

# **Conditions & Trends**

## **2<sup>nd</sup> Generation Southeast Landscape Plan**

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**MFRC Southeast Regional Landscape Committee**

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**February 2014**



Minnesota Forest Resources Council (MFRC)

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## Executive Summary

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The Minnesota Forest Resources Council was established in 1995 by the Minnesota Legislature to provide advice to public and private organizations on forest sustainability issues through the Sustainable Forest Resources Act (SFRA). This legislation provided authorization for establishing regional landscape committees to foster landscape-based forest resource planning and coordination. These regional committees provide an opportunity to involve private citizens, forestry professionals and members of various interest groups in developing and implementing landscape-level plans that promote forest sustainability.

The SFRA defines landscape-level planning as *“long-term or broad based efforts that may require extensive analysis or planning over large areas that may involve or require extensive coordination across all ownerships.”* It charges the regional committees to: 1) include representative interests, 2) serve as a forum to discuss issues, 3) identify and implement an open and public process whereby landscape-level strategic planning can occur, 4) identify sustainable forest resource goals for the landscape and strategies to achieve those goals, and 5) provide a regional perspective on forest sustainability to the Council.

From 1998 to 2005, the first generation landscape plans were prepared for each of the six forested regions in the state. The first generation Southeast Landscape Plan was approved by the Council in 2003. Now with over ten years of implementation, it is time to update the landscape plan as well as the technical documents that support its preparation.

The Council established a general planning process for the development of landscape plans. The process includes the following steps:

- Prepare an assessment of current conditions and trends in the landscape;
- Determine vision, goals, and issues that address existing and potential conditions considered desirable for the region;
- Develop strategies for implementing the vision, goals and/or resolve issues in the region;
- Encourage voluntary implementation of the strategies by coordination between landowners; and
- Conduct an evaluation to determine how well the strategies accomplish the vision and goals and resolve issues.

The purpose of the first step in the general planning process – conducting a landscape assessment – is to provide a common understanding of ecological and socioeconomic conditions in order to further planning and coordination among multiple landowners and interests. This assessment information provides a scientific base for the goal-setting and collaborative-decision making in the landscape plan development process.

This Conditions and Trends Report gives as accurate a picture of the thirteen-county Southeast Minnesota Landscape (Dodge, Fillmore, Freeborn, Goodhue, Houston, Le Sueur, Mower, Olmsted, Rice, Steele, Wabasha, Waseca, Winona) as possible given the limitations of available information and resources. It also points to areas where more specific assessments are needed to resolve the primary issue of sustainability in the landscape over time as well as points out gaps

where more information is needed. This report is a starting point for addressing forest sustainability in southeastern Minnesota, not the end result.

To guide the regional forest resource committees as they carry out landscape-level planning and coordination, the Council also established four broad goals that describe overarching strategies for sustaining forests. The MFRC used the Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota to develop these goals. This updated Southeast Conditions and Trends report is structured around these four goals. The goals are stated below with the findings, recommendations and additional data needs concerning that goal.

*Notes to Reader:* Additional regional data can be found in the report, “Demographic Data Report: 2<sup>nd</sup> Generation Southeast Landscape Plan”, MFRC Southeast Planning Committee, 2014. Updates/revisions to some of the following summary statements may be found in the *Southeast Landscape Plan: A Regional Plan to Guide Sustainable Forest Management*.

**Goal 1: Forestland Cover.** Land area covered by forests within a region’s landscape will be the same or larger.

#### Key Findings

- **Historic loss of upland forests.** The region, which covers nearly 5 million acres, has lost approximately one-third – over 330,000 acres – of “upland forests” to agriculture and development since European settlement. The most heavily impacted counties include Le Sueur County and Rice County, as well as Wabasha County, Houston County, and parts of Olmsted County.
- **Forest cover is increasing.** Despite historic losses, forestland is increasing in recent years. According to the United States Forest Service Forest Inventory and Analysis (USFS FIA) definitions and estimates of forestland, forest cover in the 13-county region increased by a total of 92,333 acres (14.6%) between 1990 and 2012. This total includes an initial decrease of approximately 60,000 acres between 1990 and 2003.
- **Agriculture remains the prevailing land cover.** Despite decreases in agricultural land and increases in upland grass land cover, agriculture remains the dominate land use in southeast Minnesota, comprising over 54% of the total landscape according to the 2006 National Land Cover Dataset.
- **Farmland and farm operations:** Land defined as “ag land,” “crop land,” and pasture only” decreased between 1997 and 2007, but overall acres operated as part of a farm (including land not in production) remained relatively consistent with slight increase.
- **Development continues to rise.** Developed acres increase by over 230% between 1992 and 2006 (approximately 111,000 acres to just over 367,000).
- **Forested acres are greatest in Houston County and least in and Freeborn County.** According to USFS FIA estimates, Houston County contains 21.6% of the Southeast Landscape’s approximately 724,000 forested acres, followed by Winona County with 20.8% and Fillmore County with 13.2%. Mower, Steele, and Freeborn counties contain a combined 10.8% of the forested acres in the Southeast Landscape.
- **Forest and Agriculture cover by Subsection:** Of the three most predominate Ecological Subsections in the region, the Blufflands contains the most forest/woody wetland cover (over 40%), and the least agriculture cover (18.5%) for the area within the Southeast Landscape. The Rochester Plateau/Southeast Landscape intersection contains

approximately 8.8% forest/woody wetland and 53.4% agriculture, and the Oak Savanna/Southeast Landscape intersection contains 3.5% forest/woody wetland cover and 78.1% agriculture.

**Goal 2: Land Ownership.** Forests within a region’s landscape will be in a variety of ownerships, serving both public and private interests.

Key Findings

- **Private ownership remains the vast majority ownership pattern.** Over 96% of total land cover and over 85% of timberland cover in the Southeast Landscape is in private ownership. Between 1990 and 2012, public timberland increased by 3,843 acres and private timberland increased by 75,088 acres. The ratio of publically- to privately-owned land remained relatively stable between 1990 and 2012, though there was a slight overall increase in the amount of private to public land.
- **Public Land ownership is minimal.** Most public land is scattered along the Mississippi River. Whitewater State Park comprises a large portion of this public land.
- **Most of the Richard J. Dorer Memorial Hardwood Forest is privately owned.** Nearly all of the Richard J. Dorer forest is within the MFRC Southeast Landscape; of the area within the Southeast Landscape, over 93% of the land is privately owned.
- **Total federally-owned timberland decreased between 1990 and 2012.** Inconsistent with the general trend of forest land in southeast Minnesota between 1990 and 2012, which according to FIA data experienced an overall increase for private, state and local, and total timberland acres, federally-owned timberland decreased by 15.8 – about 3,000 acres – during that time.
- **Forest Stewardship Plan coverage is limited in IFRAs.** Approximately 5% of the Important Forest Resource Areas (IFRAs) acreage identified by the MN DNR in the Southeast Landscape is currently covered by a Forest Stewardship Plan. This exceeds the state-wide coverage by approximately 0.8%.
- **Farm operation falls mainly to full or part owners.** The majority of farm operations are operated by full owners, but the majority of farm acreage is operated by part owners. Tenant landowners make up less than 1/10 of the operation/acreage control in the region.

**Goal 3: Healthy Forests.** Within forested landscapes, healthy, resilient, and functioning ecosystems will be maintained within appropriate mixes of forest cover types and age classes to promote timber production, biological diversity, and viable forest-dependent fish and wildlife habitats.

Key Findings

- **Areas of highest biodiversity significance appear to be concentrated along riparian areas in the eastern half of the region.** (See Figure 11)
- **Biodiversity significance is high in the region overall.** One-third of the area surveyed in the Southeast Landscape by the Minnesota Biological Survey was classified as having “High” or “Outstanding” biodiversity significance, which amounts to 3.3% of the total land in the region. It is possible that more sites of biodiversity significance exist within un-surveyed areas.



- **Tree species abundance has changed since pre-settlement.** Based on an analysis completed by John Almendinger that compared 1990 FIA data and Marschner’s pre-settlement data from the Public Land Survey, between the late 1800’s and 1990 disturbance-loving species such as box-elder (*Acer negundo*) and eastern redcedar (*Juniperus virginiana*) increased greatly in population, while a variety of oak species, such as Black oak (*Quercus nigra*), bur oak (*Quercus macrocarpa*), and jack oak (northern pin oak - *Quercus ellipsoidalis*) declined in numbers.
- **Large-diameter oak/hickory forests comprised the most timberland acreage over time.** Oak/hickory forest made up over half of the timberland in the Southeast Landscape between 1990 and 2012, and a large component of this was large-diameter trees.
- **There are nearly 900 million cubic feet of growing stock timber in the Southeast Landscape.** The greatest amount of growth and mortality was among “other eastern soft hardwoods.” The greatest amount of removal was for cottonwood and aspen.
- **There are over 3.1 billion board feet of sawtimber (International ¼-inch rule) in the Southeast Landscape.** “Select red oaks” had the greatest net volume, but other eastern soft hardwoods experienced the greatest net growth.
- **Over half of Minnesota’s plant species are found in the Southeast Landscape.** The region contains 1,376 of Minnesota’s 2,250 species of plants. 1179 of these plants are native, 193 are introduced, four have unknown status; 75 of these plant species are found nowhere else in the state, and 11 are found nowhere else in the state beyond Houston County.
- **The Southeast Landscape contains significant vertebrate diversity.** At least 21 species of small (or incidental) mammals, 44 species of amphibians and reptiles, and 156 species of breeding birds are found in the region.
- **The Southeast Landscape contains 4 endangered, 5 threatened, and 27 special concern vertebrate species (excluding fish).** Over half of the forest-associated species of endangered, threatened, and special concerns species in the state are found in this region.
- **The Blufflands Subsection contains the greatest number of Species of Greatest Conservation Need (SGCN) in the region.** The Blufflands contains 156 SGCN, the Rochester Plateau contains 94 SGCN, and the Oak Savanna contains 93 SGCN.
- **Terrestrial invasive species are commonly observed.** The most frequently observed invasive terrestrial species on public land in the Southeast Landscape include reed canary grass, wild parsnip, and common buckthorn. Observations may differ on private land.
- **Emerald ash borer is present in Southeast Minnesota.** Quarantines have been placed on Houston and Winona Counties; risk of spread is highest to lumber vending and processing sites such as firewood dealers and sawmills, and to human-frequented areas such as campgrounds and urban areas.
- **Over half of the counties in the region have evidence of gypsy moth invasion.** Eight of 13 counties in the region had evidence of gypsy moth invasion in 2013. Moth numbers increased dramatically in 2008 for reasons that are unclear in this dataset, then decreased again in subsequent years, possibly due in part to a treatment implemented in 2009.
- **Aquatic invasive species are present in major waterways.** The Mississippi and Zumbro rivers and lakes along the Cannon River have been designated as infested waters by the Minnesota Department of Natural Resources.

- **Watershed health scores decrease in a westwardly directly across the region.** There are over 42,000 acres of contaminated lakes and 1500 miles of contaminated streams in the Southeast Landscape.
- **The Southeast Landscape remains an important area for trout stream protection.** In southeast Minnesota, there are over 800 miles of designated trout streams and over 1000 miles of protected tributaries to trout streams located in Goodhue, Wabasha, Winona, Houston, and Fillmore Counties, and a small part of Olmstead County.
- **Many water pollutants show no trend or decreasing trend over time, except nitrate/nitrite pollutants.** All contaminants monitored by the MPCA have decreased or remained stable in the region over time, except for nitrites/nitrates, which have increased over time in the majority of test sites.
- **Karst geology in the region facilitates the movement of nitrogen pollution.** The karstic nature of the region's limestone facilitates rapid underground movement of nitrite/nitrate-enriched groundwater. Extensive cover of thick sediment (>50 feet) is needed to ensure resistance to nitrite/nitrate contamination of groundwater, as even patchy areas of thinner cover can allow infiltration of contaminants into underground water sources.
- **Row cropping and nitrogen pollution are correlated.** The MPCA has found a strongly correlated positive relationship between percentage of corn/soy in an area and concentration of nitrates in trout streams.
- **Increased groundwater consumption and agricultural tiling seem to be leading to decreased groundwater base flow, increased runoff and stream flow.** Despite steady precipitation rates since 1990, base flow of rivers (the component of flow based primarily on groundwater discharge rather than precipitation and runoff) has declined with the increase of groundwater and surface water consumption and agricultural tiling; groundwater consumption has nearly doubled since 1990. However, annual stream flow as a result of runoff seems to be increasing in the agricultural areas of southern Minnesota, due primarily to land use changes.

**Goal 4: Economic and Social Values.** Forests within a region's landscape will be providing a full range of products, services, and values, including timber products, wildlife and tourism that are major contributors to economic stability, environmental quality, social satisfaction, and community well-being.

#### **Key Findings**

- **The Southeast Landscape contains 5 active silica sand mines, 4 proposed mine sites, and 5 prospective mine sites.** Six proposed or prospective mine sites occur in southwest Winona County, an area where currently no active silica sand mines exist.
- **Nearly 12 million vehicles travel approximately 22.5 million miles along 7800 miles of roads in the Southeast Landscape daily.** Approximately 1 in 25 vehicles are considered "heavy commercial" and make up 8.8% of daily vehicle miles travelled in the region.
- **The Southeast Landscape contains a variety of diverse, multi-purpose trails.** Snowmobile trails are the most popular trail-type in the Southeast Landscape, following by hiking. ATV trails are less common in the southeast than the rest of the state.

- **In 2013 there were 323 forest-related payroll jobs in the Southeast Landscape.** Over the last decade, forest-related payroll jobs have ranged from 271 (2010) to 604 (2005).
- **Minnesota had over 40,000 jobs** and \$9.7 billion in direct economic impact related to forestry, logging, and primary and secondary forest products manufacturing in 2008.
- **8,425 cord equivalents of timber were harvested in the Southeast Landscape in 2011.** Comparatively, in 2009 over 21,000 cord equivalents were processed in the region, suggesting that the region imports timber from other areas for processing.
- **There were at least 26 saw mills in the Southeast Landscape in 2007.**
- **In 2010, Minnesota ranked 8<sup>th</sup> among the 50 states in terms of gross state product per capita for combined pulp and paper and wood products.**
- **In 2012, the state had nearly 1500 forest industry-related facilities** including four pulp and paper mills.
- **Farmland, tillable land, and timberland prices have increased dramatically in the last two decades.** Farmland price per acre has increased 10-fold in Houston county in the last 20 years, and 4.5 to 9 fold in all other counties in the region during that time period. Tillable land increased 4.5 to 7.5 fold across the region during the 20-year period, with Fillmore County seeing the largest percent increase. Timberland was not documented in all counties over the 20-year period, but increased approximately 12 to 14 fold for the counties of Fillmore, Wabasha, and Houston during that time, and only 4 to 5 fold in Goodhue and Winona Counties. Farmland and Tillable land was highest in Mower County in 2013 and Timberland was highest in Olmsted County in 2013.
- **There are five active dimension stone or silica sand mines in the Southeast Landscape,** and many crushed stone and sand/gravel quarries throughout the region.
- **As of 2013, no new “frac sand” mines are proposed for the region,** though many small silica sand mines for agricultural bedding exist throughout the region.
- **Citizens of southern Minnesota prefer walking/hiking, boating, and swimming as** their top three outdoor activities.
- **Leisure and Hospitality is a nearly \$1 billion industry** in the 13-county Southeast Landscape, providing over 20,000 jobs.
- **Whitewater State Park is an important Minnesota tourist destination.** In 2010, Whitewater state park was the most popular tourist attraction (of facilities reporting to Explore Minnesota) in the 38-county South Region of Minnesota with over 250,000 visitors that year.
- **Survey results indicate that trout angling in Southeast Minnesota was most popular among locals and Twin Cities residents.** In 2005, trout anglers in southeast Minnesota caught over 214,000 trout in nearly 191,000 angling-hours. Over 90% of anglers interviewed were from Minnesota. Over 50% of interviewees were from the 11-county southeast study area, while over 30% were from the Twin Cities metro.
- **Trout angling has economic impact in the Driftless Area.** Resident trout anglers of southeast Minnesota may spend over \$200 per outing, while non-resident anglers may spend nearly double that amount per outing, according to 2008 estimates.
- **Population model estimates indicates relatively stable deer populations in the region between 2008 and 2013,** having decreased somewhat in designated permit areas that had the highest deer densities in 2008. Deer harvest numbers have dropped slightly since 2003, potentially due to changes in hunting regulations.

- **Landowner perceptions of deer population and impacts** - A 2013 survey of 2,312 landowners (with 40 acres or more) in Goodhue, Wabasha, Houston, and Winona counties indicated that the largest percentage of both hunting and non-hunting landowners felt that deer populations were “about right” around their property; however, landowners who do not hunt were more likely to report that numbers were “too high” than those who do hunt (45% of non-hunters compared to 23% of hunters). Respondents estimated a total of \$3.5 million worth of damage to crops (in large part, corn) in 2011 due to deer.
- **Based on car counts, deer hunting pressure in the Whitewater Wildlife Management Area has decreased steadily** over the last 3 decades for the opening day of the second season, but remained relatively steady for the opening day of the first season, and increasing in 2010 and 2011 for this day.



## Goal 1 – Forest Land Cover

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**MFRC Goal 1: Land area covered by forests within a region's landscape will be the same or larger.**

The MFRC Southeast Landscape Region contains the counties of Dodge, Fillmore, Freeborn, Goodhue, Houston, Le Sueur, Mower, Olmsted, Rice, Steele, Wabasha, Waseca, and Winona. These thirteen counties cover 4,885,507 acres, of which 724,139 acres (14.8%) are forested. The data in this section shows the extent of forestlands across the region at present and in recent decades.

### 1.1 – Land Cover Data Sources

Pre-settlement Vegetation of Minnesota: is based on Francis J. Marschner's original analysis done in the 1930's of 19th century of Public Land Survey notes. Marschner compiled his results in map format which has been subsequently captured in digital format.

1990 Census Land Use and Cover: integrates six different source data sets to provide a simplified 8-category view of Minnesota's land use / cover in 30 meter grid cells.

1992 GAP Analysis Project: created land cover datasets as part of its mission to identify habitats that need further protection. This dataset is based on similar satellite imagery to the National Land Cover Database, however it provides a more detailed classification system than the NLCD and places special emphasis on natural plant communities.

2001 and 2006 National Land Cover Database (NLCD): is a 16-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters. NLCD is based primarily on Landsat satellite data and a variety of supporting information.

Forest Inventory Analysis (FIA): is the systematic collection of data and forest information by the U.S. Forest Service for assessment or analysis to assess America's forests. This continuous forest census reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. This data is not meant to be represented spatially.

## **1.2 – Spatial Forestland Cover Analysis (Pre-settlement, GAP, and NLCD)**

Between pre-settlement times and 2006, this region has lost over 330,000 acres – or approximately one third – of its Upland Forest land cover (Table 1). However, it should be noted that the loss by 1992 had been much greater – nearly 600,000 acres of forestland. Thus, southeast Minnesota saw a recovery of over 200,000 acres of Upland Forest land cover between 1992 and 2006. This time period was also marked by a decrease in agricultural land and an increase in Upland Grass, with decreases in Upland Shrub and increases in developed land. The figures and tables below provide detail on quantity and location of all land cover types in 1895 (Table 2, Figure 1), 1992 (Table 3, Figure 2), 2001 (Table 4, Figure 3), and 2006 (Table 5, Figure 4).

It should be noted that the land cover classifications discussed above are novel comparative classes meant to provide a common metric across the four different datasets presented below (Marschner’s pre-settlement data, GAP Land Cover, and NLCD 2001 and 2006); this reclassification was done to better demonstrate change over time. Each map has an accompanying cross-walk table to demonstrate how the datasets’ original land cover classifications compare to the reclassifications.

**Table 1:** Land cover change in the Southeast Landscape, Pre-settlement to 2006.

Comparative Class	Marschner's Pre-settlement (1895)					GAP Land Cover (1992)			
	Area (Acres)	% of Total	NA	NA		Area (Acres)	% of Total	Change 1895 to 1992 (Acres)	Change 1895 to 1992 (% Cover)
Upland Forest	1,054,837	21.2	-	-		469,866	9.4	-584,971	-11.7
Upland Shrub	224,998	4.5	-	-		33,003	0.7	-191,995	-3.9
Upland Grass	3,228,472	64.8	-	-		834,838	16.8	-2,393,634	-48.1
Lowland Vegetation	390,224	7.8	-	-		147,744	3.0	-242,480	-4.9
Agriculture	0	0.0	-	-		3,291,895	66.1	3,291,895	66.1
Open Water	56,754	1.1	-	-		91,037	1.8	34,283	0.7
Barren	0	0.0	-	-		121	0.0	121	0.0
Developed	0	0.0	-	-		110,896	2.2	110,896	2.2
Unclassified	24,144	0.5	-	-		29	0.0	-24,114	-0.5
Comparative Class	NLCD (2001)					NLCD (2006)			
	Area (Acres)	% of Total	Change 1992 to 2001 (Acres)	Change 1992 to 2001 (% Cover)		Area (Acres)	% of Total	Change 2001 to 2006 (Acres)	Change 2001 to 2006 (% Cover)
Upland Forest	673,365	13.5	203,499	4.1		672,341	13.5	-1,024	0.0
Upland Shrub	10,759	0.2	-22,244	-0.4		11,327	0.2	568	0.0
Upland Grass	1,003,655	20.2	168,817	3.4		998,160	20.0	-5,495	-0.1
Lowland Vegetation	115,586	2.3	-32,158	-0.6		118,124	2.4	2,538	0.1
Agriculture	2,709,445	54.4	-582,450	-11.7		2,704,690	54.3	-4,755	-0.1
Open Water	104,064	2.1	13,027	0.3		104,309	2.1	245	0.0
Barren	3,214	0.1	3,094	0.1		3,412	0.1	198	0.0
Developed	359,339	7.2	248,443	5.0		367,064	7.4	7,725	0.2
Unclassified	0	0.0	-29	0.0		0	0.0	0	0.0
<b>Total Southeast Region</b>	<b>4,979,428</b>	<b>100.0</b>				<b>4,979,428</b>	<b>100.0</b>		

Sources: MN DNR Data Deli, Multi-Resolution Land Characteristics Consortium, adapted by Jeff Reinhart (2013).

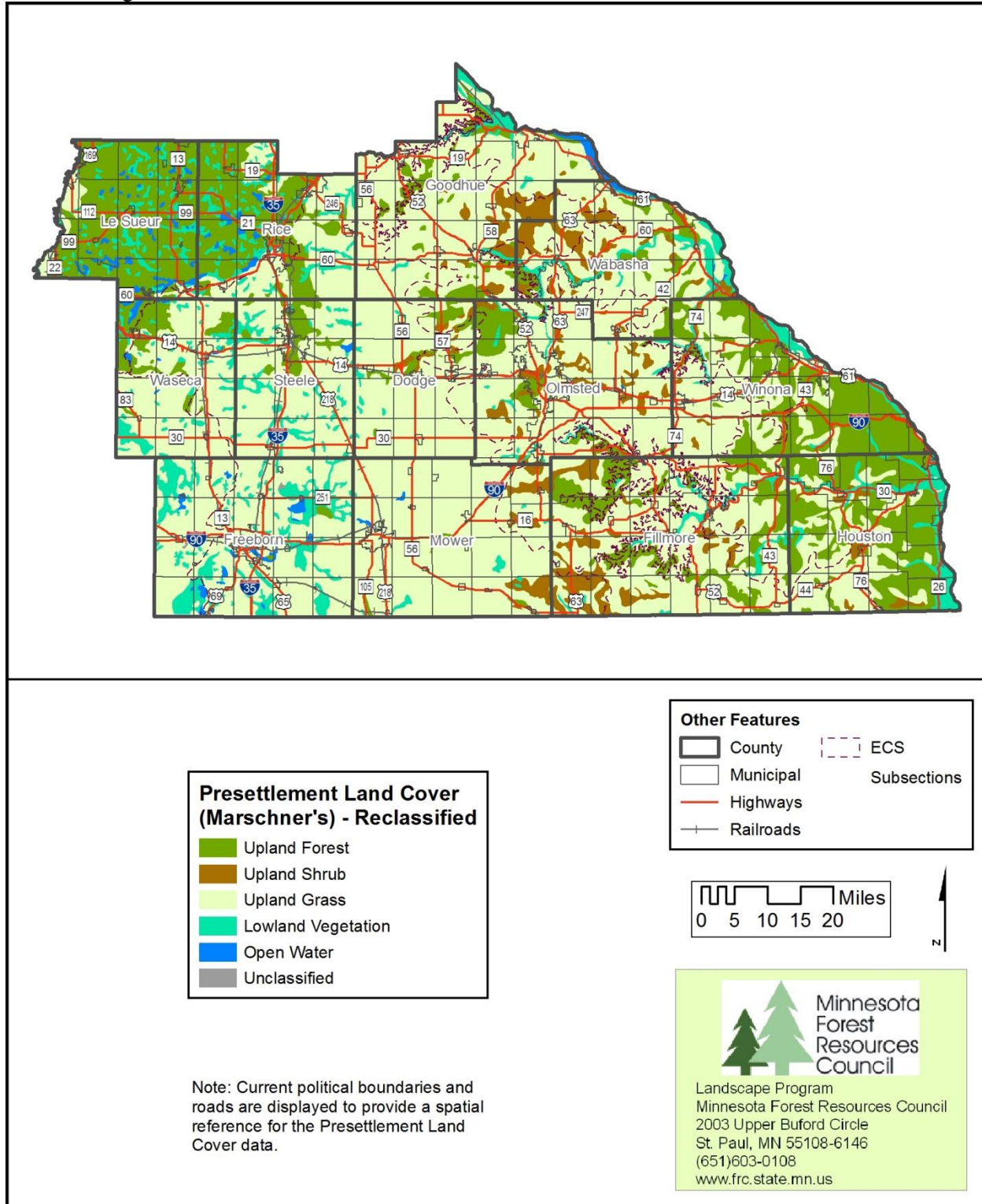
**Table 2:** Comparative classes of vegetation vs. original Marschner classifications.

Comparative Class	Presettlement Land Cover (Marschner's)	Area (Acres)
Upland Forest	Aspen-Oak Land	157,930
	Big Woods - Hardwoods (oak, maple, basswood, hickory)	896,907
<b>Subtotal (Upland Forest)</b>		<b>1,054,837</b>
Upland Shrub	Brush Prairie	224,998
<b>Subtotal (Upland Shrub)</b>		<b>224,998</b>
Upland Grass	Oak openings and barrens	1,620,956
	Prairie	1,607,516
<b>Subtotal (Upland Grass)</b>		<b>3,228,472</b>
Lowland Vegetation	River Bottom Forest	129,542
	Wet Prairie	260,682
<b>Subtotal (Lowland Vegetation)</b>		<b>390,224</b>
Open Water	Lakes (open water)	56,754
<b>Subtotal (Open Water)</b>		<b>56,754</b>
Unclassified	Undefined	24,144
<b>Subtotal (Unclassified)</b>		<b>24,144</b>
<b>Total Southeast Region</b>		<b>4,979,428</b>

**Source:** Minnesota DNR Data Deli, adapted by Jeff Reinhart (2013).



**Figure 1:** Pre-settlement land cover in the Southeast Landscape from Marschner's Map, 1895.  
[Note: Categories reclassified, see Table 2]



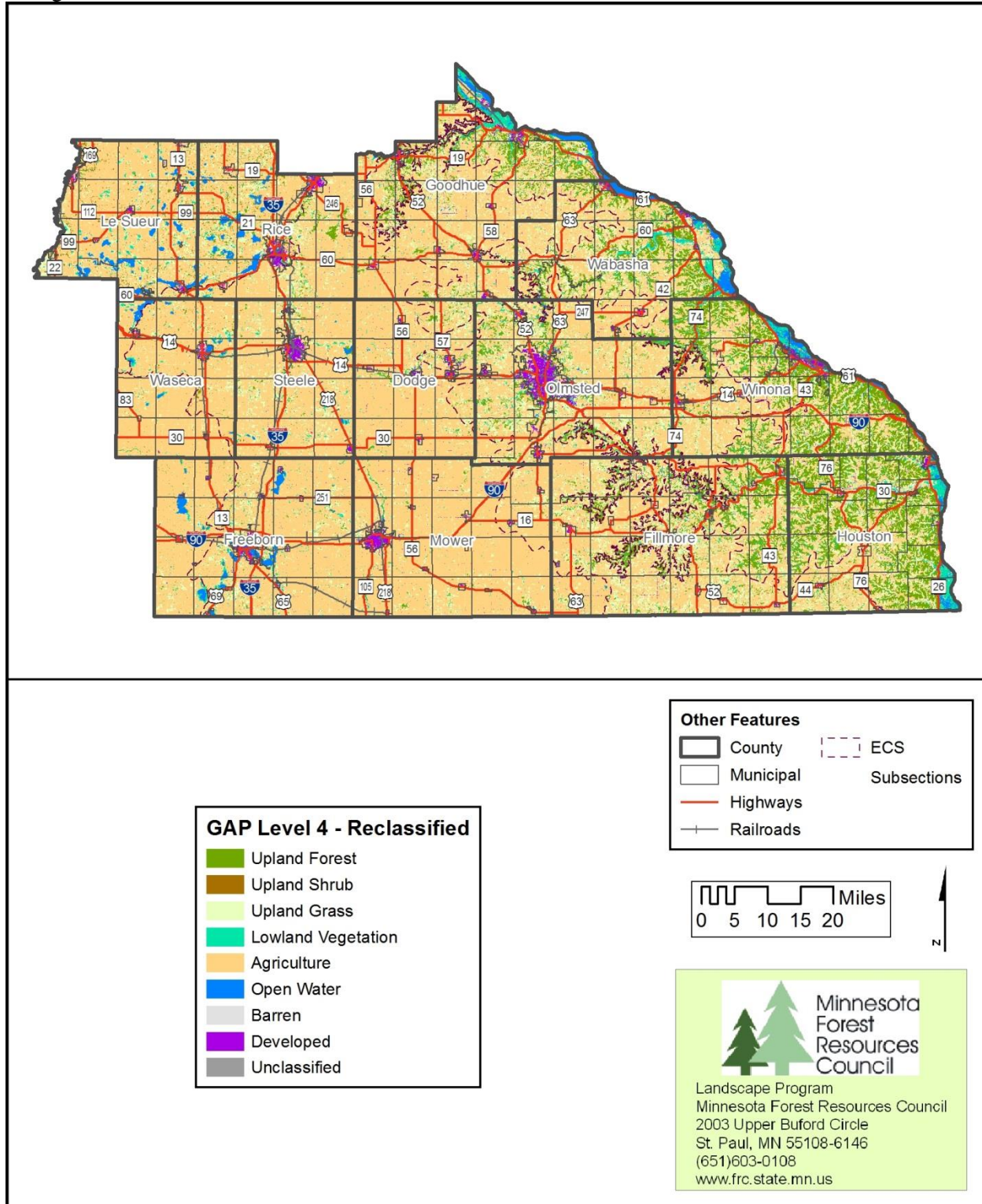
**Source:** Minnesota DNR Data Deli, adapted by Jeff Reinhart (2013).

**Table 3:** Comparative classes of vegetation vs. original 1992 GAP classifications.

Comparative Class	GAP Level 4	Area (Acres)
Upland Forest	Aspen/White Birch	202
	Bur/White Oak	41,428
	Maple/Basswood	17,410
	Red Oak	288,369
	Red Pine	2,399
	Red/White Pine	486
	Red/White Pine-Deciduous mix	1,136
	Redcedar	1,529
	Redcedar-Deciduous mix	5,311
	Upland Deciduous	13,504
	White Pine mix	785
	White/Red Oak	97,308
<b>Subtotal (Upland Forest)</b>		<b>469,866</b>
Upland Shrub	Upland Shrub	33,003
<b>Subtotal (Upland Shrub)</b>		<b>33,003</b>
Upland Grass	Grassland	834,838
<b>Subtotal (Upland Grass)</b>		<b>834,838</b>
Lowland Vegetation	Broadleaf Sedge/Cattail	23,353
	Cottonwood	1,342
	Floating Aquatic	1,024
	Lowland Deciduous	62,272
	Lowland Deciduous Shrub	25,525
	Sedge Meadow	11,145
	Silver Maple	23,074
<b>Subtotal (Lowland Vegetation)</b>		<b>147,744</b>
Agriculture	Cropland	3,291,895
<b>Subtotal (Agriculture)</b>		<b>3,291,895</b>
Open Water	Water	91,037
<b>Subtotal (Open Water)</b>		<b>91,037</b>
Barren	Barren	121
<b>Subtotal (Barren)</b>		<b>121</b>
Developed	Low intensity urban	56,845
	Transportation	28,932
	High intensity urban	25,118
<b>Subtotal (Developed)</b>		<b>110,896</b>
Unclassified	Unidentified	29
<b>Subtotal (Unclassified)</b>		<b>29</b>
<b>Total Southeast Region</b>		<b>4,979,428</b>

Source: Minnesota DNR Data Deli, adapted by Jeff Reinhart (2013).

**Figure 2:** Land use and cover for the Southeast Landscape, 1992 GAP analysis. [Note: Categories reclassified, see Table 3]



**Source:** Minnesota DNR Data Deli, adapted by Jeff Reinhart (2013).

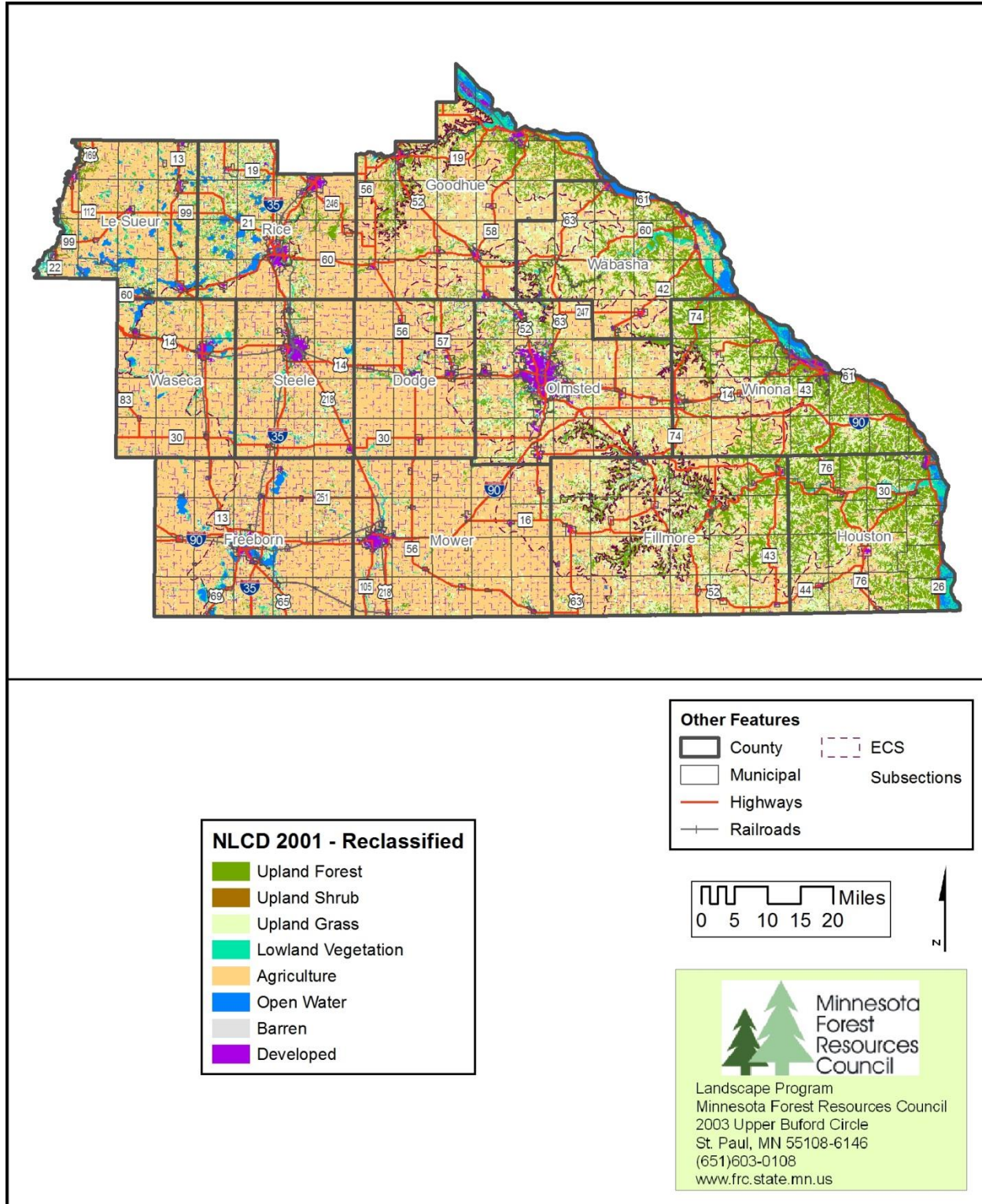
**Table 4:** Comparative classes of vegetation vs. original 2001 NLCD classifications.

Comparative Class	National Land Cover Dataset 2001		Area (Acres)
Upland Forest		Deciduous Forest	662,880
		Evergreen Forest	9,868
		Mixed Forest	616
<b>Subtotal (Upland Forest)</b>			<b>673,365</b>
Upland Shrub		Shrub/Scrub	10,759
<b>Subtotal (Upland Shrub)</b>			<b>10,759</b>
Upland Grass		Grassland/Herbaceous	400,996
		Pasture/Hay	602,659
<b>Subtotal (Upland Grass)</b>			<b>1,003,655</b>
Lowland Vegetation		Woody Wetlands	55,792
		Emergent Herbaceous Wetlands	59,795
<b>Subtotal (Lowland Vegetation)</b>			<b>115,586</b>
Agriculture		Cultivated Crops	2,709,445
<b>Subtotal (Agriculture)</b>			<b>2,709,445</b>
Open Water		Open Water	104,064
<b>Subtotal (Open Water)</b>			<b>104,064</b>
Barren		Barren Land (Rock/Sand/Clay)	3,214
<b>Subtotal (Barren)</b>			<b>3,214</b>
Developed		Developed, Open Space	246,238
		Developed, Low Intensity	88,100
		Developed, Medium Intensity	18,751
		Developed, High Intensity	6,250
<b>Subtotal (Developed)</b>			<b>359,339</b>
<b>Total Southeast Region</b>			<b>4,979,428</b>

Source: Multi-Resolution Land Characteristics Consortium, adapted by Jeff Reinhart (2013).



**Figure 3:** Southeast landscape land Cover, NLCD 2001. [Note: Categories have been reclassified, see Table 4.]



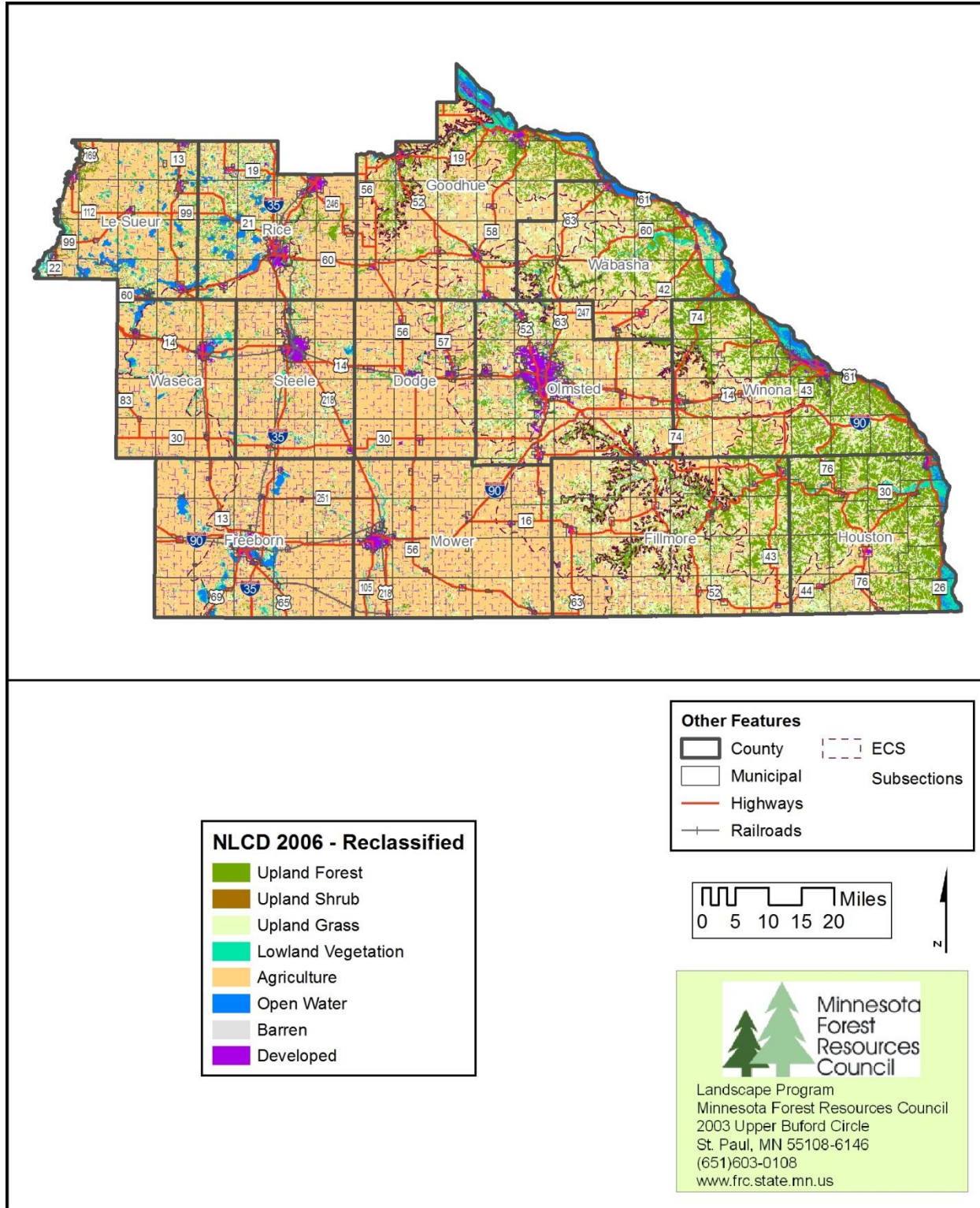
**Source:** Multi-Resolution Land Characteristics Consortium, adapted by Jeff Reinhart (2013).

**Table 5:** Comparative classes of vegetation vs. original 2006 NLCD classifications.

Comparative Class	National Land Cover Dataset 2006		Area (Acres)
Upland Forest		Deciduous Forest	661,882
		Evergreen Forest	9,829
		Mixed Forest	630
<b>Subtotal (Upland Forest)</b>			<b>672,341</b>
Upland Shrub		Shrub/Scrub	11,327
<b>Subtotal (Upland Shrub)</b>			<b>11,327</b>
Upland Grass		Grassland/Herbaceous	397,202
		Pasture/Hay	600,958
<b>Subtotal (Upland Grass)</b>			<b>998,160</b>
Lowland Vegetation		Woody Wetlands	56,702
		Emergent Herbaceous Wetlands	61,422
<b>Subtotal (Lowland Vegetation)</b>			<b>118,124</b>
Agriculture		Cultivated Crops	2,704,690
<b>Subtotal (Agriculture)</b>			<b>2,704,690</b>
Open Water		Open Water	104,309
<b>Subtotal (Open Water)</b>			<b>104,309</b>
Barren		Barren Land (Rock/Sand/Clay)	3,412
<b>Subtotal (Barren)</b>			<b>3,412</b>
Developed		Developed, Open Space	248,553
		Developed, Low Intensity	90,652
		Developed, Medium Intensity	21,086
		Developed, High Intensity	6,773
<b>Subtotal (Developed)</b>			<b>367,064</b>
<b>Total Southeast Region</b>			<b>4,979,428</b>

Source: Multi-Resolution Land Characteristics Consortium, adapted by Jeff Reinhart (2013).

**Figure 4:** Southeast landscape land Cover, NLCD 2006. [Note: Categories have been reclassified, see Table 5]



**Source:** Multi-Resolution Land Characteristics Consortium, adapted by Jeff Reinhart (2013).

### 1.3 – The Extent of Forestland in Recent Decades

#### Section 1.3.1: Land use in the Southeast Landscape

According to United States Forest Service (USFS) Forest Inventory and Analysis (FIA) estimates, between 1990 and 2012, the MFRC Southeast Landscape increased its forested acreage by over 90,000 acres overall, despite a decrease of approximately 60,000 acres between 1990 and 2003 (Table 6). As of 2012, there were approximately 17 acres of forested land to every 100 acres of non-forested land in the region; nearly 15% of total terrestrial acreage in the region is forested.

According to USFS FIA estimates from 2008-2012, Houston County contains 21.6% of the Southeast Landscape’s approximately 724,000 forested acres, followed by Winona County with 20.8% and Fillmore County with 13.2% (Table 7). Mower, Steele, and Freeborn counties are the three least-forested counties, containing a combined 10.8% of the forested acres in the Southeast Landscape.

The Southeast Landscape saw a decrease in acreage defined as “ag land,” “crop land,” and pasture only” land by the USDA National Agricultural Statistics Service (NASS) between 1997 and 2007, according to census information (Table 8). This type of acreage decreased by about 43%, falling from over 156,500 acres to less than 90,000 over the decade. However, total acreage operated as part of a “farm operation” (including, woodland, wasteland, house lot, etc.) remained relatively stable during this time, and actually increasing slightly (Table 9).

**Table 6:** Estimated extent of forestland in the Southeast Landscape, 1990-2012.

Land Use	1990 area	2003 area	2012 area
Forestland <sup>A</sup>	631,806	571,785	724,139
Non-forestland <sup>B</sup>	4,274,462	4,270,964	4,161,368
<i>Total</i>	<i>4,906,268</i>	<i>4,842,749</i>	<i>4,885,507</i>
Ratio of forestland to non-forestland:	15/100	13/100	17/100

**Source:** Forest Inventory and Analysis estimate.

<sup>A</sup> FIA defines forestland as: Land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and not currently developed for a non-forest use. The minimum area for classification as forest land is one acre. Roadside, stream-side, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas are classified as forest, if less than 120 feet in width or one acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied. Forest land includes three sub-categories: timberland, reserved forestland, and other forestland.

<sup>B</sup> All terrestrial acres not designated as forestland.

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

**Table 7:** Estimated acres of forestland<sup>a</sup> per county in the MFRC Southeast Landscape, in order from greatest to least (in total acres) in 2012.



County	Forestland (in acres)
Houston	156,643
Winona	150,358
Fillmore	95,869
Wabasha	88,513
Goodhue	73,883
Olmsted	52,744
Rice	40,470
Le Sueur	21,791
Dodge	15,869
Waseca	10,008
Mower	7,231
Steele	6,492
Freeborn	4,267

**Source:** Forest Inventory and Analysis estimate, 2012.

<sup>a</sup>FIA defines forestland as: Land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and not currently developed for a non-forest use. The minimum area for classification as forest land is one acre. Roadside, stream-side, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas are classified as forest, if less than 120 feet in width or one acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied. Forest land includes three sub-categories: timberland, reserved forestland, and other forestland.

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 8: Number of acres of land defined as “ag land,” “crop land”, and “pastured only” land in the Southeast Landscape; 1997, 2002, 2007.

County	2007	2002	1997
FREEBORN	9,150	4,343	3,722
LE SUEUR	3,895	2,925	4,249
RICE	7,850	5,662	7,609
STEELE	3,454	4,401	3,245
WASECA	2,156	1,185	2,350
DODGE	4,757	4,535	5,601
FILLMORE	13,677	18,340	26,430
GOODHUE	8,501	12,827	19,719
HOUSTON	8,343	12,369	22,561
MOWER	5,015	3,904	6,818
OLMSTED	7,196	12,535	18,954

WABASHA	7,714	14,188	17,105
WINONA	8,194	13,418	18,210
Total SE Landscape:	89,902	110,632	156,573

**Source:** USDA National Agricultural Statistics Service Quick Stats. Accessed Feb. 13, 2014. Available at: <http://quickstats.nass.usda.gov/>

Table 9: Total acres operated as part of a farm operation in the Southeast Landscape; 1997, 2002, 2007.

	2007	2002	1997
FREEBORN	388,488	394,408	376,923
LE SUEUR	250,696	238,076	217,338
RICE	253,094	248,818	256,572
STEELE	266,199	281,847	235,872
WASECA	254,531	231,328	243,634
DODGE	248,125	233,375	253,543
FILLMORE	446,331	441,153	432,804
GOODHUE	396,743	384,108	396,367
HOUSTON	244,404	253,600	301,114
MOWER	419,889	412,145	407,685
OLMSTED	296,039	313,020	303,388
WABASHA	262,263	267,058	256,970
WINONA	305,560	310,976	299,386
Total SE Landscape	4,032,362	4,009,912	3,981,596

**Source:** USDA National Agricultural Statistics Service Quick Stats. Accessed Feb. 13, 2014. Available at: <http://quickstats.nass.usda.gov/>

### *Section 1.3.2: Land use by Subsection*

Upland Forest and Woody Wetlands make up over 40% or over 500,000 acres of land in the intersection between the Southeast Landscape and the Blufflands Subsection (Table 10). This is significantly more forested land than is present in the intersection between the Southeast Landscape and the other two predominating Subsections within the Landscape – the Rochester Plateau (8.8%, about 115, 000 acres) (Table 11) and the Oak Savanna (3.5%, over 56,000 acres) (Table 12). Agriculture predominates in these latter two subsections at 53.4% cover in the Rochester Plateau/Southeast Landscape intersection and 78.1% in the Oak Savanna intersection, while comprising only 18.5% of land cover in the Blufflands/Southeast Landscape intersection. Upland Forest/Woody Wetland cover in the less dominate subsections is somewhat minimal, including 8.8% cover in the Big Woods intersection and 1.3% in the Minnesota River Prairie (Table 13). However, the acreage of forested/woody wetland land in the small Big Woods (Table 14) intersection with the Southeast Landscape is comparable to that in the total Oak Savanna intersection, where forests are much more spread out. This suggests a greater concentration of forests in the northwest corner of the region than in the rest of the western portion of the region.

Table 10: Land classification in the Blufflands Subsection

Comparative Class	National Land Cover Dataset 2006	Area (Acres)	% of Total
Upland Forest	Deciduous Forest	470,269	36.8
	Evergreen Forest	7,419	0.6
	Mixed Forest	456	0.0
<b>Subtotal (Upland Forest)</b>		<b>478,144</b>	<b>37.4</b>
Upland Shrub	Shrub/Scrub	776	0.1
<b>Subtotal (Upland Shrub)</b>		<b>776</b>	<b>0.1</b>
Upland Grass	Grassland/Herbaceous	124,299	9.7
	Pasture/Hay	265,035	20.7
<b>Subtotal (Upland Grass)</b>		<b>389,334</b>	<b>30.5</b>
Lowland Vegetation	Woody Wetlands	31,737	2.5
	Emergent Herbaceous Wetlands	19,275	1.5
<b>Subtotal (Lowland Vegetation)</b>		<b>51,012</b>	<b>4.0</b>
Agriculture	Cultivated Crops	236,481	18.5
<b>Subtotal (Agriculture)</b>		<b>236,481</b>	<b>18.5</b>
Open Water	Open Water	52,464	4.1
<b>Subtotal (Open Water)</b>		<b>52,464</b>	<b>4.1</b>
Barren	Barren Land (Rock/Sand/Clay)	718	0.1
<b>Subtotal (Barren)</b>		<b>718</b>	<b>0.1</b>
Developed	Developed, Open Space	45,186	3.5
	Developed, Low Intensity	18,311	1.4
	Developed, Medium Intensity	4,716	0.4
	Developed, High Intensity	1,385	0.1
<b>Subtotal (Developed)</b>		<b>69,598</b>	<b>5.4</b>
<b>Total The Blufflands in Southeast Region</b>		<b>1,278,527</b>	<b>100.0</b>

Table 11: Land classification in the Rochester Plateau Subsection

Comparative Class	National Land Cover Dataset 2006	Area (Acres)	% of Total
Upland Forest	Deciduous Forest	108,091	8.3
	Evergreen Forest	1,304	0.1
	Mixed Forest	29	0.0
<b>Subtotal (Upland Forest)</b>		<b>109,424</b>	<b>8.4</b>
Upland Shrub	Shrub/Scrub	108	0.0
<b>Subtotal (Upland Shrub)</b>		<b>108</b>	<b>0.0</b>
Upland Grass	Grassland/Herbaceous	174,354	13.4
	Pasture/Hay	208,502	16.1
<b>Subtotal (Upland Grass)</b>		<b>382,856</b>	<b>29.5</b>
Lowland	Woody Wetlands	5,513	0.4

Vegetation	Emergent Herbaceous Wetlands	1,380	0.1
<b>Subtotal (Lowland Vegetation)</b>		<b>6,893</b>	<b>0.5</b>
Agriculture	Cultivated Crops	693,516	53.4
<b>Subtotal (Agriculture)</b>		<b>693,516</b>	<b>53.4</b>
Open Water	Open Water	1,646	0.1
<b>Subtotal (Open Water)</b>		<b>1,646</b>	<b>0.1</b>
Barren	Barren Land (Rock/Sand/Clay)	697	0.1
<b>Subtotal (Barren)</b>		<b>697</b>	<b>0.1</b>
Developed	Developed, Open Space	61,560	4.7
	Developed, Low Intensity	32,907	2.5
	Developed, Medium Intensity	7,016	0.5
	Developed, High Intensity	2,317	0.2
<b>Subtotal (Developed)</b>		<b>103,800</b>	<b>8.0</b>
<b>Total Rochester Plateau in Southeast Region</b>		<b>1,298,940</b>	<b>100.0</b>

Table 12: Land classification in the Oak Savanna Subsection

Comparative Class	National Land Cover Dataset 2006	Area (Acres)	% of Total
Upland Forest	Deciduous Forest	40,409	2.5
	Evergreen Forest	336	0.0
	Mixed Forest	14	0.0
<b>Subtotal (Upland Forest)</b>		<b>40,760</b>	<b>2.5</b>
Upland Shrub	Shrub/Scrub	916	0.1
<b>Subtotal (Upland Shrub)</b>		<b>916</b>	<b>0.1</b>
Upland Grass	Grassland/Herbaceous	85,883	5.2
	Pasture/Hay	39,178	2.4
<b>Subtotal (Upland Grass)</b>		<b>125,061</b>	<b>7.6</b>
Lowland Vegetation	Woody Wetlands	15,650	1.0
	Emergent Herbaceous Wetlands	18,088	1.1
<b>Subtotal (Lowland Vegetation)</b>		<b>33,739</b>	<b>2.1</b>
Agriculture	Cultivated Crops	1,284,671	78.1
<b>Subtotal (Agriculture)</b>		<b>1,284,671</b>	<b>78.1</b>
Open Water	Open Water	15,332	0.9
<b>Subtotal (Open Water)</b>		<b>15,332</b>	<b>0.9</b>
Barren	Barren Land (Rock/Sand/Clay)	595	0.0
<b>Subtotal (Barren)</b>		<b>595</b>	<b>0.0</b>
Developed	Developed, Open Space	108,552	6.6
	Developed, Low Intensity	26,519	1.6
	Developed, Medium Intensity	6,709	0.4
	Developed, High Intensity	2,167	0.1
<b>Subtotal (Developed)</b>		<b>143,947</b>	<b>8.8</b>

<b>Total Oak Savanna in Southeast Region</b>	<b>1,645,020</b>	<b>100.0</b>
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Table 13: Land classification in the Minnesota River Prairie Subsection

<b>Comparative Class</b>	<b>National Land Cover Dataset 2006</b>	<b>Area (Acres)</b>	<b>% of Total</b>
Upland Forest	Deciduous Forest	1,863	0.7
	Evergreen Forest	8	0.0
	Mixed Forest	0	0.0
<b>Subtotal (Upland Forest)</b>		<b>1,870</b>	<b>0.7</b>
Upland Shrub	Shrub/Scrub	0	0.0
<b>Subtotal (Upland Shrub)</b>		<b>0</b>	<b>0.0</b>
Upland Grass	Grassland/Herbaceous	3,761	1.5
	Pasture/Hay	2,323	0.9
<b>Subtotal (Upland Grass)</b>		<b>6,084</b>	<b>2.4</b>
Lowland Vegetation	Woody Wetlands	1,459	0.6
	Emergent Herbaceous Wetlands	2,412	1.0
<b>Subtotal (Lowland Vegetation)</b>		<b>3,871</b>	<b>1.5</b>
Agriculture	Cultivated Crops	219,713	87.4
<b>Subtotal (Agriculture)</b>		<b>219,713</b>	<b>87.4</b>
Open Water	Open Water	4,110	1.6
<b>Subtotal (Open Water)</b>		<b>4,110</b>	<b>1.6</b>
Barren	Barren Land (Rock/Sand/Clay)	62	0.0
<b>Subtotal (Barren)</b>		<b>62</b>	<b>0.0</b>
Developed	Developed, Open Space	14,513	5.8
	Developed, Low Intensity	992	0.4
	Developed, Medium Intensity	218	0.1
	Developed, High Intensity	47	0.0
<b>Subtotal (Developed)</b>		<b>15,770</b>	<b>6.3</b>
<b>Total Minnesota River Prairie in Southeast Region</b>		<b>251,481</b>	<b>100.0</b>

Table 14: Land classification in the Big Woods Subsection

<b>Comparative Class</b>	<b>National Land Cover Dataset 2006</b>	<b>Area (Acres)</b>	<b>% of Total</b>
Upland Forest	Deciduous Forest	41,249	8.2
	Evergreen Forest	763	0.2
	Mixed Forest	131	0.0
<b>Subtotal (Upland Forest)</b>		<b>42,143</b>	<b>8.3</b>
Upland Shrub	Shrub/Scrub	9,527	1.9
<b>Subtotal (Upland Shrub)</b>		<b>9,527</b>	<b>1.9</b>
Upland Grass	Grassland/Herbaceous	8,906	1.8

	Pasture/Hay	85,919	17.0
<b>Subtotal (Upland Grass)</b>		<b>94,825</b>	<b>18.8</b>
Lowland Vegetation	Woody Wetlands	2,342	0.5
	Emergent Herbaceous Wetlands	20,267	4.0
<b>Subtotal (Lowland Vegetation)</b>		<b>22,609</b>	<b>4.5</b>
Agriculture	Cultivated Crops	270,309	53.5
<b>Subtotal (Agriculture)</b>		<b>270,309</b>	<b>53.5</b>
Open Water	Open Water	30,758	6.1
<b>Subtotal (Open Water)</b>		<b>30,758</b>	<b>6.1</b>
Barren	Barren Land (Rock/Sand/Clay)	1,340	0.3
<b>Subtotal (Barren)</b>		<b>1,340</b>	<b>0.3</b>
Developed	Developed, Open Space	18,743	3.7
	Developed, Low Intensity	11,923	2.4
	Developed, Medium Intensity	2,427	0.5
	Developed, High Intensity	856	0.2
<b>Subtotal (Developed)</b>		<b>33,949</b>	<b>6.7</b>
<b>Total Big Woods in Southeast Region</b>		<b>505,461</b>	<b>100.0</b>



## Goal 2 – Land Ownership

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**MFRC Goal 2: Forests within a region’s landscape will be in a variety of ownerships, serving both public and private interests.**

Data presented in this section show recent trends in public and private forestland ownership in southeast Minnesota.

### 2.1. Land Ownership Data Sources

GAP Stewardship 2008: Created land ownership information for the entire state of Minnesota. These data were created specifically to support the GAP Analysis Project. The base cartography is derived from mathematically subdivided PLS quarter-quarter sections and the 40 acre polygons have been dissolved on the ownership values in the attribute table. Ownership reflects surface features only. Ownership is only as current as the source information and should not be considered comprehensive for the entire state. Land interest is expressed only when some organization owns or administers more than 50 percent of a forty except where sub-forty accuracy stewardship polygons were created.

Forest Inventory Analysis (FIA): The systematic collection of data and forest information by the U.S. Forest Service for assessment or analysis to assess America's forests. This continuous forest census reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. This data is not meant to be represented spatially but breaks forestland and timberland estimates down by ownership class.

#### MN DNR Private Forest Management Program, Forest Stewardship Program

- (FSP 2013): The Forest Stewardship program “provides technical advice and long-range forest management planning to interested landowners.” More information available at: <http://www.dnr.state.mn.us/grants/forestmgmt/stewardship.html>
- (Arends et al. 2009): Arends, Andrew, Gary Michael, and the Forest Stewardship Council. Nov. 23, 2009. “Charging for stewardship plans.” Available at: [http://files-intranet.dnr.state.mn.us/user\\_files/1865/changingstewardshipplans.pdf?ticket=ST-2616560-Oz8c867MPmLKUtuuOR24](http://files-intranet.dnr.state.mn.us/user_files/1865/changingstewardshipplans.pdf?ticket=ST-2616560-Oz8c867MPmLKUtuuOR24)
- (USFS 2009): U.S. Forest Service. 2009. Spatial Analysis Program. More information available at: <http://www.fs.fed.us/na/sap/products/mn.shtml>

MN DNR Data Deli: The internet-based spatial data acquisition site hosted by the Minnesota Department of Natural Resources. <http://deli.dnr.state.mn.us/index.html>

National Woodland Owner Survey (NWOS): The official census of forest owners in the United States. On an annual basis, the NWOS contacts forest-land owners from across the county to ask them questions about: The forest land they own, their reasons for owning it, how they use it, if

and how they manage it, sources of information about their forests, their concerns and issues related to their forests, their intentions for the future of their forests, and their demographics.

## 2.2 Land Ownership by Entity

The vast majority of timberland of forestland in the MFRC Southeast Landscape – over 85% – is privately-owned (Table 15). The ratio of public to private timberland stayed relatively consistent between 1990 and 2012, though there was a slight increase in the amount of private land relative to the amount of public land. Most publically-owned timberland is state- or locally-owned, while only a small percent of overall timberland in the area is federally-owned. Similar trends can be seen for forest land (Table 16). An even higher percentage of total land in the Southeast Landscape is privately owned – over 96%, excluding private conservancy land (Table 17, Figure 5). Only very slight differences can be seen between ownership and management of land in southeast Minnesota; for example, a small amount of land owned by the Federal Bureau of Indian Affairs is managed by the Dakota Indians (Table 18, Figure 6). Table 19 compares ownership to management of forest lands in the region.

Nearly all of the Richard J. Dorer Memorial Hardwood Forest is within the MFRC Southeast Landscape. While about 7% is owned by the State and other entities, most of the approximately one million acre forest is within private ownership (Table 20, Figure 7).

**Table 15:** Area of timberland by ownership group for the MFRC Southeast Landscape, 1990, 2003, 2012 (FIA).

Ownership Group	1990	2003	2012	% Change 1990-2012
Total	623,616	539,199	702,547	12.7%
Public	94,310	69,750	98,153	4.1%
% of total	15.1%	12.9%	14.0%	
• Other federal	19,500	6,109	16,410	-15.8%
% of total	3.1%	1.1%	2.3%	
• State and local	74,810	63,641	81,743	9.3%
% of total	12.0%	11.8%	11.6%	
Private	529,305	469,449	604,393	14.2%
% of total	84.9%	87.1%	86.0%	

**Source:** Forest Inventory Analysis estimate.

Note: The FIA database combines Native American, Forest Industry, and Non-industrial Private land as ‘Private’. For some analysis these categories cannot be separated due to disclosure laws.

**Table 16:** Area of forest land by ownership group for the MFRC Southeast Landscape, 1990, 2003, 2012 (FIA).



Ownership Group	1990	2003	2012	% Change 1990-2012
Total	631,806	571,785	724,139	14.6%
Public	97,401	85,900	101,093	3.8%
% of total	15.4%	15.0%	14.0%	
• Other federal	19,500	9,551	16,410	-15.8%
% of total	3.1%	1.7%	2.3%	
• State and local	77,901	76,350	84,683	8.7%
% of total	12.3%	13.4%	11.7%	
Private	534,405	485,885	623,046	16.6%
% of total	84.6%	85.0%	86.0%	

**Source:** Forest Inventory Analysis estimate.

Note: The FIA database combines Native American, Forest Industry, and Non-industrial Private land as 'Private'. For some analysis these categories cannot be separated due to disclosure laws.

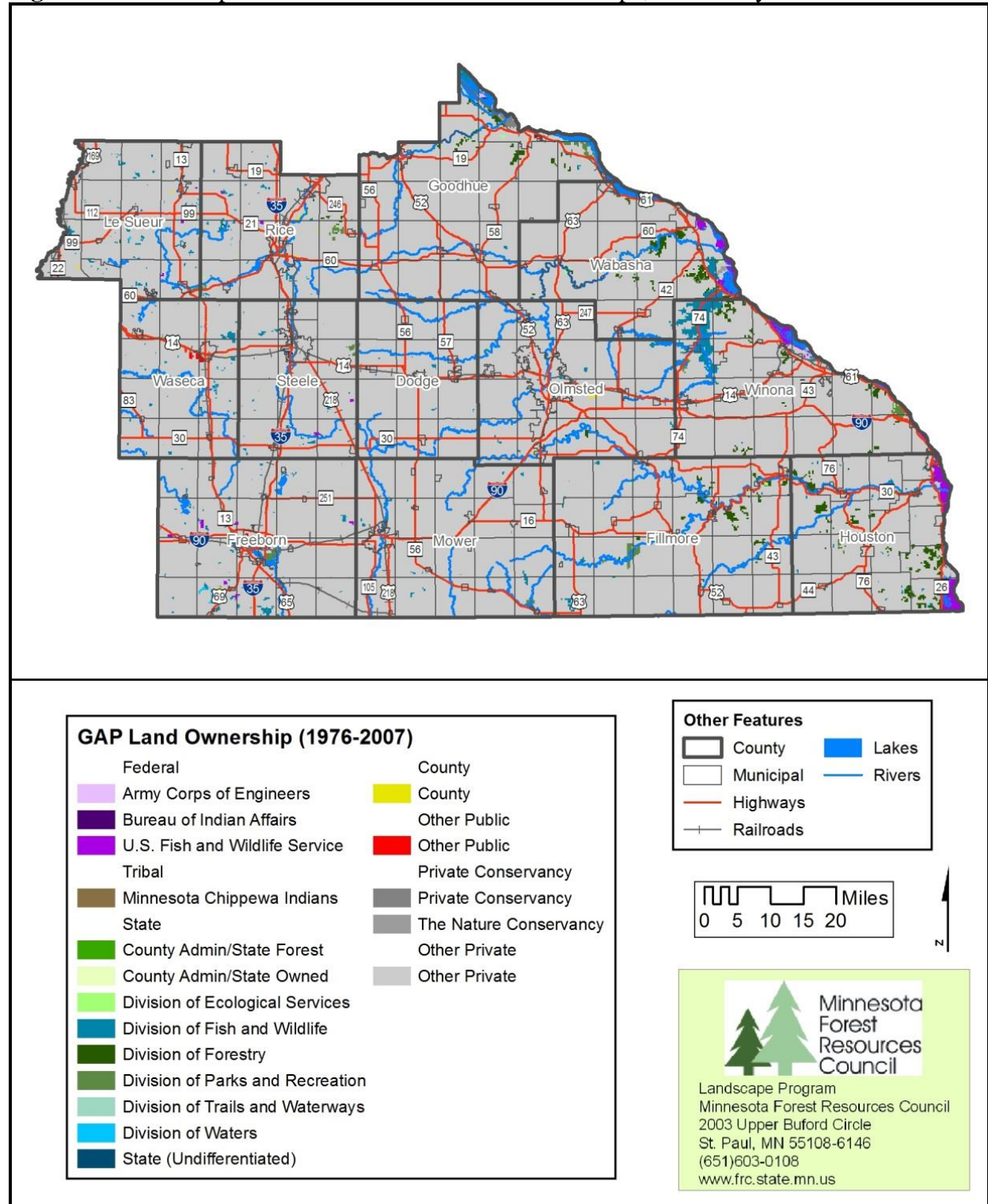
**Table 17:** Land ownership in the Southeast Landscape from GAP Stewardship 1976-2007.

Ownership Type	Land Ownership	Acres	% of Total
Federal	Army Corps of Engineers	1,212	0.0
	Bureau of Indian Affairs	476	0.0
	U.S. Fish and Wildlife Service	38,334	0.8
<b>Total Federal</b>		<b>40,022</b>	<b>0.8</b>
State	County Admin/State Forest	41	0.0
	County Admin/State Owned	274	0.0
	Division of Ecological Services	3,420	0.1
	Division of Fish and Wildlife	67,336	1.4
	Division of Forestry	47,106	0.9
	Division of Parks and Recreation	14,639	0.3
	Division of Trails and Waterways	345	0.0
	Division of Waters	1,303	0.0
	State (Undifferentiated)	608	0.0
<b>Total State</b>		<b>135,073</b>	<b>2.7</b>
County	County	4,165	0.1
<b>Total County</b>		<b>4,165</b>	<b>0.1</b>
Other Public	Other Public	1,621	0.0

<b>Total Other Public</b>			<b>1,621</b>		<b>0.0</b>
Private		Private Conservancy	2,307		0.0
Conservancy		The Nature Conservancy	1,024		0.0
<b>Total Private Conservancy</b>			<b>3,332</b>		<b>0.1</b>
<b>Total Public and Private Conservancy</b>			<b>184,212</b>		<b>3.7</b>
<b>Total Tribal</b>		<b>Minnesota Chippewa Indians</b>	<b>330</b>		<b>0.0</b>
<b>Total Private</b>		<b>Private</b>	<b>4,794,887</b>		<b>96.3</b>
<b>Total Southeast Region</b>			<b>4,979,428</b>		<b>100.0</b>

Source: Minnesota DNR GIS Data Deli

**Figure 5:** Ownerships of all lands in the Southeast Landscape, GAP analysis 1976-2007.



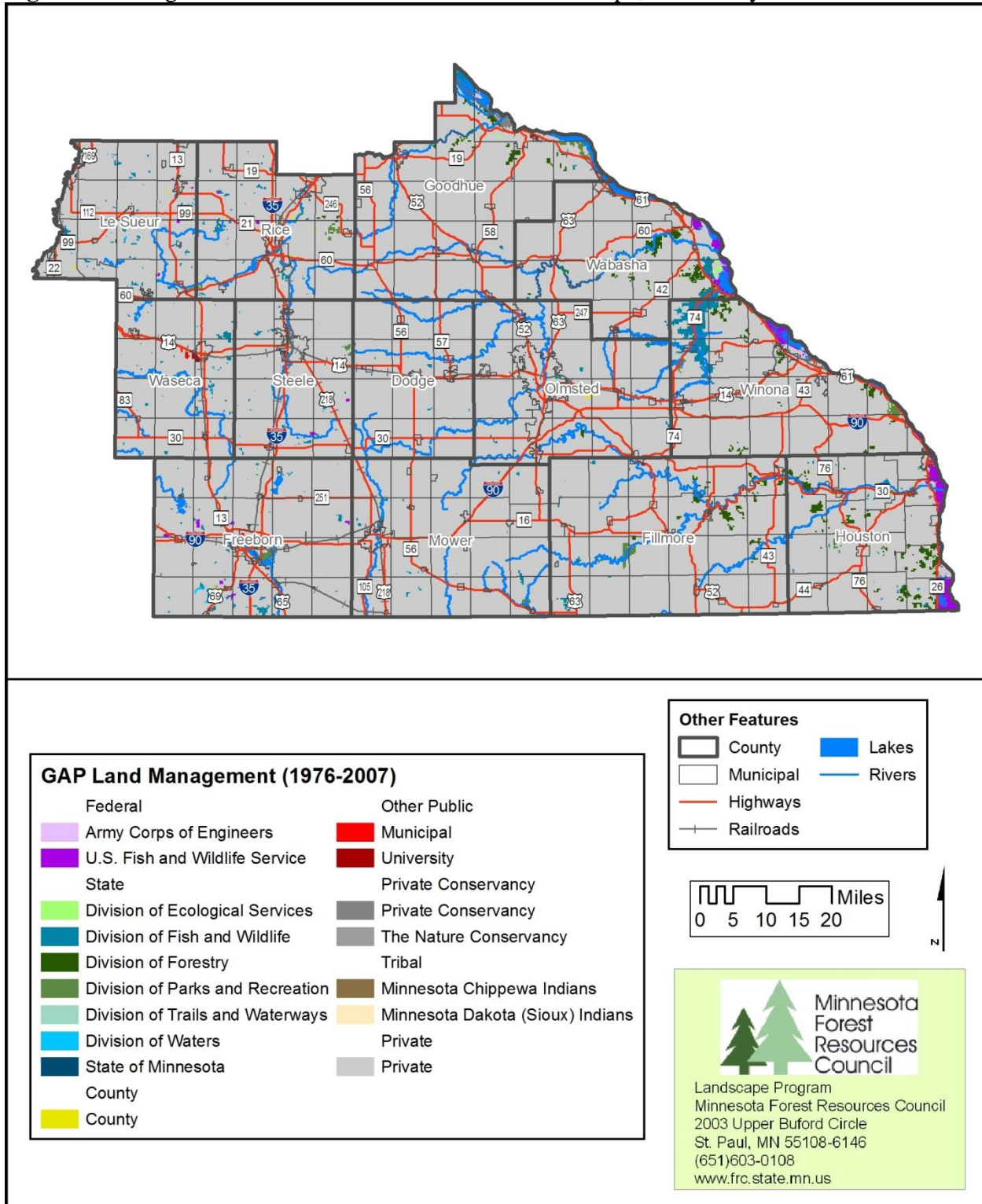
Source: Minnesota DNR Data Deli

**Table 18:** Land Management in the Southeast Landscape from GAP Stewardship 1976-2007.

Management Type	Land Management	Acres	% of Total
Federal	Army Corps of Engineers	1,212	0.0
	U.S. Fish and Wildlife Service	38,334	0.8
<b>Total Federal</b>		<b>39,546</b>	<b>0.8</b>
State	Division of Ecological Services	4,336	0.1
	Division of Fish and Wildlife	67,336	1.4
	Division of Forestry	46,809	0.9
	Division of Parks and Recreation	14,639	0.3
	Division of Trails and Waterways	345	0.0
	Division of Waters	1,303	0.0
	State of Minnesota	608	0.0
<b>Total State</b>		<b>135,377</b>	<b>2.7</b>
County	Fillmore County	20	0.0
	Freeborn County	379	0.0
	Goodhue County	136	0.0
	Houston County	148	0.0
	Le Sueur County	352	0.0
	Olmsted County	1,893	0.0
	Rice County	1,121	0.0
	Steele County	38	0.0
	Wabasha County	80	0.0
	Waseca County	272	0.0
	Winona County	41	0.0
<b>Total County</b>		<b>4,480</b>	<b>0.1</b>
Other Public	Municipal	799	0.0
	University	822	0.0
<b>Total Other Public</b>		<b>1,621</b>	<b>0.0</b>
Private Conservancy	Private Conservancy	2,307	0.0
	The Nature Conservancy	405	0.0
<b>Total Private Conservancy</b>		<b>2,712</b>	<b>0.1</b>
<b>Total Public and Private Conservancy</b>		<b>183,736</b>	<b>3.7</b>
Tribal	Minnesota Chippewa Indians	330	0.0
	Minnesota Dakota (Sioux) Indians	476	0.0
<b>Total Tribal</b>		<b>806</b>	<b>0.0</b>
<b>Total Private</b>		<b>4,794,887</b>	<b>96.3</b>

Source: Minnesota DNR Data Deli, GAP Stewardship 2008, adapted by Jeff Reinhart (2013).

**Figure 6:** Management of all lands in the Southeast Landscape, GAP analysis 1976-2007.



Source: Minnesota DNR Data Deli, GAP Stewardship 2008, adapted by Jeff Reinhart (2013).

**Table 19:** Comparisons of land ownership vs. management in Southeast MN.

Ownership Type	Land Ownership	Management Type	Land Management	Acres	% of Total
Federal	Army Corps of Engineers	Federal	Army Corps of Engineers	1,212	0.0
Federal	Bureau of Indian Affairs	Tribal	Minnesota Dakota (Sioux) Indians	476	0.0
Federal	U.S. Fish and Wildlife Service	Federal	U.S. Fish and Wildlife Service	38,334	0.8
Tribal	Minnesota Chippewa Indians	Tribal	Minnesota Chippewa Indians	330	0.0
State	County Admin/State Forest	County	Winona County	41	0.0
State	County Admin/State Owned	County	Fillmore County	20	0.0
State	County Admin/State Owned	County	Houston County	148	0.0
State	County Admin/State Owned	County	Le Sueur County	26	0.0
State	County Admin/State Owned	County	Wabasha County	80	0.0
State	Division of Ecological Services	State	Division of Ecological Services	3,420	0.1
State	Division of Fish and Wildlife	State	Division of Fish and Wildlife	67,336	1.4
State	Division of Forestry	State	Division of Ecological Services	297	0.0
State	Division of Forestry	State	Division of Forestry	46,809	0.9
State	Division of Parks and Recreation	State	Division of Parks and Recreation	14,639	0.3
State	Division of Trails and Waterways	State	Division of Trails and Waterways	345	0.0
State	Division of Waters	State	Division of Waters	1,303	0.0
State	State (Undifferentiated)	State	State of Minnesota	608	0.0
County	County	County	Freeborn County	379	0.0
County	County	County	Goodhue County	136	0.0
County	County	County	Le Sueur County	326	0.0
County	County	County	Olmsted County	1,893	0.0
County	County	County	Rice County	1,121	0.0
County	County	County	Steele County	38	0.0
County	County	County	Waseca County	272	0.0
Other Public	Other Public	Other Public	Municipal	799	0.0
Other Public	Other Public	Other Public	University	822	0.0
Private Conservancy	Private Conservancy	Private Conservancy	Private Conservancy	2,307	0.0
Private Conservancy	The Nature Conservancy	Private Conservancy	The Nature Conservancy	405	0.0
Private Conservancy	The Nature Conservancy	State	Division of Ecological Services	619	0.0
Private	Private	Private	Private	4,794,887	96.3
<b>Total SE Region</b>				<b>4,979,428</b>	<b>100.0</b>

Source: Minnesota DNR Data Deli, GAP Stewardship 2008, adapted by Jeff Reinhart (2013).

**Table 20:** Ownership within the Richard J. Dorer Memorial Hardwood Forest.

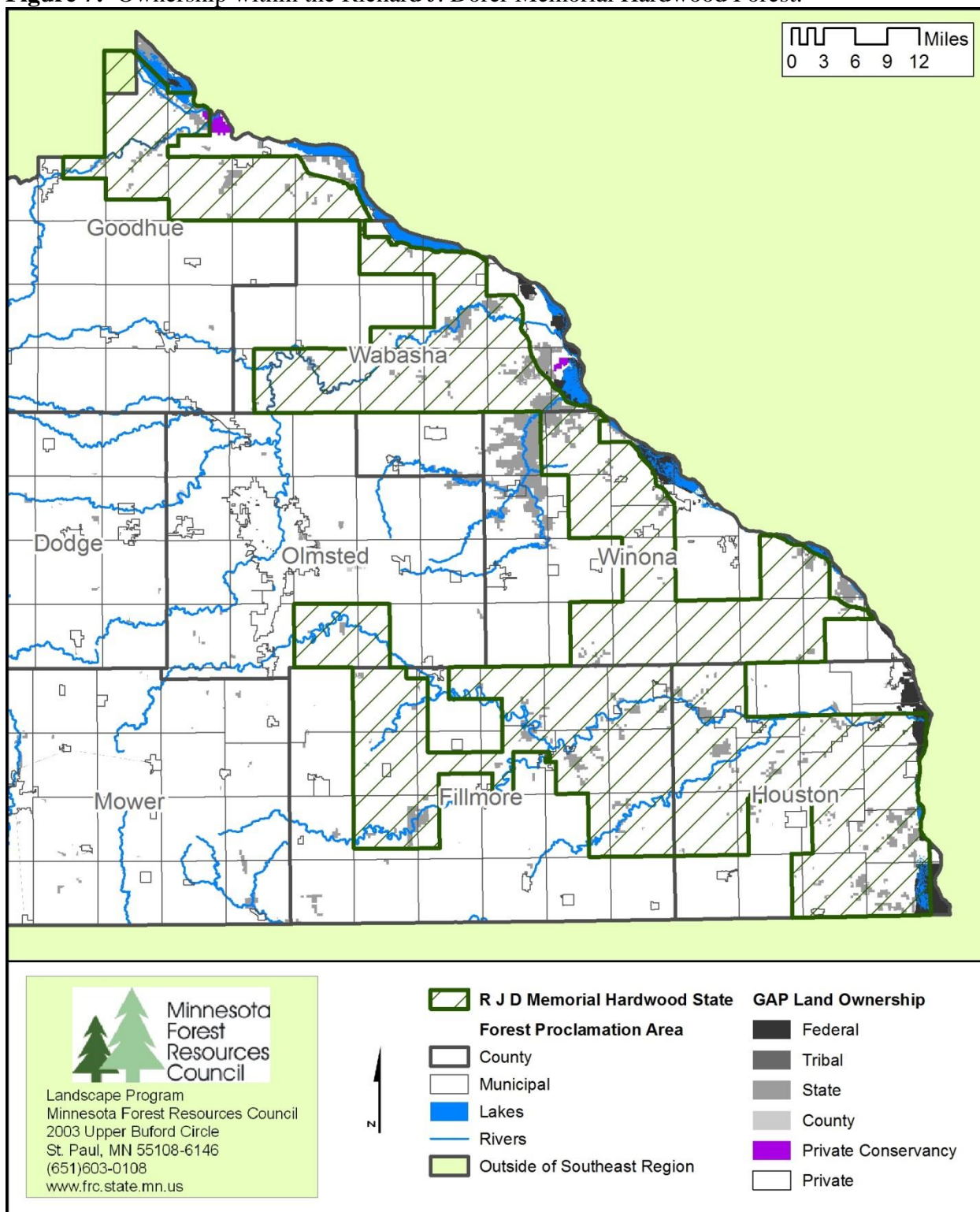
<b>R J D Memorial Hardwood</b>	<b>Acres</b>	<b>% of Total</b>
Outside of Southeast Landscape Region	7,597	0.7
Within Southeast Landscape Region	1,008,630	99.3
<b>Total Area for R J D Memorial Hardwood</b>	<b>1,016,227</b>	<b>100.0</b>

<b>Ownership in R J D Memorial Hardwood in Southeast Region</b>	<b>Acres</b>	<b>% of Total</b>
Federal	8,359	0.8
Tribal	250	0.0
State	59,040	5.9
County	135	0.0
Private Conservancy	487	0.0
Private	940,359	93.2
<b>Total Area for R J D Memorial Hardwood in Southeast Region</b>	<b>1,008,630</b>	<b>100.0</b>

Source: Minnesota DNR GIS Data Deli



**Figure 7:** Ownership within the Richard J. Dorer Memorial Hardwood Forest.



Source: Minnesota DNR Data Deli



## 2.3 Forest Stewardship Plans

According to the Minnesota Department of Natural Resources' Forest Stewardship Program, "The DNR Forest Stewardship Program provides technical advice and long-range forest management planning to interested landowners. All aspects of the program are voluntary. Plans are designed to meet landowner goals while maintaining the sustainability of the land. The entire property except active farming areas, is covered by the plan." (FSP 2013)

It should be noted that not all private forest land is eligible for a Forest Stewardship Plan; for example, a landowner must have at least 20 eligible acres to enroll. Non-forested land that meets certain criteria is eligible for the program as well; examples include agricultural land that will be converted to forest and non-forested wetlands (Arends et al. 2009).

The Spatial Analysis Project (SAP) was conducted by the Minnesota DNR Forestry Private Lands Program in 2006. The purpose of the SAP was to create "a GIS layer representing the level of "benefit" gained from potential forest stewardship work." Several factors that were determined to "contribute to the overall benefits gained by active forest stewardship" were mapped, overlaid, and scored, and then scores were weighted by the importance of the factor. The resulting scores were then classified into low, medium and high potential benefit gained by active forest stewardship. Similar to Forest Stewardship Plan eligibility, the SAP process considered other factors in addition to areas of existing forest; therefore non-forested areas may have also been identified as gaining potential benefit from forest stewardship. More information on this process can be found at <http://www.fs.fed.us/na/sap/products/mn.shtml>. (USFS 2009).

To quantify Forest Stewardship Plan accomplishments, the USFS asked the states to designate Important Forest Resource Areas (IFRA). Accomplishments would then be based on how much of those areas are covered by current forest stewardship plans (plans are current for 10 years in Minnesota). For the IFRAs in Minnesota, the medium and high areas delineated in the SAP were used.

Forest stewardship plan areas in Minnesota were compared against the IFRAs. Table 21 lists the accomplishments for Minnesota state-wide and within the Southeast Landscape for forest stewardship plans current as of the end of the Federal Fiscal Year (Sept. 30, 2013). IFRA's across the State were at 4.20% coverage. In the Southeast Landscape, IFRA's were at 4.98% coverage.

**Table 21:** Areas covered by Forest Stewardship Plans (FSP) compared to Important Forest Resource Areas (IFRA)

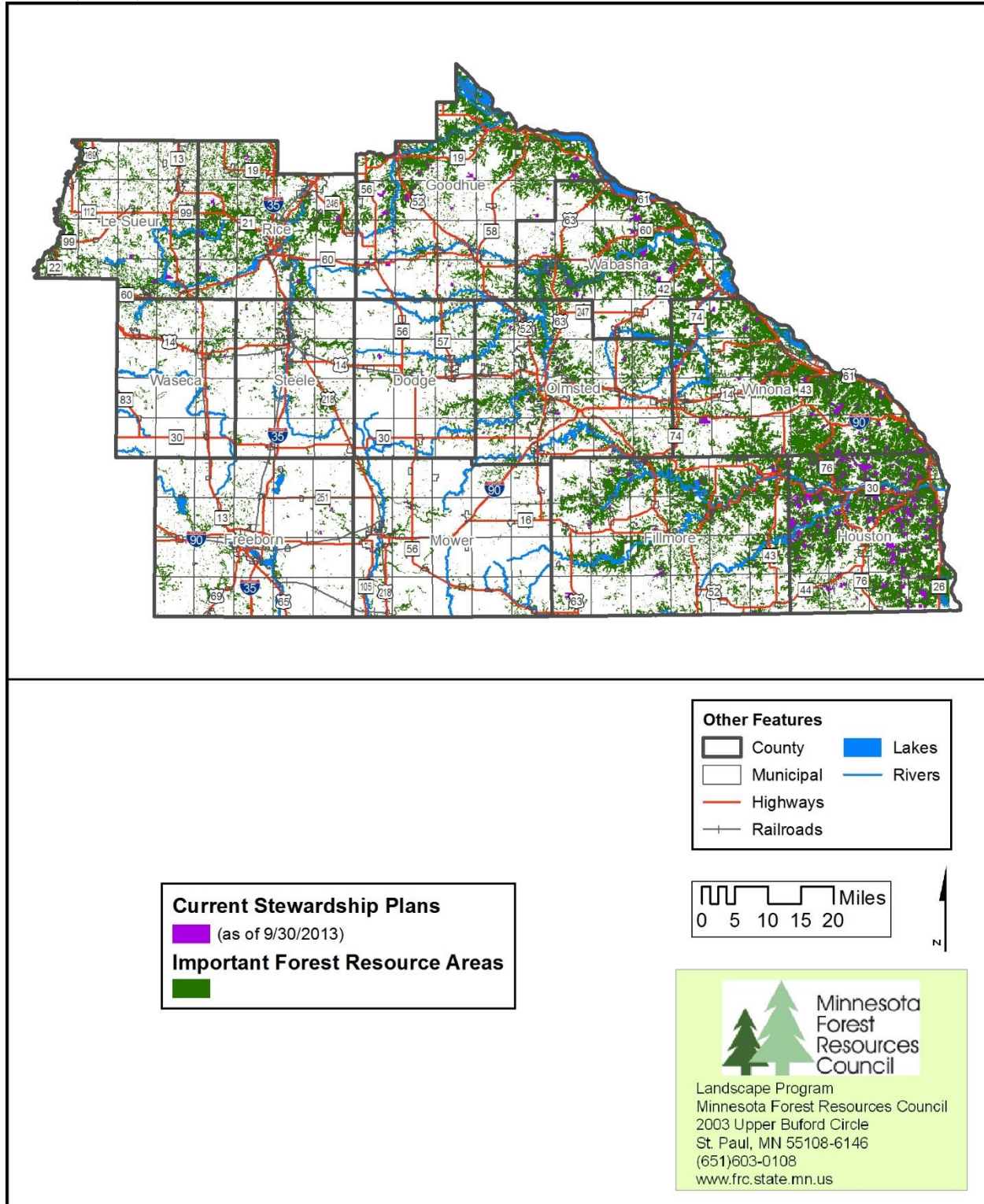
Study Area	Metric	Acres
Southeast	Acres covered by current forest stewardship plans	66,870
	Acres of Important Forest Resource Areas	826,556
	Acres in Important Forest Resource Areas covered by current Forest Stewardship Plans	41,184
Minnesota	Acres covered by current forest stewardship	618,682

	plans	
	Acres of Important Forest Resource Areas	9,898,192
	Acres in Important Forest Resource Areas covered by current Forest Stewardship Plans	415,893

**Source:** Spatial Analysis Project (SAP), Minnesota DNR Forestry Community and Private Lands Program (2006). For further information on this data, contact the MN DNR Private Forest Management Program.

**Notes:** The SAP that created the IFRA used GAP Land Cover (1992) data to determine forested acres. IFRA acres exceed 1992 forested acres because the SAP process considered areas of potential forest gain and areas that could have significant effect on forests as well. Acres covered by forest stewardship plans only include forest stewardship plans submitted to the DNR; other plans may exist that were not submitted to the DNR.

**Figure 8:** Areas covered by Forest Stewardship Plans compared to Important Forest Resource Areas (IFRA)



**Source:** Spatial Analysis Project (SAP), Minnesota DNR Forestry Community and Private Lands Program (2006)

## 2.4 Ownership patterns for farm operations

The majority of farm operations in the Southeast Landscape are operated by “full owners,” as defined by the NASS (see note on Table 22). In 2007, over 64% of farm operations in the region were controlled by full owners, which was a slight increase in percentage over the previous decade. The majority of acres, however, were operated by “part owners” – about 62% in 2007. This percentage had also increased over the previous decade. “Tenant” operators made up only a small percentage of both acreage and operations operated – less than 10% - and both of these had seen a slight decrease in percentage among all ownership types over the decade.

Table 22: Acres operated and number of operations by full owners, part owners, and tenants in the Southeast Landscape; 1997, 2002, 2007.

	County	Full Owner		Part Owner		Tenant	
		Acres	Operations	Acres	Operations	Acres	Operations
1997	FREEBORN	87,572	574	249,725	430	39,626	189
	LE SUEUR	71,939	566	134,860	302	10,539	66
	RICE	102,669	846	133,951	348	19,952	96
	STEELE	63,792	416	156,604	295	15,476	92
	WASECA	60,324	348	153,918	279	29,392	108
	DODGE	76,350	395	152,012	251	25,181	70
	FILLMORE	199,894	1,055	199,558	424	33,352	146
	GOODHUE	144,814	943	218,272	490	33,281	149
	HOUSTON	131,475	661	154,411	279	15,228	58
	MOWER	124,477	624	237,479	401	45,729	141
	OLMSTED	118,317	914	156,647	358	28,424	127
	WABASHA	126,576	627	115,430	289	14,964	87
	WINONA	132,237	662	146,667	350	20,482	91
	Total SE Landscape	1,440,436	8,631	2,209,534	4,496	331,626	1,420
2002	FREEBORN	106,696	617	247,244	420	40,468	135
	LE SUEUR	73,002	635	150,150	286	14,924	53
	RICE	81,234	857	150,469	360	17,115	79
	STEELE	99,555	576	171,944	253	10,348	70
	WASECA	66,810	419	143,164	266	21,354	74
	DODGE	65,249	423	142,746	220	25,380	54
	FILLMORE	183,495	1,070	235,220	442	22,438	88
	GOODHUE	141,002	1,078	216,155	470	26,951	131
	HOUSTON	135,650	744	103,267	238	14,683	49
	MOWER	153,610	650	216,104	342	42,431	96
	OLMSTED	124,137	955	160,327	347	28,556	93
	WABASHA	117,294	647	132,584	299	17,180	53
	WINONA	151,886	757	146,255	311	12,835	57
	Total SE	1,499,620	9,428	2,215,629	4,254	294,663	1,032

	Landscape						
2007	FREEBORN	66,253	673	280,370	438	41,865	146
	LE SUEUR	66,345	738	161,223	288	23,128	65
	RICE	97,196	1,072	142,384	349	13,514	73
	STEELE	68,571	612	187,922	264	9,706	58
	WASECA	61,606	493	176,782	302	16,143	53
	DODGE	41,471	406	168,207	230	38,447	87
	FILLMORE	155,354	1,090	272,068	480	18,909	97
	GOODHUE	112,848	1,010	243,090	527	40,805	107
	HOUSTON	128,274	770	106,549	232	9,581	39
	MOWER	98,432	602	289,653	402	31,804	84
	OLMSTED	100,441	950	172,879	356	22,719	78
	WABASHA	108,521	645	142,201	275	11,541	56
	WINONA	129,605	807	163,686	330	12,269	66
	Total SE Landscape	1,234,917	9,868	2,507,014	4,473	290,431	1,009

**Source:** USDA National Agricultural Statistics Service Quick Stats. Accessed Feb. 20, 2014. Available at: <http://quickstats.nass.usda.gov/>

Note: The NASS defines ownership as follows: “Full owners operated only land they owned. Part owners operated land they owned and also land they rented from others. Tenants operated only land they rented from others or worked on shares for others. Farms with hired managers are classified according to the land ownership characteristics reported. For example, a corporation owns all the land used on the farm and hires a manager to run the farm. The hired manager is considered the farm operator, and the farm is classified with a tenure type of “full owner” even though the hired manager owns none of the land he/she operates.” Source: USDA National Agricultural Statistics Service. 2007 Census of Agriculture. “Appendix B. General Explanation and Census of Agriculture Report Form.”

[http://www.agcensus.usda.gov/Publications/2007/Full\\_Report/Volume\\_1,\\_Chapter\\_1\\_US/usappxb.pdf](http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_US/usappxb.pdf)

## 2.5. Additional Data Needs

- National Woodland Owner Survey data for the Southeast Landscape specifically
- School Trust Land data
- Updated Spatial Analysis Project (SAP)



## Goal 3 – Healthy Forests

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**MFRC Goal 3: Within forested landscapes, healthy, resilient, and functioning ecosystems will be maintained within appropriate mixes of forest cover types and age classes to promote timber production, biological diversity, and viable forest-dependent fish and wildlife habitats.**

This section includes a variety of data related to forest health in the MFRC's Southeast Landscape. It includes data on pre-settlement forest patterns; tree species; forest composition and age structure; growth and removals on timberland; species richness and species at risk; invasive species; soils; and lake and stream water quality.

### 3.1. Healthy Forests Data Sources

Minnesota Ecological Classification System (ECS): According to the *Field Guide to the Native Plant Communities of Minnesota* (MN DNR 2005), "The Minnesota Department of Natural Resources and the U.S. Forest Service developed an Ecological Classification System for ecological mapping and landscape classification in Minnesota following the National Hierarchical Framework of Ecological Units (ECOMAP 1993)." For more information on this system see Section 3.2.

- Minnesota Department of Natural Resources (MN DNR). 2005. *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province*. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR St. Paul, MN.
- Minnesota Department of Natural Resources (MN DNR). 2013 (1). "Native Plant Community Classification." Accessed 11/21/2013. Available at: [www.dnr.state.mn.us/npc/classification.html](http://www.dnr.state.mn.us/npc/classification.html).

Native Plant Communities (NPC): This is a classification system of the native vegetation of Minnesota developed by the Minnesota DNR. This system is intended to provide a framework and common language for improving vegetation management, surveys of natural areas, identifying research needs, and promoting the study and appreciation of native vegetation in Minnesota. For more information on this system see Section 3.3. For references, see ECS citations above.

Minnesota Biological Survey (MBS): The MBS is a systematic survey of rare biological features. The goal of the MBS is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and natural communities. More information on this system can be found in Section 3.4.

- Minnesota Department of Natural Resources (MN DNR). 2013 (2). "Minnesota County Biological Survey." Accessed 11/21/2013. Available at: <http://www.dnr.state.mn.us/mbs/index.html>.

High conservation value forests (HCVF):

- Minnesota Department of Natural Resources (MN DNR). 2013 (9). Forest Certification: High conservation value forests.  
<http://www.dnr.state.mn.us/forestry/certification/hcvf.html>.

Pre-settlement Vegetation of Minnesota: The Public Land Survey of Minnesota started in 1847 and by 1908 the entire state of Minnesota had been mapped. As an essential part of the survey process, surveyors notched or blazed bearing trees to facilitate the relocation of survey corners. They also noted the species, diameter, and distance and azimuth from the corner for each bearing tree. This data has been used to estimate tree species abundance across the state prior to European settlement.

- Almendinger, John. 2000. Public Land Survey Bearing Tree Data, late 1800's and United States Forest Service Forest Inventory and Analysis. Available in: Minnesota Forest Resources Council. 2000. "Southeast Minnesota Landscape Current Conditions and Trends Assessment." Further information at:  
<http://files.dnr.state.mn.us/eco/nhnrp/brgtree.pdf>

Forest Inventory Analysis (FIA): The FIA is a systematic collection of data and forest information by the U.S. Forest Service for assessment or analysis to assess America's forests. This continuous forest census is designed to provide reliable estimates on the type, extent, growth, mortality, and removals of forestland. This data is not meant to be represented spatially but breaks forestland and timberland estimates down by ownership class.

- Barnett, Charles. United States Forest Service. Personal communication 11/21/2013.
- Forest Inventory and Analysis estimates. Miles, P.D. Tue Oct 22 2013. Forest Inventory EVALIDator web-application version 1.5.1.05. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://apps.fs.fed.us/Evalidator/tmattribute.jsp>]

MNTaxa: This database contains vascular plant species that reflect vouchered specimens present in herbarium collections at the University of Minnesota and University of Minnesota Duluth herbariums.

Animal species richness data:

- Cieminski, Karen. and Steve Stucker, Minnesota Biological Survey, MN DNR Division of Ecological and Water Resources, 2013
- Hall, Carol. 2013. Minnesota Biological Survey.
- Minnesota Department of Natural Resources (MN DNR). 2013 (3). Minnesota County Biological Survey distribution maps, updated October 30, 2013. Available online at:  
[http://files.dnr.state.mn.us/eco/mcbs/herp\\_maps/reptile\\_and\\_amphibian\\_maps\\_2ecs.pdf](http://files.dnr.state.mn.us/eco/mcbs/herp_maps/reptile_and_amphibian_maps_2ecs.pdf).

Minnesota's Endangered, Threatened, and Special Concern Species:

- Minnesota Department of Natural Resources (MN DNR). 2013 (4). "Minnesota's Endangered, Threatened, and Special Concern Species." Accessed 11/21/2013. Available at: <http://www.dnr.state.mn.us/ets/index.html>
- Minnesota Department of Natural Resources (MN DNR). 2013 (5). Minnesota's List of Endangered, Threatened, and Special Concern Species, 2013. MN DNR Division of



Ecological and Water Resources. Available online at:  
[http://files.dnr.state.mn.us/natural\\_resources/ets/endlist.pdf](http://files.dnr.state.mn.us/natural_resources/ets/endlist.pdf)

MN DNR Rare Species Guide: The Rare Species Guide is an online tool that can be used to query the MN DNR's database of 439 endangered, threatened, and special concern species. This data is available through the MN DNR Division of Ecological and Water Resources and the Minnesota Natural Heritage System.

- Minnesota Department of Natural Resources (MN DNR). 2013 (6). "Rare Species Guide." Accessed 11/21/2013. Available at: <http://www.dnr.state.mn.us/rsg/index.html>.

#### Invasive Species:

- Gupta, Angie. University of Minnesota Extension Service. Personal communication, 11/21/2013.
- Minnesota Department of Agriculture (MDA). 2013 (1). 2013 Noxious and Invasive Weeds Program. Available online at:  
<http://www.mda.state.mn.us/plants/badplants/~media/Files/plants/weeds/noxiouslists.ashx>
- Minnesota Department of Agriculture (MDA). 2013 (2). "Oriental Bittersweet." Accessed 11/20/2013. Available at:  
<http://www.mda.state.mn.us/plants/badplants/orientalbittersweet.aspx>
- Minnesota Department of Natural Resources (MN DNR). 2013 (7). "Emerald Ash Borer (EAB)." Accessed 11/21/2013. Available at:  
<http://www.dnr.state.mn.us/invasives/terrestrialanimals/eab/index.html>.
- Minnesota Department of Agriculture (MDA). 2006. "Emerald Ash Borer Introduction Risk Model for Minnesota." MDA Plant Protection Division, Invasive Species Exclusion Unit. Available at:  
<http://www.mda.state.mn.us/Global/MDADocs/pestsplants/eab/riskmodel.aspx>
- Minnesota Department of Agriculture (MDA). 2011. "Biological Control of Emerald Ash Borer in Minnesota." Available at:  
<http://www.mda.state.mn.us/~media/Files/plants/eab/eabbiocontrolinmn.ashx>
- Minnesota Department of Natural Resources Division of Ecological and Water Resources. 2013 (8). MN DNR Deli. <http://deli.dnr.state.mn.us/index.html>
- Minnesota Department of Agriculture (MDA) Early Detection and Distribution Mapping System (EDD MapS). 2013. This application uses Google Maps to pinpoint locations where reports have come in for newly invasive terrestrial plant species:  
<http://gis.mda.state.mn.us/earlydetection/>

#### Water Health data:

- Minnesota DNR GIS Data Deli. <http://deli.dnr.state.mn.us/index.html>
- United States Geological Survey (USGS). 2013. "Hydrologic map units." Accessed 11/21/2013. Available at: <http://water.usgs.gov/GIS/huc.html>.
- Minnesota Pollution Control Agency (MPCA). 2013 (1). "Impaired Waters List." Accessed 11/21/2013. Available at: <http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/impaired-waters-list.html>.
- Minnesota Pollution Control Agency (MPCA). 2013 (2). "More About the Section 319 Program." Accessed 11/21/2013. Available at:



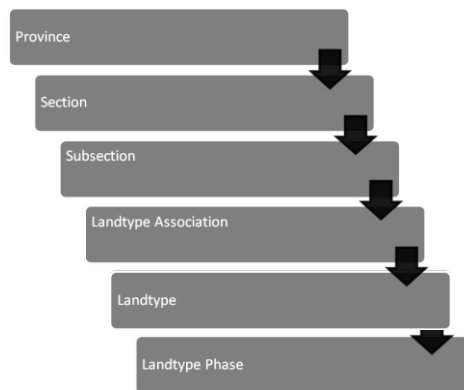
<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/water-nonpoint-source-issues/clean-water-partnership/more-about-the-section-319-program.html>.

- Runkel, A.C, J.R. Steenberg, R.G. Tipping, A.J. Retzler. 2013. “Geologic controls on groundwater and surface water flow in southeastern Minnesota and its impact on nitrate concentrations in streams.” Minnesota Geological Survey.
- Watkins, J., N. Rasmussen, G. Johnson, A. Streitz, K. Ahmad, B. Beyerl, and J. Roebuck. 2013. “Nitrate-Nitrogen in the Springs and Trout Streams of Southeast Minnesota.” Minnesota Pollution Control Agency.
- Streitz, A. Changes to River Baseflow Across Minnesota. Presentation, Midwest Ground Water Conference, October 1, 2012. Minnesota Pollution Control Agency.
- Lenhart, C. and J. Niebert. 2011. “Quantifying differential streamflow response of Minnesota ecoregions to climate change and implications for management.” Report as of FY2010 for 2010MN270B.

### 3.2. Minnesota Ecological Classification System (ECS)

The following excerpt is taken from the MN DNR *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province* (MN DNR 2005):

“The Minnesota Department of Natural Resources and the U.S. Forest Service have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in Minnesota following the [National Hierarchical Framework of Ecological Units](#) (ECOMAP 1993). Ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The system uses associations of biotic and environmental factors including climate, geology, topography, soils, hydrology, and vegetation. There are eight levels of ECS units in the United States. Six of these units occur in Minnesota: Provinces, Sections, Subsections, Land Type Associations, Land Types, and Land Type Phases.”

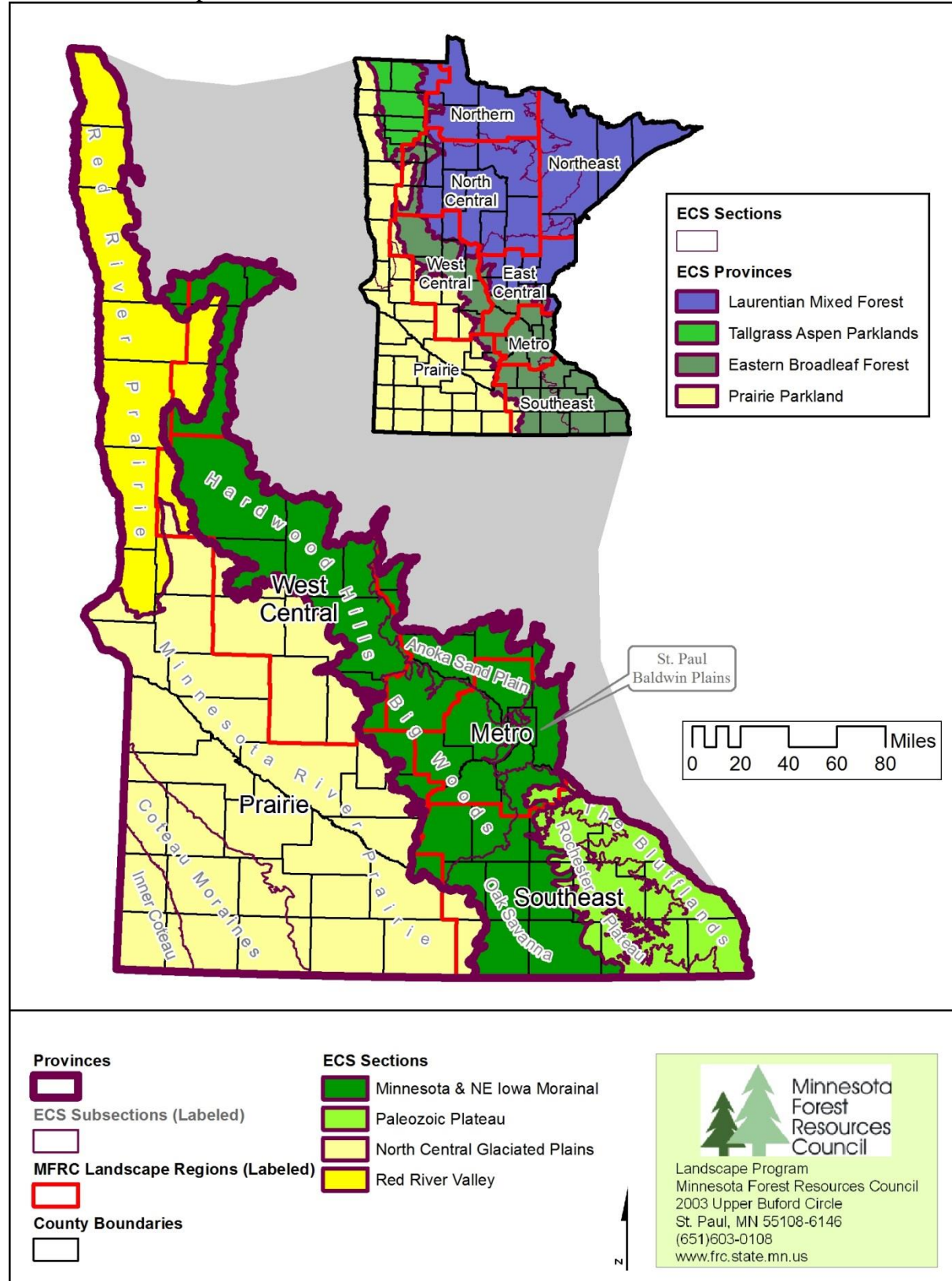


The highest four levels for Minnesota are, according to the following definitions taken from the Field Guide (MN DNR 2005), as follows:

- **“Provinces** are units of land defined using major climate zones, native vegetation, and biomes such as prairies, deciduous forests, or boreal forests. There are four ecological provinces in Minnesota.
- **Sections** are units within Provinces that are defined by origin of glacial deposits, regional elevation, distribution of plants, and regional climate. Minnesota has ten ecological sections.
- **Subsections** are units within Sections that are defined using glacial deposition processes, surface bedrock formations, local climate, topographic relief, and the distribution of plants, especially trees. Minnesota has 26 ecological subsections.
- **Land Type Associations (LTAs)** are divisions within Subsections that are delineated using glacial landforms, bedrock types, topographic roughness, lake and stream distributions, wetland patterns, depths to groundwater table, soil parent material and pre-European settlement vegetation. There are 291 LTAs in the state.”

The MFRC Southeast Landscape exists almost entirely within the Eastern Broadleaf Forest Province, an eco-region that winds throughout 12 states in the east-central United States. A small portion of both Waseca and Freeborn counties are within the neighboring Prairie Parkland Province (Figure 9). The Eastern Broadleaf portion of the Southeast Landscape is divided into two ECS Sections – the Minnesota & NE Iowa Morainal and the Paleozoic Plateau – while the small Prairie Parkland portion is within the North Central Glaciated Plains Section. These three Sections contain five Subsections and 34 Landtype Associations, in regards to the Southeast Landscape region (Table 23, Figure 10).

**Figure 9:** Ecological Classification System (ECS) Provinces and Sections in the MFRC Southeast Landscape.



Source: Minnesota DNR Data Deli

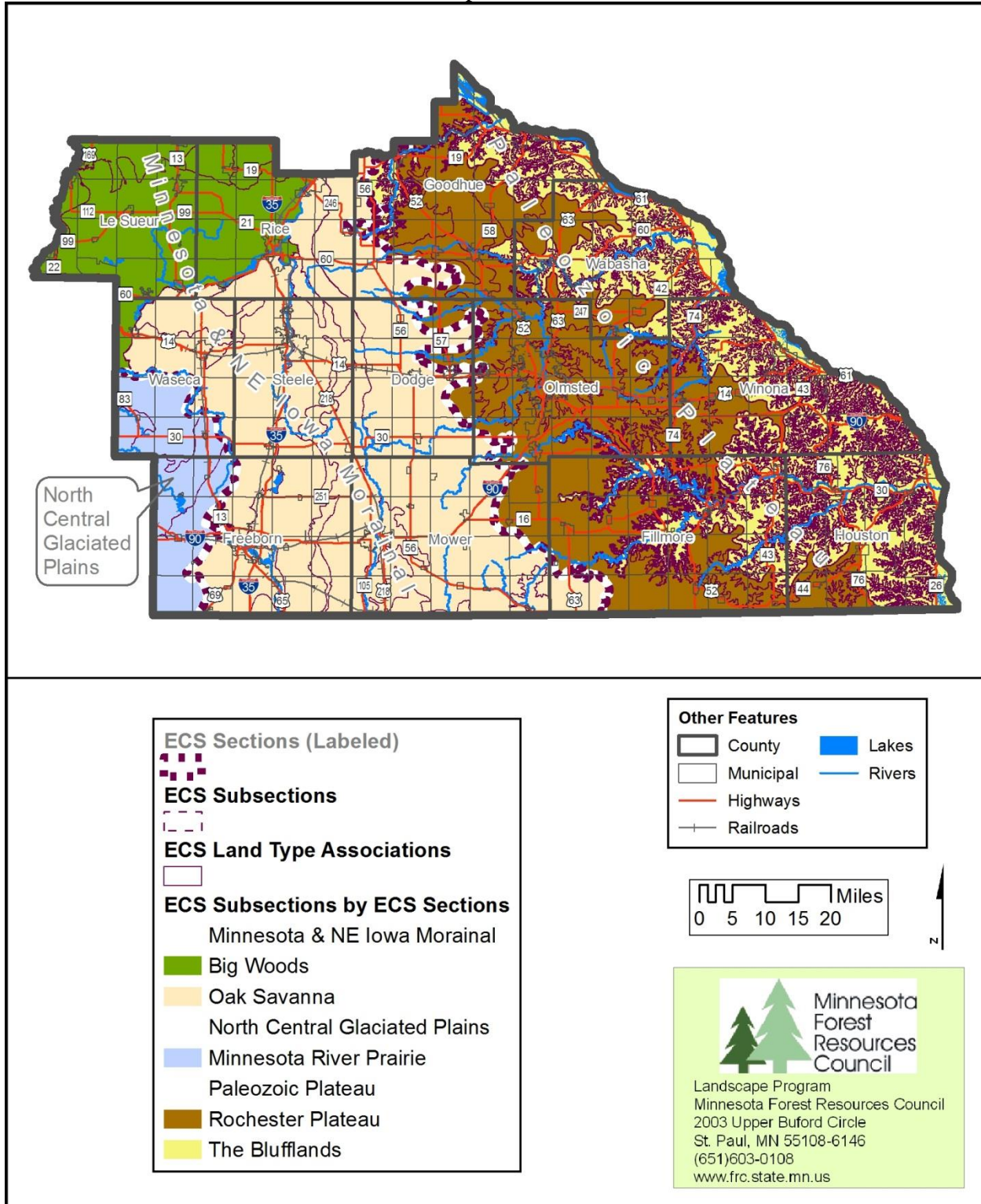
**Table 23:** Ecological Classification System (ECS) Section and Subsection Areas in the Southeast Landscape

<b>ECS Section</b>	<b>ECS Subsection</b>	<b>Acres</b>	<b>% of Total</b>	<b># of Landtype Associations</b>
Minnesota & NE Iowa Morainal	Big Woods	505,461	10.2	5
	Oak Savanna	1,645,020	33.0	9
<b>Subtotal (Section)</b>		<b>2,150,480</b>	<b>43.2</b>	<b>14</b>
North Central Glaciated Plains	Minnesota River Prairie	251,481	5.1	4
<b>Subtotal (Section)</b>		<b>251,481</b>	<b>5.1</b>	<b>4</b>
Paleozoic Plateau	Rochester Plateau	1,298,940	26.1	5
	The Blufflands	1,278,527	25.7	11
<b>Subtotal (Section)</b>		<b>2,577,467</b>	<b>51.8</b>	<b>16</b>
<b>Total Southeast Region</b>		<b>4,979,428</b>	<b>100.0</b>	<b>34</b>

**Source:** Minnesota DNR GIS Data Deli

Note: These data represent Section, Subsections, and Landtype Associations that intersect the Southeast Landscape, but are not necessarily entirely contained within the Landscape.

**Figure 10:** Ecological Classification System (ESC) Subsection areas and Land Type Associations in the MFRC Southeast Landscape.



Source: Minnesota DNR Data Deli



### 3.3. Native Plant Communities (NPC)

The following excerpt is taken from the MN DNR *Field Guide to the Native Plant Communities of Minnesota* (MN DNR 2005):

“A **native plant community** is a group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plant species form recognizable units, such as oak savannas, pine forests, or marshes, that tend to repeat over space and time. Native plant communities are classified and described by considering 1) vegetation, 2) hydrology, 3) landforms, 4) soils, and 5) natural disturbance regimes. Examples of natural disturbances include: wildfires, severe droughts, windstorms, and floods.

Sometimes referred to as native habitats or natural communities, native plant communities are named for the characteristic plant species within them or for characteristic environmental features. Examples of native plant communities in Minnesota include Dry Barrens Oak Savanna, Red Pine-White Pine Forest, Bulrush Marsh, Sedge Meadow, and Mesic Sandstone Cliff. There are many kinds of vegetated areas that are not native plant communities. These include places where native species have largely been replaced by exotic or invasive species such as smooth brome grass, buckthorn, and purple loosestrife, and planted areas such as orchards, pine plantations, golf courses, and lawns. Other areas not considered to be native plant communities include areas where modern human activities such as farming, overgrazing, non-sustainable logging, and development have destroyed or greatly altered the vegetation.”

More information on NPC Classes for Southeast Minnesota can be found in the *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province* (MN DNR 2005) or at [www.dnr.state.mn.us/npc/classification.html](http://www.dnr.state.mn.us/npc/classification.html) (MN DNR 2013 (1)).

#### 3.3.1. Native Plant Community Classification

The following excerpt is taken from the MN DNR webpage, “Native Plant Community Classification,” available at [www.dnr.state.mn.us/npc/classification.html](http://www.dnr.state.mn.us/npc/classification.html):

“In 2003, researchers in the Minnesota Department of Natural Resources (DNR) completed a new classification of the native vegetation of Minnesota, Minnesota's Native Plant Community Classification (Version 2.0). The DNR's new classification is intended to provide a framework and common language for improving our ability to manage vegetation, to survey natural areas for biodiversity conservation, to identify research needs, and to promote study and appreciation of native vegetation in Minnesota.

Background: Version 2.0 of the DNR's native plant community classification is based strongly on plant species composition and was developed through analysis of extensive field data collected from [sample plots](#) in forests, prairies, wetlands, and other habitats. The classification is hierarchical, with vegetation units described at levels ranging from broad landscape-level ecological systems to local communities (Table 24). One of the most important features of the new classification is the inclusion of ecological processes as an organizing principle.

Classification Hierarchy: The NPC classification has six levels (Table 24). **System Groups**, the highest level, were created to allow development of manageable field keys for lower levels of the classification. System Groups were formed by combining lower levels of the classification along major physiognomic and hydrologic splits in vegetation. **Ecological Systems** are groups of native plant communities that are unified by strong influence from a major ecological process or set of processes, especially nutrient cycling and natural disturbances. **Floristic Regions** are divisions within Ecological Systems that reflect the distribution of Minnesota's plant species into characteristically northern, northwestern, central, and southern groups, or floras. The important influences on these species distributions appear to be climate and paleohistory. **Native Plant Community Classes** are units of vegetation that generally have uniform soil texture, soil moisture, soil nutrients, topography, and disturbance regimes. For wooded vegetation, Native Plant Community Classes were developed by emphasizing understory vegetation more than canopy trees, under the hypothesis that in much of Minnesota understory plants are often more strongly tied to specific habitat conditions (such as levels of nutrients and moisture) than are canopy trees. **Native Plant Community Types** are defined by dominant canopy trees, variation in substrate, or fine-scale differences in environmental factors such as moisture or nutrients. Type distinctions were also made to describe geographic patterns within a Class. **Native Plant Community Subtypes** are based on finer distinctions in canopy composition, substrates, or other environmental factors. In some instances, Subtypes represent apparent trends within a Type for which more study and collection of data are needed. In other instances Subtypes are well-documented, fine-scale units of vegetation that are useful for work such as rare plant habitat surveys.”

**Table 24:** Native Plant Community (NPC) classification hierarchy.

Classification Level	Dominant Factors	Examples found in SE MN
<b>System Group</b>	Vegetation structure & geology	Upland Forest & Woodland Systems
<b>Ecological System</b>	Ecological processes	Mesic Hardwood Forest
<b>Floristic Region</b>	Climate & paleohistory	Southern
<b>NPC Class</b>	Local environmental conditions	Southern Mesic Maple-Basswood Forest
<b>NPC Type</b>	Canopy dominants, substrate, or finer environmental conditions	Sugar Maple-Basswood-(Bitternut Hickory) Forest
<b>NPC Subtype</b>	Finer distinctions in canopy dominants, substrate, or environmental conditions	[n/a in SE MN forests]

**Source:** Table adapted from the MN DNR *Field Guide to the Native Plant Communities of Minnesota*, [www.dnr.state.mn.us/npc/classification.html](http://www.dnr.state.mn.us/npc/classification.html)

### 3.4. Minnesota County Biological Survey (MCBS)

The Minnesota Biological Survey (MBS) began in 1987 as a systematic survey of rare biological features. The goal of the MBS is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and natural communities. To accomplish this goal the MBS uses a multi-level procedure, beginning with evaluation of existing inventory data and followed by an assessment of the quality and condition of selected areas using aerial photographs and classified satellite imagery, followed by ground survey of sites that are thought to be “important areas of native vegetation or habitat” (MN DNR 2013 (2)). This is supplemented by specialized field surveys of selected rare species or groups of species. Through this process the MBS “systematically collects, interprets, and delivers baseline data on the distribution and ecology of rare plants, rare animals, native plant communities, and functional landscapes needed to guide decision making” (MN DNR 2013 (2)). The MBS has been completed in 81 out of 87 Minnesota counties, including all counties in the MFRC Southeast Landscape. According to the MN DNR webpage on the “Status and outcomes” of the Minnesota Biological Survey,

“To date MBS has added over 15,000 new records of rare plants and animals to the DNR's Natural Heritage Information System (NHIS), added over 8,800 vegetation plots to the Relevé Database, recorded 20 native plant species and 3 native amphibians not previously documented in Minnesota, conducted aquatic plant surveys in over 1,500 lakes, produced printed and digital maps of native plant communities and rare species for 38 counties, and digital maps for an additional 18 counties and 3 Ecological subsections.” (MN DNR 2013 (2)).

Out of the 486,726 acres surveyed in the MFRC Southeast Landscape, 162,605 (33.4%) were found to be of “Outstanding” or “High” biodiversity significance (Table 25). Comparing the map of MBS surveyed areas (Figure 11) to the most current map of land cover types (Figure 4) it can be seen that survey plots were concentrated in areas of Upland Forest, as other land types are rare and agriculture dominates much of the remaining landscape. Within these forested areas, riparian areas appear to be the most prevalent location of “Outstanding” or “High” biological significance.

**Table 25:** Areas of biological significance in the Southeast Landscape from the Minnesota Biological Survey.

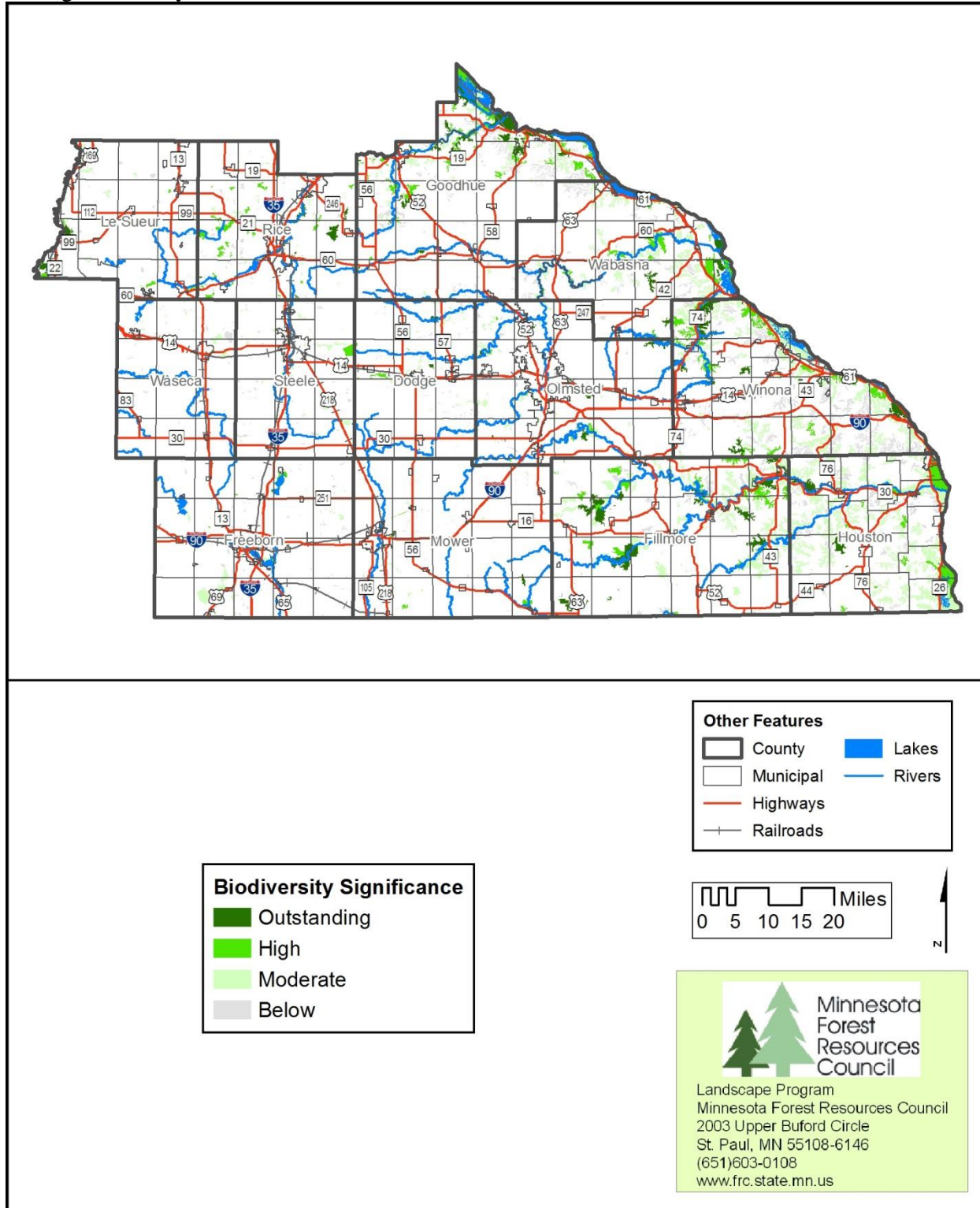
Biodiversity Significance	Acres	% of Total
Outstanding	69,921	1.40
High	92,684	1.86
Moderate	223,778	4.49
Below	100,344	2.02
<b>Total Surveyed Area</b>	<b>486,726</b>	<b>9.77</b>
<b>Total Southeast Area</b>	<b>4,979,428</b>	<b>-</b>

**Source:** Minnesota DNR Data Deli

Note: The Minnesota Biological Survey purposively selected sample plots based on evidence of biological significance, giving higher priority and more detailed investigation to areas that appeared to be the most important biologically. The ratios of the biodiversity significance categories are not intended for projection across the remaining un-surveyed areas. For more information on the plot selection process visit: [http://www.dnr.state.mn.us/eco/mcbs/procedures\\_sites.html](http://www.dnr.state.mn.us/eco/mcbs/procedures_sites.html)



**Figure 11:** Areas of biological significance in the Southeast Landscape from the Minnesota Biological Survey.



Source: Minnesota DNR Data Deli

### 3.5. High conservation value forests (HCVFs)

The Minnesota Department of Natural Resources (MN DNR) states on their webpage about forest certification that:

“The Forest Stewardship Council (FSC) broadly defines high conservation value forests (HCVFs) as *“areas of outstanding biological or cultural significance.”* Certificate holders are required to develop a practical definition and process for implementing the HCVF concept, relative to their scope and scale of operations. [...] All decisions regarding DNR's HCVF approach have been based on the interpretation that most sites managed as HCVFs will remain working forests.” (MN DNR 2013 (9))

The MN DNR has identified 18 HCVFs that intersect with the Southeast Landscape, which they released for public comment in late 2013. Most of these sites are located in the Blufflands subsection (Table 26, Figure 12). Total acreage of the proposed HCVFs that intersect the Southeast Landscape is 20,376 acres; 17,447 of these acres are actually within the boundaries of the Southeast Landscape. The Department intends to complete the HCVF designation process by the end of 2013.

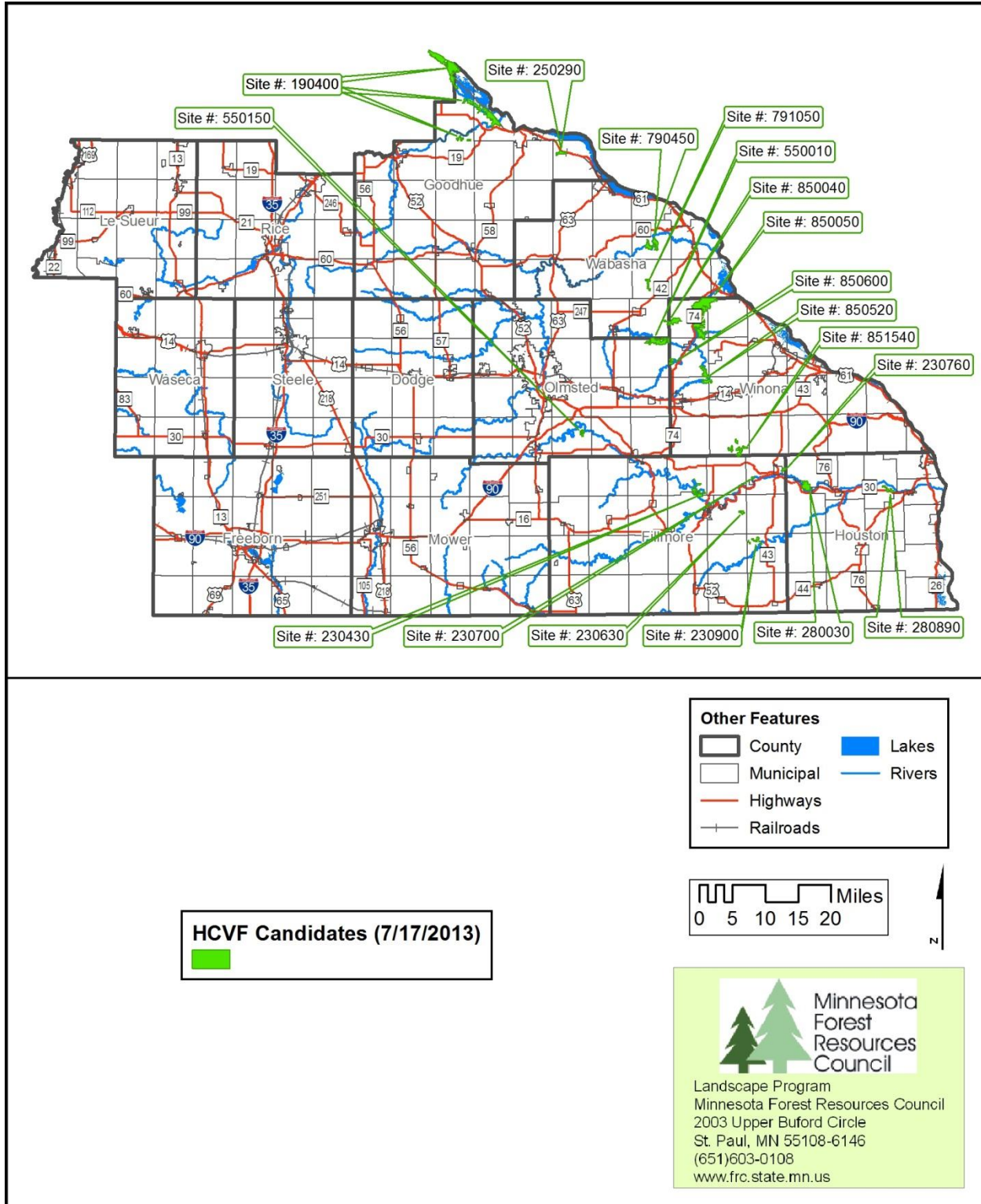
**Table 26:** High Conservation Value Forests (HCVFs) proposed by the MN DNR, 2013.

Site #	Site Name	County*	ECS Subsection	Acres	Percent in Region
190400	Vermillion Bottoms & Lower Cannon River Area	Dakota	The Blufflands	5,897	50.3
230430	Brightsdale Forestry Unit	Fillmore	Rochester Plateau	782	100.0
230630	Diamond Creek Unit	Fillmore	The Blufflands	153	100.0
230700	North Peterson Unit	Fillmore	The Blufflands	61	100.0
230760	Rushford Bluffs	Fillmore	The Blufflands	119	100.0
230900	Shattuck Creek	Fillmore	The Blufflands	268	100.0
250290	Perched Valley	Goodhue	The Blufflands	348	100.0
280030	Vinegar Ridge	Houston	The Blufflands	892	100.0
280890	Mound Prairie	Houston	The Blufflands	316	100.0
550010	North Fork Whitewater WMA	Olmsted	The Blufflands	1,353	100.0
550150	Partridge Creek	Olmsted	The Blufflands	227	100.0
790450	Zumbro Bottoms	Wabasha	The Blufflands	1,033	100.0
791050	West Indian Creek	Wabasha	The Blufflands	293	100.0
850040	Upper Beaver Creek Valley	Winona	The Blufflands	752	100.0
850050	Whitewater Sand Savannas	Winona	The Blufflands	5,856	100.0
850520	South Fork Whitewater WMA	Winona	Rochester Plateau	989	100.0
850600	Callahan Unit--WWMA	Winona	The Blufflands	204	100.0
851540	Pine Hemingway Creek	Winona	The Blufflands	833	100.0
<b>Total acres proposed</b>					20,376
<b>Acres proposed in SE Landscape</b>					17,447

**Source:** MN DNR Forestry. High Conservation Value Forests (MN DNR 2013 (9)).

\* May intersect more than one county

**Figure 12:** Location of High Conservation Value Forests (HCVFs) proposed by the MN DNR, 2013.



Source: MN DNR Forestry. High Conservation Value Forests (MN DNR 2013 (9)).

### 3.6 Comparison of pre-settlement vegetation to current vegetation

The Public Land Survey of Minnesota began in 1847 and by 1908 the entire state of Minnesota had been mapped. As an essential part of the survey process, surveyors notched or blazed bearing trees to facilitate the relocation of survey corners. They also noted the species, diameter, and distance and azimuth from the corner for each bearing tree. John Almendinger of the Minnesota Department of Natural Resources Ecological Classification System Program analyzed bearing tree data and compared it to FIA 1990 plot-level data. Tree records were selected from the 1990 FIA plot data to reproduce as nearly as possible the procedure that the surveyors used to select bearing trees. For a more detailed description of the methodology used, see “Minnesota’s Bearing Tree Database” (<http://files.dnr.state.mn.us/eco/nhnrp/brgtree.pdf>).

Table 27 shows the results of this analysis for Southeast Minnesota. Box-elder (*Acer negundo*) and eastern redcedar (*Juniperus virginiana*) portrayed the largest positive proportional difference, each with over 400x as much representation in the 1990 FIA sample than in the Public Land Survey data. Black oak (*Quercus nigra*), bur oak (*Quercus macrocarpa*), and jack oak (northern pin oak - *Quercus ellipsoidalis*), however, all portrayed negative proportional differences – i.e., there were fewer in the 1990 FIA sample than in the Public Land Survey data.

**Table 27:** Difference in percentages and proportional difference between relative abundance of tree species estimated from Public Land Survey bearing tree database (late 1800s) and the 1990 Forest Inventory and Analysis (FIA) point data for the Southeast Landscape. Bearing tree names are shown in bold, while un-bolded scientific names are species equivalents found in the FIA database. Proportional Difference represents the factor by which the species increased or decreased between pre-settlement and 1990, based on bearing tree data and selected comparison trees from the 1990 FIA data; e.g. ash was 23x more abundant in the 1990 FIA sample than in the Public Land Survey data.

Tree Species	Difference in Relative Abundance (%)	Proportional Difference
<b>Ash</b> — <i>Fraxinus nigra</i> , <i>F. pennsylvanica</i> , <i>F. americana</i>	12.04%	23.18
<b>Aspen</b> — <i>Populus tremuloides</i> , <i>P. grandidentata</i> , <i>P. balsamifera</i> (in lesser part)	-1.29%	2.65
<b>Birch</b> — <i>Betula papyrifera</i> , <i>B. cordifolia</i>	4.21%	24.89
<b>Black Birch</b> — <i>Betula nigra</i> , <i>B. alleghaniensis</i> (in part)	0.01%	1.14
<b>Black Oak</b> — <i>Quercus nigra</i> , <i>Q. ellipsoidalis</i> (in part)	-24.31%	-49.4
<b>Black Walnut</b> — <i>Juglans nigra</i>	2.92%	21
<b>Box-Elder</b> — <i>Acer negundo</i>	25.32%	406.04
<b>Bur Oak</b> — <i>Quercus macrocarpa</i>	-167.38%	-12.5
<b>Butternut</b> — <i>Juglans cinerea</i>	2.3%	18.26
<b>Cherry</b> — <i>Prunus serotina</i> , <i>P. pennsylvanica</i>	9.62%	94.9
<b>Cottonwood</b> — <i>Populus deltoides</i>	5.96%	141.26
<b>Elm</b> — <i>Ulmus americana</i> , <i>U. rubra</i> , <i>U. thomasii</i>	15.48%	14.2
<b>Hackberry</b> — <i>Celtis occidentalis</i>	2.54%	29.75

<b>Hawthorn</b> — <i>Crataegus</i> spp.	0.74%	0
<b>Hickory</b> — <i>Carya cordiformis</i> , <i>C. ovata</i>	7.17%	18.26
<b>Illegible or Not Recorded</b> —equivalent unknown	0.7%	38.58
<b>Ironwood</b> — <i>Ostrya virginiana</i>	-2.26%	6.77
<b>Jack Oak</b> — <i>Quercus ellipsoidalis</i>	-4.67%	-11.33
<b>Jack Pine</b> — <i>Pinus banksiana</i>	3.05%	0
<b>Juniper or Red Cedar</b> — <i>Juniperus virginiana</i>	2.76%	439.23
<b>Linden or Basswood</b> — <i>Tilia americana</i>	19.39%	20.6
<b>Maple</b> — <i>Acer rubrum</i> , <i>A. saccharum</i> , <i>A. saccharinum</i>	4.71%	19.71
<b>Oak</b> — <i>Quercus rubra</i> , <i>Q. macrocarpa</i> , <i>Q. ellipsoidalis</i> , <i>Q. velutina</i> , <i>Q. alba</i> , <i>Q. bicolor</i>	-0.53%	0
<b>Plum</b> —probably <i>Prunus americana</i>	0.34%	1.89
<b>Red Elm</b> — <i>Ulmus rubra</i>	10.65%	0
<b>Red Oak</b> — <i>Quercus rubra</i> , <i>Q. ellipsoidalis</i> (in part or as hybrid)	49.35%	30.38
<b>Red, Norway, or Yellow Pine</b> — <i>Pinus resinosa</i>	0.17%	20.81
<b>Sugar Maple</b> — <i>Acer saccharum</i>	10.82%	62.29
<b>Tamarack</b> — <i>Larix laricina</i>	-0.9%	0
<b>White Pine</b> — <i>Pinus strobus</i>	0.49%	26.42
<b>Willow</b> — <i>Salix</i> spp.	7.91%	55.97

**Source:** (Almendinger 2000); Public Land Survey Bearing Tree Data, late 1800's and United States Forest Service Forest Inventory and Analysis; this table was taken from the "Southeast Minnesota Landscape Current Conditions and Trends Assessment."

Note: This table is missing the relative abundances of species, which may make comparison of overall abundance among species difficult.

### 3.7. Age class structure of timberland

The three tables below (Table 28, Table 29, Table 30) show the amount of timberland (in acres) in the MFRC Southeast Landscape by specific forest type and by stand-size class according to Forest Inventory Analysis (FIA) data for 1990, 1999-2003, and 2008-2012. As the Forest Service did not consistently record forest type information prior to the annual surveys beginning in 1999, the 1990 data contains significantly fewer forest types (C. Barnett, personal communication). Because of this, all three tables also show the forest type groups, which better explain change across time.

The oak/hickory group maintains the largest percent of acreage across time, following a similar pattern to overall forest acreage by decreasing slightly by 2003 and increasing again by 2012. The elm/ash/cottonwood group, however, despite making up a lower percentage of total timberland, has increased steadily since 1990. The maple/beech/birch group has shown an overall decrease since 1990, though it increased between 2003 and 2012. Within that latter timeframe the hard maple/basswood type remained relatively consistent, though the sugar maple/beech/yellow birch type increased somewhat. The aspen/birch group also decreased substantially – by over 50% - since 1990, though it makes up a relatively small percentage of the southeast Minnesota forest.

In terms of stand-size class, large diameter stands have consistently made up the vast majority of timberland acreage, dipping somewhat drastically by 2003 but increasing beyond 1990 acreage by 2012. Acres of medium diameter stands have increased slightly since 1990 while acres of small diameter stands have decreased or stayed relatively the same over time (Figure 13).

**Table 28:** Area (in acres) of timberland by forest type group, forest type, and stand-size class for the Southeast landscape, 1990.

			Stand-size class		
Forest type group	Forest type	Total	Large diameter	Medium diameter	Small diameter
	<b>Total</b>	623,616	469,177	87,428	67,011
White / red / jack pine group	Red pine	806	-	305	501
<b>Group Subtotal</b>		<b>806</b>	<b>-</b>	<b>305</b>	<b>501</b>
Oak / hickory group	Oak / hickory group	369,960	315,637	39,720	14,603
<b>Group Subtotal</b>		<b>369,960</b>	<b>315,637</b>	<b>39,720</b>	<b>14,603</b>
Elm / ash / cottonwood group	Elm / ash / cottonwood group	83,203	61,801	12,801	8,601
<b>Group Subtotal</b>		<b>83,203</b>	<b>61,801</b>	<b>12,801</b>	<b>8,601</b>
Maple / beech / birch group	Maple / beech / birch group	133,540	77,438	18,001	38,101
<b>Group Subtotal</b>		<b>133,540</b>	<b>77,438</b>	<b>18,001</b>	<b>38,101</b>
Aspen / birch group	Aspen	24,207	7,101	11,901	5,205
	Paper birch	11,900	7,200	4,700	-
<b>Group Subtotal</b>		<b>36,107</b>	<b>14,301</b>	<b>16,601</b>	<b>5,205</b>

**Source:** Forest Inventory and Analysis estimate, 1990

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

**Table 29:** Area (in acres) of timberland by forest type group, forest type, and stand-size class for the Southeast landscape, 2003.

			Stand-size class			
Forest type group	Forest type	Total	Large diameter	Medium diameter	Small diameter	Non-stocked
	<b>Total</b>	539,199	338,870	153,388	40,423	6,517
White / red / jack pine group	Red pine	3,957	1,518	2,439	-	-
	Eastern white pine	6,652	3,617	3,035	-	-
<b>Group Subtotal</b>		<b>10,609</b>	<b>5,135</b>	<b>5,474</b>	<b>-</b>	<b>-</b>
Other eastern softwoods group	Eastern redcedar	8,977	2,715	-	6,262	-
<b>Group Subtotal</b>		<b>8,977</b>	<b>2,715</b>	<b>-</b>	<b>6,262</b>	<b>-</b>
Oak / hickory group	Oak / hickory group	646	160	486	-	-
	White oak / red oak / hickory	183,124	113,505	65,094	4,525	-
	White oak	5,751	5,751	-	-	-
	Northern red oak	45,853	45,853	-	-	-



	Bur oak	25,595	22,019	3,577	-	-
	Black walnut	3,716	2,811	905	-	-
	Elm / ash / black locust	13,542	2,455	8,811	2,276	-
	Mixed upland hardwoods	34,025	25,005	9,020	-	-
<b>Group Subtotal</b>		<b>312,252</b>	<b>217,559</b>	<b>87,893</b>	<b>6,801</b>	<b>-</b>
Elm / ash / cottonwood group	Elm / ash / cottonwood group	570	82	488	-	-
	Black ash / American elm / red maple	2,871	-	416	2,455	-
	Cottonwood	9,520	9,520	-	-	-
	Willow	2,398	-	-	2,398	-
	Sycamore / pecan / American elm	848	848	-	-	-
	Sugarberry / hackberry / elm / green ash	73,190	23,996	32,959	16,235	-
	Silver maple / American elm	7,788	6,190	1,599	-	-
	Cottonwood / willow	5,759	5,759	-	-	-
<b>Group Subtotal</b>		<b>102,944</b>	<b>46,395</b>	<b>35,462</b>	<b>21,088</b>	<b>-</b>
Maple / beech / birch group	Sugar maple / beech / yellow birch	34,782	23,094	7,646	4,043	-
	Hard maple / basswood	45,210	40,581	4,629	-	-
<b>Group Subtotal</b>		<b>79,992</b>	<b>63,675</b>	<b>12,275</b>	<b>4,043</b>	<b>-</b>
Aspen / birch group	Aspen	11,356	-	9,126	2,230	-
	Paper birch	6,551	3,393	3,159	-	-
<b>Group Subtotal</b>		<b>17,907</b>	<b>3,393</b>	<b>12,285</b>	<b>2,230</b>	<b>-</b>
Nonstocked	Nonstocked	6,517	-	-	-	6,517
<b>Group Subtotal</b>		<b>6,517</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>6,517</b>

**Source:** Forest Inventory and Analysis estimate, 1999-2003

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

**Table 30:** Area (in acres) of timberland by forest type group, forest type, and stand-size class for the Southeast landscape, 2012.

			Stand-size class			
Forest type group	Forest type	Total	Large diameter	Medium diameter	Small diameter	Non-stocked
	<b>Total</b>	702,547	490,724	163,878	44,527	3,418
White / red / jack pine group	Red pine	3,150	1,468	1,682	-	-
	Eastern white pine	8,895	5,888	2,202	805	-
<b>Group Subtotal</b>		<b>12,045</b>	<b>7,356</b>	<b>3,884</b>	<b>805</b>	
Spruce / fir group	White spruce	5,493	547	4,946	-	-
<b>Group Subtotal</b>		<b>5,493</b>	<b>547</b>	<b>4,946</b>	<b>-</b>	
Other eastern softwoods group	Eastern redcedar	6,616	5,676	940	-	-
<b>Group Subtotal</b>		<b>6,616</b>	<b>5,676</b>	<b>940</b>	<b>-</b>	<b>-</b>
Oak / pine group	Eastern redcedar /	6,728	3,364	3,364	-	-

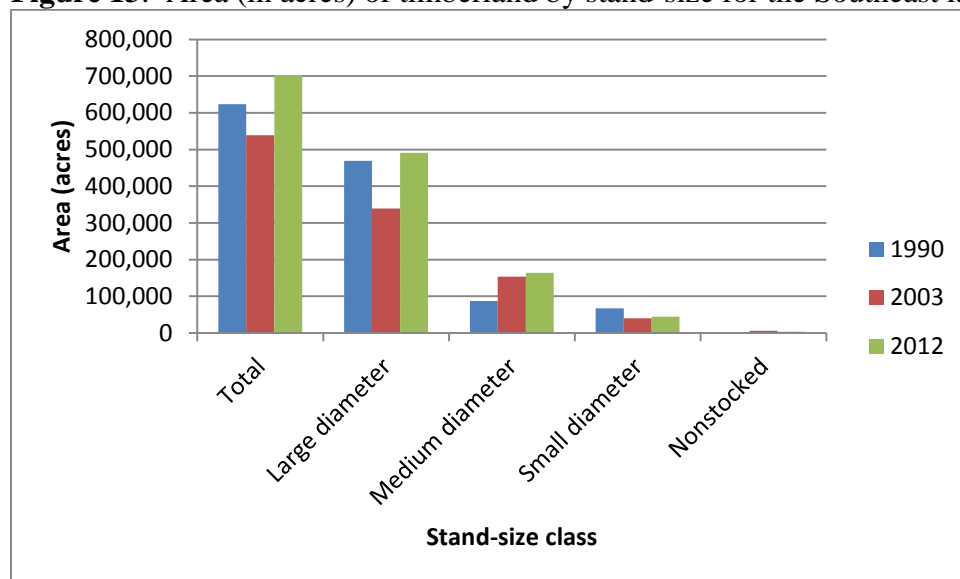
	hardwood					
<b>Group Subtotal</b>		<b>6,728</b>	<b>3,364</b>	<b>3,364</b>	<b>-</b>	<b>-</b>
Oak / hickory group	White oak / red oak / hickory	211,787	156,473	55,313	-	-
	White oak	7,675	7,675	-	-	-
	Northern red oak	66,458	61,089	144	5,225	-
	Bur oak	37,521	37,521	-	-	-
	Black walnut	11,649	6,665	3,360	1,624	-
	Elm / ash / black locust	18,947	4,841	3,683	10,423	-
	Mixed upland hardwoods	63,256	41,821	16,142	5,293	-
<b>Group Subtotal</b>		<b>417,293</b>	<b>316,085</b>	<b>78,642</b>	<b>22,565</b>	<b>-</b>
Elm / ash / cottonwood group	Black ash / American elm / red maple	12,951	11,226	1,724	-	-
	Cottonwood	18,992	18,992	-	-	-
	Willow	733	733	-	-	-
	Sugarberry / hackberry / elm / green ash	73,178	29,195	36,286	7,697	-
	Silver maple / American elm	19,965	13,219	4,173	2,573	-
	Cottonwood / willow	3,273	3,273	-	-	-
<b>Group Subtotal</b>		<b>129,092</b>	<b>76,638</b>	<b>42,183</b>	<b>10,270</b>	<b>-</b>
Maple / beech / birch group	Sugar maple / beech / yellow birch	58,885	38,942	14,187	5,756	-
	Hard maple / basswood	41,159	35,353	3,200	2,606	-
<b>Group Subtotal</b>		<b>100,044</b>	<b>74,295</b>	<b>17,387</b>	<b>8,362</b>	<b>-</b>
Aspen / birch group	Aspen	11,017	4,240	5,068	1,708	-
	Paper birch	6,621	2,523	4,098	-	-
<b>Group Subtotal</b>		<b>17,638</b>	<b>6,763</b>	<b>9,166</b>	<b>1,708</b>	<b>-</b>
Other hardwoods group	Other hardwoods	4,182	-	3,364	818	-
<b>Group Subtotal</b>		<b>4,182</b>	<b>-</b>	<b>3,364</b>	<b>818</b>	<b>-</b>
Nonstocked	Nonstocked	3,418	-	-	-	3,418
<b>Group Subtotal</b>		<b>3,418</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3,418</b>

**Source:** Forest Inventory and Analysis estimate, 2008-2012.

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.



**Figure 13:** Area (in acres) of timberland by stand-size for the Southeast landscape, 1990-2012.



**Source:** Forest Inventory and Analysis estimate 1990, 2003, 2012

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

### 3.8. Annual growth, mortality, and removals of growing stock on timberland

According to Forest Inventory and Analysis (FIA) 2008-2012 estimates (as of October 2013) of growing stock on timberland, there are nearly 900 million cubic feet of growing stock timber in southeast Minnesota (Table 31). The species groups that experienced the greatest quantity of net growth (in board feet, NOT by percent of total) were “other eastern soft hardwoods,” followed by hard maple, then basswood, then select red oaks. By a large margin, the species group with the greatest quantity of mortality was “other eastern soft hardwoods” by a similar quantity to total net growth after mortality, followed by select red oaks, cottonwood and aspen, and select white oaks. Species groups that experienced the highest removal quantities (in cubic feet) were cottonwood and aspen, select red oaks, and ash.

Estimates of sawtimber volumes were greater. By 2012, the MFRC Southeast Landscape had an estimated over 3.1 billion board feet (International ¼-inch rule) of sawtimber (Table 32). Select red oaks had the greatest net volume by a large margin, followed by select white oaks, cottonwood and aspen, and other eastern soft hardwoods. In terms of growth, however, other eastern soft hardwoods experienced the greatest overall quantity of net growth, followed by select red oaks, hard maple, and basswood. Mortality and removal numbers were not available for all species; however, “other eastern hard hardwoods” and “other” species experienced negative net growth, possibly due to high mortality rates.

U.S. Forest Service definitions for FIA terms are listed below.

Forest Inventory and Analysis Definitions (USFS):

- Growing stock. All live trees of commercial species that meet minimum merchantability standards (at least 5 inches d.b.h.). In general, these trees have at least one solid 8-foot section, are reasonably free from defect on the merchantable bole, and at least 34% or more of the volume is merchantable. Excludes rough or rotten cull trees.
- Sawtimber. A tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.
- Net cubic-foot volume. For timber species, this is the net volume of wood in the central stem of a sample tree  $\geq 5.0$  inches in diameter, from a 1-foot stump to a minimum 4-inch top diameter, or to where the central stem breaks into limbs all of which are  $<4.0$  inches in diameter. For woodland species (trees where the diameter is measured at root collar [DRC]), this is the net volume of wood and bark from the DRC measurement point(s) to a 1-1/2 inch top diameter; includes branches that are at least 1-1/2 inches in diameter along the length of the branch.
- Average annual net growth. The average annual change in the volume of trees during the period between inventories. Components include the change in volume of trees that have met the minimum size requirements over the inventory period, plus the volume of trees reaching the minimum size during the period (ingrowth), minus the volume of trees that died during the period, minus the volume of cull during the period. Mortality removals (trees killed in the harvesting process and left on site) and diversion removals (trees removed from the forest-land base due to a change from forest to non-forest land) are not included.
- Average annual removals of growing stock. Trees that were growing-stock trees on timberland at the time of the previous inventory and were removed from timberland by the time of the current inventory. Removals are cut and utilized trees, trees killed as a result of harvest operations but not utilized and live trees associated with land-use reclassifications.
- Average annual mortality of growing stock. Volume of growing stock trees that were alive at the time of the previous inventory and are dead in the current inventory. Tree death associated with insects, disease, fire, animals, weather, and other factors are included.
- Average annual sawtimber board-foot removals on timberland. Growing-stock trees that were or achieved sawtimber-size by the midpoint between inventory periods and were removed from timberland by the time of the current inventory. Removals are cut and utilized trees, trees killed as a result of harvest operations but not utilized, and live trees associated with land-use reclassifications.
- Sampling error percent. Equals 100 multiplied by the square root of the variance divided by the sample estimate.
- Timberland. Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as timberland are capable of producing at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.

**Table 31:** Estimated current net volume, and average net annual growth, mortality and removals of growing stock (in cubic feet) on timberland by species group for the MFRC Southeast Landscape, 2012.

	Total volume		Net growth		Mortality		Removals	
Species group	cubic feet	sampling error	cubic feet	sampling error	cubic feet	sampling error	cubic feet	sampling error
<b>Total</b>	873,980,019	7.33	25,778,326	10.44	9,459,981	11.93	7,863,503	34.79
Eastern white and red pine	24,082,888	48.28	1,601,511	44.04	71,908	98.07	-	-
Spruce and balsam fir	4,905,185	59.39	853,899	58.93	n/a	-	-	-
Other eastern softwoods	7,071,731	33.25	492,092	39.64	n/a	-	-	-
Select white oaks	100,231,168	15.17	1,518,211	29.01	598,812	36	432,607	60.88
Select red oaks	155,764,447	13.52	2,474,251	39.57	1,175,550	45.27	1,718,502	62.48
Other red oaks	25,741,919	31.64	1,371,262	61.97	7,621	92.28	344,345	73.42
Hickory	31,699,240	15.28	989,689	22.72	241,223	47.1	-	-
Hard maple	56,346,328	21.82	3,068,069	36.49	n/a	-	71,871	92.28
Soft maple	60,515,956	38.6	1,085,486	36.76	155,999	56.61	170,334	67.78
Ash	29,539,730	18.95	1,316,647	35.73	235,874	83.55	1,707,211	75.97
Cottonwood and aspen	86,900,124	22.91	2,492,347	28.99	870,127	36.53	1,911,147	68.65
Basswood	81,461,361	14.86	2,713,336	25.3	484,814	67.54	340,009	97.84
Black walnut	36,630,987	18.11	2,146,283	24.57	139,615	61.1	585,798	62.02
Other eastern soft hardwoods	168,874,955	8.57	5,919,095	15.85	5,450,394	13.11	566,824	43.16
Other eastern hard hardwoods	4,214,001	40.8	-19,029	-1,295.42	28,045	66.6	14,856	93.37
Eastern non-commercial hardwoods	n/a	n/a	-21,966	-92.28	n/a	-	-	-
Other	n/a	n/a	-2,222,856	-27.71	n/a	-	-	-

**Source:** Forest Inventory and Analysis estimates. Miles, P.D. Tue Oct 22 2013. Forest Inventory EVALIDator web-application version 1.5.1.05. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://apps.fs.fed.us/Evalidator/tmattribute.jsp>]

**Table 32:** Estimated current net volume, and average net annual growth, mortality and removals of sawtimber (in board feet, international 1/4" rule) on timberland by species group for the Southeast landscape, 2012.

Species Group	Net Volume		Growth		Mortality		Removals	
	board feet	sampling error	board feet	sampling error	board feet	sampling error	board feet	sampling error
<b>Total</b>	3,146,057,661	8.76	101,474,605	11.18	24,863,557	17.13	36,043,565	37.89
Eastern white and red pine	94,686,457	53.62	7,229,751	52.71	328,915	98.07	-	-
Spruce and balsam fir	8,796,972	57.87	1,682,095	57.93	-	-	-	-
Other eastern softwoods	15,247,388	43.88	388,624	43.69	-	-	-	-
Select white oaks	411,615,711	16.76	8,444,502	23.59	1,358,283	56.12	1,902,572	65.64
Select red oaks	725,197,567	14.64	13,341,211	36.24	4,876,495	54.11	8,422,975	62.55
Other red oaks	117,868,805	32.87	6,557,330	63.63	-	-	1,681,316	74.91
Hickory	68,047,665	20.66	3,081,289	27.78	411,787	92.28	-	-
Hard maple	203,672,966	25.61	11,590,651	41.24	-	-	304,191	92.28
Soft maple	287,131,538	40.98	6,569,544	34.74	486,895	70.88	468,631	92.28
Ash	100,581,898	24.79	4,731,692	41.05	852,115	92.28	7,961,937	82.22
Cottonwood and aspen	355,045,140	27.54	9,842,099	27.11	2,789,108	44.43	9,783,407	73.3
Basswood	286,742,247	19.96	10,479,040	31.49	2,336,804	69.54	825,357	102.35
Black walnut	124,974,933	22.67	6,332,252	30.19	339,586	92.28	2,899,714	64.42
Other eastern soft hardwoods	335,801,499	12.97	18,464,069	19.96	11,083,569	18.43	1,793,464	57.34
Other eastern hard hardwoods	10,646,877	50.8	-59,589	-1,380.46	-	-	-	-
Other	n/a	n/a	-7,199,955	-33.54	-	-	-	-

**Source:** Forest Inventory and Analysis estimates. Miles, P.D. Tue Oct 22 2013. Forest Inventory EVALIDator web-application version 1.5.1.05. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://apps.fs.fed.us/Evalidator/tmattribute.jsp>]

### 3.9. Southeast vascular plant

The Minnesota DNR maintains a list of vascular plant species that reflect vouchered specimens present in herbarium collections at the University of Minnesota Herbarium, a division of the Bell Museum of Natural History on the St. Paul campus, and select plant families (Cyperaceae, Orchidaceae, and ferns) from the Olga Lakela Herbarium at University of Minnesota Duluth. This database, called MNTaxa, provides the species “full scientific name, including family, genus, species, and variety or subspecies (when applicable). Other attributes available include: whether the species is introduced to Minnesota; current status according to Minnesota's Endangered Species Statute and associated Rules; physiognomy; and the counties and subcounties in which the species has been documented,” according to the MNTaxa website. For further information on this database visit: [www.dnr.state.mn.us/eco/mcbs/plant\\_lists.html](http://www.dnr.state.mn.us/eco/mcbs/plant_lists.html)

According to this dataset total vascular plant species richness in Minnesota is 2,250 with 1,376 documented in the Southeast Landscape (Table 33). Of these 1,376 species, 1179 are native, 193 are introduced, and there are four for which the native or non-native status is unknown. There are 75 vascular plant species in the Southeast Landscape Region that are found nowhere else in the state, according to herbarium records; 11 of those species have recorded Minnesota occurrences only in Houston County (Table 34).

**Table 33:** Vascular plant species richness in the Southeast Landscape

	<b>Dodge</b>	<b>Fillmore</b>	<b>Freeborn</b>	<b>Goodhue</b>	<b>Houston</b>	<b>Le Sueur</b>	<b>Mower</b>
Native	427	743	418	811	854	514	562
Introduced	52	107	62	134	139	73	79
Unknown	2	2	1	2	3	1	1
<b>Total Species</b>	481	852	481	947	996	588	642
%Native	88.8%	87.2%	86.9%	85.6%	85.7%	87.4%	87.5%
	<b>Olmstead</b>	<b>Rice</b>	<b>Steele</b>	<b>Wabasha</b>	<b>Waseca</b>	<b>Winona</b>	<b>Southeast Landscape</b>
Native	568	566	457	790	409	831	<b>1179</b>
Introduced	72	86	65	108	69	127	<b>193</b>
Unknown	2	1	2	1	1	2	<b>4</b>
<b>Total Species</b>	642	653	524	899	479	960	<b>1376</b>
%Native	88.5%	86.7%	87.2%	87.9%	85.4%	86.6%	<b>85.7%</b>

**Source:** Minnesota DNR, MNTaxa

Note: The number of species with recorded occurrences in a given landscape reflect herbarium records and not necessarily the richness of the landscape.

**Table 34:** Number of vascular plants in Minnesota with recorded occurrence limited to the MFRC Southeast Landscape; number of these vascular plants with recorded occurrence limited to single counties within the Southeast region.

<b>Southeast Landscape</b>	<b>75</b>
Dodge	0
Fillmore	4
Freeborn	0

Goodhue	3
Houston	11
Le Sueur	0
Mower	4
Olmstead	0
Rice	0
Steele	0
Wabasha	2
Waseca	0
Winona	5

**Source:** Minnesota DNR, MNTaxa

Note: The number of species with recorded occurrences in a given landscape reflect herbarium records and not necessarily the richness of the landscape.

### 3.10. Species richness of mammals, amphibians and reptiles, and birds in the MFRC's Southeast Landscape.

According to vertebrate surveys performed during the Minnesota Biological Survey, there are at least 71 small and incidental mammals, 21 (29.6%) of which are in southeast Minnesota (note: recorded observations of larger mammals on an “incidental” basis do not necessarily represent all large mammals in the state) (Table 35). Fifty-two amphibians and reptiles were observed state-wide during the surveys, 44 (84.6%) of which were found in southeast Minnesota, and 247 breeding birds were observed statewide, 156 (%) of which were found in southeast Minnesota.

**Table 35:** Total species richness and richness of small and incidental mammals\*, amphibians and reptiles, and breeding birds in Minnesota and the MFRC Southeast Landscape.

	Small/incidental mammals <sup>a</sup>	Amphibians and reptiles <sup>b</sup>	Breeding Birds <sup>a</sup>
<b>Minnesota</b>	71	52	247
<b>Southeast Landscape</b>	21	44	156
Dodge	6	20	94
Fillmore	9	29	91
Freeborn	8	15	118
Goodhue	9	32	84
Houston	9	38	106
Le Sueur	7	22	97
Mower	7	25	101
Olmstead	8	28	83
Rice	15	22	79
Steele	7	16	98
Wabasha	7	32	97
Waseca	6	13	108
Winona	12	38	110

\*These data are still preliminary at this time. “Incidental” mammals are larger mammals whose presence was observed during grid trapping sessions for small mammals.

<sup>a</sup>Karen Cieminski and Steve Stucker, Minnesota Biological Survey, MN DNR Division of Ecological and Water Resources, 2013.

<sup>b</sup>(Hall 2013); (MN DNR 2013 (3)). For distribution maps:

[http://files.dnr.state.mn.us/eco/mcbs/herp\\_maps/reptile\\_and\\_amphibian\\_maps\\_2ecs.pdf](http://files.dnr.state.mn.us/eco/mcbs/herp_maps/reptile_and_amphibian_maps_2ecs.pdf). Note: the following types of recordings were included for amphibians/reptiles : *vouchered record, post-1960*, specimen or photo collected after 1960; *vouchered record, pre-1960*, specimen or photo collected prior to 1960; *sighting or literature record*, description of species lacking a photo or specimen. Massasagua was not included as according to Hall the species is likely extirpated from the state.

### 3.11. Species at risk

As stated by the Minnesota Department of Natural Resources (MN DNR) webpage on endangered, threatened, and special concern species:

“Minnesota law requires the Department of Natural Resources to maintain a list of species that are at risk of disappearing from the state. Listed species are placed into one of three categories: endangered, threatened and special concern (ETSC). The list is based on scientific field studies, such as those conducted by the Minnesota Biological Survey.” (MN DNR 2013 (4))

The state’s List of Endangered, Threatened and Special Concern Species was first established in 1984; it was updated once in 1996 and again in 2013 (Table 36).

As stated in “Minnesota’s list of endangered, threatened, and special concern species,” Minnesota designates species as:

- “Endangered, if the species is threatened with extinction throughout all or a significant portion of its range;
- Threatened, if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range;
- Species of Special Concern, if although the species is not endangered or threatened, it is extremely uncommon in this state, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range that are not listed as threatened may be included in this category along with those species that were once threatened or endangered but now have increasing or protected, stable populations.” (MN DNR 2013 (2))

#### *Section 3.11.1: Endangered, Threatened, and Special Concern Species in the Southeast Landscape*

In the MFRC Southeast Landscape, there are a combined 4 endangered, 5 threatened, and 27 special concern vertebrate species (excluding fish). Of the 31 species of forest-associated ETSC species, 17 are found in southeast Minnesota; examples include the least weasel (*Mustela nivalis*), red-shouldered hawk (*Buteo lineatus*), timber rattlesnake (*Crotalus horridus*), and Blanding’s turtle (*Emys blandingii*) (Table 37). [Note: These numbers need to be verified by the update to the online Rare Species Guide tool (appears to not be updated as of 8/18/2014). The 7 mammals, 5 birds, 3 reptiles or amphibians added in August are not in the RSG and location/habitat type had to be extrapolated from descriptive summaries created for the revision of the ETSC list, and at times these delineations were not clear.]

**Table 36:** Numbers of endangered, threatened, and special concern species for Minnesota, 2013.

	Endangered	Threatened	Special Concern	Total
Mammals	0	2	19	21
Birds	9	2	21	32
Amphibians and Reptiles	2	4	10	16
Fish	4	5	25	34
Mollusks	13	11	9	33
Jumping Spiders	0	1	9	10
Leafhoppers	0	0	3	3
Dragonflies	0	1	7	8
Butterflies and Moths	8	1	10	19
Caddisflies	5	11	8	24
Tiger Beetles	3	2	4	9
Vascular Plants	86	93	130	309
Fungi	3	0	5	8
Lichens	7	9	21	37
Mosses and Liverworts	3	7	17	27
<b>Total</b>	<b>143</b>	<b>149</b>	<b>298</b>	<b>590</b>

**Source:** Minnesota's List of Endangered, Threatened, and Special Concern Species, 2013. MN DNR Division of Ecological and Water Resources.

**Table 37:** Complete list of endangered, threatened, and special concern species of mammals, breeding birds, and amphibians and reptiles in Minnesota, 2013. Forest-associated species are designated with (F); species present in Southeast Minnesota are in bolded print.

	Endangered	Threatened	Special Concern
<b>Mammals</b>	--	<ul style="list-style-type: none"> <li>• eastern spotted skunk (F)</li> <li>• northern pocket gopher</li> </ul>	<ul style="list-style-type: none"> <li>• moose (F)</li> <li>• elk (F)</li> <li>• North American least shrew</li> <li>• <b>big brown bat (F?)</b></li> <li>• Canada lynx (F) (Fed. Status: T)</li> <li>• <b>prairie vole</b></li> <li>• <b>woodland vole (F)</b></li> <li>• <b>least weasel (F)</b></li> <li>• <b>little brown myotis (F?)</b></li> <li>• <b>northern myotis (F)</b></li> <li>• northern grasshopper mouse</li> <li>• <b>tri-colored bat (F)</b></li> <li>• <b>plains pocket mouse</b></li> <li>• eastern heather vole (F)</li> <li>• mountain lion (F)</li> <li>• <b>western harvest mouse</b></li> <li>• smoky shrew (F)</li> <li>• northern bog lemming (F)</li> <li>• Richardson's ground squirrel</li> </ul>



<b>Breeding Birds</b>	<ul style="list-style-type: none"> <li>• Baird's sparrow</li> <li>• <b>Henslow's sparrow</b></li> <li>• Sprague's pipit (Fed. Status: C)</li> <li>• burrowing owl</li> <li>• chestnut-collared longspur</li> <li>• piping plover (Fed. Status: E/T)</li> <li>• <b>loggerhead shrike</b></li> <li>• horned grebe</li> <li>• <b>king rail</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Wilson's phalarope</b></li> <li>• common tern</li> </ul>	<ul style="list-style-type: none"> <li>• northern goshawk (F)</li> <li>• boreal owl (F)</li> <li>• Nelson's sparrow</li> <li>• <b>short-eared owl</b></li> <li>• <b>red-shouldered hawk (F)</b></li> <li>• <b>lark sparrow</b></li> <li>• yellow rail</li> <li>• <b>trumpeter swan</b></li> <li>• <b>Acadian flycatcher (F)</b></li> <li>• <b>peregrine falcon</b></li> <li>• <b>common gallinule</b></li> <li>• Franklin's gull</li> <li>• marbled godwit</li> <li>• <b>Louisiana waterthrush (F)</b></li> <li>• American white pelican</li> <li>• <b>purple martin</b></li> <li>• <b>cerulean warbler (F)</b></li> <li>• <b>hooded warbler (F)</b></li> <li>• <b>Forster's tern</b></li> <li>• greater prairie-chicken</li> <li>• <b>Bell's vireo</b></li> </ul>
<b>Reptiles and Amphibians</b>	<ul style="list-style-type: none"> <li>• <b>northern cricket frog (F)</b></li> <li>• massasauga<sup>a</sup> (F) (Fed. Status: C)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>timber rattlesnake (F)</b></li> <li>• <b>Blanding's turtle (F)</b></li> <li>• <b>wood turtle (F)</b></li> <li>• <b>western ratsnake (F)</b></li> </ul>	<ul style="list-style-type: none"> <li>• spotted salamander (F)</li> <li>• Great Plains toad</li> <li>• <b>smooth softshell</b></li> <li>• <b>North American racer (F)</b></li> <li>• four-toed salamander (F)</li> <li>• <b>plains hog-nosed snake</b></li> <li>• mudpuppy (F?)</li> <li>• <b>gopher snake</b></li> <li>• <b>common five-lined skink</b></li> <li>• lined snake</li> </ul>

**Source:** Minnesota's List of Endangered, Threatened, and Special Concern Species, 2013 (5), MN DNR Division of Ecological and Water Resources; Rare Species Guide, MN DNR 2013 (6).

<sup>a</sup>Massasauga is not shown as present in southeast MN as according to Carol Hall of the Minnesota Biological Survey staff, the species is likely extirpated from the state.

### *Section 3.11.2: SCGN Species by Subsection for the three main Subsections in the Southeast Landscape*

When examined by the three most dominate Subsections, the Blufflands also contains the highest number of Species of Greatest Conservation Need (SGCN) in the region. The Blufflands contains 156 SGCN, which is approximately two-thirds more than either the Rochester Plateau (94) or the Oak Savanna Subsections (93) (Table 38-Table 40).

Table 38: SGCN in the Blufflands Subsection

	# of SGCN	Percentage of SGCN Set by Taxon	Examples of SGCN
Amphibians	3	50	Pickerel frog
Birds	53	54.6	Blue-winged warbler
Fishes	26	55.3	Crystal darter
Insects	14	25	Karner blue butterfly
Mammals	9	40.9	Northern myotis
Mollusks	32	82.1	Hubricht's vertigo
Reptiles	16	94.1	Timber rattlesnake
Spiders	3	37.5	<i>P. apacheanus</i>
TOTAL SGCN	156		

Table 39: SGCN in the Rochester Plateau Subsection

	# of SGCN	Percentage of SGCN Set by Taxon	Examples of SGCN
Amphibians	3	50	Pickerel frog
Birds	46	47.4	Loggerhead shrike
Fishes	11	23.4	Gravel chub
Insects	7	12.5	<i>None documented since 1990</i>
Mammals	6	27.3	Eastern pipistrelle
Mollusks	9	23.1	Ellipse
Reptiles	12	70.6	Six-lined racerunner
Spiders	0	0	NA
TOTAL SGCN	94		

Table 40: SGCN in the Oak Savanna Subsection

	# of SGCN	Percentage of SGCN Set by Taxon	Examples of SGCN
Amphibians	2	33.3	Common Mudpuppy
Birds	48	49.5	Bobolink
Fishes	12	25.5	Slender madtom
Insects	7	12.5	<i>None documented since 1990</i>
Mammals	7	31.8	Western harvest mouse
Mollusks	9	23.1	Spike
Reptiles	8	47.1	Eastern fox snake
Spiders	0	0	NA
TOTAL SGCN	93		

### 3.12. Invasive Species

Non-native invasive species pose a significant threat to Minnesota’s forests, lakes, and associated economies. Figure 14 through Figure 16 show the distribution of invasive plants listed on Minnesota’s Prohibited Noxious Weeds List. The Minnesota Department of Agriculture (MDA) is responsible for maintaining and updating this list which includes, according to the MDA’s website, “annual, biennial, or perennial plants that the commissioner designates as having the potential or are known to be detrimental to human or animal health, the environment, public roads, crops, livestock or other property” (MDA 2013). Plants on this list are designated as:

1. “Eradicate List: plants that are not currently known to be present in Minnesota or are not widely established. These species must be eradicated, meaning all of the above and below ground parts of the plant must be destroyed, as required by Minnesota Statutes, Section 18.78. Additionally, no transportation, propagation, or sale of these plants is allowed. Measures must also be taken to prevent and exclude these species from being introduced into Minnesota.
2. Control List: plants established throughout Minnesota or regions of the state. Species on this list must be controlled, meaning efforts must be made to prevent the spread, maturation and dispersal of any propagating parts, thereby reducing established populations and preventing reproduction and spread as required by Minnesota Statutes, Section 18.78. Additionally, transportation, propagation, or sale of these plants is prohibited.
3. Restricted Noxious Weeds: plants that are widely distributed in Minnesota and are detrimental to human or animal health, the environment, public roads, crops, livestock or other property, but whose only feasible means of control is to prevent their spread by prohibiting the importation, sale, and transportation of their propagating parts in the state except as allowed by Minnesota Statutes, Section 18.82. Plants designated as Restricted Noxious Weeds may be reclassified if effective means of control are developed.” (MDA 2013)

Table 41 summarizes the total number of observations of terrestrial plant invasive species present on both the Noxious Weeds list and in the Southeast Landscape that were made by the Minnesota Department of Natural Resources (MN DNR) Division of Ecological and Water Resources, as well as the Minnesota Department of Agriculture’s (MDA) Early Detection and Distribution Mapping System (EDD MapS). Reed canary grass (*Phalaris arundinacea*) is not listed on the Noxious Weeds List, but is included because of its abundance in the region. The most frequently observed species included reed canary grass, wild parsnip (*Pastinaca sativa*), and common buckthorn (*Rhamnus cathartica*). As seen in Figure 14, Figure 15, and Figure 16, the largest observed concentrations of these terrestrial invasive plant species are along waterways and highways, such as portions of the Mississippi and Root rivers, and along Hwy 60/the Cannon River in Le Sueur and Rice counties. It should be noted, however, that these data contain heavy sampling bias, as roadways and public lands were the only accessible sample sites. It is therefore possible that many more observations of these terrestrial invasive species could be made on private land in southeast Minnesota. It should also be noted that the species presented are only those found on the MDA’s “Noxious Weeds” list (MDA 2013 (1)) and does not include all terrestrial invasive plants that may be present in the region, such as Japanese barberry (*Berberis thunbergii*).

Figure 14 shows species on the MDA “Eradicate List,” indicating that they are not yet widely distributed in the state. However, while not yet widely distributed it is possible that some of these species have existed within the state for a while, undetected. According to the MDA, the first Minnesota reported outbreak and control of oriental bittersweet occurred in 2010 in the Twin Cities metro area, where it had been mistaken with American bittersweet (*Celastrus scandens*) and planted; however, estimates show that some outbreaks may be 30 years old, indicating that the species has been in the state and gone unnoticed for quite some time (A. Gupta, personal communication). There are currently reported outbreaks of this destructive plant in both Goodhue and Winona counties (MDA 2013 (2)).

More information on terrestrial invasive plants in Minnesota can be found at:

[www.mda.state.mn.us/plants/badplants/noxiouslist.aspx](http://www.mda.state.mn.us/plants/badplants/noxiouslist.aspx) or  
[www.dnr.state.mn.us/invasives/terrestrial/index.html](http://www.dnr.state.mn.us/invasives/terrestrial/index.html)  
<http://www.dnr.state.mn.us/invasives/terrestrialanimals/eab/index.html>

Another terrestrial invasive species of major concern in Southeast Minnesota in recent years is the emerald ash borer (*Agrilus planipennis*). According to the Minnesota Department of Natural Resources webpage on emerald ash borer:

“Emerald ash borer (EAB) is a nonnative invasive insect that destroys ash trees. EAB has currently been identified in the Metro and Southeastern regions of the state and quarantine has been placed on Ramsey, Hennepin, Houston, and Winona counties to help slow the spread of EAB to other areas.” (MN DNR 2013 (7))

Areas of highest risk of EAB introduction were inferred based on the presence of campgrounds, firewood dealers, sawmills, urban areas and other potential sources of EAB introduction due to human movement of the insect (MDA 2006). Areas of highest introduction risk in the Southeast Landscape include the city of Rochester and areas surrounding the lakes along the Cannon River in Le Sueur County (Figure 17). Presence of EAB has been confirmed for several sites in Winona and Houston counties (Table 42, Figure 17).

The following EAB definitions for Table 42 are from the Minnesota Dept. of Agriculture:

- **Emerald Ash Borer Introduction Risk:** “The purpose of the risk model and map is to optimize the placement of emerald ash borer detection (trap) trees in Minnesota.” (MDA 2006, p. 1)

**EAB Biological Control Sites:** “Biological control is the only management option that can be applied at the forest landscape level. The goal of EAB biological control is to use natural enemies to bring EAB populations into balance and reduce damage. There are three species of parasitoid wasps that are approved for release. These species were selected by the US Department of Agriculture’s Animal and Plant Health Inspection Service (APHIS) and Forest Service. These three species were tested to ensure that they will not negatively impact other species or the environment. APHIS rears these biological control agents at a specialized facility and provides them to states with EAB infestations. Biological control implementation is a collaborative effort by local governments and state and federal agencies. The Minnesota Department of Agriculture coordinates the statewide EAB biological control program.” (MDA

2011, p.2) Figure 21 shows waters designated by the MN DNR as being infested with aquatic invasive plants. Major areas of impact, as seen in the figure, include the Mississippi and Zumbro rivers, and in lakes along the Cannon river such as Cannon and Tetonka lakes in Steele and Rice counties.

Gypsy moth trapping results from 2002 to 2013 indicate somewhat irregular results from 2002 to 2007, with a sudden peak in 2008 (Table 43). Concentrations of trapped moths were highest in Houston County that year. A treatment was imposed in some locations in 2009 (Figure 19). Trapped moth numbers dropped again in 2009 through 2013, though it is unclear whether lower moth numbers were a direct result of that treatment or if other factors were involved, considering the irregular numbers in pre-2008 years. Eight of 13 counties in the region had evidence of moth presence in 2013 (Table 46).

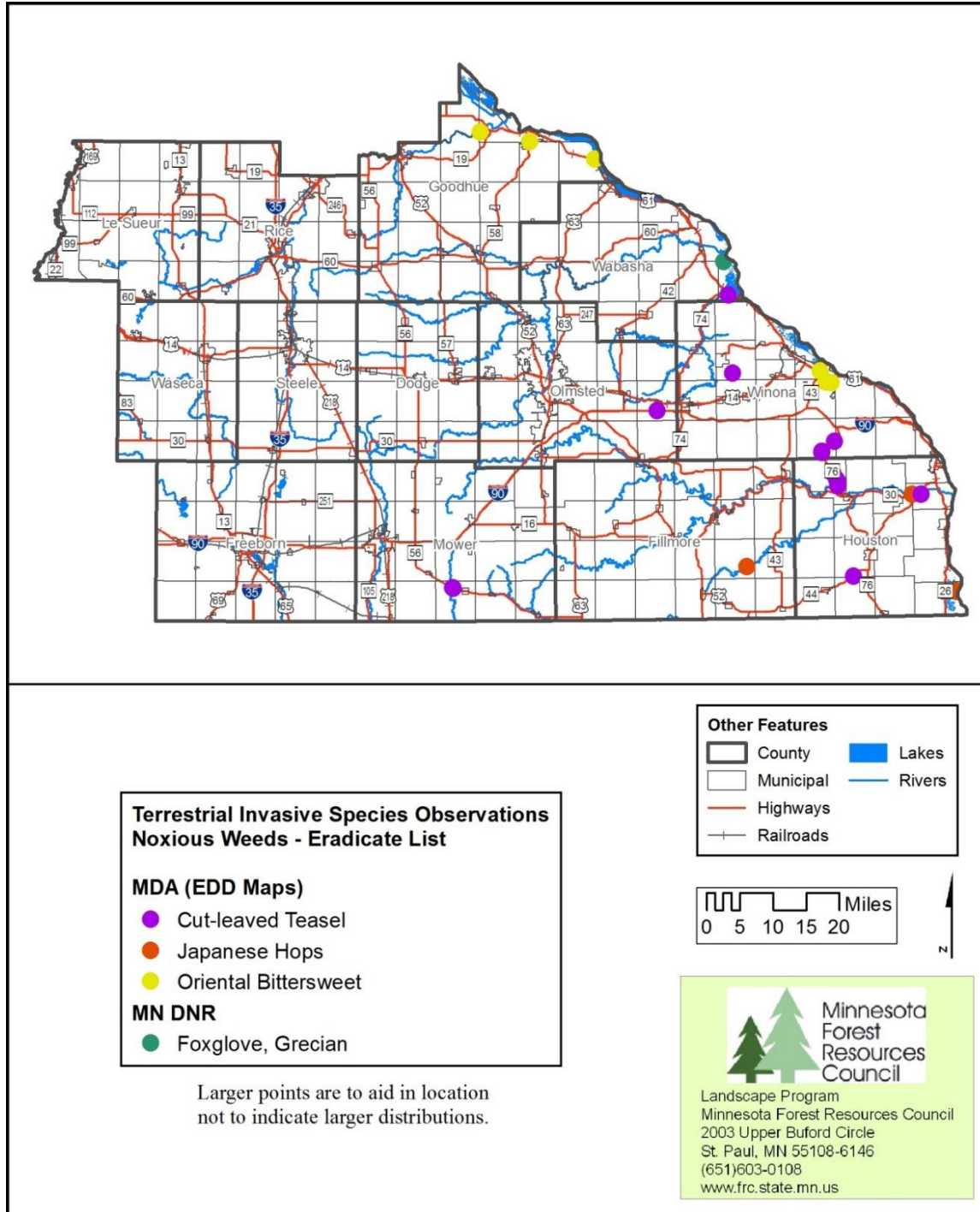
**Table 41:** Terrestrial invasive plant species observations in the Southeast Landscape, 2004 to 2012.

Noxious Weed List Status	Source	Scientific name	Common name	Number of Observations
Eradicate	EDD MapS	Dipsacus laciniatus	cutleaf teasel	16
	EDD MapS	Humulus japonicas	Japanese hops	4
	EDD MapS	Celastrus orbiculatus	oriental bittersweet	6
	MN DNR	Digitalis lanata	Grecian foxglove	1
Control	MN DNR	Centaurea stoebe	spotted knapweed	25
	MN DNR	Lythrum salicaria	purple loosestrife	111
	MN DNR	Alliaria petiolata	garlic mustard	371
	MN DNR	Pastinaca sativa	wild parsnip	4124
	MN DNR	Euphorbia esula	leafy spurge	77
	MN DNR	Tanacetum vulgare	common tansy	962
	MN DNR	Cirsium arvense	Canada thistle	254
	MN DNR	Carduus nutans	musk/nodding thistle	8
	MN DNR	Carduus acanthoides	plumeless thistle	8
Restricted	MN DNR	Rhamnus cathartica	common buckthorn	2921
	MN DNR	Frangula alnus	glossy buckthorn	33
Not listed	MN DNR	Phalaris arundinacea	reed canary grass	4778

**Source:** Minnesota Department of Natural Resources Division of Ecological and Water Resources, MN DNR Data Deli (MN DNR 2013 (8)); Minnesota Dept. of Agriculture Early Detection and Distribution Mapping System (EDD MapS)

Note: Observations were made between 6/17/2004 and 10/8/2013. Each observation may vary for the number of plants observed, distribution of plants, and acres infected. Separate observations may represent the same location, therefore the count of observations may over-represent the distribution of a species. Some current distribution records in EDD MapS have not been verified.

**Figure 14:** Terrestrial invasive plant species observations in the Southeast Landscape, 2004 to 2012, MDA Eradicate List.

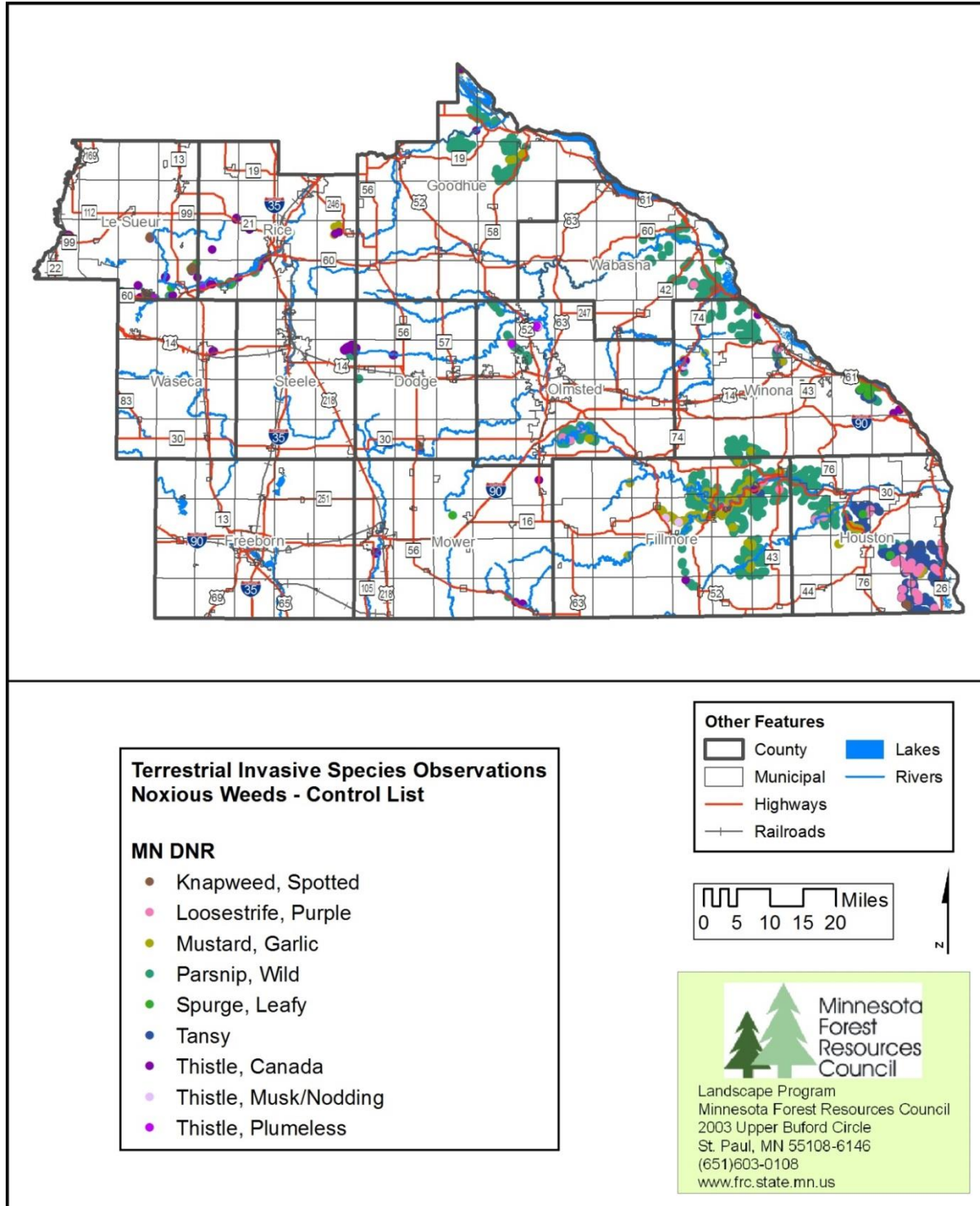


**Source:** Minnesota DNR Data Deli; Minnesota Dept. of Agriculture Early Detection and Distribution Mapping System

**Notes:** The species represented in this figure are designated by the MN Department of Agriculture as ‘Noxious Weeds’ (Eradicate List) and therefore falling under the Noxious Weed Law

([www.mda.state.mn.us/plants/badplants/noxiouslist.aspx](http://www.mda.state.mn.us/plants/badplants/noxiouslist.aspx)). Colored dots are overlapping (least common species are in the top layers) and thus some dots may not be visible. Some current distribution records in EDD MapS have not been verified.

**Figure 15:** Terrestrial invasive plant species observations in the Southeast Landscape, 2004 to 2012, MDA Control List.

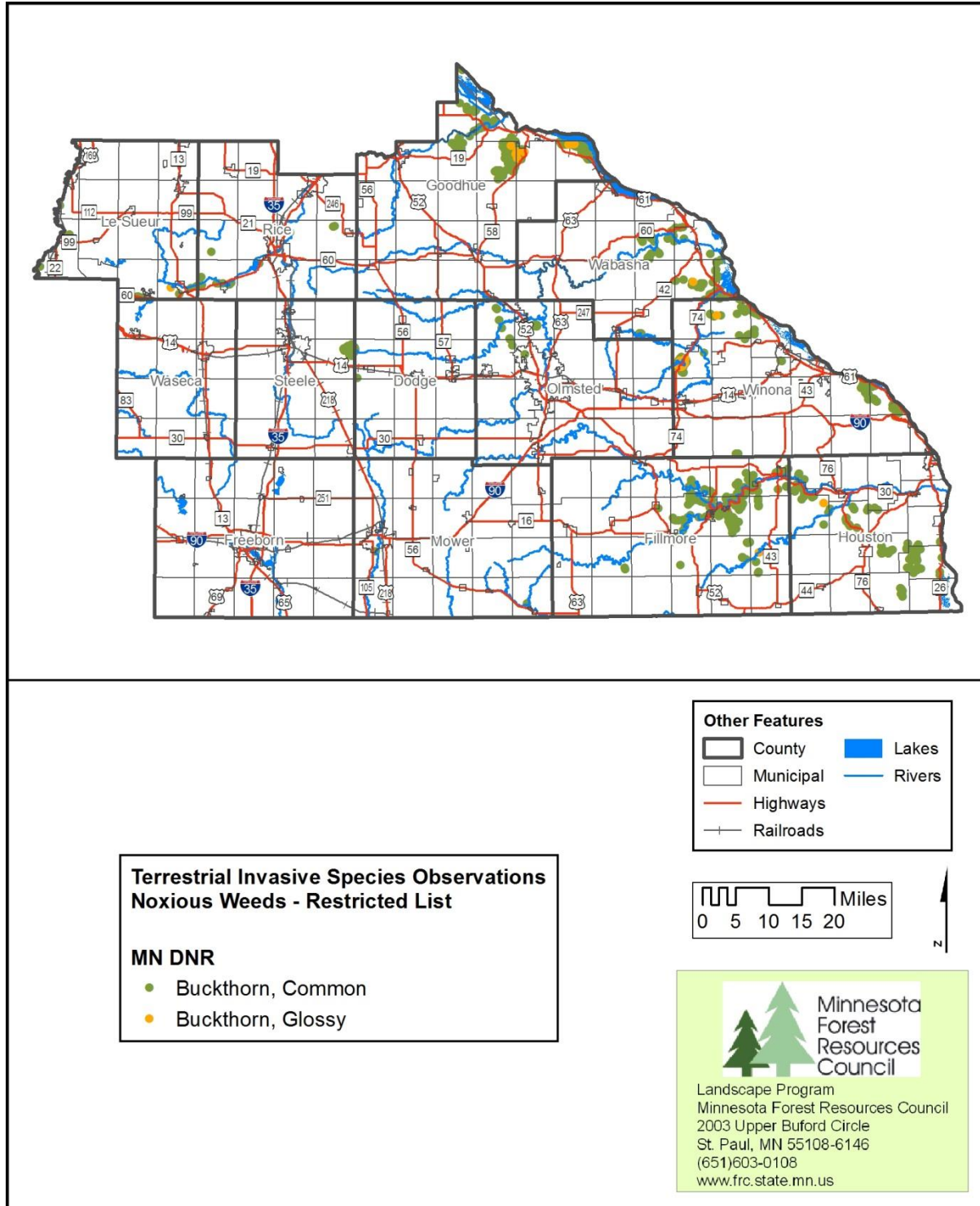


**Source:** Minnesota DNR Data Deli

Notes: With the exception of reed canary grass, the species represented in this figure are designated by the MN Department of Agriculture as ‘Noxious Weeds’ (Control List) and therefore falling under the Noxious Weed Law ([www.mda.state.mn.us/plants/badplants/noxiouslist.aspx](http://www.mda.state.mn.us/plants/badplants/noxiouslist.aspx)). Colored dots are overlapping (least common species are in the top layers) and thus some dots are not visible.



**Figure 16:** Terrestrial invasive plant species observations in the Southeast Landscape, 2004 to 2012, MDA Restricted List.



**Source:** Minnesota DNR Data Deli

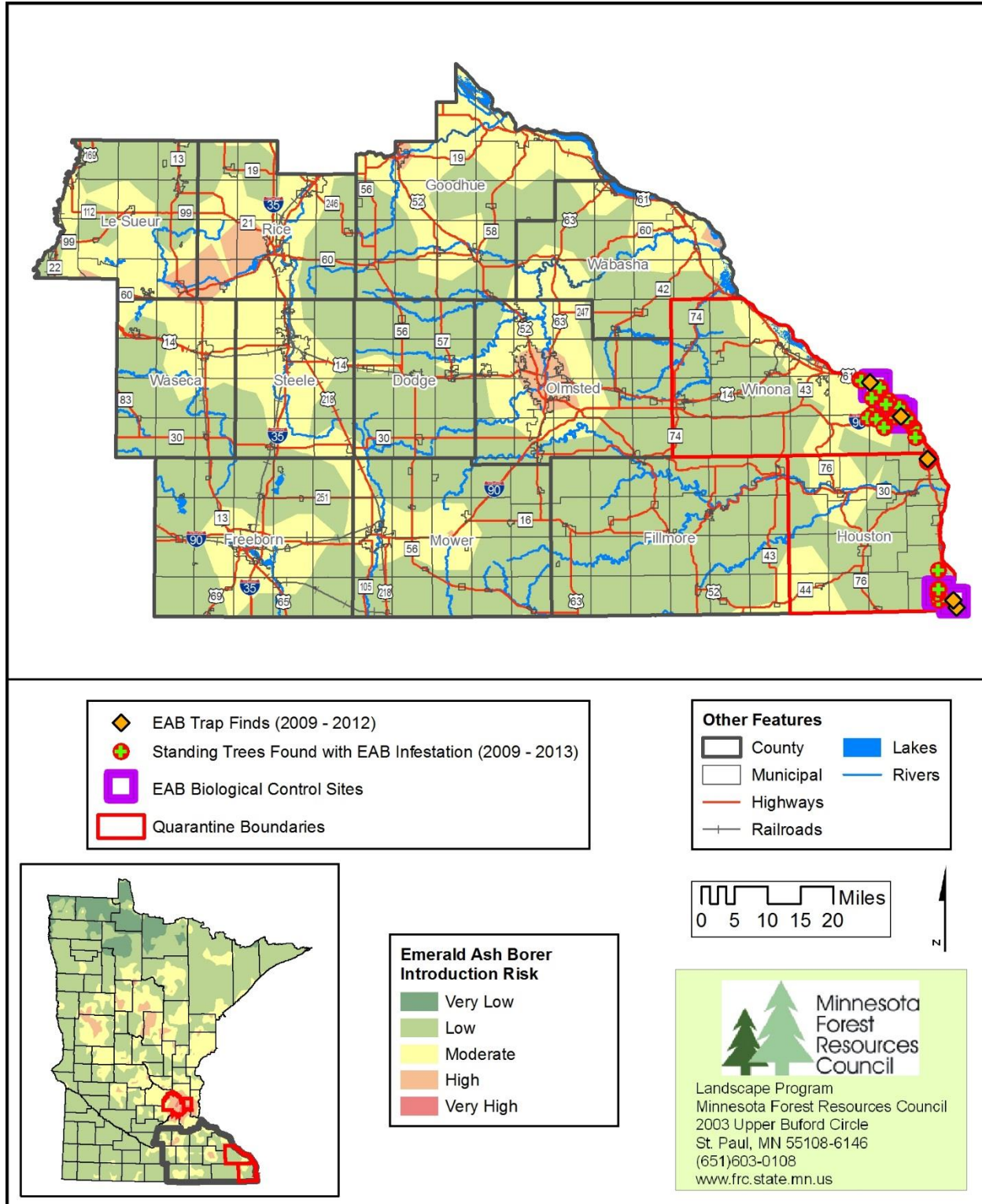
Notes: The species represented in this figure are designated by the MN Department of Agriculture as ‘Noxious Weeds’ (Restricted List) and therefore falling under the Noxious Weed Law ([www.mda.state.mn.us/plants/badplants/noxiouslist.aspx](http://www.mda.state.mn.us/plants/badplants/noxiouslist.aspx)). Colored dots are overlapping (least common species are in the top layers) and thus some dots are not visible.

**Table 42:** Evidence of emerald ash borer (EAB) in the Southeast Landscape and number of biological control sites in affected counties, 2009-2013.

County	Item	Count
Winona	EAB Trap Finds (2009 - 2012)	2
	Standing Trees Found with EAB Infestation (2009 - 2013)	71
	EAB Biological Control Sites	4
Houston	EAB Trap Finds (2009 - 2012)	3
	Standing Trees Found with EAB Infestation (2009 - 2013)	19
	EAB Biological Control Sites	2

**Source:** Minnesota MDA, Emerald Ash Borer Status Map, <http://gis.mda.state.mn.us/eab/>

**Figure 17:** Emerald ash borer introduction and introduction risk in the Southeast Landscape, 2009-2013.



Source: Minnesota MDA, Emerald Ash Borer Status Map, <http://gis.mda.state.mn.us/eab/>

Table 43: Gypsy Moth Trap results in the Southeast Landscape, 2002-2013.

<b>Year</b>	<b>Southeast Region Trap Catch Results</b>
2002	21
2003	213
2004	34
2005	7
2006	10
2007	321
2008	2,872
2009	166
2010	248
2011	122
2012	34
2013	184

Table 44: Gypsy Moth trap results, by county in the Southeast Landscape, 2008.

<b>County</b>	<b>Trap Catch Results (2008)</b>
Dodge	2
Fillmore	196
Freeborn	0
Goodhue	42
Houston	1,374
Le Sueur	2
Mower	0
Olmsted	148
Rice	1
Steele	0
Wabasha	153
Waseca	0
Winona	954
<b>Total Southeast Region</b>	<b>2,872</b>

Figure 18: Gypsy Moth trap results, by county in the Southeast Landscape, 2008.

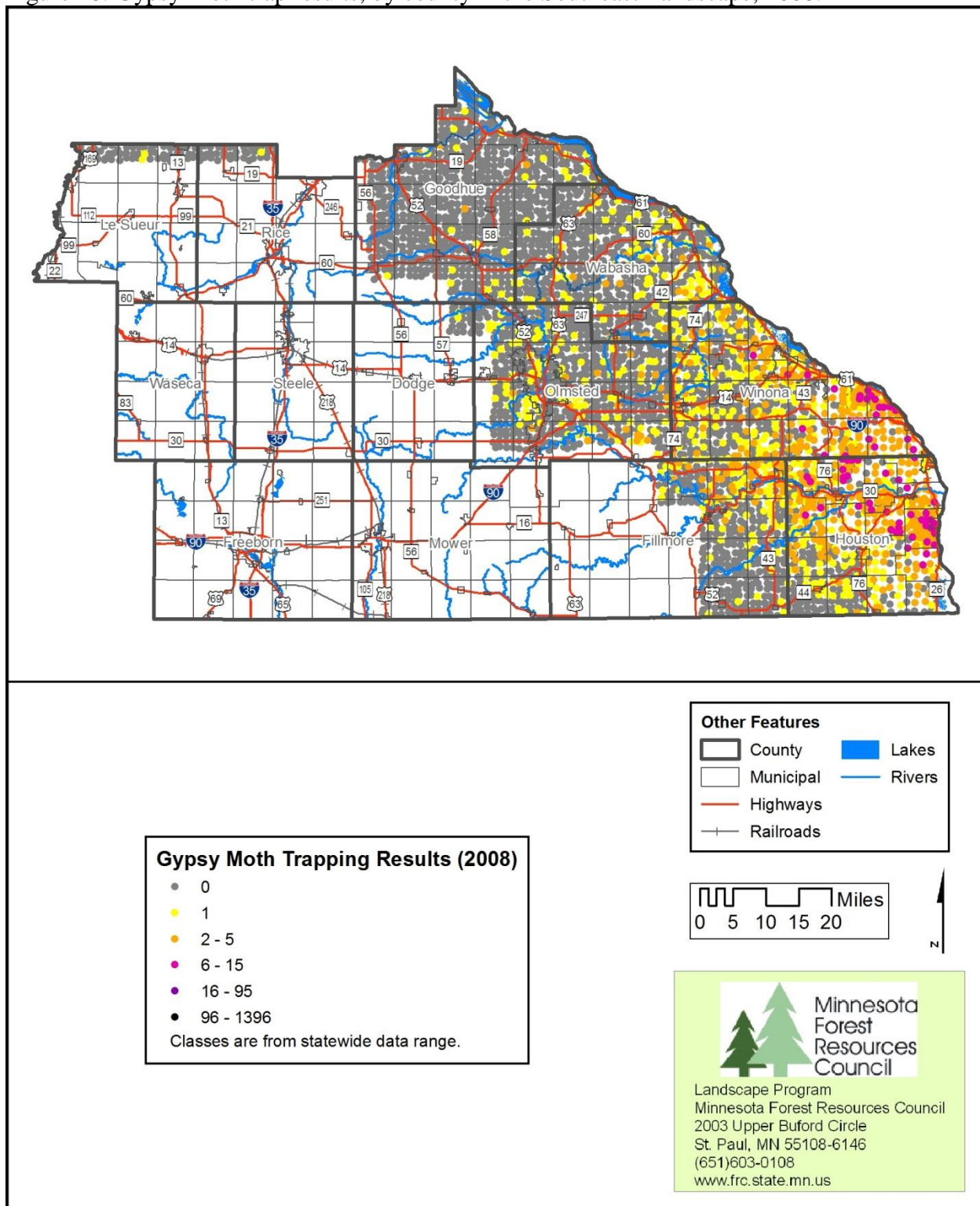


Table 45: Gypsy Moth trap results, by county in the Southeast Landscape, 2009.

<b>County</b>	<b>Trap Catch Results (2009)</b>
Dodge	0
Fillmore	13
Freeborn	0
Goodhue	1
Houston	75
Le Sueur	0
Mower	0
Olmsted	28
Rice	1
Steele	0
Wabasha	9
Waseca	0
Winona	39
<b>Total Southeast Region</b>	<b>166</b>



Figure 19: Gypsy Moth trap results, by county in the Southeast Landscape, 2009.

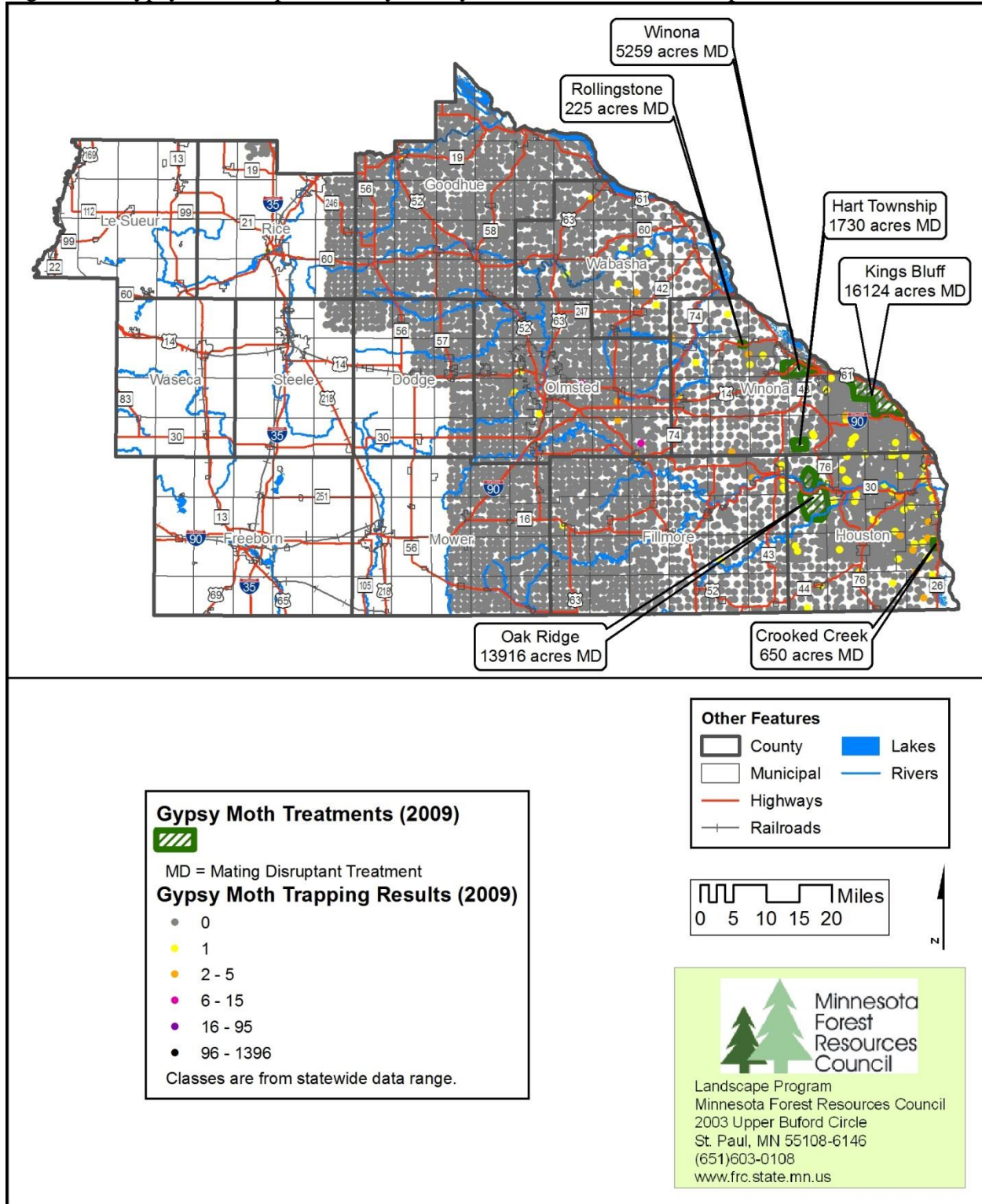
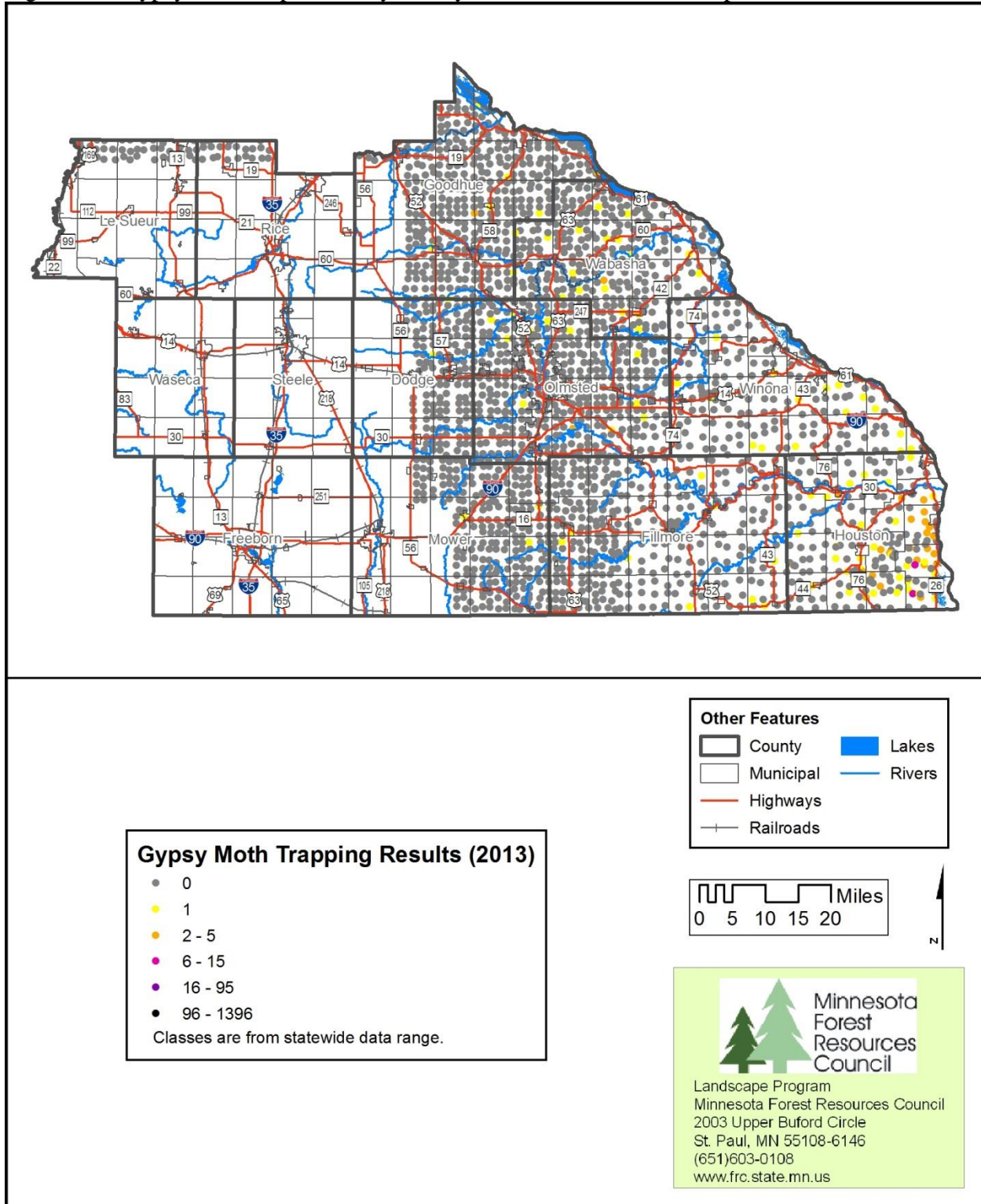




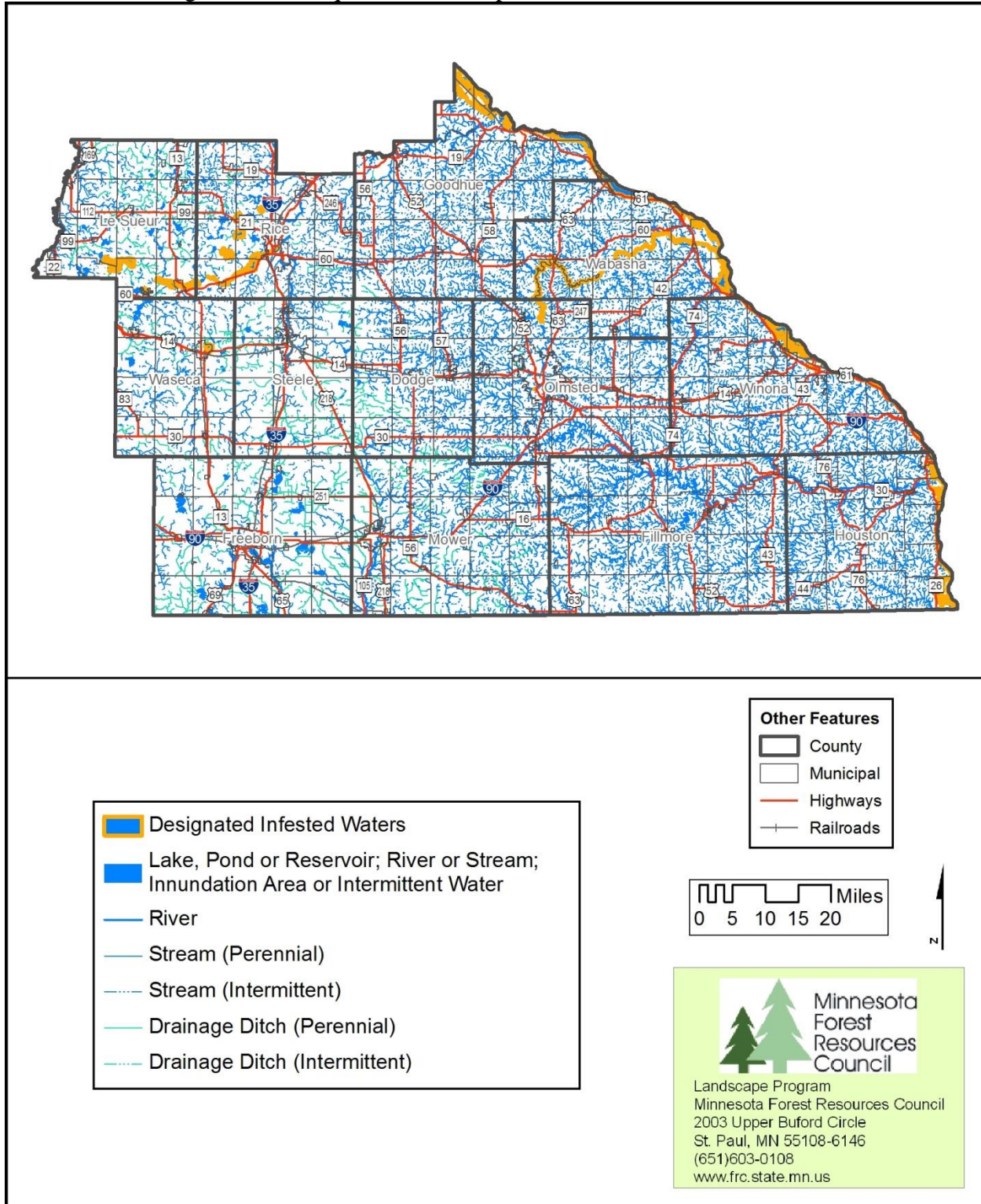
Table 46: Gypsy Moth trap results, by county in the Southeast Landscape, 2013.

<b>County</b>	<b>Trap Catch Results (2013)</b>
Dodge	1
Fillmore	9
Freeborn	0
Goodhue	12
Houston	102
Le Sueur	0
Mower	3
Olmsted	13
Rice	0
Steele	0
Wabasha	22
Waseca	0
Winona	22
<b>Total Southeast Region</b>	<b>184</b>

Figure 20: Gypsy Moth trap result, by county in the Southeast Landscape, 2013.



**Figure 21:** Lakes and streams in the MFRC Southeast Landscape designated by the Minnesota DNR as containing non-native aquatic invasive species, 2013.



**Source:** Minnesota DNR Division of Ecological and Water Resources.

### 3.13. Water quality in lakes and streams

The United States Geological Survey uses the HUC system to hierarchically subdivide the nation's watersheds in a series of four levels (USGS 2013). There are 16 watersheds in the MFRC Southeast Landscape that are categorized as hydrologic unit code (HUC) level 8 (Figure 22).

The Minnesota Pollution Control Agency (MPCA) is the state agency responsible for protecting Minnesota's water quality:

“Water quality standards are fundamental tools that help protect Minnesota's abundant and valuable water resources from pollution. “*Beneficial uses*” are the uses that water resources and their associated aquatic communities provide. Under the federal Clean Water Act, states are required to monitor and assess their waters to determine if they meet water quality standards and thereby support the beneficial uses they are intended to provide. Waters that do not meet their designated uses because of water quality standard violations are impaired. States are then required to develop a list of impaired waters that require Total Maximum Daily Loads (TMDL) studies, and to submit an updated list to the U.S. Environmental Protection Agency every even-numbered year for approval.” (MPCA 2013 (1))

TMDL studies are used to identify both point and nonpoint sources of each pollutant that fails to meet water quality standards and to “define how much of the pollutant can be in the surface and/or ground water while still allowing the waterbody to meet its designated uses, such as drinking water, fishing, swimming, irrigation or industrial purposes” (MPCA 2013 (2)). Rivers and streams may have several TMDLs, each one determining the limit for a different pollutant.

More information about impaired waters in Minnesota can be found at:

[www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/minnesotas-impaired-waters-and-total-maximum-daily-loads-tmdls.html](http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/minnesotas-impaired-waters-and-total-maximum-daily-loads-tmdls.html).

and: <http://www.pca.state.mn.us/index.php/water/water-types-and-programs/water-nonpoint-source-issues/clean-water-partnership/more-about-the-section-319-program.html>

There are over 42,000 acres of lakes impaired by either mercury or high nutrient load (or both) in southeast Minnesota and over 1500 miles of streams contaminated by a wide variety of impairments, including mercury, PCBs, E. coli, fecal coliform, and nitrates (Table 48, Table 49, Figure 23). The overall health of the watersheds in southeast Minnesota can be seen in Figure 24. On a 1-100 point scale, all watersheds fall in the mid-range of health; however the healthiest area is located in a small part of Winona and Houston counties along the Blufflands, with health scores decreasing in a westwardly direction, likely due to the prominence of agriculture.

Healthy forests maintain high quality aquatic systems such as cold water trout streams through shading and water temperature maintenance, erosion and nutrient loading reduction, and providing coarse woody debris and structural cover. In southeast Minnesota, there are over 800 miles of designated trout streams and over 1000 miles of protected tributaries to trout streams located in Goodhue, Wabasha, Winona, Houston, Fillmore and small part of Olmstead counties (Table 50, Figure 25).



According to 2013 data from the Minnesota Pollution Control Agency’s (MPCA) Milestone Project, most water pollutants have shown decreasing trend or no trend over time in the region’s watersheds (Table 51). The exception is nitrites/nitrates, which have shown an increasing trend in eight of the 13 Milestone testing sites within the Southeast Landscape. In a study by the Minnesota Geological Survey of southeastern Minnesota streams, Runkel et al. (2013) note that “Nitrate contamination of surface water and groundwater is a long-standing issue in the region. Impacts to municipal and private drinking water supplies by nitrate are widespread and well-documented.” (p. 4). This study identified a relationship between sedimentary cover and nitrate contamination, noting that consistent sedimentary cover of 50 feet or more is needed to ensure water quality protection from nitrite/nitrate contamination in an area:

“In this analysis, 11.8% of wells where sedimentary cover is less than 50 feet thick had a nitrate concentration greater than 2 ppm whereas 8.1% of wells where the cover is more than 50 feet had values greater than 2 ppm. This relationship is much more pronounced in a comparison of shallow bedrock groundwater from wells within the *interior* of the drift dominated landscape, to all other areas. The results indicate that 12.5% of wells outside of the interior of the drift dominated landscape have nitrate concentrations greater than 2 ppm and only 1.77% wells within the interior of the drift dominated landscape, nearly an order of magnitude less, have nitrate concentrations that exceed 2 ppm. The marked contrast between the two analyses indicates that a relatively continuous cover of unconsolidated sediment greater than 50 ft thick is required to generally protect underlying bedrock aquifers from nitrate contamination. In areas of less continuous cover, individual wells located where unconsolidated sediment is greater than 50 ft thick have nearly the same probability of having nitrate concentrations greater than 2 ppm as do wells elsewhere in the bedrock dominated landscape where the cover is thinner. This reflects the three dimensional character of the flow system in the bedrock dominated landscape: An individual well located on an isolated patch of thick sedimentary cover is drawing water that likely in part includes a source of nitrate-enriched water from nearby areas lacking a thick cover of unconsolidated sediment, and transported laterally to the well site.” (Runkel et al. 2013, p. 39-40)

The ability for contaminated water to flow laterally below the surface and mix with nearby water sources is due to the karst geology of the region (Figure 26). Runkel et al. (2013) also note that as water moves further from sites of intensive agriculture, nitrite/nitrate concentrations decrease, likely due to dilution from deeper, nitrate-poor water sources:

“Progressively greater contribution from more deeply sourced, nitrate-poor groundwater likely accounts for this trend of downstream-decreasing stream water nitrate concentrations relative to row crop production.” (p. 53 Runkel et al. 2013)

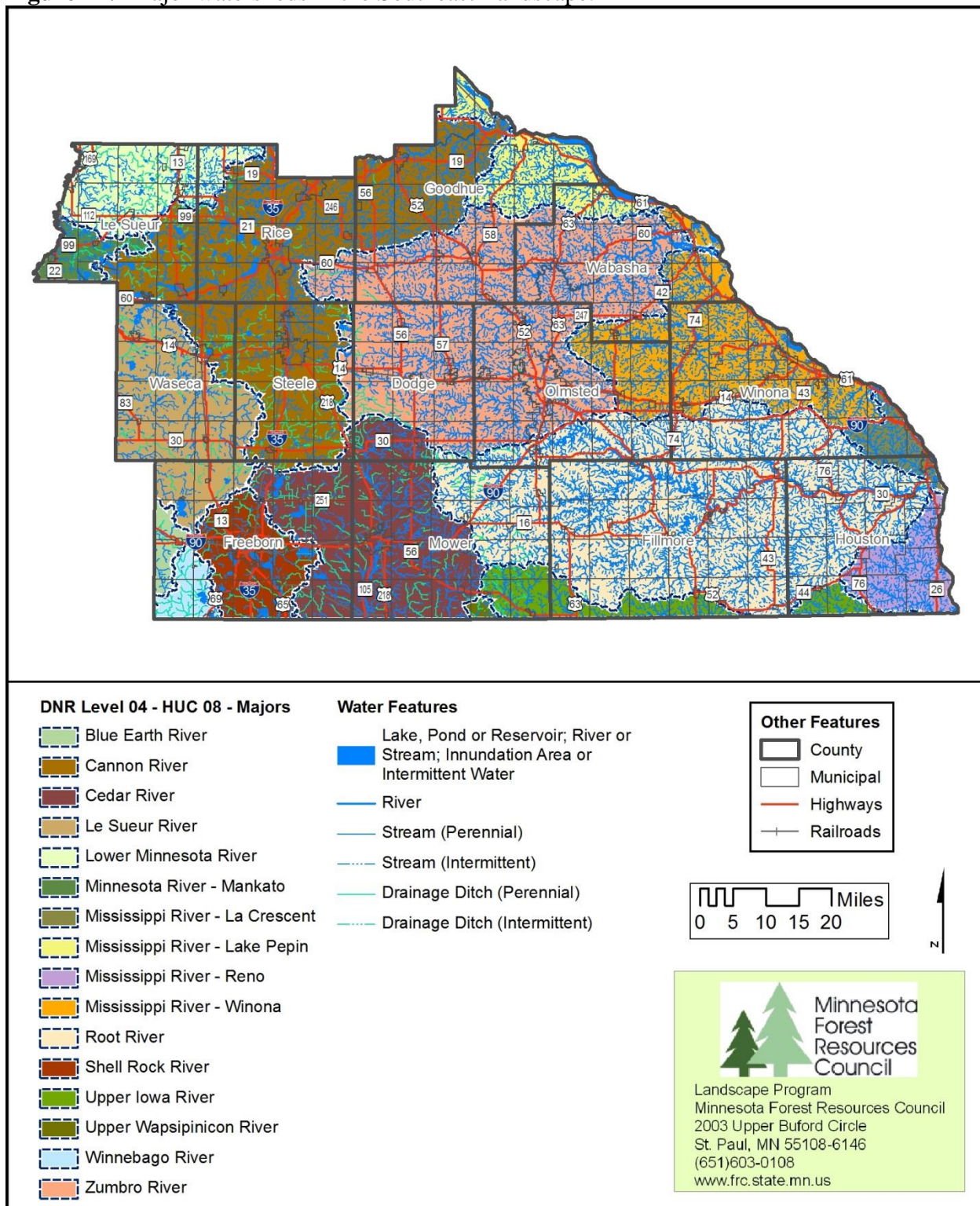
Further, Watkins et al. (2013) found a direct, positive relationship between the baseflow concentrations of nitrates in trout streams of southeast Minnesota and the percentage of surrounding land in corn and soybean row-cropping (Figure 27). Further supporting the findings of Runkel et al. (2013), Watkins et al. (2013) also found a steady increase in nitrate concentrations in the Peterson Hatchery spring water between 1988 and 2012 (Figure 28). As row cropping has actually decreased in the region during recent years (Table 8), this suggests a

lag in the impact of surface-level agricultural practices on subsurface groundwater nitrate concentrations (J. Watkins, personal communication).

Pressure on groundwater *quantity* is also a growing issue in Minnesota. According to Streit (2012), river summer baseflow (the component of flow based primarily on groundwater discharge rather than precipitation and runoff) state-wide have been showing a decline, despite steady precipitation since 1990. Streit indicates increases in groundwater consumption – nearly doubled since 1990 – and surface water consumption, as well as increased underground tiling, as contributing factors (Streit 2012). However, Lenhart and Niebert (2011) found that unlike baseflow, annual streamflow as a result of runoff was increasing in the agricultural areas of southern Minnesota due primarily to land use changes.

Watershed health scores can be seen to be highest in the Blufflands, decreasing in the Rochester Plateau (higher in the southern portion, lower in the northern for both of these subsections), and decreasing further still in the Oak Savanna (Figure 29).

**Figure 22:** Major watersheds in the Southeast Landscape.



Source: Minnesota DNR Data Deli



**Table 47:** Impairment abbreviations.

Abbreviation	Impairment	Abbreviation	Affected Use
Cl-	Chloride	AQC	Aquatic consumption
DO	Dissolved oxygen	AQL	Aquatic life
E.coli	Escherichia coli	AQR	Aquatic recreation
FC	Fecal coliform	DW	Drinking water
F-IBI	Fish - Index of Biological Integrity		
HgF	Mercury in fish tissue		
HgW	Mercury in water column		
LCWA	Lack of a coldwater assemblage		
NO3	Nitrates		
PCBF	PCB in fish tissue		
PCBW	PCB in water column		
PFOS	Perfluorooctane Sulfate		
T	Turbidity		
TM	Temperature		

Source: Minnesota Pollution Control Agency

**Table 48:** Area of impaired lakes in the Southeast Landscape by affected use and impairment, 2010.

Impairment	Affected Use	Area (Acres)
HgF	AQC	181
HgF, Nutrients	AQC, AQR	11,138
Nutrients	AQR	30,763
<b>Total Area</b>		<b>42,083</b>

Source: Minnesota Pollution Control Agency

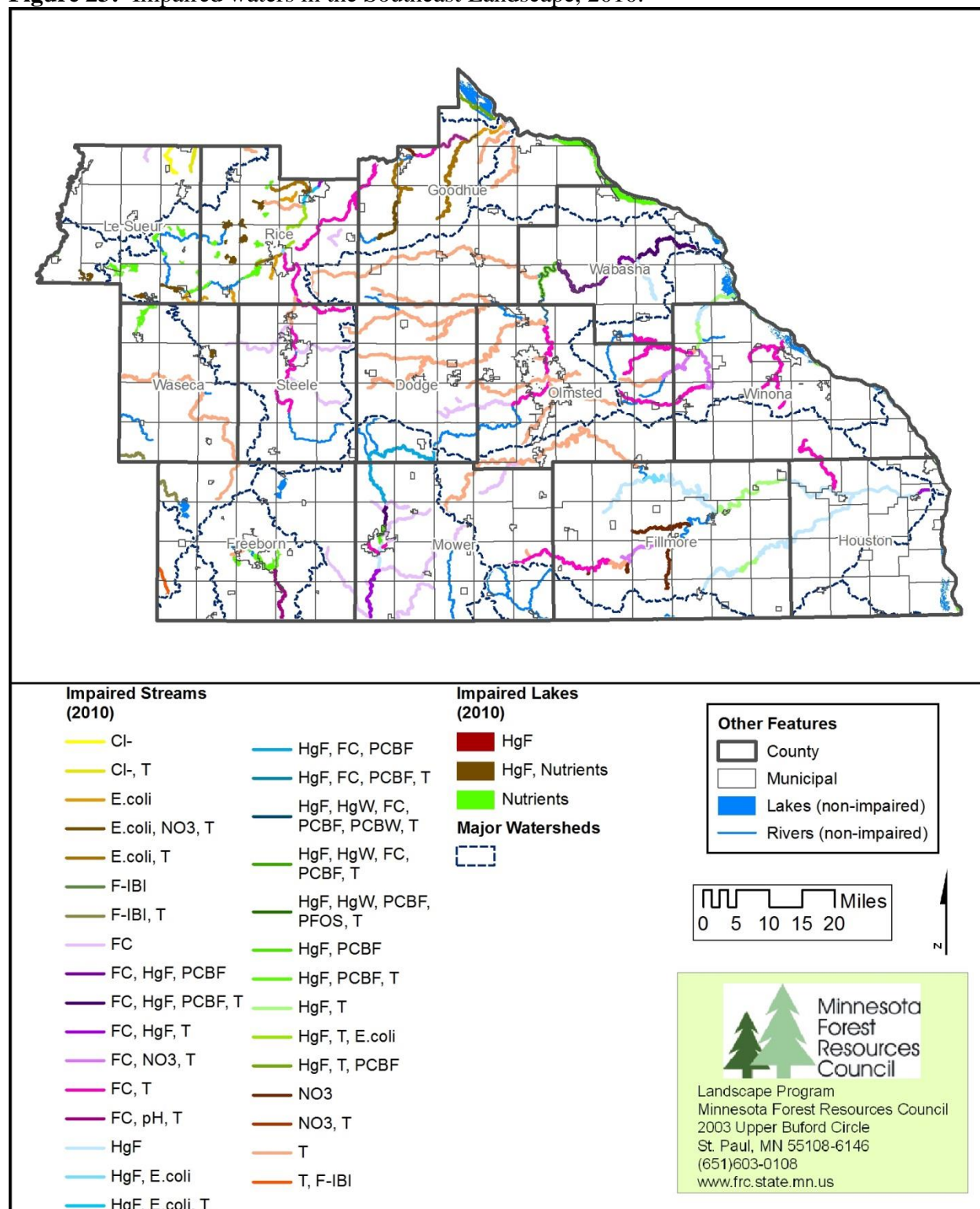
**Table 49:** Length of impaired rivers and streams in the Southeast Landscape by affected use and impairment, 2010.

Impairment	Affected Use	Length (Miles)
Cl-	AQL	7.3
Cl-, T	AQL	5.7
E.coli	AQR	26.1
E.coli, NO3, T	AQL, AQR, DW	12.4
E.coli, T	AQL, AQR	53.3
F-IBI	AQL	0.8
F-IBI, T	AQL	15.4
FC	AQR	166.1

FC, HgF, PCBF	AQC, AQR	24.6
FC, HgF, PCBF, T	AQC, AQL, AQR	29.4
FC, HgF, T	AQC, AQL, AQR	18.1
FC, NO3, T	AQL, AQR, DW	37.5
FC, pH, T	AQL, AQR	12.1
FC, T	AQL, AQR	246.4
HgF	AQC	127.4
HgF, E.coli	AQC, AQR	6.9
HgF, E.coli, T	AQC, AQL, AQR	4.9
HgF, FC, PCBF	AQC, AQR	28.6
HgF, FC, PCBF, T	AQC, AQL, AQR	6.2
HgF, HgW, FC, PCBF, PCBW, T	AQC, AQL, AQR	3.0
HgF, HgW, FC, PCBF, T	AQC, AQL, AQR	2.6
HgF, HgW, PCBF, PFOS, T	AQC, AQL	30.9
HgF, PCBF	AQC	77.2
HgF, PCBF, T	AQC, AQL	4.1
HgF, T	AQC, AQL	38.7
HgF, T, E.coli	AQC, AQL, AQR	11.1
HgF, T, PCBF	AQC, AQL	10.3
NO3	DW	30.2
NO3, T	AQL, DW	0.1
T	AQL	471.1
T, F-IBI	AQL	5.6
<b>Total Length</b>		<b>1514.2</b>

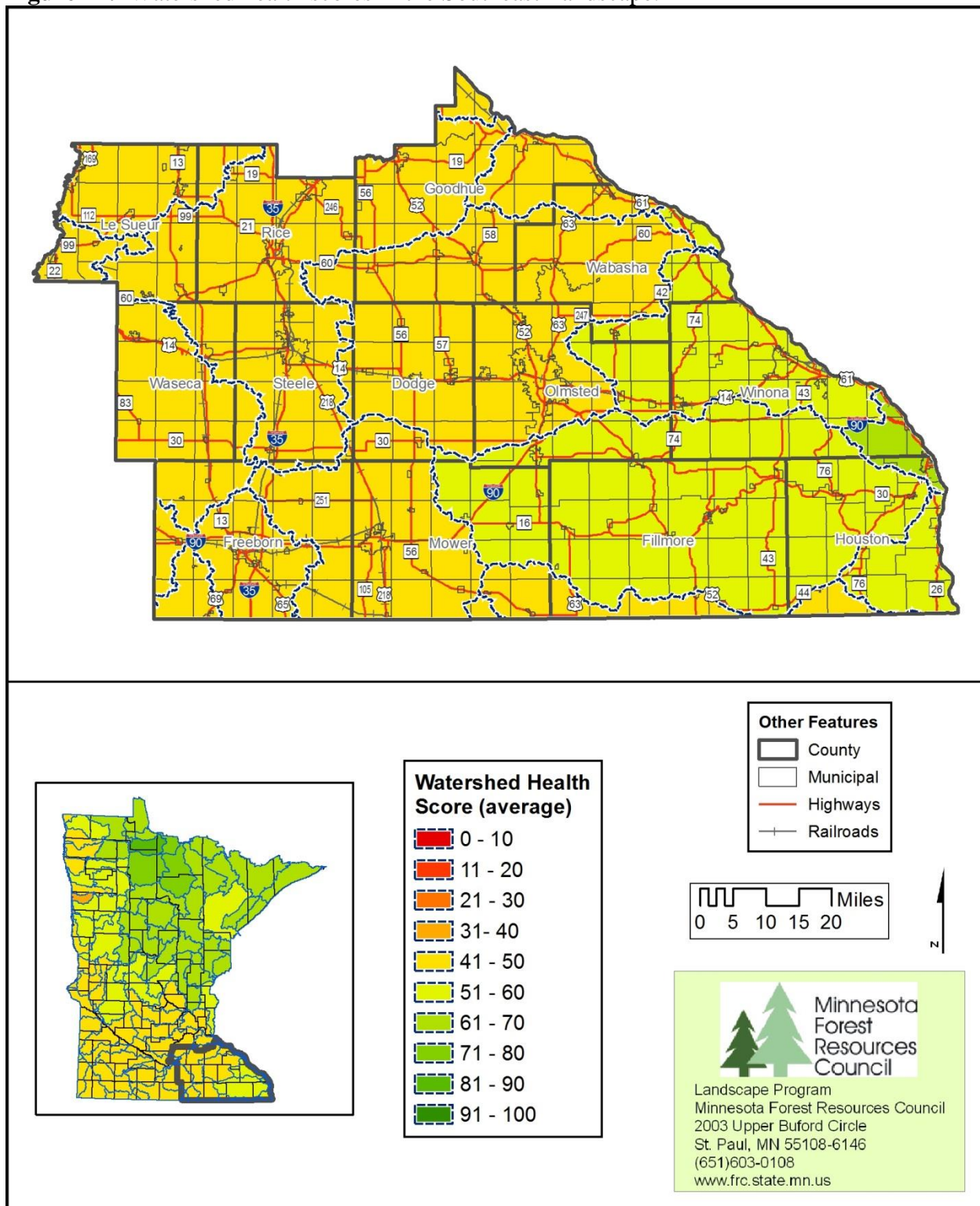
**Source:** Minnesota Pollution Control Agency

**Figure 23:** Impaired waters in the Southeast Landscape, 2010.



Source: Minnesota Pollution Control Agency

**Figure 24:** Watershed health scores in the Southeast Landscape.



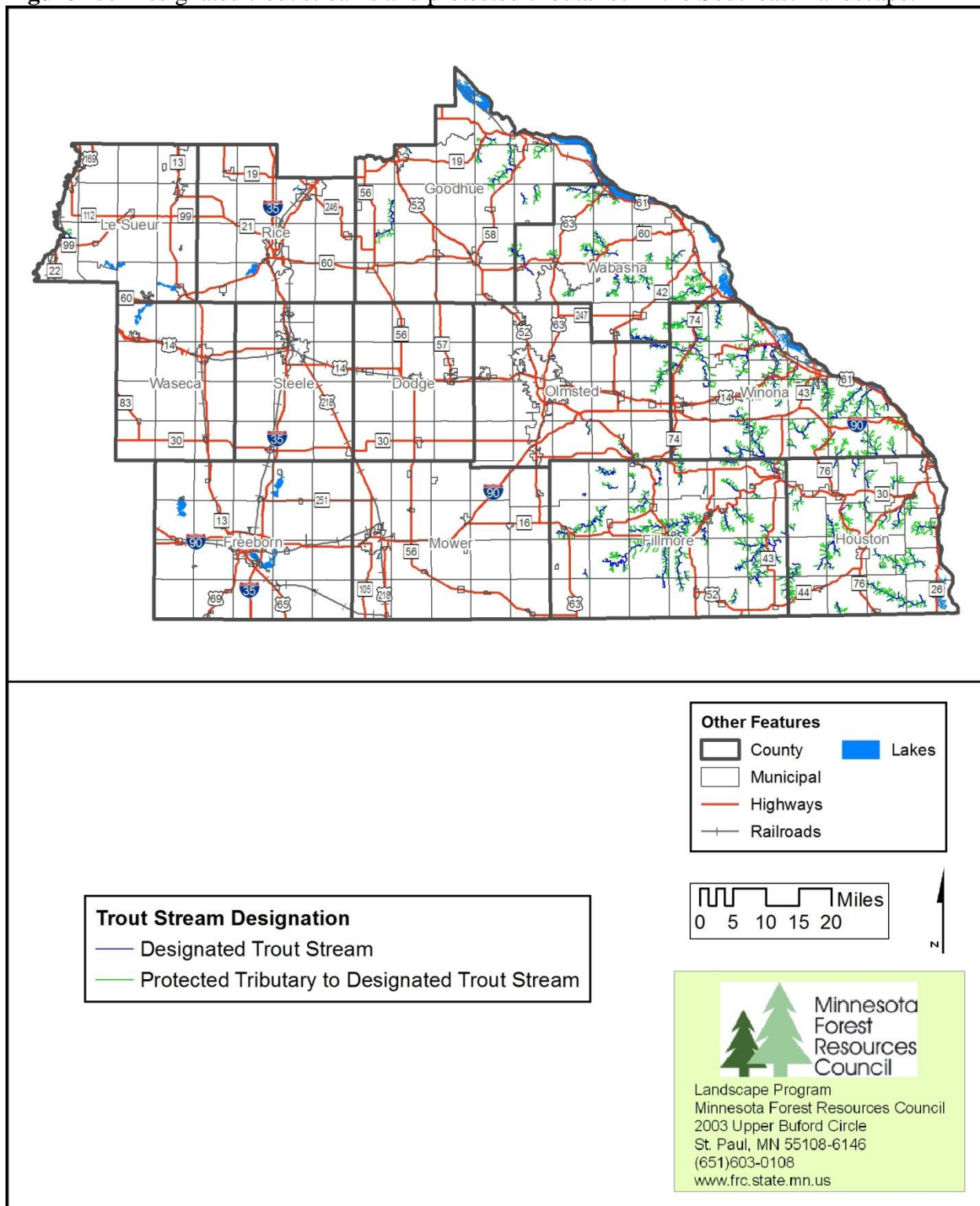
Source: Minnesota DNR Watershed Health Assessment Framework <http://www.dnr.state.mn.us/whaf/index.html>.

**Table 50:** Designated trout streams and protected tributaries in the Southeast Landscape.

<b>Trout Stream Designation</b>	<b>Length (Miles)</b>
Designated Trout Stream	803
Protected Tributary to Designated Trout Stream	1,064
<b>Total Length</b>	<b>1,867</b>

**Source:** Minnesota DNR Data Deli

**Figure 25:** Designated trout streams and protected tributaries in the Southeast Landscape.



Source: Minnesota DNR Data Deli



Table 51: Pollution Trends at MPCA Milestone Sites in the Southeast Landscape:  
**Upper Mississippi River Basin -- Lower Portion**

Contaminant	Unit	Cannon River						Garvin Brook					
		1950s	1960s	1970s	1980s	1990s	overall trend	1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	3.3	---	---	2.5	2.5	decrease	---	---	---	1.6	1.4	decrease
Total Suspended Solids	(geomean in mg/l)	---	---	---	22.8	15.1	decrease	---	---	---	85.8	35.5	no trend
Total Phosphorus	(geomean in mg/l)	---	---	---	0.26	0.18	decrease	---	---	---	0.25	0.13	no trend
Nitrite/Nitrate	(median in mg/l)	---	---	---	3.00	3.90	no trend	---	---	---	1.30	1.70	increase
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0060	0.0040	decrease	---	---	---	0.0050	0.0040	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	---	---	139	52	decrease	---	---	---	670	851	no trend
Contaminant	Unit	Root River						Straight River					
		1950s	1960s	1970s	1980s	1990s	overall trend	1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	---	5.5	2.4	1.8	1.5	decrease	6.4	4.6	---	2.4	1.8	decrease
Total Suspended Solids	(geomean in mg/l)	---	58.5	92.6	81.3	99.1	no trend	---	25.8	---	22.5	21.0	no trend
Total Phosphorus	(geomean in mg/l)	---	0.16	0.26	0.18	0.17	decrease	---	---	---	0.33	0.24	decrease
Nitrite/Nitrate	(median in mg/l)	---	---	1.90	2.65	3.90	increase	---	---	---	4.90	6.20	no trend
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0025	0.0020	decrease	---	---	---	0.0095	0.0030	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	1,276	703	322	615	decrease	---	3,433	---	353	537	decrease

		Mississippi River (at La Crosse)						Mississippi River (at Trempealeau, WI)					
Contaminant	Unit	1950s	1960s	1970s	1980s	1990s	overall trend	1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	---	---	3.4	2.5	2.6	decrease	---	4.1	3.4	2.3	2.5	decrease
Total Suspended Solids	(geomean in mg/l)	---	---	19.1	20.9	27.8	no trend	---	27.6	27.5	19.1	25.5	decrease
Total Phosphorus	(geomean in mg/l)	---	---	0.21	0.18	0.18	decrease	---	0.21	0.24	0.18	0.20	decrease
Nitrite/Nitrate	(median in mg/l)	---	---	0.85	0.78	1.30	increase	---	---	---	0.97	1.60	no trend
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0055	0.0030	decrease	---	---	---	0.0060	0.0030	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	---	50	68	101	no trend	---	188	174	46	120	decrease
		Mississippi River (near Minneiska)						Zumbro River South Fork					
Contaminant	Unit	1950s	1960s	1970s	1980s	1990s	overall trend	1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	---	---	3.4	2.3	2.6	decrease	---	---	5.0	2.8	2.1	decrease
Total Suspended Solids	(geomean in mg/l)	---	---	20.9	18.1	25.0	no trend	---	---	30.5	25.6	36.8	no trend
Total Phosphorus	(geomean in mg/l)	---	---	0.21	0.18	0.18	decrease	---	---	0.95	0.35	0.22	decrease
Nitrite/Nitrate	(median in mg/l)	---	---	0.90	1.16	2.00	increase	---	---	3.30	5.20	5.95	increase
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0070	0.0040	decrease	---	---	---	0.0085	0.0020	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	---	66	28	63	no trend	---	---	132	115	409	no trend
		Whitewater River South Fork											



Contaminant	Unit	1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	---	---	2.5	1.6	1.7	decrease
Total Suspended Solids	(geomean in mg/l)	---	---	19.0	19.3	41.7	no trend
Total Phosphorus	(geomean in mg/l)	---	---	0.47	0.45	0.52	no trend
Nitrite/Nitrate	(median in mg/l)	---	---	6.00	7.10	8.90	increase
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0050	0.0020	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	---	487	373	1,157	no trend

### Minnesota River Basin

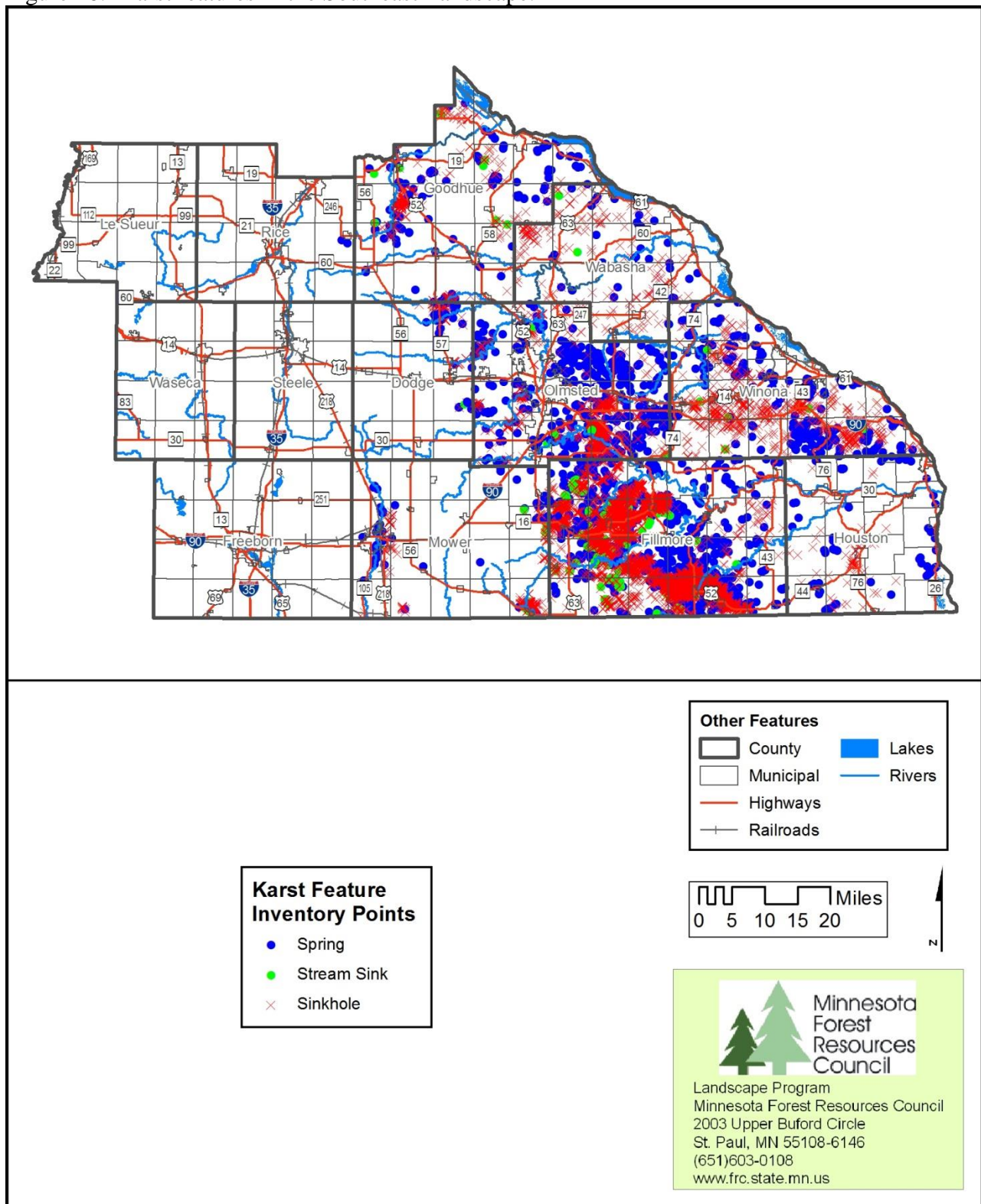
		Minnesota River					
		1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	5.8	---	4.7	3.2	2.8	decrease
Total Suspended Solids	(geomean in mg/l)	---	---	79.4	76.4	103.7	no trend
Total Phosphorus	(geomean in mg/l)	---	---	0.37	0.28	0.27	decrease
Nitrite/Nitrate	(median in mg/l)	---	---	3.20	4.30	5.65	no trend
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0080	0.0030	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	---	230	132	153	decrease

**Cedar - Des Moines Rivers Basin**

		<b>Cedar River (near Austin)</b>						<b>Cedar River (near Lansing)</b>					
		1950s	1960s	1970s	1980s	1990s	overall trend	1950s	1960s	1970s	1980s	1990s	overall trend
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	---	5.2	5.8	3.1	2.4	decrease	---	3.3	3.0	1.9	1.4	decrease
Total Suspended Solids	(geomean in mg/l)	---	31.0	30.5	23.4	28.8	no trend	---	23.0	25.5	18.9	21.1	no trend
Total Phosphorus	(geomean in mg/l)	---	0.64	0.72	0.43	0.36	decrease	---	0.18	0.28	0.19	0.16	decrease
Nitrite/Nitrate	(median in mg/l)	---	---	3.20	3.90	5.45	increase	---	---	---	4.40	6.55	no trend
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0135	0.0070	decrease	---	---	---	0.0060	0.0030	decrease
Fecal Coliform Organisms	(geomean in col/100 ml)	---	2,307	697	199	280	decrease	---	409	589	302	374	no trend
		<b>Shell Rock River</b>											
		1950s	1960s	1970s	1980s	1990s	overall trend						
Biochemical Oxygen Demand (5-day)	(geomean in mg/l)	---	13.4	11.2	8.1	6.4	decrease						
Total Suspended Solids	(geomean in mg/l)	---	77.5	35.1	44.4	41.8	decrease						
Total Phosphorus	(geomean in mg/l)	---	0.52	0.73	0.91	0.41	no trend						
Nitrite/Nitrate	(median in mg/l)	---	---	0.33	3.95	1.95	increase						
Un-ionized Ammonia	(median in mg/l)	---	---	---	0.0160	0.0045	decrease						
Fecal Coliform Organisms	(geomean in col/100 ml)	---	140	158	175	150	no trend						

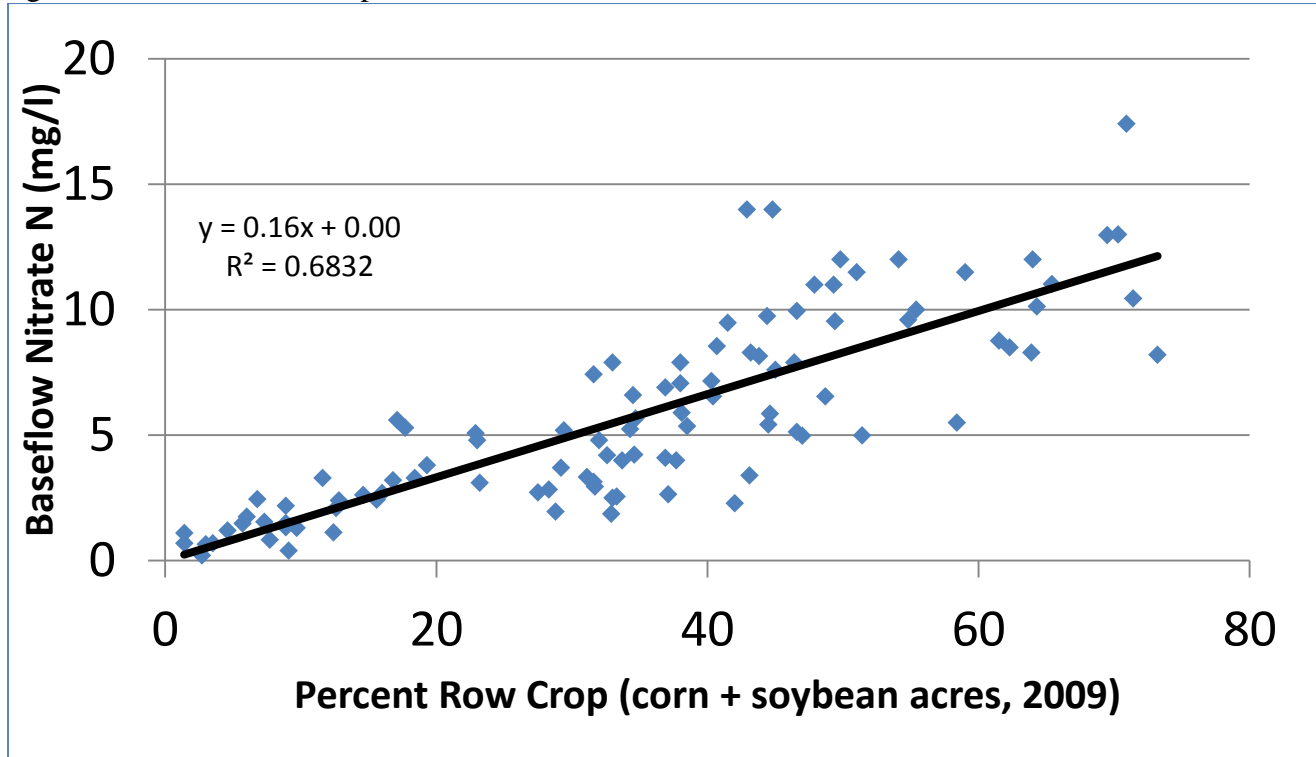
**Source:** Minnesota Pollution Control Agency, 2013. "Milestone Trends by Decade." Available at: <http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/streams-and-rivers/minnesota-milestone-river-monitoring-program.html>.

Figure 26: Karst features in the Southeast Landscape.



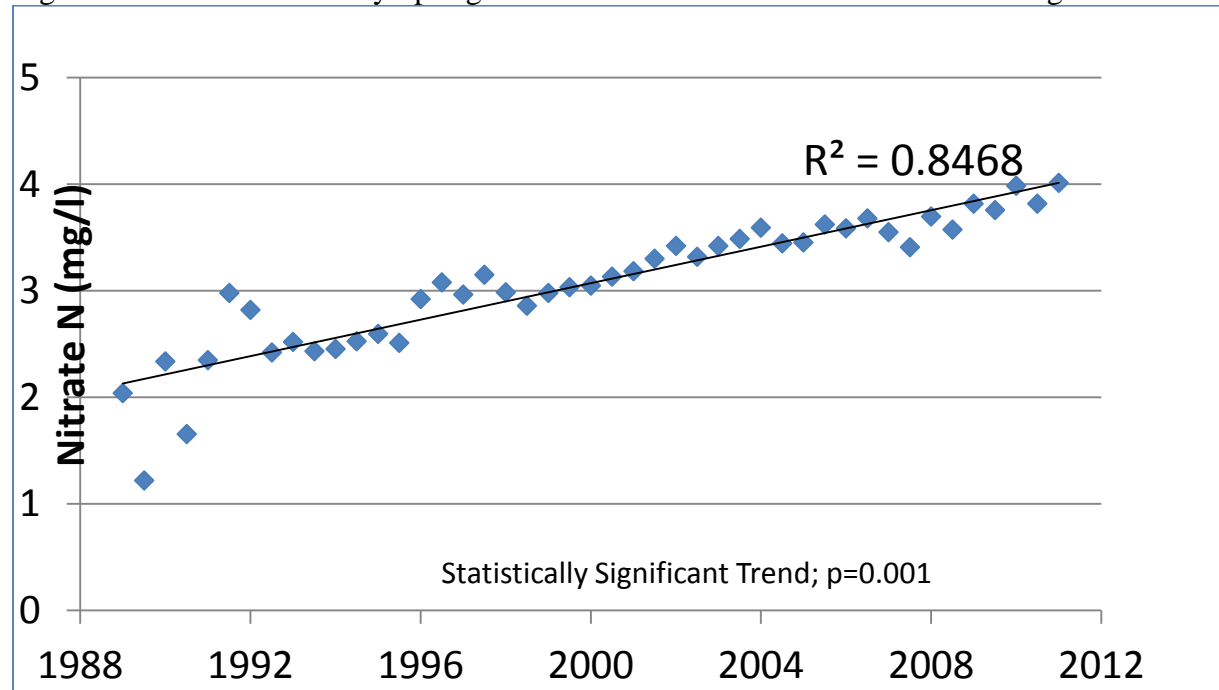
Source: Karst Feature Inventory Points and Other Features: MN DNR Data Deli

Figure 27: Percent Row Crop vs. Baseflow Nitrate-N Concentration in Trout Stream Watersheds of SE MN; n = 100



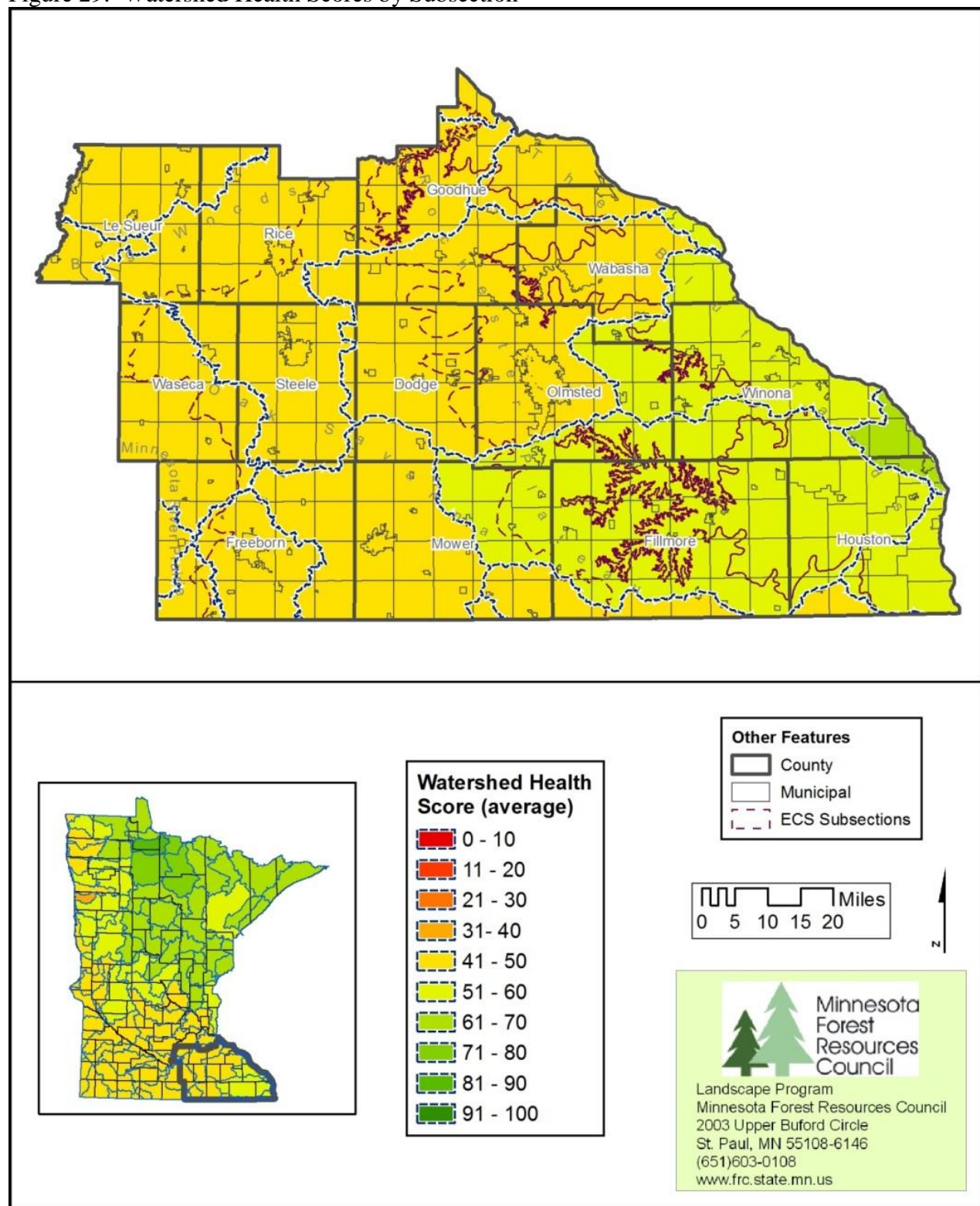
Source: Watkins, J., N. Rasmussen, G. Johnson, A. Streitz, K. Ahmad, B. Beyerl, and J. Roebuck. 2013. "Nitrate-Nitrogen in the Springs and Trout Streams of Southeast Minnesota." Minnesota Pollution Control Agency.

Figure 28: Peterson Hatchery Spring Nitrate-N Concentrations Six-Month Averages



Source: Watkins, J., N. Rasmussen, G. Johnson, A. Streitz, K. Ahmad, B. Beyerl, and J. Roebuck. 2013. "Nitrate-Nitrogen in the Springs and Trout Streams of Southeast Minnesota." Minnesota Pollution Control Agency.

Figure 29: Watershed Health Scores by Subsection



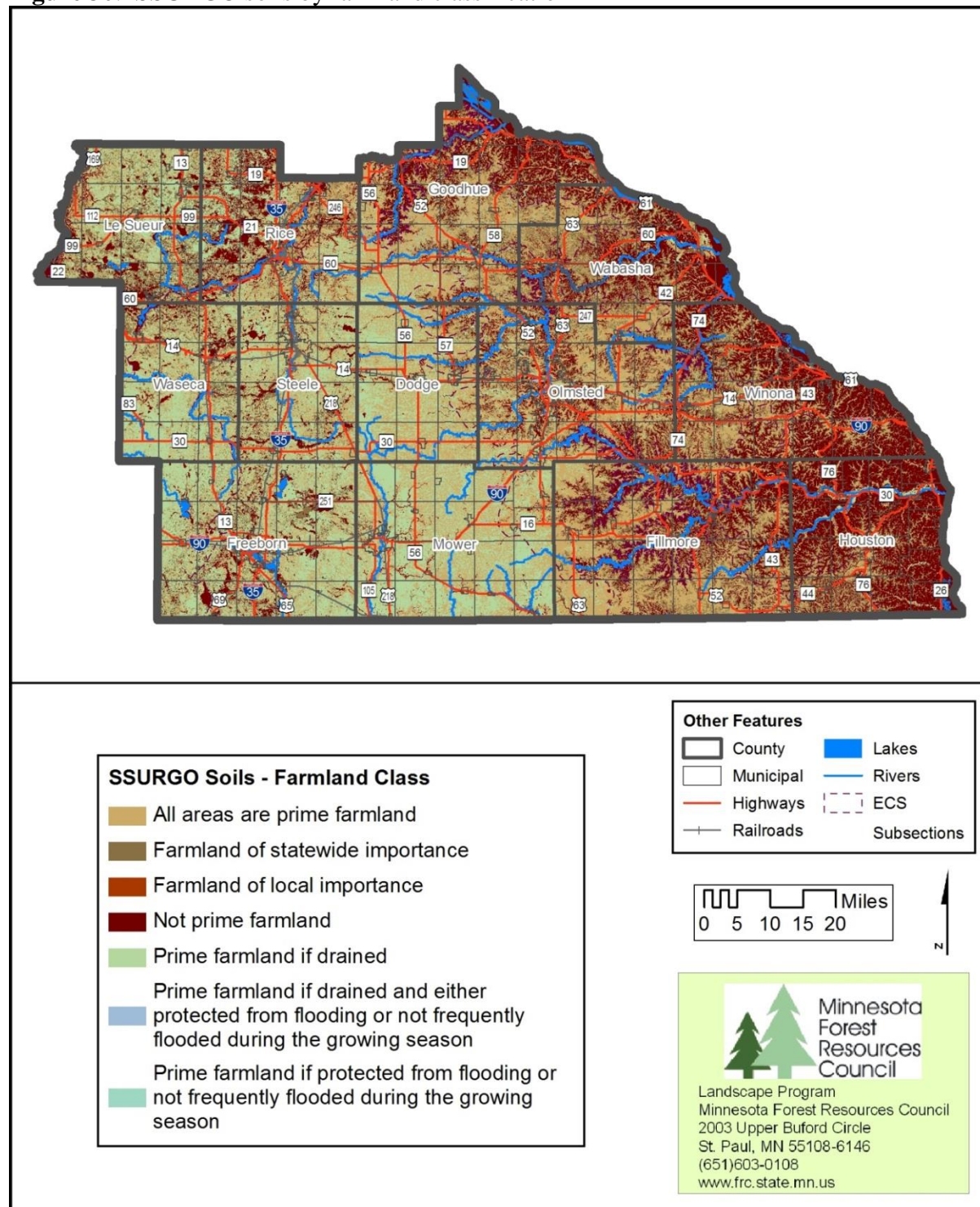
Source: MN DNR Watershed Health Assessment Framework; MN DNR Data Deli



### 3.14. Soils

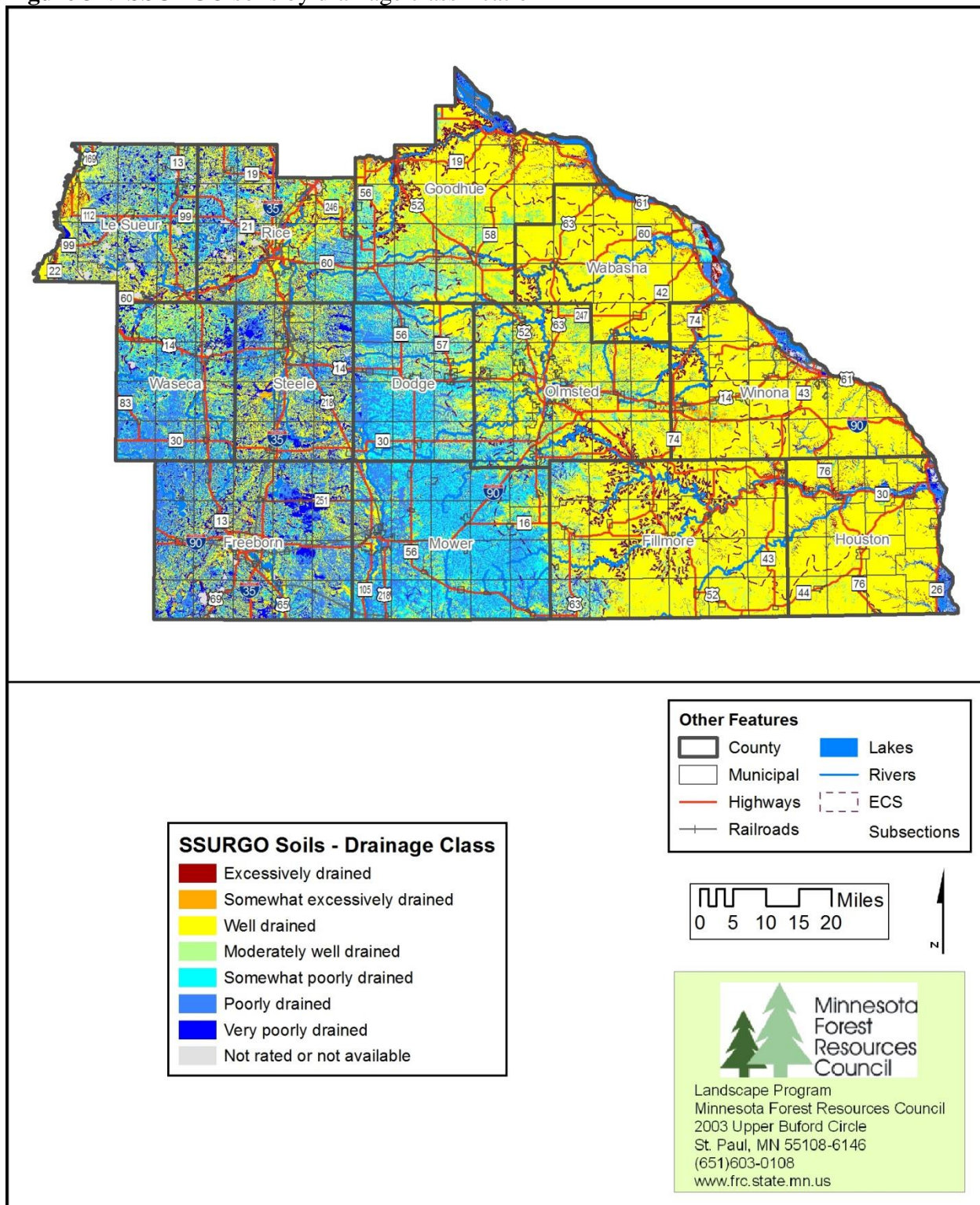
Figures display various soil attributes in the MFRC Southeast Landscape, including farmland classification (Figure 30), drainage classification (Figure 31), and hydric rating (Figure 32).

**Figure 30: SSURGO soils by farmland classification**



Source: NRCS Web Soil Survey. <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

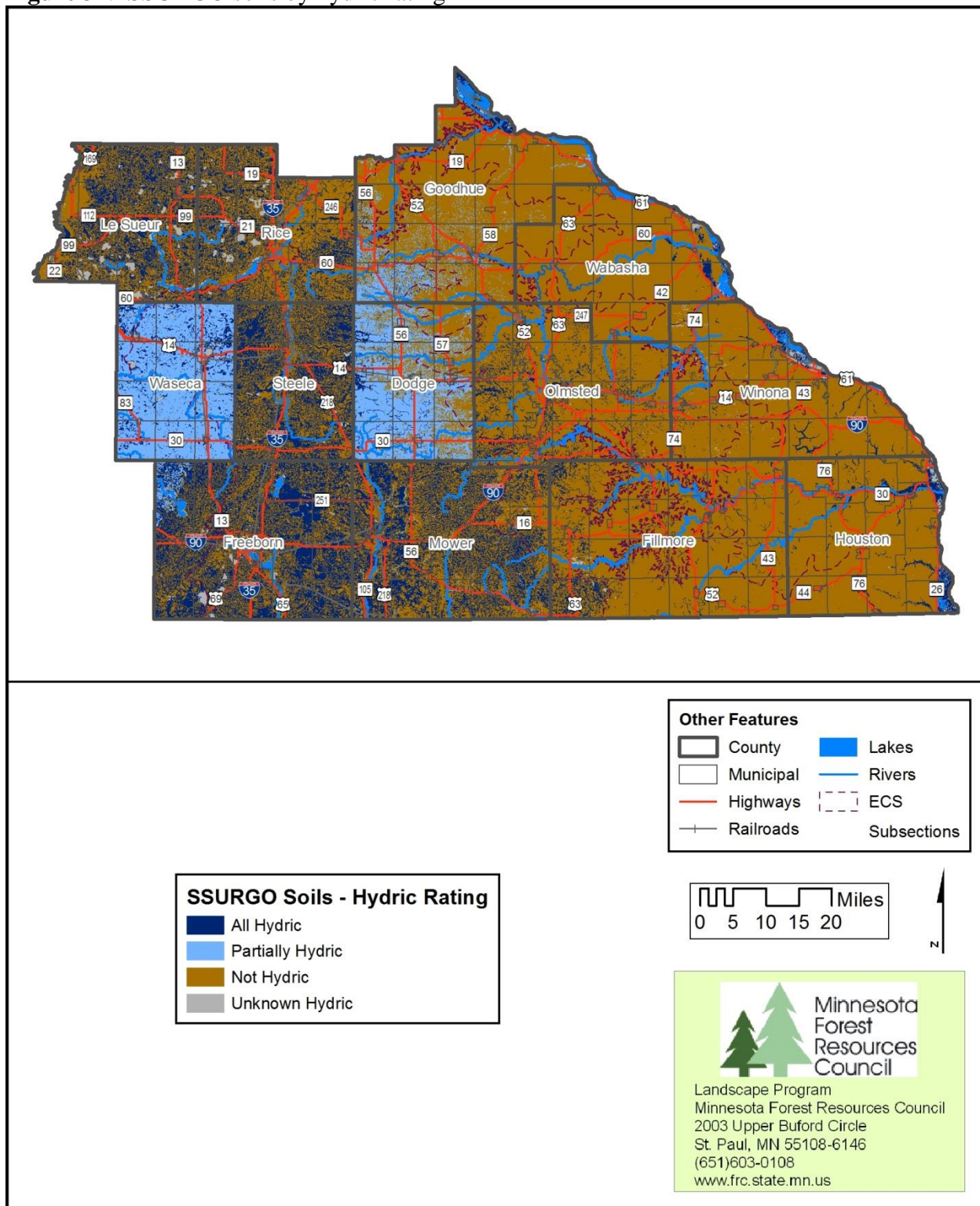
**Figure 31: SSURGO soils by drainage classification**



Source: NRCS Web Soil Survey. <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.



**Figure 32: SSURGO soils by hydric rating**



Source: NRCS Web Soil Survey. <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

### **3.15. Additional data needs**

- CRP, 2c, SFIA land enrollment - change over time
- Wetland data – drainage and restoration, change over time
- Native Plant Community systems in Southeast Minnesota
- Missing relative abundance data from Table 27, pre-settlement vs. FIA 1990 tree species data
- 2013 updates to the Rare Species Guide online tool
- GIS data on all MDA-listed Noxious Weeds in Minnesota and specifically the Southeast Landscape.
- Climate change data
- Forestland carbon stock



## Goal 4 – Economic and Social Values

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**MFRC Goal 4: Economic and Social Values.** Forests within a region’s landscape will be providing a full range of products, services, and values, including timber products, wildlife, and tourism that are major contributors to economic stability, environmental quality, social satisfaction, and community well-being.

Note: Population and economic data for the Southeast Landscape that is related to Goal 4 can be found in the Demographic Data Report for the 2<sup>nd</sup> generation Forest Resource Management Plan for the Southeast Region.

### 4.1 Data Sources

#### Hydraulic sand fracturing

- Minnesota Department of Transportation.

#### Roads:

- Minnesota Department of Transportation.
- Minnesota House of Representatives Research Department.

#### Trails:

- Table: Lawton, John. 2013. MN DNR Division of Parks and Trails.
- Map: MN DNR Data Deli

### 4.2. Forest products industry

#### *Section 4.2.1: Forest Products Industry – Southeast Minnesota*

According to data from MN DEED’s Quarterly Census of Employment and Wages, there were nearly 323 forest-related payroll jobs in the Southeast Landscape in 2013 (Table 52). This was slightly up from 2010, which had the decade-low number of forest-related payroll jobs (271), but well below 2005 when forest-related payroll jobs peaked for the decade (604). Freeborn County had the most forest-related payroll jobs in 2013 (137), followed by Wabasha (91), Houston (70), and Mower (25); no other counties reported forest-related jobs in 2013.

8,425 cord equivalents (1000 boardfeet ~ 2 cords) of timber were harvested in the region in 2011, the majority of which came from Fillmore (3,361) and Houston (1,868) Counties (Table 53). Comparatively, over 21,000 cord equivalents of timber were processed in the region in 2009, indicating that the region imports timber from other parts of the state or other states for processing (Table 54).

Table 55 and Figure 33 show the locations of 26 sawmills in the Southeast Landscape in 2007. Most of these facilities are located in the Rochester Plateau and Blufflands Subsections.

Table 52: Forest-related payroll employment in the Southeast Landscape, 2004-2013.

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Dodge	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fillmore								36	58	
Freeborn	140	141	143	144	145	114	99	122	139	137
Goodhue		104	104	68	47	30				
Houston	179	188	157	115	97	75	65	63	64	70
Le Sueur	20		13	11						
Mower	36	34	29	30	29	26	25	25	24	25
Olmsted					6	5	7	7		
Rice	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Steele	16	21								
Wabasha	128	116	91	79	78	81	75	56	52	91
Waseca	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Winona	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
<b>TOTAL SE Landscape</b>	<b>519</b>	<b>604</b>	<b>537</b>	<b>447</b>	<b>402</b>	<b>331</b>	<b>271</b>	<b>309</b>	<b>337</b>	<b>323</b>

Note: Table updated Aug. 2014.

**Source:** Deckard, Don. MN DNR Forest Economist. Data queried from MNDEED QCEW (Quarterly Census of Employment and Wages) 8-19-2014.

Table 53: Timber harvest by Minnesota county in the Southeast Landscape, 2011.

County	Harvest (cords)
Dodge	179
Fillmore	3,361
Freeborn	153
Goodhue	595
Houston	1,868
Le Sueur	209
Mower	117
Olmsted	807
Rice	48
Steele	78
Wabasha	191
Waseca	57
Winona	763
<b>TOTAL SE Landscape</b>	<b>8,425</b>

Note: Table updated Aug. 2014.

**Source:** Deckard, Don. MN DNR Forest Economist. Compiled from: MNDNR 2010 Sawmill Survey and USFS 2011 Pulpwood Survey, 8-19-2014.

Table 54: Timber Processed in the Southeast Landscape, 2009.

County	Harvest (thousand boardfeet)
Dodge	0
Fillmore	4,357
Freeborn	270
Goodhue	181
Houston	5,349
Le Sueur	0
Mower	20
Olmsted	120
Rice	48
Steele	84
Wabasha	43
Waseca	0
Winona	61
TOTAL SE Landscape (thousand boardfeet)	10,533
TOTAL SE Landscape (cord equivalents)	21,066

Notes: Mill Type: Portable sawmill - Post/Pole/Piling operation - Stationary sawmill - Veneer mill; Production Volume Range: (ALL). Table updated Aug. 2014.

**Source:** Deckard, Don. MN DNR Forest Economist. 2009. Compiled from: Minnesota Forest Products Primary Processors Database, 8-19-2014.

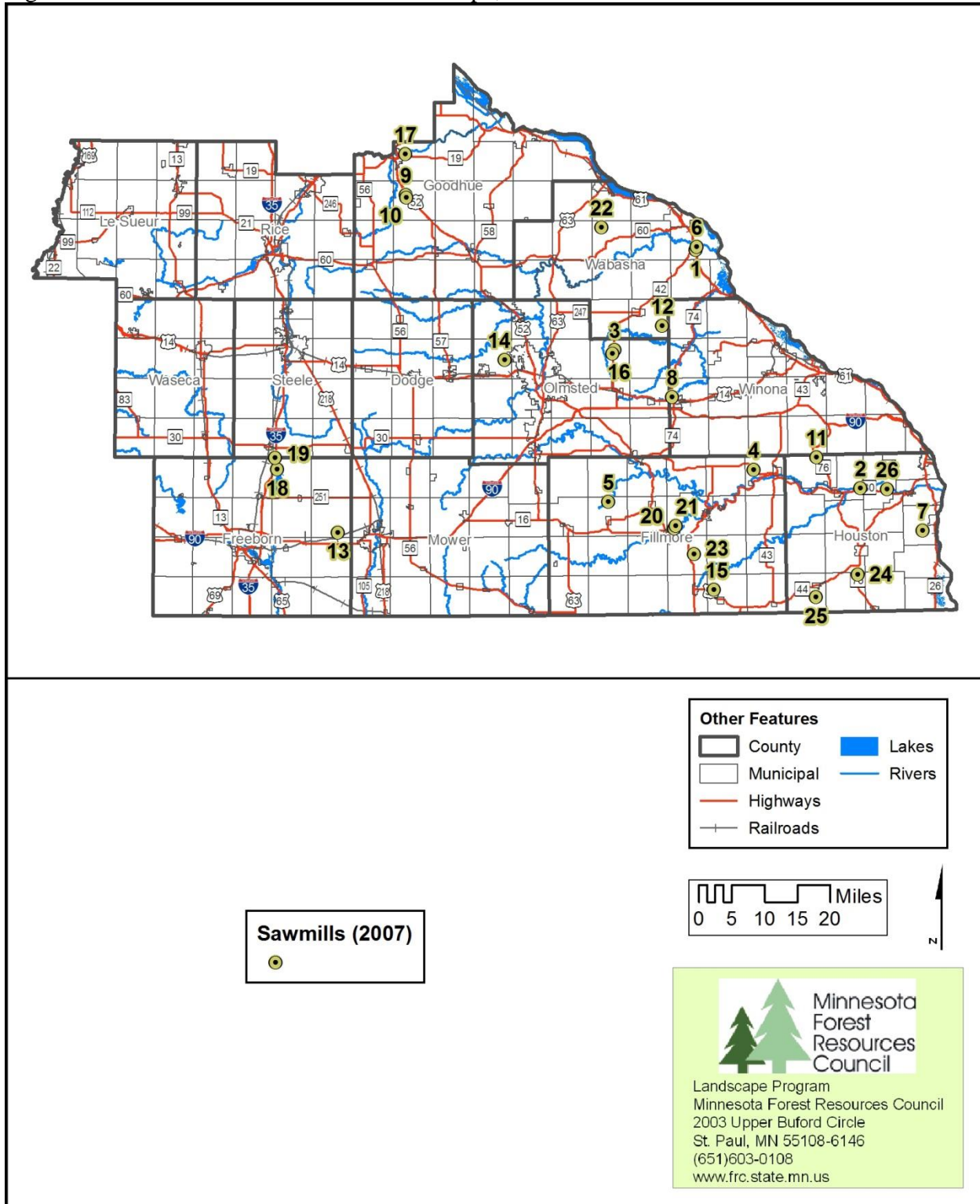
Table 55: Sawmills in the Southeast Landscape in 2007.

<b>Sawmill Name</b>	<b>Map Number</b>	<b>County</b>
Axley Bros. Inc.	1	Wabasha
Crystal Valley Hardwoods	2	Houston
Edgewood Lumber	3	Olmsted
Ellefson Mill	4	Fillmore
Fillmore Sawmill	5	Fillmore
G & G Logging	6	Wabasha
Holzwarth Mill	7	Houston
Jilk (Pete) Mill	8	Winona
Johnson Logging Inc.- Mill	9	Goodhue
Johnson Logging Inc.- Residence/Woodyard	10	Goodhue
Jordan (John) Mill	11	Houston
Kolb - Jeff Mill	12	Wabasha
Len's Wood Products	13	Freeborn
Logan (Mike) Mill	14	Olmsted
Mattson (Lynn) Mill	15	Fillmore
Mulholland Logging	16	Olmsted
Northern Hardwood	17	Goodhue
Richards Wood Products	18	Freeborn
Richards Wood Products	19	Steele
Root River Hardwoods	20	Fillmore
Root River Hardwoods - Woodyard	21	Fillmore
Schuman (Dick) Mill	22	Wabasha
Scotland Sawmill	23	Fillmore
Staggemeyer Stave Co.	24	Houston
Thomas (Gary) Mill	25	Houston
Tri - State Forest Products	26	Houston

Source: Minnesota Dept. of Agriculture

Note: According to K. Hilstrom (2/24/2014), GIS Support Specialist for MN DNR Information Technology Services, this data is at least 7 years old (2007) and may require updating.

Figure 33: Sawmills in the Southeast Landscape, 2007.



Source: Minnesota Dept. of Agriculture

Note: According to K. Hilstrom (2/24/2014), GIS Support Specialist for MN DNR Information Technology Services, this data is at least 7 years old (2007) and may require updating.



*Section 4.2.2: Forest Products Industry – Statewide, Minnesota*

(Note: these are taken directly from the Northeast Conditions and Trends report)

In 2008, Minnesota had over 40,000 jobs statewide directly related to forestry, logging, and primary and secondary forest products manufacturing, and \$9.7 billion of direct economic impact from these industries (Table 56). In 2010, Minnesota ranked 8<sup>th</sup> among the 50 states in terms of gross state product per capita for combined pulp and paper and wood products (Figure 34). In 2012, the state had nearly 1500 forest industry-related facilities including four pulp and paper mills (Table 57). Figure 36 shows stumpage prices per cord for a variety of softwood and soft hardwood species statewide; aspen yielded the highest per cord price among these species in 2009.

Table 56: Direct contribution and total economic impact of Minnesota forest products manufacturing and related sectors, 2008.

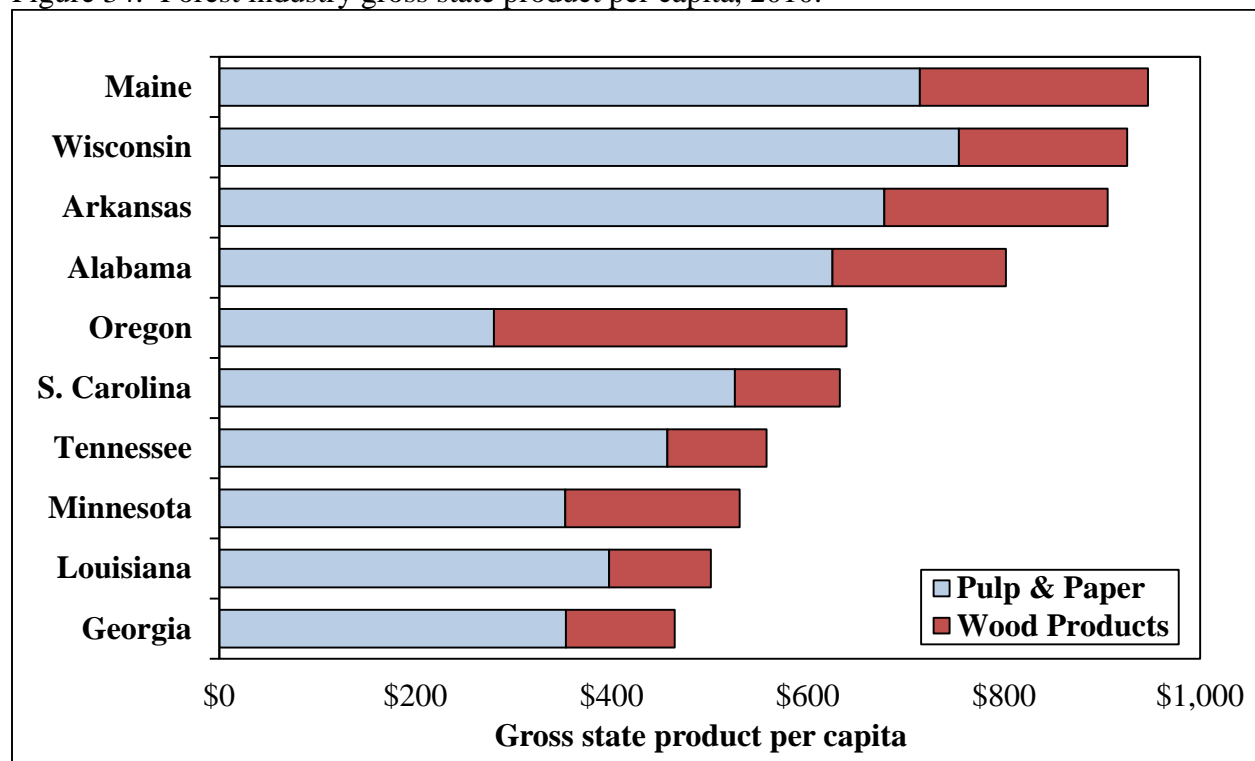
	Employment		Output (Billion \$)		Value Added (Billion \$)	
<b>IMPLAN<sup>1</sup> Sector</b>	<b>Direct Contribution</b>	<b>Total Impact</b>	<b>Direct Contribution</b>	<b>Total Impact</b>	<b>Direct Contribution</b>	<b>Total Impact</b>
Primary Forest Products Mfg.	5,353	19,153	\$2.90	\$5.20	\$0.80	\$1.90
Secondary Forest Products Mfg.	31,743	68,541	\$6.80	\$12.40	\$2.20	\$5.20
Forestry and Logging	3,273	6,231	\$0.70	\$1.10	\$0.20	\$0.40
<b>Totals<sup>2</sup></b>	<b>40,369</b>	<b>86,775</b>	<b>\$9.70</b>	<b>\$17.10</b>	<b>\$3.00</b>	<b>\$6.90</b>

Source: Deckard and Skurla 2011.

<sup>1</sup> IMPLAN – (IMpact analysis for PLANning) software and data combines classic economic input-output analysis with regional specific social accounting matrices and multiplier models.

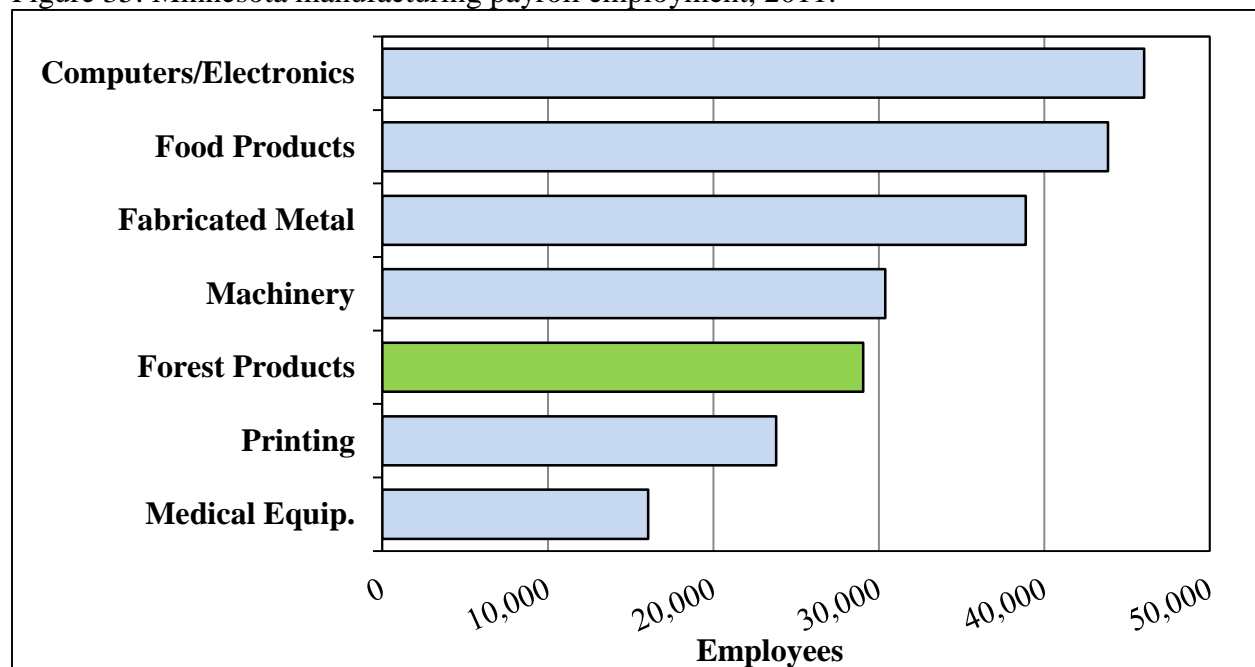
<sup>2</sup> To avoid the appearance of double counting, forestry and logging were discounted from primary manufacturing estimates of output and value added.

Figure 34: Forest industry gross state product per capita, 2010.



Source: Don Deckard, Minnesota DNR, Division of Forestry.

Figure 35: Minnesota manufacturing payroll employment, 2011.



Source: Don Deckard, Minnesota DNR, Division of Forestry.

Note: Forest products employment value includes Forestry and Logging (Industry Code; 113), Support Activities for Forestry (Industry Code; 1153), Wood Product Manufacturing (Industry Code; 321), Paper Manufacturing (Industry Code; 322), 50% of Furniture and Related Product Manufacturing total (Industry Code; 337), and Forest Products Non-employer values.

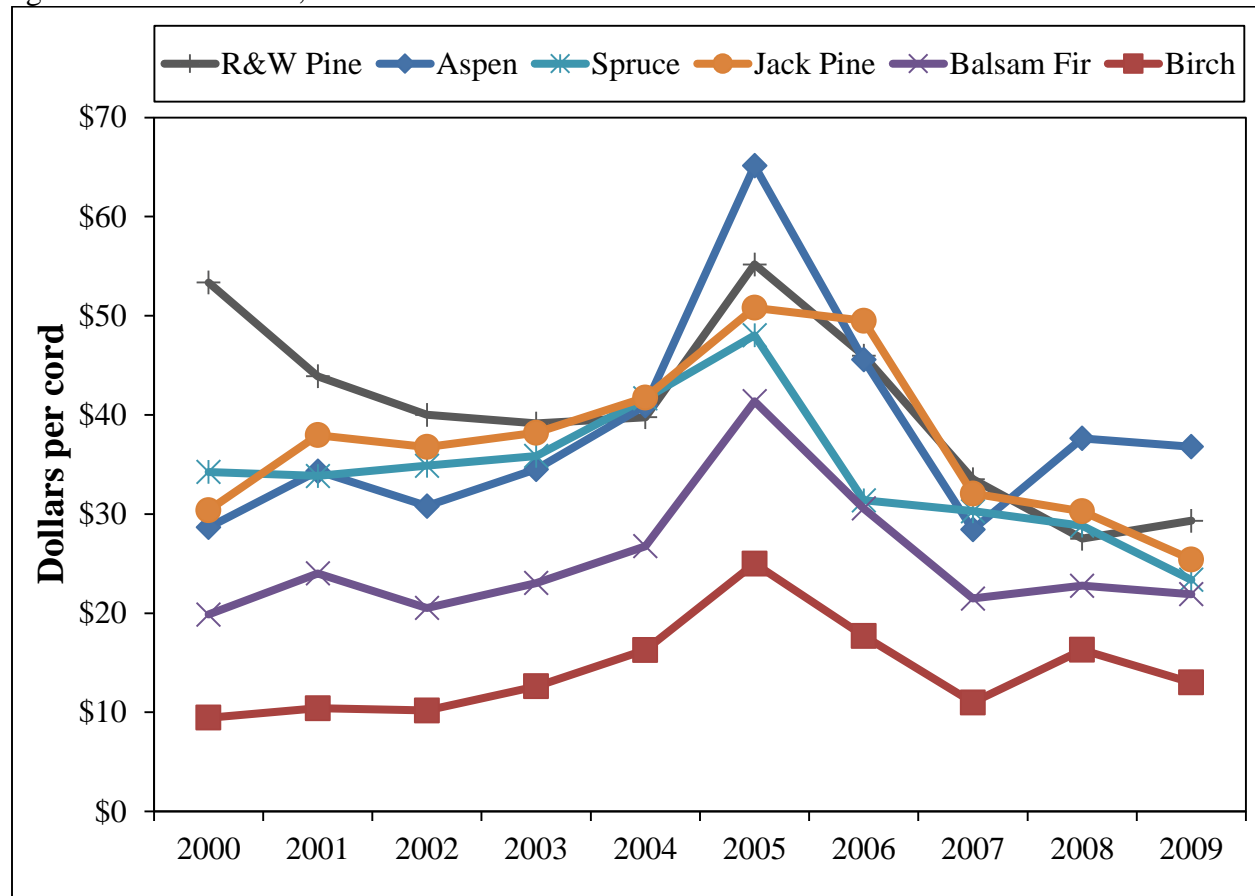
Table 57: Forest industry related facilities in Minnesota.

<b>Manufacturing &amp; Energy Facilities 2012</b>	
Pulp & Paper Mills	4 (Verso, Sartell shutdown 8/12)
Recycled Pulp & Paper Mills	3
Hardboard & Specialty Plants	1 (G-P, Duluth shutdown 8/12)
Oriented Strand Board / Structural Panel Plants	2
Sawmills	500+
Specialty Businesses	150
Secondary Manufacturers	800+
Renewable Energy <sup>1</sup>	14

Source: Don Deckard, Minnesota DNR, Division of Forestry

<sup>1</sup>Includes: electricity generation, combined heat & power (CHP), and fuel pellet manufacturing facilities with >10,000 cord annual consumption.

Figure 36: Average prices received for stumpage per cord by species sold by public land agencies in Minnesota, 2000-2009



Source: Minnesota DNR, Minnesota's Forest Resources 2010

Note: Data represents the Pulp & Bolts in Combination. A bolt is defined as a short log, usually 100" length, with a specific minimum top diameter, generally sawn for lumber.

### *Section 4.2.3: Land Value Data*

According to 2014 estimates created by Steven Taff of Minnesota Land Economics at the University of Minnesota, land prices in the Southeast Landscape have increased enormously over the past 20 years. Farmland (which includes “2a agricultural land” after 2008) increased by over 450% in all counties, with greatest increases in Houston (997%), Winona (915%), and Fillmore (901%) Counties. Mower County currently (2013) has the most expensive farmland, valued at \$7,440 per acre (Table 58).

Tillable land (“2a tillable land” after 2008) increased somewhat less than farmland, but still significantly; price per acre increased approximately 450% to 750% among the counties, with Fillmore (757%), Olmsted (707%), and Winona (647%) Counties seeing the largest increase among counties with 20-year records (Table 59). Wabasha county lacked records for 1993, but saw a 19-year increase of 525%, placing it 8<sup>th</sup> of the 13 counties in terms of tillable acreage value increase for that same time span. Mower County currently (2013) has the most expensive tillable land, valued at \$7,704 per acre.

Timberland (“2b timberland” after 2008) was not well documented for most counties, especially before 2007, but so the largest percent increases for some of the counties that did have available data for the 20 year period (Table 60). The top three counties in the region with 20-year data, in terms of percent increase for timberland, were Fillmore (1374%), Wabasha (1283%), and Houston (1188%) Counties. Olmsted County currently (2013) has the most expensive timberland, valued at \$3,958 per acre.

Table 58: Changes in land value (\$) per acre in Farmland (1993-2008) and 2a agricultural land (2009-2013) in the MFRC Southeast Landscape.

	Dodge	Fillmore	Freeborn	Goodhue	Houston	Le Sueur	Mower	Olmsted	Rice	Steele	Wabasha	Waseca	Winona
1993	955	538	1090	899	439	901	951	726	963	1062	615	1160	537
1994	991	588	1089	964	483	900	952	827	1029	1074	668	1272	570
1995	1010	671	1089	969	585	1045	1028	829	1123	1146	670	1278	617
1996	1062	734	1023	981	800	1142	1087	913	1226	1209	705	1415	669
1997	1212	770	1260	1112	759	1220	1217	1009	1391	1319	825	1416	676
1998	1364	927	1323	1212	786	1296	1293	1052	1574	1528	949	1565	835
1999	1512	1027	1494	1326	814	1374	1425	1218	1651	1534	1039	1751	1032
2000	1660	1226	1494	1425	998	1586	1524	1334	1905	1597	1171	1751	1288
2001	1682	1237	1633	1587	1038	1688	1665	1490	2141	1648	1366	1752	1556
2002	1793	1473	1641	1786	1370	2029	1798	1716	2360	1805	1434	2050	1586
2003	1944	1595	1708	1914	1436	2260	1874	1935	2997	1926	1505	2274	1814
2004	2309	1798	1998	2255	1548	2648	2146	2914	3461	2104	1708	2270	1994
2005	2591	2106	2430	2847	1868	3098	2325	3475	4142	2472	1910	2567	2302
2006	2807	2536	2626	3488	2176	3912	2679	3771	5772	2806	2315	2968	2588
2007	3253	2537	2787	3461	2563	4401	3124	4003	5801	3098	2494	3252	2823
2008	3453	2937	3001	3669	2712	4438	3281	4077	5810	3380	2880	3584	3202
2009	3919	3136	3968	3830	2895	5024	3806	3137	5705	3958	3508	4168	3848
2010	4249	3444	4366	3778	2888	4887	4069	4049	4984	3958	3571	4554	3789
2011	4677	3685	4230	4031	3215	4797	4280	4072	4686	4183	3775	4781	3838
2012	5521	4406	4901	4516	3765	5501	5176	4489	5304	5046	4374	5343	4171
2013	7223	5383	6793	6117	4817	6446	7440	5652	5593	6043	5240	6979	5451
20 year change (\$)	6268	4845	5703	5218	4378	5545	6489	4926	4630	4981	4625	5819	4914
20 year change (%)	656%	901%	523%	580%	997%	615%	682%	679%	481%	469%	752%	502%	915%

Source: Steven Taff, Minnesota Land Economics. 2014. "Estimated Land Values." University of Minnesota. [landeconomics.umn.edu](http://landeconomics.umn.edu)

Table 59: Changes in land value (\$) per acre in Tillable land (1993-2008) and 2a tillable land (2009-2013) in the MFRC Southeast Landscape.

	<b>Dodge</b>	<b>Fillmore</b>	<b>Freeborn</b>	<b>Goodhue</b>	<b>Houston</b>	<b>Le Sueur</b>	<b>Mower</b>	<b>Olmsted</b>	<b>Rice</b>	<b>Steele</b>	<b>Wabasha</b>	<b>Waseca</b>	<b>Winona</b>
<b>1993</b>	1027	696	1166	1008	740	1044	1012	744	1077	1096	0	1123	764
<b>1994</b>	1066	766	1166	1086	776	1043	1014	911	1126	1092	801	1114	832
<b>1995</b>	1087	874	1166	1089	917	1208	1086	911	1202	1213	805	1063	924
<b>1996</b>	1139	944	1095	1089	1186	1307	1155	1016	1263	1211	850	1473	1018
<b>1997</b>	1305	965	1349	1218	1058	1376	1302	1130	1421	1367	926	1442	1021
<b>1998</b>	1444	1151	1419	1318	1024	1437	1375	1169	1563	1600	993	1376	1026
<b>1999</b>	1603	1179	1604	1448	989	1473	1522	1357	1641	1600	1114	1688	1249
<b>2000</b>	1762	1352	1604	1524	1060	1698	1627	1474	1882	1681	1276	1686	1537
<b>2001</b>	1782	1350	1755	1652	1095	1708	1776	1651	2001	1719	1493	1680	1652
<b>2002</b>	1900	1559	1766	1871	1412	2034	1923	1845	2259	1876	1567	1996	1620
<b>2003</b>	2060	1660	1841	1983	1484	2291	1995	2505	2825	1997	1639	2184	1752
<b>2004</b>	2454	1859	2137	2364	1573	2398	2283	2585	3201	2199	1855	2145	1800
<b>2005</b>	2698	2159	2612	2987	1768	2689	2461	2888	3339	2588	2059	2456	1988
<b>2006</b>	2857	2567	2811	3632	2053	2970	2824	3072	5027	2939	2481	2808	2276
<b>2007</b>	3115	2568	2977	3703	2272	4309	3189	3748	6103	3256	2665	3186	2993
<b>2008</b>	3521	2972	3214	3958	2558	4352	3342	3806	6104	3570	3112	3518	3546
<b>2009</b>	3925	3266	3865	4114	2684	4811	3744	3327	5679	3933	3302	3975	3455
<b>2010</b>	4245	3467	4309	4056	2685	4843	4143	4150	5278	3934	3362	4351	3453
<b>2011</b>	4685	3754	4509	4346	3038	4844	4361	4124	4730	4160	3556	4572	3604
<b>2012</b>	5607	4755	5237	4874	3534	5709	5306	4594	5406	5022	4151	5178	3990
<b>2013</b>	7451	5966	7325	6649	4585	6777	7704	6005	5863	6356	5004	6887	5709
<b>20 year change (\$)</b>	6424	5270	6159	5641	3845	5733	6692	5261	4786	5260	5004	5764	4945
<b>20 year change (%)</b>	626%	757%	528%	560%	520%	549%	661%	707%	444%	480%	n/a	513%	647%

**Source:** Steven Taff, Minnesota Land Economics. 2014. "Estimated Land Values." University of Minnesota. [landeconomics.umn.edu](http://landeconomics.umn.edu)



Table 60: Changes in land value (\$) per acre in Timberland (1993-2008) and 2b timber land (2009-2013) in the MFRC Southeast Landscape.

	Dodge	Fillmore	Freeborn	Goodhue	Houston	Le Sueur	Mower	Olmsted	Rice	Steele	Wabasha	Waseca	Winona
1993		150		409	156						214		380
1994		170		420	218						253		397
1995		170		436	280						270		391
1996		170		452	450						312		305
1997		248		492	340						484		340
1998		344		590	418						742		780
1999		614		624	533						783		968
2000		857		650	873						773		1199
2001		860		807	921						834		1516
2002		1125		850	1228						854		1614
2003		1291		870	1275						928		1787
2004		1493		959	1456						1021		2205
2005		1862		1060	1904						1227		2584
2006		2283		1198	2207	3231					1535		2816
2007		2308		1236	2792	3700	1190		3903		1663		2447
2008	1958	2628	2476	1346	2779	4309	1577	5000	5170		1929		2645
2009	1945	2682		1779	2900	4262		2419		1502	2056		2537
2010	2296	2921	985	1601	2700	4244	2000	3984	3829	1794	1982		2537
2011	2520	2914	1057	1604	2499	3879	1998	4003	3352	1794	2112	1190	2515
2012	2583	2612	1551	1803	2250	3580	1997	3827	3652	1996	2493	1447	2365
2013	2760	2211	1370	2152	2009	3574	1997	3958	3199	2293	2959	1833	2368
<b>20 year change (\$)</b>	n/a	2061	n/a	1743	1853	n/a	n/a	n/a	n/a	n/a	2745	n/a	1988
<b>20 year change (%)</b>	n/a	1374%	n/a	426%	1188%	n/a	n/a	n/a	n/a	n/a	1283%	n/a	523%

Source: Steven Taff, Minnesota Land Economics. 2014. "Estimated Land Values." University of Minnesota. landeconomics.umn.edu

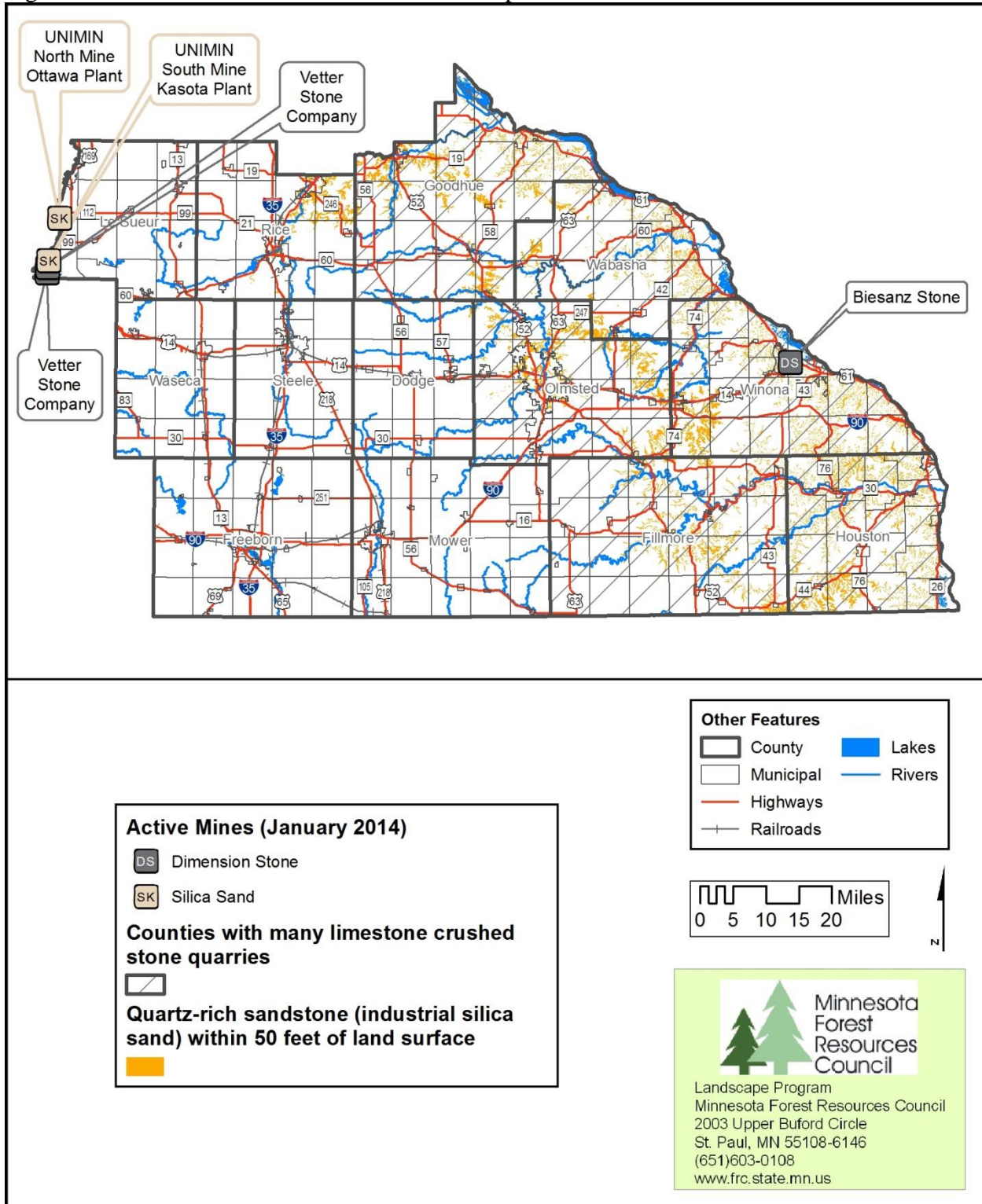
### **4.3. Mining**

According to the MN DNR Division of Lands and Minerals and the Minnesota Geological Survey, there are currently five active dimension stone or silica sand mines in the Southeast Landscape: four in Le Sueur County and one in Winona County (Figure 37). Limestone crushed stone quarries are abundant, however, and spread throughout the quart-rich sandstone regions of the Blufflands and Rochester Plateau.

Only three of the 13 counties in the region had specific data available on resource potential for mining aggregate crushed stone and sand/gravel: Dodge, Le Sueur, and Olmsted Counties. Of these, Olmsted County has the highest crushed stone resource potential, with over half of the county's total acreage identified as having low to high potential for this material (Figure 38, Table 61). Dodge County had the highest potential for sand and gravel of the three counties, with 18.3% of its total acreage identified as having low to high potential for this material (Figure 39, Table 62). However, most of this potential was "low" for all three counties – less than 2.5% for each. Between the three counties, there are 765 aggregate mining locations (Table 63).

According to the State Program Director of the MN DNR, in terms of hydraulic fracturing sand mining no new mines are currently being planned in the region, as development of new mines is currently halted in the state. However, many small silica sand mines that produce agricultural bedding exist throughout the region and are tracked at the county level (H. Arends, personal communication).

Figure 37: Active Mines in the Southeast Landscape.



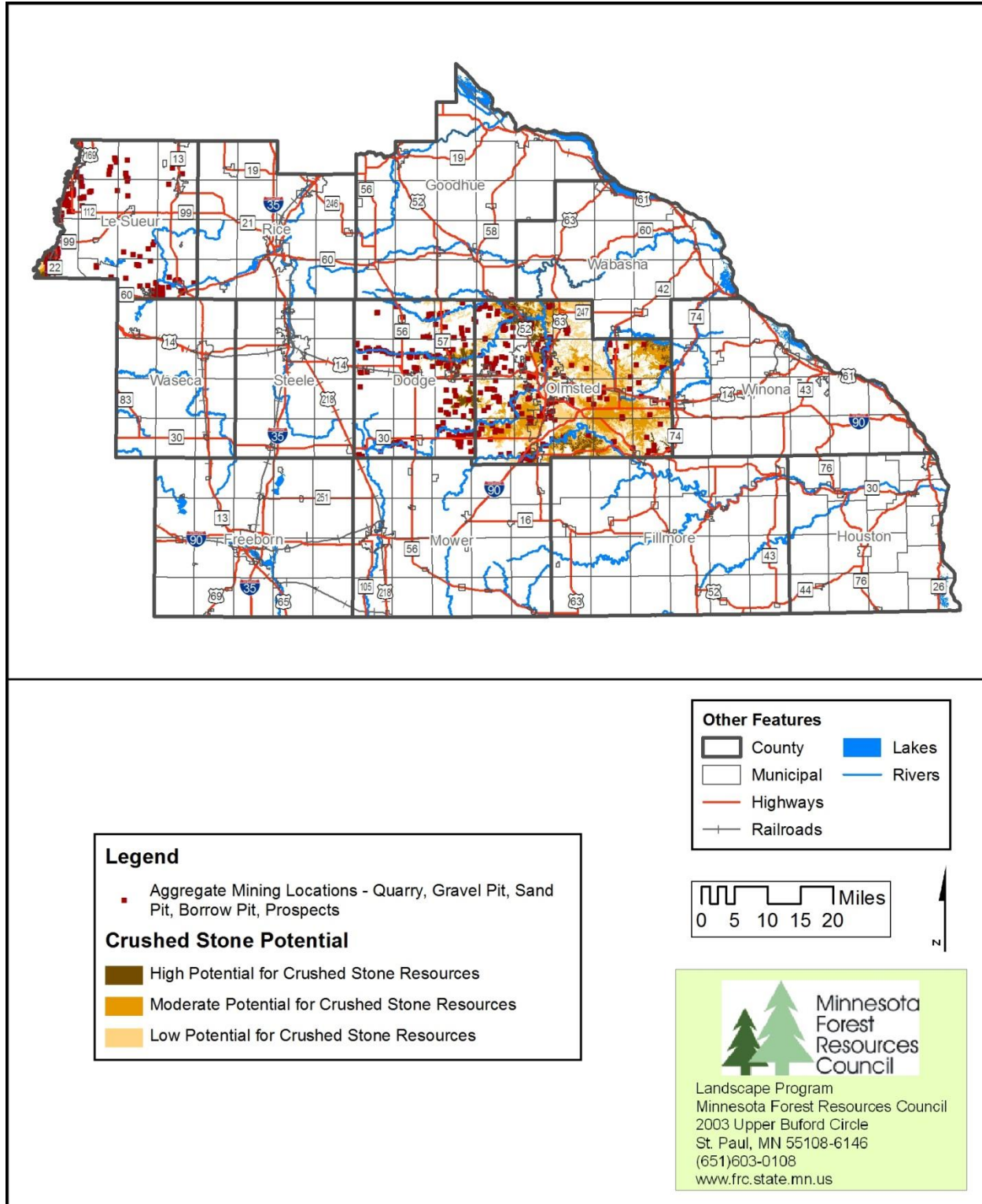
Source: MN DNR Division of Lands & Minerals and Minnesota Geological Survey

Table 61: Resource Potential for mining aggregate crushed stone in Dodge, Le Sueur, and Olmstead Counties.

<b>County</b>	<b>Aggregate Potential</b>	<b>Acres</b>	<b>% of Total</b>
Dodge	High Potential for Crushed Stone Resources	8,225	2.9
	Moderate Potential for Crushed Stone Resources	4,878	1.7
	Low Potential for Crushed Stone Resources	9,296	3.3
Total Crushed Stone Resources Potential		22,398	8.0
<b>Total County Area</b>		<b>281,164</b>	
<b>County</b>	<b>Aggregate Potential</b>	<b>Acres</b>	<b>% of Total</b>
Le Sueur	High Potential for Crushed Stone Resources	813	0.3
	Moderate Potential for Crushed Stone Resources	2,553	0.8
	Low Potential for Crushed Stone Resources	1,360	0.4
Total Crushed Stone Resources Potential		4,726	1.6
<b>Total County Area</b>		<b>303,022</b>	
<b>County</b>	<b>Aggregate Potential</b>	<b>Acres</b>	<b>% of Total</b>
Olmsted	High Potential for Crushed Stone Resources	25,244	6.0
	Moderate Potential for Crushed Stone Resources	90,610	21.6
	Low Potential for Crushed Stone Resources	113,372	27.1
Total Crushed Stone Resources Potential		229,226	54.7
<b>Total County Area</b>		<b>418,743</b>	

**Source:** Minnesota DNR Lands and Minerals, Aggregate Resource Mapping Program

Figure 38: Mining locations and resource potential for mining aggregate crushed stone in Dodge, Le Sueur, and Olmstead Counties.



Source: Minnesota DNR Lands and Minerals, Aggregate Resource Mapping Program

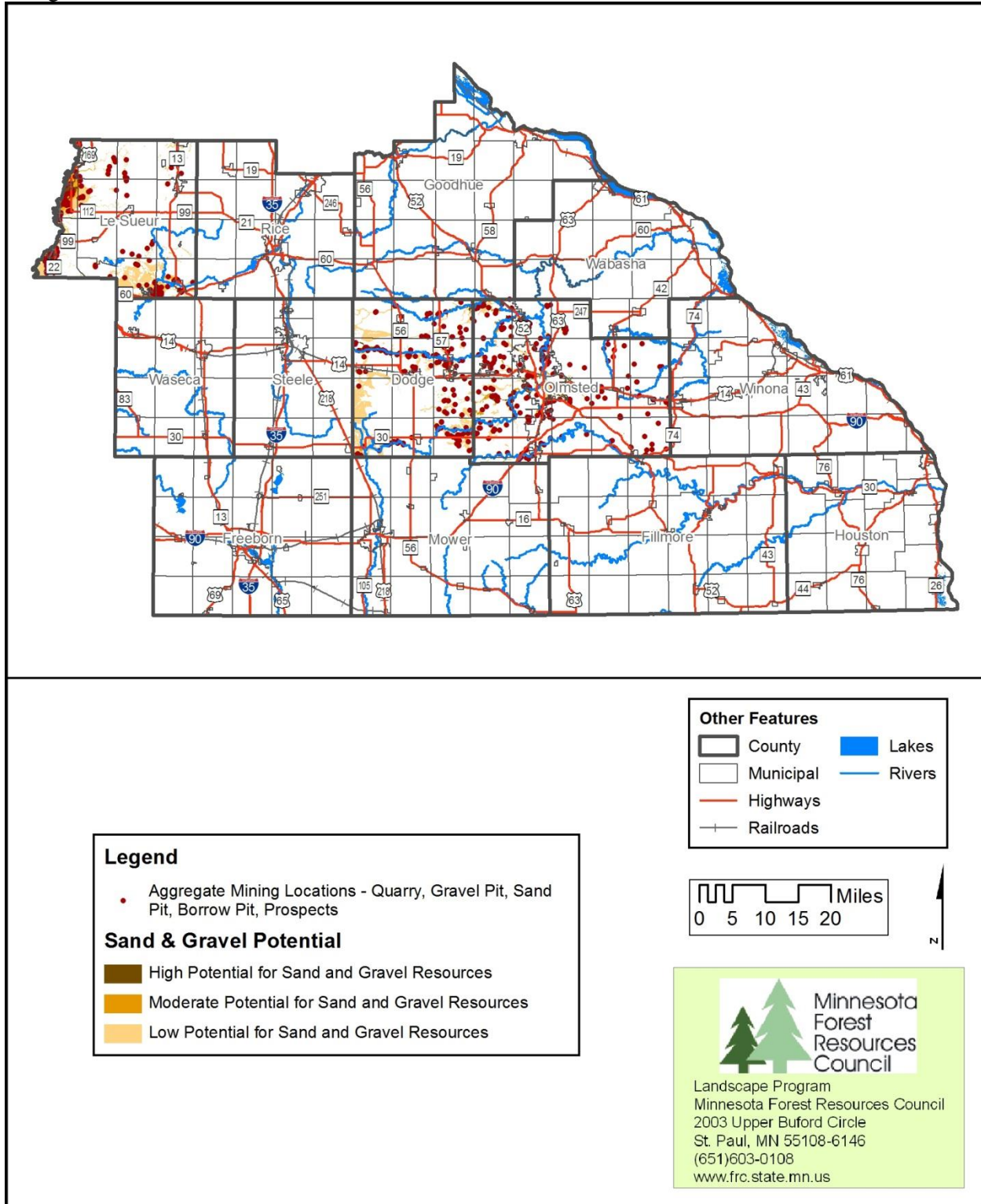
Table 62: Resource potential for mining aggregate sand and gravel in Dodge, Le Sueur, and Olmstead Counties.

<b>County</b>	<b>Aggregate Potential</b>	<b>Acres</b>	<b>% of Total</b>
Dodge	High Potential for Sand and Gravel Resources	1,813	0.6
	Moderate Potential for Sand and Gravel Resources	3,219	1.1
	Low Potential for Sand and Gravel Resources	46,507	16.5
Total Sand and Gravel Resources Potential		51,539	18.3
<b>Total County Area</b>		<b>281,164</b>	
<b>County</b>	<b>Aggregate Potential</b>	<b>Acres</b>	<b>% of Total</b>
Le Sueur	High Potential for Sand and Gravel Resources	4,418	1.5
	Moderate Potential for Sand and Gravel Resources	7,878	2.6
	Low Potential for Sand and Gravel Resources	37,966	12.5
Total Sand and Gravel Resources Potential		50,263	16.6
<b>Total County Area</b>		<b>303,022</b>	
<b>County</b>	<b>Aggregate Potential</b>	<b>Acres</b>	<b>% of Total</b>
Olmsted	High Potential for Sand and Gravel Resources	8,633	2.1
	Moderate Potential for Sand and Gravel Resources	10,087	2.4
	Low Potential for Sand and Gravel Resources	21,127	5.0
Total Sand and Gravel Resources Potential		39,847	9.5
<b>Total County Area</b>		<b>418,743</b>	

Source: Minnesota DNR Lands and Minerals, Aggregate Resource Mapping Program



Figure 39: Mining locations and resource potential for mining aggregate sand and gravel in Dodge, Le Sueur, and Olmstead Counties.



Source: Minnesota DNR Lands and Minerals, Aggregate Resource Mapping Program



Table 63: Aggregate Mining Locations. in Dodge, Le Sueur, and Olmstead Counties

County	Aggregate Mining Locations
Dodge	169
Le Sueur	326
Olmsted	270
<b>Total Recorded Pits and Quarries</b>	<b>765</b>

Source: Minnesota DNR Lands and Minerals, Aggregate Resource Mapping Program

## 4.4 Recreation

### Section 4.4.1: Participation and Economic Impact

Data on recreation activity preferences of Minnesotans was not specifically available for the 13-county Southeast Landscape; however, data was available for a broader 38-county South Region as defined in the 2004 Outdoor Recreation Participation Survey of Minnesotans. The top three most popular outdoor activities among South Region citizens were walking/hiking, boating (including fishing from boats), and swimming (Table 64).

The Leisure and Hospitality Industry in the Southeast Landscape is a nearly \$1 billion industry that employs over 21,000 people (Table 65). These numbers encompass accommodations, food and drink places, and arts, entertainment, and recreation. Olmsted County makes up the largest portion of this industry, with nearly \$400 million in gross sales in 2012 and nearly 8,000 jobs. The next three top grossing counties in the region are Rice, Winona, and Goodhue. Winona County employs over 100 more jobs than Rice County, despite lower overall gross sales.

According to Explore Minnesota, Whitewater State Park was the most popular tourism attraction in the Southern region and 23<sup>rd</sup> ranking attraction in the state in 2010 (of attractions that monitored and reported attendance to Explore Minnesota that year), with 256,218 visitors<sup>1</sup>.

<sup>1</sup>Source: Explore Minnesota. 2012. "PRELIMINARY Top Minnesota Attractions by Region, 2010." [www.exploreminnesota.com](http://www.exploreminnesota.com)

Table 64: Recreation Activity Participation by South Region (see note)

Activity	Participation (%)
Walking/hiking	51
Boating of all types, including fishing from a boat	40
Swimming or wading (all places)	38
Driving for pleasure on scenic roads or in a park	35
Picnicking	35
Fishing of all types	30
Biking (bicycling of all types, including mountain biking)	26
Camping of all types	22
Visiting nature centers	25
Nature observation of all types (e.g., viewing, identifying)	23

Golfing	21
Outdoor field sports (e.g., soccer, softball/baseball, football)	19
Visiting historic or archaeological sites	18
Sledding and snow tubing	16
Outdoor court sports (e.g., volleyball, basketball, tennis)	16
Hunting of all types	14
Running or jogging	13
Snowmobiling	10
Off-road ATV driving	9
Downhill skiing/snowboarding	9
Gather mushrooms, berries, or other wild foods	7
Inline skating, rollerblading, roller skating, roller skiing	6
Horseback riding	5
Ice skating/hockey outdoors	4
Cross country skiing	4
Snowshoeing	3

**Notes:** Data based on population 20 years of age and older. The South Region, as defined by this study, consists of 38 Minnesota counties to the south and west of the Metro area, including the 13 counties in the MFRC Southeast Landscape. It should be noted that Minnesota citizens in the southwest portion of the state may value very different recreation activities than those in the southeast.

**Source:** Kelly, T. (2005). 2004 Outdoor Recreation Participation Survey of Minnesotans: Report on Findings. Saint Paul, MN: Minnesota Department of Natural Resources, Office of Management and Budget Services. In Davenport, M, I. Schneider, A. Date, and L. Filter. 2010. Minnesota's Network of Parks and Trails, An Inventory of Recreation Experience Opportunities in Minnesota: South Region Profile. University of Minnesota, College of Design. Available online at: [http://ccl.design.umn.edu/documents/SouthRegionRecreationInventory05-26-10forweb\\_000.pdf](http://ccl.design.umn.edu/documents/SouthRegionRecreationInventory05-26-10forweb_000.pdf).

Table 65: The Southeast Landscape's Leisure and Hospitality Industry, 2012.

County	Gross Sales	Sales Tax	Private Sector Employment
Dodge	\$10,603,708	\$748,724	402
Fillmore	\$20,503,063	\$1,444,022	578
Freeborn	\$42,175,002	\$2,830,232	1,092
Goodhue	\$69,132,826	\$4,750,638	1,733
Houston	\$9,754,403	\$694,858	275
Le Sueur	\$24,367,527	\$1,550,019	613
Mower	\$56,191,224	\$3,363,419	1,306
Olmsted	\$396,425,482	\$26,354,806	7,982
Rice	\$139,958,353	\$6,025,710	2,333
Steele	\$61,538,609	\$4,121,598	1,401
Wabasha	\$25,620,714	\$1,718,486	777
Waseca	\$14,349,281	\$907,047	388
Winona	\$93,844,551	\$6,407,935	2,448
<b>Total Southeast Landscape</b>	<b>\$964,464,743</b>	<b>\$60,917,494</b>	<b>21,328</b>

**Note:** The Leisure and Hospitality industry consists of Accommodations; Food Services and Drinking Places; and Arts, Entertainment and Recreation.

**Sources:** Minnesota Department of Revenue; Minnesota Department of Employment and Economic Development. In Explore Minnesota Tourism. 2014. Tourism and Minnesota's Economy factsheet. Available online at: <http://www.exploreminnesota.com/industry-minnesota/research-reports/researchdetails/index.aspx?nid=135>.

#### *Section 4.4.2: Fish and Wildlife-based Recreation*

A Creel Survey performed in the summer of 2005 by the MN DNR identified a variety of metrics related to trout fishing in southeast Minnesota:

“Thirty-three trout streams were surveyed from April 1 to September 30, 2005 throughout southeast Minnesota in a roving creel survey. Anglers were interviewed, counted, and given a post-card to return indicating total hours fished. Anglers consisted of mostly males (90.2%) using a variety of bait (37.0%), fly (35.3%), lure (20.7%), and mixed method (7.0%) gear types. Mean angler trip length was calculated as 3.77 hours with a catch rate of 1.10 trout/hour. An estimated 214,307 trout were caught in 52,687 angler trips totaling 190,859 angler-hours. Angler harvest rates were 17.3% for brown trout and 34.4% for rainbow trout.”<sup>2</sup>

Further, the survey identified the vast majority of anglers as Minnesotan residents:

“Minnesota residents consisted of 90.6% of anglers interviewed, while Wisconsin and Iowa residents consisted of 3.9 and 0.9% of anglers, respectively. About 40% of anglers traveled 50 miles or less to fish, while about 20% drove between 50 and 100 miles.” “Local” anglers were defined as those living in the eleven counties in our management area (Fillmore, Goodhue, Houston, Olmsted, Rice, Wabasha, Winona, Dodge, Freeborn, Mower, and Steele) and were 52.3% of anglers interviewed. “Metro” anglers were defined as those living in the seven counties surrounding Minneapolis/St Paul (Dakota, Ramsey, Washington, Anoka, Scott, Carver, and Hennepin). Those anglers consisted of approximately 31.1% of anglers interviewed.”<sup>2</sup>

According to a 2008 study by North Star Economics and Trout Unlimited, the total economic impact of trout anglers in the Driftless Area may be as much as \$210 per outing for residents and \$392 per outing for non-residents (Table 66). Non-residents spend more than residents in all areas (restaurants, entertainment, guiding services, lodging, etc.) except actual fishing supplies, suggesting that angling may be part of overall vacation plans for non-resident anglers.

Total harvest of deer in the Southeast Landscape decreased between 2003 and 2013; this may be reflective of changes in harvest regulations rather than deer population numbers (Table 67). Population models for designated permit areas (DPAs) show relatively stable deer populations in the region between 2008 and 2013, having decreased somewhat in DPAs that had the highest deer densities in 2008 (Table 68).

A survey of 2,312 landowners (with 40 acres or more) in Goodhue, Wabasha, Houston, and Winona counties found that respondents estimated a total of over \$3.5 million worth of damage - the majority of this to corn - from deer in 2011 and attributed 40% of total crop damage that year to deer. The majority of respondents did not perceive a change in amount of damage from deer compared to 5 years prior to the survey. Over 60% of the respondents reported hunting deer in the recent seasons; most of these hunted on their own land. 88% allowed hunting on their

land, most commonly to friend or neighbors (77%), or family (74%). While the highest percentage of respondents in both the hunting and non-hunting strata felt that deer populations were “about right” around their property, landowners who do not hunt were more likely to report that numbers were “too high” (45%) than those who do hunt (23%) (Table 69).

Based on car counts within the Whitewater Wildlife Management Area on opening day of the first and second deer seasons, deer hunting pressure fluctuated somewhat between 1979 and 2000, then decreased gradually until 2010 and 2011, which saw an increase in visitors on those opening days (Table 70). However, the increase was mostly for the opening day of the first (or “buck”) season; visits during the opening day of the second (or “doe”) season have generally decreased gradually since 1979 (J. Cole, personal communication).

<sup>2</sup> Source: Snook, V.A. and D. J. Dieterman. 2006. A Roving Creel Survey of Selected Southeast Minnesota Trout Streams – 2005. Minnesota Department of Natural Resources, report: F-29-R(P)-25. Available online at: [http://files.dnr.state.mn.us/areas/fisheries/lanesboro/Creel\\_Report\\_Final\\_7\\_25\\_06.pdf](http://files.dnr.state.mn.us/areas/fisheries/lanesboro/Creel_Report_Final_7_25_06.pdf).

Table 66: Average Spending Per Outing by Driftless Area Anglers\*

	Resident Anglers	Non-resident anglers
Fishing Supplies	\$43.22	\$31.84
Guiding Services	\$13.93	\$37.37
Restaurants / Bars	\$39.73	\$86.76
Amusements / Entertainment	\$5.78	\$9.58
Auto-related Expenses	\$47.08	\$60.77
Lodging	\$20.75	\$112.54
Groceries	\$32.29	\$40.89
Souvenirs / Gifts / Apparel	\$3.65	\$8.57
Other	\$3.07	\$3.55
<b>Total Per Outing</b>	<b>\$209.50</b>	<b>\$391.88</b>

**Source:** North Star Economics, Inc. and Trout Unlimited. 2008. "The Economic Impact of Recreational Trout Angling in the Driftless Area," p. 4.

\*Due to rounding, the sums and products of the numbers shown in these tables may not appear to exactly equal the totals. However, these totals are correct and are based upon the calculation of the precise mean spending figures.

Table 67: Total Deer Harvest by Designated Permit Area (DPA) for all permit areas in the Southeast Landscape\*, 2003 and 2013.

<b>DPA</b>	<b>2003</b>	<b>2013</b>
461/292	1,213	991
463/230	541	561
466/254	1,311	1,228
464/232	591	622
462/293	1,296	1,312
465/233	622	520

467/255	1,451	1,072
341	2,351	1,735
343	2,429	1,602
347	1,831	1,293
342	1,788	1,762
344	1,205	1,008
345	1,334	1,067
348	2,137	1,638
346	2,687	2,515
349	3,447	2,988
602	-	1,345
<b>Total</b>	<b>26,234</b>	<b>23,259</b>

\* Notes: All designated permit areas that were at least 50% within the 13-county Southeast Landscape. Permit area numbers changed between 2003 and 2013 for 7 areas, but boundaries of these areas did not change.

**Source:** MN DNR. "Minnesota Deer Harvest Report" 2003 and 2013. Division of Fish and Wildlife.

Table 68: Pre-fawn deer density (deer/mi<sup>2</sup>) as simulated from population modeling in each designated permit area (DPA) in Minnesota, 2008-2013.

DPA	Area (mi <sup>2</sup> )	Pre-fawn density					
		2008	2009	2010	2011	2012	2013
230	453	3	3	3	4	3	4
232	377	5	4	4	4	5	5
233	390	4	4	4	4	5	5
254	931	3	3	3	3	3	3
255	774	3	3	3	3	3	4
292	481	8	7	7	6	6	6
293	506	7	7	7	7	7	7
341	596	10	10	10	10	11	12
342	352	13	13	14	14	14	14
343	663	11	11	10	10	10	11
345	326	10	9	8	8	9	10
346	319	21	20	19	19	17	16
347	434	9	8	7	8	8	8
348	332	18	15	14	14	14	14
349	492	22	21	20	19	19	18

**Source:** Grund, Marrett. 2013. "Monitoring Population Trends of White-tailed Deer in Minnesota - 2013." MN DNR, Farmland Wildlife Populations and Research Group.

Table 69: Perception of deer population around property and surrounding area: Comparison of landowners\* who hunt deer and do not hunt deer.

Strata	n	Too high	About right	Too low
Hunt deer	1281	23.20%	55.40%	21.40%

<b>Do not hunt deer</b>	722	44.70%	49.00%	6.20%
		Chi-Sq = 139.45, P < 0.001		

**Notes:** n = 2,312 survey of landowners in Goodhue, Wabasha, Houston, and Winona counties with 40 or more acres.

**Source:** Table taken directly from Pradhananga, A., Davenport, M., & Cornicelli, L. (2013). 2013 survey of deer management on private lands in southeast Minnesota. University of Minnesota, Minnesota Cooperative Fish and Wildlife Research Unit, Department of Fisheries, Wildlife, and Conservation Biology and Department of Forest Resources.

Table 70: Car counts on opening day of different deer hunting seasons in the Whitewater Wildlife Management Area, 1979-2011.

	1st Season (Buck)	2nd Season (Doe)	Muzzleloader
1979	1000	1500	580
1980	825	1500	517
1981	972	1085	385
1982	1113	1350	405
1983	1030	1280	347
1984	970	1222	525
1985	1072	1162	265
1986	1205	1202	265
1987	1325	1215	350
1988	1287	1017	267
1989	1062	1005	NS
1990	1107	1045	282
1991	1037	905	80
1992	1220	1270	248
1993	1072	1160	195
1994	1285	1320	153
1995	1105	1237	132
1996	1325	1135	NS
1997	1305	1237	NS
1998	1198	1293	NS
1999	1270	1210	NS
2000	1145	970	NS
2001	1078	1043	NS
2002	1038	845	NS
2003	965	867	NS
2004	NS	NS	NS
2005	1020	520	NS
2006	1085	622	NS
2007	1070	497	NS

2008	1150	505	NS
2009	1218	485	NS
2010	1480	525	NS
2011	1450	503	NS

**Note:** NS = Not Surveyed

**Source:** Jon Cole, Whitewater Wildlife Management Area Manager, personal communication. Feb. 6, 2014.

## 4.5 Roads and Trails

This section provides information on the length, distribution, and usage of roads and trails statewide as well as those specifically within the 13-county MFRC Southeast Landscape.

### 4.5.1 Roads

Table 71 shows the total mileage of roads in Minnesota from 1989-2005. Table 72 shows the general breakdown of these roads with the majority being town roads and county highways. Historic road mileage summaries not available by county. An average net gain of 162 miles per year was added to Minnesota roads annually from 1989 to 2005 with an overall increase of 2,594 miles.

Nearly 12 million vehicles travel along southeast Minnesota roads every day (Table 73). Approximately 450,000 of these vehicles, or nearly 1 out of every 25 (3.8%), are considered “heavy commercial” (Table 74). As would be expected, heaviest annual average daily traffic (AADT) centers around and flows through major city centers, e.g. Rochester, Owatonna, Faribault (Figure 40). Heavy commercial daily traffic (HCDT) tends not to cluster around city centers, but does flow through them via the major highways and interstates (Figure 41). Though AADT is heavy along Highway 61, which follows the Mississippi River and travels through the Blufflands, HCDT is somewhat lighter along this highway.

There are over 7800 miles of roads in the Southeast Landscape, and vehicles travel an average of over 22.5 million miles along these roads every day (Table 75, Figure 42). Measurements of heavy commercial vehicle mileage in the region is restricted to interstates and United States and Minnesota highways (approximately 2050 miles of road); despite making up on 3.8% of the vehicle traffic, heavy commercial vehicles average over 2 million miles per day along these roads, or 8.8% of the total daily miles travelled (Table 76, Figure 43). For information on the functional classes of these roads, see Table 77 and Figure 44.

**Table 71:** Minnesota statewide road mileage, 1989-2005.

Year	Mileage
1989	132,697
1995	133,710
1999	134,337
2005	135,291

**Source:** Minnesota Department of Transportation.



**Table 72:** Minnesota statewide road mileage by road type, June 2005.

	<b>Road type</b>	<b>Miles</b>
State trunk highways	Interstate highways	914
	Other trunk highways	10,983
	Total state trunk highways	11,897
County highways	County state-aid highways	30,459
	Other county highways	14,752
	Total county highways	45,211
City streets	Municipal state-aid streets	2,970
	Other city streets	16,005
	Total city streets	18,975
Town roads	Town roads	54,785
Other roads	Roads in unorganized townships	1,300
	State & U. S. forest roads	2,379
	Indian reservations	383
	Other	361
	Total other roads	4,423
State Total		135,291

**Source:** Minnesota House of Representatives Research Department.

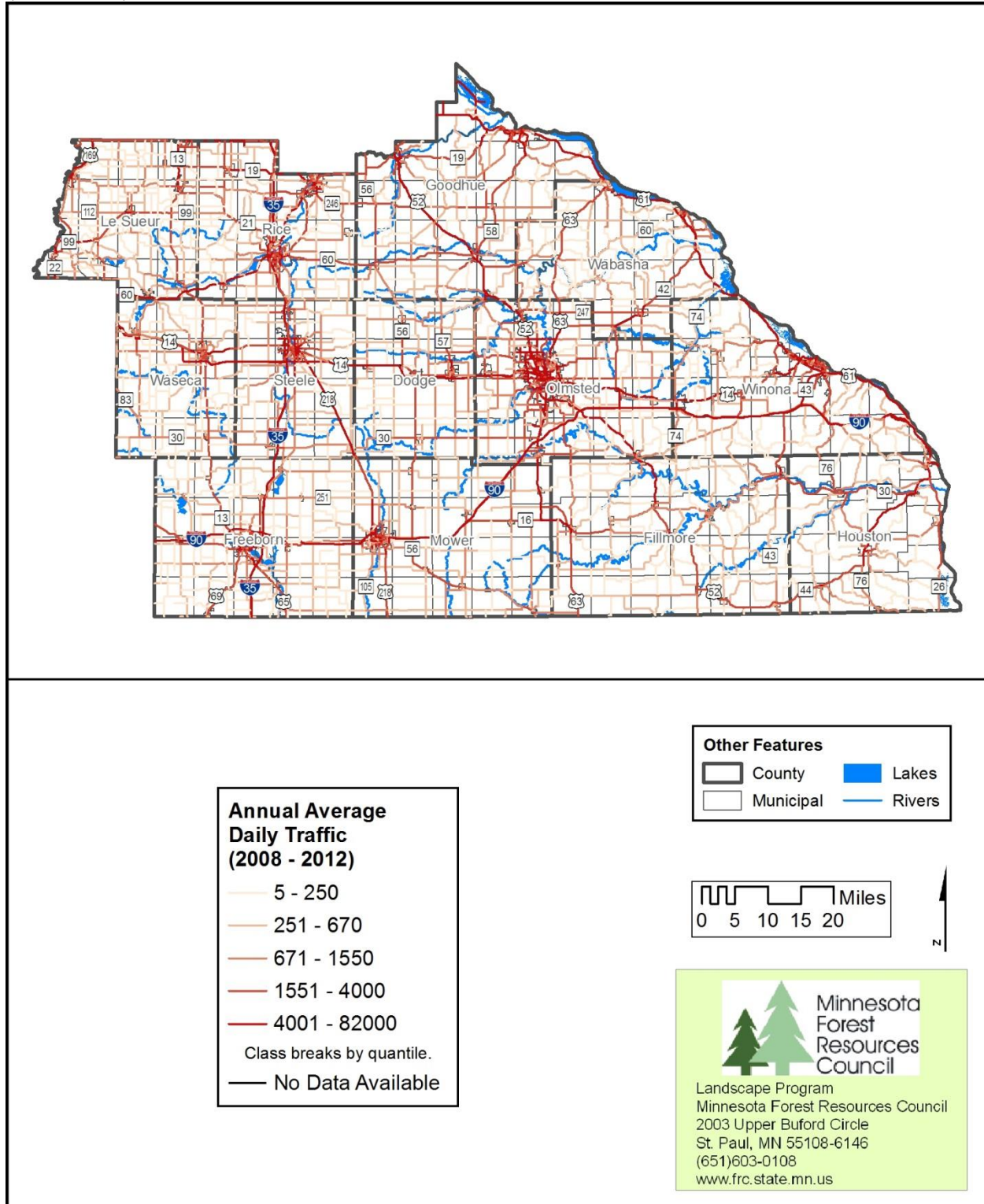
**Table 73:** Annual average daily traffic on selected highways in the Southeast Landscape (2008-2012).

<b>Route Type</b>	<b>Annual Average Daily Traffic</b>
Interstate	1,063,200
US Highway	2,772,700
MN Highway	1,556,330
County State Aid Highway	2,857,645
Municipal State Aid Street	3,198,815
County Road	294,810
Township Road	13,615
Municipal Street	89,410
<b>Total</b>	<b>11,846,525</b>

**Source:** Minnesota Department of Transportation.

Note: Annual Average Daily Traffic (AADT) is the number of vehicles that travel a section of road per day (averaged for 365 days in one year). MNDOT measures traffic for road sections every 2-4 years. Note that AADT is per section of road. If more sections of road exist for a Route Type, more AADT will be reported for that Route Type in the table above. For a normalized comparison of the amount of traffic on each route type, refer to the Annual Average Daily Vehicle Miles Traveled.

**Figure 40:** Annual average daily traffic on selected highways in the Southeast Landscape (2008-2012).



**Source:** Minnesota Department of Transportation.

Note: Reported value represents a mean of all sampling points along the road and data only represents traffic on these roads within the thirteen-county area.

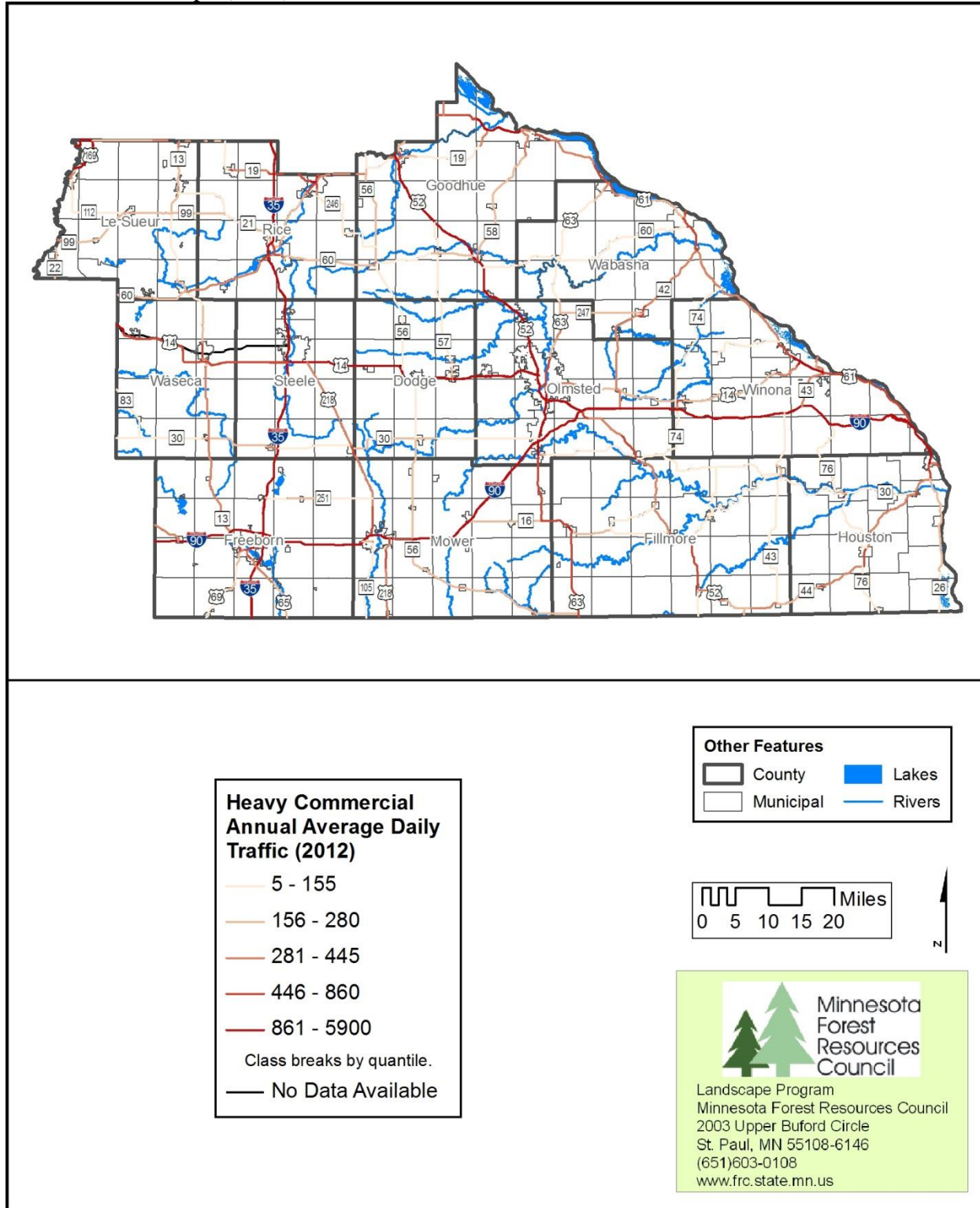
**Table 74:** Heavy commercial annual average daily traffic on selected highways in the Southeast Landscape (2012).

Route Type	Heavy Commercial Annual Average Daily Traffic
Interstate	160,880
US Highway	182,955
MN Highway	104,960
<b>Total</b>	<b>448,795</b>

**Source:** Minnesota Department of Transportation.

Note: Heavy Commercial Annual Average Daily Traffic (HCAADT) is the number of trucks with at least 2 axles and 6 tires that travel a section of road per day (averaged for 365 days in one year). MNDOT measures traffic for road sections every 2-4 years. Note that HCAADT is per section of road. If more sections of road exist for a Route Type, more HCAADT will be reported for that Route Type in the table above. For a normalized comparison of the amount of traffic on each route type, refer to the Heavy Commercial Annual Average Daily Vehicle Miles Traveled map.

**Figure 41:** Heavy commercial annual average daily traffic on selected highways in the Southeast Landscape (2012).



**Source:** Minnesota Department of Transportation.

**Table 75:** Annual average daily vehicle miles travelled in the MFRC Southeast Landscape (2012).

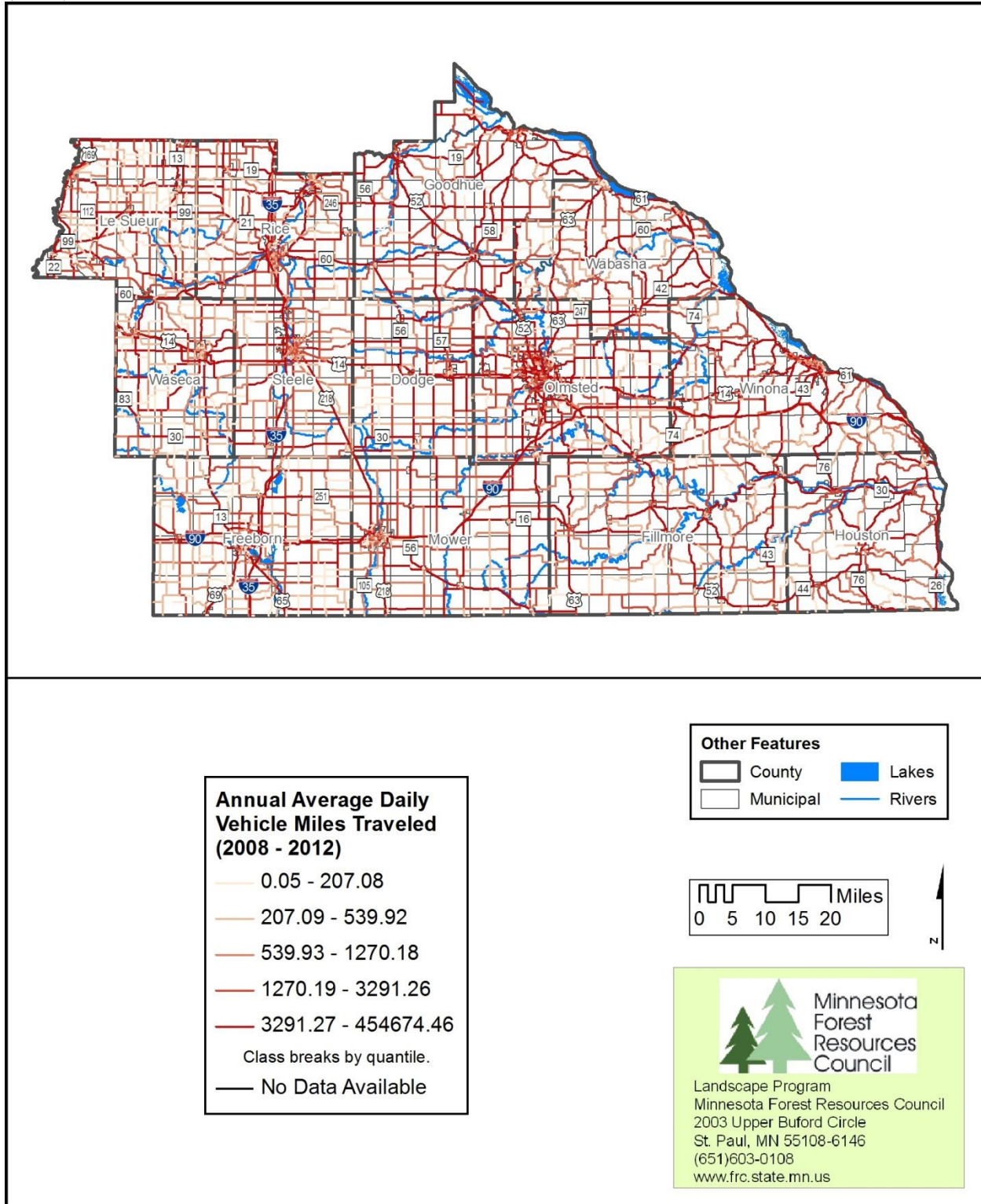
Route Type		Length (miles)		Annual Average Daily Vehicle Miles Traveled
Interstate		415.2		7,048,944
US Highway		688.2		7,808,147
MN Highway		961.9		2,588,087
County State Aid Highway		4039.8		3,638,322
Municipal State Aid Street		296.0		1,227,592
County Road		1381.1		350,190
Township Road		18.9		13,356
Municipal Street		11.5		23,666
<b>Total</b>		<b>7812.6</b>		<b>22,698,305</b>

**Source:** Minnesota Department of Transportation.

Note: Annual Average Daily Vehicle Miles Traveled (AAD VMT) is the number of vehicles that travel a section of road per day (averaged for 365 days in one year) multiplied by the length of the section of road. If 2 vehicles traveled a 2 mile section of road every day over the course of one year, the AAD VMT for that section of road would be 4. The AAD VMT should be used when comparing routes for traffic volume given that it provides a normalized comparison for traffic measurements (the Annual Average Daily Traffic count can be skewed by the presence of multiple sections of a Route Type).



**Figure 42:** Annual average daily vehicle miles travelled in the MFRC Southeast Landscape (2012).



**Source:** Minnesota Department of Transportation.

**Table 76:** Heavy commercial annual average daily vehicle miles travelled in the MFRC Southeast Landscape (2012).

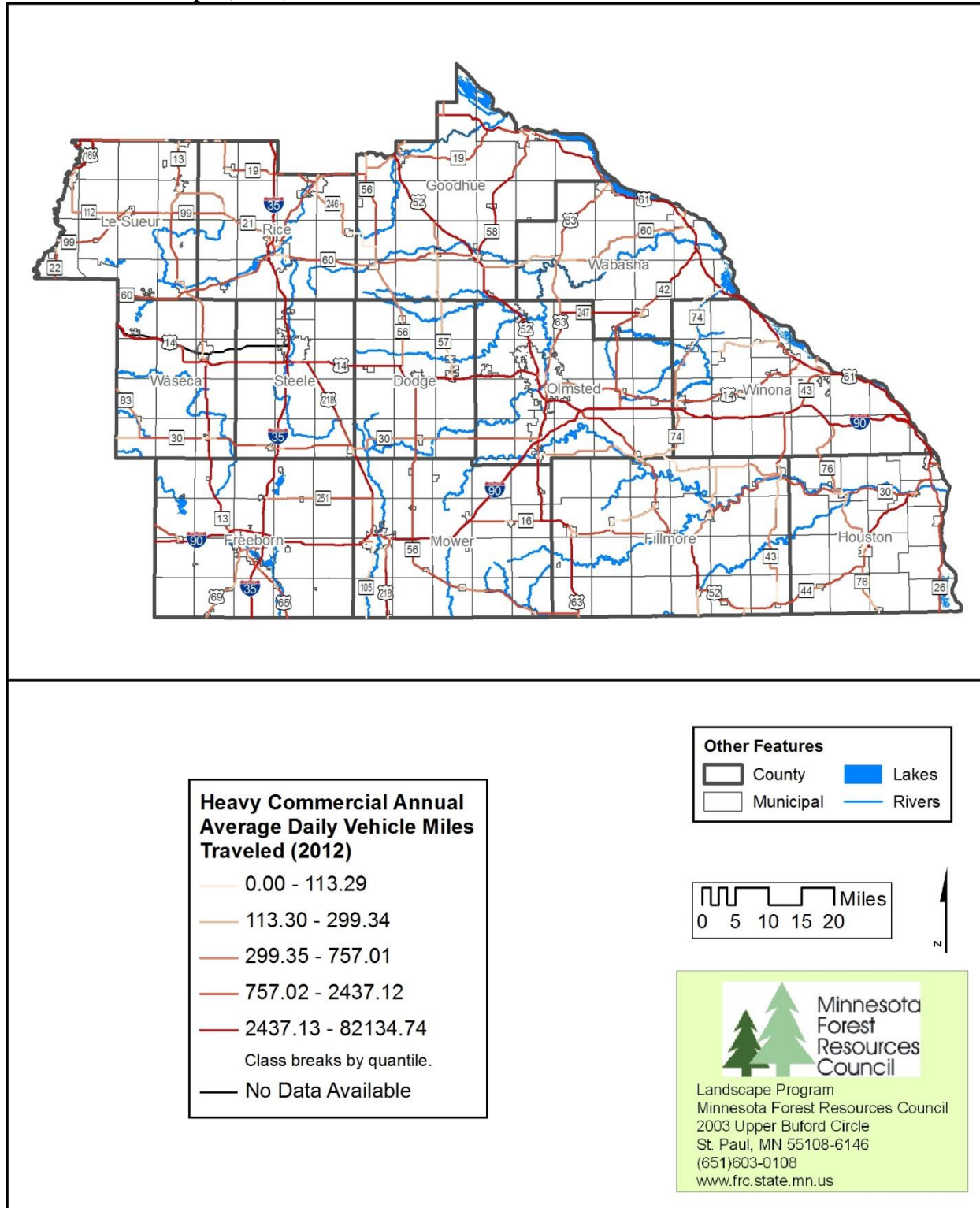
<b>Route Type</b>	<b>Length (miles)</b>	<b>Heavy Commercial Annual Average Daily Vehicle Miles Traveled</b>
Interstate	415.2	1,200,518
US Highway	670.9	611,621
MN Highway	961.1	188,034
<b>Total</b>	<b>2047.3</b>	<b>2,000,173</b>

**Source:** Minnesota Department of Transportation.

Note: Heavy Commercial Annual Average Daily Vehicle Miles Traveled (HCAAD VMT) is the number of trucks with at least 2 axles and 6 tires that travel a section of road per day (averaged for 365 days in one year) multiplied by the length of the section of road. If 2 trucks traveled a 2 mile section of road every day over the course of one year, the HCAAD VMT for that section of road would be 4. The HCAAD VMT should be used when comparing routes for traffic volume given that it provides a normalized comparison for traffic measurements (the Heavy Commercial Annual Average Daily Traffic count can be skewed by the presence of multiple sections of a Route Type).



**Figure 43:** Heavy commercial annual average daily vehicle miles travelled in the MFRC Southeast Landscape (2012).



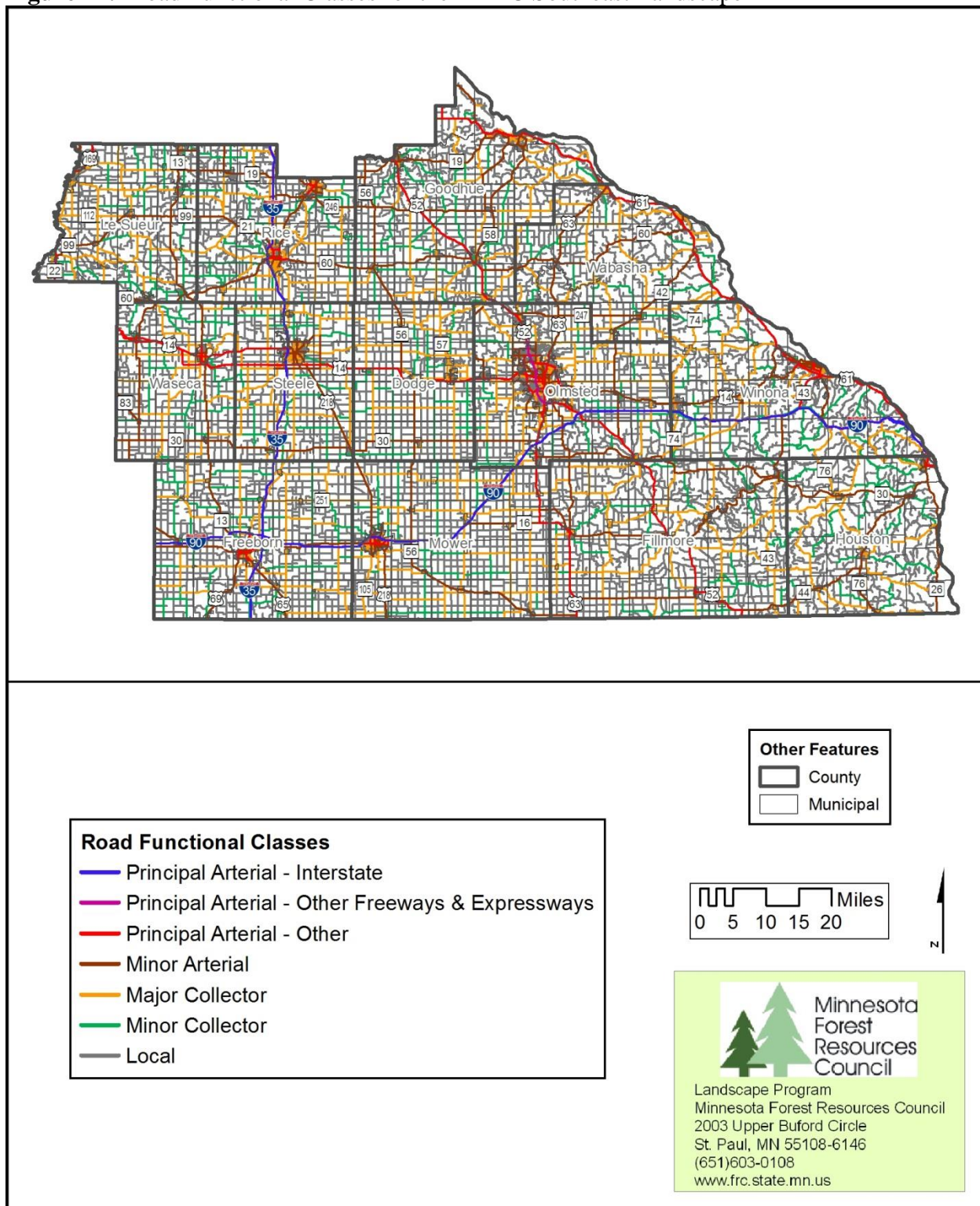
**Source:** Minnesota Department of Transportation.

**Table 77:** Road Functional Classes for the MFRC Southeast Landscape

<b>Road Functional Class</b>	<b>Miles</b>
Principal Arterial - Interstate	415
Principal Arterial - Other Freeways & Expressways	21
Principal Arterial - Other	639
Minor Arterial	1,280
<b>Total Arterial</b>	<b>2,355</b>
Major Collector	2,256
Minor Collector	1,507
<b>Total Collector</b>	<b>3,762</b>
Local	10,721
<b>Total Local</b>	<b>10,721</b>
<b>Total Southeast Landscape</b>	<b>16,838</b>

**Source:** Minnesota Department of Transportation.

**Figure 44:** Road Functional Classes for the MFRC Southeast Landscape



**Source:** Minnesota Department of Transportation.

#### *4.5.2. Trails*

Snowmobiling trails are the most common trail type in both Minnesota and the Southeast Landscape (Table 78, Figure 45). Hiking trails are also common both state-wide and region-wide. All-terrain vehicle trails, however, while the 3<sup>rd</sup> most common trail type of those queried for Minnesota, made up a smaller percentage of total queried trail miles in southeast Minnesota, suggesting that this activity may be less common there than in other parts of the state.

**Table 78:** Length of MN DNR recreational trails in Minnesota and Southeast Landscape.

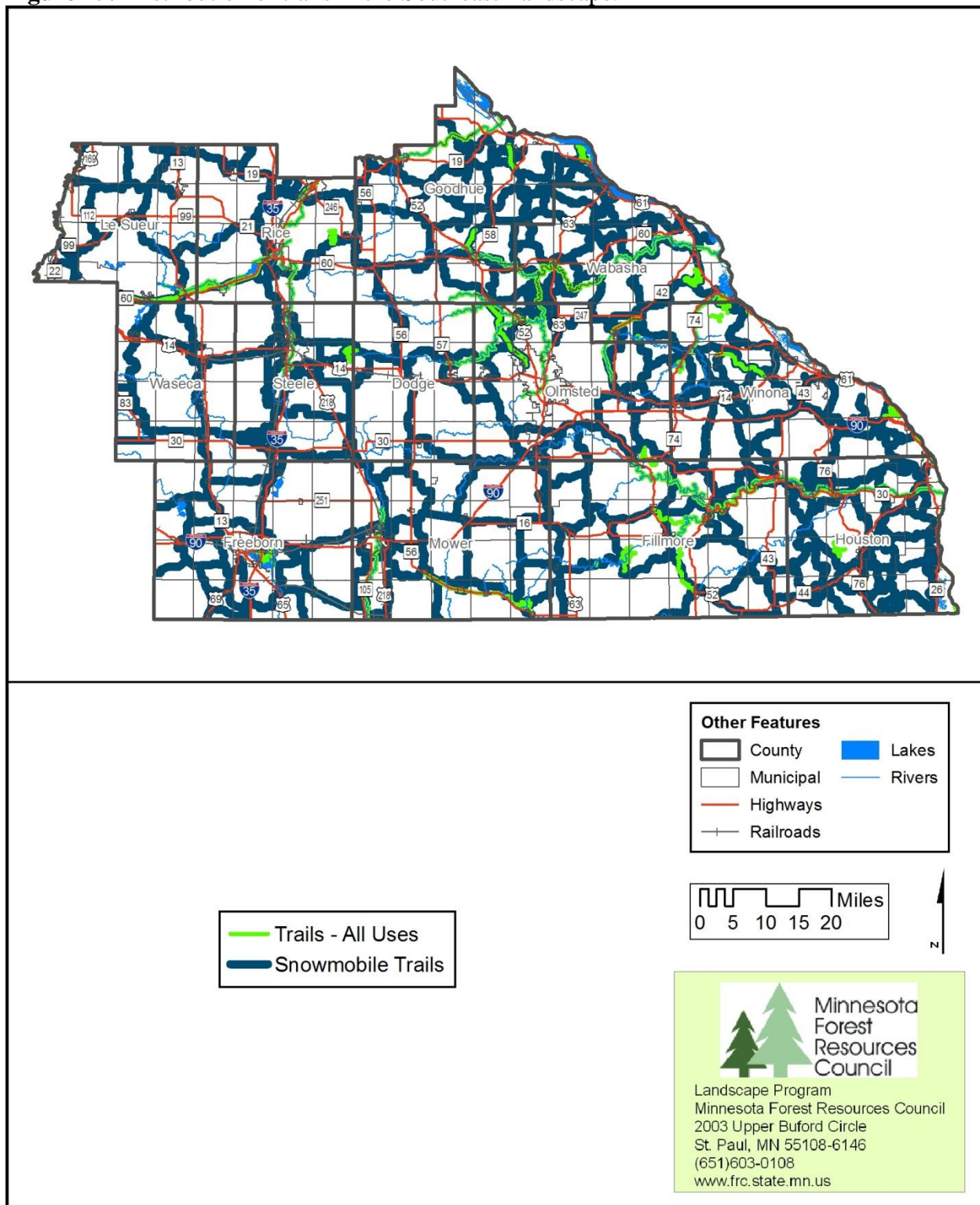
Trail Type	Minnesota miles	SE (rounded) Miles
Snowmobile	22,361	2,956
Bicycle	698	152
Mountain Bike	1,124	137
Hiking	2,415	360
Winter Hiking	142	32
Horse	1,061	50
Cross-country ski	993	186
All-Terrain Vehicle (ATV) trails (category includes both Class 1 and Class 2 ATVs)	1,941	52
Off-Highway Motorcycle (OHM) trails	1,496	21
Off-Road Vehicle (ORV) trails	458	0
Inline skates	[not requested]	151
Snowshoe	[not requested]	1
Motorized watercraft (water trail)	[not requested]	453
Nonmotorized watercraft (water trail)	[not requested]	632
Skateski	[not requested]	3
<b>Total</b>	<b>32,689</b>	<b>3,946 (5,186)</b>

**Source:** MN DNR Division of Parks and Trails

Note: The mileage value for each trail use was calculated from the subset of trail features that met the conditions of the associated query listed above; therefore each use category is NOT mutually exclusive, since many trails permit more than one use. Therefore, some multiple use trail miles may be counted more than once. Further, this is not an exhaustive list of trail types in Minnesota.



**Figure 45:** Distribution of trails in the Southeast Landscape.



**Source:** Minnesota DNR Data Deli

Notes: Additional trails may exist that are not represented in this data set. Green “All Uses” trails may also include snowmobiling, as the information comes from a separate dataset than the “Snowmobile Trails” dataset.

#### **4.6 Additional Data Needs**

- Further forest products industry data for Southeast MN
- Destination Medical Center information