Forests, Water and People

Drinking water supply and forest lands in Minnesota

USDA Forest Service
Northeastern Area
State and Private Forestry

Project Description

In the Northeast and Midwest United States, forests are critically important to the supply of clean drinking water. Protecting and managing forests in source watersheds is an essential part of future strategies for providing clean safe drinking water that citizens can afford. The Forests, Water and People analysis identified private forests that are most important for drinking water supply and most in need of protection from development pressure. This fact sheet gives the results of the analysis for the State of Minnesota. For more detailed description of methods, and results for the Northeast and Midwest United States, see the **full report**.

The Process

Through a 4 step GIS-based overlay analysis, four indices were developed for each watershed (see Figure 1).

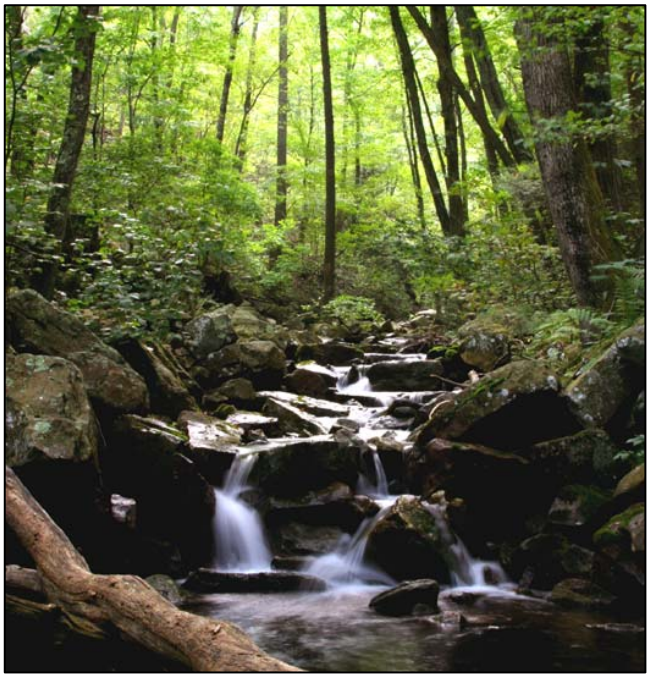
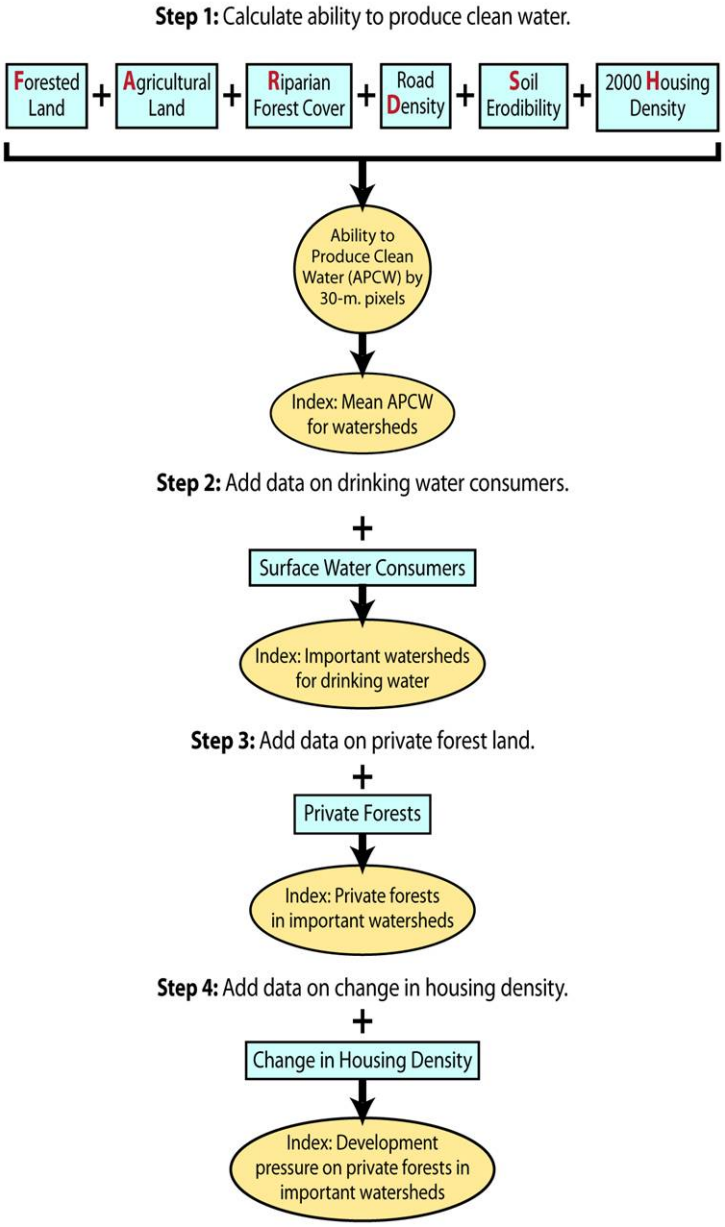


Photo by Michael Land.

"Water, in all its uses and permutations, is by far the most valuable commodity that comes from the forest land that we manage, assist others to manage, and/or regulate." Policy Statement, National Association of State Foresters

Figure 1. *Nine layers of GIS data (boxes) were combined in stepwise fashion, to produce four indices (ovals) of watershed importance for drinking water supplies and the need for private forest management to protect those supplies.*



Minnesota Results

Highlights

- The watersheds in northeastern Minnesota scored above average in each step of the analysis, with the highest scores in step 1. The State contains large protected forest areas in the northeast, an even mix of private and publicly owned forest (51 percent private), and high development pressure around the Twin Cities.
- Those Minnesota watersheds that scored highest in their ability to produce clean water (step 1) are located in the northeastern part of the State, where there are large areas of forested land. Eleven watersheds in Minnesota (or fourteen percent of all the State's watersheds) tied for the highest score in step 1.
- In the ability of watersheds to provide drinking water to the most people (step 2), several Minnesota watersheds scored above average, particularly those in the northeastern part of the State. The scores were not as high as in other parts of the study area due to the fact that many areas of Minnesota get their drinking water from ground water supplies, which are not included in this study. The area far to the north of the Twin Cities scored highest, including the Mississippi Headwaters, Leech Lake, Prairie-Willow, and Pine watersheds.
- In the ability of watersheds to provide drinking water on private lands (step 3), the same area far to the north of the Twin Cities scored highest, including the Mississippi Headwaters, Leech Lake, Prairie-Willow, and Pine watersheds.
- Step 4 ranked watersheds based on their development pressure and land ownership status (private lands ranked higher because they are subject to conversion). The two highest ranked watersheds were the Pine and Rum watersheds, which were in the top sixteen percent of all the study area's watersheds, and are located north of the Twin Cities region.

Table 1. Watershed results for Minnesota

Watershed Name	Hydrologic Unit Code	Mean APCW for watersheds	Surface drinking water consumers	% private forest in watershed	% watershed with housing density increase	Index: Development pressure on private forests important for drinking water supply Score (Step 4)	Rank (Step 4)
Pine	07010105	9 of 10	30,373	39 %	6 %	28 of 40	88 of 540
Rum	07010207	6 of 10	61,437	35 %	14 %	28 of 40	88 of 540
Clearwater-Elk	07010203	5 of 10	108,809	20 %	18 %	26 of 40	126 of 540
Mississippi Headwaters	07010101	9 of 10	78,755	27 %	4 %	26 of 40	126 of 540
Prairie-Willow	07010103	10 of 10	81,990	38 %	2 %	26 of 40	126 of 540
Leech Lake	07010102	9 of 10	54,552	24 %	4 %	25 of 40	148 of 540
Crow Wing	07010106	7 of 10	78,453	39 %	3 %	25 of 40	148 of 540
Elk-Nokasippi	07010104	8 of 10	66,491	41 %	4 %	25 of 40	148 of 540
Upper St. Croix	07030001	9 of 10	0	45 %	6 %	23 of 40	199 of 540
St. Louis	04010201	10 of 10	15,171	38 %	2 %	22 of 40	229 of 540
Long Prairie	07010108	6 of 10	35,390	27 %	3 %	22 of 40	229 of 540
Platte-Spunk	07010201	6 of 10	40,010	24 %	5 %	22 of 40	229 of 540
Crow	07010204	4 of 10	57,637	12 %	12 %	22 of 40	229 of 540
Beartrap-Nemadji	04010301	9 of 10	0	44 %	3 %	21 of 40	264 of 540
Twin Cities	07010206	1 of 10	42,350	14 %	22 %	21 of 40	264 of 540
Snake	07030004	8 of 10	0	34 %	6 %	21 of 40	264 of 540
Vermilion	09030002	10 of 10	11,495	31 %	1 %	21 of 40	264 of 540
Kettle	07030003	8 of 10	0	50 %	3 %	21 of 40	264 of 540
Lower St. Croix	07030005	5 of 10	0	24 %	22 %	20 of 40	289 of 540
Upper Red	09020104	2 of 10	125,099	2 %	10 %	20 of 40	289 of 540
Beaver-Lester	04010102	9 of 10	0	41 %	2 %	20 of 40	289 of 540
Redeye	07010107	6 of 10	34,724	28 %	1 %	20 of 40	289 of 540
Upper Rainy	09030004	10 of 10	6,703	27 %	0 %	20 of 40	289 of 540
La Crosse-Pine	07040006	5 of 10	0	39 %	12 %	20 of 40	289 of 540
South Fork Crow	07010205	4 of 10	50,183	6 %	9 %	19 of 40	320 of 540
Otter Tail	09020103	6 of 10	13,470	22 %	4 %	18 of 40	337 of 540
Sauk	07010202	4 of 10	40,750	12 %	4 %	18 of 40	337 of 540
Little Fork	09030005	10 of 10	0	40 %	0 %	18 of 40	337 of 540
Rush-Vermillion	07040001	3 of 10	0	15 %	19 %	17 of 40	352 of 540
Coon-Yellow	07060001	5 of 10	0	37 %	3 %	17 of 40	352 of 540
Cloquet	04010202	10 of 10	0	30 %	0 %	17 of 40	352 of 540

Watershed Name	Hydrologic Unit Code	Mean APCW for watersheds	Surface drinking water consumers	% private forest in watershed	% watershed with housing density increase	Index: Development pressure on private forests important for drinking water supply Score (Step 4)	Rank (Step 4)
Baptism-Brule	04010101	10 of 10	0	19 %	0 %	17 of 40	352 of 540
Red Lakes	09020302	9 of 10	0	31 %	1 %	17 of 40	352 of 540
Lower Rainy	09030008	8 of 10	0	29 %	0 %	16 of 40	380 of 540
Rainy Lake	09030003	10 of 10	0	25 %	0 %	16 of 40	380 of 540
Lake of the Woods	09030009	8 of 10	0	32 %	1 %	16 of 40	380 of 540
Rapid	09030007	10 of 10	0	20 %	0 %	16 of 40	380 of 540
Big Fork	09030006	10 of 10	0	18 %	0 %	15 of 40	394 of 540
Rainy Headwaters	09030001	10 of 10	3,724	10 %	0 %	15 of 40	394 of 540
Buffalo-Whitewater	07040003	5 of 10	0	33 %	3 %	15 of 40	394 of 540
Red Lake	09020303	4 of 10	40,574	13 %	1 %	14 of 40	407 of 540
Lower Minnesota	07020012	3 of 10	0	10 %	11 %	14 of 40	407 of 540
Lower Big Soiux	10170203	2 of 10	128,000	2 %	3 %	13 of 40	427 of 540
Cannon	07040002	3 of 10	0	9 %	8 %	13 of 40	427 of 540
Sandhill-Wilson	09020301	3 of 10	24,661	4 %	3 %	13 of 40	427 of 540
Zumbro	07040004	2 of 10	0	8 %	8 %	12 of 40	442 of 540
Middle Minnesota	07020007	4 of 10	0	7 %	4 %	12 of 40	442 of 540
Root	07040008	4 of 10	0	20 %	1 %	12 of 40	442 of 540
Clearwater	09020305	6 of 10	0	22 %	0 %	12 of 40	442 of 540
Roseau	09020314	6 of 10	0	15 %	0 %	11 of 40	454 of 540
Thief	09020304	7 of 10	0	9 %	0 %	11 of 40	454 of 540
Upper Iowa	07060002	4 of 10	0	17 %	0 %	10 of 40	465 of 540
Upper Minnesota	07020001	4 of 10	20,237	2 %	0 %	10 of 40	465 of 540
Two Rivers	09020312	5 of 10	0	13 %	0 %	10 of 40	465 of 540
Redwood	07020006	3 of 10	0	2 %	3 %	10 of 40	465 of 540
Eastern Wild Rice	09020108	5 of 10	0	16 %	0 %	10 of 40	465 of 540
Le Sueur	07020011	4 of 10	0	5 %	3 %	10 of 40	465 of 540
Upper Big Soiux	10170202	2 of 10	0	2 %	3 %	9 of 40	484 of 540
Upper Wapsipinicon	07080102	4 of 10	0	8 %	1 %	9 of 40	484 of 540
Grand Marais-Red	09020306	2 of 10	4,516	2 %	1 %	9 of 40	484 of 540
Cottonwood	07020008	4 of 10	0	3 %	1 %	9 of 40	484 of 540
Blue Earth	07020009	3 of 10	10,947	3 %	1 %	9 of 40	484 of 540
Upper Cedar	07080201	3 of 10	0	5 %	1 %	8 of 40	498 of 540
Snake	09020309	4 of 10	0	6 %	0 %	8 of 40	498 of 540
Hawk-Yellow Medicine	07020004	3 of 10	0	4 %	1 %	8 of 40	498 of 540
Chippewa	07020005	3 of 10	0	6 %	0 %	8 of 40	498 of 540
Little Sioux	10230003	3 of 10	8,388	2 %	1 %	8 of 40	498 of 540
Buffalo	09020106	3 of 10	0	7 %	1 %	8 of 40	498 of 540
Winnebago	07080203	3 of 10	0	3 %	1 %	8 of 40	498 of 540
Pomme De Terre	07020002	3 of 10	0	6 %	1 %	8 of 40	498 of 540
Upper Des Moines	07100002	4 of 10	0	2 %	0 %	7 of 40	511 of 540
East Fork Des Moines	07100003	4 of 10	0	2 %	0 %	7 of 40	511 of 540
Des Moines Headwaters	07100001	3 of 10	0	2 %	1 %	7 of 40	511 of 540
Watonwan	07020010	4 of 10	0	3 %	0 %	7 of 40	511 of 540
Lower Red	09020311	3 of 10	1,555	6 %	0 %	7 of 40	511 of 540
Shell Rock	07080202	3 of 10	0	4 %	0 %	7 of 40	511 of 540
Bois De Sioux	09020101	3 of 10	0	1 %	0 %	6 of 40	528 of 540
Mustinka	09020102	3 of 10	0	2 %	0 %	6 of 40	528 of 540
Lac Qui Parle	07020003	3 of 10	0	2 %	0 %	6 of 40	528 of 540
Elm-Marsh	09020107	2 of 10	0	2 %	0 %	5 of 40	535 of 540
Rock	10170204	2 of 10	0	1 %	0 %	5 of 40	535 of 540

Average or total value for all watersheds listed in Table 1

Mean APCW for watersheds:		5.4	of 10
Important watersheds for drinking water composite score:		8.0	of 20
Private forests in important watersheds composite score:		11.1	of 30
Development pressure on private forests in important watersheds composite score:		14.7	of 40
Forested Land (acres):	22,617,959.2		
Private Forest (acres):	11,552,201.8		
Private Forest Land under Development Pressure by 2030 (acres):	579,747.9		
(% private forest land):	5.0%		

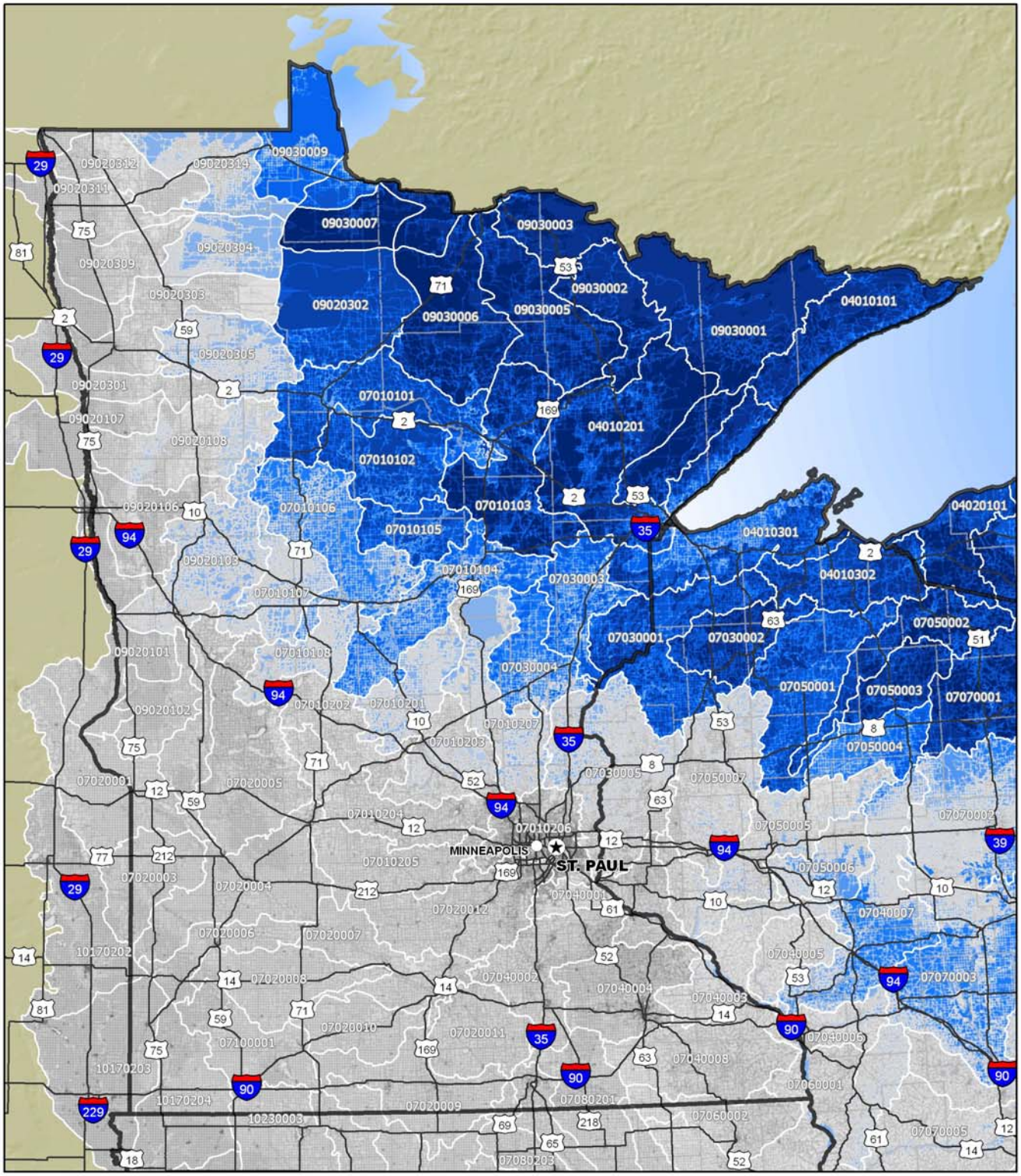
Note: If a watershed fell partially in Minnesota, the whole watershed was considered for this project. State results reflect the total acreage for all watersheds that impact that State (this may account for a higher acreage figure than if only lands within State boundaries were considered).

Maps

The following maps depict the results of each step in the Forests, Water and People analysis. Each watershed is labeled with the eight-digit HUC and the watershed composite score for the analysis step. (Note: the APCW, 30-m. pixel view does not have a watershed score)

All of the maps were produced by Rebecca Whitney Lilja, Office of Knowledge Management, Northeastern Area State and Private Forestry.

Ability to Produce Clean Water (APCW) (Step 1), 30-m View - Minnesota



STEP 1 COMPOSITE SCORE, 30-m VIEW

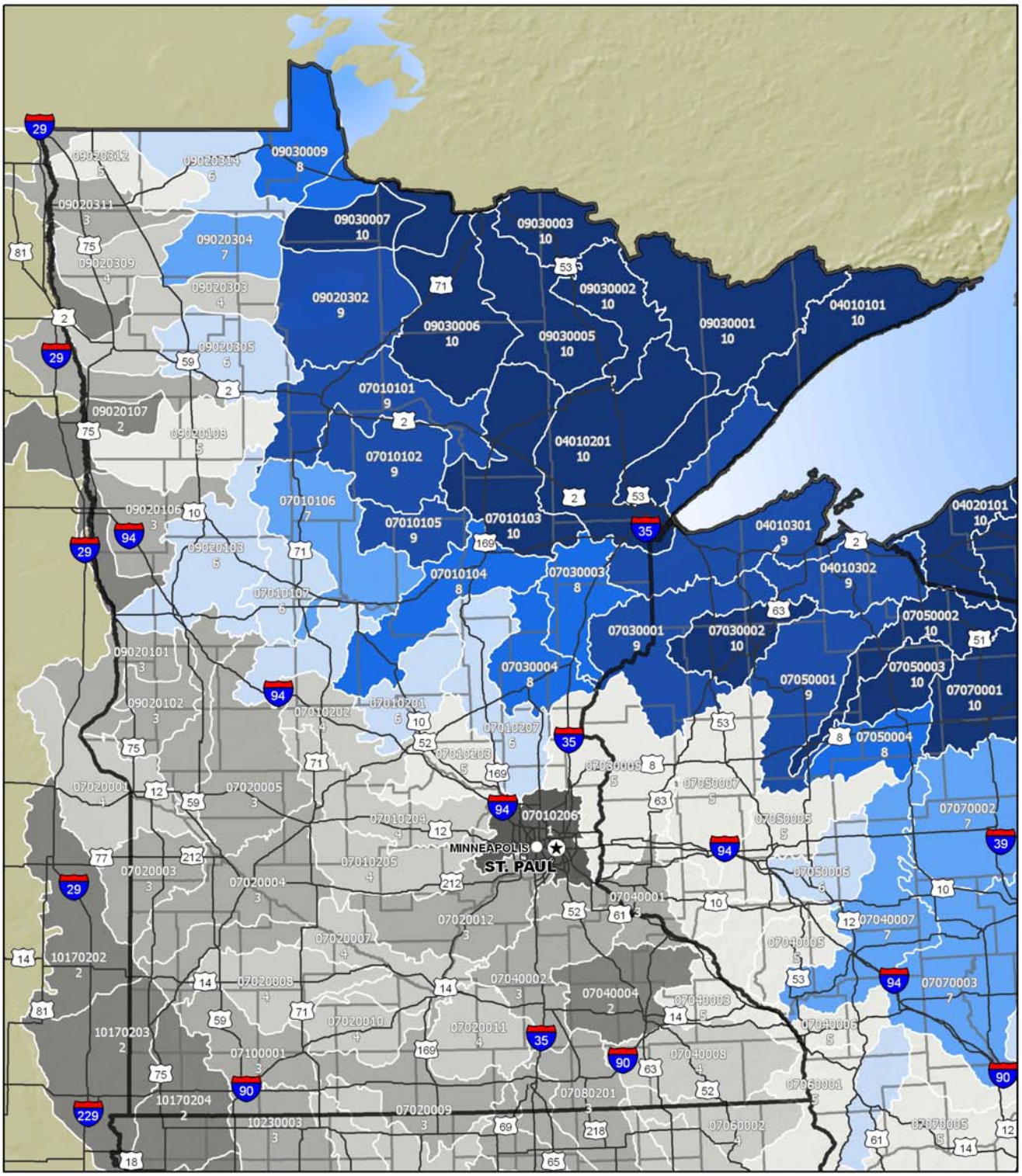
6 (Low APCW) 10 15 20 24 (High APCW)

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC)

0 15 30 60 Miles

Mean Ability to Produce Clean Water (APCW) by Watershed (Step 1, Continued) - Minnesota



STEP 1 COMPOSITE SCORE

1 (Low APCW) 5 10 (High APCW)

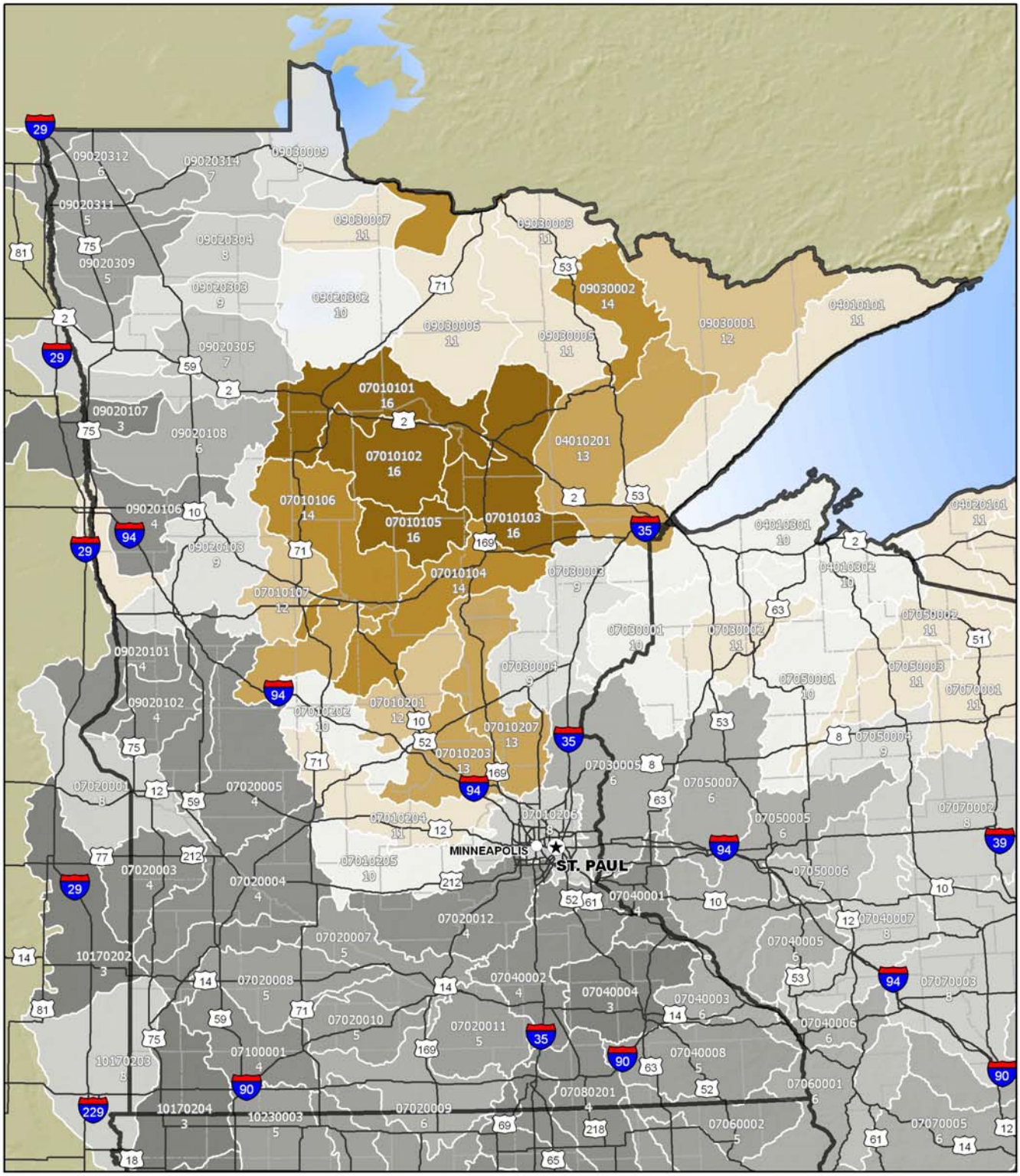
N W E S

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score

0 15 30 60 Miles

Importance of watersheds for drinking water supply (Step 2) - Minnesota



STEP 2 COMPOSITE SCORE

2 5 10 15 19

(Low APCW and Small number of water consumers) (High APCW and Large number of water consumers)

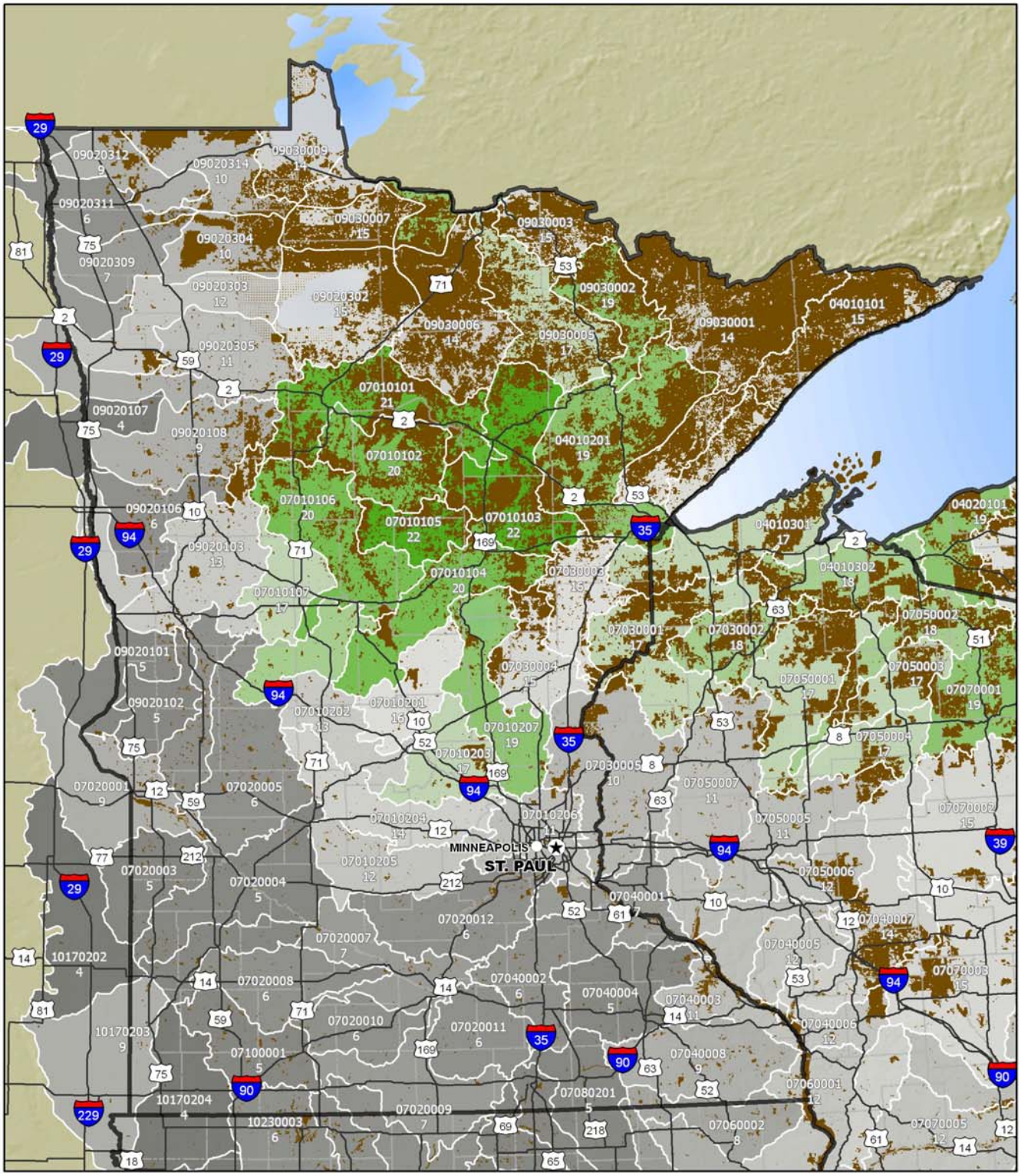
N W E S

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score

0 15 30 60 Miles

Importance of watersheds and private forest for drinking water supply (Step 3) - Minnesota



STEP 3 COMPOSITE SCORE

3 5 10 15 20 25 29

(Low APCW; Small number of water consumers; and Low % private forest)

(High APCW; Large number of water consumers; and High % private forest)

Protected Land

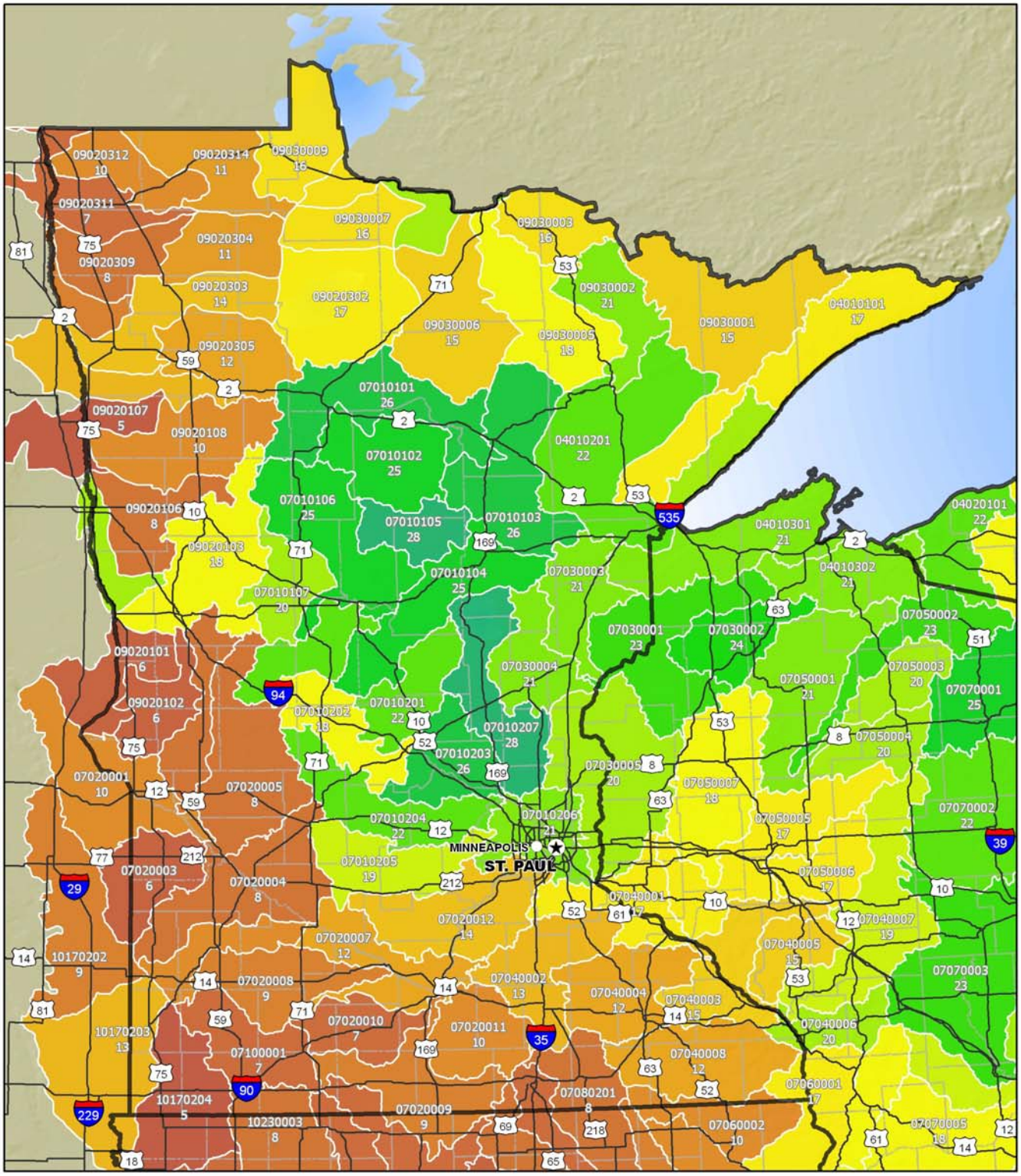
N W E S

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score

0 15 30 60 Miles

Development pressure on private forests in drinking water supply watersheds (Step 4) - Minnesota



STEP 4 COMPOSITE SCORE

5 10 15 20 25 30 37

(Low APCW; Small number of water consumers; Low % private forest; and Low development pressure)

(High APCW; Large number of water consumers; High %private forest; and High development pressure)

N W E S

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score

0 15 30 60 Miles

References

Table 2. Datasets used in the Forests, Water and People Analysis

Attribute	Dataset	Source*
Forest land	1992 National Landcover Dataset	U.S. Geological Survey 1999
Agricultural land by watershed	1992 National Landcover Dataset	U.S. Geological Survey 1999
Riparian forest cover by watershed	1:100,000-scale National Hydrography Dataset, buffered to 30 meters	Hatfield 2005
Road density	2002 Bureau of Transportation Statistics (BTS) Roads	U.S. Department of Transportation 2002
Soil erodibility	STATSGO Soil Dataset, kffact	Miller and White 1998
Housing density by watershed	Housing density in 2000	Theobald 2004
Surface drinking water consumers per unit area	Public Drinking Water System (PWS) Consumers by eight-digit HUC; City Drinking water consumers for New York City, Philadelphia, St. Louis, St. Paul, and Washington DC	U.S. Environmental Protection Agency 2005
Private forest by watershed	Protected Areas Database, Version 4; Wisconsin Stewardship Data	Conservation Biology Institute 2006; U.S. Geological Survey, Upper Midwest Environmental Sciences Center 2005
Development pressure per unit area	Housing density in 2000 and 2030	Theobald 2004

*Note: See the **full report** for complete reference citations.

Watershed Resources

Northeastern Area Watershed— http://www.na.fs.fed.us/watershed

Forest-to-Faucet Partnership—http://www.wetpartnership.org/index.html

Trust for Public Land Source Water Stewardship Project—http://www.tpl.org/

Forests on the Edge—http://www.fs.fed.us/openspace/fote/index.html

American Water Works Association—Professional and Technical Resources—
http://www.awwa.org/Resources/index.cfm?&navItemNumber=1416

Source Water Collaborative—http://www.protectdrinkingwater.org/

Environmental Protection Agency—Surf Your Watershed—http://cfpub.epa.gov/surf/locate/index.cfm

Environmental Protection Agency—Safe Drinking Water Information System—

http://www.epa.gov/enviro/html/sdwis/sdwis_ov.html

This project was a collaborative effort between the Northeastern Area and Dr. Paul K. Barten, Associate Professor, University of Massachusetts-Amherst and Co-director of the Forest-to-Faucet Partnership.

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