
Watershed Context Report

Upper Iowa River
September, 2017



The Watershed Context Report is supported by the Watershed Health Assessment Framework (WHAF) team; River Ecology Unit, Division of Ecological and Water Resources.

Contact the WHAF Team:
WHAF.DNR@state.mn.us
651-345-3331 ext 228

Visit the Watershed Health Assessment Framework online at mndnr.gov/whaf



Funding for this project comes from the Clean Water Fund, which receives 33 percent of the sales tax revenue from the Clean Water, Land and Legacy Amendment, approved by voters in November 2008. The Clean Water Fund's purpose is to protect, enhance and restore water quality in lakes, rivers, streams and groundwater. At least 5 percent of the money is targeted for the protection of drinking water sources. The Legislature allocates funds for water quality work and drinking water protection based on recommendations from the Clean Water Council.



This publication produced by:

Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, MN 55155-4040
888-646-6367 or 651-296-6157
mndnr.gov

The Minnesota DNR prohibits discrimination in its programs and services based on race, color, creed, religion, national origin, sex, public assistance status, age, sexual orientation or disability. Persons with disabilities may request reasonable modifications to access or participate in DNR programs and services by contacting the DNR ADA Title II Coordinator at info.dnr@state.mn.us or 651-296-6157. Discrimination inquiries should be sent to Minnesota DNR, 500 Lafayette Road, St. Paul, MN 55155-4049; or Office of Civil Rights, U.S. Department of the Interior, 1849 C. Street NW, Washington, D.C. 20240.

Sign language interpretation or language translation services are available by request with two weeks notice by emailing info.dnr@state.mn.us or by calling 651-296-6157.

©2017, State of Minnesota, Department of Natural Resources

Watershed Context Report: Upper Iowa River

DNR Major ID: 46

HUC 8: 07060002

This report provides an overview of ecological conditions and human influences in the Upper Iowa River watershed. Physical characteristics, landscape alterations, human infrastructure and population trends influence watershed health and health risk. This background information is foundational for understanding the health challenges that face the watershed.

This report is designed as a companion document for exploring watershed health scores and other data with the WHAF interactive map. The appendix lists the spatial data sources for each report page. Each appendix entry is hyper-linked to open the WHAF map with that data displayed for further exploration.

Table of Contents

Physical Characteristics

- Topography**
- Hydrologic Position**
- Ecological Classification System**
- Soils**
- Groundwater**
- Climate**

Landscape Alteration

- Historic Land Cover**
- Current Land Cover - NLCD**
- Current Land Cover - CDL**
- Habitats of Biodiversity Significance**
- Change in Water Storage**

Human Aspects

- Population**
- Transportation Networks**

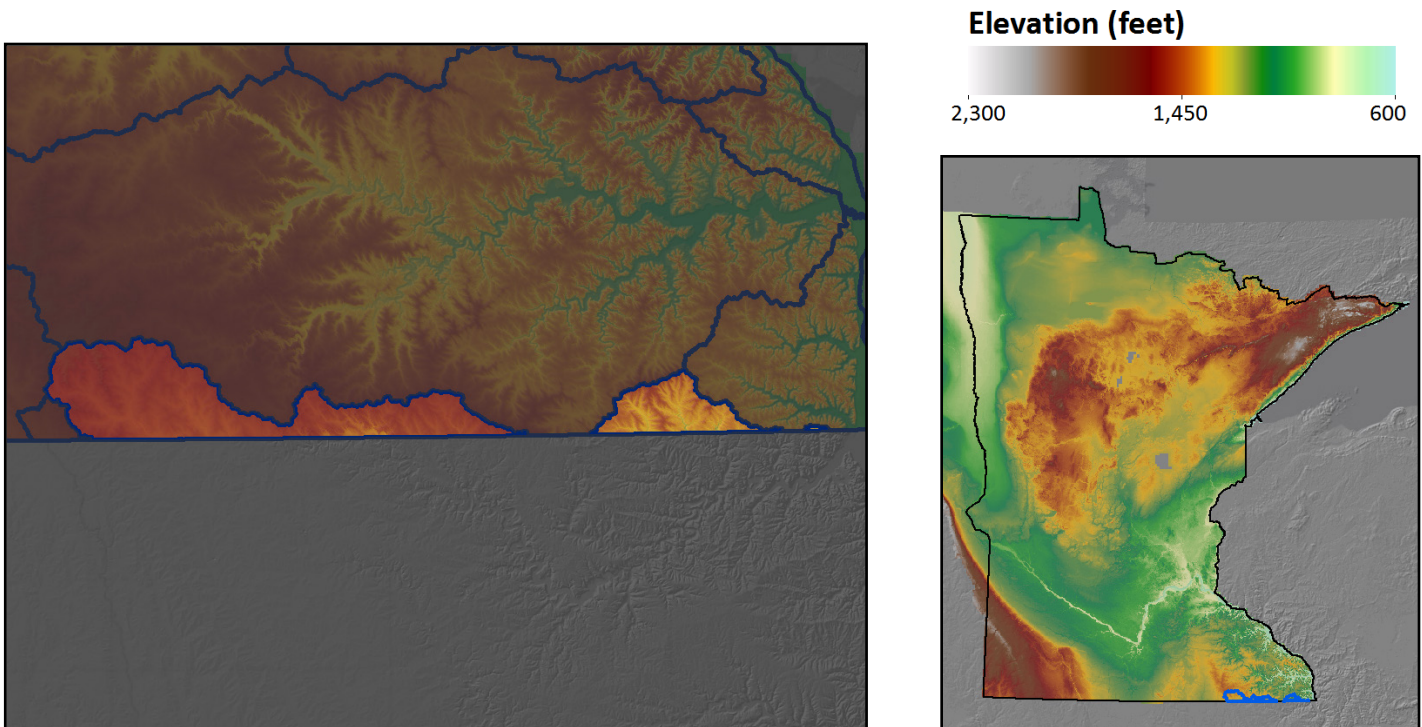
Appendix - GIS Data Sources

Physical Characteristics

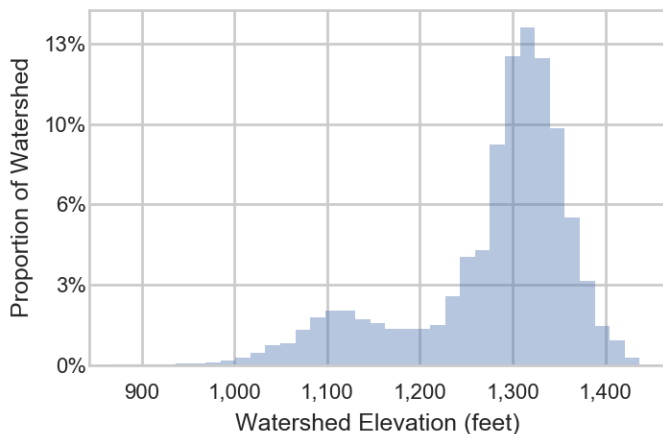
Topography

Topography is a foundational landscape condition. The elevation and slope of the land affects factors as diverse as wind, water flow, temperature and land use. Elevation change or 'relief' is the amount a geographic area varies in its height above sea level. Minnesota's landscapes range from the flat Red River Valley basin in the west, to steep slopes and bluffs near Lake Superior and along the Minnesota, Mississippi and St. Croix rivers.

The steepness and length of slopes impacts other landscape features. Slope concentrates water flows leading to the formation of streams and rivers. Soil erosion also accelerates on long steep slopes. Historically, steep slopes have been less used for agriculture and human development. Important remnant native plant and animal communities are now often found on steep slopes.

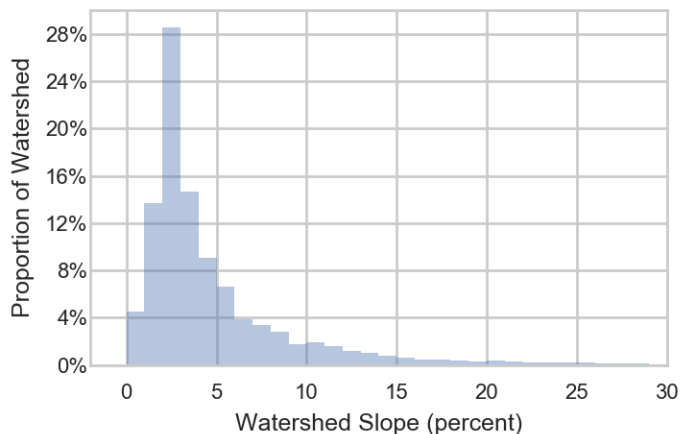


Distribution of Watershed Elevation



The distribution of watershed area over the elevation range. Each vertical bar represents the percent of this watershed at that elevation value.

Distribution of Watershed Slope



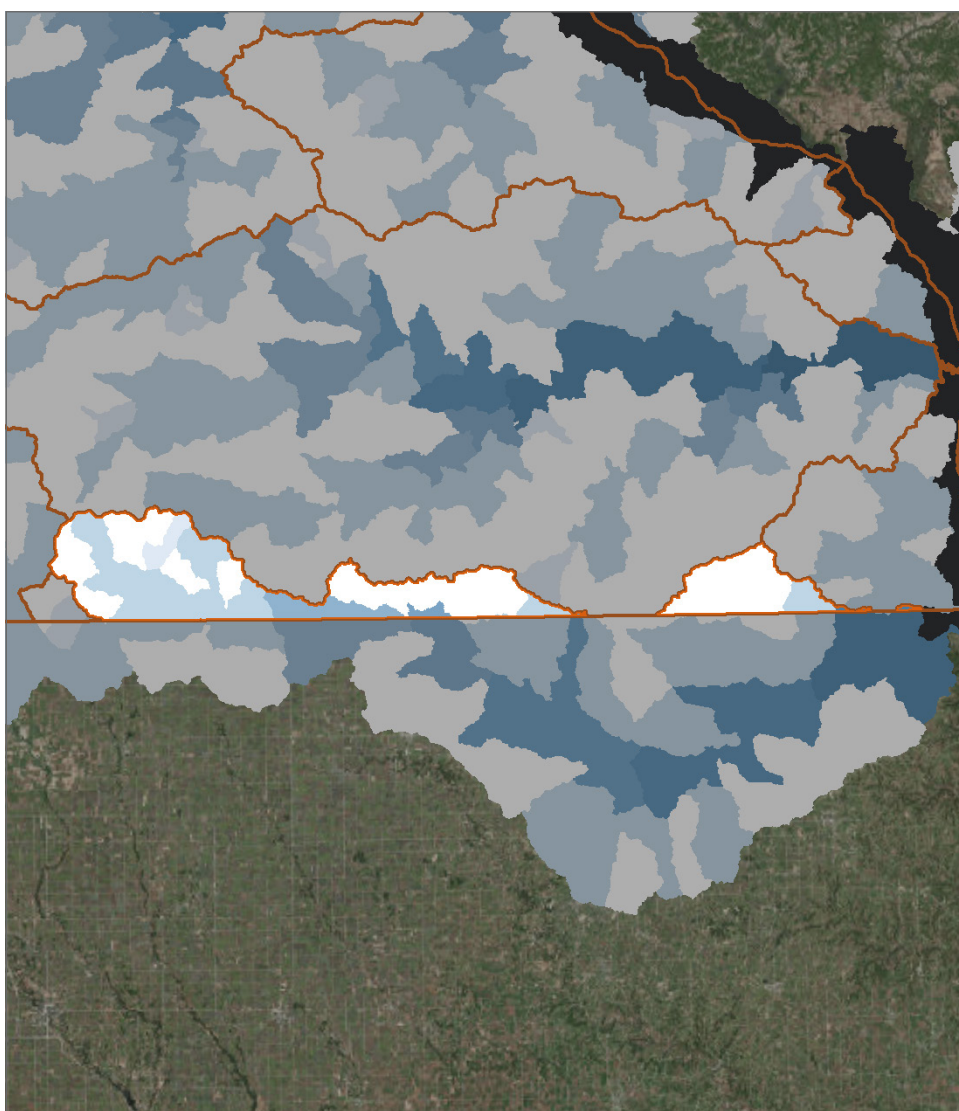
The distribution of watershed area over the range of hillslope. Each vertical bar represents the percent land area for a given slope value.

Physical Characteristics

Hydrologic Position

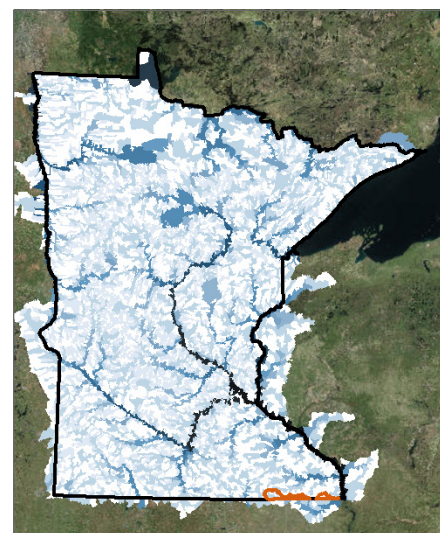
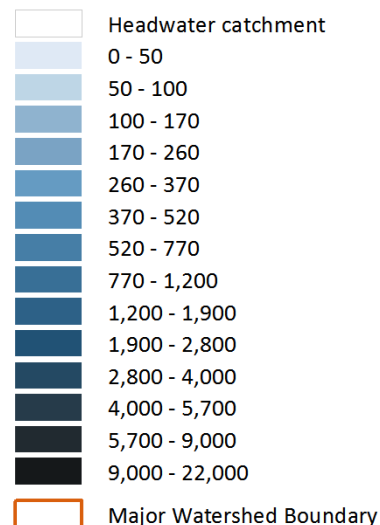
The hydrologic position map helps to illustrate where each watershed catchment resides on the landscape in relationship to neighboring catchments. This relationship is based on the location of the mouth or 'pour point' of each catchment and the area that is upstream of that point. The amount of land area upstream influences the amount of water that leaves or 'discharges' from the mouth of each catchment.

Headwater catchments are shown in white. These areas do not receive overland water flow from upstream but rather collect surface water within their boundary and send it downstream. In contrast, those catchments that encompass a major river receive flow from all catchments upstream. The mouth of major rivers accumulate all the water from the upstream river basin and have the largest water discharge amounts shown in dark blue. The discharge amounts in cubic feet per second (cfs) are estimates based on modeling, not actual measurements of stream flow.



Hydrologic Position

Modeled Stream Discharge (cfs)



Physical Characteristics

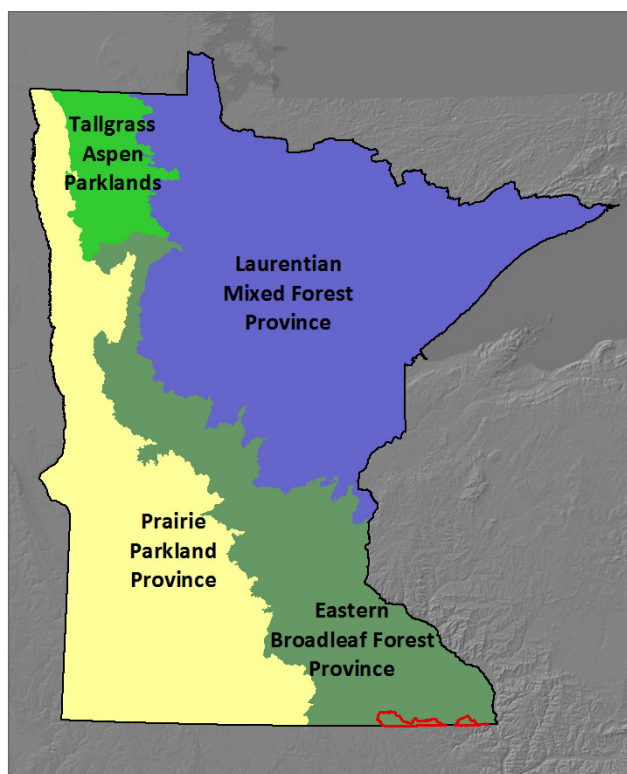
Ecological Classification System

The Ecological Classification System is a system developed by the MN DNR and US Forest Service for mapping and classifying landscape ecosystems. The system provides a nested set of classification units which, from broadest to most detailed, includes: Provinces, Sections, Subsections and Land Type Associations. Each scale maps progressively more uniform ecological features, including climate, geology, topography, soils, hydrology and vegetation. These patterns represent different correlated landscape features and can help guide appropriate resource management approaches across different spatial scales.

For additional information on Minnesota's Ecological Classification System go to – www.mndnr.gov/ecs

Provinces are units of land defined using major climate zones, native vegetation, and biomes such as prairies, deciduous forests, or boreal forests.

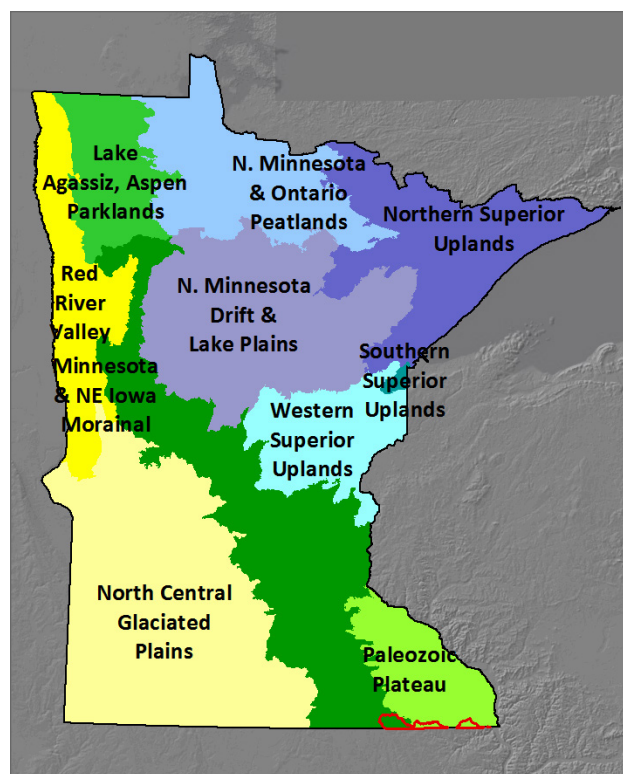
Sections are units within Provinces that are defined by origin of glacial deposits, regional elevation, distribution of plants, and regional climate.



Map of the Ecological Classification System Provinces in Minnesota

Percent Watershed Area by Province:

Eastern Broadleaf Forest Province: 100.0%



Map of the Ecological Classification System Sections in Minnesota

Percent Watershed Area by Section:

Minnesota & NE Iowa Morainal: 52.2%

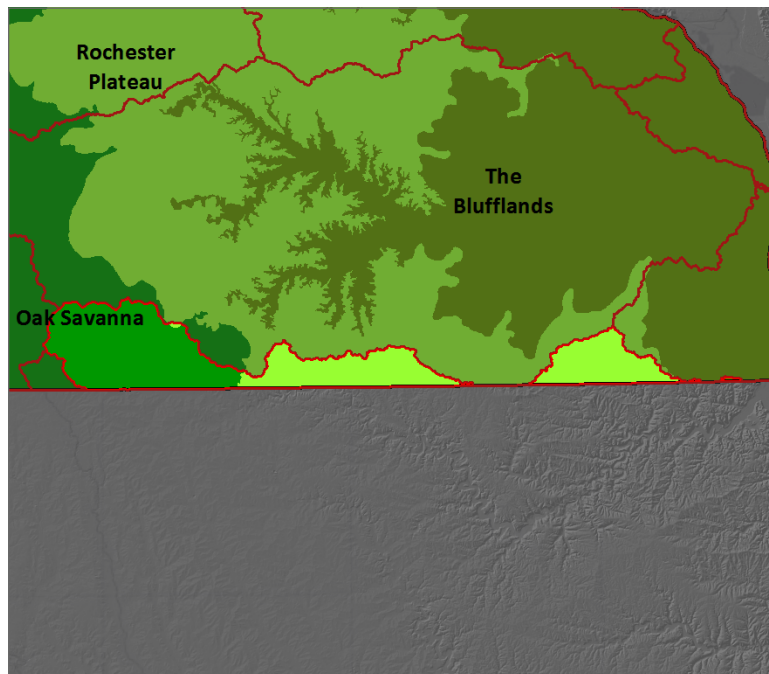
Paleozoic Plateau: 47.8%

Physical Characteristics

Ecological Classification System (continued)

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.

Land Type Associations are units within Subsections that are defined using glacial landforms, bedrock types, topographic roughness, lake and stream distributions, wetland patterns, depth to ground water table, soil parent material and pre-European settlement vegetation. www.mndnr.gov/ecs



Percent Watershed Area by Subsection:

Oak Savanna: 52.2%

Rochester Plateau: 47.3%

The Blufflands: 0.5%

Percent Watershed Area by Land Type Association:

Hayfield Till Plain: 41.6%

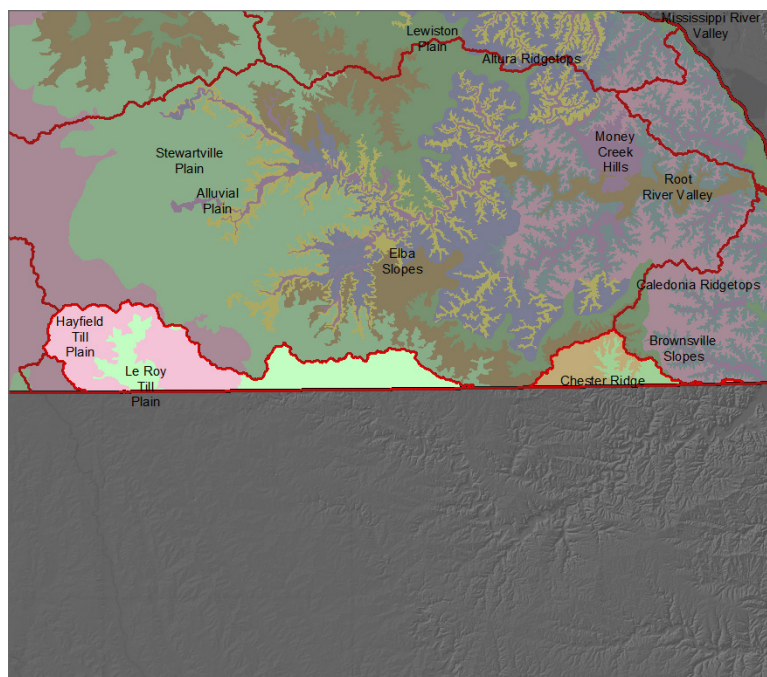
Stewartville Plain: 27.2%

Chester Ridge: 13.4%

Le Roy Till Plain: 10.6%

Lewiston Plain: 6.7%

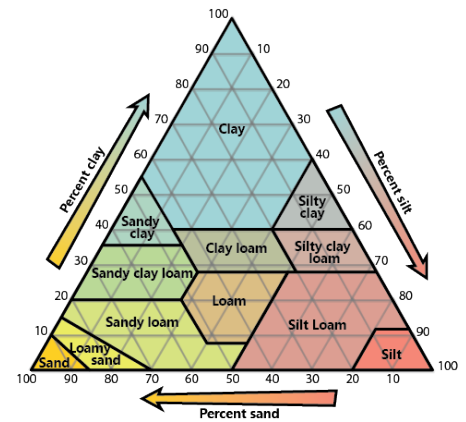
Caledonia Ridgetops: 0.5%



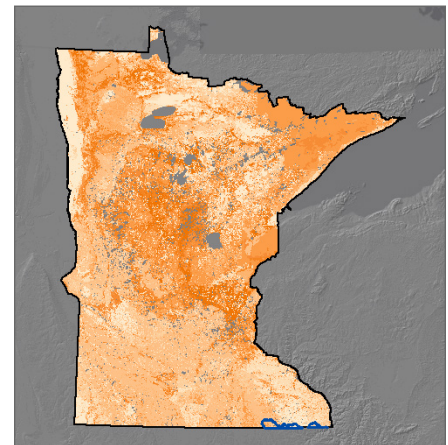
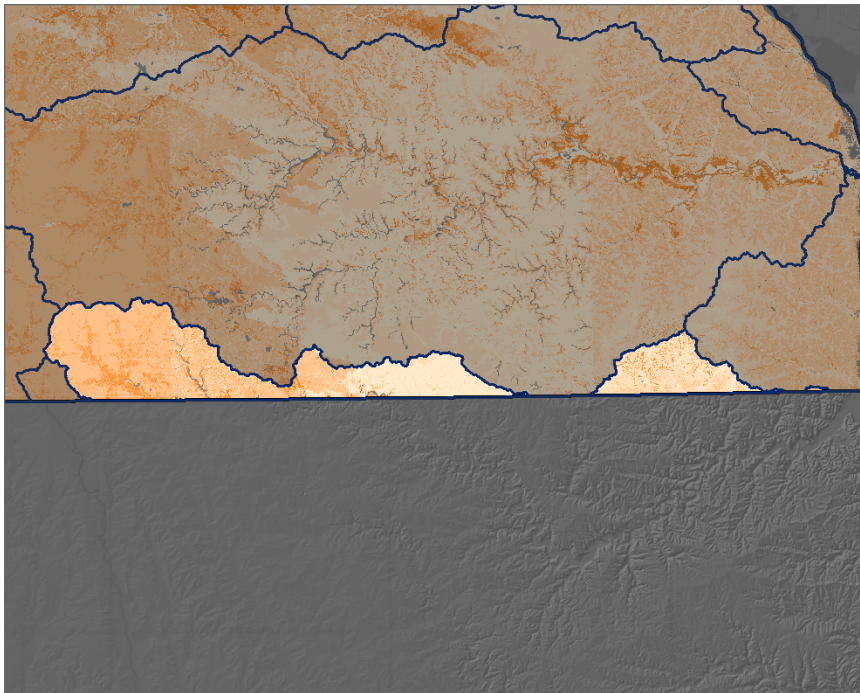
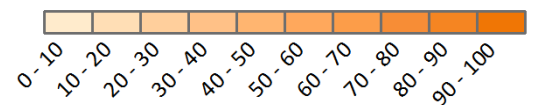
Physical Characteristics

Soils

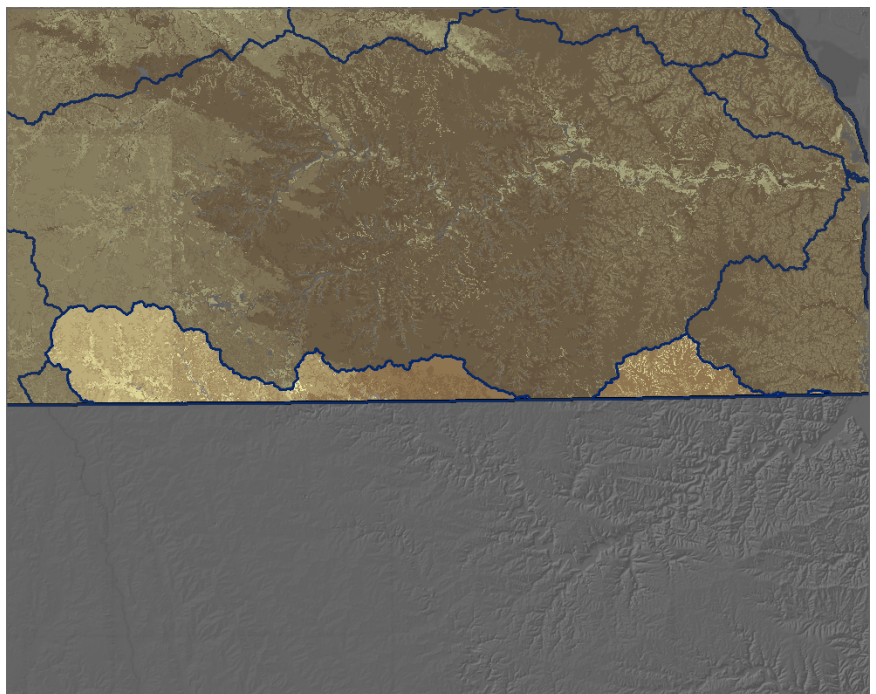
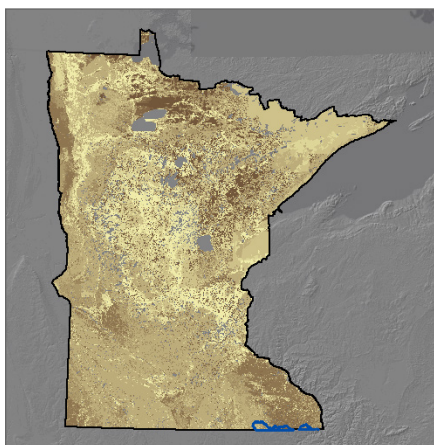
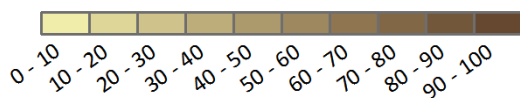
Soil texture results from the relative amount of sand, silt and clay present in the soil. These particle types vary in size from clay particles ($< .002$ mm), to silt ($.002 - .05$ mm) to sand particles ($> .05$ mm). The combination and relative amount of each particle type influences many soil properties. This chart shows the relationship between some common soil texture classes and the relative amount of each particle type. Soil texture in turn influences soil erodibility, permeability and suitability for various uses.



Percent Sand

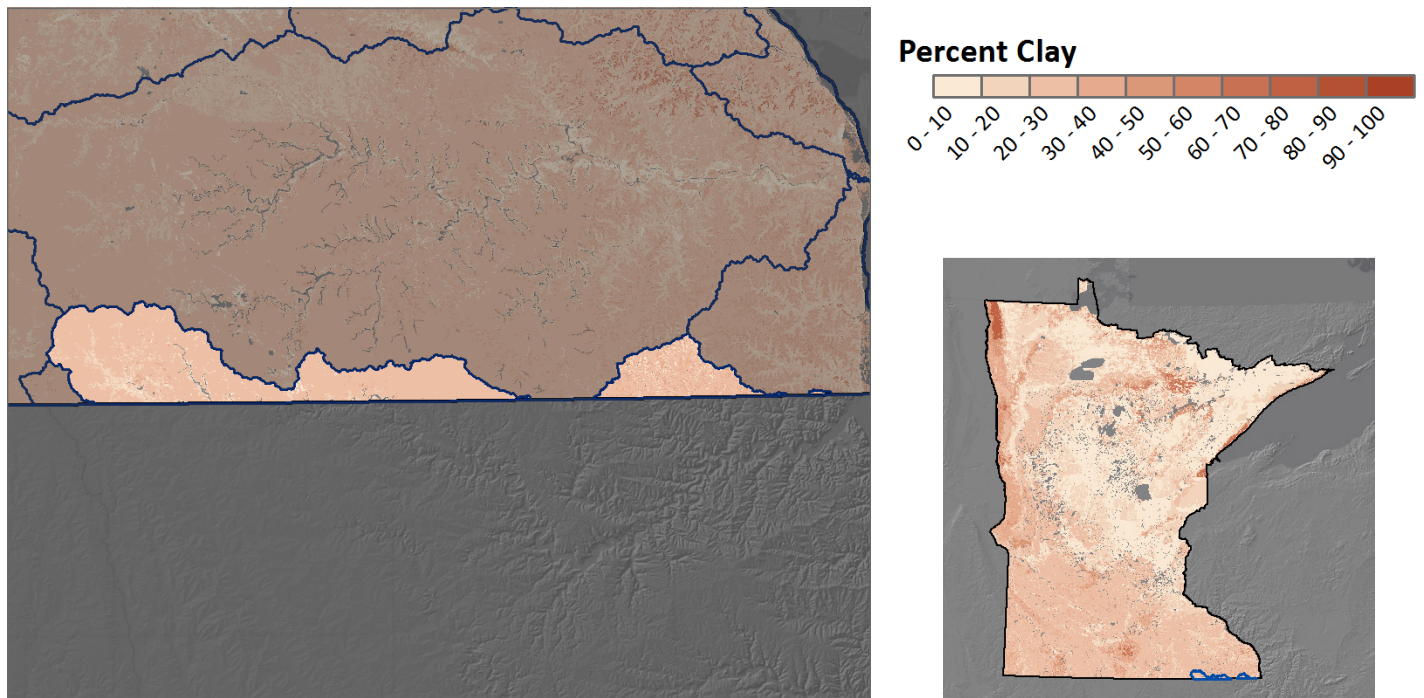


Percent Silt



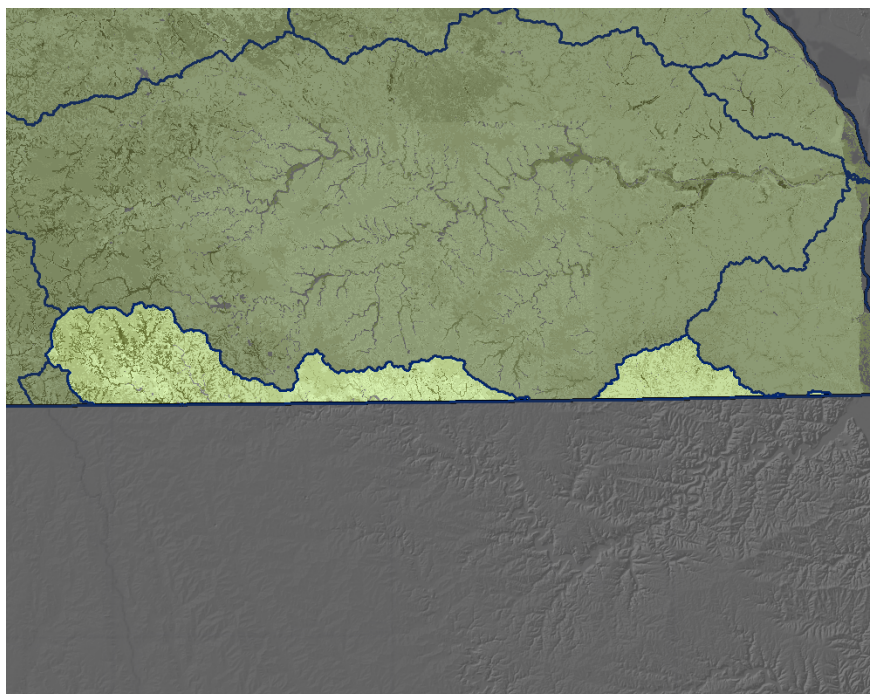
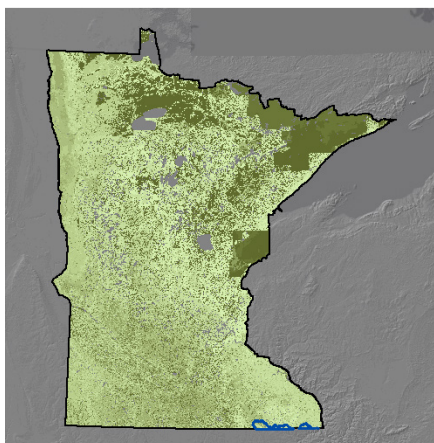
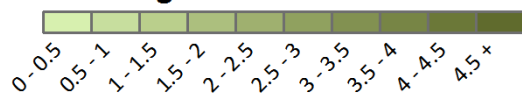
Physical Characteristics

Soils (continued)



Organic matter is an important factor affecting soil physical properties such as water infiltration rate and water and nutrient holding capacity. Unlike particle size, the amount of organic matter can change; it can be either enhanced or depleted in response to land management activities.

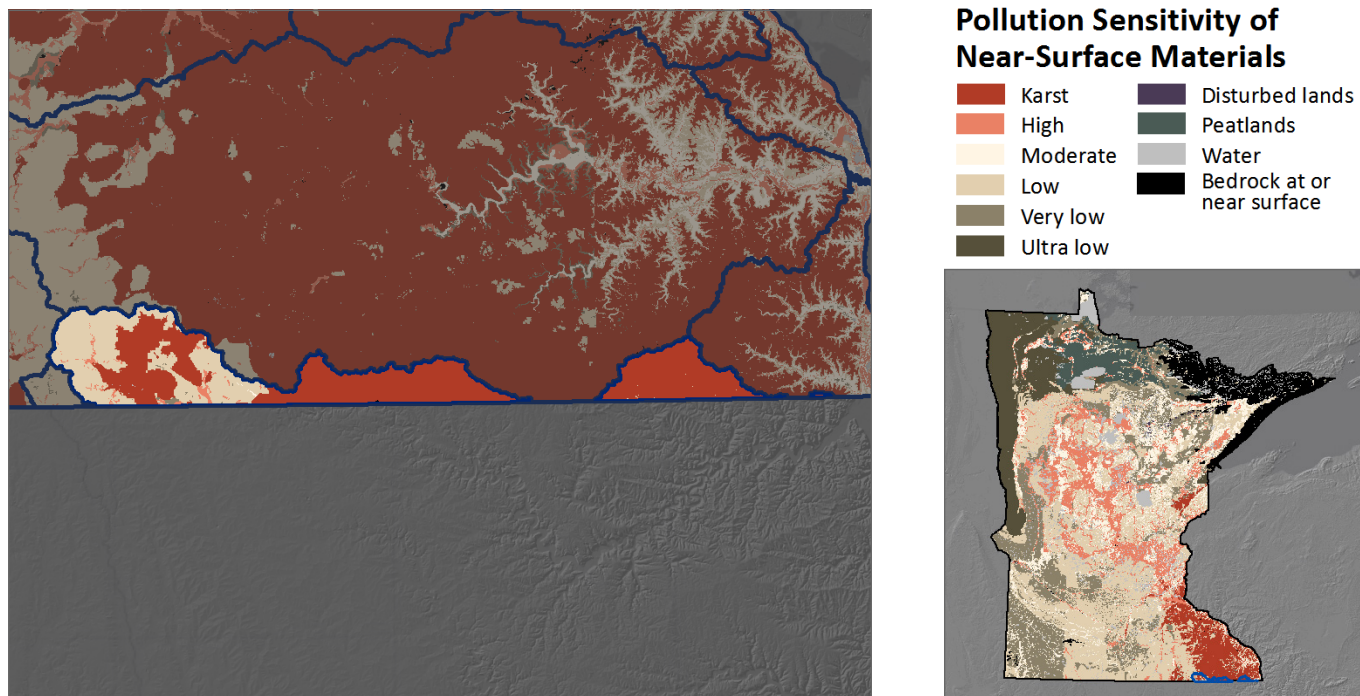
Percent Organic Matter



Physical Characteristics

Groundwater

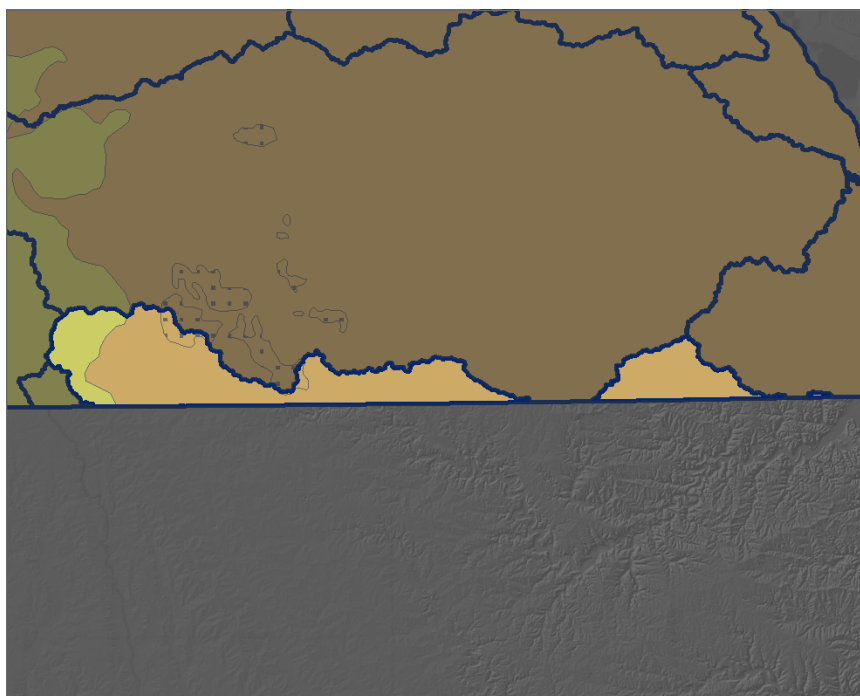
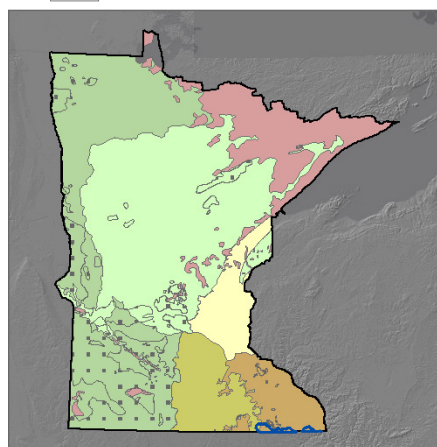
The Pollution Sensitivity of Near-Surface Materials delineates different rates at which contaminants may travel through the top 10 feet of the soil profile. The different rates across the state show the range in risk level for contamination to infiltrate toward groundwater resources. In some areas, the surface is so hard that it limits infiltration of water, but increases the risk that contaminants may run over the surface directly into lakes and streams.



The six ground water provinces of the state are based on bedrock and glacial geology. Within each province, groundwater sources and the availability of ground water for drinking water, industrial, and agricultural uses are similar. For additional information - www.mndnr.gov/groundwater/provinces/index.html

Groundwater Provinces

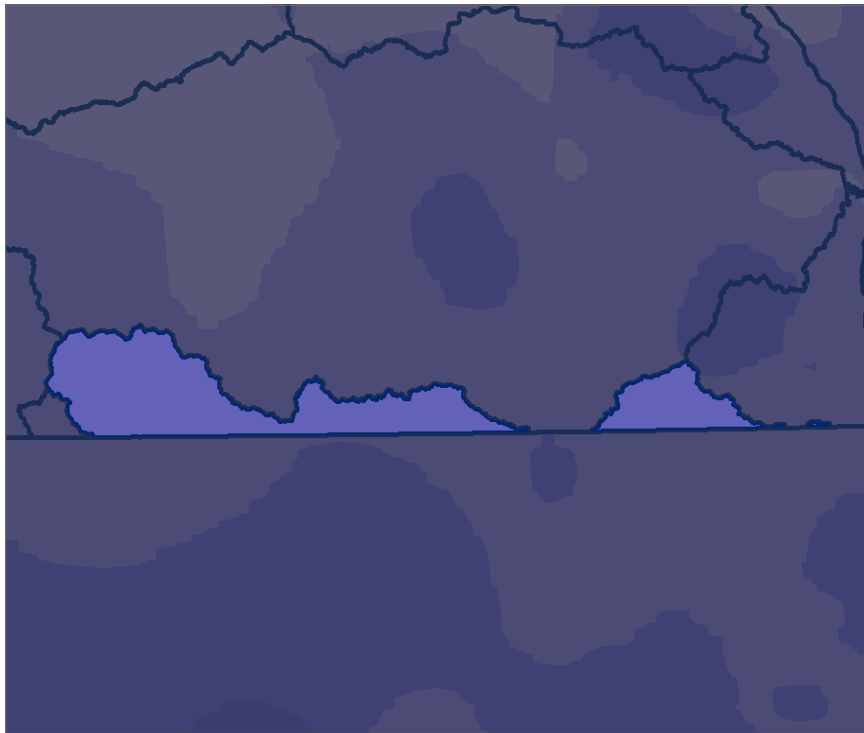
- 1 - Metro Province
- 2 - South-Central Province
- 3 - Southeast Province
- 4 - Central Province
- 5 - Western Province
- 6 - Arrowhead Province
- Cretaceous Bedrock



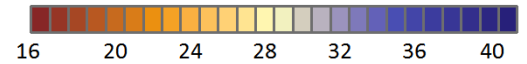
Physical Characteristics

Climate

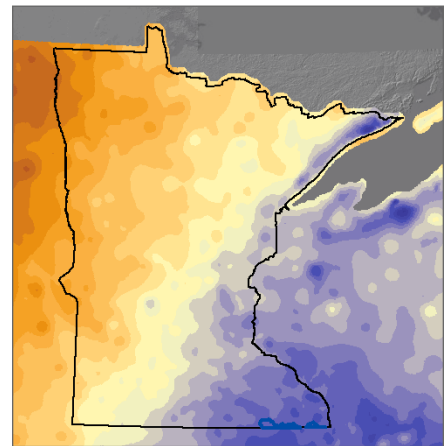
Minnesota's landscape is located at the intersection of three distinct ecological biomes. Precipitation and temperature play an important role in defining the boundaries of these biomes. These two climate trends show different statewide patterns which create a range of temperature and precipitation combinations.



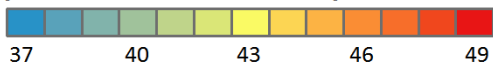
**Normal Annual Precipitation
(Inches, 1981 - 2010)**



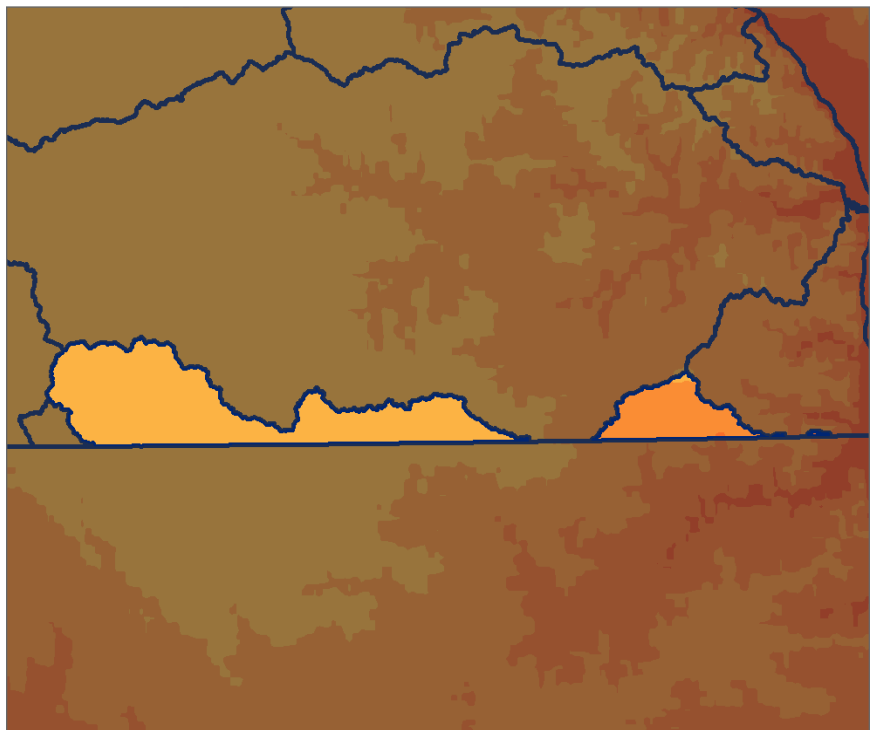
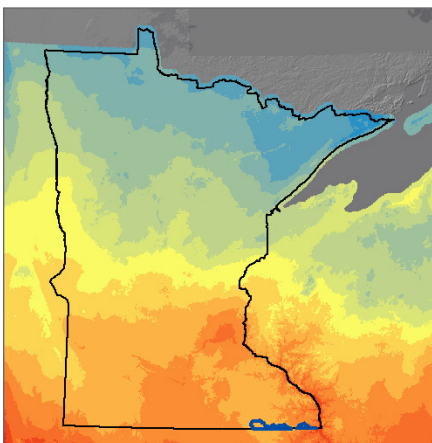
Watershed-wide 30-year average:
34.4 in. (liquid equivalent)



**Normal Annual Temperature
(Fahrenheit, 1981 - 2010)**



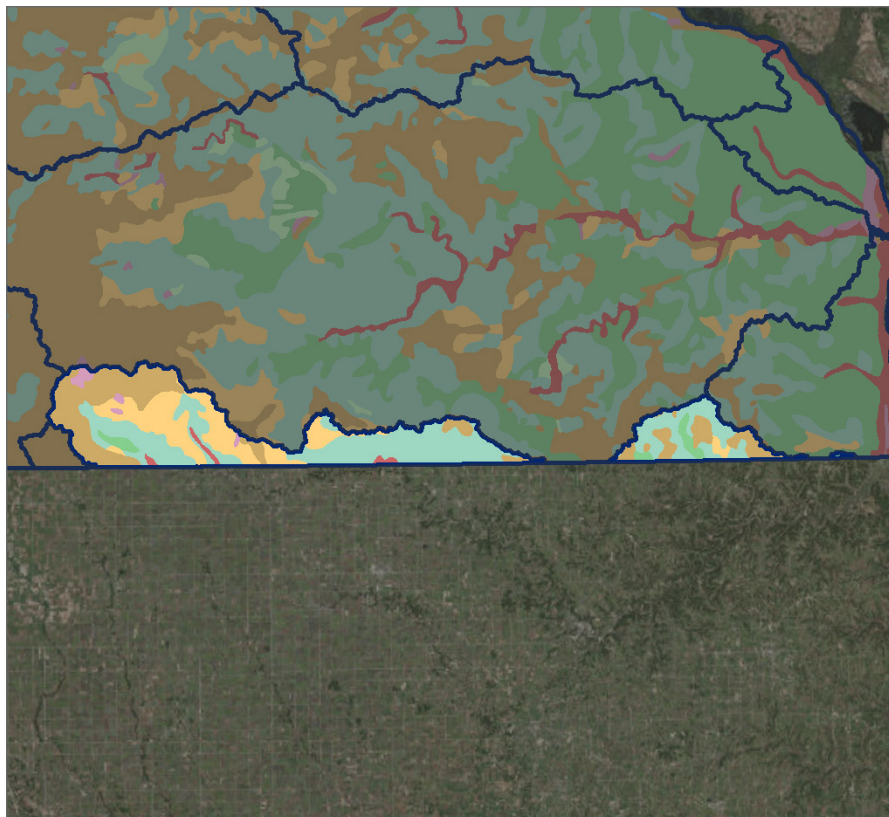
Watershed-wide 30-year average:
44.8 degrees Fahrenheit



Landscape Alteration

Historic Land Cover

Marschner's Early-European Settlement Vegetation Map is interpreted from Public Land Survey notes from the 1890's. This map gives an insight in to the distribution of vegetation before non-Native Americans began to significantly impact the land cover patterns of Minnesota.



Marschner's Pre-European Settlement Land Cover

- Prairie
- Brush Prairie
- Wet Prairie
- Aspen-Oak Land
- Aspen-Birch (trending to hardwoods)
- Oak Openings and Barrens
- Big Woods - Hardwoods
- River Bottom Forest
- Mixed Hardwood and Pine
- White Pine
- Mixed White Pine and Red Pine
- Jack Pine Barrens and Openings
- Pine Flats
- Aspen-Birch (trending to Conifers)
- Conifer Bogs and Swamps
- Open Muskeg
- Lakes (open water)
- Undefined

Percent of Watershed by Marschner Land Class:

Oak openings and barrens: 42.1%

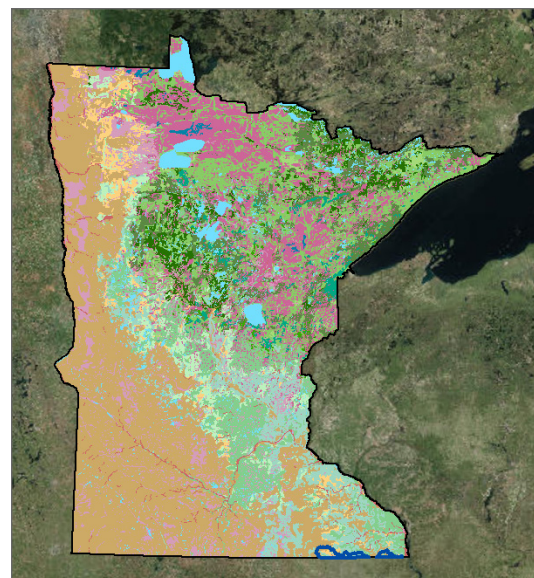
Prairie: 29.1%

Brush Prairie: 20.7%

Big Woods - Hardwoods (oak, maple, basswood, hickory): 3.7%

Wet Prairie: 1.6%

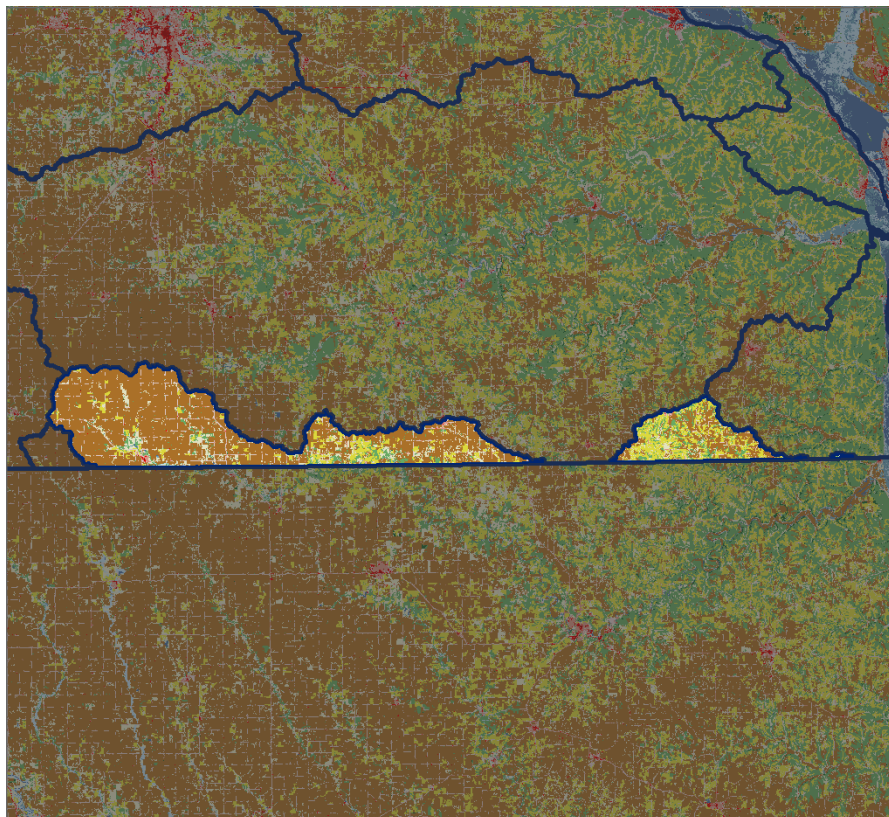
River Bottom Forest: 1.3%



Landscape Alteration

Current Land Cover - NLCD

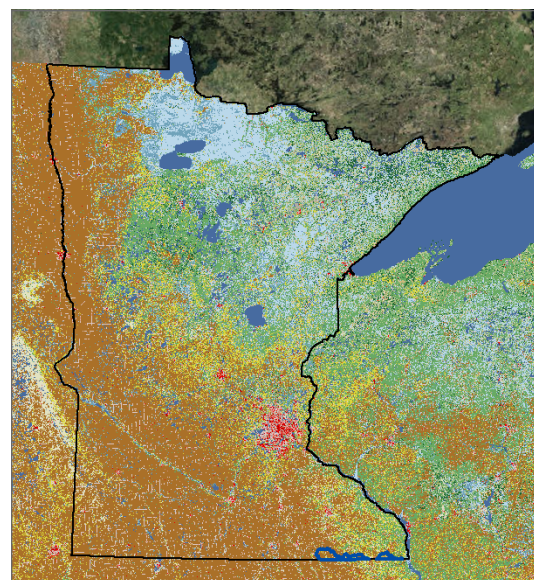
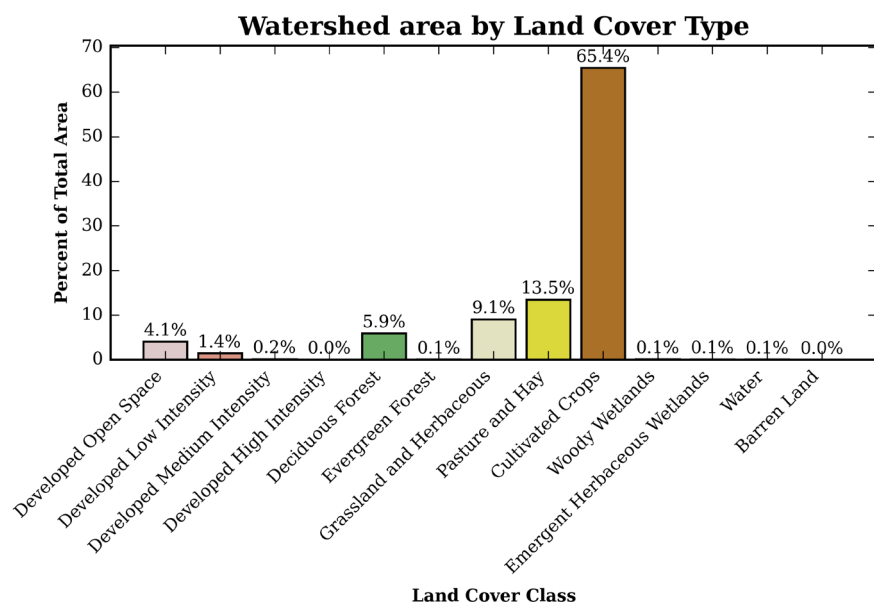
Land cover data provides information on current and past land use patterns primarily derived from satellite and aerial imagery. The National Land Cover Database (NLCD) is a nation-wide data set classifying all lands into one of 16 categories. Every five years, an update of land cover is completed giving land cover trends over time. The most recent layer currently available is based primarily on Landsat Satellite data collected in 2011.



National Land Cover Database

Land Cover Class

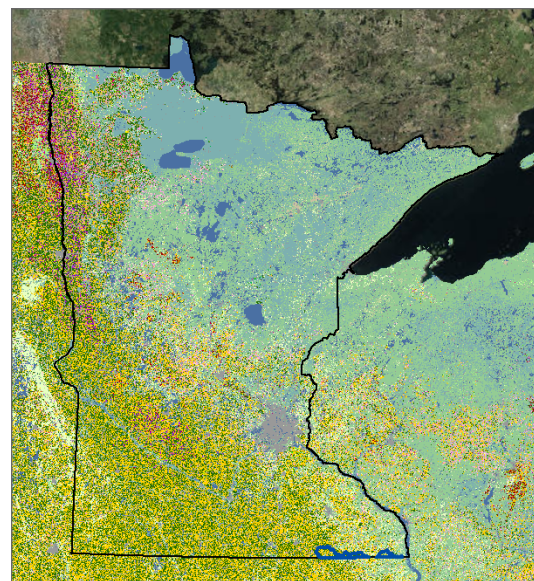
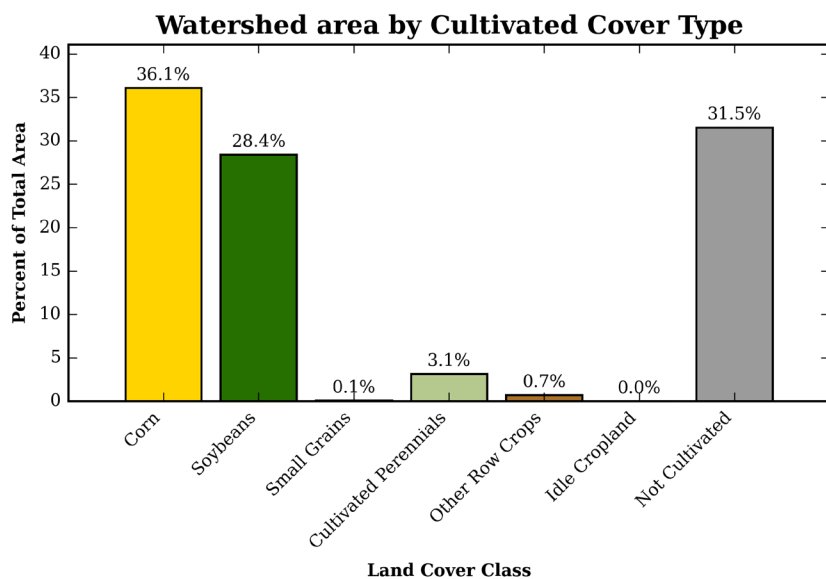
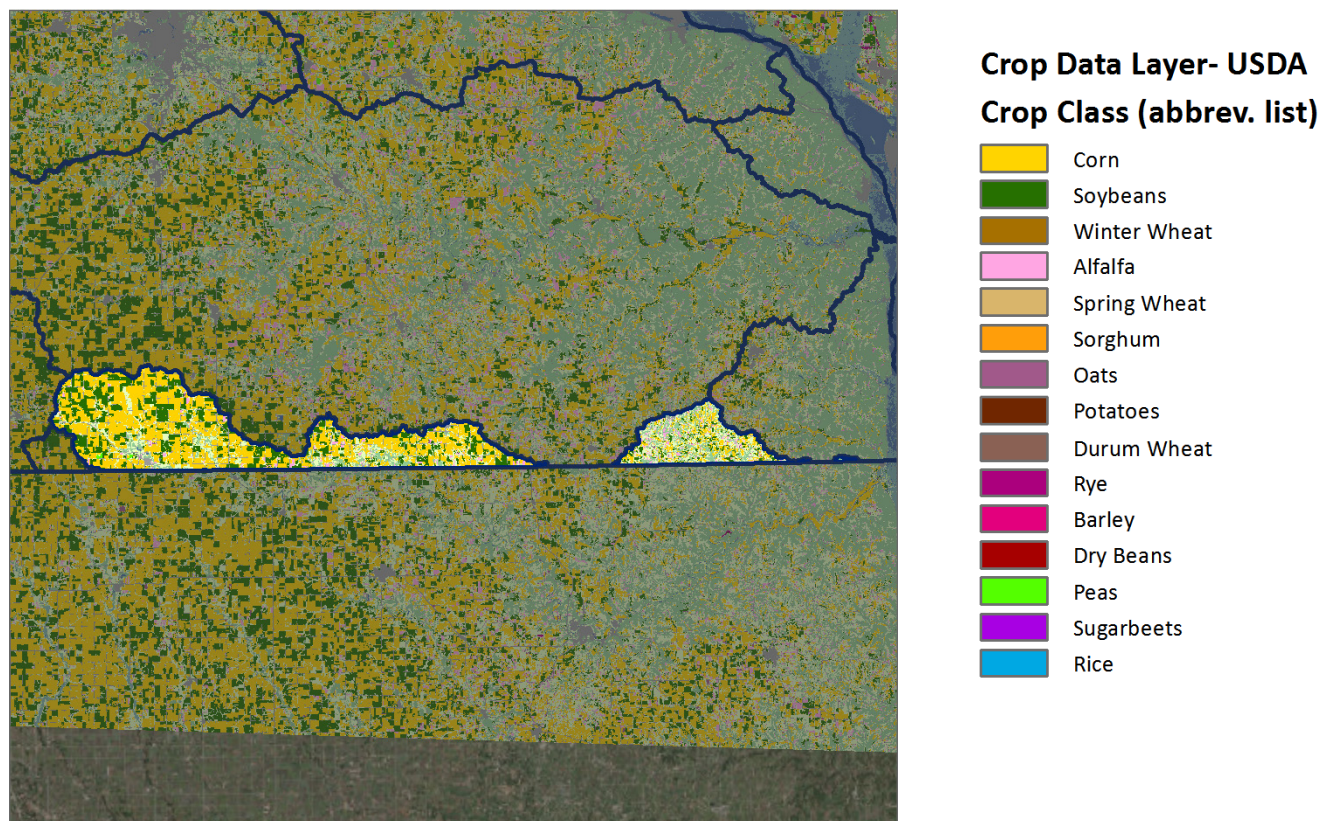
	Open Water
	Developed, Open Space
	Developed, Low Intensity
	Developed, Med Intensity
	Developed, High Intensity
	Barren Land
	Deciduous Forst
	Evergreen Forest
	Mixed Forest
	Shrub/Scrub
	Grassland/Herbaceous
	Pasture/Hay
	Cultivated Crops
	Woody Wetlands
	Emergent Herbaceous Wetland



Landscape Alteration

Current Land Cover - CDL

The USDA Crop Data Layer (CDL) gives detail about the location and amount of various types of agricultural cultivation. The national data contains a very wide range of crops, but only some of these are present in Minnesota and different regions of Minnesota have different typical crop rotations. The Crop Data Layer data is summarized to show the percent of land area in each major watershed used to produce each of the major crop types found in Minnesota (based on 2016 data).



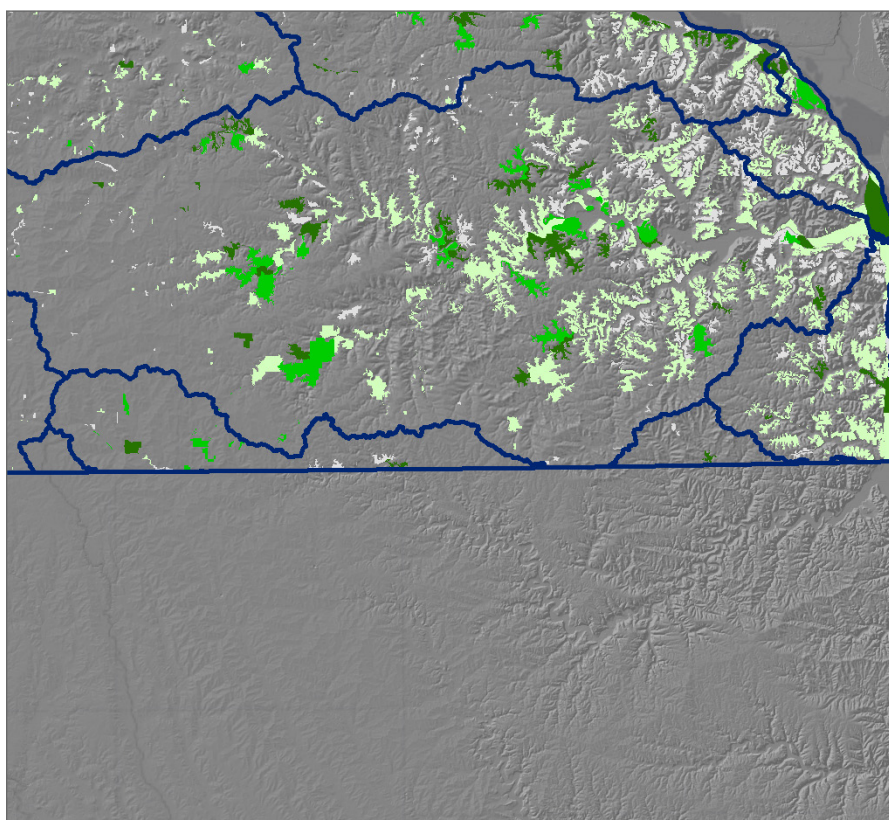
Landscape Alteration

Habitats of Biodiversity Significance

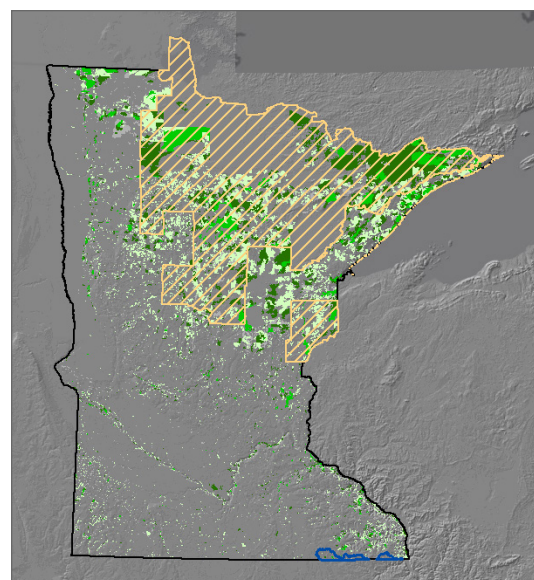
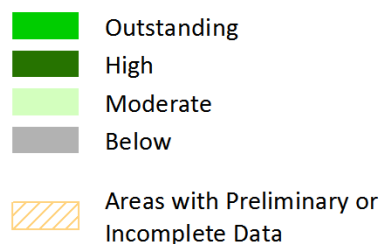
Minnesota Biological Survey (MBS) ecologists rank the biodiversity of habitat sites based on the presence of rare species populations, the size and condition of native plant communities within the site, and the landscape context. In many areas of Minnesota, remaining sites occur primarily along steep slopes and near water features, while most of the upland has been converted to human use. For more information visit - www.mndnr.gov/eco/mcbs/biodiversity_guidelines.html

There are four biodiversity significance ranks, outstanding, high, moderate, and below:

- Outstanding sites contain the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most ecologically intact or functional landscapes.
- High sites contain very good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes.
- Moderate sites contain occurrences of rare species, moderately disturbed native plant communities, and/or landscapes that have strong potential for recovery of native plant communities and characteristic ecological processes.
- Below sites lack occurrences of rare species and natural features or do not meet MBS standards for outstanding, high, or moderate rank. These sites may include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movement, buffers surrounding higher-quality natural areas, areas with high potential for restoration of native habitat, or open space.



Minnesota Biological Survey Sites of Biodiversity Significance



Area of Sites of Biological Significance Rank

Outstanding: 2.4 sq. mi. (1.1%)

High: 2.2 sq. mi. (1.0%)

Moderate: 0.3 sq. mi. (0.1%)

Below: 2.4 sq. mi. (1.1%)

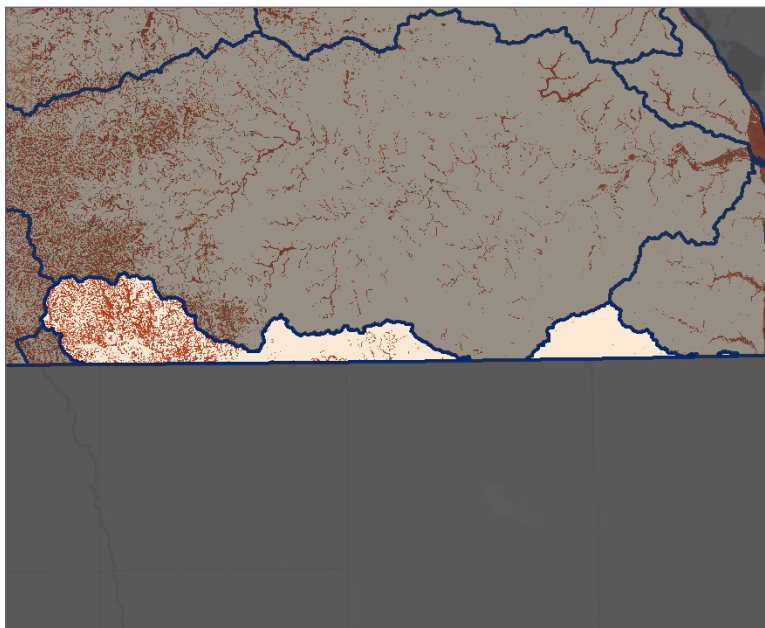
Landscape Alteration

Change in Water Storage - Wetlands

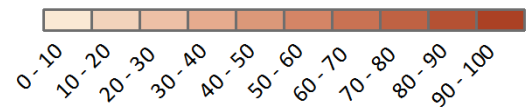
In much of Minnesota, the historic landscape had many more seasonal and perennial wetlands. Land has been drained using ditches and tile lines, streams have been straightened to accommodate agriculture, communities and roads. The scale of this change has accelerated the rate at which rain fall moves through the system, creating rapid fluctuations in Minnesota's stream and lake levels.

Hydric soils form when the soil is saturated for a long enough period of time during the growing season to create an an-aerobic condition. This is a lasting change that allows soil scientists to use the extent of hydric soils today to approximate where there were saturated soils historically.

Comparing the extent of hydric soils to the extent of current wetlands provides an estimate for the amount of wetland loss that has taken place within the watershed.



Hydric Soils (SSURGO/STATSGO)

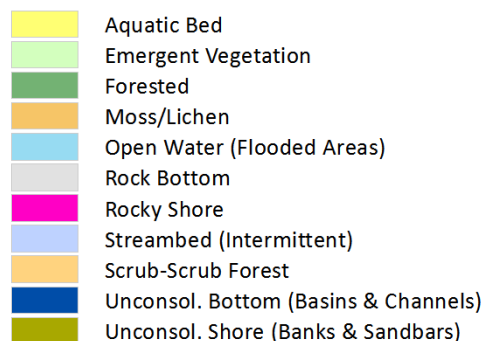


Watershed Hydric Area:

Area: 47.3 sq. mi.

Percent of major watershed: 21.8%

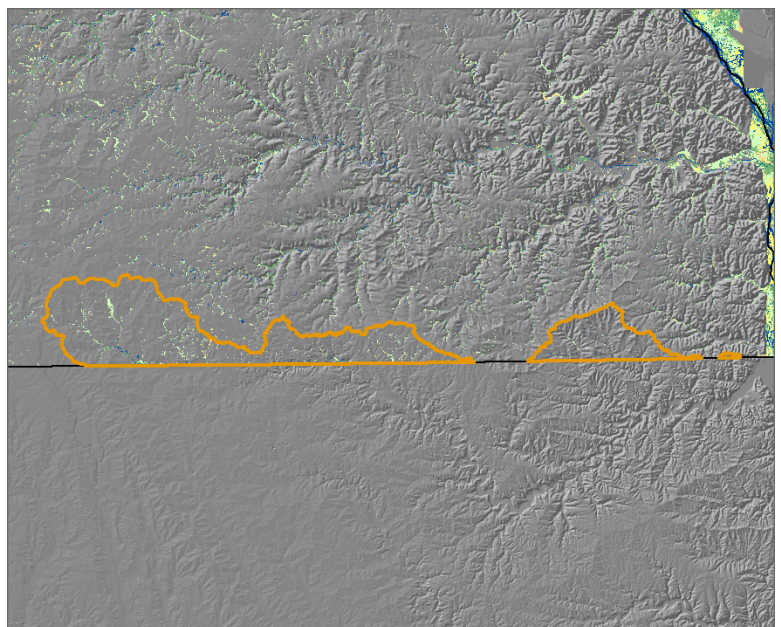
National Wetland Inventory Cowardin Wetland Classification



Watershed Wetland Area:

Area: 3.7 sq. mi.

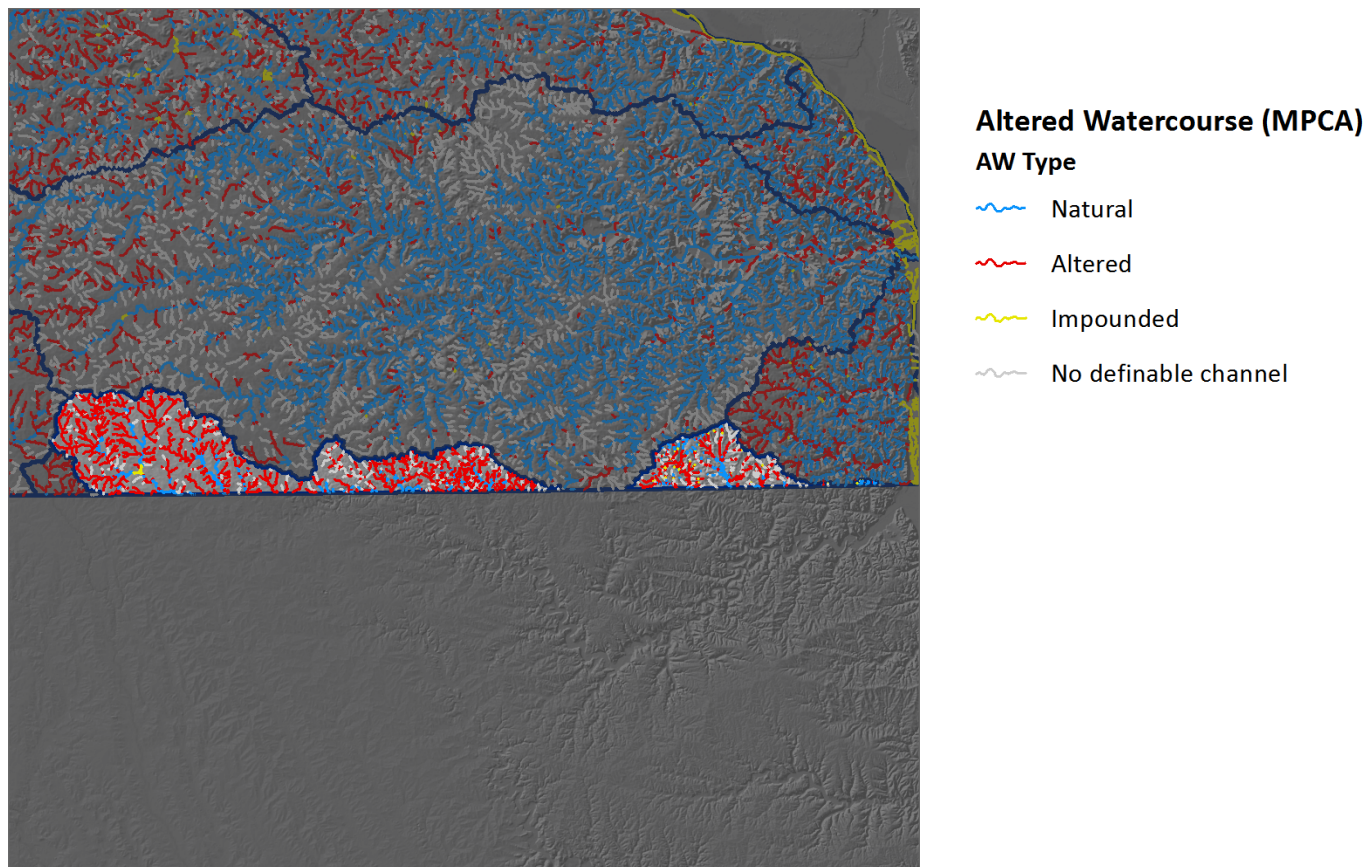
Percent of major watershed: 1.7%



Landscape Alteration

Change in Water Storage - Streams

In addition to loss of storage in wetlands, more than 50% of Minnesota's streams have been altered by ditching or impoundments. This alteration has also accelerated the rate at which water leaves the landscape, compounding the impact from lost wetland storage.



Watercourses within Watershed:

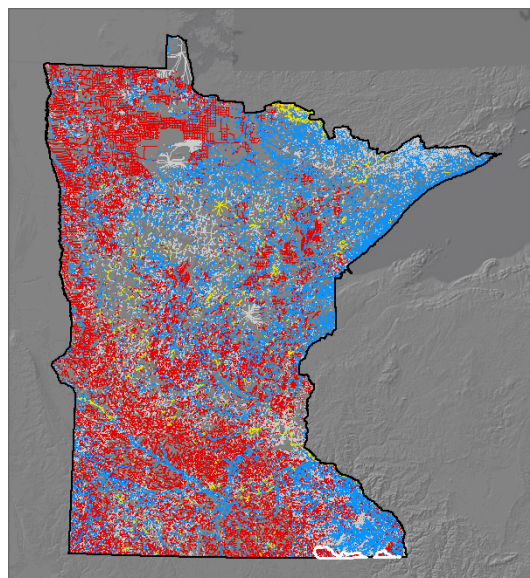
Class: length in miles (% of all watercourses)

Natural: 100.2 mi. (18.6%)

Altered: 349.3 mi. (64.9%)

Impounded: 4.1 mi. (0.8%)

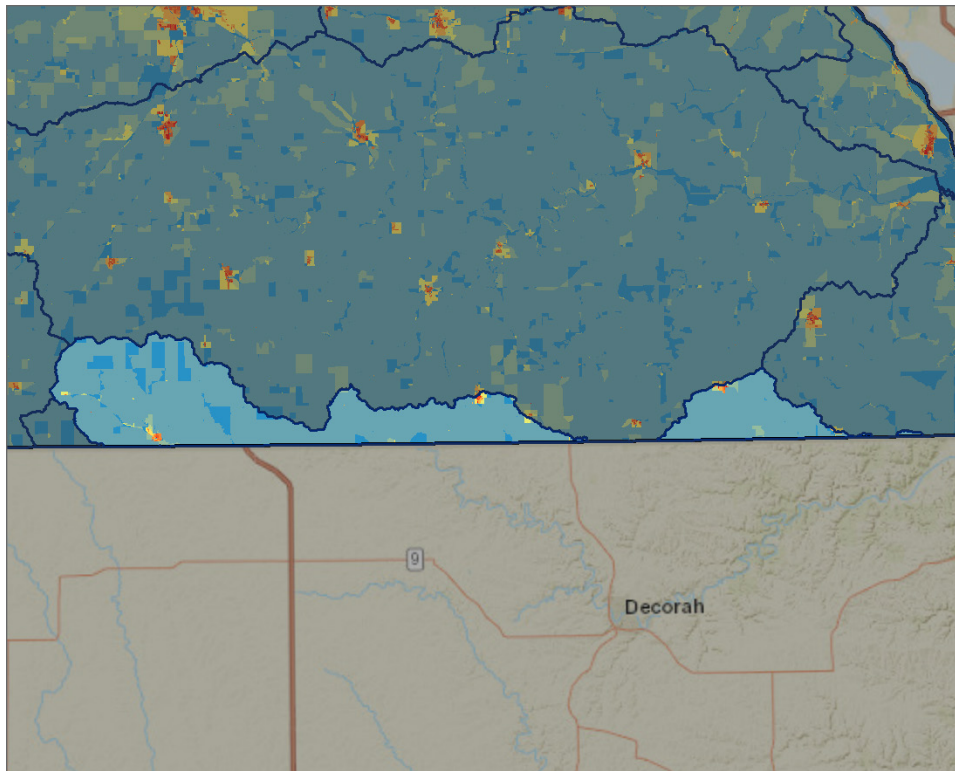
No Definable Channel: 84.5 mi. (15.7%)



Human Aspects

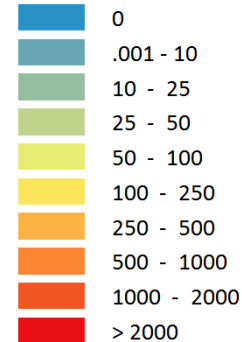
Population

The distribution of human populations on the landscape is the primary driver of land use patterns over time. As population distributions change over time, the types of land use pressure and impacts change.



Population Density (2010)

People per square mile



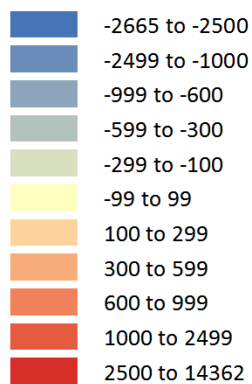
Major Watershed Population:

People per sq. mi.: 22.73

Total Population: 4,929

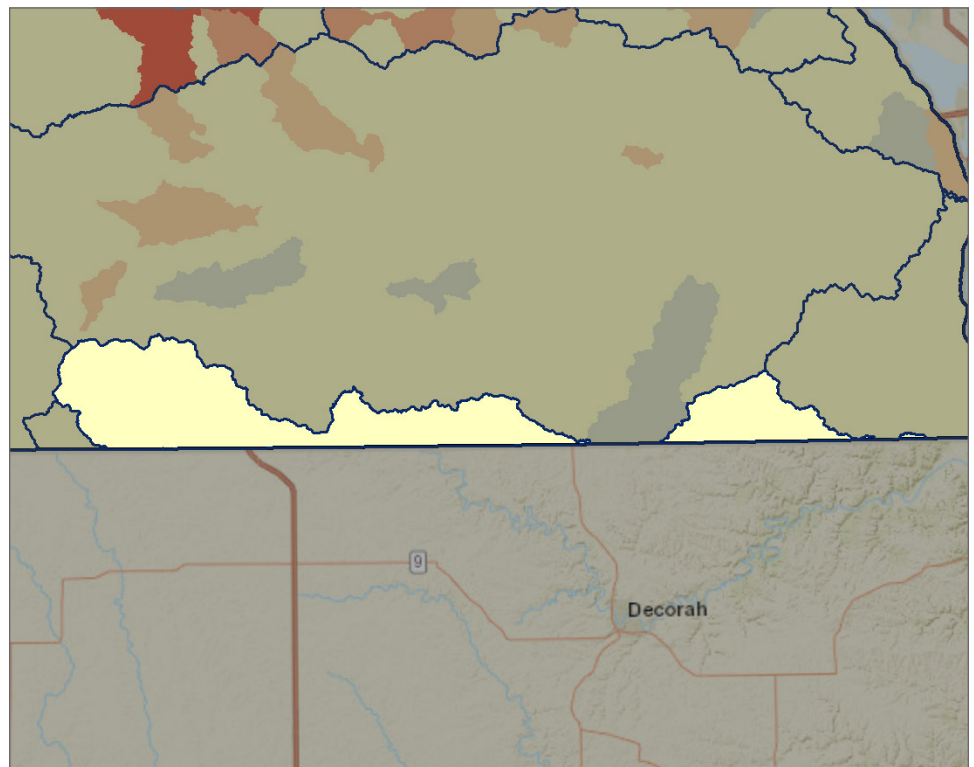
Population Change

Between 2000 and 2010



Major Watershed Population Change:

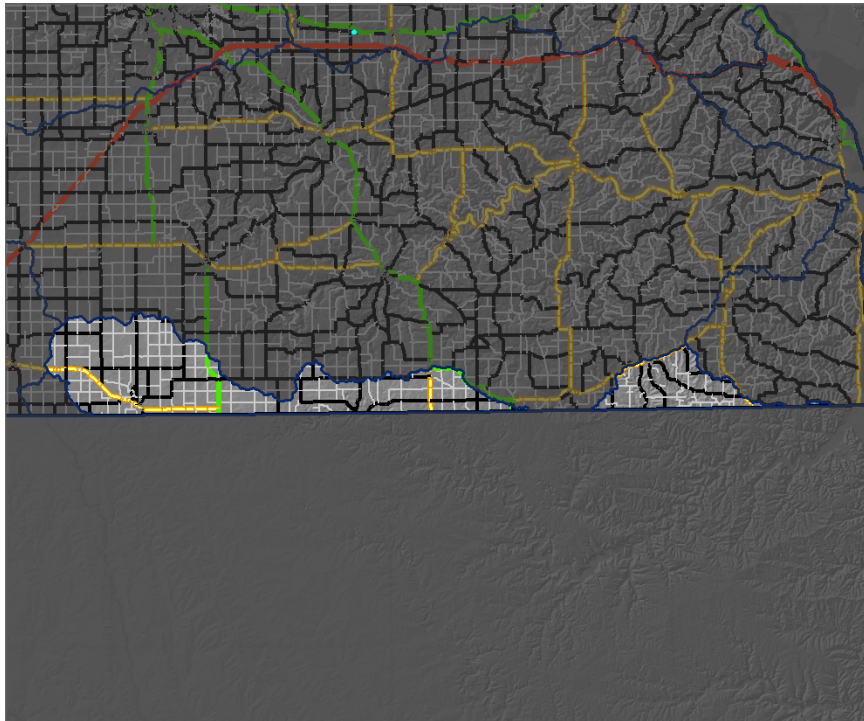
2000 to 2010: -255



Human Aspects

Transportation Networks

Roads, railroads, and other infrastructure impacts the way water moves across the landscape by channelizing water along roadways and creating storm water systems for communities. These built features also change the connections between terrestrial habitats by disrupting travel corridors and bisecting habitat patches. Often these human networks are also the conduits for spreading other threats such as invasive species across the landscape and between water bodies.



Road Network (MnDOT)

- Interstate Trunk Highway
- U.S. Trunk Highway
- MN Trunk Highway
- County Highway
- Municipal Road
- Township or Other Road
- Ramp

Road Length by Type within Major Watershed:

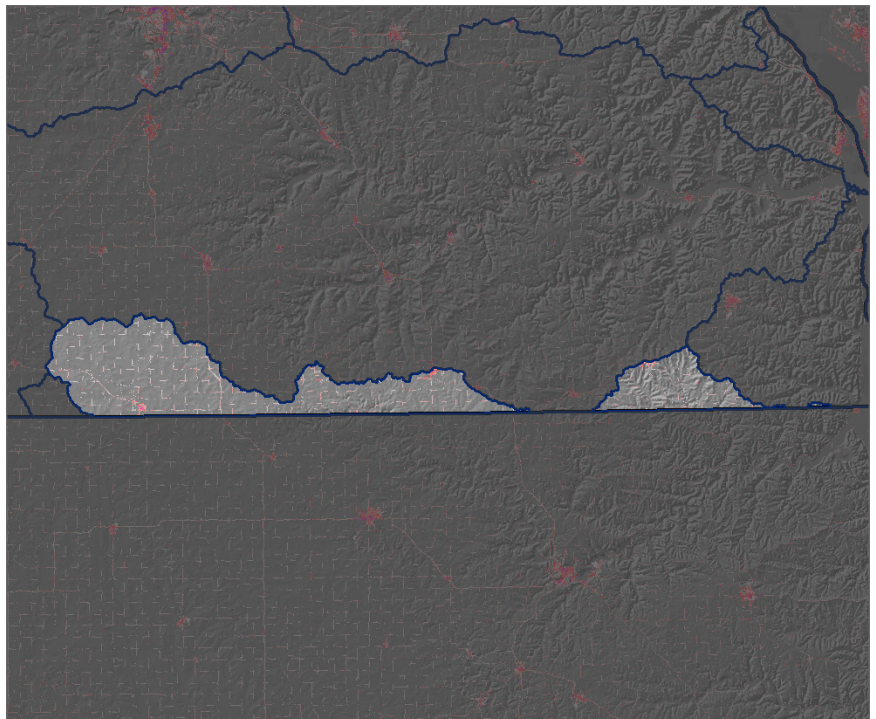
Interstate: 0.0 mi. (0%)
 U.S. Highway: 8.6 mi. (2%)
 MN Highway: 26.9 mi. (6%)
 County Highway: 119.9 mi. (28%)
 Municipal Road: 22.4 mi. (5%)
 Township/other: 257.7 mi. (59%)
 Ramp: 0.1 mi. (0%)

Percent Imperviousness



Percent of Major Watershed Covered by Impervious Surfaces:

0.94%



Appendix - GIS Data Sources

References to data sources are grouped by the document page they appear in. For most pages the GIS data is also available in the WHAF web application. Use the shortened URL to launch the WHAF mapping application with the associated data layers pre-loaded.

Page	Link	Data Sources
Page 4 - Topography		Minnesota LiDAR Derived Digital Elevation Model (DEM). Various sources, data made available by Minnesota Geospatial Information Office. Available online at https://gisdata.mn.gov/ . 2006-2012.
Page 5 - Hydrologic Position	http://bit.ly/1N1A65k	An Index of Water Use Intensity for Minnesota. Minnesota Department of Natural Resources, Department of Ecological and Water Resources. 2014.
Page 6 - Ecological Classification	http://bit.ly/1SGm39A	Ecological Provinces of Minnesota. Minnesota Department of Natural Resources. 1999. Ecological Sections of Minnesota. Minnesota Department of Natural Resources. Available online at https://gisdata.mn.gov/ . 1999.
Page 7 - Ecological Classification	http://bit.ly/1RROTz7	Ecological Subsections of Minnesota. Minnesota Department of Natural Resources. 1999. Land Type Associations of Minnesota. Minnesota Department of Natural Resources. Available online at https://gisdata.mn.gov/ . 1999.
Page 8 - Soils, Silt and Sand	http://bit.ly/1UQZZ01	Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database & the U.S. General Soil Map (STATSGO2) for Minnesota. United States Department of Agriculture, Natural Resources Conservation Service. Available online at http://datagateway.nrcs.usda.gov/ . 2015 official release.
Page 9 - Soils, Clay and OM	http://bit.ly/1SMaRs0	Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database & the U.S. General Soil Map (STATSGO2) for Minnesota. United States Department of Agriculture, Natural Resources Conservation Service. Available online at http://datagateway.nrcs.usda.gov/ . 2015 official release.
Page 10 - Groundwater	http://bit.ly/2wj9Im9	Groundwater Provinces. Minnesota Department of Natural Resources – County Geologic Atlas Program. Available online at www.mndnr.gov/groundwater/provinces/index.html . 2001. Adams, R. 2016. Pollution Sensitivity of Near-Surface Materials. St. Paul, Minnesota Department of Natural Resources. Minnesota Hydrogeology Atlas Series HG-02, report and plate, accessible at http://www.dnr.state.mn.us/waters/programs/gw_section/mapping/platesum/mha_ps-ns.html .
Page 11 - Climate	http://bit.ly/1SMaXjB	Normal Annual Precipitation Average, Minnesota, 1981-2010. MN Department of Natural Resources, State Climatology Office. Available online at https://gisdata.mn.gov/ . 2010. 30-yr Normal Mean Temperature, Annual: 1981-2010. PRISM Climate Group, Oregon State University. Available online at http://prism.oregonstate.edu . 2012.
Page 12 - Historic Land Cover	http://bit.ly/1SMaY6V	Presettlement Vegetation (1895). Minnesota Department of Natural Resources. Available online at https://gisdata.mn.gov/ . 1994.
Page 13 - NLCD Land Cover	http://bit.ly/1SMb0vH	National Land Cover Database (NLCD), Land Cover 2011. Multi-Resolution Land Characteristics Consortium. Available online at http://www.mrlc.gov/index.php . 2014. Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K., 2015, <i>Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information</i> . Photogrammetric Engineering and Remote Sensing, v. 81, no. 5, p. 345-354

Appendix - GIS Data Sources

Page	Link	Data Sources
Page 14 - CDL (Crop) Land Cover	http://bit.ly/1SMb2nn	USDA National Agricultural Statistics Service Cropland Data Layer. 2015. Published crop-specific data layer [Online]. Available at https://nassgeodata.gmu.edu/Crop-Scape/ (accessed 3/15/2016; verified 3/2/2016). USDA-NASS, Washington, DC
Page 15 - MBS Biodiv. Significance	http://bit.ly/1SMbBxk	MBS Sites of Biodiversity Significance. Minnesota Department of Natural Resources, Minnesota Biological Survey. Available online at https://gisdata.mn.gov/ . 2016.
Page 16 - Change in Water Stor- age, Wetlands	http://bit.ly/2fO1091	Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database & the U.S. General Soil Map (STATSGO2) for Minnesota. United States Department of Agriculture, Natural Resources Conservation Service. Available online at http://datagateway.nrcs.usda.gov/ . 2015 official release. National Wetland Inventory, Minnesota, 1980-1986. Minnesota Department of Natural Resources – Division of Waters. Available online at https://gisdata.mn.gov/ . 1994. National Wetland Inventory Update for Minnesota. Minnesota Department of Natural Resources; Ducks Unlimited; St. Mary's University of Minnesota. Available online at https://gisdata.mn.gov/ . 2015.
Page 17 - Change in Water Stor- age, Streams	http://bit.ly/1SMbQIF	Statewide Altered Watercourse Project. Minnesota Geospatial Information Office for the Minnesota Pollution Control Agency. Available online at https://gisdata.mn.gov/ . 2014.
Page 18 - Population	http://bit.ly/1SMbT7A	Census 2010. U.S. Department of Commerce, U.S. Census Bureau. Generated using American FactFinder. Available online at http://factfinder2.census.gov . 2015. TIGER 2010 Census. U.S. Department of Commerce, U.S. Census Bureau. Available online at https://gdg.sc.egov.usda.gov/ . 2015.
Page 19 - Transporta- tion	http://bit.ly/1SMbVMJ	Roads, Minnesota, 2012. Minnesota Department of Transportation (MnDOT). Available online at https://gisdata.mn.gov/ . 2012. National Land Cover Database (NLCD), Percent Developed Imperviousness 2011. Multi-Resolution Land Characteristics Consortium. Available online at http://www.mrlc.gov/index.php . 2014. Xian, G., Homer, C., Dewitz, J., Fry, J., Hossain, N., and Wickham, J., 2011. The change of impervious surface area between 2001 and 2006 in the conterminous United States. Photogrammetric Engineering and Remote Sensing, Vol. 77(8): 758-762.
Reference Data and Basemaps		MN DNR Watershed Suite. Minnesota Department of Natural Resources. Available online at https://gisdata.mn.gov/ . 2014. ESRI Basemap Service Layers: World Imagery - Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community World Street Map - Sources: Esri, DeLorme, HERE, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (HongKong), Esri (Thailand), MapmyIndia, TomTom Light Gray Canvas Maps - Sources: Esri, DeLorme, HERE, MapmyIndia World Dark Gray Base - Sources: Esri, HERE, DeLorme, MapmyIndia, INCREMENT P, © OpenStreetMap contributors, and the GIS user community