housing at 65% of desired housing stock.
Does the element incorporate neighborhood commercial and/or mixed-used development to encourage transportation related walking?	No	Express bus is likely going to be the first major transit investment for peak hours only.
For pedestrian/bicyclist safety, are speed limits set at or below 35 mph (optimally 20 mph) for 70-90% of streets?	Yes	V2-8- Goal 2-Objective 1.
	Yes	Mostly 25 with increasing speeds around industrial park and Windsor Rd.

Are there plans or policies to provide adequate street lighting along all major streets?	Yes	Lighting policy and plans discussed primarily covers preventing light pollution and aesthetic regulation. Could be expanded to address lighting for safety in pedestrian and bicycle travel.
Is the off-street trail system planned to serve all residential areas, preferably within 400-600m of all residential areas?	No	Trails are extensive and discussed as regional connectors and off-street bike paths as development occurs, however not all are within this distance buffer. Trail from Patrick Marsh to McCarthy Park
Is there a multimodal transportation plan that connects all residential areas to services (i.e. employment centers, grocery stores, hospitals, etc)?	Yes	Plan identifies and promotes several travel modes. A shared ride taxi service is provided through Union Cab. A shuttle exists through the Colonial Club for residents outside. A pilot was completed for a shuttle to East Towne from downtown. Bus service through Madison Metro is provided to the American family Parkway Area. Future plans for expansion of transit are being studied.
Are there a variety of nearby destinations for residents (e.g., employment, health care, grocery stores, etc.) and can these destinations be reached by a variety of transportation modes (e.g., bicycling, walking, automobile, transit)?	Yes	Access diminishes further from the downtown area for travel modes beside automobile.
Are there policies/plans supporting cycling and walking?		
Are there policies/plans that prioritize the transportation needs of underserved populations (e.g., seniors, children, persons with disabilities such as the blind and immobile, low-income residents, etc.)?	Yes	V2-8-23 General Policy 1, 5 and 10.
Are there plans to create multi-modal developments?	Yes	V2-8-20 Policy and Safe Routes To School in both Volumes.
Are the TODs incorporated into a multimodal transportation system?	N/A	
Does the plan use pedestrian overlay zones that include polices that encourage walking and bicycling through streetscape amenities, such as benches, trash receptacles, planters, pole lights, kiosks, newsstands, drinking fountains and bike racks?	Yes	Streetscape is addressed in Vol. II 8-8, Goal 1, Objective 11.
Benches, trash receptacles, planters, and water fountains not mentioned.		

Are there urban design guidelines that relate to sidewalk width and materials, lighting, signage, landscaping, way finding, crosswalks, curb ramps, refuge islands, corner radii, and signals?	Yes	V2-8-19,20, also in Zoning
Do pedestrian policies provide protection through parallel parking, bollards and street trees as features?	Yes	Bollards not specifically discussed. Street trees are mentioned in the presentation of Form-based Codes in the Land Use Chapter.
Is their guidance on transportation/travel demand management strategies (i.e. flex work hours, TMO's and commuter choice programs)?	No	Not in policy language. Discussed as part of Regional Plan and Transportation Improvement (MPO) description.
Does the plan address specific strategies that would promote social interaction or gatherings?	No	Not explicitly, though could be achieved through traditional neighborhood design.

Chapter 9: Land Use

Is there explicit language connecting the plan element to human health?	Yes/	Discussed as a purpose of Land Use Planning in Volume1. In
What other health topics, if any, could be incorporated into this section?	No	Volume 2, it is discussed in the section for Mixed-Use Land Use District. Phasing development for public health. Both discuss access to healthcare facilities.
Does the land use plan incorporate neighborhood commercial and/or mixed-used development to encourage transportation related walking?	Yes	In Volume 2, it is discussed in the section for Mixed-Use Land Use District.
Are mixed-use centers included as alternatives to the conventional suburban style office and research park type employment center?	No	Not consistently throughout future development plans.
Do planning policies for redevelopment include evaluation of lead-bearing substances in exposed surfaces of dwelling units, child care facilities, schools, or recreation facilities used by children?	No	
Are there plans to ensure that there are supermarkets/fruit and vegetable stores located throughout the municipality?	No	
Does the plan provide separation between residential and heavy industrial (potentially contaminating) uses?	Yes	
Does the plan provide separation between natural resources and heavy industrial (potentially contaminating) uses?	Yes	
Does the plan identify brownfield locations that may be opportunities for infill development if cleaned up?	No	Referred to as Environmentally Contaminated Sites also. Sites are not mapped as part of the plan.

Are there policies or incentives that regulate the brownfield cleanup?	Yes	Regulating brownfields involves multiple tiers of government regulation. Vol. II Goal 7, Objective 7 and Policies and Recommendation 6.
Does the plan link existing and future housing development with employment and services?	Yes	
Have principles of Crime Prevention Through Environmental Design (CPTED) been incorporated into the plan to create a sense of safety?	-	Not explicitly though mention of public safety and the benefit of providing pedestrians with a sense of safety and large-scale commercial developments.
Has a safety checklist been consulted for standards on pedestrians and bicyclists, health/accessibility, motor-vehicle and transit riders, building, home and workplace, public facilities, and the natural environment?	-	Standards are provided. Could be expanded or checklist created to connect to health and safety outcomes and distribute to developers and builders.
Have educational materials been distributed to farmers, developers, landowners and the general public about the options and alternatives to sprawl (i.e. TDR, PDR, conservation subdivisions)?	N/A	
Are polluting sources regulated by local, state and federal governments (evaluating businesses that disproportionately pollute within neighborhoods like dry cleaners, automotive paint shops, manufacturing)?	Yes	
Does the plan require that at least a small amount of green space be provided for all development?	Yes	
Will public information disclosure about toxics be used as tools to mitigate health hazards?	-	
Are brownfields inventoried through a shared database providing liability resources?	Yes	Database is maintained at state level. This could be discussed in the Plan.
Does the plan address the views of greenery or vistas?	Yes	Vol. II 3-7 Objective 1 and 9-39 Goal 2, Objective

Chapter 10: Implementation

Is there explicit language connecting the plan element to human health?	No	While health is an outcome of many implementation actions it is not explicitly stated here. The implementation actions expressed could serve positive public health outcomes, such as trails and Traditional Neighborhood Design.
What other health topics, if any, could be incorporated into this section?		

Sun Prairie Sustainability Audit Matrix

This matrix summarizes LEED® Neighborhood Development requirements, credit opportunities, their intent, whether Sun Prairie has attained the goal or has the policies/standards to do so, and recommendations to help Sun Prairie meet these criterion in future developments and redevelopment where gaps in policy or implementation exist.

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
SLL- Smart Location and Linkage					
Prerequisite 1	Smart location	<ul style="list-style-type: none"> To encourage development within and near existing communities and public transit infrastructure. To reduce vehicle trips and vehicle miles traveled (VMT). To reduce the incidence of obesity, heart disease, and hypertension by encouraging daily physical activity associated with walking and bicycling. To reduce vehicle trips and vehicle miles traveled (VMT). To reduce the incidence of obesity, heart disease, and hypertension by encouraging daily physical activity associated with walking and bicycling. 	<ul style="list-style-type: none"> Require development to be on water and sewer infrastructure. Be on a site adjacent to development, an infill site, on a transit line or within walking distance of several amenities. 	<ul style="list-style-type: none"> Sun Prairie's Comprehensive Plan discourages urban uses and unsewered development outside the urban service area (USA), though several unsewered subdivisions exist beyond just outside the USA boundary. The Comprehensive Plan recommends using Sun Prairie's 3-mile extra territorial plat review to limit non-sewered residential development to one unit per 35 acres. 	<ul style="list-style-type: none"> Focus future development within urban service areas to the greatest extent possible. (Refer to Comprehensive Plan) When rural development is planned, it should be clustered near mixed-use areas, such as hamlets, to the greatest extent possible. A transfer of development rights program could help implement this goal. (Refer to Ch. 17 Zoning Ord., and Dane County Ch. 10 Zoning Ord. for TDR)
	Imperiled species and ecological communities	<ul style="list-style-type: none"> To conserve imperiled species and ecological communities. 	<ul style="list-style-type: none"> Prepare a habitat conservation plan if imperiled or endangered species are found on a site proposed for development. 	<ul style="list-style-type: none"> There are protections for endangered species (animals), which are administered by the DNR. See sections NR 27 and NR 29 for more information. 	
Prerequisite 3	Wetland and water body conservation	<ul style="list-style-type: none"> To preserve water quality, natural hydrology, habitat, and biodiversity through conservation of wetlands and water bodies. 	<ul style="list-style-type: none"> Locate new development greater than 50 feet away from wetlands and 100 feet away from other water bodies (excludes redevelopment of sites near water features). 	<ul style="list-style-type: none"> Wetlands are contained in environmental corridors, which are protected from development in urban service areas. Environmental corridors include a 100 foot buffer surrounding wetlands. NR 117 recently required updates to shoreland Ord.s to further protect sensitive areas. Most undeveloped land surrounding shorelines will be included in environmental corridors and be protected from future development. 	
Prerequisite 4	Agricultural land conservation required	<ul style="list-style-type: none"> To preserve irreplaceable agricultural resources by protecting prime and unique soils on farmland and forestland from development. 	<ul style="list-style-type: none"> Locate the project on a site that is not within a state or locally designated agricultural preservation district, and 	<ul style="list-style-type: none"> Sun Prairie recognizes its future growth will require conversion of farm land to urban uses, but its Comprehensive Plan discusses strategies to preserve agricultural uses. 	<ul style="list-style-type: none"> To reduce conflicts at the urban edge, focus agricultural preservation efforts outside peripheral growth areas (Refer to Comprehensive Plan and Ch. 17 Zoning Ord.)
			<ul style="list-style-type: none"> Locate project so it does not impact prime soils, is on an infill site, is served by transit, and is in a development receiving zone or purchase easements to permanently protect other land. 	<ul style="list-style-type: none"> Sun Prairie strongly recommends surrounding towns create policies that protect agricultural lands from unsewered development, such as Windsor's Agricultural Enterprise area, which encourages land to remain in agriculture by providing tax benefits to farmers. The Comprehensive Plan also discusses working with surrounding Towns to identify and protect agricultural preservation areas, within the context of larger boundary agreements. 	<ul style="list-style-type: none"> Investigate potential of TDR programs in other townships and consider locating receiving zones at existing rural hamlets. (Refer to Dane County Ch. 10 Zoning Ord. and Dane County Planning & Development Department for TDR)
				<ul style="list-style-type: none"> When unsewered development occurs, Sun Prairies plans recommends the development be clustered so as to preserve large, contiguous areas of agricultural land that are still viable for farming. 	
				<ul style="list-style-type: none"> Sun Prairie's plan recognizes that infill and redevelopment can reduce pressure on green field development and can delay agricultural conversions. 	
Prerequisite 5	Floodplain avoidance required	<ul style="list-style-type: none"> To protect life and property, promote open space and habitat conservation, and enhance water quality and natural hydrological systems. 	<ul style="list-style-type: none"> Develop in areas without floodplains or on infill or redevelopment sites with a mitigation plan. 	<ul style="list-style-type: none"> Floodplains are contained in environmental corridors, which are protected from development in urban service areas. 	

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
SLL-Smart Location and Linkage (cont.)					
Credit 1	Preferred locations	<ul style="list-style-type: none"> To encourage development within existing cities, suburbs, and towns to reduce adverse environmental and public health effects associated with sprawl. To reduce development pressure beyond the limits of existing development. To conserve natural and financial resources required for construction and maintenance of infrastructure. 	<ul style="list-style-type: none"> Develop on a site adjacent to or surrounded by development, or previously developed site (additional credits for infill and redevelopment). Develop on a site with a high level of street connectivity in the surrounding half mile (min 200 intersections per square mile, additional points up to 400). 	<ul style="list-style-type: none"> See SLL PREREQUISITE 1 	
Credit 2	Brownfield redevelopment	<ul style="list-style-type: none"> To encourage the reuse of land by developing sites that are complicated by environmental contamination, thereby reducing pressure on undeveloped land. 	<ul style="list-style-type: none"> Locate project on a brownfield and remediate site contamination. 	<ul style="list-style-type: none"> Sun Prairies Comprehensive Plan discusses brownfield development in a few places. It recognizes the importance of redevelopment occurring on these sites and states the City shall place a greater emphasis on redevelopment and infill development on brownfield sites or underutilized sites in need of redevelopment verses development on the edge of the community and should reuse existing buildings, especially those with historical value, where feasible verses demolishing such buildings. The Comprehensive Plan continues that providing incentives for redevelopment, such as Ord. waivers, flexibility, and/or TIF assistance where applicable, may be required. In Sun Prairie, the vast majority of open contamination records (or those requiring on-going activity such as monitoring) are located on parcels within TIF Districts. These parcels are generally clustered near Cannery Square, Linnerud St/ rail corridor and on Main Street. TIF districts are an effective way of encouraging redevelopment and have been successful in the downtown area. 	Continue to plan for redevelopment on brownfields and use financial incentives to assist redevelopment of contaminated properties. (Refer to Comprehensive Plan)
Credit 3	Locations with reduced automobile dependence	<ul style="list-style-type: none"> To encourage development in locations shown to have multimodal transportation choices or otherwise reduced motor vehicle use, thereby reducing greenhouse gas emissions, air pollution, and other adverse environmental and public health effects associated with motor vehicle use. 	<ul style="list-style-type: none"> Locate the project in an area well served by transit, or Locate the project in an traffic area zone (TAZ) which has below average vehicle miles traveled (VMT) compared to the metropolitan area. 	<ul style="list-style-type: none"> Sun Prairie currently does not have transit service, as Metro bus service extends only to the American Center. Several studies have identified future transit routing that could serve Sun Prairie. The recent Bus Rapid Transit (BRT) study by the Madison Area Transportation Planning Board (MPO) identified the east route extending to East Towne, with a possible extension to Sun Prairie. Other studies have also identified routing options for two express bus routes. Sun Prairie has organized a shuttle service to East Towne Mall, to connect with regular Metro bus service. The shuttle cost \$3.25 and does not include Metro Fair (making a total trip cost of \$5.25 one way). Sun Prairie is on a rail corridor which has been studied for potential transit, but no station has been identified in Sun Prairie and this would likely be a long-term development. According to CNT's H+T Index, Sun Prairie's VMT range is generally 21,000-26,000 miles per year per household, with a small area near Main Street having a level of 18,500-21,000 miles per year per household. Approximately 55% of households in Dane County have an estimated annual VMT below 21,000. Approximately 35% of households in Dane County fall within the 21,000-26,000 VMT range (see http://htaindex.cnt.org/map/). Sun Prairie can have some influence on VMT within its jurisdiction. Higher densities, transit access, mixed uses and smaller block sizes have been shown to reduce VMT in recent studies. (Refer to Comprehensive Plan and Ch. 17 Zoning Ord. and Land Use Ord.) 	<ul style="list-style-type: none"> Develop in higher densities surrounding identified express commuter bus stops. 10 to 15 units/ac.s is often cited as the minimum density that supports frequent transit. Support the downtown and maintain long-term potential for rail transit by encouraging higher density surrounding the station area and maintain options for future station planning. Continue to build employment opportunities in and around the Sun Prairie area, allowing residents to live and work in the same community. Consider maximum block sizes for future development and explore opportunities to enhance connectivity through developed areas.
Credit 4	Bicycle network and storage	<ul style="list-style-type: none"> To promote bicycling and transportation efficiency, including reduced VMT. To support public health by encouraging utilitarian and recreational physical activity 	<ul style="list-style-type: none"> Locate the project in an area with an existing bicycle network located within ¼ mile of project boundary that connects to important services. Provide enclosed bicycle storage at the rates of 1 per residential unit, 1 per 5,000 sf of retail space and/or spaces for 10% of employees. 	<ul style="list-style-type: none"> Sun Prairie has fifteen miles of trails, some are located along arterial and collector streets providing Sun Prairie residents with alternative travel options. The Comprehensive Plan calls for the creation of a future bike trails map to aid in wayfinding and make the system easier to navigate. Many of the trails link residential areas with parks and schools. The Comprehensive Plan calls for the Adoption of a Complete Streets policy that accommodates cyclists in all areas. The Comprehensive Plan also addresses bike parking, and states that bike racks should be installed in city parks, at public buildings and other public facilities, and strongly encouraged with industrial, institutional, multi-family, and commercial uses. However, no mention of bike parking requirements were found in the zoning code. (Refer to Comprehensive Plan and Ch. 10.32 Bicycles Ord.) 	<ul style="list-style-type: none"> Ensure new developments provide connections to existing and planned bicycle routes by creating a bike and pedestrian plan. Expand planned bicycle routes beyond future rails to trails conversions noted in Comprehensive Plan, possibly including safe routes to school and planning future paths/routes on official map. Adopt bike parking standards and require new development to have bike storage areas, preferably covered.

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
SLL-Smart Location and Linkage (cont.)					
Credit 5	Housing and jobs proximity	<ul style="list-style-type: none"> To encourage balanced communities with a diversity of uses and employment opportunities. 	<ul style="list-style-type: none"> Include a residential component to the project and locate it in an area where the number of FTE jobs within ½ mile exceeds the number of dwelling units in the project, or Include a nonresidential component to the project within ½ mile of a transit stop and existing dwelling units. 	<ul style="list-style-type: none"> Sun Prairie has the majority of its employment clustered on Main Street, Windsor Street and in its business park northeast of CTH N and Hwy 151. According to 2011 Census data, Sun Prairie has 9,265 jobs in the city and a workforce of 16,283. 2,306 jobs in Sun Prairie are held by residents (14% of local workforce is employed in Sun Prairie; 25% of jobs are held by residents). These employment areas are generally surrounded by residential. Planned Mixed Use and Planned Neighborhood allow employment as well as residential uses. 	<ul style="list-style-type: none"> Use infill and cluster development to develop in higher densities near employment centers. Promote diverse neighborhoods and mixed-use developments through zoning and land division codes. Refer to Comprehensive Plan and Ch. 17 Zoning Ord. and Land Use Ord.
Credit 6	Steep slope protection	<ul style="list-style-type: none"> To minimize erosion to protect habitat and reduce stress on natural water systems by preserving steep slopes in a natural, vegetated state. 	<ul style="list-style-type: none"> Do not disturb or limit development on slopes over 15%, or Restored previously developed slopes over 15% with native or noninvasive adapted plants, or Develop agreements that will protect steep slopes in perpetuity. 	<ul style="list-style-type: none"> Slopes over 12% adjacent to water bodies are generally incorporated in Environmental Corridors, created by CARPC, which are protected from development. Required natural resource site evaluation would identify any steep slopes not contained in environmental corridors and prevent development on impacted areas or allow development with mitigation. 	<ul style="list-style-type: none"> Potentially identify opportunities for restoration of steep slopes. Refer to Comprehensive Plan and Ch. 17.28 Environmental Corridor: Natural Resource Protection Regulations Ord.
Credit 7	Site design for habitat or wetland and water body conservation	<ul style="list-style-type: none"> To conserve native plants, wildlife habitat, wetlands, and water bodies. 	<ul style="list-style-type: none"> Avoid sites with significant habitat, wetlands, or water bodies, or Work with experts to identify significant habitat, wetlands, and water bodies and buffer these areas from development. 	<ul style="list-style-type: none"> Sun Prairie's Comprehensive Plan calls for protection of natural areas, including wetlands, wildlife habitats, lakes, woodlands, open spaces and ground water. These areas will be protected through the enforcement of the City's adopted natural resource protection zoning standards and through the use of the City's Subdivision Ord. See SLL Prerequisite 3. 	<ul style="list-style-type: none"> Use conservation easements, PDR, TDR, and other mechanisms to protect natural resources. Leverage outside sources of funding to purchase/protect sensitive areas. Refer to Comprehensive Plan, Ch. 17.28 Environmental Corridor: Natural Resource Protection Regulations Ord., and Dane County Ch. 10 Zoning Ord. and Dane County Planning & Development for TDR.
Credit 8	Restoration of habitat or wetlands and water bodies	<ul style="list-style-type: none"> To restore native plants, wildlife habitat, wetlands, and water bodies that have been harmed by previous human activities. 	<ul style="list-style-type: none"> Use native plants to restore pre-development ecological conditions in an area greater than 10% of development footprint. 	<ul style="list-style-type: none"> Sun Prairie's Comprehensive Plan acknowledges the need to protect sensitive areas and addresses the need for restoration through removal of invasive species while promoting public awareness of the negative impacts of invasive species. It references existing Ord. provision that direct removal of invasive species but no provision was found upon searching the zoning Ord. The Land Division Ord. requires land dedication of one acre of land per 23 residential units, which will generally be greater than 10% of the development footprint (impervious surface) in most contexts. However this does not address restoration. Refer to Comprehensive Plan, Ch. 16.28.090 Public Lands and Open Spaces Ord., and Ch. 17.28 Environmental Corridor: Natural Resource Protection Regulations Ord. 	<ul style="list-style-type: none"> With future land divisions, consider encouraging or requiring a percentage of the land dedication be restored to pre-development condition, especially in proximity to environmental corridors, other natural features or habitats.
Credit 9	Long-term conservation management of habitat or wetlands and water bodies	<ul style="list-style-type: none"> To conserve native plants, wildlife habitat, wetlands, and water bodies. 	<ul style="list-style-type: none"> Create and commit to at least a 10-year management plan to conserve native habitats, wetlands, and water bodies. 	<ul style="list-style-type: none"> Sun Prairie does not require a long-term management plan for protected areas but the Comprehensive Plan references current and potential on-going actions that can maintain high quality natural resources. These include continued efforts to improve and maintain the Patrick Marsh Wildlife Area and to investigate the feasibility of restoring degraded natural systems. As previously mentioned, the Comprehensive Plan encourages planting native species and removal of invasive noxious plant material. Refer to Comprehensive Plan and Ch. 17.28 Environmental Corridor: Natural Resource Protection Regulations Ord. 	<ul style="list-style-type: none"> Consider requiring long-term management plans as a part of development approvals on lands abutting or containing sensitive areas. Require that adequate funds are set aside or will be made available to manage habitats, wetlands, and water bodies.

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
Neighborhood Pattern and Design					
Prerequisite 1	Walkable streets	<ul style="list-style-type: none"> To promote transportation efficiency, including reduced vehicle miles traveled (VMT). To promote walking by providing safe, appealing, and comfortable street environments that support public health by reducing pedestrian injuries and encouraging daily physical activity. 	<ul style="list-style-type: none"> Entries: New buildings shall have a principal, functional entry on the street or public space (not a parking lot) and is connected to sidewalks Building Height: At least 15% of street frontage has a minimum building height to-street-width ratio of 1:3 (measured from building face to building face) (credit for 40%) Sidewalks: Sidewalks are present on both sides of the street, are at least 8 feet in width in retail/mixed use area and 4 feet in other areas (a credit given for widths of 10 and 5 feet) Garages: No more than 20% of street frontages are faced with garage or service bays openings (doors). 	<ul style="list-style-type: none"> Entries: Sun Prairie has zoning provision within the Main Street overlay districts and for large commercial developments that require street-facing entries on all buildings. There is not a requirement in the zoning code. In certain conditions, parking is not permitted between buildings and the street. Building Height: With the exception of the downtown, buildings in Sun Prairie generally do not meet this criteria, though this has more to do with setbacks than building height. With ROW widths, minimum setbacks and maximum heights, the zoning Ord. frequently prevent this criteria from being met in all areas but the downtown or by PUD. Sidewalks: The majority of Sun Prairie's major streets have sidewalks on both sides, though gaps do exist. The City's current policy on sidewalk reconstruction is a 50/50 cost share with residents in conjunction with street reconstruction or safe routes to school efforts. Garages: Sun Prairie does not appear to have a policy addressing the orientation of garage or service opening. In many residential areas, garages face the street. In commercial areas, most service areas face the rear of the property, with the exception of automobile service facilities. 	<ul style="list-style-type: none"> Entries: Consider establishing building frontage and entry requirements or guidelines. The relationship of these two regulation can create design and occupancy challenges. Building Height: Consider reducing minimum setbacks and establishing maximum setbacks for appropriate zoning categories. Sidewalks: Consider creating guidelines for new commercial areas in PUDs, identifying pavement width and treatments, tree spacing, lighting fixtures, etc. Garages: Consider creating guidelines to address the siting, orientation and impacts (visual, acoustic, etc.) from these areas on adjacent properties. Refer to Ch. 12 Streets, Sidewalks, and Public Places Ord., Ch. 17.20 Density & Intensity Regulations Ord., Ch. 17.24 Bulk Regulations Ord., and Ch. 17.36 Performance Standards Ord.
Prerequisite 2	Compact development	<ul style="list-style-type: none"> To conserve land. To promote livability, walkability, and transportation efficiency, including reduced vehicle miles traveled (VMT). To leverage and support transit investments. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling. 	<ul style="list-style-type: none"> In areas within walking distance of existing or planned transit service (1/4 mile for bus, 1/2 mile for rail): <ul style="list-style-type: none"> Residential densities- 12 units/ac. Non-residential densities of 0.8 floor area ratio (FAR) In areas without existing or planned transit service: <ul style="list-style-type: none"> Residential densities- 7 units/ac. Non-residential densities of 0.5 floor area ratio (FAR) (credits given for higher densities) 	<ul style="list-style-type: none"> Sun Prairie's overall residential density is 5.5 units/ac. Residential density varies by context, with higher densities clustered near Main Street, Hwy 151, Windsor Street and Bird Road. Sun Prairie's commercial has an overall FAR of 0.22, though this does not include industrial, civic, and institutional uses. The Comprehensive Plan calls for high density housing within convenient and safe walking distance of transit. In areas within walking distance of existing/planned transit service (1/4 mile for bus, 1/2 mile for rail) residential densities average 5.3 units/ac. Planned development in the Westside neighborhood will likely increase this density. FAR of commercial buildings near future transit facilities is slightly higher than the community average at 0.23. It is challenging to say if this will increase with future development, as commercial components of mixed use areas are often not significantly higher density. 	<ul style="list-style-type: none"> Focus redevelopment and intensification efforts around downtown and potential rail transit stop. Identify potential express bus service stops and encourage higher density development within walking distance of the stops. Continue to identify areas appropriate for elevated levels of both residential and commercial density, such as neighborhood centers in planned neighborhoods. Encourage developments to include long-term intensification options, such as potential building sites in underutilized parking areas. Refer to Comprehensive Plan, Ch. 17.20 Density & Intensity Regulations Ord., and Ch. 17.24 Bulk Regulations Ord.
Prerequisite 3	Connected and open community	<ul style="list-style-type: none"> To promote projects with high levels of internal connectivity and are well connected to the community at large. To encourage development within existing communities that promotes transportation efficiency through multimodal transportation. To improve public health by encouraging daily physical activity. 	<ul style="list-style-type: none"> In projects that will create streets: <ul style="list-style-type: none"> Have an intersection density of 140 intersections per square mile (including streets and off-street bike/pedestrian paths) Have through streets at spacing no greater than every 800 feet. Projects that don't create new streets should be located in areas with intersection density of at least 90 intersections per square mile. 	<ul style="list-style-type: none"> Sun Prairie has, on average, 111 intersections/square mile, The smallest blocks are near downtown, the largest are further west. Sun Prairie's street policies have resulted in a generally well connected development pattern. There are relatively frequent local streets that create connection through neighborhoods, as well as surrounding arterials. Sun Prairie has use various tools to ensure a quality street network is developed. This includes the official map and detailed planning efforts like the Westside Plan, which has been implemented through planned unit developments. Sun Prairie's land division Ord. states that intersections on arterials shall be minimized, with connections every 1,200+ feet. Street and block standards will generally require block widths to be greater than 150/250/300 feet (depending on street context) and lengths greater than 500 feet and less than 1,200 feet. This yields a maximum intersection density of 140 intersections per mile, but likely result in a significantly lower value. 	<ul style="list-style-type: none"> Encourage smaller block sizes and greater intersection density in areas where moderate and high levels of pedestrian activity is anticipated. Encourage future local streets to have at least one through street between planned collector streets. Encourage four way over "T" intersections. To assist in way finding, encourage through routes to generally travel in one directions (ie north-south), and generally not result in perpendicular travel routes (for example, starting north and terminating west). Refer to Ch. 16.28 Design Standards.

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:
NPD-Neighborhood Pattern and Design (cont.)				
Credit 1	Walkable streets <ul style="list-style-type: none"> To promote transportation efficiency, including reduced vehicle miles traveled (VMT). To promote walking by providing safe, appealing, and comfortable street environments that support public health by reducing pedestrian injuries and encouraging daily physical activity. 	<p>Facades and Entries:</p> <ul style="list-style-type: none"> 80% of street-facing buildings within 25 feet of the property line. 50% of street-facing building within 18 feet of the property line. 50% of mixed-use and nonresidential street-facing building façades within 1 foot of sidewalk. Functional entries occur at intervals of 75 feet or less (bonus for 30 feet or less) on non-residential or mixed-use buildings or blocks. Ground-Level use and parking. Clear glass on 60%+ of commercial facades at 3 to 8 feet above grade. No more than 40% or 50 feet of a façade on a sidewalk can be blank. On-street parking on 70% of streets. 50% of ground-floor housing units must have finished floor no less than 24 inches above the sidewalk grade. Commercial and mixed use buildings should have an active use on the ground floor facing a street. Street design speeds for safe pedestrian and bicycle travel. 75% of residential streets are designed for a 20 mph target speed or slower. 70% of nonresidential/mixed-use streets are designed for a 25 mph target speed. Sidewalk intrusions. Driveways are no more than 10% sidewalk length. 	<ul style="list-style-type: none"> Generally residential zones have a minimum front setback of 20 feet and could meet this standard. Non-residential uses have more varied setback requirements between 0 and 25 feet. Within the Main Street overlay districts, a build-to zone has been established, requiring building to occupy 50% of the frontage between 5 and 20 feet from the ROW. In the downtown area, many of the buildings would comply with criteria, and are within 1 foot of the sidewalk. Within the Main Street overlay districts, commercial buildings are required to have 50% transparency on ground level street-facing facades. Residential and other uses that require more privacy are required to have 30% transparency. There is also a transparency requirement for large commercial developments, requiring 60% transparency on street-facing facades of outlot buildings. Both zoning sections have provisions to prevent blank walls from occurring. On-street parking is present on many, but not all streets in Sun Prairie. Sun Prairie does not have a guideline or standard addressing the elevation of residential units above grade. This type of regulation is generally contained in design guidelines/standards address Crime Prevention Through Environmental Design (CPTED). Zoning provisions do address overall use but do not address the location of active spaces such as those discussed occur within a building. Design speeds for safe pedestrian and bicycle travel The majority of streets in Sun Prairie have a posted speed limit of 25 mph. Speed limits are higher on arterials near the business park, on Windsor Street and segments of West Main Street. The design speeds are unknown and actual travel speeds will significantly depend upon road design. Wide, open street generally result in higher speeds regardless of the posted speed limit. Sidewalk intrusions. 	<ul style="list-style-type: none"> Reduce minimum setbacks and create maximum setbacks in appropriate locations. Adopt standards that require parking behind (preferred) or on the side of buildings. Encourage multi-tenant retail buildings to locate at the street, with entries on the sidewalk. Refer to Comprehensive Plan, Chapter 17.16 Land Use Regulations Ord., Chapter 17.20 Density & Intensity Regulations Ord., Chapter 17.24 Bulk Regulations Ord., and Chapter 17.36 Performance Standards Ord. Consider creating transparency guidelines or standards for commercial and mixed use buildings, especially in the downtown and surrounding commercial areas. Continue to evaluate the potential need and utilization for on-street parking on a case-by-case basis. In certain contexts such as downtown, on-street parking may be preferable to off-street lots. If on-street parking is rarely used, the space may be more appropriate for bike lanes, landscaping/stormwater areas, etc. Consider a guideline or standard that elevates ground floor residential spaces more than two feet above grade unless they are intended as accessible units. Design speeds for safe pedestrian and bicycle travel Evaluate existing street standards do determine if the design speeds are appropriate. If design speeds are higher than desired, consider updating street standards based on ITE information. Sidewalk intrusions. Encourage mixed-use and commercial buildings with active interior spaces visible from the sidewalk. Encourage shared driveways and cross access easements between similar uses where possible. Limit future driveways in pedestrian areas. Encourage driveways on the less active street frontage.
Credit 2	Compact development	<ul style="list-style-type: none"> Credits given for densities above those stated in NPD P-2 	<ul style="list-style-type: none"> See NPD P-2 	
Credit 3	Mixed-use neighborhood centers <ul style="list-style-type: none"> To cluster diverse land uses in accessible neighborhood and regional centers to encourage daily walking, biking, and transit use, reduce vehicle miles traveled (VMT) and automobile dependence, and support car-free living. 	<ul style="list-style-type: none"> 50% of housing units within ¼ mile walk distance of a minimum of 4 diverse uses (typically retail goods and services); (additional credits given to greater numbers of uses), and uses are cluster so at least 3 uses are within 300 feet of each other. 	<ul style="list-style-type: none"> 41% of residential units in the city are located within ¼ mile of retail and service businesses. A simple buffer was used so actual walking distance might be greater. 	<ul style="list-style-type: none"> Encourage higher densities surrounding commercial areas, the downtown, neighborhood centers and on redevelopment sites near the Hwy 51 corridor.
Credit 4	Mixed-income diverse communities <ul style="list-style-type: none"> To promote socially equitable and engaging communities by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community. 	<ul style="list-style-type: none"> Have a Housing Diversity Score of greater than 0.5; or Include an affordable housing component for households making less than the Area Median Income. 	<ul style="list-style-type: none"> Sun Prairie has a diverse housing stock, with 50% multifamily housing units (includes duplex, townhomes and apartment buildings), up from 34% in 1980. Owner occupied housing prices in Sun Prairie have a similar distribution as other areas in Dane County, with somewhat greater levels of homes below \$300,000. Rental housing has slightly lower levels of very high end and very low-end units, with greater levels of rentals between \$650 and \$1,250. One of the Comprehensive Plan housing goals is to provide a variety of quality and affordable housing. Policy recommendations aimed to accomplish this include considering amendments Ord.s to allow accessory dwelling units (increasing housing choice, density and affordability), encouraging smaller lot sizes and considering amending public improvement standards. 	<ul style="list-style-type: none"> Continue encouraging diversity in housing stock to ensure all current, future and potential residents have housing options that meet their needs.

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
NPD-Neighborhood Pattern and Design (cont.)					
Credit 5	Reduced parking footprint	<ul style="list-style-type: none"> To design parking to increase the pedestrian orientation of projects and minimize the adverse environmental effects of parking facilities. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling. 	<ul style="list-style-type: none"> All off-street parking lots located on the side or behind the building Have parking account for no more than 20% of a projects total development footprint (impervious surface of site) Bike parking as required in SLL Credit 4 Dedicate 10% of parking in commercial lots for carpool/car share and locate close to entry. 	<ul style="list-style-type: none"> Sun Prairie has design guidelines and standards for certain districts, primarily the Main Street overlays and Downtown, which require parking to be located behind or on the side of buildings, except in certain conditions. Off-street parking is not required for certain uses in the downtown area. Many buildings utilize public or private lots behind the buildings and on-street spaces. Sun Prairie's zoning Ord. does not have maximum parking standards. Parking generally accounts 20%+ of the development footprint. This criteria is unattainable without the majority of parking in structures. Sun Prairie's zoning Ord. does not have priority parking requirements for car-pools and there is no car share program currently in Sun Prairie. 	<ul style="list-style-type: none"> Consider an evaluation of current minimum parking requirements to ensure they do not require more parking than necessary. Consider allowing a limited number of on-street parking spaces count toward required parking. Encourage major employer to consider giving priority spaces to car pools.
	Street network		<ul style="list-style-type: none"> Credits given for having through street spacing and intersection density above those discussed in NPD Prerequisite 2. 	<ul style="list-style-type: none"> See NPD-P2 Sun Prairie currently does not have transit service, however the MPO has identified potential for express bus service, as previously discussed. 	
Credit 6	Transit facilities	<ul style="list-style-type: none"> To encourage transit use and reduce driving by providing safe, convenient, and comfortable transit waiting areas and safe and secure bicycle storage facilities for transit users. 	<ul style="list-style-type: none"> Work with transit agency to ensure development allows for transit improvements, such as covered shelters, transit information and bicycle parking. 	<ul style="list-style-type: none"> While some congestion may be present in Sun Prairie, major peak hour traffic generators and traffic counts are not at levels that would require strategies such as TDM. 	<ul style="list-style-type: none"> Along the identified route, ensure sufficient space exists within the right of way for the appropriate level improvements, or incorporate improvements into future developments or redevelopment projects.
Credit 7	Transportation demand management	<ul style="list-style-type: none"> To reduce energy consumption, pollution from motor vehicles, and adverse public health effects by encouraging multimodal travel. 	<ul style="list-style-type: none"> Implement a transportation demand management (TDM) plan that reduces weekday peak-period motor vehicle trips by 20%. 	<ul style="list-style-type: none"> 85% of housing units are located within ¼ mile of a public park or open space no less than 1/6 acre. 	<ul style="list-style-type: none"> If congestion is problematic in the future, consider working with major employers to create a TDM strategy such as modification of work schedules (shifts),
Credit 8 & 10	Access to civic and public space and access to recreation facilities	<ul style="list-style-type: none"> To improve physical and mental health and social capital by providing a variety of open spaces close to work and home to facilitate social networking, civic engagement, physical activity, and time spent outdoors. 	<ul style="list-style-type: none"> 90% of housing units within ¼ mile of a public park or open space 1/6+ acres. 90% of housing units and non-residential buildings are within 1/2 mile of a public park with improvements (such as athletic fields) no less than 1/2 acre. 	<ul style="list-style-type: none"> Over 98% of housing units are located within ½ mile of improved parks no less than ½ acre. 	<ul style="list-style-type: none"> Continue to require park/open space dedications with future land divisions. Consider developing additional recreational facilities such as athletic facilities throughout the city. Consider creating a parks and open space plan addressing current and future parks.
	Visit-ability and universal design	<ul style="list-style-type: none"> To enable the widest spectrum of people, regardless of age or ability, to more easily participate in community life by increasing the proportion of areas usable by people of diverse abilities. 	<ul style="list-style-type: none"> Accessible units account for 20% of housing units. 	<ul style="list-style-type: none"> One of the Comprehensive Plan housing recommendations is to increase new, non-single-family housing units to be built incorporating elements of universal design (e.g. at grade entryways, lever handles, rocker light switches, wider doorways/hallways, discreet grab bars, etc). Sun Prairie does not have a policy addressing the quantity of accessible units needed, however the comprehensive plan recognizes the increase in seniors. 	<ul style="list-style-type: none"> Encourage a portion of new residential to be built as accessible or visitable, assisting future residents ability to age in place.
Credit 9	Community outreach and involvement	<ul style="list-style-type: none"> To encourage responsiveness to community needs by involving the people who live or work in the community in project design and planning. 	<ul style="list-style-type: none"> Actively engage the public, (residents, property owners, business owners/employers, community leaders, etc.) throughout the process. 	<ul style="list-style-type: none"> Sun Prairie has engaged residents in many ways during its various planning processes. The Comprehensive plan utilized a series of outreach efforts to gain input during its creation. 	<ul style="list-style-type: none"> Continue to engage residents and other stakeholder in planning efforts and on-going developments of the city.
Credit 11	Local food production	<ul style="list-style-type: none"> To promote community-based food production, improve nutrition through increased access to fresh produce, support preservation of small farms producing a wide variety of crops, reduce the negative environmental effects of large-scale industrialized agriculture, and support local economic development that increases the economic value and production of farmlands and community gardens. 	<ul style="list-style-type: none"> Use deed restrictions or other regulations to ensure the growing of produce is not prohibited (ie allowed in all yards, balconies, patios). Dedicate land for the purpose of community gardens. Have a nearby farmers market that operates at least weekly for more than 5 months per year. 	<ul style="list-style-type: none"> Sun Prairie's zoning code defines landscaped areas to include garden plants, presumably meaning a small produce garden is permitted anywhere. Sun Prairie has one community garden located 1330 Linnerud Drive next to the Sun Prairie Public Library. The Comprehensive Plan states an expanded community garden program should be pursued if demand exists. Sun Prairie's comprehensive plan has a goal to support local agriculture by providing land for community gardens and a City parking lot for the farmers market. Sun Prairie's farmers market is located in the Municipal Building's parking lot at 300 E. Main Street in the rear. The comprehensive plan calls for investigating public market potential (City's Downtown, Phase II Plan). The comprehensive plan discusses amending the City's Ord.s to allow urban agricultural uses that are compatible with surrounding uses. 	<ul style="list-style-type: none"> Evaluate need to regulate small green houses on residential properties. Evaluate the need for additional community garden space, especially in areas of the city with smaller lots and higher rates of multi-family. Continue to promote the farmers market to residents, visitors and employees in and around the city.
	Tree-lined and shaded streets	<ul style="list-style-type: none"> To encourage walking, bicycling, and transit use and discourage speeding. To reduce urban heat island effects and cooling demand, improve air quality, and increase evapotranspiration. 	<ul style="list-style-type: none"> Have street trees on both sides of the street between the street and sidewalk at a spacing averaging no more than 40 feet for 60% of streets. 	<ul style="list-style-type: none"> Sun Prairie's subdivision Ord. requires street trees be spaced apart at a distance determined by the city forester, with a spacing no less than sixteen feet and a recommended distance of twenty-five feet to fifty feet between terrace area trees depending on the size of the tree and other factors. 	<ul style="list-style-type: none"> Amend Ord. to require consistent and tighter spacing of trees (every XX feet) on ALL new streets. Create a list of preferred street trees, note if they are native, salt and drought tolerant, and provide optimal stormwater mitigation.
Credit 12	Neighborhood schools	<ul style="list-style-type: none"> To promote community interaction and engagement by integrating schools into the neighborhood. To support students' health by encouraging walking and bicycling to school. 	<ul style="list-style-type: none"> 50% of dwelling units within ½ mile of elementary/middle schools or 1 mile of a high school All streets surrounding schools must have sidewalks on both sides and bicycle lanes or traffic calming measures New school campuses not to exceed: High schools: 15 acre Middle schools: 10 acres Elementary schools: 5 acres 	<ul style="list-style-type: none"> Over 64% of housing units are located within ½ mile of an elementary or middle school, and 18% are located within 1 mile of the city's high school. Sun Prairie's Safe Routes to School Plan states schools generally have sidewalks present surrounding the schools, however, the surrounding neighborhoods lack reliable sidewalks and many gaps exist. School parcels in Sun Prairie are generally larger than those specified in LEED criteria. 	<ul style="list-style-type: none"> Site future schools in areas that are accessible by foot or bike to minimize reliance on bussing and automobile. This could include expansion or reconstruction of existing schools, development of schools with large neighborhood plans, etc.
Credit 13					
Credit 14					
Credit 15					

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
GIB: Green Infrastructure and Buildings					
Prerequisite 1	Certified green building	<ul style="list-style-type: none"> To encourage the design, construction, and retrofit of buildings that utilize green building practices. 	<ul style="list-style-type: none"> Have at least one building in the project area be LEED certified or higher. 	<ul style="list-style-type: none"> Sun Prairie is home to one LEED Gold building WPPI Energy. 	<ul style="list-style-type: none"> Sun Prairie could encourage private sector buildings to pursue LEED similar certification. Many municipalities adopted resolutions that require future municipal facilities to achieve LEED status or other energy efficiency standard, such as Energy STAR.
Prerequisite 2	Minimum building energy efficiency	<ul style="list-style-type: none"> To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and adverse environmental effects from energy production and consumption. 	<ul style="list-style-type: none"> All non-residential and multi-unit residential exhibit efficiency 10% greater baseline standard (ANSI/ASHRAE/IESNA Standard 90.1-2007) 	<ul style="list-style-type: none"> Sun Prairie does not have specific policies which discuss building efficiency. Like most communities, Sun Prairie relies on state building codes, which was updated with building energy efficiency requirements in 2011. Sun Prairie offers energy audits of homes and businesses and encourages buildings to use energy efficient systems and design practices. Sun Prairie Utilities is participating in the Focus on Energy program which encourages the implementation of renewable energy systems. 	<ul style="list-style-type: none"> Encourage future developments to pursue energy savings as appropriate.
Prerequisite 3	Minimum building water efficiency	<ul style="list-style-type: none"> To reduce effects on natural water resources and reduce burdens on community water supply and wastewater systems. 	<ul style="list-style-type: none"> All non-residential and multi-unit residential utilize 20% less water than baseline 	<ul style="list-style-type: none"> Like energy use, no local standards for water use were found. Sun Prairie's Comprehensive Plan discusses encouraging the use of low-flow/no-flush restroom fixtures and other water saving strategies through public education and incentives. 	<ul style="list-style-type: none"> Encourage future developments to pursue water efficiency as appropriate.
Prerequisite 4	Construction activity pollution prevention	<ul style="list-style-type: none"> To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust generation. 	<ul style="list-style-type: none"> Create and implement an erosion and sedimentation control plan for all new construction activities associated with the project. 	<ul style="list-style-type: none"> Sun Prairie ordinances currently include a construction site erosion control requirement adopted from State standards. Sun Prairie has adopted Dane County's stormwater and erosion control management ordinance and the City contracts with Dane County Land Conservation for all stormwater management and erosion control reviews and inspections. 	<ul style="list-style-type: none"> Continue monitoring construction sites to ensure erosion from construction activities is avoided to the greatest extent possible.
Credit 1	Certified green buildings	<ul style="list-style-type: none"> To encourage the design, construction, and retrofit of buildings that utilize green building practices. 	<ul style="list-style-type: none"> Credits awarded for additional LEED or equivalent buildings beyond GIB Prerequisite 1. 	<ul style="list-style-type: none"> See above 	<ul style="list-style-type: none"> See above
Credit 2	Building energy efficiency	<ul style="list-style-type: none"> To encourage energy-efficient buildings that reduce air, water, and land pollution and adverse environmental effects from energy production and consumption. 	<ul style="list-style-type: none"> All non-residential and multiunit residential exhibit efficiency 18% greater baseline standard (14% for renovations) (ANSI/ASHRAE/IESNA Standard 90.1-2007). 	<ul style="list-style-type: none"> See above 	<ul style="list-style-type: none"> See above
Credit 3	Building water efficiency	<ul style="list-style-type: none"> To reduce effects on natural water resources and reduce burdens on community water supply and wastewater systems. 	<ul style="list-style-type: none"> All non-residential and multiunit residential utilize 40% less water than baseline. 	<ul style="list-style-type: none"> See above 	<ul style="list-style-type: none"> See above
Credit 4	Water-efficient landscaping	<ul style="list-style-type: none"> To limit or eliminate the use of potable water and other natural surface or subsurface water resources on project sites, for landscape irrigation. 	<ul style="list-style-type: none"> Reduce water consumption for outdoor landscape irrigation 50% from baseline, based on species selection, irrigation efficiency and use of non-potable water (rain, gray, treated, etc) 	<ul style="list-style-type: none"> Sun Prairie does not have irrigation standards or policies for landscaping in the zoning ordinance. The comprehensive plan discusses the use of native plants, which are often more drought-tolerant and less irrigation, and encourages water conservation and reducing stormwater runoff by offering stormwater utility credits for maintaining an operable rain garden/rain barrel. 	<ul style="list-style-type: none"> Consider adding guidelines or standards to the zoning ordinances section on landscape areas to encourage the use of native plants which have a greater degree of drought tolerance, the use of stormwater for irrigation purposes and high efficiency irrigation systems. Encourage the use of rain barrels or other rainwater collection system for the purpose of irrigation.
Credit 5 & 6	Existing building reuse, historic resource preservation and adaptive use	<ul style="list-style-type: none"> To extend the life cycle of existing building stock to conserve resources, reduce waste, and reduce adverse environmental effects of new buildings related to materials manufacturing and transport. To encourage the preservation and adaptive use of historic buildings and cultural landscapes that represent significant embodied energy and cultural value, in a manner that preserves historic materials and character-defining features. 	<ul style="list-style-type: none"> Reuse the existing habitable building stock to the greatest extent practical Do not demolish any historic buildings When historic buildings are rehabilitated, do so in accordance with local review or federal standards for rehabilitation. 	<ul style="list-style-type: none"> Sun Prairie has five building and sites on the National Registry and the Comprehensive plan outlines the preservation efforts in place. The plan indicates facade grants are currently in use to assist historic property renovations. The plan also outlines potential strategies that should be considered, including a historic preservation committee and historic districts. 	<ul style="list-style-type: none"> Continue to identify potential landmarks and work with property owners to increase the number of registered landmarks and historic properties. Work to minimize periods of non-occupied historic buildings to prevent eventual demolition do to neglect and deferred maintenance.

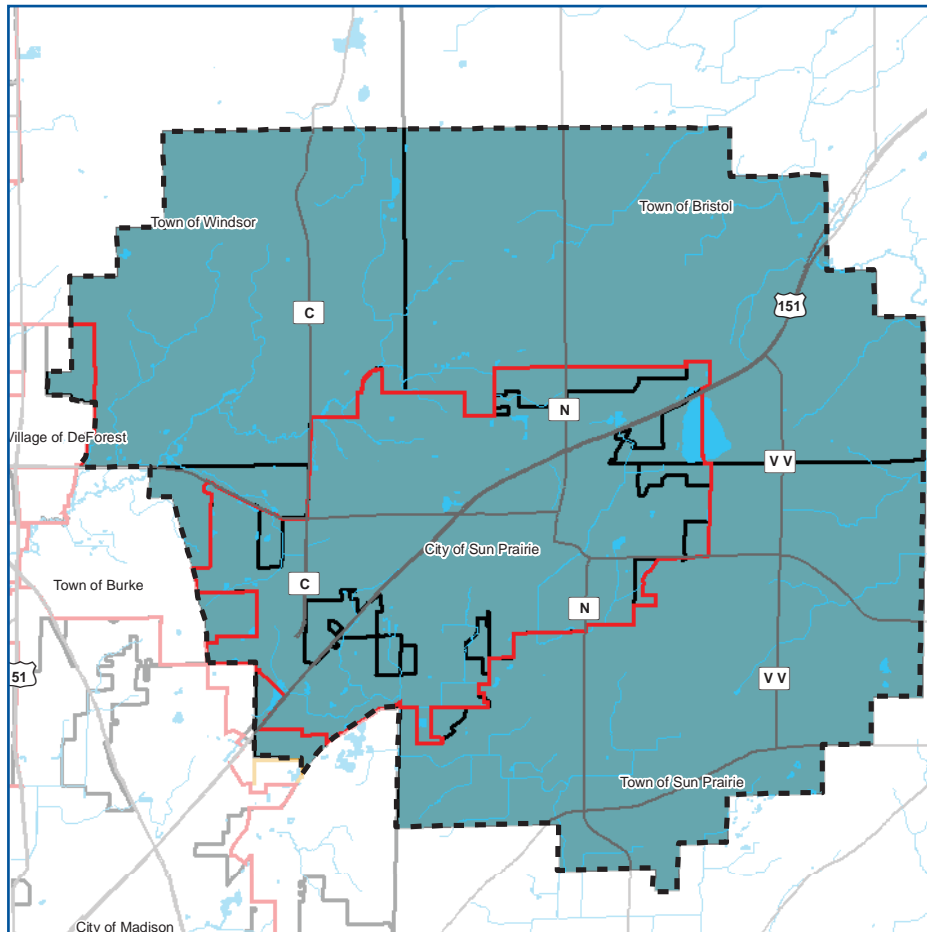
Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
GIB: Green Infrastructure and Buildings (cont.)					
Credit 7	Minimized site disturbance in design and construction	<ul style="list-style-type: none"> To preserve existing noninvasive trees, native plants, and pervious surfaces. 	<ul style="list-style-type: none"> Development footprint on previously developed land or, Do not develop or disturb a portion of the project area based on residential density or FAR (20% for under 15 du/ac or 0.5 FAR, 15% for 15-21 du/ac and 0.5-1 FAR, 10% for over 21 du/ac and over 1 FAR), and Preserve the large trees on site (with minimum preservation based on size). 	<ul style="list-style-type: none"> Sun Prairie does have park/open space dedication requirement of one acre for each twenty-three dwelling units or a fee in lieu of dedication. However, the LEED criteria requires this land be undisturbed, which would not be likely in many cases. Sun Prairie has some protections for defined woodlands, but protections don't address size of trees. Preliminary plats require an existing condition drawing showing the location of all trees on site greater than twelve inches in diameter, but no tree preservation guidelines or standards are explicitly stated in the Land division ordinance. 	<ul style="list-style-type: none"> Continue to actively promote infill and redevelopment where opportunities exist. Where appropriate, potentially based on environmentally sensitive conditions, encourage developments to dedicate land beyond the minimum open space requirement and work to protect this area from disturbance during construction. Consider pursuing an urban forestry plan, and/or guidelines or standards addressing trees on private property (Tree Commission).
Credit 8	Stormwater management	<ul style="list-style-type: none"> To reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions. 	<ul style="list-style-type: none"> Implement a stormwater plan that retains on site a minimum rainfall event equal to the 80 percentile of events over a 20-40 year period (credits increase for every 5 percentile over 80). 	<ul style="list-style-type: none"> Dane County's 90% stay-on stormwater standard, enacted in 2010, may accomplish this criteria. Development prior to 2010, which accounts for nearly all developed land, utilized lesser standards. Sun Prairie has a Stormwater Utility to fund stormwater management projects. Sun Prairie has adopted Dane County's stormwater and erosion control management ordinance and the City contracts with Dane County Land Conservation for all stormwater management and erosion control reviews and inspections except for one and two-family development. 	<ul style="list-style-type: none"> Consider encouraging stormwater management upgrades on developed properties by providing a credit on stormwater utility for improvements, such as rain barrels, rain gardens and other infiltration measures.
Credit 9	Heat island reduction	<ul style="list-style-type: none"> To reduce heat islands to minimize effects on the microclimate and human and wildlife habitat. 	<ul style="list-style-type: none"> Shade or use light-colored materials (SRI>29) for non-roof hardscapes, or Use vegetative or light-colored roofs (SRI>29 for pitched, SRI>78 for flat). 	<ul style="list-style-type: none"> The zoning ordinance does not address the shading hardscape or color of hardscape, but public sidewalks are generally made of light-colored concrete which would meet the SRI standard referenced. Within the Main Street Overlay District, building design standards require that pitched roofs shall be finished with asphalt shingles, other decorative shingles, or standing seam metal roof materials, though no discussion of color is given. 	<ul style="list-style-type: none"> Encourage lighter colored materials in large hardscape areas, such as parking lots. Evaluate parking lot landscape standards to determine the potential shading potential and its sufficiency. Encourage vegetated roof surfaces and consider requiring flat-roofed buildings to use a "white roof."
Credit 10	Solar orientation	<ul style="list-style-type: none"> To encourage energy efficiency by creating optimum conditions for the use of passive and active solar strategies. 	<ul style="list-style-type: none"> Orient buildings so that the longer façade is oriented within 15 degrees of the east west axis. 	<ul style="list-style-type: none"> Sun Prairie does not appear to have any standards or policies that address solar orientation of buildings or streets. 	<ul style="list-style-type: none"> Investigate creating guidelines for future land divisions that considers building orientation when creating new streets. More compact residential, with homes generally perpendicular to the street, would have more solar exposure on north south streets, while large lot residential with homes parallel to the street would have more exposure on east west streets.
Credit 11	On-site renewable energy sources	<ul style="list-style-type: none"> To encourage on-site renewable energy production to reduce the adverse environmental and economic effects associated with fossil fuel energy production and use. 	<ul style="list-style-type: none"> Credits given for on-site renewables that account from more than 5% of a projects electrical and thermal energy cost. Additional credits given for higher rates. 	<ul style="list-style-type: none"> Sun Prairie participates in the Focus on Energy program that provides cash-back rewards for those who install renewable energy systems. They also allow customer's the option of purchasing renewable energy as part of their regular bill. The Comprehensive Plan recommends the City should participate in and strive to achieve the goals of the Office of Energy Independence 25 x 25 program, aimed at getting 25% energy from renewable energy sources by the year 2025 (note this applies only to municipal buildings and properties and not the entire city). The Comprehensive Plan recommends the City adopt an ordinance streamlining renewable energy review and approval and consider providing incentives for incorporating renewable/alternative energy technology. 	<ul style="list-style-type: none"> Consider expanding on-site renewable energy on municipal facilities with optimum solar exposure, and encouraging private sector buildings to do the same. Consider the creation of zoning standards or guidelines that address on-site renewables to avoid any unforeseen impacts on adjacent properties.
Credit 12	District heating and cooling	<ul style="list-style-type: none"> To encourage energy-efficient neighborhoods by employing district heating and cooling strategies that reduce energy use and adverse energy-related environmental effects. 	<ul style="list-style-type: none"> Incorporate a district heating/cooling system which accounts for 80% of an areas heating/cooling needs. 	<ul style="list-style-type: none"> District heating and cooling is generally used by institutions, campuses or major developments. It would generally not be feasible in this context. 	<ul style="list-style-type: none"> If a campus or other major development is proposed in Sun Prairie, work with the developer to identify appropriate sustainability strategies, potentially including district heating and cooling.
Credit 13	Infrastructure energy efficiency	<ul style="list-style-type: none"> To reduce adverse environmental effects from energy used for operating public infrastructure. 	<ul style="list-style-type: none"> Install new infrastructure, such as traffic, street lights, pumps, etc, to achieve a 15% energy saving below baseline 	<ul style="list-style-type: none"> LED street lights have been installed on West Main Street as part of the recent reconstruction. The Comprehensive Plan discusses LED lighting and encourages their use in developing areas. 	<ul style="list-style-type: none"> Continue to investigate and potentially pursue energy saving options, such as LED street lighting and traffic control systems, when areas are developed or redeveloped and as existing equipment is replaced.
Credit 14	Wastewater management	<ul style="list-style-type: none"> To reduce pollution from wastewater and encourage water reuse. 	<ul style="list-style-type: none"> Retain, treat and use 25% of wastewater on site. (Additional credit for 50%) 	<ul style="list-style-type: none"> To staff's knowledge, there is only limited onsite reuse of wastewater in Sun Prairie. 	<ul style="list-style-type: none"> Where appropriate, encourage the reuse of wastewater (graywater) for water-intensive uses.
Credit 15	Recycled content in infrastructure	<ul style="list-style-type: none"> To use recycled and reclaimed materials to reduce the adverse environmental effects of extracting and processing virgin materials 	<ul style="list-style-type: none"> Use recycled materials (post and one half of pre-consumer) and in-place reclaimed materials for 50% of the mass of infrastructure materials 	<ul style="list-style-type: none"> Construction specifications often refer to State or industry organizational standards (such as ASTM). The extent to which these currently allow, or can potentially allow recycled material is unknown. 	<ul style="list-style-type: none"> Work with public works staff to understand the extent to which recycled materials can be allowed in infrastructure projects.

Credit	Intent	Requirement (generalized)	Sun Prairie Condition and/or Policy:	Recommendations:	
GIB: Green Infrastructure and Buildings (cont.)					
Credit 16	Solid waste management infrastructure	<ul style="list-style-type: none"> To reduce the volume of waste deposited in landfills. To promote the proper disposal of hazardous wastes. 	<ul style="list-style-type: none"> Meet four of following criteria Have collection services for recyclable materials Have a drop-off point or collection service for hazardous household waste (ie, paint, oil, etc.) Have a compost station or collection of compostable material Have recycling containers where public waste receptacles are located on non-residential streets Recycle or salvage 50% of non-hazardous construction debris. 	<ul style="list-style-type: none"> Sun Prairie provides recycling collection as part of regular waste services and has a recycling center that accepts household hazardous waste, electronics and yard waste/brush. The Comprehensive Plan encourages the City to consider the adoption of a policy aimed at encouraging the recycling of construction waste materials on public construction projects. 	<ul style="list-style-type: none"> Consider adding permanent recycling receptacles next to existing trash receptacles in the Main Street area of downtown. Consider creating community compost facilities in conjunction with community gardens.
Credit 17	Light pollution reduction	<ul style="list-style-type: none"> To minimize light trespass from project sites, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce adverse effects on wildlife environments. 	<ul style="list-style-type: none"> In residential areas, have at least 50% of exterior light fixtures have motion detector switches, and In public areas, all light fixtures should have day lighting controls Follow criteria which specify allowable lighting power density, up-lighting (dark sky), and light level at project boundary. 	<ul style="list-style-type: none"> Sun Prairie's exterior lighting standards address a minimum illumination level in parking areas (0.4 fc), and maximum level at the property line (0.5 fc, compared to LEED's 0.1 fc criteria for most zones). LEED criteria address illumination levels based on site condition, such as walkway or entry. 	<ul style="list-style-type: none"> Continue to pursue LED street lighting, which creates more uniform light at lower power densities. Consider amending lighting standards to use a condition based standard rather than the current site average. Consider adopting a dark sky ordinance that limits the amount of up-lighting depending on context and use.



City of Sun Prairie
Future Urban Development Area Planning

Environmental Conditions Report



Conclusion

Conclusion

The City of Sun Prairie and the surrounding towns show a commitment to cooperative intergovernmental planning and growing efficiently so as not to compromise the integrity of natural and agricultural resources as they move forward. As populations grow and urban areas accommodate these new residents, communities must consider the demographic, environmental and agricultural realities that will shape the future and the livelihoods of their residents. The Environmental Conditions Report offers several variables and analyses to help urban communities make regionally and locally informed decisions as they build their communities. This tool can assist communities as they work with developers, community residents, CARPC and other governments that have a role in Sun Prairie peripheral development and preservation decisions and similar decisions made in the surrounding towns.

References

- Apfelbaum, S. I., and A. Haney. 2010. *Restoring Ecological Health to Your Land*. Island Press. Washington, D.C.
- Bedford, R.L., E.H. Zimmerman, and J.H. Zimmerman. 1974. *The Wetlands of Dane County, Wisconsin* for the Dane County Regional Planning Commission. Madison, WI.
- Berger, J. J. 2008. *Forests Forever: Their Ecology, Restoration and Protection*. The University of Chicago Press. Chicago, IL.
- Bradbury, K., et al. 1999. *Hydrogeology of Dane County*. Wisconsin Geological and Natural History Survey, Madison, WI. Open File Report 1999-04.
- Brierley, G. J. et al. 2008. *Working with Change: The Importance of Evolutionary Perspective in Framing the Trajectory of River Adjustment* in River Futures: An Integrative Scientific Approach to River Repair. Brierley G. J. and K. A. Fryiers (eds). Island Press. Washington, D.C.
- Capital Area Regional Planning Commission. 2011. draft *Urban Nonpoint Source Analysis*. Appendix D of the Dane County Water Quality Plan. Madison, WI
- Cassie, D. 2006. *The Thermal Regime of Rivers: A review*. *Freshwater Biology* 51:1389-1406.
- Clements, et al. 1996. *Framework for a Watershed Management Program*. Water Environment Research Foundation, Alexandria, VA.
- Czarapata, E. J. 2005. *Invasive Plants of the Upper Midwest: An Illustrated Guide to their Identification and Control*. The University of Wisconsin Press. Madison, WI
- Dane County, et al. 2010. *A Clean Future for the Yahara Lakes: Solutions for Tomorrow, Starting Today*. Madison, WI.
- Dane County. 2006. *Dane County Parks and Open Space Plan 2006-2011*. Madison, WI.
- Dane County Regional Planning Commission. 1994. *Dane County Water Quality Summary Plan*. Madison, WI.
- Dane County Regional Planning Commission. 1997. *Dane County Land Use and Transportation Plan*. Madison, WI.
- Dane County Regional Planning Commission. 1999. *Dane County Groundwater Protection Plan*. Appendix G of the Dane County Water Quality Plan. Madison, WI.
- Dane County Regional Planning Commission. 2004. *Dane County Regional Hydrologic Study Modeling and Management Program Reports (1997-2004)*. Madison, WI.
- Dane County Regional Planning Commission. 2008. *Dane County Wetlands Resource Management Guide*. Madison, WI.
- Douglas, J. and N. Abery. 2009. *Responses of Brown Trout (Salmo trutta) to Willow Management and Habitat Improvements in the Rubicon River*. State Government of Victoria, Department of Primary Industries, Fisheries Revenue Allocation Committee.
- Dudley, N. et al. 2005. Forest Landscape Restoration in Context. In *Forest Restoration in Landscapes: Beyond Planting Trees*. Springer Science & Business Media, Inc. New York, N. Y.
- Easterling, D. R., et al. 2000. *Climate Extremes: Observations, Modeling, and Impacts*. *Science* 289:2068-2074.
- Environmental Law Institute. 2003. *Conservation Thresholds for Land Use Planners*. Washington, D.C.
- Hay, Robert, WDNR Herpetologist. 2008. Personal communication.

- Hilderbrand, R. H., et al. 2005. *The Myths of Restoration Ecology*. Ecology and Society 10(1): 19.
- Hilsenhoff, W. L. 1987. *An Improved Biotic Index of Organic Stream Pollution*. The Great Lakes Entomologist 20(1): 31-36.
- Hunt, R., and J. Steuer. 2000. *Simulation of the Recharge Area for Frederick Springs, Dane County, Wisconsin*. U.S. Geological Survey WRI Report 00-4172.
- Lathrop, R. and S. Carpenter. 2010. *Response to Phosphorus Loading in the Yahara Lakes Preliminary Findings*, talk given to U.W. Nelson Institute Community Environmental Forum on the Yahara Lakes, Madison, WI., Feb. 23, 2010
- Lathrop, R. and K. Kirsch. 2010. In *A CLEAN Future for the Yahara Lakes: Solutions for Tomorrow, Starting Today*. Dane County Lakes and Watershed Commission, WDNR, DATCP, and City of Madison, WI.
- Lyons, J. 1992. *Using the Index of Biotic Integrity (IBI) to Measure Environmental Quality in Warmwater Streams in Wisconsin*. USDA General Technical Report NC-149.
- Lyons, J., L. Wang, and T. Simonson. 1996. *Development and Validation of an Index of Biotic Integrity (IBI) for Coldwater Streams in Wisconsin*. North American Journal of Fisheries management, Vol. 16, No. 2.
- MacArthur, R. H. and E. O Wilson. 2001. *The Theory of Island Biogeography*. Princeton University Press.
- McCormick F. H. et al. 2010. Invasive Species on Water Quality and Quantity. In *A Dynamic Invasive Species Research Vision: Opportunities and Priorities 2009-29* Dix, M. E. and K. Britton (eds.) United States Department of Agriculture, Forest Service. General Technical Report WO-79/83.
- Naiman, R. J and H. Decamps. 1997. *The Ecology of Interfaces: Riparian Zones*. Annual Review of Ecology and Systematics. 28:621-658.
- Naiman, R. J, et al. 2005. *Riparia: Ecology, Conservation and Management of Streamside Communities*. Elsevier Academic Press. Amsterdam.
- National Research Council (U.S.). 1992. *Restoration of Aquatic Ecosystems: Science, Technology and Public Policy*. National Academy Press. Washington, D.C.
- Neller, R.J. 1989. *A Comparison of Channel Erosion in Small Urban and Rural Catchments, Armidale, New South Wales*. Earth Surface Processes and Landforms 13: 107.
- North American Lake Management Society (NALMS). 2007. *Fundamentals of Urban Runoff Management Technical and Institutional Issues*. Madison, WI.
- Noss, R. F. 1997. *The Science of Conservation Planning: Habitat Conservation Under the Endangered Species Act*. Island Press. Washington, D. C.
- Palmer, M. A. et al. 2005. *Standards for Ecologically Successful River Restoration*. Journal of Applied Ecology 42: 208-217.
- Palmer, M. A. 2010. *Beyond infrastructure*. Nature 467: 534-535.
- Parsons, Tim, WDNR Financial Specialist. 2011. Personal communication.
- Radeloff, V. C. et al. 2010. *Housing Growth in and near United States' Protected Areas Limits Their Conservation Value*. Proceedings of the National Academy of Sciences 107:940-945.
- Schueler, T.R. 1994. *The Importance of Imperviousness*. Watershed Protection Techniques 1(3): 100-111.
- Seavy, N. E. et al. 2009. *Why Climate Change Makes Riparian Restoration More Important than Ever: Recommendations for Practice and Research*. Ecological Restoration 27:330-338.

- Semlitsch, R. and J Bodie. 2003. *Biological Criteria for Buffer Zones Around Wetlands and Riparian Habitats for Amphibians and Reptiles*. Conservation Biology 17(5): 1219-1228.
- Semlitsch, R and J. Jensen. 2001. *Core Habitat, Not Buffer Zone*. National Wetlands Newsletter 23(4) Environmental Law Institute, Washington, D.C.
- Semlitsch, R. 1997. *Biological Delineation of Terrestrial Buffer Zones for Pond-Breeding Salamanders*. Conservation Biology 12(5): 1113-1119.
- Sorge, M. 1996. *Lake Mendota Priority Watershed Surface Water Resource Appraisal Report*. Wisconsin Department of Natural Resources, Madison, WI.
- Steuer J., and R. Hunt. 2001. *Use of a Watershed-Modeling Approach to assess Hydrologic Effects of Urbanization, North Fork Pheasant Branch Basin Near Middleton, Wisconsin*. U.S. Geological Survey WRI Report 01-4113.
- Tilman, D. 2011. *Energy Gains and Greenhouse Gas Reductions from Food-Based versus Biomass-Based Biofuels*. The German Marshall Fund of the United States. Economic Policy Program, Policy Brief. (http://www.gmfus.org/galleries/pdf/Biofuels_Tilman.pdf on 8.5.2011).
- Uesugi, A. and M. Murakami. 2007. *Do Seasonally Fluctuating Aquatic Subsidies Influence the Distribution Pattern of Birds Between Riparian and Upland Forests?* Ecological Research 22:274-281.
- United State Department of Agriculture, Natural Resources Conservation Service. 2007. Part 654 Stream Restoration Design National Engineering Handbook, Technical Supplement 140: Stream Habitat Enhancement Using LUNKERS. NRCS Report 210-VI-NEH.
- United State Department of Agriculture, Natural Resources Conservation Service. 2007. Part 654 Stream Restoration Design National Engineering Handbook, Technical Supplement 14S: Sizing Stream Setbacks to Help Maintain Stream Stability. NRCS Report 210-VI-NEH.
- Vogelsang, Mike, WDNR Fisheries Manager. 2000. Personal communication.
- Walsh, C. J. et al. 2005. *The Urban Stream Syndrome: Current Knowledge and the Search for a Cure*. Journal of the North American Benthological Society 24(3):706-723.
- Wisconsin Department of Natural Resources. 2000. *Nonpoint Source Control Plan or the Lake Mendota Priority Watershed*. Publication WT-5360-00-REV
- Wisconsin Department of Natural Resources. 2002. *Lower Rock River Water Quality Management Plan Appendix*. Publication WT-668a-2002.
- Wisconsin Department of Natural Resources. 2002. *The State of the Lower Wisconsin River Basin*. Publication WT-559-2002.
- 2007 Census of Agriculture State and County Data, Wisconsin. USDA Agricultural Census. http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/Wisconsin/wiv1.pdf?bcsi_scan_991819FA721D10BC=0&bcsi_scan_filename=wiv1.pdf
- Dane County Agriculture: Value and economic impact. University of Wisconsin-Extension, Cooperative Extension, Dane County, Wisconsin Farm Bureau Federation, Wisconsin Milk Marketing Board, 2004. <http://www.uwex.edu/ces/ag/wisag>
- Final Population Projections for Wisconsin Counties by Components of Change: 2000 – 2030. Department of Administration: Demographic Services. January 2004. <http://www.doa.state.wi.us/docview.asp?locid=9&docid=2065>
- Agricultural Impact Statement, Rockdale Substation Expansion, Dane County. American Transmission Company. PSC Docket #: 137-CE-149
- SSM, USDA Handbook No. 18, October 1993

Wisconsin Working Lands Initiative: Report from the Steering Committee (2006)
www.farmlandinfo.org/farmland_search/index.cfm?function=article_view&articleID=38341

“Why Worry About the Agriculture of the Middle?” www.agofthemiddle.org

S. Deller (Mar. 2011), The Economic Impacts of Agriculture in Wisconsin Counties
<http://www.aae.wisc.edu/pubs/misc/docs/deller.economic%20impacts.03.11.pdf>

“A Better Future...for Farms” by American Farmland Trust, American Farmland, Winter 2009.

2010 United States Census

2009-2001 American Community Survey, United States Census

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THE WETLANDS OF DANE COUNTY, WISCONSIN

1974

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for the

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in cooperation with the

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PHEASANT BRANCH MARSH

Yahara River Valley Region

Priority Group II

Wetland Description

Pheasant Branch Marsh, in the Town of Middleton, is under consideration by the City of Middleton for a purchase and preservation program. It is part of the Lake Mendota watershed, and as such, its preservation is important in protecting the quality of the lakes.

This report describes Pheasant Branch Marsh as of the beginning of 1973. The marsh, with a lowland area of 311 acres, has a surface watershed of 1,400 acres. This does not necessarily coincide with sources of spring water, which are more difficult to determine. There is a good possibility at this time that a student at the University of Wisconsin will be making a hydrologic study of the region. This will be necessary to understand the action of the marsh on ground and surface water and vice versa. Counting the springs and streams entering the marsh does not give a sufficient picture of this action. However, it can be said that there is a continuous flow of water through the lowland basin, and that over half of the water appears to pass down open channels, rather than through stands of emergent vegetation. This may limit the capacity of the marsh to clean the water.

Six plant communities can be recognized in the area: upland old field; upland forest; lowland forest; sedge meadow-shrub carr, including sedges, grasses, and shrubs; shallow marsh, including mostly bur reed; and submerged aquatic plants in open water. At least some of the upland old field has been used in the past as cropland or orchard. This area provides winter weed seeds and cover for birds, a winter source of apples for deer, and bird nest sites in summer. The proximity of upland old field, lowland shrub areas, and open water at the springs has made Pheasant Branch an attractive area for small birds in winter. We have noted much higher numbers of wintering small birds here than in most other marshes.

On the west edge of the area, on the hillside next to Pheasant Branch Road is a small region of recent dumping whose winter ecology deserves brief mention. It will serve as an example to show that limited disturbance can add to the food web, provided plants are allowed to re-invade. Due to the dumping and earlier plowing, several weed species are found to be abundant here. These are pioneer species; that is, they require bare soil to start their

growth, and in turn provide moisture and shade for other plant species to grow later. Especially notable for their seed crop are giant ragweed (Ambrosia trifida) and pigweed (Amaranthus sp., Chenopodium sp.). The seeds are being taken by large numbers of tree sparrows and mice (Microtus sp.). These in turn, especially the mice, provide food for various predators. Two owls, the great horned owl and the short-eared owl, have been seen in the area this winter. House cat tracks were seen in the weed area among the mouse tracks.

In winter, the only other heavy wildlife use is found in the open water channels. A large open channel is found in the center of the marsh, flowing southward from the largest spring. Here hundreds and sometimes thousands of ducks can be found. Recently a flock of 160 mallards and 4 black ducks was seen. Earl Loyster of the Department of Natural Resources has noted over 2,000 wintering ducks here on occasion.

The rest of the lowland, including the sedge-grass-shrub area, the black willow forest, and the large stands of bur reed, supports much more bird and animal life in the warmer seasons. During migration the open water is used by mallards, black ducks, shovelers, lesser scaup, wigeons, coots, blue-winged teal, green-winged teal, and wood ducks for rest and feeding.

The three lookout areas designated on the management map provide vantage points for observing without disturbing these ducks. The breeding season brings at least moderate numbers of the usual wetland nesting birds -- red-winged blackbirds, swamp sparrows, sora and Virginia rails, mallards, blue-winged teal, long-billed marsh wrens, short-billed marsh wrens, etc. -- along with a few representatives of species less commonly seen in Dane County. One immature male yellow-headed blackbird was seen, and a female harrier has been observed feeding in the area on several occasions.

The combination of lowland forest with shallow marsh and open water provides a suitable habitat for nesting wood ducks, as well as perches over water from which green herons and kingfishers can hunt. Dead and dying trees attract woodpeckers. The large stand of wild rice provides food for ducks, other birds, and muskrats. At least twenty-five muskrat houses were located in the marsh in 1972.

In spite of the heavy siltation which has occurred in the marsh, the diversity of submerged aquatic vegetation is good, not being limited to or dominated by two or three species. However, the almost complete dominance of bur reed in a large area north

of the pond suggests that the silt deposits have diminished the diversity of emergent vegetation in that part of the marsh. Excessive duckweed choking the open water during late summer serves as a warning that eutrophication is occurring.

In addition to having an above average diversity of the more common native wetland flora, Pheasant Branch Marsh has several small patches of the less commonly occurring small yellow ladyslipper (Cyripedium parviflorum). We know of few other stations for this species in Dane County.

Management Considerations

It has been of interest recently to use marshes as settling basins to protect water quality downstream. This is a useful technique because (1) marshes store organic material, thus reducing the flow of nutrients into downstream lakes; and (2) marsh vegetation slows and breaks up water flow, causing finer silt to be dropped. These are both functions which an open holding pond cannot perform.

However, there is a serious drawback to looking at the pollution-siltation problem in this way. The number of marshes available in southern Wisconsin is increasingly limited. Each can clean the water effectively only if the rate of inflow of nutrients and silt is not too great. Further, the process places a load on the marsh itself, leading to eutrophication and filling with sediment. If the load is too great, the marsh ceases to be effective in protecting downstream waters, and ceases to be a healthy ecosystem itself.

For these reasons, we should turn the problem around, and use the marshes as indicators of land use problems, just as canaries are used to detect gas problems in mines. If the nutrient and silt load on the marshes is too great, it is the land practices upstream which must be altered. We can use a marsh, such as Pheasant Branch, as a warning system to let us know when to improve land practices. Further, by protecting a marsh such as this one, we automatically receive three benefits: lake protection, a healthy marsh, and the knowledge that the upland is being properly used also.

The following guidelines include some concepts which are not generally familiar, and certainly not in general use at this point. These techniques include buffer zones near the marsh, protection of springs, identification and protection of water sources above springs, erosion controls upstream, control of nutrient sources, settling areas above the marsh to control silt, and graded density development.

Buffer zones are necessary to a balanced wetland ecosystem. This is generally known by biologists and by some planners, but is rarely regarded as important in practice. This is, of course, due to our outdated land use system. In practice, edges of wetlands are dredged and filled, often with high density residential or even commercial or industrial development nearest the lowland. The values of a buffer zone include: (1) an upland breeding area for water-using animals, such as ducks and turtles; (2) a foraging and resting area for water-breeding animals, such as frogs and blackbirds; (3) an undisturbed transition zone between water and land, this being a region of heavy wildlife use; (4) protection of water quality; (5) protection against water level fluctuation; and (6) a large enough area available for home ranges to make it possible for a large number of bird and animal species to use the wetland.

Buffer zones can also be used for locating upstream water control areas, such as grassy silt-settling basins and ponds to catch sudden heavy runoff. Since most people are not confident about entering the low portions of a wetland, the existence of an upland buffer makes possible various types of low-intensity recreation, such as picnicking, hiking, nature instruction, and wildlife observation.

Springs, once abundant, are becoming less so in the Dane County area. This is due to several factors: increased pumping of ground water for city use, increased development of the land surface, which must cause at least some water to flow overland rather than entering the ground, lack of understanding, or even negligence. Three spring areas have been identified in the Pheasant Branch Marsh area to date. These provide a relatively clean steady water flow. With the improved protection of Pheasant Branch Creek, the marsh has the potential of being fed mostly by clean water. This, of course, requires that the springs themselves be purchased and protected. Further, the ground water recharge areas for the springs should be located. These must be protected if spring flow is to continue.

The results of erosion and nutrient inputs are now attracting public concern. However, much discussion still centers on cleaning up the results of bad management without attacking the sources. Water control should be practiced as far upstream as possible. Ideally, as soon as the raindrop hits the ground, its course should be properly managed. Only then will downstream cleanup become worthwhile. Pheasant Branch now provides an opportunity to demonstrate proper water control. Its watershed is small enough to handle. It is not too late to identify and correct problems.

Graded density development is perhaps a new concept. It is almost the reverse of present practice (see Figs. 15 and 16). A natural area, such as a wetland, is identified. An appropriate buffer zone is planned, including water control areas if necessary. In the ring of land nearest the buffer zone, and elsewhere on steep hills, is a zone of low density development only. This might include parks, schools, or very low density residential zoning. Light industrial zoning is appropriate if buildings are sparse and no toxic effluents enter the wetland. It should be an area of great scenic value, being nearest the natural area, and would have higher property value. The low density mentioned is definitely lower than that of most present residential (R1) developments. Strict attention should be paid to preserving natural amenities, such as scenery, trees, and natural land contours. Pavement should be at an absolute minimum. Strict controls should be placed on the amount of soil laid bare by construction, especially where hills are steep.

The second zone, moving away from the natural area, could be of greater density and include the same types of use. Attention should still be paid to protecting the land during and after construction, as it should everywhere. However, tight restrictions would not be quite as crucial as in the first zone. Further zones, if desired, could include increased use density, all the way to R-4 residential or heavy industrial. A further and very important consideration would be the placing of major travel, power, and sewer routes away from the natural area. Where reasonable, such natural areas would be connected by a green corridor system, as advocated by the Dane County Regional Planning Commission.

Future Use

Pheasant Branch Marsh, due to its size, diversity, location, and upland buffer zone, is an ideal area to develop for low-intensity recreation and for teaching. Purchase and management suggestions in this report are made with these uses in mind. The types of use available here are quite close to present uses in the University of Wisconsin Arboretum. Public pressure on the Arboretum serves to alert us that there is a definite and growing need, both for low-intensity recreation and for school and public outdoor education. The Arboretum guide system is in the process of expanding its size and coverage, and will become available for areas such as Pheasant Branch.

Some suggested uses of Pheasant Branch Marsh, by region, are:

1) Hiking on and off trails, nature study. A limited amount of walking off trails will not injure any existing values, since large numbers of people do not choose to enter the wetter areas. Suggested trail areas are: the hill along the west side (areas 8 and 4) with a loop into the willow forest (area 9) and a bridge or two across the new ditch; the wooded hillside on the east (area 5) using the present motorcycle trail, connecting with the lookout designated on the east hill (area 10) and extending southward to the County Road M; on the north side, looping up over the prairie hill (area 17), down to the major spring (area 16), and into the sedge meadow west of it (area 2); possibly also west of Pheasant Branch Road (areas 3 and 7). These trails can be planned to connect if desired, making it possible to walk all of the way around. Exact locations of trails should be planned by a naturalist, so as to take best advantage of various features while doing a minimum of damage. It will be found that the forested lowland will not be usable during some times due to mosquitoes. However, the Arboretum, which also has this problem, has never sprayed and has had no complaints by hikers. Boardwalks in the wetter portions of the marsh may be found desirable in the future.

2) Canoeing. A canoe can enter the marsh from the lower part of the creek. This is a perfectly compatible use, and does not require further development of the area other than proper water quality management, as outlined elsewhere in this report.

3) Snowshoeing. It is relatively easy to get around in an old field or sedge meadow on snowshoes. One can go anywhere without doing damage.

4) Horseback riding. It may be desirable to allow horses on certain trails. However, horses should not enter the lower areas where they will sink into soft soil.

5) Picnicking. The hillside on the west (area 8) is excellent for this use, combining opportunities for hiking, relaxing, nature study, and an excellent view. Facilities could be placed with minimum disturbance to the area. Maintenance of a natural grassland would eliminate any need for mowing, and would be more esthetic. Another possible picnic area would be on the hillside north of the marsh (area 17).

6) Public school field trips, public tours. This would be much the same sort of program as is now used in the Arboretum. The combination of steep hills, springs, marsh, and lowland forest would be excellent for introducing groups to natural diversity. Facilities used would be the trail system and picnic areas noted above. A shelter would be necessary at times. The existing house north of the marsh might be considered for this.

7) Availability of parking. Three areas are suggested as suitable for access to trails and picnic areas. None are deep within the natural area. For the west hill (area 8), a flat spot on top of the hill across the road could be used. For the south-east (areas 5 and 10), a flat place exists near the County road (M) just east of the creek. For the prairie hill area along the north (areas 16, 17, and perhaps 14) parking could be located where the present private road meets Pheasant Branch Road.

Non-compatible uses: Certain uses are not consistent with maintaining this natural area, or with public interest. Some of these are:

1) Snowmobiling, motorcycling, use of all-terrain vehicles. These are damaging to the plant communities, scare wildlife, and diminish the experience of those who come for other types of enjoyment.

2) Motorboating and fishing. The open water area is too small and shallow for these uses, which can easily be pursued in other areas nearby. Dredging for these purposes is not in the best interest of marsh preservation.

3) Skating. Due to the presence of open water in cold weather, the City of Middleton should not encourage skating here. A large proportion of the available ice surface is not reliable.

4) Shooting and trapping. As this area becomes more used by the general public, shooting will be increasingly hazardous. Due to probable use as a nature study and perhaps research area, trapping should be done only by the proper authorities to meet specific needs, as in the Arboretum.

Another type of future use of eventual public benefit is the restoration of natural communities. The dry hillside on the north, now containing some prairie remnants, is ideal for such restoration. The upland and lowland forested areas each once had characteristic wildflowers, and both areas have been disturbed. The restoration of such plants and removal of the exotic pest honeysuckle can bring much pleasure to future hikers. The maintenance of open grassland areas and semi-open areas will aid in wildlife attraction, public enjoyment, school projects, and teaching opportunities. If not maintained, some of these areas will go to shrubs and eventually to trees. The right balance in each area should be sought.

In order to carry out and aid in the above uses of the Pheasant Branch area, which could in time become the Pheasant Branch Natural Area, it is hoped that a full-time naturalist could be hired to live on the site. The present house on the north side is ideally located for this, as well as for a small nature center-shelter. The duties of such a naturalist should include:

Conducting public tours on suitable weekends;

Working with teachers and the guide system to expedite school tours;

Establishing and maintaining the trail system, as suitable;

Maintaining open areas, semi-open areas, and edge, and coordinating volunteers in brush removal;

Carrying out prairie restoration and aiding in school projects in study and restoration of prairie;

Carrying out upland and lowland forest floor plant restoration and aiding in school projects;

Coordinating overall maintenance and restoration, working in other plant communities needing attention;

Collecting seasonal data on vegetation, wildlife, water cycles, public uses, etc., and making them available to interested parties;

Acting as troubleshooter for water problems, land misuse, public nuisances and other problems, and informing appropriate parties when necessary.

Pheasant Branch Marsh offers an excellent opportunity, one which is rapidly becoming scarcer, yet more in demand. It is the hope of the writers that this opportunity be used to the fullest extent possible.

PHEASANT BRANCH MARSH
VEGETATION AND LAND USE

MAP KEY



Emergent vegetation, mostly bur reed (Sparganium eury-
carpum) in dense stand, wild rice (Zizania aquatica)
in open water area.



Mixed emergent vegetation, including sedges.



Sedge meadow, much of it with tussock sedge (Carex
stricta) dominant. Note grazed portions (see below).



Wetland shrubs, mostly willows (Salix bebbiana and S.
petiolaris) and red-osier dogwood (Cornus stolonifera).



Wetland disturbance plants, especially reed canary
(Phalaris arundinacea) and giant ragweed (Ambrosia trifida).



Old field.



Upland and lowland wooded areas.



Grazed by cattle.



Cultivated.



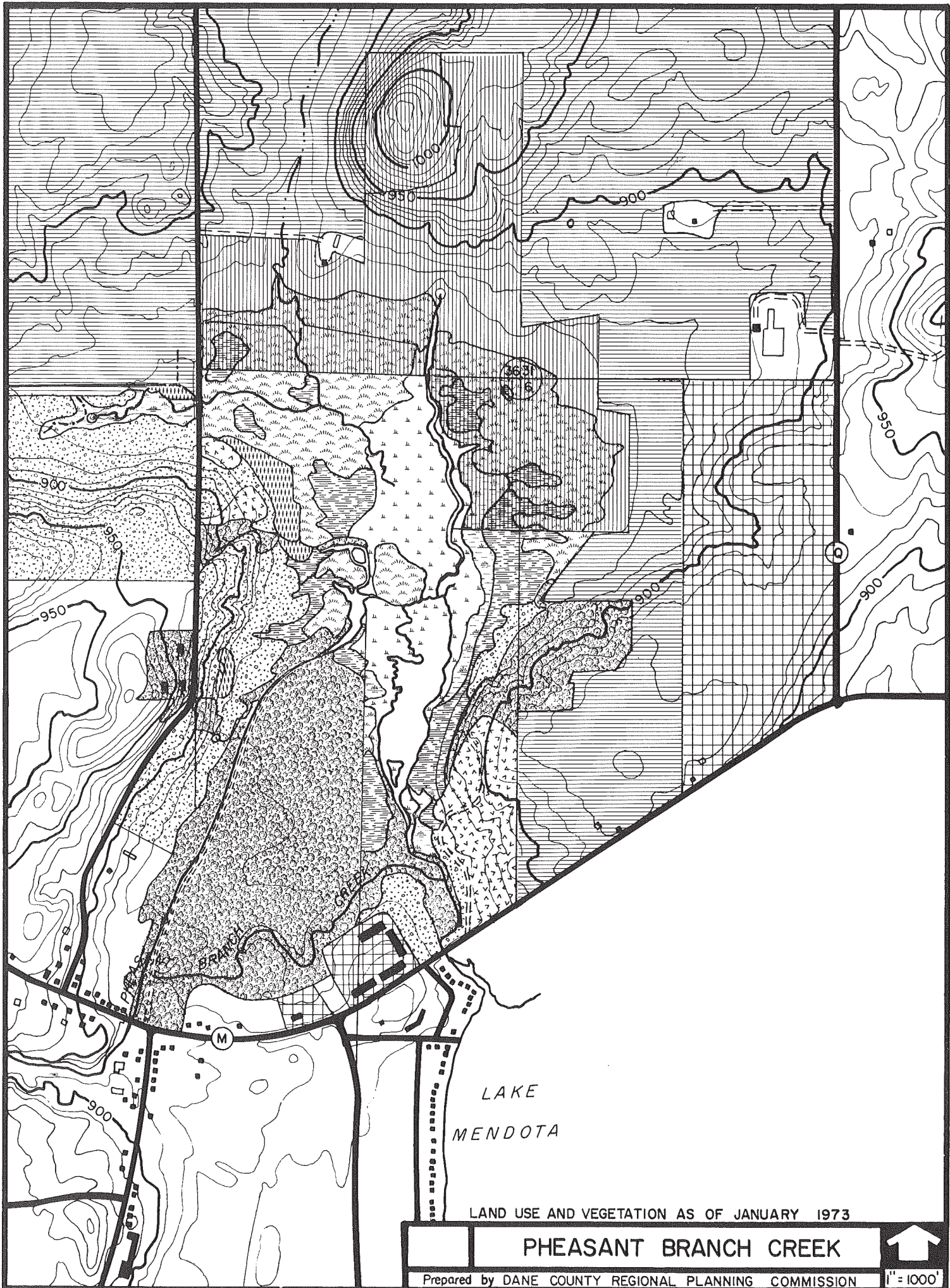
Suburban development and construction areas.



Bulldozed (east side) and dump (west side) areas.



Spring.



LAKE
MENDOTA

LAND USE AND VEGETATION AS OF JANUARY 1973

PHEASANT BRANCH CREEK

Prepared by DANE COUNTY REGIONAL PLANNING COMMISSION



Pheasant Branch Marsh

PHEASANT BRANCH MARSH

MANAGEMENT SUGGESTIONS

MAP KEY



Known winter wildlife use area.



Present extent of wildlife and natural vegetation area.



Buffer zone, additional to above.



Water collection and control area.



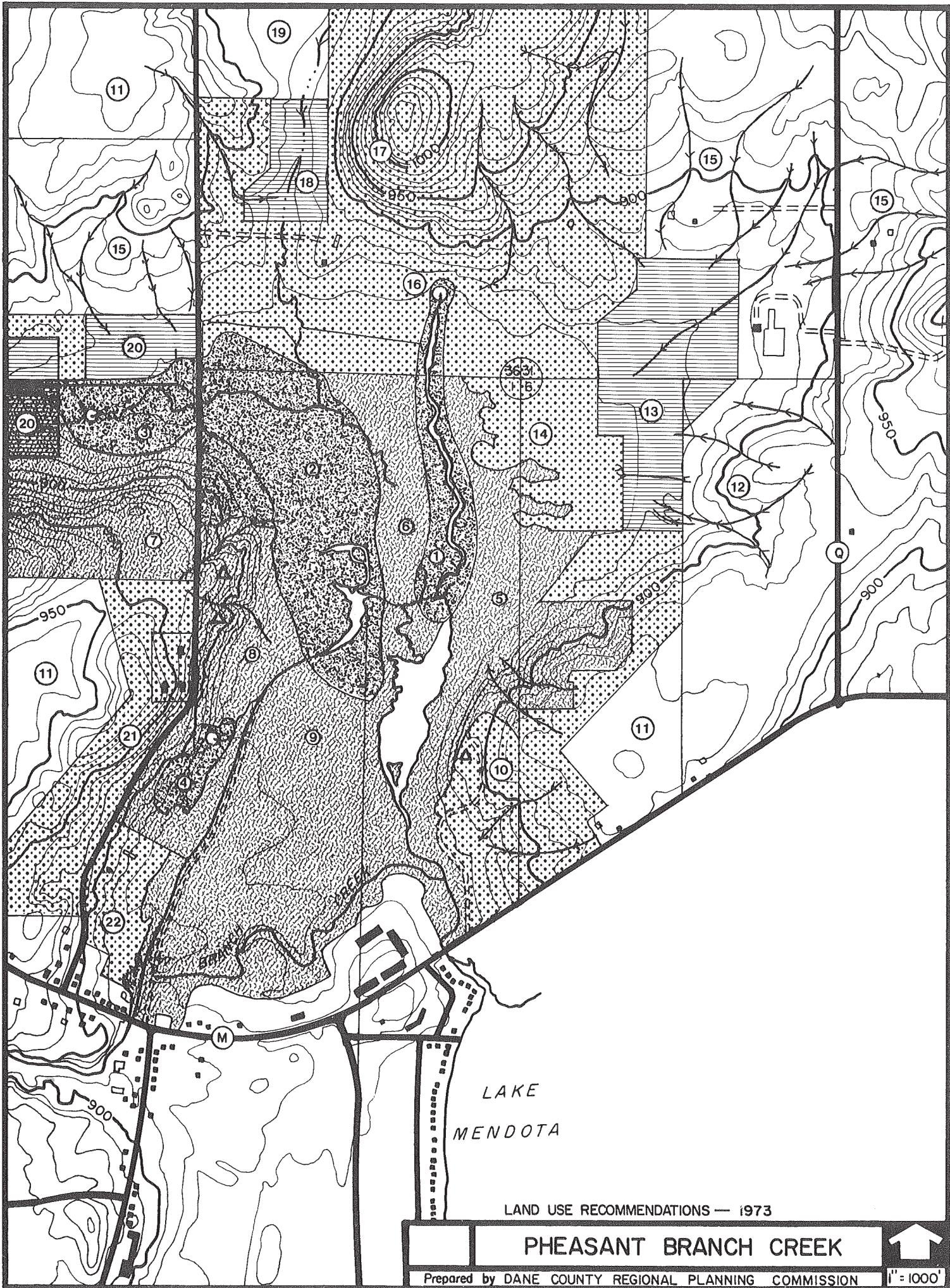
Limited development area.



Some patterns of surface flow toward marsh.



Wildlife and scenic observation point.



PHEASANT BRANCH MARSH
MANAGEMENT SUGGESTIONS

MAP EXPLANATION

Numbers in each category read roughly counterclockwise.

KNOWN WINTER WILDLIFE USE AREAS. These are areas of greatest winter wildlife density, and are considered high priority for purchase for protection and management.

1. Major spring-fed waterway. This remains open in winter, providing a wintering area for ducks numbering from several hundred to several thousand, and is, therefore, a high-priority purchase area.
2. Includes two ponds, one of which is partly open except in very cold weather. The combination of shrubs for cover, a weed patch for seed-eating small birds and mice, and open water makes this a major wildlife use area in winter. The presence of small birds and mice in turn attracts predators, such as hawks, owls, and foxes. This is a high-priority protection area.
3. Includes seepage-spring area, ditch, trees, shrubs, and other vegetative cover. Open water and cover together make this a wildlife use area. The presence of the spring and a major overland waterway entering the marsh also make it a high-priority purchase area.
4. Spring, shrubs, trees, and abandoned apple orchard. The orchard provides food for mammals, as evidenced by deer tracks. Its location close to the lowland woods make access to the orchard and spring easy for mammals. This is a high-priority purchase area for these reasons and because of the need to protect the spring as a water source.

OTHER WILDLIFE AND NATURAL VEGETATION AREAS. These are considered high priority for purchase, protection, and management, and are needed to protect the integrity of the whole marsh system. These areas contain natural vegetation as opposed to cropland, mowed, grazed, or other severely managed vegetation, and therefore support breeding wildlife and serve for the most part as reservoirs of native plant species. The open water is also included here. It receives heavy use as a feeding area by breeding wildlife and, especially, by migrating waterfowl.

Pheasant Branch Marsh

5. Includes various types of marsh vegetation in lowland, oak-hickory forest on hill; high-priority purchase area.
6. Center of marsh, includes marsh vegetation in permanently standing water (except possibly during severe drought), areas of open water; high-priority purchase area.
7. High and low old field. This is former cropland, now useful for wildlife food and cover and as a buffer zone to protect the stream area. The northern half is a high-priority purchase area to provide undisturbed space for wildlife using the stream area, and to preserve water quality. The southern or upland half is also strongly recommended as part of the buffer zone. Possible future development should be very low density only, with strict erosion and runoff control.
8. Old field hillside. This long, narrow hill facing the marsh may be the most valuable portion of the upland area for wildlife use and observation. Its protection is essential also to maintaining water and vegetation quality in the lowland next to it (regions 2 and 9). The two triangles represent excellent wildlife and scenic observation locations. If managed to remain old field with scattered groups of shrubs and occasional trees, it will remain very useful, both for wildlife and for human recreation. This is a high-priority purchase area.
9. Lowland forest area, mostly black willow. Although disturbed, this is the only large lowland forest known to us in the Madison area. Its size, closeness to water, and remoteness from human activity make it valuable for wildlife. This is a high-priority purchase area.

BUFFER ZONES FOR FUTURE PLANNING, not now wildlife use areas. These are areas whose control or purchase is necessary to: (1) protect water quality in the marsh; (2) prevent intense human activity close to the wildlife areas; (3) protect scenic values; (4) make possible teaching and recreation areas; and (5) in one area, make possible rehabilitation of already existing marsh vegetation. The future use of these areas may vary from very low density development, such as placement of structures for homes or business, to open parklands. At all times, erosion and runoff control on hillsides should be a prime consideration.

10. Steep hillside close to and facing marsh. The portion of this in section 1, which is the steepest and closest to the marsh-wildlife area, has already been terraced for suburban development. It contains an excellent waterfowl observation point (triangle). This portion is a high-priority purchase area for public use and watershed protection. The portion in section 6 above the 900-foot contour is also recommended for purchase, but if developed, should be low density. There is a portion in section 6 which is below the 900-foot contour, now under cultivation, which should be purchased and added to the wildlife area.
14. Grazed sedge meadow. This is a high-priority purchase area for restoration. It is within the marsh basin, and extends across the northeastern and northern borders of the present wildlife use area (see vegetation map).
16. In addition to protecting sedge meadow south of this point, a buffer area is of high priority to protect this large spring. At present, use by cattle is causing serious erosion near the spring.
17. Steep hill, dry, with some prairie vegetation, possible recharge area for spring. The 16-17 area, lying in parts of sections 36 and 31, is shown as a buffer zone unit. This unit would make an excellent public use and teaching area. At a time when arboretums and public land recreation plans are popular, when city dwellers are casting about for outdoor recreation, and schools are emphasizing outdoor teaching, this area presents a rare opportunity. Upland, suitable for prairie restoration and teaching, hiking, and picnicking, is next to lowland and a spring, also suitable for hiking and teaching (see discussion of land use). Purchase of this area is strongly recommended for these purposes, as well as to enhance and protect the marsh. Meanwhile, negotiations to limit lowland grazing are strongly recommended.
21. Hillside buffer, separated from marsh by road. This area is recommended as an addition to the buffer zone by purchase, but if developed, should be very low density.
22. Partly residential, partly old-field. This is an area which need not be purchased, provided future use can be controlled. Its closeness to water and wildlife areas makes high-density development unsuitable.

WATER CONTROL AREAS. These are locations where deep or shallow basins may be necessary to collect future runoff if development increases it. It may turn out that no construction is necessary; however, purchase and maintenance of these as silt-collection areas is of high priority. They should be planted to dense grass whether shallow basins are constructed or not. In the event deep basins are later needed to collect rapid, heavy runoff and release it slowly, further construction plans can be pursued at these locations. However, control of runoff in development areas should make deep basins unnecessary.

13. Collection area for northeast and east. Note arrows indicating surface runoff patterns.
18. Collection area for north. A large flat basin exists north of region 19, now in use as cropland. The flow direction from this is not known, but it may drain naturally or artificially southward.
20. Two areas for collection from northwest and protection of stream. Note one area straddles the stream. It would be preferable to control the stream edges westward to its source, using native grasses or sedges near the stream, with erosion and runoff control on nearby slopes. A water collection area in the stream valley may be necessary, however.

LIMITED DEVELOPMENT AREAS. These are areas not explicitly needed as buffer zones, but which will have an influence on the marsh area. Low density development with control of erosion and runoff is the most intense suggested use. Open farmland would be preferable, with control of fertilizer runoff.

11. Hilltops (3 areas). The southeast, northwest, and southwest each have a hilltop area which could support low to moderate density development away from the marsh. Variable runoff problems exist; good planning is necessary.
12. Already developed. The northern half of this area is already causing runoff and scenic problems. The runoff affects a farmer's field (13), and will probably be piped into the sedge meadow (14), where it will continue to cause problems. Note the field in question is an area recommended as high priority for water collection. A slight backward slope will probably be necessary to avoid erosion within the collection area.

15. Slopes (3 areas). On the northeast and northwest are areas sloping directly toward the marsh where very low density to low density development is the most intensive use recommended. Water control should be strict.
19. Valley leading southward toward marsh. Low to moderate density development is the most intensive recommended, with strict water control to protect the stream feeding the marsh.

SIXMILE CREEK

Yahara River Valley Region
Priority Group II
Wetland Description

Sixmile Creek is one of the major stream systems supplying water to Lake Mendota. It drains low glaciated topography, including some wetland areas. Waunakee Marsh, discussed elsewhere in this report, is an especially important wetland in this system. Sixmile Creek itself is meandering, with wetland borders in many places. The landscape at the time of settlement was almost certainly open, with dry prairie on the uplands, wet prairie on the lowlands grading into sedge meadows along the creek edge. In some places there were probably shallow and deep marshes. Remnants of this native wetland vegetation are now scattered among larger regions of disturbance vegetation. Typical native streambank plants include glade mallow (Napaea dioica) and cup plant (Silphium perfoliatum). Much of the disturbance vegetation is reed canary grass (Phalaris arundinacea).

The upper portion of the creek, north of County Highway "M", still has areas of sedge meadow behind built-up stream banks. Much of this is grazed, but probably still functions as an important buffer zone protecting the stream and allowing a place for flood waters to spread out. South of Highway "M" the silt deposition is heavy. Bur reed (Sparganium eurycarpum), a silt indicator, is dominant here. In this region, there are disturbed remnants of sedge meadow, shallow marsh, and deep marsh. Near the mouth of the creek, along the edge of Lake Mendota, is sedge meadow with invading shrubs.

The condition of the creek itself reflects the load which has been placed on it by heavy agricultural and some urban land use in the area. The water is turbid with suspended silt, from the action of carp disturbing the bottom. Silt deposits are thick, up to two feet deep in places along the stream and several feet deep in the bay at its mouth. Stream banks are raw and unvegetated, cut by frequent floods. Debris of all kinds may be found in the stream, on the bottom, and on the banks, also attesting to the force of floods. Ditching upstream has increased the rate of runoff and erosion. The natural ability of the stream to hold and slowly release flood waters has been further decreased by land use along its banks. Heavy grazing has not only resulted in the loss of native vegetation, but in destabilization of the stream banks and fertilization of the water. Algal blooms and abundant attached algae indicate highly fertile water, from agriculture and from a cheese factory in Waunakee. The diversity of submerged aquatic plants is low. The areas sampled contained coontail (Ceratophyllum demersum) and water milfoil (Myriophyllum sp.) almost exclusively.

Although wildlife use of the creek system has undoubtedly declined, it is still important. Northern pike make an extensive run up the creek (Harold Meier, pers. comm.). Earl Loyster (pers. comm.) notes that they spawn in Waunakee Marsh. Waterfowl use is important during migration, especially at the confluence of Spring and Sixmile Creeks. Marsh birds are still present. The DNF lists fifteen species of fish for Sixmile Creek. Don Samuelson has added 23 more by seining, making a total of 38. This list includes some important game species, e.g., northern pike, walleye, crappie, and largemouth bass.

Threats and Management

The Sixmile Creek area is in the path of suburban development. Unless careful planning is adhered to, this more intensive land use will result from a move that was intended to decrease the load on the Madison lakes and their associated watershed. The Waunakee area is now included in the Madison Metropolitan Sewerage System, which will decrease the nutrient load on Sixmile Creek and Lake Mendota. However, it could open this area up to increased development. The loss of this needed agricultural land would not result in the improvement of Sixmile Creek, because an increase in building and pavement coverage would increase overland runoff rates even further. Lawn fertilizers would be washed into the creek system, keeping it fertile. Population pressure would cause the loss of open space along the creek, with an attendant loss of wildlife use. Often under such circumstances, fill, pavement, buildings, and lawns extend right to the water's edge. Thus, Sixmile Creek, along with Spring Creek and the Upper Yahara River, urgently needs to be designated as a no-construction zone.

At the south end of Sixmile Creek, just north of its junction with Spring Creek, is a large region, perhaps as much as 80 acres, of shallow marsh and sedge meadow. Much of it is in a nearly undisturbed condition, so it still functions for flood control, for silt and nutrient control, as a wildlife area, and as open space. Most of it lies in a parcel of land which is at present offered for sale for development. There is no way intensive development can occur here without eliminating the above mentioned values and endangering the integrity of the creek system. Zoning is needed here, with a provision for graded density development. Filling of the marsh must be prevented.

Although Sixmile Creek is degraded, it is by no means beyond rehabilitation. Waterways and natural communities tend to repair themselves if the load is taken off of them. In this case, the enhancement of Sixmile Creek would bring a further benefit, a needed improvement in the water quality of Lake Mendota.

It is important to approach planning for an area under stress not by a delaying action, but by the establishment of positive goals. Our major recommendations are, therefore: (1) to control the human population density in the area, to protect both agricultural land and the watershed; and (2) to lessen the impact of agricultural activities on the watershed by instituting conservation practices. It is important to establish a buffer zone along the creek to slow runoff of water, soil, and fertilizer into it and to remove the impact of heavy stream bank grazing. The natural meanders must be protected, because they are crucial for slowing floods, especially since other land use practices at present tend to worsen flooding. Water should be held on the land as close as possible to where it fell as rain. Ditching should be stopped, and former wet areas restored. This means relinquishing some land to holding water after rainstorms rather than growing crops, but if the water is shunted quickly off the land, erosion of valuable soil increases and flood problems are merely compounded downstream. Water that runs off quickly is not available for seasonally restoring the water table. A further benefit of these protective programs should be the gradual re-establishment of natural diversity and improvement of wildlife use along the creek system.

PRELIMINARY LIST OF FISH SPECIES
COLLECTED FROM SIXMILE CREEK

(Collections made by Don Samuelson and Barbara Bedford)

Amia calvay, Bowfin
Campostoma anomalum, Stoneroller
Catostomus commersoni (Lacepede), White sucker
Chrosomus erythrogaster (Rafinesque), Southern red-bellied dace
Cottus bairdii, Mottled sculpin
Cyprinus carpio L., Carp
Esox lucius L., Northern pike
Etheostoma exile (Girard), Iowa darter
Etheostoma flabellare, Fantail darter
Etheostoma nigrum (Raf.), Johnny darter
Eucalia inconstans (Kirtland), Brook stickleback
Fundulus diaphanus (Lesueur), Banded killifish
Ictalurus melas (Raf.), Black bullhead
Ictalurus natalis (Lesueur), Yellow bullhead
Ictalurus nebulosus (Lesueur), Brown bullhead
Labidesthes sicculus (Cope), Brook silverside
Lepisosteus osseus L., Long-nosed gar
Lepomis cyanellus (Raf.), Green sunfish
Lepomis gibbosus L., Pumpkinseed
Lepomis macrochirus (Raf.), Bluegill
Micropterus salmoides (Lacepede), Largemouth bass
Notemigonus crysoleucas (Mitchill), Golden shiner
Notropis atherinoides (Raf.), Emerald shiner
Notropis cornutus (Mitchill), Common shiner
Notropis hudsonius (Clinton), Spottail shiner
Noturus gyrinus (Mitchill), Tadpole madtom
Perca flavescens (Mitchill), Yellow perch
Percina caprodes (Raf.), Logperch
Percina maculata (Girard), Blackside darter
Pimephales notatus (Raf.), Bluntnose minnow
Pimephales promelas (Raf.), Fathead minnow
Pomoxis annularis (Raf.), White crappie
Pomoxis nigromaculatus (Lesueur), Black crappie
Rhynchichthys atuatulus, Blacknose dace
Semotilus margarita, Pearl dace
Stizostedion vitreum vitreum (Mitchill), Walleye
Umbra limi (Kirtland), Central mudminnow

Spring Creek already shows the effects of the silt and nutrient loads from the farms in the watershed. Much of this may come from the tributaries at the west end of the creek, where there is little buffering wetland vegetation, and cultivated areas are close to the water courses. To protect the creek and Lake Mendota as well, it is important to establish buffer zones here. Grass strips and perhaps small holding ponds would be helpful. The present practice of hurrying the water off the farmlands creates floods and other problems downstream.

In the event that this region does become heavily developed, it would be extremely important to have Spring Creek preserved intact. Its functions would then be flood control, wildlife area, and open space.

WAUNAKEE MARSH

Yahara River Valley RegionPriority Group IIWetland Description

Waunakee Marsh is the largest and most important remaining wetland in the Sixmile Creek watershed. Its 1,043 acres of shallow marsh and sedge meadow buffer the creek and Lake Mendota against the effects of a highly agricultural watershed which has undergone extensive wetland drainage.

A major source of water for the marsh appears to be ground water seepage from the many springs all around the edge and from upwellings within the marsh itself. However, a large amount of surface water runoff, high in silt and nutrients, enters the marsh from surrounding croplands and drained, cultivated wetlands to the north. Cattle, which graze almost the entire southern edge, add more nutrients to the water. Yet, observations indicate that the quality of water leaving Waunakee Marsh is clearly better than that entering the marsh overland. For a discussion of the effects of the marsh on water quality, see pages 27-29.

Waunakee Marsh also acts as an important flood control device. In a watershed so extensively ditched as that of Sixmile Creek, water runs off the land at a rate too fast for the stream valley to handle in times of heavy rainfall. Flooding and bank erosion result, as observations downstream will verify. Without the marsh to slow and spread out some of the water, conditions downstream would be even worse.

The vegetation of Waunakee Marsh presents an interesting picture. Dominant plants are those of the shallow cattail marsh and sedge meadow. Yet it is not uncommon, when walking through the marsh, to slip suddenly through the plant roots and peat into water more than chest deep. Technically then, the water depth is that of the deep marsh. The plants apparently are floating on great chunks of peat over the water. The origins of this situation are not known, but a number of explanations are possible. It is conceivable that in an extremely dry period oxidation and subsequent subsidence of the peat occurred to the extent that when re-flooded, the peat did not entirely re-wet and floated up to the surface. Alternatively, the floating peat may be a remnant bog mat from a colder time. However, long-time residents of the area say that at one time they could cross the marsh in "low boots" and claim that the water level has been slowly rising since the Wisconsin River was dammed at Prairie du Sac (1914). The prevalence of sedge meadow plants and air photos which show the meanderings of an old stream through the marsh certainly suggest that water levels were much lower in the past. Further research is needed to answer the question.

Its large size and the presence of springs enhance the wildlife value of Waunakee Marsh. The size of the marsh permits species diversity and enough territory for the larger avian predators. Six springs and numerous seeps provide a year-round supply of clean water and wintering areas for waterfowl.

Although the low ratio of open water to vegetative cover precludes large numbers of nesting marsh birds and waterfowl, mallards and blue-winged teal breed here in moderate numbers. The more numerous species are those of the sedge meadow, shrub areas, and wetland edge: American bitterns, woodcock, short-billed marsh wrens, bobolinks, willow flycatchers, sora rails, and Virginia rails. Harriers, birds not often seen in Dane County, also nest here. Great horned owls and red-tailed hawks feed in the marsh and nest in adjacent woods. Sandhill cranes were observed in the area in August of 1972 and October of 1973.

Game species and fur-bearing animals which use Waunakee Marsh include deer, pheasant, muskrat, mink, and fox. Northern pike use the marsh as a spawning ground.

The Department of Natural Resources owns and manages 296.8 acres of Waunakee Marsh for fish and game.

Threats and Management

Poor land-use practices in the watershed and the draining of large areas of wetland north of Waunakee Marsh have over-taxed its filtering functions and portend further deterioration. An immediate management goal should be the development and implementation of an erosion control program to maintain soil and nutrients on the upland. Ideally, such a program would involve maximum use of conservation tillage practices: no tillage, minimum tillage, or mulch tillage. However, the following standard conservation practices are also effective in minimizing soil loss, especially when used in combination: (a) contour plowing; (b) planting cover crops in winter; (c) planting forage crops on slopes; (d) terracing; (e) contour strip crops, (f) crop rotations; (g) grassed waterways; (h) buffer strips of native vegetation around waterways; (i) streambank fencing; and (j) gravelled cattle crossings on streams.

In lieu of good upland management, the construction of settling basins may be necessary in crucial areas. Appropriate locations for water-control areas are suggested on the map (areas 15-19). These should be given high priority for acquisition.


Flooding has been mentioned as a management technique to open up more areas for waterfowl nesting. It is our concern that were flooding attempted, all that would result would be a further floating up of the peat. It would be advisable to experiment with raising water levels to restore deep-water marshes in smaller or lower priority areas before working with a wetland as large and valuable as Waunakee Marsh.


Addendum


In 1974, the wetland complex north and upstream of Waunakee Marsh was drained in such a way as to partially bypass the marsh. This is expected to result in an increased nutrient load on Lake Mendota (Gjestson, pers. comm.).


WAUNAKEE MARSH


MAP KEY


- 


Shallow marsh, most of which seems to be floating (see discussion). Cattail is dominant. Also present are sawgrass sedge (Carex lacustris), Carex aquatilis, soft-stem bulrush (Scirpus validus), tussock sedge, tufted loosestrife (Lysimachia thyrsiflora), marsh dock (Rumex orbiculatus), and others. Variations are due primarily to greater or lesser presence of cattail. Occasional sedge or sedge-forb areas have no cattail. There is a strip of sedge meadow around the edges which is too narrow to indicate.
- 

Area of heavy siltation. This shallow marsh has plant species characteristic of silt flow, especially bur reed and jewelweed. There is some cattail and arrowhead, with many muskrat houses.
- 

Mixed wetland vegetation, mostly tussock sedge with sparse to medium cattail density, and scattered forbs.
- 

Sedge meadow, mostly tussock sedge with sawgrass sedge, bluejoint grass, and sedge meadow forbs such as marsh milkweed (Asclepias incarnata), marsh thistle (Cirsium muticum), and marsh lousewort (Pedicularis lanceolata).
- 

Grazed lowland, some native sedges but mostly European grasses on wet muck.
- 

Marsh edge disturbance species. Basically this is a sedge meadow with invading European grasses, briar bushes (Rubus spp.), and tall forbs such as nettle, greater ragweed (Ambrosia trifida), saw-toothed sunflower (Helianthus grosseserratus), blue vervain (Verbena hastata), bull thistle (Cirsium vulgare), and Canada thistle (Cirsium arvense).
- 

Shrubs, mostly willows (Salix discolor, S. bebbii, S. petiolaris, S. interior, S. nigra) and red-osier dogwood (Cornus stolonifera). Some meadowsweet (Spiraea alba), gray dogwood, and bog birch (Betula sp. [sandbergii?]).

Waunakee Marsh



Very disturbed or once cultivated sedge meadow. Reed canary grass is dominant, with marsh nettle, giant ragweed, saw-toothed sunflower, and scattered remnant wetland plants.



Old field.



Grazed old field.



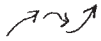
Open woods. Note grazed areas.



Wooded areas. The young upland woods contain mainly white, black, and bur oaks (Quercus alba, Q. velutina, Q. macrocarpa), black cherry (Prunus serotina), and shagbark hickory (Carya ovata).



Spring.



General pattern of water flow within the marsh.



Drainage ditch or channeled stream.

All other land is under cultivation.

WAUNAKEE MARSH

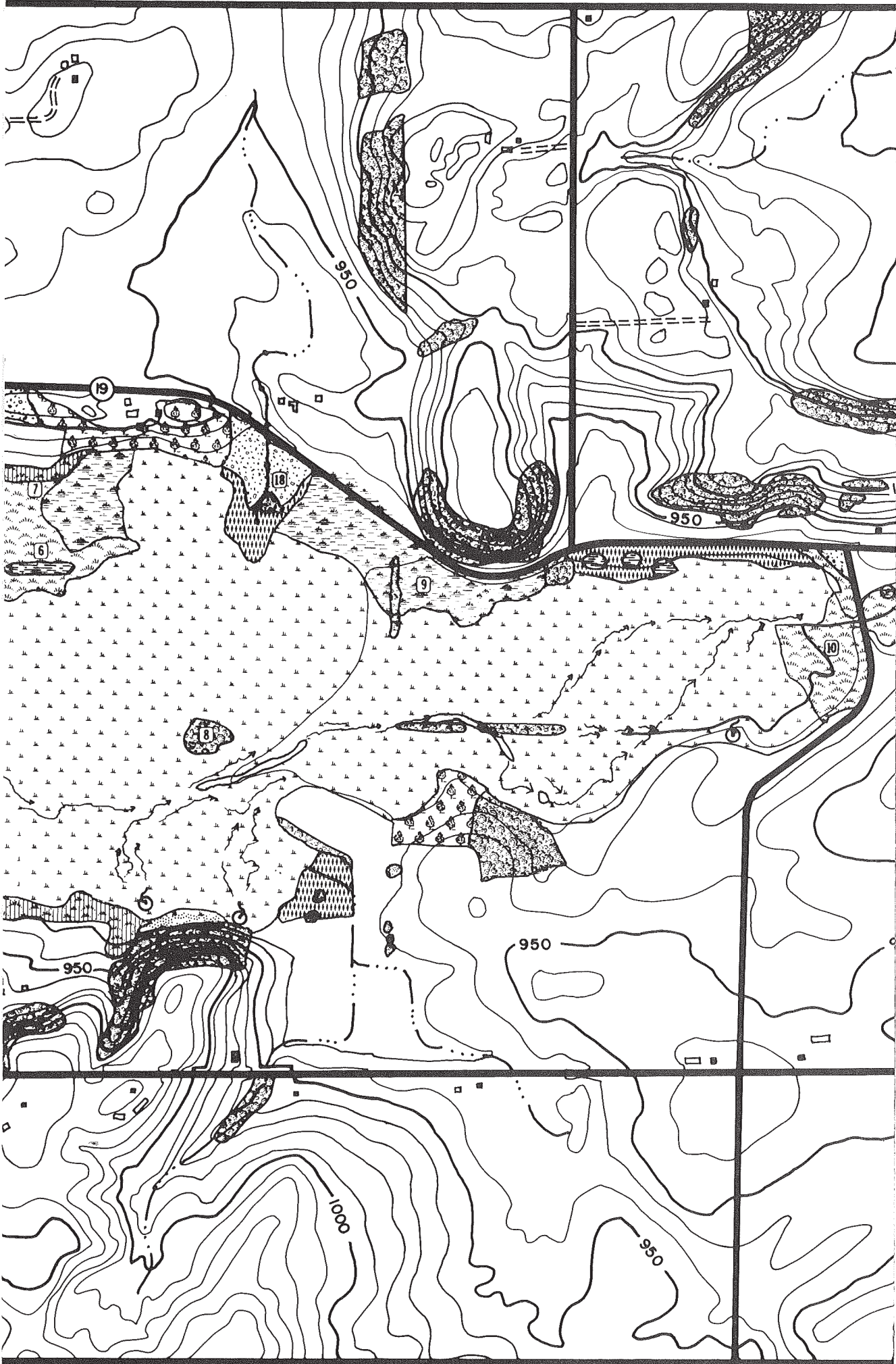
MAP EXPLANATION

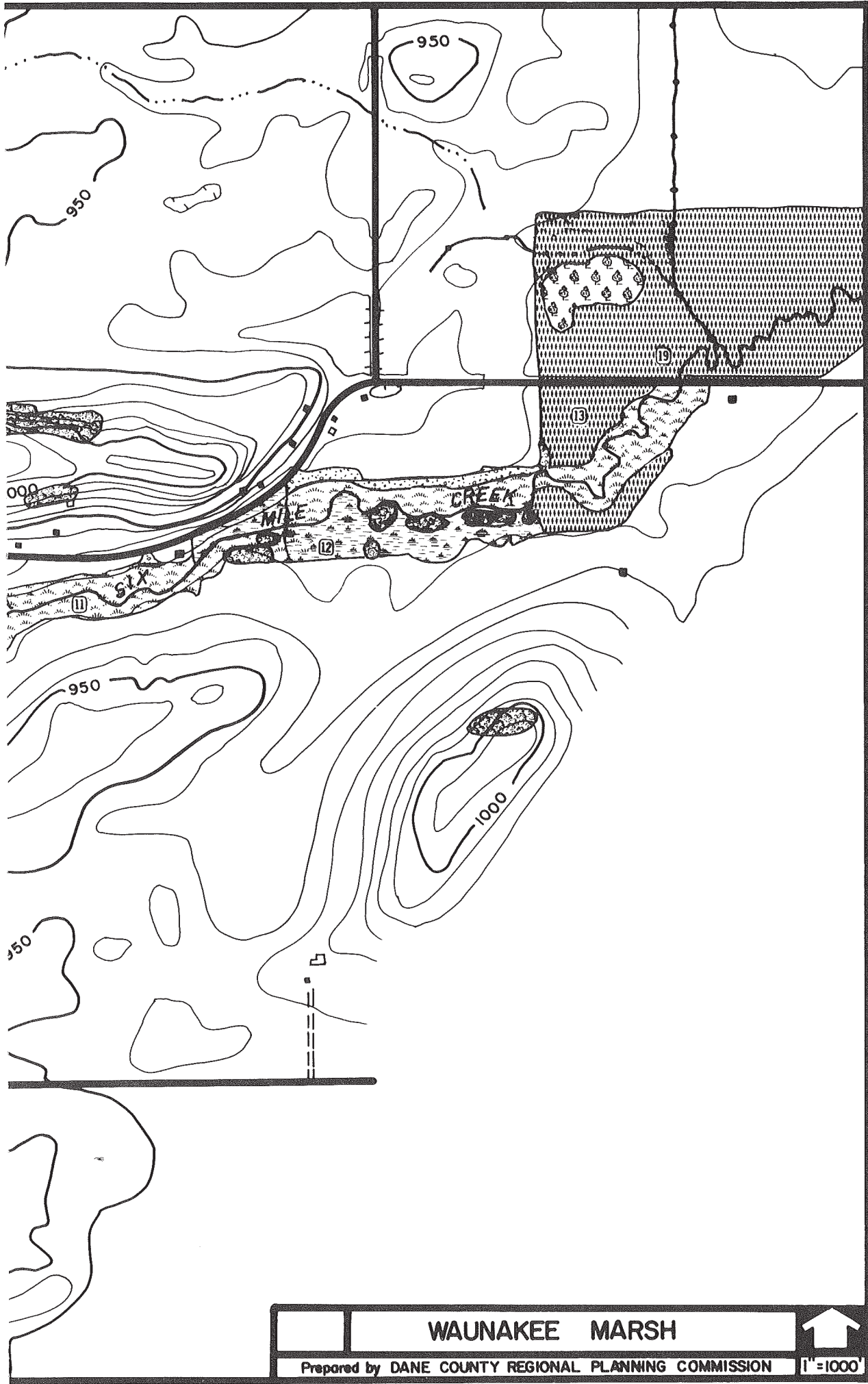
- 1) Row of black willow (Salix nigra) and quaking aspen, (Populus tremuloides) along an old drainage ditch.
- 2) Grazed sedge meadow and spring area. This is an entry point for farm runoff from the west and itself a nutrient source (in the form of animal wastes) for the marsh. The small area to the east shows disturbance due to increased silt load.
- 3) Small open water area surrounded by shrubs with sandbar willow (Salix interior), tussock sedge (Carex stricta), bluejoint grass (Calamagrostis canadensis), reed canary grass (Phalaris arundinacea), bur reed (Sparganium eurycarpum), and box elder (Acer negundo).
- 4) Large spring area, wintering area for waterfowl. The spring contains an unidentified lavender bacterium or alga. The area has received silt from the upland. Twelve carp were observed in the area on July 8, 1973.
- 5) Sedge meadow, grazed occasionally in dry years, but in good condition with scattered fen plants. Tussock sedge is dominant. Other species include the sedges Carex sartwellii, C. prairea, C. aquatilis, C. sterilis, and C. tetanica, as well as bog goldenrod (Solidago uliginosa), sage willow (Salix candida), cottongrass (Eriophorum angustifolium), marsh lousewort (Pedicularis canadensis), turtlehead (Chelone glabra), and four-flowered loosestrife (Lysimachia quadriflora).
- 6) Sedge meadow and shrub island.
- 7) A small area of clone-forming Carex aquatilis and a floating mat of Carex lacustris with scattered Carex lasiocarpa, the wiregrass sedge. This second area bounces just like a bog mat.
- 8) Small wooded island. The soil is oxidized peat and is never more than two feet above water level. The trees are mostly quaking aspen, some young oaks (Quercus spp.), box elder, with open forest shrubs such as gray dogwood (Cornus racemosa), red raspberry (Rubus idaeus), and American hazelnut (Corylus americana). A small bluejoint grass meadow is on the north side. Some low prairie plants, such as prairie dock (Silphium terebinthinaceum), are around the edge of the island.
- 9) This area disturbed near the road edge. There are patches of giant reed grass (Phragmites communis), and also some nettles (Urtica dioica), reed canary grass, bur reed, and tall composites. The water is about four inches deep.

- 10) Sedge and bluejoint meadow. Very tall tussocks (to two feet) of Carex stricta are largely taken over by bluejoint grass.
- 11) Sedge meadow along creek, which was grazed until 15 years ago, according to the landowner. Bluejoint grass and composites, especially Joe-Pye-weed (Eupatorium maculatum), are dominant.
- 12) Cattail sedge meadow, water to four inches deep. The meadow has received silt from adjacent cornfields. There is a higher presence of bur reed, bur marigold (Bidens cernua), and jewelweed (Impatiens biflora) than in other similar areas.
- 13) This once-cultivated sedge meadow is not so dominated by reed canary grass as is the large area north of the road. Rather, it is coming into a mixture of European grasses, weeds, and native wetland plants.

Sources of Overland Runoff and Proposed Water-Control Areas

- 14) Confluence of two large drainage ditch networks draining former wetlands to the north and northwest and emptying into Waunakee Marsh. A delta of siltation on the map indicates the area of most severe disturbance, where the silt deposit is several feet deep. A water control area here is recommended.
- 15) Old field, possible last resort for a ponding and silt-catching area.
- 16) Proposed water-control area. This drainageway, often too wet to cultivate, could serve to trap silt and nutrients from farmland to the west.
- 17) An intermittent stream feeding through cornfields into a grazed sedge meadow and then into the marsh. A water control area is recommended here.
- 18) Ditch carrying silty green-brown water into marsh. Cattle graze in the stream north of the road. An old field and disturbed sedge meadow area is on a slight ridge extending out into the marsh. This could serve as a water-control area.
- 19) Large area of ditched sedge meadow. Reed canary grass is dominant with scattered native wetland vegetation in wetter areas. The creek here still follows its natural meanders and its bank edges are still gradual. A suggested method of water control for this area might be to eliminate the ditches, thus forcing the water to spread out through the vegetation in order to filter out some of its nutrient and silt load.





APPENDIX A

Yahara-Mendota Priority Watershed Report

Grantee Name (county or tribal government):	Dane County Land and Water Resources Department
Grant Number:	YME-13000-N
Priority Watershed Project Name:	Yahara-Mendota Priority Lake Priority Watershed Project
Grant Begin Date:	November 12, 1987
Grant Expiration Date:	December 31, 2009

Final report contents: The document listed in parentheses next to each report topic provides a source of information or data for that topic. If you require DNR financial data reports for this final grant report, contact the Priority Watershed Grant Manager, Jeff Soellner, at jeffrey.soellner@wisconsin.gov or (608) 267-7152.

1. Introduction: Introduce the program and the project.

The purpose of the project was to assess the nonpoint pollutants affecting water quality within Lake Mendota. Implementation of best management practices and educational activities to control polluted runoff were needed to meet water resource objectives to protect and enhance Lake Mendota and other lakes, streams, groundwater and wetlands in the watershed.

2. Watershed Description: Describe particular attributes of watershed and what factors accounted for it being chosen as a Priority Watershed. Describe the quality of the water prior to project implementation. Include/attach a map of the watershed/lake. (watershed plan)

232 square mile drainage basin located in the Lower Rock River Basin. Sediment and phosphorus were the primary pollutants of concern with delivery rates of 9,613 t/y and 72,275 lbs/y respectively based on inventory and modeling. Water quality conditions did vary amongst the eleven different subwatersheds. Primary concerns that were constant included sedimentation, nutrient loading, and some channelization. Generalized conditions were decreased water clarity and nuisance algae blooms and macrophyte growth. Secondary impacts were low dissolved oxygen and thermal loading.

3. Accomplishments: Describe or list the following:

- Number of landowners/operators eligible for cost-sharing and easements (annual reports) : **567**
- Number of eligible landowners contacted during the project (annual reports): **455**
- Number of eligible landowners participating during the project (annual reports): **237**
- BMPs that were installed (DNR or grantee CSA data)

79 no. Barnyard Runoff Systems (Eaves, Sediment Basins & Roofs)
10 no. Diversions
58.1 ac Grassed Waterways
3,105 ft Streambank Protection
2 no. Terrace Systems
8 no. Agricultural Sediment Basins/Grade Stabilization Structures
12.8 miles Grassed Buffers along Surface Water
18.8 ac Wetland Restoration

- Number of critical sites addressed compared to total number detected (annual reports)

Barnyards:
10 Critical Site Animal Lots were addressed of the 10 Critical Site Animal Lots detected in Dane County (one critical site lot added during watershed implementation).
Cropland:
80 Critical Site Crop Fields (54 landowners) were addressed of the 80 Critical Site Crop Fields identified in watershed plan.

➤ Major information and education activities during the project (annual reports)

1998:		
Activity:	Objective:	Attendance:
Presentation of watershed plan	Inform Village Board of Deforest on program requirements	10
Construction site erosion control ordinance workshop	Inform builders, developers and engineers on ordinance	65
Presentation at Sauk County LCD	Use LMN as a case study for urban conservation	30
Presentation to Waunakee Village Board	Information on priority watershed requirements	10
Attend Waunakee Village Board Meeting	Provide technical background on construction site erosion control ordinance	10
County Watershed Tour	Tour Dane County Watersheds with Lakes & Watershed Commission	12
Wisconsin Association of Vocational Ag Instructors	Organized a urban and rural conservation program for ag teachers	35
Presentation to Middleton High School	Presentation to environmental conservation classes on LMN	65
Presentation to Middleton High School	Urban field trip showing effects of construction site erosion	65
Presentation to Environmental Science class at MATC	Inform students on LMN project goals	25
Teacher Training Workshop	Train area teachers on water quality testing procedures	77
Presentation to Middleton High School	Soils and habitat assessment field study with students	48
Project WET	Workshop for Deforest High School Teachers	24
Presentation to Oregon High School	Inform and educate students on stream ecology	56
Presentation to Friends of Pheasant Branch	Presentation on low input lawn care	34
Presentation to Sherman Ave. Neighborhood Assoc.	Presentation on Better Lawns and Gutters	11
Stormwater Stenciling	Teach 4-H youth leaders about stenciling program	22
1999:		
Nutrient Management Planning Workshop	Increase farmers knowledge of nutrient management planning	8
2000:		
Nutrient Management Planning Workshop	Increase farmers knowledge of nutrient management planning	13
Presentation at Danco Prairie FS field day	Inform farmers and consultants on nutrient management	10
Presentation to Deforest High School Ag Class	Educate ag students on conservation planning	15
Work with Middleton High School Envirothon Team	Inform students on landuse and its effects on environment	12
Presentation to local municipalities	Work with communities on implementation of erosion control and stormwater standards	100
2001:		
Presentation to Metro Grow Employees	Inform employees about nutrient management	20
North American Lake Management Society Bus Tour	Tour of conservation practices in LNM Watershed	20
2002:		
Citizen Based Monitoring began in the LMN Watershed	Staff worked with various citizen groups to train and assist in monitoring of water quality within the watershed.	
Workshop on development of nutrient management plans	Informed ag producers on the development and implementation of nutrient management plans	13
Developed two newsletters	Newsletter focused on watershed program	650
2004:		
Municipal Roundtable	Staff met with representatives of municipalities to discuss progress in updating erosion control ordinances.	

2006:		
Workshop on development of nutrient management plans	Informed ag producers on the development and implementation of nutrient management plans	10
2007:		
Workshop on development of nutrient management plans	Informed ag producers on the development and implementation of nutrient management plans	10
2009:		
Workshop on development of nutrient management plans	Informed ag producers on the development and implementation of nutrient management plans	18

- Water and soil conservation ordinances adopted during the project (annual reports)

1995: Dane County Construction Site Erosion Control Ordinance 2001: Dane County Stormwater and Erosion Control Ordinance 2002: Dane County Manure Storage Ordinance 2005: Dane County Winter Manure Spreading Ordinance
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4. **Urban Nonpoint Source Project Component:** If the watershed plan had an urban component, list and describe the accomplishments and goals met, as applicable, such as storm water management plans and utilities developed, storm water and erosion control ordinances developed, structural BMPs designed and installed, etc. If available, list the associated pollutant load reduction information for the urban practices installed.

<p>The Dane County LCD worked very closely with the municipalities of Madison, De Forest, Waunakee, Middleton, and Sun Prairie throughout the course of the project. In the late 90's, the DNR implemented new protocols for municipal funding basically creating a competitive format under the Urban Nonpoint Source grant program. Those communities were therefore on their own to apply for and implement urban initiatives.</p> <p>Unique to this project was the urban critical sites criteria which was a first for Wisconsin's Priority Watershed Program. While NR 120 didn't recognize this aspect, staff worked exclusively with all five major municipalities implement the 7.5 t/a/y soil loss standard from construction sites. Additionally, this approach also lead to Dane County amending its' own stormwater and erosion control ordinance (Chapter 14) to include such standards county-wide.</p> <p>Dane County provided \$198,803 in funding through the Urban Water Quality Grant Program to assist municipalities in the installation of best management practices resulting in a reduction of 36.7 lbs of phosphorus from reaching Lake Mendota annually.</p> <p>Attached is additional information (pages 7-12 of this report) , which will provide a more detailed analysis of accomplishments, related to urban components.</p>
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5. **Water Resource Evaluation:** Describe the water resource goals met and the percent of applicable pollutant load reduction and other goals reached. (annual reports)
- Barnyard phosphorus:
Reduced barnyard phosphorus runoff by 8923 lbs annually (72 % of project goal)
 - Upland sediment
Reduced upland sediment loss to surface water through conservation planning by 4,034 tons/annually (38% of project goal)
 - Streambank/shoreline erosion
Reduced streambank erosion by 93 tons annually (26% of project goal)
 - Gully erosion
Reduced gully erosion by 1,606 tons annually (no project goal)
 - Nutrient management acres
Nutrient management plans were developed on 45% of cropland within watershed. The below table lists nutrient management plans reviewed by county staff within the watershed. Typical, nutrient management plans are funded for a three year period. (no project goal)

- Conservation plan acres
89.6% of cropland within the watershed is farmed at or below tolerable soil loss levels.
- Wetland restoration
18.8 acres of cropland have been restored to wetlands.

6. **Financial Evaluation:** Compare the cost-share grant amount to the total amount of money spent on BMPs, including urban BMPs. List the amount of money spent per BMP. (DNR or grantee accounting data)

Rural Projects:

The original watershed grant amount was \$2,878,340 of which \$776,083.72 was spent on the installation of best management practices. Below is a table listing the amount spent per practice.

	Practice	Units installed	Total Cost-share
C3	Diversion	2050 lin. ft.	\$6,686.79
C5	Grassed Waterways	10.9 acres	\$20,437.32
L1	Barnyard Runoff Management	17 sites	\$143,725.71
L2	Manure Storage (Manure Transfer)	1 no	\$13,201.92
LR	Roof for Barnyard Management	7 sites	\$400,059.53
M2	Grade Stabilization Structure	4 no.	\$19,501.57
M4	Agricultural Sediment Basins	4 no.	\$19,312.01
M5	Nutrient Management	1,851.7 acres	\$11,687.53
MR	Streambank Protection	2455 lin. ft.	\$18,340.34
R6	Critical Area Seeding	0.2 acres	\$350.00
513	Total Confinement of Livestock	1 site	\$122,781.00
			\$776,083.72

In addition to cost-share funds from the priority watershed program, county staff worked with producers within the watershed to enter into 195 Federal Environmental Quality Incentive Program (EQIP) contracts for \$1,516,874 in cost share and incentive payments. Of this amount, \$1,128,817 has been used to install best management practices within the watershed.

Urban Projects: (Funding from Urban Non-Point Source Program)

Municipality Name	Name of Grant	Grant Cycle	Objective	Completion Date	Cost
Urban SW Construction Grant					
City of Madison	Wexford Retention Retrofit	2000	Retrofit dry to wet pond	2000	\$249,325
City of Middleton	Pheasant Branch Creek Stabilization Conservation Project	2006-2007	Erosion control and streambank stabilization	2008	\$58,450
City of Middleton	Hwy 12 Catch Basin	2005-2006	Proprietary device installation	2006	\$65,000
City of Middleton	Pheasant Branch Wet Pond	1997-2001	Wet pond construction	2001	\$151,200
City of Sun Prairie	Token Creek Water Control	2000	SW Control	2000	\$37,392
University of Wisconsin	Lot 34	2005-2006	Retrofit parking lot	2007	\$150,000
University of Wisconsin	Angler's Cove Parking Lot	2003-2004	Retrofit parking lot	2004	\$40,000
Village of DeForest	Industrial Park Pond	2000-2003	Wet pond construction	2003	\$24,500
				Total:	\$917,547
Storm Water Planning Grants					
City of Middleton	Storm Water Plan	2005-2006	Develop storm water mgmt plan	2007	\$85,000
Village of DeForest	Storm Water Plan	2005-2006	Develop storm water mgmt plan	2007	\$70,000
Village of Waunakee	Storm Water Plan	2006-2007	Update storm water mgmt plan	2007	\$43,610

Village of Waunakee	Storm Water Plan	2000	SW Plan/ Erosion Control Ord.	2000	\$43,574
Village of Maple Bluff	Storm Water Plan	2006-2007	Develop storm water mgmt plan	2007	\$18,000
Village of Shorewood Hills	Storm Water Plan	2006-2007	Develop storm water mgmt plan	2007	\$63,982
City of Sun Prairie	Storm Water Plan	2000-2001	SW Plan/ I&E/ Erosion Control Ord.	2001	\$19,285
University of Wisconsin	Storm Water Plan	2002-2005	Develop storm water mgmt plan	2005	\$96,430
				Total	\$439,881

Evaluate the effectiveness of local assistance grant expenditures. (DATCP or grantee accounting data)

The local assistance grant was effective in assisting Dane County to fund staff to work on the watershed project. Staff were able to conduct outreach programs promoting the watershed and to assist landowners in the design and installation of conservation practices. The urban staff funded by the local assistance grant focused on the municipalities within the watershed assisting in updating of ordinances and improving construction site erosion inspections. The rural staff partnered with the Natural Resources Conservation Service in administering the federal Environmental Quality Incentive Program providing landowners an alternative cost share source for the installation of conservation practices.

A frustration with the local assistance grant was that funds did not increase over the years to cover the increase in salary costs.

7. Summary and Conclusions: Summarize the report and evaluate the overall success of the project.

The Yahara-Mendota Priority Lake Project spanned a time of changes in both the priority watershed program and agriculture. During the early years of the project, cost share funds available for installation of best management practices were limited. This resulted in project staff using the federal Environmental Quality Incentive Program (EQIP) as a cost share source. This resulted in over \$1.2 million dollars of federal funds being used to install conservation practices. In agriculture, the farms transformed to larger, family corporations resulting in the concentration of livestock. Thus, best management practices typically installed (i.e. barnyard runoff systems) no longer solved the barnyard runoff resource concern. This resulted in Roofs for Barnyard Management being promoted as the best management practice to solve the resource concern from animal waste runoff.

Agricultural Summary:

- 42% of landowners/producers within the watershed installed or implemented a best management practice.
- All animal waste critical sites identified in the watershed plan were addressed.
- All cropland critical sites identified in the watershed plan were addressed.
- 79 animal lots within the watershed have installed conservation practices or implemented management changes, which reduced animal waste runoff.
- 155.9 ac of cropland has been seeded to grasses to establish buffers along surface water and wetlands. These buffers trap sediment and filter nutrients before runoff enters surface water. (Assuming an average width of 100-ft, this represents about 12.8 miles of surface water with grassed buffers installed).
- As part of Dane County winter spreading ordinance, staff worked with 29 livestock operations to develop winter spreading plans to minimize runoff from applications of liquid manure on frozen, snow covered or ice covered ground.
- Greater than 45% of the cropland acres in the watershed developed and updated nutrient management plans.
- Completed Farm Practices Inventory Survey (FPI) with producers to establish baseline data and trends. The same producers are being surveyed in 2010 to identify changes that have occurred as a result of the watershed project.

Urban Summary

- Municipal adoption of the 7.5 tons/acre construction site erosion control standard.
- Development and application of two interim BMPs including polymers and urban catchment basins.
- Identification and mapping of all urban outfalls.
- Provided municipalities with hydric soils maps for consideration when developing.
- Provided technical assistance and guidance when applying for Urban Non-point Source grants.
- Sun Prairie, Waunakee, and DeForest developed stormwater management plans.
- Developed and administered intergovernmental agreements for erosion control and stormwater plan review and inspections in DeForest, Waunakee, Middleton, and Sun Prairie.
- Developed criteria for urban critical sites, which was a first for the Wisconsin Priority Watershed Program.

- Provided administrative and technical support on all phases of erosion control and stormwater management initiatives to municipal partners.
- Watershed plan was impetus for further development and adoption of Dane County Chapter 14 Code of Ordinances Subchapter II, in 2002.
- Conducted two USEPA funded research projects evaluating effectiveness of erosion control practices.
- Dane County provided \$198,803 in cost share funds to municipalities for the installation of best management practices at channel outfalls reducing 36.7 lbs of phosphorus from reaching Lake Mendota annually.

Completed by:	
Name (first mi. Last)	Steven J Ottelien and Peter L Jopke
Title:	Soil and Water Conservationist/ Water Resources Planner
Phone Number:	608-224-3734/ 608-224-3733
Email:	ottelien@co.dane.wi.us jopke@co.dane.wi.us
Date Completed: (mo day yr)	April 30, 2010
Signature:	

Attachments: Map of the project
 Photos of the project

DNR Copy distribution (3):

- (1) 2 copies to Priority Watershed Grant Manager – Jeff Soellner, WI DNR CF/2, PO Box 7921, Madison, WI 53707-7921
- (2) NPS Region Coordinator

Lake Mendota Priority Watershed

Interim Review of Success in Meeting Urban Pollutant Reduction Goals

The urban project goals include both sediment and phosphorus objectives. They were broken down into two categories to include existing and transitional areas. A third component (future) was also included but it is assumed that these future developments will be addressed by the new Dane County Erosion Control and Stormwater Management Ordinance (Chapter 14). Phosphorus objectives will be met in the following categories if the overall sediment objectives are satisfied.

Urban Project Goals- (Existing)

Sediment-40%

Phosphorus-20%

Urban Project Goals- (Transitional)

Sediment-80%

Phosphorus-60%

Existing Urban Areas-Management Needs & Alternatives

<i>Management</i>	<i>Status</i>	<i>Recommendation</i>
Increase street-sweeping frequencies to one time per week in areas identified as downtown commercial strip.	At this time, project staff do not know whether this alternative is being implemented	Visit with municipalities to review street-sweeping frequencies and areas targeted.
Increase and maintain street sweeping in other established urban areas to once every three weeks.	At this time, project staff do not know whether this alternative is being implemented	Visit with municipalities to review street-sweeping frequencies and areas targeted.
Construct and maintain urban catchment basins where there is direct discharge of stormwater to surface waters.	To date, it is estimated that three basins have been constructed in such areas.	Staff met with municipalities on various occasions to identify and prioritize locations. Municipalities indicated financial support as a limiting factor. Will continue to encourage pursuing Urban Nonpoint Source and Stormwater DNR Grants.
Direct runoff to buffer strips, porous pavement, infiltration trenches, and shallow depressions where sediment can be deposited and runoff reduced.	This recommendation is targeted for redevelopment. It is not known to what extent this is occurring although contracted municipalities have been addressing these issues where they can according to ec/sw plans reviewed by this office.	Continue to encourage this through the plan review process.
Adopt effective storm water management plans for each future development site.	All municipalities have stormwater management plans including Sun Prairie, Waunakee, and Deforest which prepared plans during the planning phase of this project.	The new Dane County EC/SW Ordinance will force compliance.

Transitional Urban Areas- Management Needs & Alternatives

<i>Management</i>	<i>Status</i>	<i>Recommendation</i>
Apply and enforce the 7.5 tons/acre construction site erosion control standard to all municipalities in the watershed.	All municipalities adopted this standard prior to the County Requirements in August 2002. The LCD has also contracted for plan review/inspection of construction sites in DeForest, Middleton, Waunakee, and Sun Prairie. Madison has hired an additional staff person and does this internally.	Continue to work with municipality in the watershed in this capacity.
Avoid development in areas with hydric soils.	LCD staff have provide municipality with maps indicating where hydric soils are located within their municipality boundaries.	Continue to work with municipality staff on the importance of not developing in these areas. Suggest alternatives and continue to recognize the value of these areas during the plan review process.
Reduce direct discharge coming from developing areas by 80%.	Direct discharges have been addressed during plan review. All plans within the municipalities having contracts are meeting this requirement.	Continue to address through the plan review process. Although LCD staff do not do this per contract requirements, suggestions are made per the approval letter.
Maintain peak stormwater flows to pre-development conditions for the 1,2 and 10-year 24-hour storm.	Peak flows are addressed for the 2 and 10-year storms only. With the exception of Sun Prairie, all municipality administer this through their own consulting firms or staff.	Continue to address through the plan review process. Although LCD staff do not do this per contract requirements, suggestions are made per the approval letter.

Urban Streambank Erosion

Urban streambanks are evaluated on a site-by-site basis. Currently, the North Fork of Pheasant Branch Creek is be reconfigured by the City of Middleton. As part of the development in that sub-watershed, the stream will be re-routed with a meandering pattern while strategically rip rapping certain segment. The South Fork of Pheasant Branch had a portion of its banks stabilized in 1997-1998. The Village of DeForest has been conducting annual stream clean-ups on the Yahara River but has not done any stabilization work. Finally, the City of Sun Prairie has undertaken an aggressive approach to minimizing thermal runoff into Token Creek. Although this was not an original goal of the Plan, all development in the Token Creek Watershed will include management practices for thermal pollutant reduction.

Pollution Prevention Practices

Pollution prevention practices are intended to remove pollutants at the source and prevent the need for treatment after they enter the water resource. Types of pollution prevention practices identified in the plan include:

- Reduce or eliminate the use of galvanized roof materials, which are sources of zinc in urban runoff.
- Immediate removal of pet wastes from urban areas, which can contribute bacteria to area surface waters.
- Control the use of herbicide and pesticide applications.
- Proper disposal of automobile fluids to keep them out of the stormsewer system.
- Removal of accumulated sediment, leaf material, and other debris from catch basins, streets, and parking lots. This can contribute nutrients to surface waters while inhibiting overall municipal maintenance.
- Control development and redevelopment through zoning which may influence the overall stormwater management impacting water quality, flooding, and habitat degradation.
- Minimize the use of de-icing compounds. Sodium chloride levels have shown an increase in groundwater resources.
- Control construction site erosion.
- Reduce the amount of motorized traffic.
- Reduce the areal extent of parking lots.

The above programs are best administered through the local municipality. Each municipality should be encouraged to address these issues. All of the prevention practices listed were part of the Information and Education strategies developed for this watershed. However, due to budget deficiencies and changes at the staff level, the information and education strategies have not been given a high priority with the exception of construction site erosion control and post development stormwater. From a priority standpoint, the project goals will have a higher likelihood of being met with the emphasis being placed on proper erosion control and stormwater management.

Urban Critical Sites

This watershed plan was the first in Wisconsin to include urban critical sites. Urban critical sites are all transitional areas that exceed 7.5 tons/acre/year in soil loss during the construction phase. The other critical site component includes areas of direct discharge into Lake Mendota or other surface waters that meet the following criteria: outfalls with a ratio of sediment (tons) to land area (acres) that is greater or equal to 0.2 and where best management practices are identified through a feasibility study.

Since all municipalities in the watershed area have adopted the 7.5 tons/acre/year soil loss rate and are actively administering it, there are no critical sites falling into that category. However, the second critical site component is not actively being targeted. Part of the reason is that there is no legal authority under NR 120 governing critical sites in urban areas. Secondly, although areas were initially identified during the inventory phase, no additional effort has been made to work with communities where the ratio is greater than 0.2.