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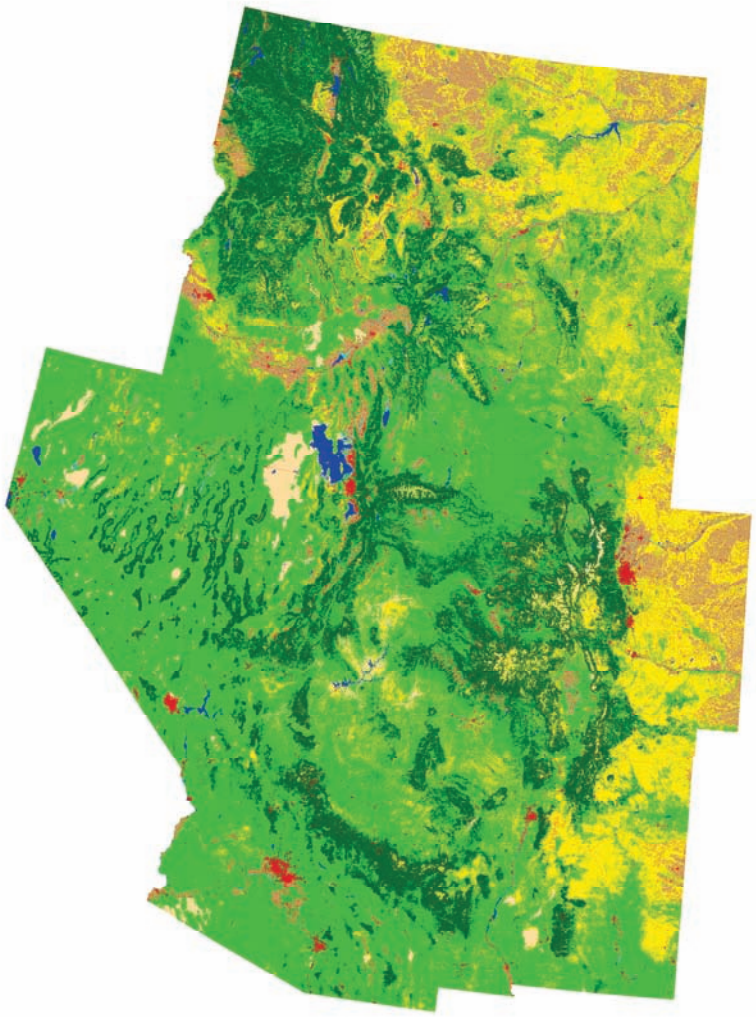
Research Station**

General Technical
Report NRS-63

Urban and Community Forests of the Mountain Region

Arizona
Colorado
Idaho
Montana
Nevada
New Mexico
Utah
Wyoming

David J. Nowak
Eric J. Greenfield



Abstract

This report details how land cover and urbanization vary within the states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming by community (incorporated and census designated places), county subdivision, and county. Specifically this report provides critical urban and community forestry information for each state including human population characteristics and trends, changes in urban and community lands, tree canopy and impervious surface cover characteristics, distribution of land-cover classes, a relative comparison of urban and community forests among local government types, determination of priority areas for tree planting, and a summary of urban tree benefits. Report information can improve the understanding, management, and planning of urban and community forests. The data from this report is reported for each state on the CD provided in the back of this book, and it may be accessed by state at: http://www.nrs.fs.fed.us/data/urban.

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INTRODUCTION

As part of the Forest and Rangeland Renewable Resources Planning Act of 1974, the first national assessment of urban forests was completed in 2000 (Dwyer et al. 2000, Nowak et al. 2001b). This assessment used 1-km resolution Advanced Very-High Resolution Radiometer (AVHRR) data (Zhu 1994) and 1990 U.S. Census Bureau (2007) population and geographic data to assess urban tree cover. The assessment concluded that urban areas in the conterminous United States doubled in size between 1969 and 1994 and covered 3.5 percent of the total land area. Urban areas were estimated to contain approximately 3.8 billion trees with an average tree canopy cover of 27 percent.

To update this first report, higher resolution (30 m) tree canopy and impervious surface cover maps were used (from 2001 Landsat satellite imagery and published in 2007) (Homer et al. 2007, U.S. Geol. Surv. 2007) in conjunction with 1990 and 2000 census and geographic data (1:5,000,000 scale cartographic boundary files) (U.S. Census Bureau 2007) to assess current urban and community forest attributes. These results are being published for each of the lower 48 United States to provide information on urban change and state-specific urban and community forestry data.

This report includes information for the following states: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.

Data are reported for the state, county, county subdivision, and community jurisdictions. The jurisdictional units used in this report are derived from U.S. Census (2007) geographic data and defined legal or statistical divisions. "County"[1] refers to the primary subdivision within states. "County subdivisions" are primary divisions of a county and are statistically equivalent entities for the reporting of census data. They include census county divisions (CCD), census sub areas, minor civil divisions (MCD), and unorganized territories. "Communities" are incorporated and census designated places, and consolidated cities (U.S. Census Bureau 2007). For detailed definitions, see http://www.census.gov/geo/www/cob/cs_metadata.html (2007).

[1]The primary legal divisions of most states are termed "counties." In Louisiana, these divisions are known as "parishes." In four states (Maryland, Missouri, Nevada, and Virginia), there are one or more incorporated places that are independent of any county organization and thus constitute primary divisions of their states; these incorporated places are known as "independent cities" and are treated as equivalent to counties for statistical purposes. (For some statistical purposes they may be treated as county subdivisions and places.) The District of Columbia has no primary divisions, and the entire area is considered equivalent to a county for statistical purposes. (http://www.census.gov/geo/www/cob/co_metadata.html, 2007)

REPORT OVERVIEW

The information in this report can aid local and regional managers and planners of urban and community forest resources. This report provides urban and community forest reference information and data from the state to local level on the following attributes related to the urban and community forest resource:

- Human population characteristics and trends
- Urban and community land
- Tree canopy cover characteristics
- Impervious surface cover characteristics
- Classified land-cover characteristics
- Relative comparisons of urban and community forests
- Priority areas for tree planting
- Urban tree benefits

Information in this report can be used by urban and community forestry professionals to:

- Understand general land-cover characteristics and urbanization trends at several geographic scales
- Compare tree canopy cover among similar communities
- Determine areas of greatest growth and areas of highest tree planting priority
- Relate urban and community forests to pollution removal and carbon storage
- Promote more detailed and/or locally appropriate urban and community forest inventories, censuses, or field surveys (e.g., i-Tree – www.itreetools.org)
- Establish local to statewide standards related to urban and community forestry
- Support urban and community forestry programs
- Improve urban and community forest management and planning

The remainder of this section details how information was derived for each attribute reported for the urban and community areas. The subsequent state summaries detail the findings for each state in this region. Most tables for each state are not given in this report, rather they can be found on the CD provided with this report or accessed at: http://www.nrs.fs.fed.us/data/urban.

URBAN FOREST ATTRIBUTES

Human Population Characteristics and Trends

Human population and population density changes over time, and geographic distribution are important measurements of the urban environment because human populations are an integral part of community and urban forest dynamics. Within divisions of state, county, county subdivision, and community, total population, population changes from 1990 to 2000 and population density are detailed based on U.S. Census data (U.S. Census Bureau 2007).

Urban and Community Land

Two geographic definitions overlap: “community” and “urban”. The definition of community is based on jurisdictional or political boundaries delimited by U.S. Census definitions of places (U.S. Census Bureau 2007). Community lands are places of established human settlement that may include all, some, or no urban land within their boundaries.

The definition of urban is based on population density as delimited using the U.S. Census Bureau’s (2007) definition: all territory, population, and housing units located within urbanized areas or urban clusters. Urbanized area and urban cluster boundaries encompass densely settled territories, which are described by one of the following:

- One or more block groups or census blocks with a population density of at least 386.1 people/km^2 (1,000 people/$mile^2$)
- Surrounding block groups and census blocks with a population density of 193.1 people/km^2 (500 people/$mile^2$)
- Less densely settled blocks that form enclaves or indentations, or are used to connect discontinuous areas

More specifically, urbanized areas consist of territory with 50,000 or more people. Urban clusters, a concept new to the 2000 Census, consist of territory with at least 2,500 people but fewer than 50,000 people. This new definition tends to be more restrictive than the 1990 U.S. Census urban definition and encompasses many areas typically considered suburban. The 2000 Census definition of urban was applied to 1990 Census geographic data to analyze change in urban land between 1990 and 2000 (Nowak et al. 2005).

As urban land reveals the more heavily populated areas (population density-based definition) and community land indicates both urban and rural (i.e., non-urban) communities that are recognized by their geopolitical boundaries (political definition), both definitions provide information related to human settlements and the forest resources within those settlements. As some urban land exists beyond community boundaries and not all community land is urban (i.e., communities are often a mix of urban and rural land), the category of "urban or community" was created to understand forest attributes accumulated by the union of these two definitions. The "urban or community" term used throughout this report encompasses both urban land and land in communities.

Percent urban land is a ratio of urban land over total land within a census geographic division, and percent community land is a ratio of community land over total land within the geopolitical unit. In addition, changes in urban land and changes in community land are reported between 1990 and 2000.

For each state, Tables 1 through 4 summarize the population, and urban and community land attributes for the state, communities, county subdivisions, and counties respectively (CD and http://www.nrs.fs.fed.us/data/urban).

Tree Canopy Cover Characteristics

Tree canopy cover is a critical measure of the urban and community forest resource. Tree canopy cover gives a broad indication of the overall forest resource and its associated benefits. To assess urban and community land cover characteristics, the multi-resolution land characteristics consortium's National Land Cover Database (NLCD) was used (Homer et al. 2004, U.S. Geol. Surv. 2007, Yang et al. 2003). The NLCD, released in early 2007, was processed from 2001 Landsat satellite imagery and provides estimates of percentage tree canopy and impervious surface cover within 30-m pixels or cells across the state. The tree canopy percentages in this report are calculated using the land area (not including water) of the geopolitical units derived from the U.S. Census cartographic boundary data and NLCD. In addition to percentage tree cover, four other canopy cover attributes, derived from the same data, were assessed:

- Tree canopy cover per capita—Tree canopy cover (m^2) divided by the number of people within the area of analysis.
- Total green space—Total area minus impervious and water cover (ha). This attribute estimates pervious cover (i.e., grass, soil, or tree-covered areas).
- Canopy green space—Tree cover divided by total green space (percent). This value is the proportion of the total green space that is filled by tree canopies.
- Available green space—Total green space minus tree canopy cover (ha). This value is the amount of grass and soil area not covered with tree canopies and potentially available for planting.

Impervious Surface Cover Characteristics

Similar to tree cover, impervious surface cover provides another piece of valuable information related to the urban environment. Impervious surface cover gives an indication of an area's developed hardscape, which has important influences on urban air temperatures and water flows and also yields information on limitations to urban tree cover. Impervious surface cover also was derived from the NLCD database (U.S. Geol. Surv. 2007). The impervious surface cover percentages in this report are calculated using the land area (not including water) of the geopolitical units derived from the U.S. Census

cartographic boundary data and NLCD. Impervious surface per capita is calculated from NLCD 2001 and U.S. Census data.

For each state, Tables 1, and 5 through 7 summarize the tree canopy and impervious surface cover attributes for the state, communities, county subdivisions, and counties respectively (CD and http://www.nrs.fs.fed.us/data/urban).

Classified Land-cover Characteristics

Land-cover types also are summarized using 2001 Landsat satellite data that were classified with the U.S. Geological Survey land cover categorization scheme based on a modified Anderson land-cover classification (U.S. Geol. Surv. 2007). Land area, tree canopy cover, and available green space within generalized land cover categories vary among communities, county subdivisions, counties, and state. The percentages are calculated from the NLCD 2001 and U.S. Census cartographic boundary data. The land-cover categories defined here are derived from established NLCD 2001 land-cover classes. These generalized land-cover categories or types may not be present in some states.

- Developed—NLCD classes 21 (developed-open space), 22 (developed-low intensity), 23 (developed-medium intensity), and 24 (developed-high intensity)
- Barren—NLCD class 31 (barren land [rock/sand/clay])
- Forested—NLCD classes 41 (deciduous forest), 42 (evergreen forest), and 43 (mixed forest)
- Shrub/Scrub—NLCD class 52 (shrub/scrub)
- Grassland—NLCD class 71 (grassland/herbaceous)
- Agriculture—NLCD classes 81 (pasture/hay) and 82 (cultivated crops)
- Wetland—NLCD classes 90 (woody wetlands) and 95 (emergent herbaceous wetlands)

For each state, Tables 8 through 10 summarize the classified land-cover characteristics for communities, county subdivisions, and counties and state respectively (CD and http://www.nrs.fs.fed.us/data/urban).

Relative Comparisons of Tree Cover

A question commonly asked in evaluating the urban and community forest resource is, “How does my community compare with other communities?”

To help answer this question, tree canopy cover was compared among the counties, county subdivisions, and communities relative to other areas with comparable population density and within the same NLCD mapping unit (ecoregion). For this comparison, seven population density classes were established:

- Density class 1 — 0 to 38.6 people/km^2 (0 to 99.9 people/mile^2)
- Density class 2 — 38.7 to 96.5 people/km^2 (100 to 249.9 people/mile^2)
- Density class 3 — 96.6 to 193.1 people/km^2 (250 to 499.9 people/mile^2)
- Density class 4 — 193.2 to 289.6 people/km^2 (500 to 749.9 people/mile^2)
- Density class 5 — 289.7 to 386.2 people/km^2 (750 to 999.9 people/mile^2)
- Density class 6 — 386.3 to 1931.2 people/km^2 (1000 to 4999.9 people/mile^2) and
- Density class 7 — 1931.3 or greater people/km^2 (5000 or greater people/mile^2)

Mapping zones were delimited within the NLCD to increase classification accuracy and efficiency (Fig. A). The mapping units represent relatively homogeneous ecological conditions (Homer and Gallant 2001). To locate geopolitical units within a mapping zone, centroid (geometric center) points of the local governments were used.

For three or more geographic units in the same mapping zone and population density class, a standardized tree canopy score based on the range of values within that zone and class was assigned to each unit. The standardized score is calculated as:

Standardized score = (tree canopy percent of unit – minimum tree canopy percentage in class)/range of tree canopy percent in class.

Figure A.—The mapping zones of the continental United States relative to states and land cover (NLCD 2001).

Communities, county subdivisions, and counties were assigned to one of the following categories based on their standardized score:

- Excellent—Standardized score of 0.9 to 1.0
- Very Good—0.7 to 0.89
- Good—0.5 to 0.69
- Fair—0.3 to 0.49
- Poor—0 to 0.29

To help understand the variability of tree cover, minimum, median, maximum, and weighted mean values for percent tree canopy cover in each population density class of each political subdivision are reported in Table 11 for each mapping zone (CD and http://www.nrs.fs.fed.us/data/urban). This information can be used to understand the actual range and values used for the assessment.

For each state, Tables 12 through 14 summarize the urban and community forest ratings for communities, county subdivisions, and counties respectively (CD and http://www.nrs.fs.fed.us/data/urban).

Priority Areas for Tree Planting

NLCD (U.S. Geol. Survey 2007) and 2000 U.S. Census data (2007) were used to produce an index that prioritizes tree planting areas for communities, county subdivisions, and counties. An index was developed to help identify areas with relatively low tree canopy cover and high population density (high priority tree-planting areas). This index provides one form of prioritization. States and local governments may design their own prioritization method incorporating individual and diverse value systems. The index used in this report combines three criteria.

- Population density—The greater the population density, the greater the priority for tree planting
- Canopy green space—The lower the value, the greater the priority for tree planting
- Tree canopy cover per capita—The lower the amount of tree canopy cover per person, the greater the priority for tree planting

Each criterion above was standardized[2] on a scale of 0 to 1, with 1 representing the maximum population density and minimum canopy green space and tree cover per capita. The standardized values were weighted to produce a combined score:

$$I = (PD * 40) + (CG * 30) + (TPC * 30)$$

Where I is the combined index score
PD is the standardized population density value
CG is the standardized canopy green space value, and
TPC is the standardized tree cover per capita value.

The combined score was standardized again and multiplied by 100 to produce the planting priority index. The tree planting priority index (PPI) ranks each state's communities, county subdivisions, and counties with values from 100 (highest priority) to 0 (lowest priority). This index is a type of "environmental equity" index with areas of higher human population density and lower canopy green space and tree cover per capita tending to get the higher index value.

For each state, Tables 15 through 17 summarize the tree planting priority index for communities, county subdivisions, and counties respectively (CD and http://www.nrs.fs.fed.us/data/urban).

Urban Tree Benefits

Urban and community forests are important for human and ecological health (Nowak and Dwyer 2007). The benefits ascribed to urban and community trees include:

- Carbon storage and sequestration
- Air pollution removal
- Surface air temperature reduction
- Reduced building energy use
- Absorption of ultraviolet radiation
- Improved water quality
- Reduced noise pollution
- Improved human comfort
- Increased property value
- Improved human physiological and psychological well-being
- Improved aesthetics
- Improved community cohesion

To understand the contribution and magnitude of the forest resource in urban or community areas, the total number of trees, carbon storage and annual carbon uptake (sequestration), air pollution removal, and the associated dollar values for carbon and air pollution benefits are estimated.

Carbon sequestration and storage values were estimated from tree cover (m^2) multiplied by average carbon storage (9.1 kg C/m^2), and sequestration (0.3 kg C/m^2) density values derived from several U.S. communities (e.g., Nowak and Crane 2002). Monetary values associated with urban tree carbon storage and sequestration were based on the 2001-2010 projected marginal social cost of carbon dioxide emissions, $22.8/t C (Fankhauser 1994). The number of urban and community trees was estimated in a similar manner multiplying tree canopy cover (m^2) by average tree density per hectare of canopy cover from several U.S. cities (Table A).

Air pollution removal estimates are derived from the Urban Forest Effects (UFORE) model (Nowak and Crane 2000) and 2000 weather and pollution data (National Climatic Data Center 2000, U.S. EPA 2008). The UFORE model was used to integrate hourly pollution and weather data with urban or community tree cover data to estimate annual pollution removal in each state (Nowak and Crane 2000, Nowak et al. 2006d).

[2]Standardized value for population density (PD) was calculated as PD=(n–min)/r, where PD is the value 0-1, n is the value for the geopolitical unit (population/km^2), min is the minimum value for all units, and r is the range of values among all units (maximum value – minimum value). Standardized value for canopy green space (CG) was calculated as CG=(max–n)/r, where CG is the value 0-1, max is the maximum value for all geopolitical units, n is the value for the unit (tree canopy cover m^2/total green space m^2), and r is the range of values. Standardized value for tree cover per capita (TPC) was calculated as TPC=(max–n)/r, where TPC is the value (0-1), max is the maximum value for all geographic units, n is the value for the geopolitical unit (m^2/capita), and r is the range of values among all units.

Table A.—Average number of trees, carbon storage, and carbon sequestration rates per unit of canopy cover for several U.S. cities

		Carbon	
	Trees	Storage	Sequestration
City	(no./ha cover)	(kg C/m^2 cover)	(kg C/m^2 cover)
Atlanta, GA [a]	751.5	9.7	0.3
Baltimore, MD [a]	598.1	12.3	0.3
Boston, MA [a]	371.7	9.1	0.3
Chicago, IL [b]	618.0	12.9	n/a
Casper, WY [c]	252.8	7.0	0.2
Freehold, NJ [a]	275.0	10.4	0.3
Jersey City, NJ [a]	308.7	4.4	0.2
Minneapolis, MN [d]	245.5	5.7	0.2
Moorestown, NJ [a]	547.9	9.9	0.3
Morgantown, WV [a]	829.6	10.6	0.3
New York, NY [e]	312.0	7.3	0.2
Philadelphia, PA [f]	394.3	9.0	0.3
San Francisco, CA [g]	468.1	12.3	0.3
Syracuse, NY [h]	583.1	10.5	0.3
Oakland, CA [i]	570.0	5.2	n/a
Washington, DC [j]	423.4	10.4	0.3
Woodbridge, NJ [a]	557.3	8.2	0.3
Mean	476.9	9.1	0.3

[a] Unpublished data analyzed using UFORE model
[b] Nowak 1994a,b
[c] Nowak et al. 2006a
[d] Nowak et al. 2006b
[e] Nowak et al. 2007a
[f] Nowak et al. 2007b
[g] Nowak et al. 2007c
[h] Nowak et al. 2001a
[i] Nowak 1993; Nowak and Crane 2002
[j] Nowak et al. 2006c

To estimate pollution by urban trees in each state, state pollutant flux rates (grams of pollution removal per square meter of canopy per year) were derived from a study of national pollution removal by urban trees for the year 1994 (Nowak et al. 2006d). As pollution concentrations vary through time, the 1994 flux rates were adjusted to 2000 values based on average regional pollution concentration changes between 1994 and 2000 (U.S. EPA 2003). As

flux rate = deposition velocity $*$ pollution concentration,

the ratio of the pollution concentration between years was used to update the flux rate. Arithmetic mean concentration values were used for nitrogen dioxide, particulate matter less than 10 microns, and sulfur dioxide, 2nd Max. 8-hr average for carbon dioxide, and 4th Max. 8-hr average for ozone, to determine the ratio of change between 1994 and 2000 (U.S. EPA 2003). The new 2000 flux rates were multiplied by urban or community tree cover in the state to estimate total pollution removal by trees.

Pollution removal dollar value estimates were calculated using 1994 national median externality values used in energy decision making (Murray et al. 1994, Ottinger et al. 1990). The 1994 values were adjusted to 2007 dollars based on the producer price index (U.S. Dept. of Labor 2008). These values, in dollars/metric ton (t) are:

- Nitrogen dioxide (NO_2) = $9,906/t
- Particulate matter less than 10 microns (PM_{10}) = $6,614/t
- Sulfur dioxide (SO_2) = $2,425/t
- Carbon monoxide (CO) = $1,407/t

Externality values for ozone (O_3) were set to equal the value for NO_2. Externality values can be considered the estimated cost of pollution to society that is not accounted for in the market price of the goods or services that produced the pollution.

For each state, Table 1 summarizes carbon storage and air pollution removal estimates for urban, community, and urban or community trees statewide.

Data Accuracy and Application

The data presented in this report yield the most comprehensive and up-to-date assessment of continental U.S. urban and community forests. The data allows for relative comparisons among geographies and provides baseline information for assessing relative changes in urban and community forest cover in the future. As stated previously, tree cover information was based on finer resolution data than used in the original urban forest assessment (Dwyer et al. 2000). As the methodologies for quantifying tree cover have changed between the original and current assessment, evaluating changes is not possible since the detected changes could be caused by either actual landscape changes or differences in methodology.

The U.S. Census generalized cartographic boundary data are a simplified and smoothed extracts of the Topologically Integrated Geographic Encoding and Referencing (TIGER) database, with a target scale range of 1:5,000,000 (U.S. Census Bureau 2007). Because of this scale and generalization, border simplification impacts attribute measurements that are derived from the boundary data, especially for small areas and at the local scale. In particular, percentages (unitless ratios) generated from attribute measurements made for the smallest communities or county subdivisions may be under- or overstated depending upon the relative location of the smoothed border of the geopolitical unit.

While the 2001 NLCD is a substantial improvement over the 1991 AVHRR data (30-m versus 1-km resolution), it also has local-scale data and application limitations. Initial tree canopy cover results revealed mean absolute errors (mean of the absolute difference between predicted and actual values) from 8.4 percent to 14.1 percent, with correlation coefficients between predicted and actual values ranging from 0.78 to 0.93. Impervious surface cover results revealed mean absolute errors from 4.6 percent to 7 percent, with *r*-values from 0.83 to 0.91 (Homer et al. 2004).

A more recent analysis of 127 community and 20 county geographies sampled throughout the continental United States compared NLCD tree canopy and impervious surface cover estimates with high resolution (1-m or less resolution) aerial photo-interpreted estimates. This analysis revealed that NLCD underestimates both tree canopy and impervious surface cover compared to photo-interpreted values. NLCD underestimates of tree cover vary by mapping zone, while underestimates of impervious surface cover, which are relatively minor, varies by population density (Greenfield et al. 2009). These findings are consistent with Walton (2008), who found a consistent under-prediction bias for the 2001 NLCD derived tree canopy cover values in census places (communities) of western New York.

The tree cover and impervious cover data given in this report are directly from the NLCD database. To help understand the potential underestimate in the cover values, each U.S. mapping zone was photo-interpreted using Google Earth images[3]. Table B provides a comparison of results from NLCD versus photo-interpreted data for mapping zones applicable to this collection of states.

Comparisons between NLCD impervious surface cover estimates and photo-interpreted values were not reported because differences were related to population density, which can vary significantly among geographic units. Despite the potential underestimates in tree canopy cover values, relative comparisons

[3]Nowak, D.J.; Greenfield, E.J. Tree and impervious cover in the conterminous United States: Testing of NLCD cover estimates by mapping zone. In review.

Table B.—Comparison of NLCD versus photo-interpretation (PI) derived values of percent tree canopy cover by NLCD mapping zones

Mapping zone [a]	n [b]	Percent tree canopy cover		Difference [e]	Margin of error [f]	Significant difference [g]
		NLCD [c]	PI [d]			
6	996	35.6%	58.9%	23.3%	2.8%	Yes
8	639	1.3%	3.2%	1.8%	1.3%	Yes
9	903	12.6%	18.9%	6.3%	2.6%	Yes
10	965	47.8%	72.1%	24.3%	2.6%	Yes
12	998	5.9%	11.2%	5.3%	2.0%	Yes
13	983	0.7%	8.4%	7.7%	1.8%	Yes
14	671	1.0%	20.3%	19.3%	3.1%	Yes
15	423	23.4%	35.1%	11.7%	4.6%	Yes
16	998	27.5%	34.7%	7.2%	2.9%	Yes
17	992	6.8%	16.2%	9.5%	2.3%	Yes
18	983	2.2%	9.1%	7.0%	1.9%	Yes
19	977	31.0%	42.5%	11.5%	2.6%	Yes
20	992	3.9%	21.0%	17.1%	2.4%	Yes
21	995	34.3%	40.9%	6.6%	2.9%	Yes
22	993	1.8%	8.3%	6.5%	1.7%	Yes
23	929	11.2%	16.8%	5.6%	2.4%	Yes
24	600	11.4%	14.3%	2.9%	2.8%	Yes
25	942	6.2%	14.7%	8.5%	2.3%	Yes
26	866	0.8%	8.5%	7.8%	1.9%	Yes
27	997	3.3%	8.3%	5.1%	1.7%	Yes
28	827	37.9%	47.7%	9.7%	3.2%	Yes
29	977	6.3%	9.9%	3.5%	1.8%	Yes
30	771	1.1%	1.8%	0.8%	0.9%	No
31	624	1.9%	3.8%	1.9%	1.4%	Yes
33	761	0.3%	1.0%	0.7%	0.7%	Yes
34	929	1.2%	8.1%	6.9%	1.7%	Yes

[a] NLCD mapping zones
[b] Number of photo-interpreted sample points
[c] Percent tree canopy value derived from NLCD data
[d] Percent tree canopy derived from photo-interpreted data
[e] PI value minus NLCD value
[f] 95% confidence interval of PI value
[g] Significant difference between NLCD and PI values if NLCD value is outside of 95% confidence interval of PI value

of tree cover among geographies in this report (e.g., planting priority index and the ratings of excellent to poor for local government tree cover) are reasonable as the under-prediction of tree cover is fairly consistent within each mapping zone. However, it is important to note that the tree canopy and impervious surface cover could be underestimated, as well as their associated ecosystem services and values. A forthcoming analysis will better assess the accuracy of the NLCD cover maps (Homer et al. 2007), but these maps and data provide comprehensive, consistent, and comparable estimates (with an inherent degree of error and uncertainty) of tree canopy and impervious surface cover to help urban and community forest management, planning and policy making. Higher resolution cover data may provide more accurate results at the local scale, but the NLCD cover maps provide a cost-effective means to consistently assess and compare the relative differences of urban cover types regionally. For more refined and locally appropriate data, local field or high resolution (1 m or less) image analyses are recommended (e.g., i-Tree – www.itreetools.org; UTC – www.nrs.fs.fed.us/urban/utc).

Because of limited urban and community forest field data, data from several urban and community forests were used to estimate the number of trees and carbon storage by trees. These coarse estimates reveal that urban and community forests contain a large number of trees and provide significant environmental benefits. Field data are needed from all states to help improve these estimates as well as to estimate other forest effects (e.g., building energy conservation and changes

in stream flow and water quality). Data from long-term monitoring of urban and community forests used in conjunction with satellite-based cover maps will provide essential information to assess forest health and change, and to improve urban and community forest management.

Practical Applications for Managers

The data from this report can be used to aid urban forest management at both the state and local levels. Data can be used to:

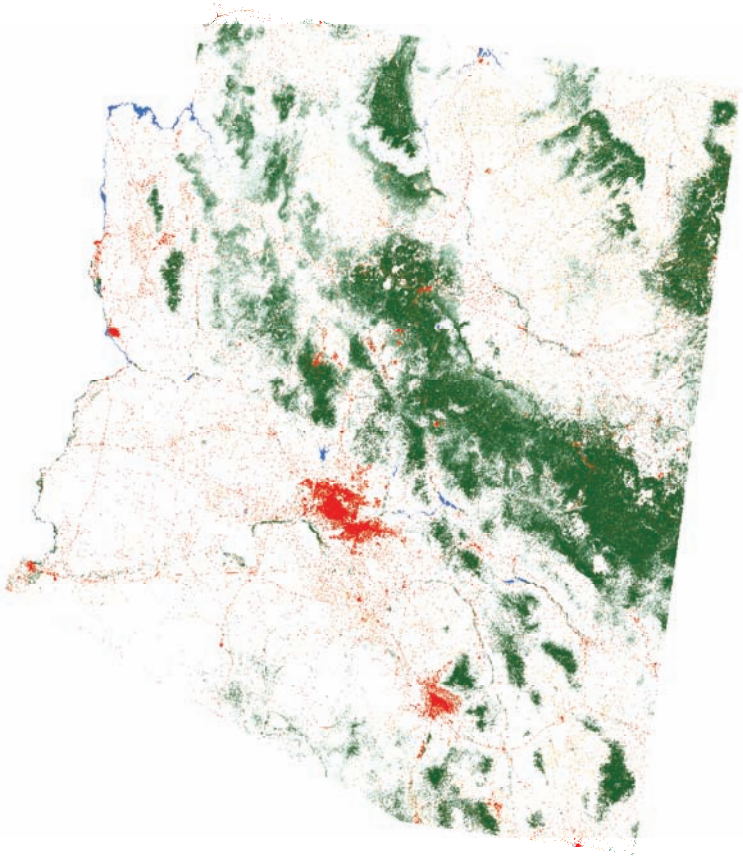
- Determine the extent, magnitude, and variation in the urban and community forestry resource
- Determine areas of greatest population growth, urbanization, and development (sprawl) to direct urban and community forestry to minimize negative impacts and maximize environmental benefits
- Evaluate existing tree canopy, impervious surface cover, and available planting space (available green space) to direct current and future urban and community forestry efforts such as planting programs
- Compare tree canopy cover for similar geopolitical units and set tree canopy goals
- Prioritize tree planting based on population density, tree canopy green space, and tree canopy cover per person
- Understand the pollution removal and carbon storage benefits of urban and community forests
- Promote more detailed and/or locally appropriate urban and community forest inventories, censuses, or field surveys (e.g. i-Tree – www.itreetools.org)
- Establish statewide to local standards related to urban and community forestry (e.g., establishing minimum goals of percent canopy green space or tree cover per capita and directing resources so that communities can reach the minimum standards)
- Improve urban and community forest management and cost estimation by providing an estimate of the number of trees in each geopolitical unit (i.e., urban area size (ha) $*$ percent tree cover $*$ 477 trees/ha, or local tree density information from local data)
- Guide policy decisions related to urban sprawl and urban and community forest management

SUMMARY

The data presented in this report provide a better understanding of urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the state. The following sections detail specific urban and community forestry data for the states in this regional report.

ACKNOWLEDGMENTS

This research was funded, in part, by the U.S. Forest Service's RPA Assessment Staff, State and Private Forestry's Urban and Community Forestry Program, and Northeastern Area State and Private Forestry. Thanks also goes to Chris Sorrentino for assistance with report compilation, Nana Efua Imbeah for assistance with data processing, and Mike Boarman for assistance with image processing.



ARIZONA'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Arizona comprises about 5.3 percent of the state land area in 2000, an increase from 3.3 percent in 1990. Statewide tree canopy cover averages 9.3 percent and tree cover in urban or community areas is about 6.3 percent, with 8.2 percent impervious surface cover and 6.9 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Arizona has an estimated 47.2 million trees, which store about 9.0 million metric tons of carbon ($205.2 million), and annually remove about 297,000 metric tons of carbon ($6.8 million) and 8,760 metric tons of air pollution ($71.3 million) (Table AZ-1).

Tables AZ-2 through AZ-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table AZ-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Arizona		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	5,130,632	4,523,535	4,651,044	n/a
	1990	3,665,228	3,206,973	3,078,005	n/a
	% Change (1990-2000)	40.0	41.1	51.1	n/a
	% Total population (2000)	100.0	88.2	90.7	n/a
Total area	km^2 (2000)	295,254.2	4,350.7	15,370.4	15,791.6
	km^2 (1990)	295,254.2	3,139.0	9,220.9	9,739.7
	% Change (1990-2000)	0.0	38.6	66.7	62.1
Land area	km^2 (2000)	294,538.6	4,341.5	15,310.9	15,731.4
	% Land area (2000)	100.0	1.5	5.2	5.3
	km^2 (1990)	294,538.6	3,133.3	9,196.0	9,714.8
	% Land area (1990)	100.0	1.1	3.1	3.3
	% Change (1990-2000)	0.0	38.6	66.5	61.9
Population density (people/land area km^2)	2000	17.4	1,041.9	303.8	n/a
	1990	12.4	1,023.5	334.7	n/a
	% Change (1990-2000)	40.0	1.8	-9.2	n/a
Tree canopy cover (2000)	km^2	27,354.5	191.9	969.1	990.5
	% Land area	9.3	4.4	6.3	6.3
	Per capita (m^2/person)	5,331.6	42.4	208.4	n/a
	% Canopy green space [d]	9.3	5.9	6.9	6.9
Total green space (2000) [e]	km^2	292,662.0	3,239.4	14,060.7	14,433.8
	% Land area	99.4	74.6	91.8	91.8
Available green space (2000) [f]	km^2	265,309.0	3,048.5	13,092.8	13,444.6
	% Land area	90.1	70.2	85.5	85.5
Impervious surface cover (2000)	km^2	1,876.5	1,102.1	1,250.2	1,297.6
	% Land area	0.6	25.4	8.2	8.2
	Per capita (m^2/person)	365.8	243.6	268.8	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	9,200,000	46,200,000	47,200,000
	Carbon				
	Carbon stored (metric tons)	n/a	1,700,000	8,800,000	9,000,000
	Carbon stored ($)	n/a	$38,800,000	$200,600,000	$205,200,000
	Carbon sequestered (metric tons/year)	n/a	58,000	291,000	297,000
	Carbon sequestered ($/year)	n/a	$1,322,000	$6,635,000	$6,772,000
	Pollution				
	CO removed (metric tons/year)	n/a	62	313	320
	CO removed ($/year)	n/a	$87,100	$440,000	$449,700
	NO_2 removed (metric tons/year)	n/a	280	1,412	1,443
	NO_2 removed ($/year)	n/a	$2,770,700	$13,989,100	$14,298,300
	O_3 removed (metric tons/year)	n/a	664	3,353	3,427
	O_3 removed ($/year)	n/a	$6,579,000	$33,216,000	$33,950,000
	SO_2 removed (metric tons/year)	n/a	46	234	239
	SO_2 removed ($/year)	n/a	$112,200	$566,400	$578,900
	PM_{10} removed (metric tons/year)	n/a	645	3,257	3,329
	PM_{10} removed ($/year)	n/a	$4,266,700	$21,542,200	$22,018,200
	Total pollution removal (metric tons/year)	n/a	1,700	8,570	8,760
	Total pollution removal ($/year)	n/a	$13,800,000	$69,800,000	$71,300,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

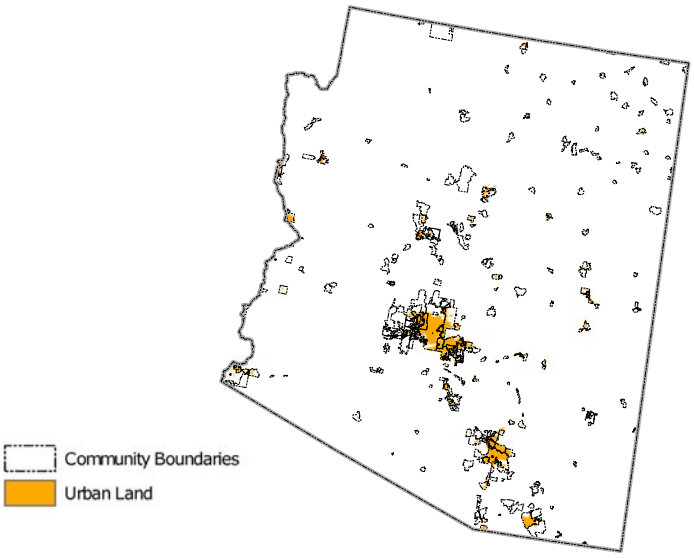


Figure AZ-1.—Urban or community land in 2000; urban area relative to community boundaries.

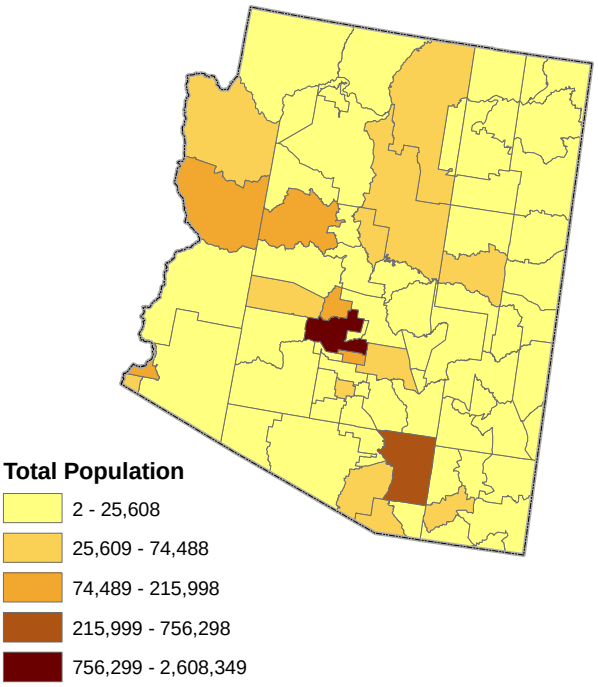


Figure AZ-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Arizona increased 40.0 percent, from 3,665,228 in 1990 to 5,130,632 in 2000 (Table AZ-1). In Arizona, 88.2 percent of the State's population is in urban areas (Fig. AZ-1), and 90.7 percent of the population is within communities (Fig. AZ-2).

Urban and Community Land

Urban land comprises 1.5 percent of the land area of Arizona, while lands within communities make up 5.2 percent of the State (Fig. AZ-1). Between 1990 and 2000, urban area increased 38.6 percent, while community land increased from 3.1 to 5.2 percent (Table AZ-1). Urban area in Arizona is projected to increase to 5.1 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. AZ-3; Tables AZ-2 through 4).

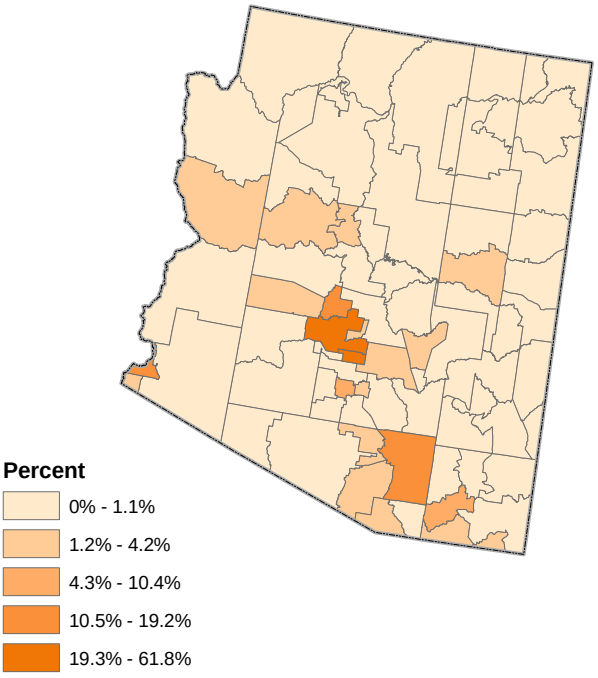


Figure AZ-3.—Percent of county subdivision area classified as urban land in 2000.

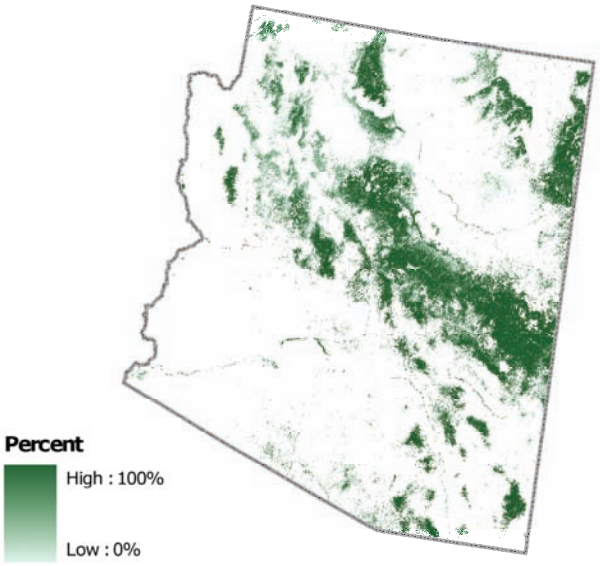


Figure AZ-4.—Percentage tree canopy cover.

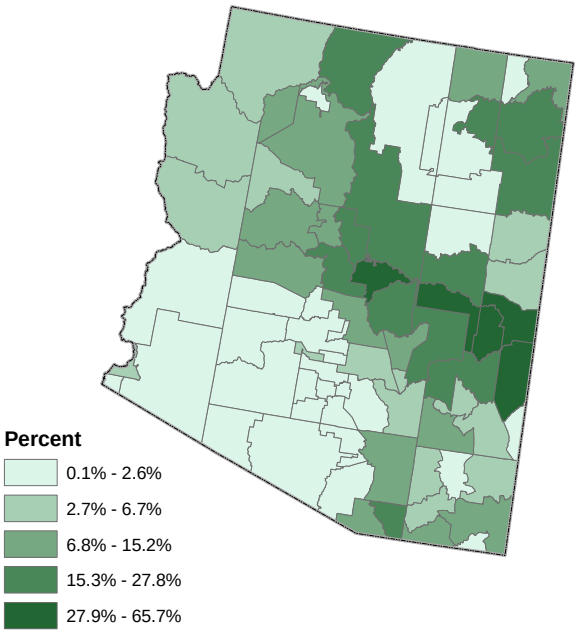


Figure AZ-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Arizona averages 9.3 percent (Fig. AZ-4), with 99.4 percent total green space, 9.3 percent canopy green space, and 5,331.6 m^2 of canopy cover per capita. Average tree cover in urban areas in Arizona was 4.4 percent, with 74.6 percent total green space, 5.9 percent canopy green space, and 42.4 m^2 of canopy cover per capita. Within community lands in Arizona, average tree cover was 6.3 percent, with 91.8 percent total green space, 6.9 percent canopy green space, and 208.4 m^2 of canopy cover per capita (Table AZ-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. AZ-5 through 6; Tables AZ-5 through 7).

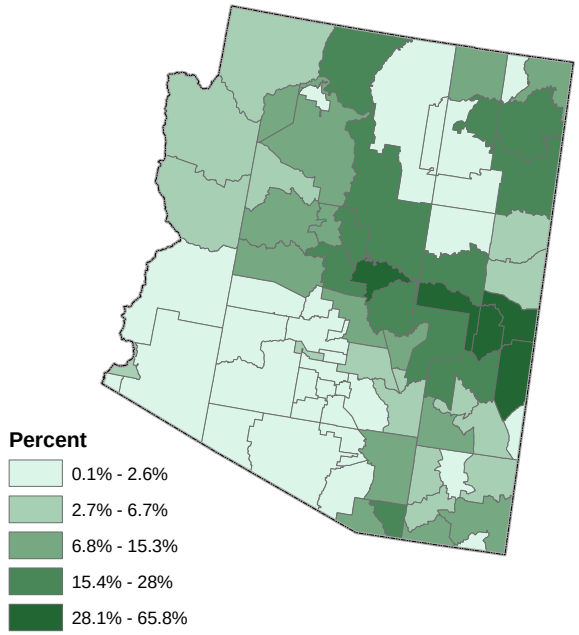


Figure AZ-6.—Percentage tree canopy green space in county subdivisions.

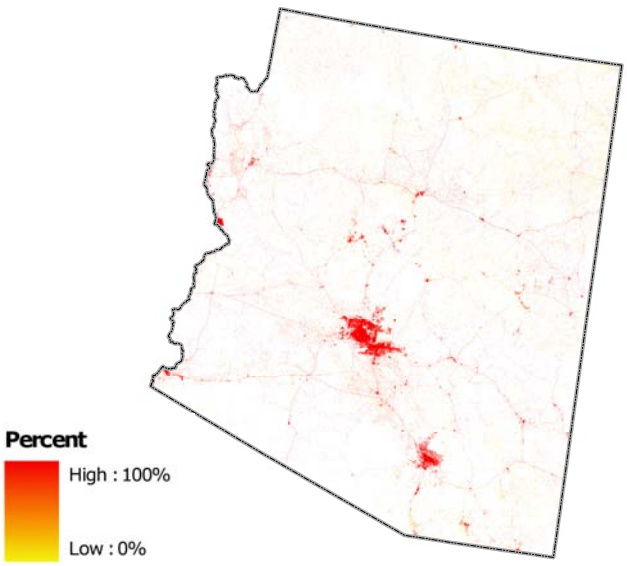


Figure AZ-7.—Percentage impervious surface cover.

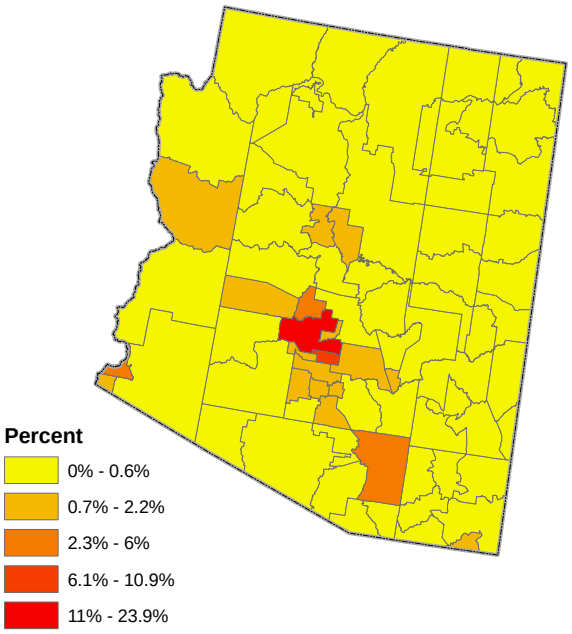


Figure AZ-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Arizona is 0.6 percent of the land area (Fig. AZ-7), with 365.8 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 25.4 percent, with 243.6 m^2 of impervious surface cover per capita. Within community lands in Arizona, average impervious surface cover was 8.2 percent with 268.8 m^2 of impervious surface cover per capita (Table AZ-1). Impervious surface cover varied across the State (Fig. AZ-8; Tables AZ-5 through 7).

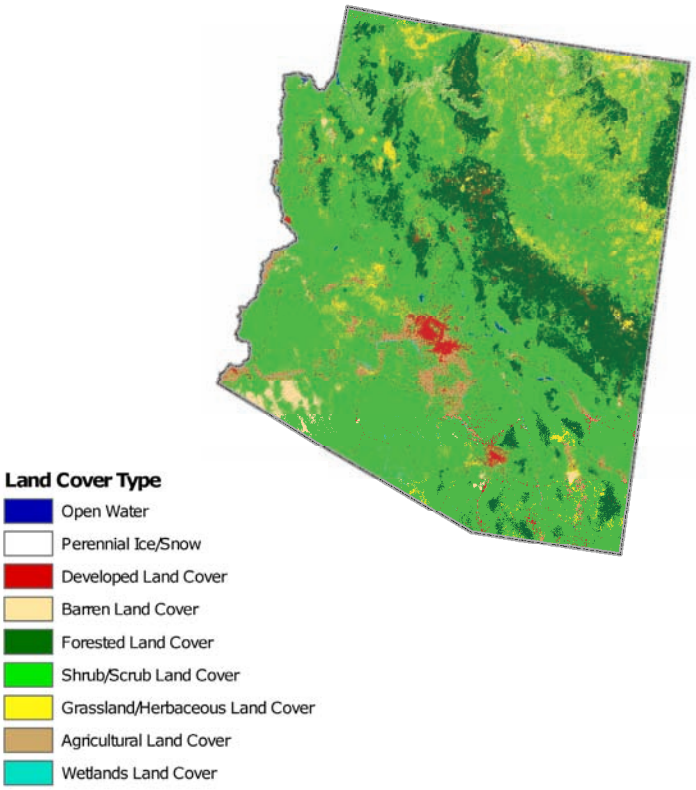


Figure AZ-9.—Classified land cover.

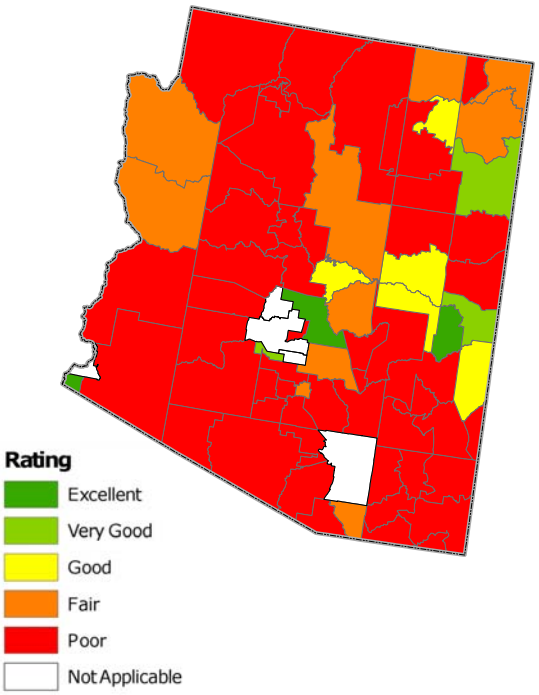


Figure AZ-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Arizona's land cover is dominated by scrub/shrub land (Fig. AZ-9). The characteristics as a percent of the total land area in Arizona are (Tables AZ-8 through 10):

- Scrub/Shrub – 72.1 percent
- Forested – 15.3 percent
- Grassland – 6.1 percent
- Barren – 2.4 percent
- Agricultural – 2.2 percent
- Developed – 2.0 percent
- Wetland – 0.1 percent

Relative Comparisons of Tree Cover

Out of the 250 Arizona communities, 16 received a rating of excellent and 191 received a rating of poor (Table AZ-12). Of the 78 county subdivisions, three had a rating of excellent and 52 were rated poor (Fig. AZ-10, Table AZ-13); and out of 15 counties, one was given a rating of excellent and four were given a rating of poor (Table AZ-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. AZ-10; Tables AZ-11 through 14).

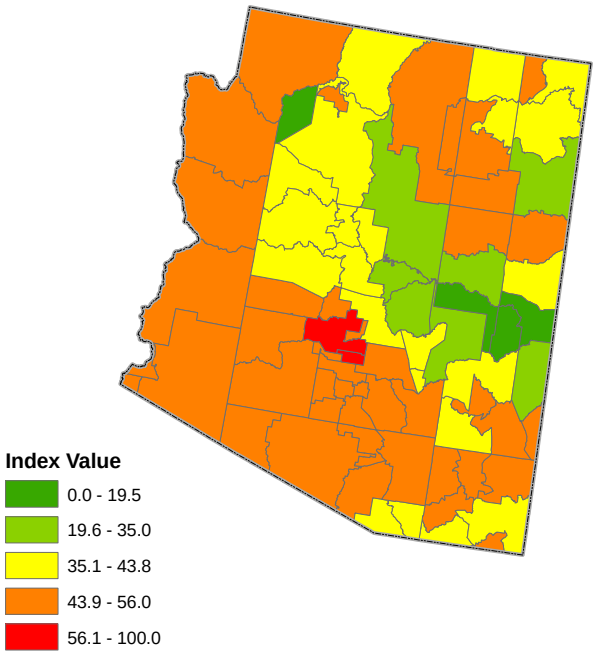


Figure AZ-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

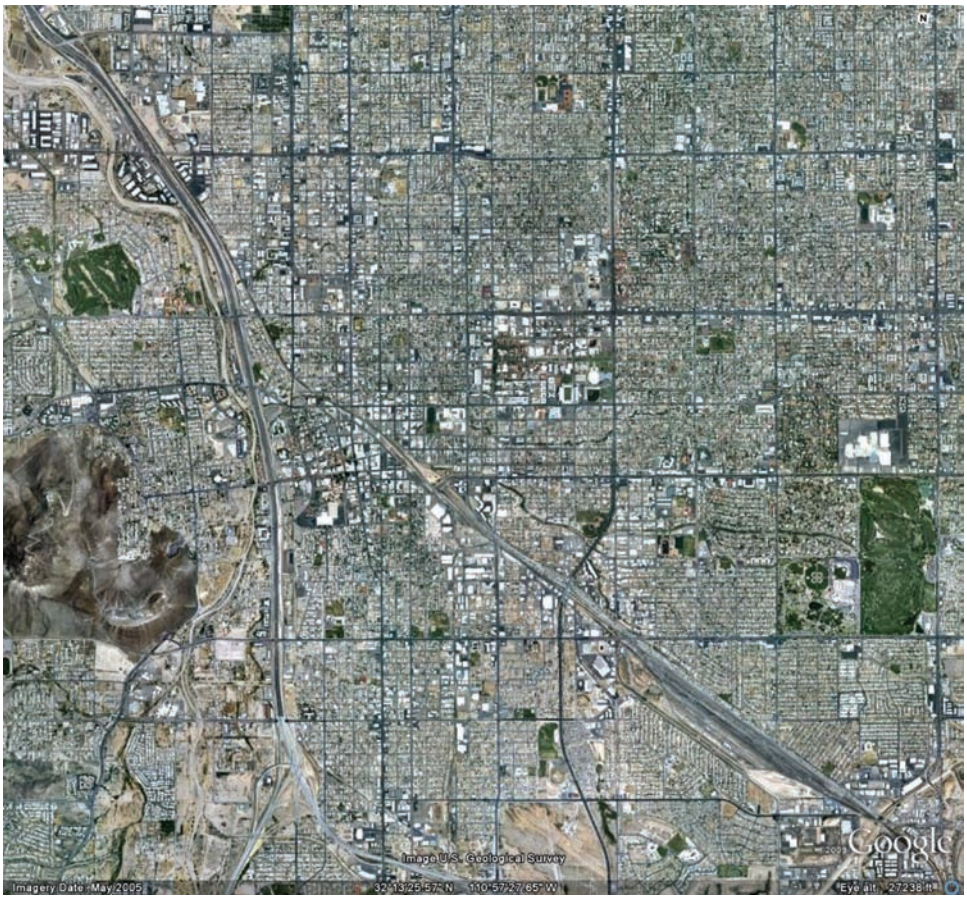
Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. AZ-11; Tables AZ-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Arizona (Table AZ-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 47.2 million trees
- 9.0 million metric tons of C stored ($205.2 million value)
- 297,000 metric tons/year of C sequestered ($6.8 million value)
- 8,760 metric tons/year total pollution removal ($71.3 million value)
  - 320 metric tons/year of CO removed ($449,700 value)
  - 1,443 metric tons/year NO_2 removed ($14.3 million value)
  - 3,427 metric tons/year of O_3 removed ($34.0 million value)
  - 239 metric tons/year of SO_2 removed ($578,900 value)
  - 3,329 metric tons/year of PM_{10} removed ($22.0 million value)

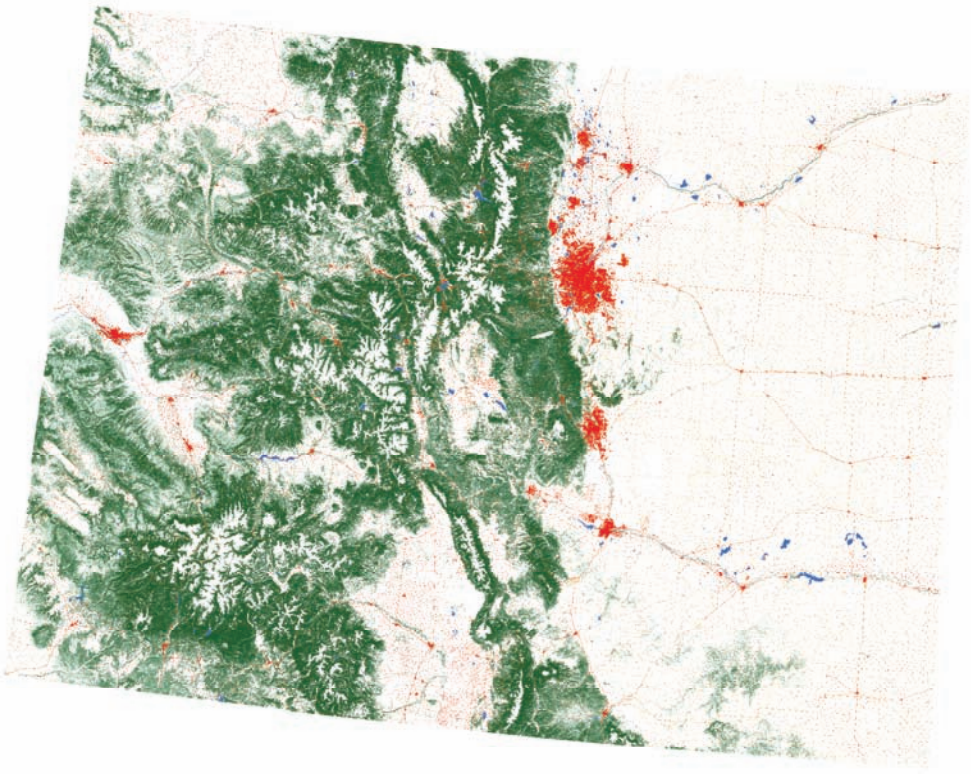


Summary

The data presented in this report provide a better understanding of Arizona's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

These data establish a baseline to assess future change and can be used to understand:

- Extent of the urban and community forest resource
- Variations in the resource across the State
- Magnitude and value of the urban and community forest resource
- Urban growth in Arizona
- Implications of policy decisions related to urban sprawl and urban and community forest management



COLORADO'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Colorado comprises about 2.6 percent of the state land area in 2000, an increase from 1.9 percent in 1990. Statewide tree canopy cover averages 18.3 percent and tree cover in urban or community areas is about 11.6 percent, with 14.5 percent impervious surface cover and 13.6 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Colorado has an estimated 39.0 million trees, which store about 7.4 million metric tons of carbon ($168.7 million), and annually remove about 246,000 metric tons of carbon ($5.6 million) and 5,050 metric tons of air pollution ($42.2 million) (Table CO-1).

Tables CO-2 through CO-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table CO-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Colorado		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	4,301,261	3,633,185	3,556,187	n/a
	1990	3,294,394	2,715,517	2,685,910	n/a
	% Change (1990-2000)	30.6	33.8	32.4	n/a
	% Total population (2000)	100.0	84.5	82.7	n/a
Total area	km^2 (2000)	269,601.1	3,295.9	6,437.6	7,137.6
	km^2 (1990)	269,601.1	2,725.0	4,672.4	5,285.1
	% Change (1990-2000)	0.0	21.0	37.8	35.1
Land area	km^2 (2000)	268,532.1	3,249.9	6,373.0	7,055.5
	% Land area (2000)	100.0	1.2	2.4	2.6
	km^2 (1990)	268,532.1	2,685.5	4,626.7	5,223.4
	% Land area (1990)	100.0	1.0	1.7	1.9
	% Change (1990-2000)	0.0	21.0	37.7	35.1
Population density (people/land area km^2)	2000	16.0	1,117.9	558.0	n/a
	1990	12.3	1,011.2	580.5	n/a
	% Change (1990-2000)	30.6	10.6	-3.9	n/a
Tree canopy cover (2000)	km^2	49,027.5	240.1	763.5	818.5
	% Land area	18.3	7.4	12.0	11.6
	Per capita (m^2/person)	11,398.4	66.1	214.7	n/a
	% Canopy green space [d]	18.4	10.0	14.1	13.6
Total green space (2000) [e]	km^2	266,858.0	2,401.6	5,432.8	6,036.0
	% Land area	99.4	73.9	85.2	85.5
Available green space (2000) [f]	km^2	217,831.0	2,161.9	4,669.7	5,217.8
	% Land area	81.1	66.5	73.3	74.0
Impervious surface cover (2000)	km^2	1,674.2	848.3	940.1	1,019.6
	% Land area	0.6	26.1	14.8	14.5
	Per capita (m^2/person)	389.2	233.5	264.4	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	11,400,000	36,400,000	39,000,000
	Carbon				
	Carbon stored (metric tons)	n/a	2,200,000	6,900,000	7,400,000
	Carbon stored ($)	n/a	$50,200,000	$157,300,000	$168,700,000
	Carbon sequestered (metric tons/year)	n/a	72,000	229,000	246,000
	Carbon sequestered ($/year)	n/a	$1,642,000	$5,221,000	$5,609,000
	Pollution				
	CO removed (metric tons/year)	n/a	17	53	57
	CO removed ($/year)	n/a	$23,500	$74,800	$80,200
	NO_2 removed (metric tons/year)	n/a	297	945	1,013
	NO_2 removed ($/year)	n/a	$2,942,300	$9,358,000	$10,033,000
	O_3 removed (metric tons/year)	n/a	629	2,001	2,145
	O_3 removed ($/year)	n/a	$6,232,000	$19,821,000	$21,251,000
	SO_2 removed (metric tons/year)	n/a	86	274	294
	SO_2 removed ($/year)	n/a	$209,200	$665,200	$713,200
	PM_{10} removed (metric tons/year)	n/a	451	1,433	1,537
	PM_{10} removed ($/year)	n/a	$2,980,800	$9,480,300	$10,164,100
	Total pollution removal (metric tons/year)	n/a	1,480	4,710	5,050
	Total pollution removal ($/year)	n/a	$12,400,000	$39,400,000	$42,200,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

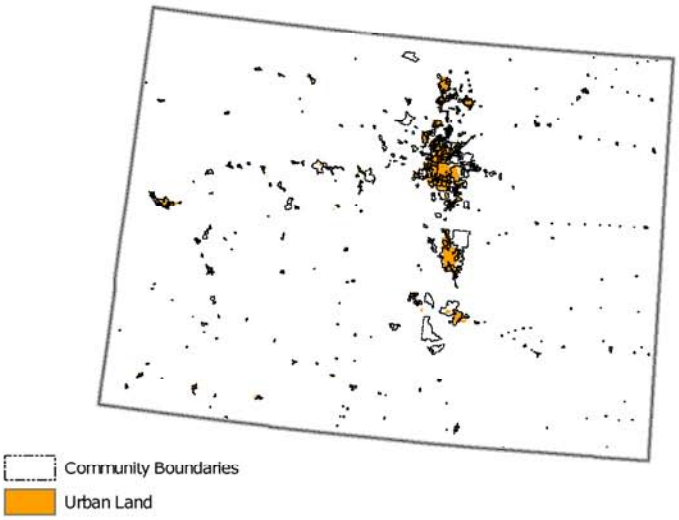


Figure CO-1.—Urban or community land in 2000; urban area relative to community boundaries.

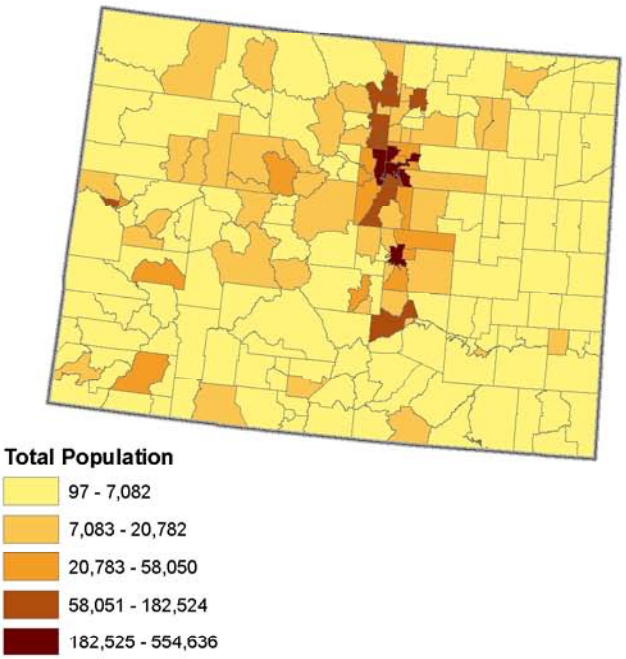


Figure CO-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Colorado increased 30.6 percent, from 3,294,394 in 1990 to 4,301,261 in 2000 (Table CO-1). In Colorado, 84.5 percent of the State's population is in urban areas (Fig. CO-1), and 82.7 percent of the population is within communities (Fig. CO-2).

Urban and Community Land

Urban land comprises 1.2 percent of the land area of Colorado, while lands within communities make up 2.4 percent of the State (Fig. CO-1). Between 1990 and 2000, urban area increased 21.0 percent, while community land increased from 1.7 to 2.4 percent (Table CO-1). Urban area in Colorado is projected to increase to 3.9 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. CO-3; Tables CO-2 through 4).

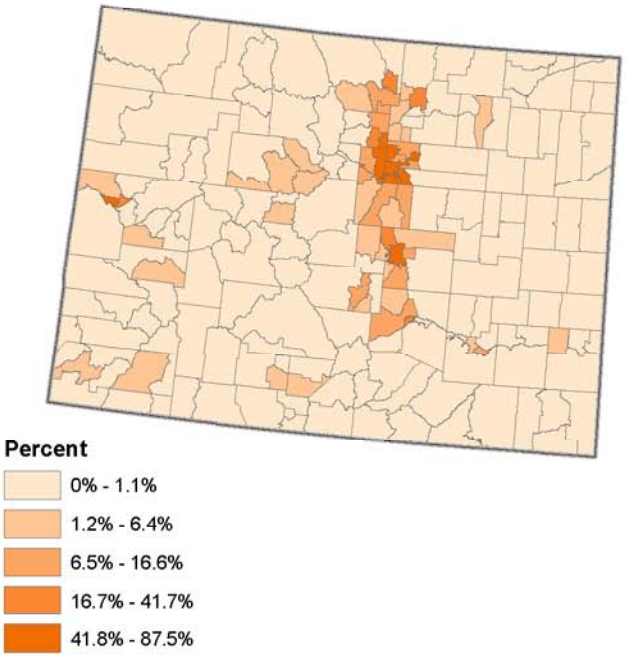


Figure CO-3.—Percent of county subdivision area classified as urban land in 2000.

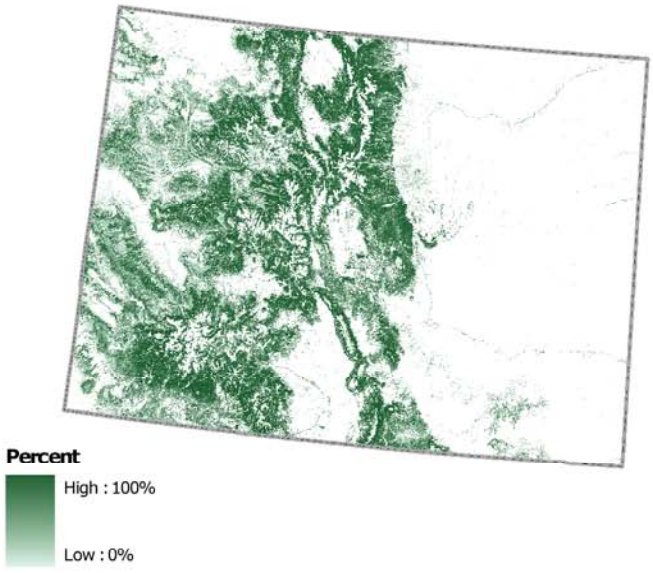


Figure CO-4.—Percentage tree canopy cover.

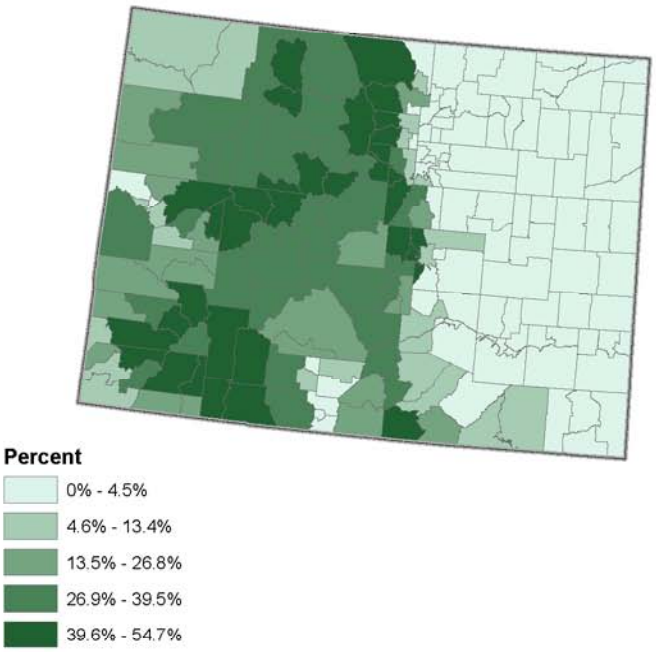


Figure CO-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Colorado averages 18.3 percent (Fig. CO-4), with 99.4 percent total green space, 18.4 percent canopy green space, and 11,398.4 m^2 of canopy cover per capita. Average tree cover in urban areas in Colorado was 7.4 percent, with 73.9 percent total green space, 10.0 percent canopy green space, and 66.1 m^2 of canopy cover per capita. Within community lands in Colorado, average tree cover was 12.0 percent, with 85.2 percent total green space, 14.1 percent canopy green space, and 214.7 m^2 of canopy cover per capita (Table CO-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. CO-5 through 6; Tables CO-5 through 7).

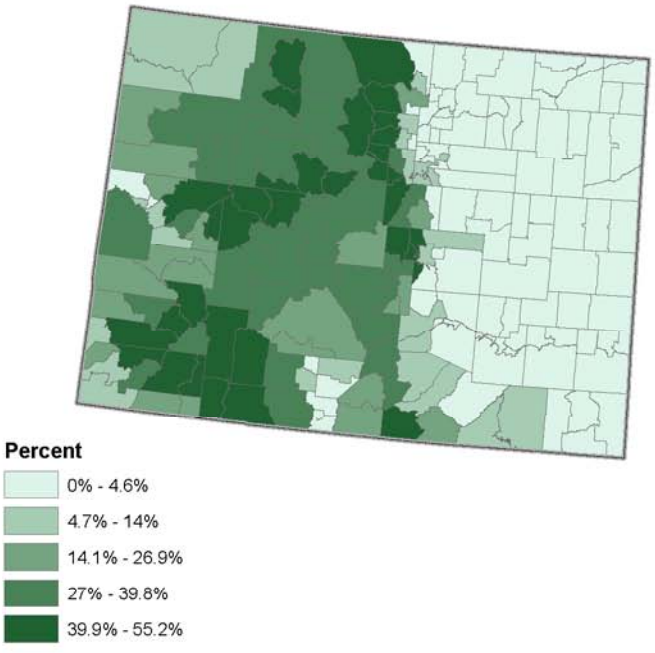


Figure CO-6.—Percentage tree canopy green space in county subdivisions.

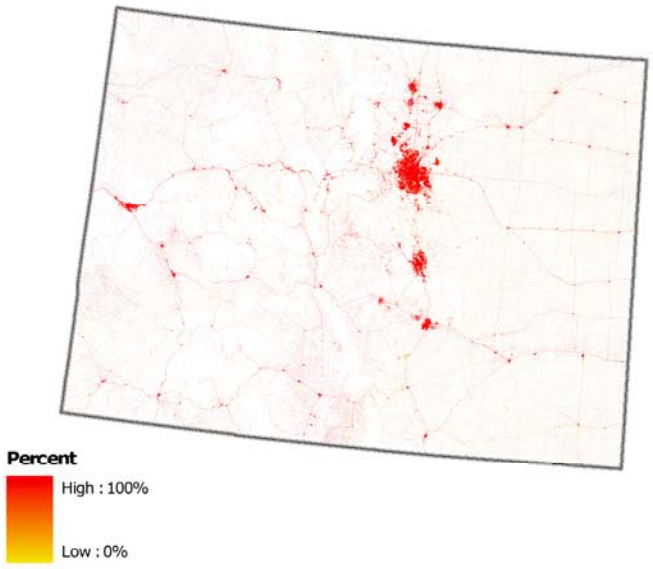


Figure CO-7.—Percentage impervious surface cover.

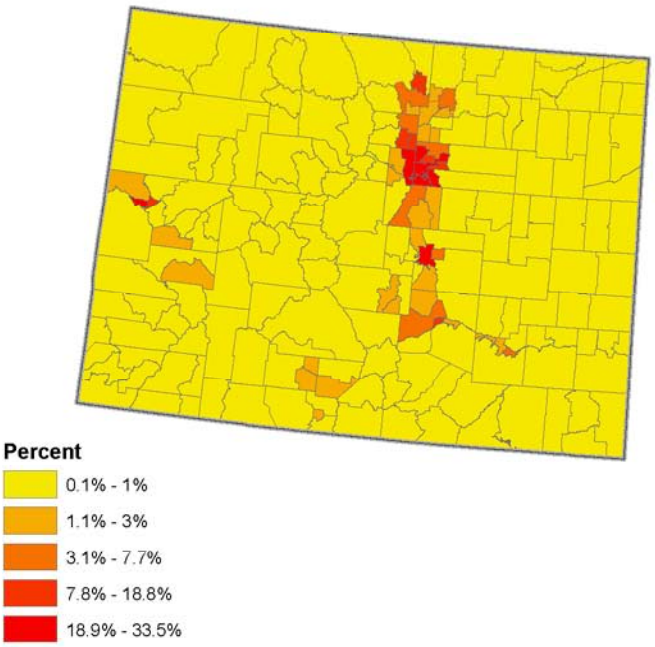


Figure CO-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Colorado is 0.6 percent of the land area (Fig. CO-7), with 389.2 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 26.1 percent, with 233.5 m^2 of impervious surface cover per capita. Within community lands in Colorado, average impervious surface cover was 14.8 percent with 264.4 m^2 of impervious surface cover per capita (Table CO-1). Impervious surface cover varied across the State (Fig. CO-8; Tables CO-5 through 7).

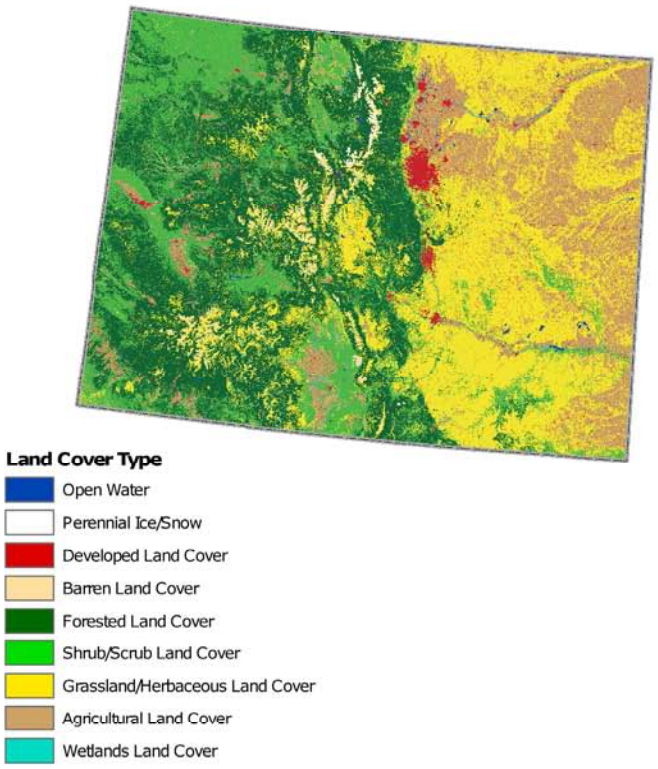


Figure CO-9.—Classified land cover.

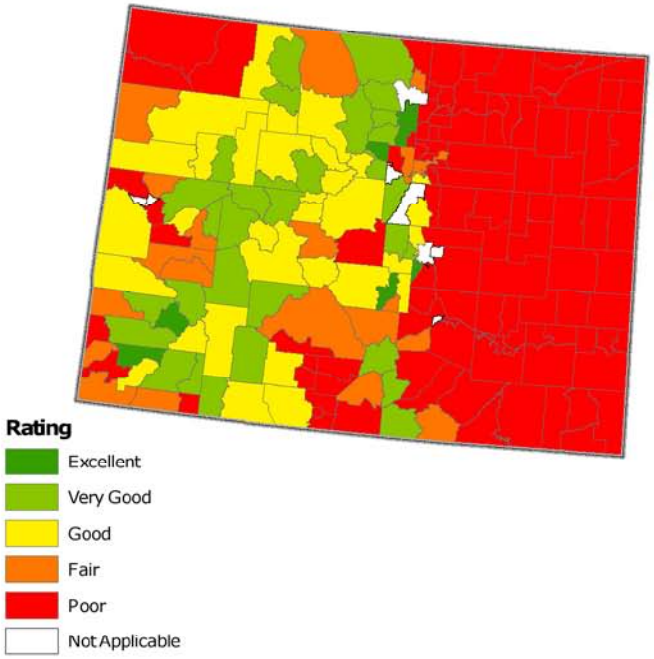


Figure CO-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Colorado's land cover is dominated by grassland (Fig. CO-9). The characteristics as a percent of the total land area in Colorado are (Tables CO-8 through 10):

- Grassland – 32.2 percent
- Forested – 29.0 percent
- Scrub/Shrub – 18.6 percent
- Agricultural – 15.3 percent
- Developed – 2.6 percent
- Barren – 1.5 percent
- Wetland – 0.5 percent

Relative Comparisons of Tree Cover

Out of the 354 Colorado communities, 25 received a rating of excellent and 235 received a rating of poor (Table CO-12). Of the 208 county subdivisions, eight had a rating of excellent and 109 were rated poor (Fig. CO-10, Table CO-13); and out of 63 counties, three were given a rating of excellent and 20 were given a rating of poor (Table CO-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. CO-10; Tables CO-11 through 14).

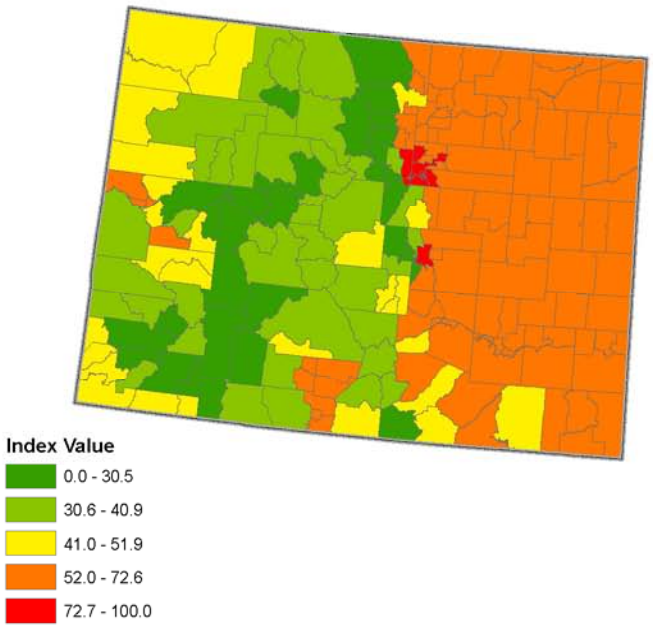


Figure CO-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

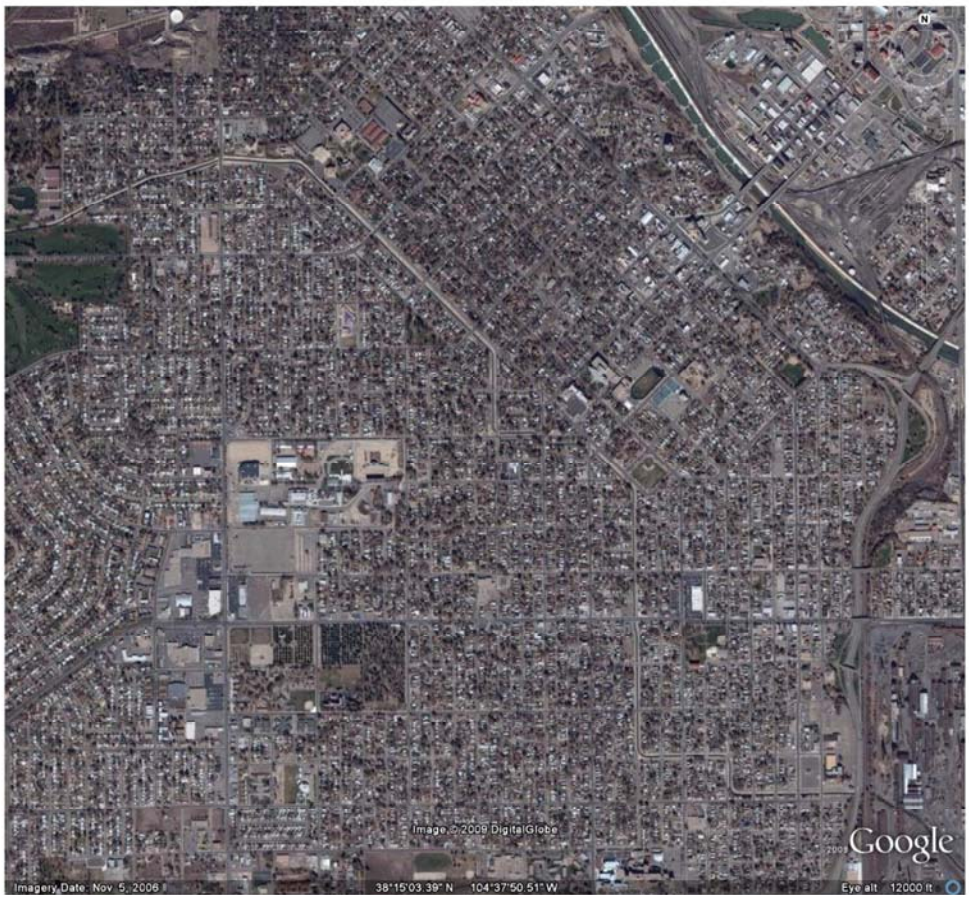
Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. CO-11; Tables CO-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Colorado (Table CO-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 39.0 million trees
- 7.4 million metric tons of C stored ($168.7 million value)
- 246,000 metric tons/year of C sequestered ($5.6 million value)
- 5,050 metric tons/year total pollution removal ($42.2 million value)
  - 57 metric tons/year of CO removed ($80,200 value)
  - 1,013 metric tons/year NO_2 removed ($10.0 million value)
  - 2,145 metric tons/year of O_3 removed ($21.3 million value)
  - 294 metric tons/year of SO_2 removed ($713,200 value)
  - 1,537 metric tons/year of PM_{10} removed ($10.2 million value).



Summary

The data presented in this report provide a better understanding of Colorado's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

These data establish a baseline to assess future change and can be used to understand:

- Extent of the urban and community forest resource
- Variations in the resource across the State
- Magnitude and value of the urban and community forest resource
- Urban growth in Colorado
- Implications of policy decisions related to urban sprawl and urban and community forest management

IDAHO'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Idaho comprises about 0.8 percent of the state land area in 2000, an increase from 0.7 percent in 1990. Statewide tree canopy cover averages 24.4 percent and tree cover in urban or community areas is about 4.6 percent, with 15.2 percent impervious surface cover and 5.4 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Idaho has an estimated 3.9 million trees, which store about 700,000 metric tons of carbon ($16.0 million), and annually remove about 24,000 metric tons of carbon ($547,000) and 580 metric tons of air pollution ($4.5 million) (Table ID-1).

Tables ID-2 through ID-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table ID-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Idaho		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	1,293,953	859,497	861,532	n/a
	1990	1,006,749	578,214	630,841	n/a
	% Change (1990-2000)	28.5	48.6	36.6	n/a
	% Total population (2000)	100.0	66.4	66.6	n/a
Total area	km^2 (2000)	216,445.5	1,055.8	1,477.0	1,799.1
	km^2 (1990)	216,445.5	876.2	1,297.0	1,617.9
	% Change (1990-2000)	0.0	20.5	13.9	11.2
Land area	km^2 (2000)	214,446.7	1,048.9	1,457.6	1,776.0
	% Land area (2000)	100.0	0.5	0.7	0.8
	km^2 (1990)	214,446.7	871.5	1,270.6	1,588.9
	% Land area (1990)	100.0	0.4	0.6	0.7
	% Change (1990-2000)	0.0	20.4	14.7	11.8
Population density (people/land area km^2)	2000	6.0	819.4	591.1	n/a
	1990	4.7	663.5	496.5	n/a
	% Change (1990-2000)	28.5	23.5	19.1	n/a
Tree canopy cover (2000)	km^2	52,350.2	44.6	71.6	81.6
	% Land area	24.4	4.2	4.9	4.6
	Per capita (m^2/person)	40,457.6	51.8	83.2	n/a
	% Canopy green space [d]	24.5	5.4	5.9	5.4
Total green space (2000) [e]	km^2	213,699.0	830.8	1,214.6	1,506.4
	% Land area	99.7	79.2	83.3	84.8
Available green space (2000) [f]	km^2	161,350.0	786.3	1,143.0	1,424.8
	% Land area	75.2	75.0	78.4	80.2
Impervious surface cover (2000)	km^2	747.4	218.1	243.0	269.6
	% Land area	0.3	20.8	16.7	15.2
	Per capita (m^2/person)	577.6	253.8	282.0	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	2,100,000	3,400,000	3,900,000
	Carbon				
	Carbon stored (metric tons)	n/a	400,000	700,000	700,000
	Carbon stored ($)	n/a	$9,100,000	$16,000,000	$16,000,000
	Carbon sequestered (metric tons/year)	n/a	13,000	21,000	24,000
	Carbon sequestered ($/year)	n/a	$296,000	$479,000	$547,000
	Pollution				
	CO removed (metric tons/year)	n/a	11	18	21
	CO removed ($/year)	n/a	$15,900	$25,500	$29,100
	NO_2 removed (metric tons/year)	n/a	42	67	77
	NO_2 removed ($/year)	n/a	$414,000	$665,700	$758,600
	O_3 removed (metric tons/year)	n/a	120	193	220
	O_3 removed ($/year)	n/a	$1,191,000	$1,915,000	$2,182,000
	SO_2 removed (metric tons/year)	n/a	31	49	56
	SO_2 removed ($/year)	n/a	$74,400	$119,600	$136,300
	PM_{10} removed (metric tons/year)	n/a	115	185	211
	PM_{10} removed ($/year)	n/a	$762,000	$1,225,200	$1,396,200
	Total pollution removal (metric tons/year)	n/a	320	510	580
	Total pollution removal ($/year)	n/a	$2,500,000	$4,000,000	$4,500,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

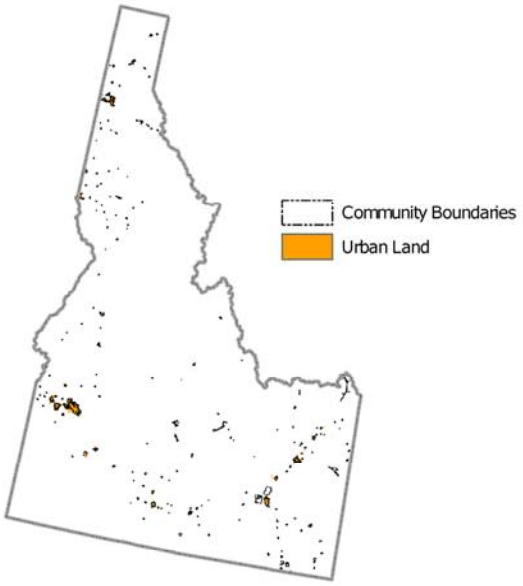


Figure ID-1.—Urban or community land in 2000; urban area relative to community boundaries.

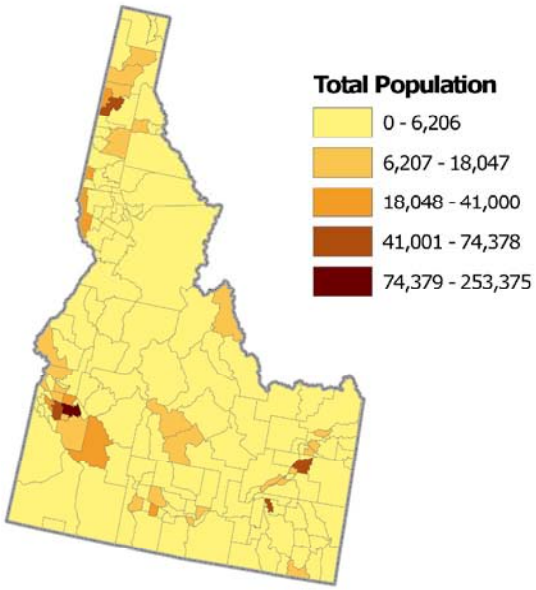


Figure ID-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Idaho increased 28.5 percent, from 1,006,749 in 1990 to 1,293,953 in 2000 (Table ID-1). In Idaho, 66.4 percent of the State's population is in urban areas (Fig. ID-1), and 66.6 percent of the population is within communities (Fig. ID-2).

Urban and Community Land

Urban land comprises 0.5 percent of the land area of Idaho, while lands within communities make up 0.7 percent of the state (Fig. ID-1). Between 1990 and 2000, urban area increased 20.4 percent, while community land increased from 0.6 to 0.7 percent (Table ID-1). Urban area in Idaho is projected to increase to 1.8 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the state (Fig. ID-3; Tables ID-2 through 4).

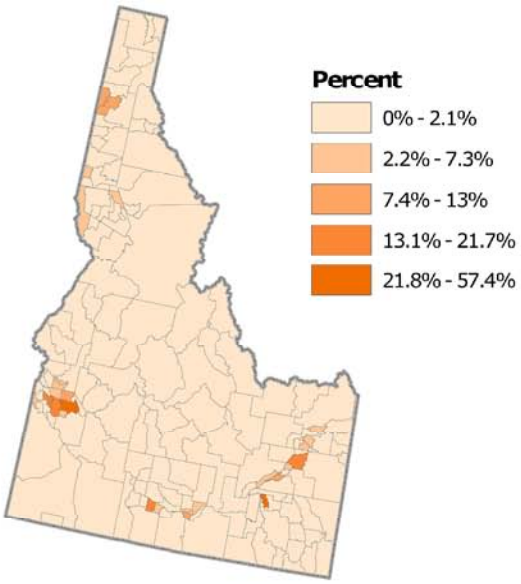


Figure ID-3.—Percent of county subdivision area classified as urban land in 2000.

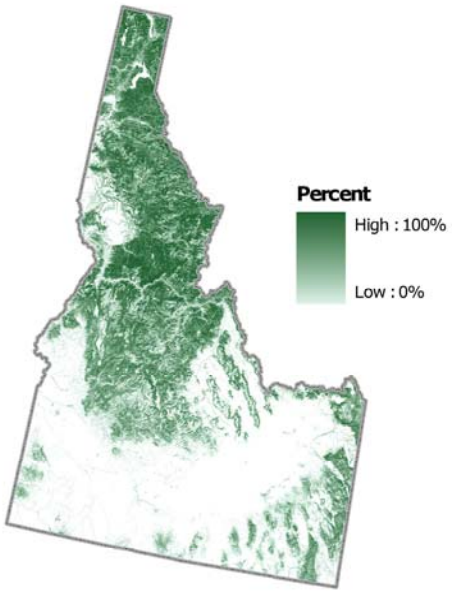


Figure ID-4.—Percentage tree canopy cover.

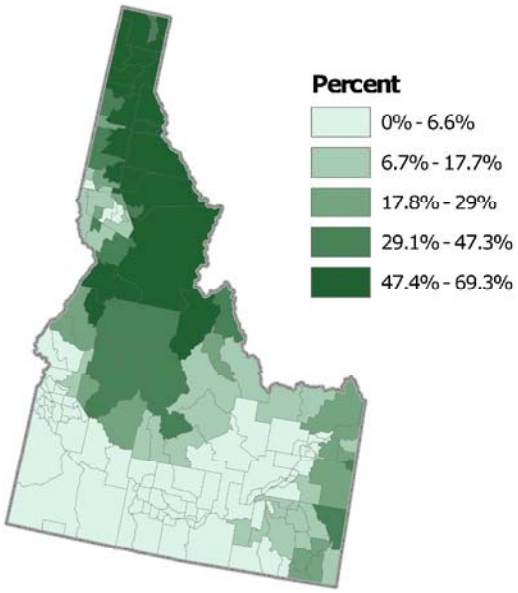


Figure ID-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Idaho averages 24.4 percent (Fig. ID-4), with 99.7 percent total green space, 24.5 percent canopy green space, and 40,457.6 m^2 of canopy cover per capita. Average tree cover in urban areas in Idaho was 4.2 percent, with 79.2 percent total green space, 5.4 percent canopy green space, and 51.8 m^2 of canopy cover per capita. Within community lands in Idaho, average tree cover was 4.9 percent, with 83.3 percent total green space, 5.9 percent canopy green space, and 83.2 m^2 of canopy cover per capita (Table ID-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. ID-5 through 6; Tables ID-5 through 7).

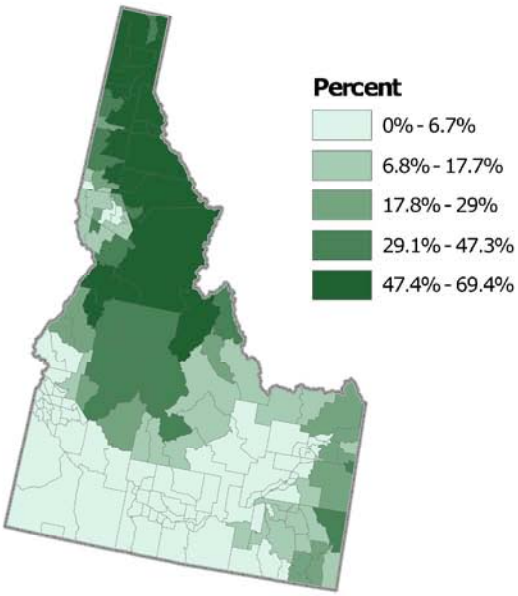


Figure ID-6.—Percentage tree canopy green space in county subdivisions.

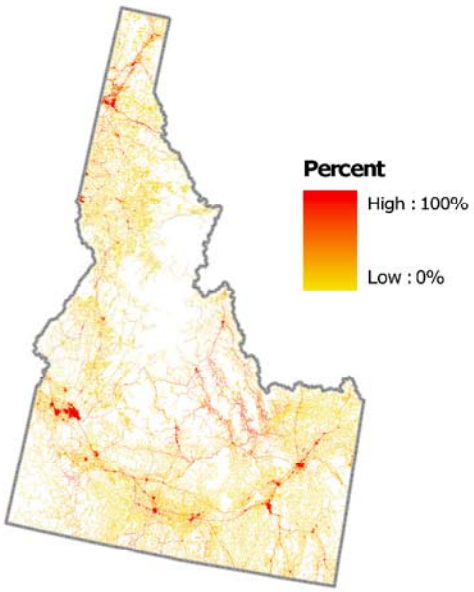


Figure ID-7.—Percentage impervious surface cover.

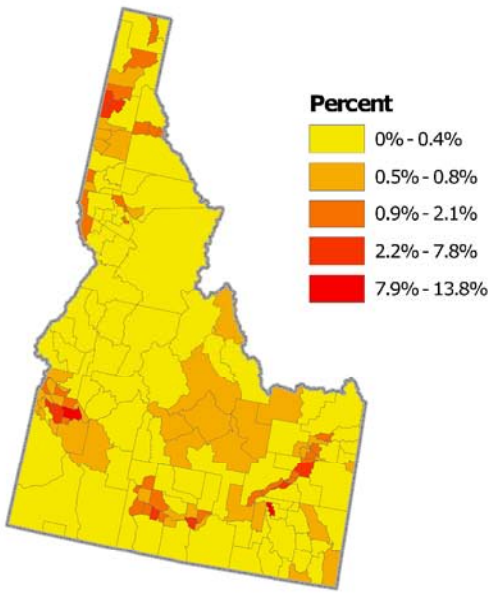


Figure ID-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Idaho is 0.3 percent of the land area (Fig. ID-7), with 577.6 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 20.8 percent, with 253.8 m^2 of impervious surface cover per capita. Within community lands in Idaho, average impervious surface cover was 16.7 percent with 282.0 m^2 of impervious surface cover per capita (Table ID-1). Impervious surface cover varied across the State (Fig. ID-8; Tables ID-5 through 7).

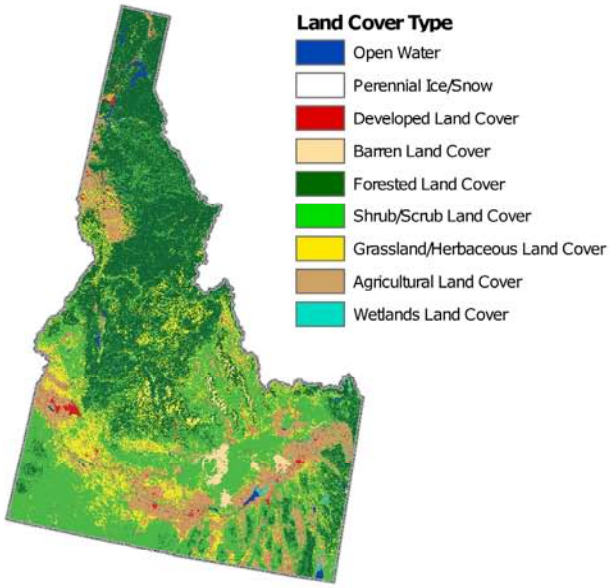


Figure ID-9.—Classified land cover.

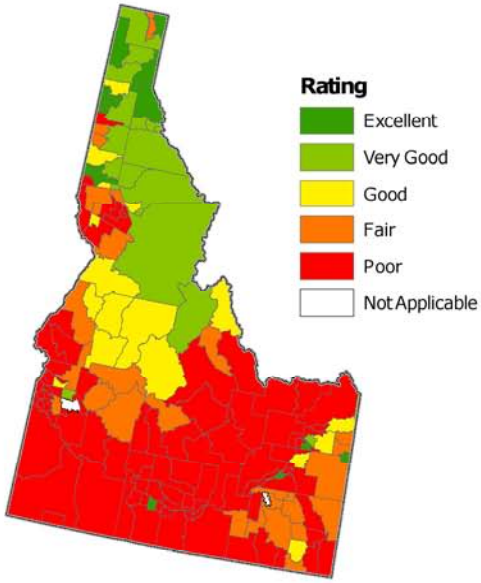


Figure ID-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Idaho's land cover is dominated by scrub/shrub land (Fig. ID-9). The characteristics as a percent of the total land area in Idaho are (Tables ID-8 through 10):

- Scrub/Shrub – 38.3 percent
- Forested – 33.4 percent
- Grassland – 13.4 percent
- Agricultural – 11.5 percent
- Developed – 1.7 percent
- Barren – 1.3 percent
- Wetland – 0.4 percent

Relative Comparisons of Tree Cover

Out of the 205 Idaho communities, 16 received a rating of excellent and 138 received a rating of poor (Table ID-12). Of the 170 county subdivisions, 12 had a rating of excellent and 94 were rated poor (Fig. ID-10, Table ID-13); and out of 44 counties, five were given a rating of excellent and 20 were given a rating of poor (Table ID-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. ID-10; Tables ID-11 through 14).

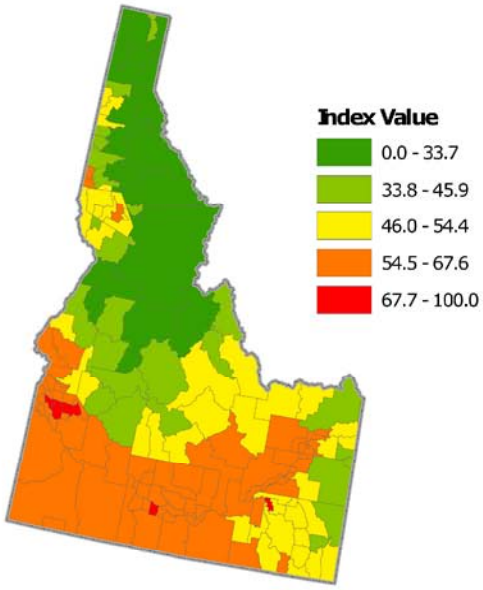


Figure ID-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. ID-11; Tables ID-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Idaho (Table ID-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 3.9 million trees
- 700,000 metric tons of C stored ($16.0 million value)
- 24,000 metric tons/year of C sequestered ($547,000 value)
- 580 metric tons/year total pollution removal ($4.5 million value)
  - 21 metric tons/year of CO removed ($29,100 value)
  - 77 metric tons/year NO_2 removed ($758,600 value)
  - 220 metric tons/year of O_3 removed ($2.2 million value)
  - 56 metric tons/year of SO_2 removed ($136,300 value)
  - 211 metric tons/year of PM_{10} removed ($1.4 million value)

Summary

The data presented in this report provide a better understanding of Idaho's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

These data establish a baseline to assess future change and can be used to understand:

- Extent of the urban and community forest resource
- Variations in the resource across the State
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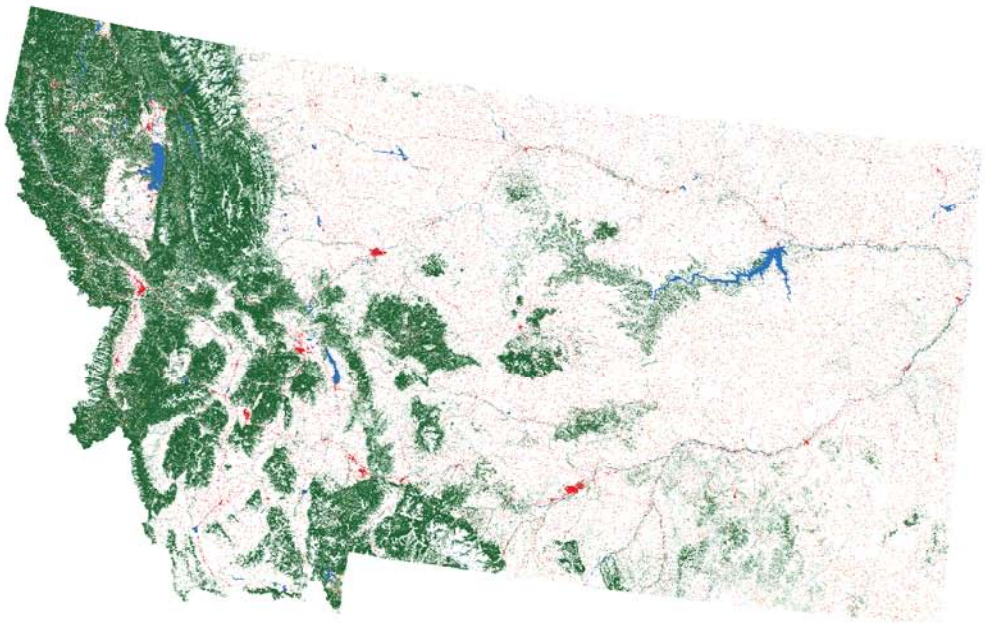
- Urban growth in Idaho
- Implications of policy decisions related to urban sprawl and urban and community forest management



MONTANA'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Montana comprises about 2.0 percent of the state land area in 2000, an increase from 1.4 percent in 1990. Statewide tree canopy cover averages 16.3 percent and tree cover in urban or community areas is about 26.7 percent, with 3.9 percent impervious surface cover and 27.8 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Montana has an estimated 98.1 million trees, which store about 18.7 million metric tons of carbon ($426.4 million), and annually remove about 617,000 metric tons of carbon ($14.1 million) and 12,760 metric tons of air pollution ($106.5 million) (Table MT-1).

Tables MT-2 through MT-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table MT-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Montana		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	902,195	487,878	595,153	n/a
	1990	799,065	419,826	507,949	n/a
	% Change (1990-2000)	12.9	16.2	17.2	n/a
	% Total population (2000)	100.0	54.1	66.0	n/a
Total area	km^2 (2000)	380,838.1	675.7	7,568.4	7,775.3
	km^2 (1990)	380,838.1	661.1	5,264.7	5,512.8
	% Change (1990-2000)	0.0	2.2	43.8	41.0
Land area	km^2 (2000)	377,582.6	672.6	7,497.2	7,702.5
	% Land area (2000)	100.0	0.2	2.0	2.0
	km^2 (1990)	377,582.6	658.2	5,206.7	5,453.4
	% Land area (1990)	100.0	0.2	1.4	1.4
	% Change (1990-2000)	0.0	2.2	44.0	41.2
Population density (people/land area km^2)	2000	2.4	725.3	79.4	n/a
	1990	2.1	637.8	97.6	n/a
	% Change (1990-2000)	12.9	13.7	-18.6	n/a
Tree canopy cover (2000)	km^2	61,382.4	36.8	2,047.3	2,056.2
	% Land area	16.3	5.5	27.3	26.7
	Per capita (m^2/person)	68,036.7	75.5	3,439.9	n/a
	% Canopy green space [d]	16.3	7.5	28.3	27.8
Total green space (2000) [e]	km^2	376,327.0	489.4	7,224.5	7,403.8
	% Land area	99.7	72.8	96.4	96.1
Available green space (2000) [f]	km^2	314,946.0	453.0	5,177.6	5,348.1
	% Land area	83.4	67.4	69.1	69.4
Impervious surface cover (2000)	km^2	1,255.6	183.2	272.7	298.6
	% Land area	0.3	27.2	3.6	3.9
	Per capita (m^2/person)	1,391.8	375.5	458.2	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	1,800,000	97,600,000	98,100,000
	Carbon				
	Carbon stored (metric tons)	n/a	300,000	18,600,000	18,700,000
	Carbon stored ($)	n/a	$6,800,000	$424,100,000	$426,400,000
	Carbon sequestered (metric tons/year)	n/a	11,000	614,000	617,000
	Carbon sequestered ($/year)	n/a	$251,000	$13,999,000	$14,068,000
	Pollution				
	CO removed (metric tons/year)	n/a	7	366	368
	CO removed ($/year)	n/a	$9,300	$515,500	$517,700
	NO_2 removed (metric tons/year)	n/a	10	547	550
	NO_2 removed ($/year)	n/a	$97,500	$5,422,800	$5,446,400
	O_3 removed (metric tons/year)	n/a	145	8,064	8,099
	O_3 removed ($/year)	n/a	$1,437,000	$79,885,000	$80,232,000
	SO_2 removed (metric tons/year)	n/a	19	1,045	1,050
	SO_2 removed ($/year)	n/a	$45,600	$2,534,800	$2,545,800
	PM_{10} removed (metric tons/year)	n/a	48	2,677	2,688
	PM_{10} removed ($/year)	n/a	$318,500	$17,703,500	$17,780,300
	Total pollution removal (metric tons/year)	n/a	230	12,700	12,760
	Total pollution removal ($/year)	n/a	$1,900,000	$106,100,000	$106,500,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

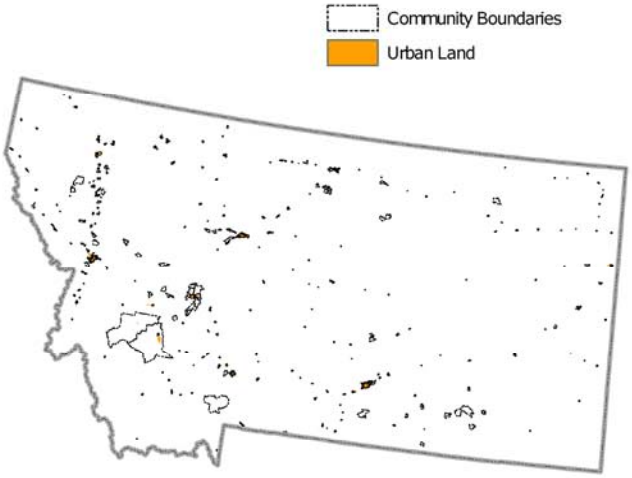


Figure MT-1.—Urban or community land in 2000; urban area relative to community boundaries.

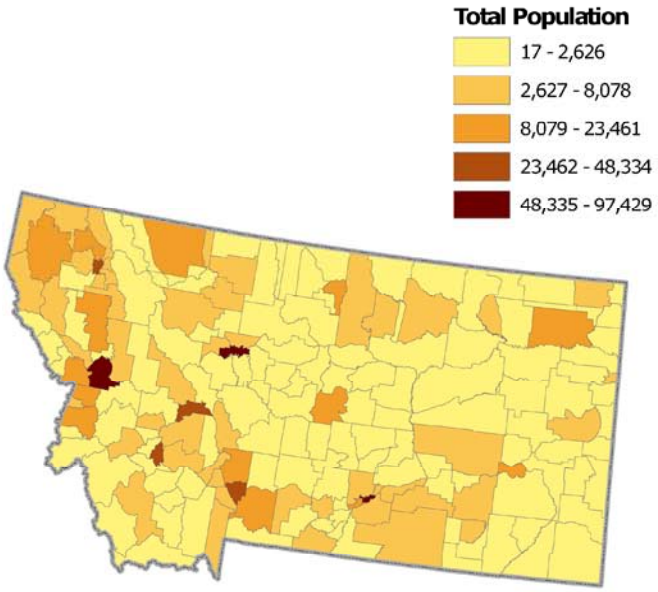


Figure MT-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Montana increased 12.9 percent, from 799,065 in 1990 to 902,195 in 2000 (Table MT-1). In Montana, 54.1 percent of the State's population is in urban areas (Fig. MT-1), and 66.0 percent of the population is within communities (Fig. MT-2).

Urban and Community Land

Urban land comprises 0.2 percent of the land area of Montana, while lands within communities make up 2.0 percent of the State (Fig. MT-1). Between 1990 and 2000, urban area increased 2.2 percent, while community land increased from 1.4 to 2.0 percent (Table MT-1). Urban area in Montana is projected to increase to 0.8 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. MT-3; Tables MT-2 through 4).

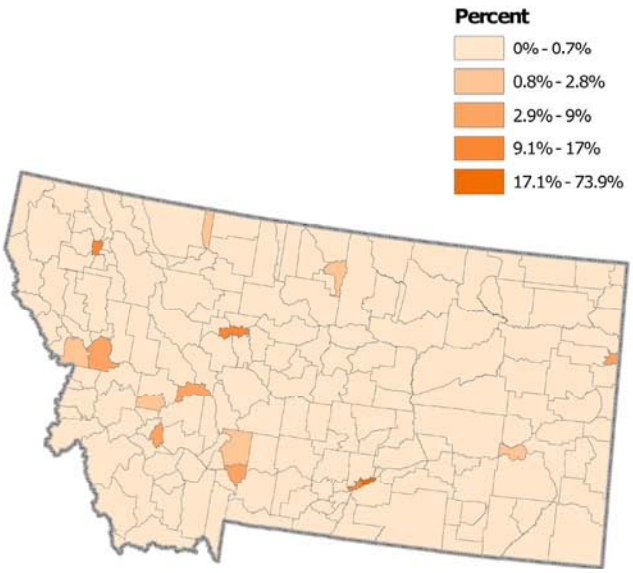


Figure MT-3.—Percent of county subdivision area classified as urban land in 2000.

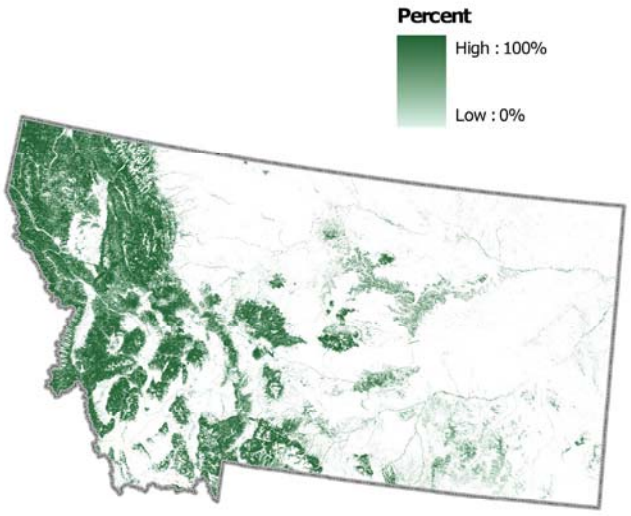


Figure MT-4.—Percentage tree canopy cover.

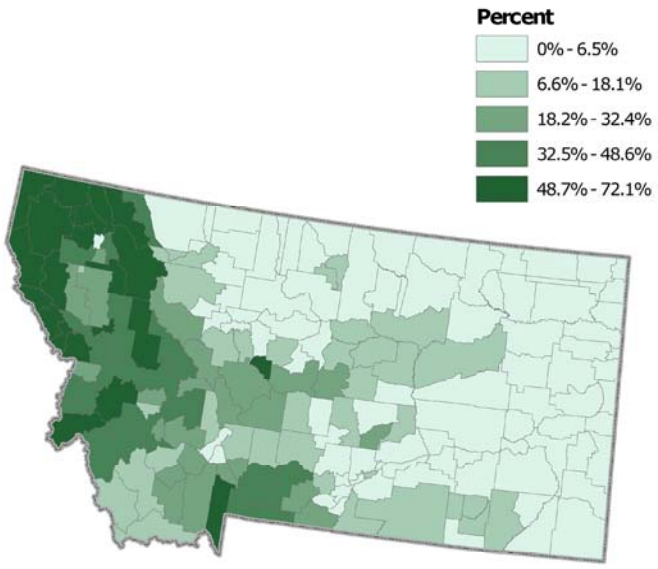


Figure MT-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Montana averages 16.3 percent (Fig. MT-4), with 99.7 percent total green space, 16.3 percent canopy green space, and 68,036.7 m^2 of canopy cover per capita. Average tree cover in urban areas in Montana was 5.5 percent, with 72.8 percent total green space, 7.5 percent canopy green space, and 75.5 m^2 of canopy cover per capita. Within community lands in Montana, average tree cover was 27.3 percent, with 96.4 percent total green space, 28.3 percent canopy green space, and 3,439.9 m^2 of canopy cover per capita (Table MT-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. MT-5 through 6; Tables MT-5 through 7).

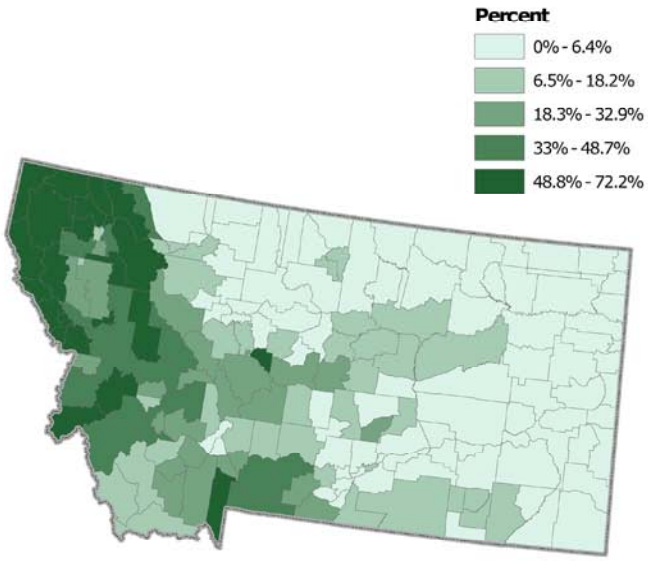


Figure MT-6.—Percentage tree canopy green space in county subdivisions.

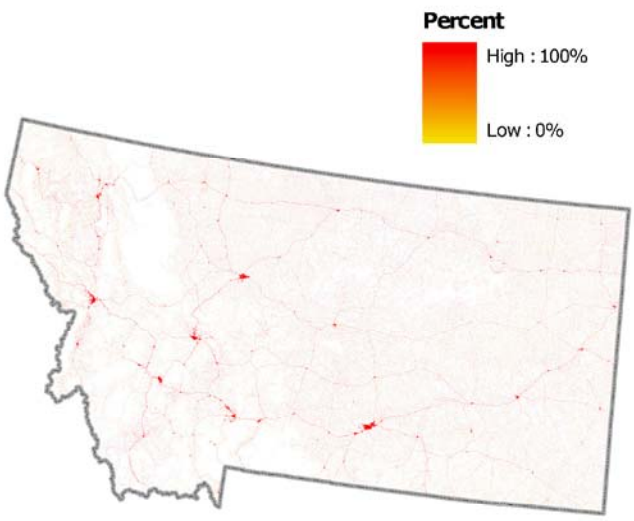


Figure MT-7.—Percentage impervious surface cover.

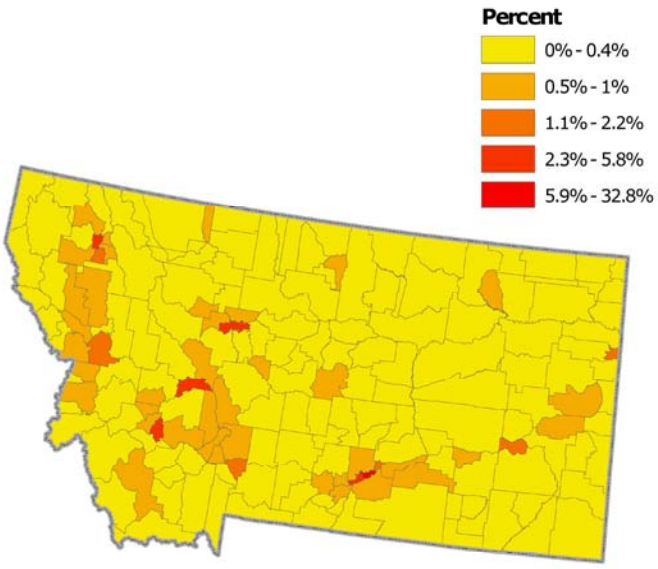


Figure MT-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Montana is 0.3 percent of the land area (Fig. MT-7), with 1,391.8 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 27.2 percent, with 375.5 m^2 of impervious surface cover per capita. Within community lands in Montana, average impervious surface cover was 3.6 percent with 458.2 m^2 of impervious surface cover per capita (Table MT-1). Impervious surface cover varied across the State (Fig. MT-8; Tables MT-5 through 7).

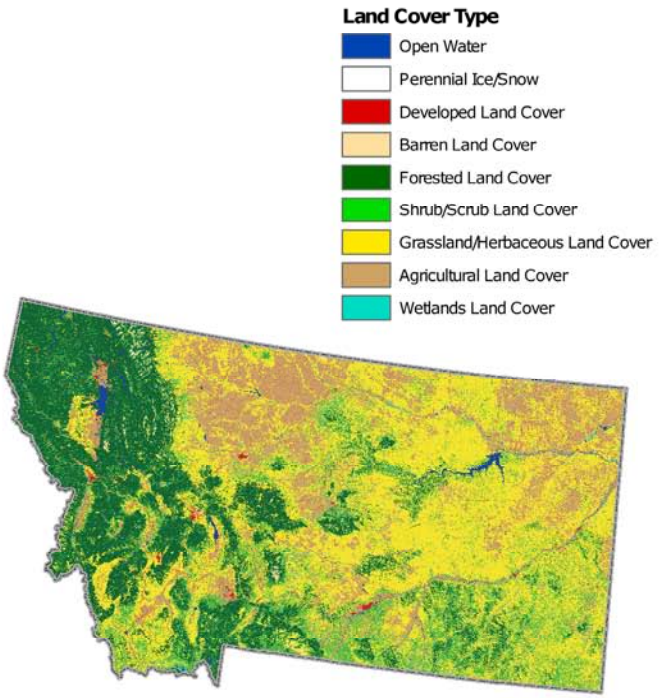


Figure MT-9.—Classified land cover.

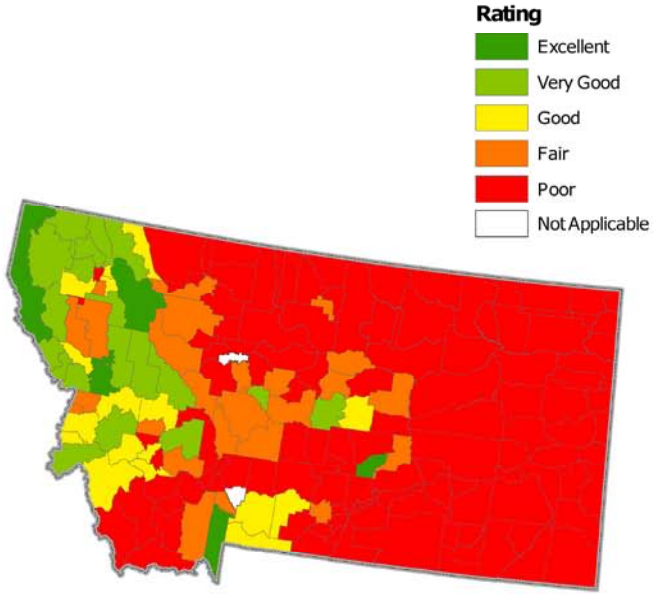


Figure MT-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Montana's land cover is dominated by grassland (Fig. MT-9). The characteristics as a percent of the total land area in Montana are (Tables MT-8 through 10):

- Grassland – 42.1 percent
- Forested – 22.7 percent
- Agricultural – 17.4 percent
- Scrub/Shrub – 15.5 percent
- Developed – 1.4 percent
- Barren – 0.6 percent
- Wetland – 0.4 percent

Relative Comparisons of Tree Cover

Out of the 275 Montana communities, 22 received a rating of excellent and 175 received a rating of poor (Table MT-12). Of the 191 county subdivisions, eight had a rating of excellent and 120 were rated poor (Fig. MT-10, Table MT-13); and out of 56 counties, eight were given a rating of excellent and 27 were given a rating of poor (Table MT-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. MT-10; Tables MT-11 through 14).

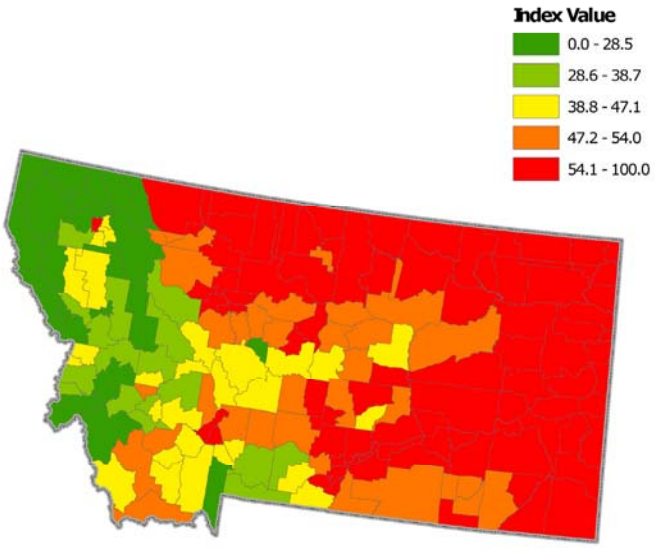


Figure MT-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

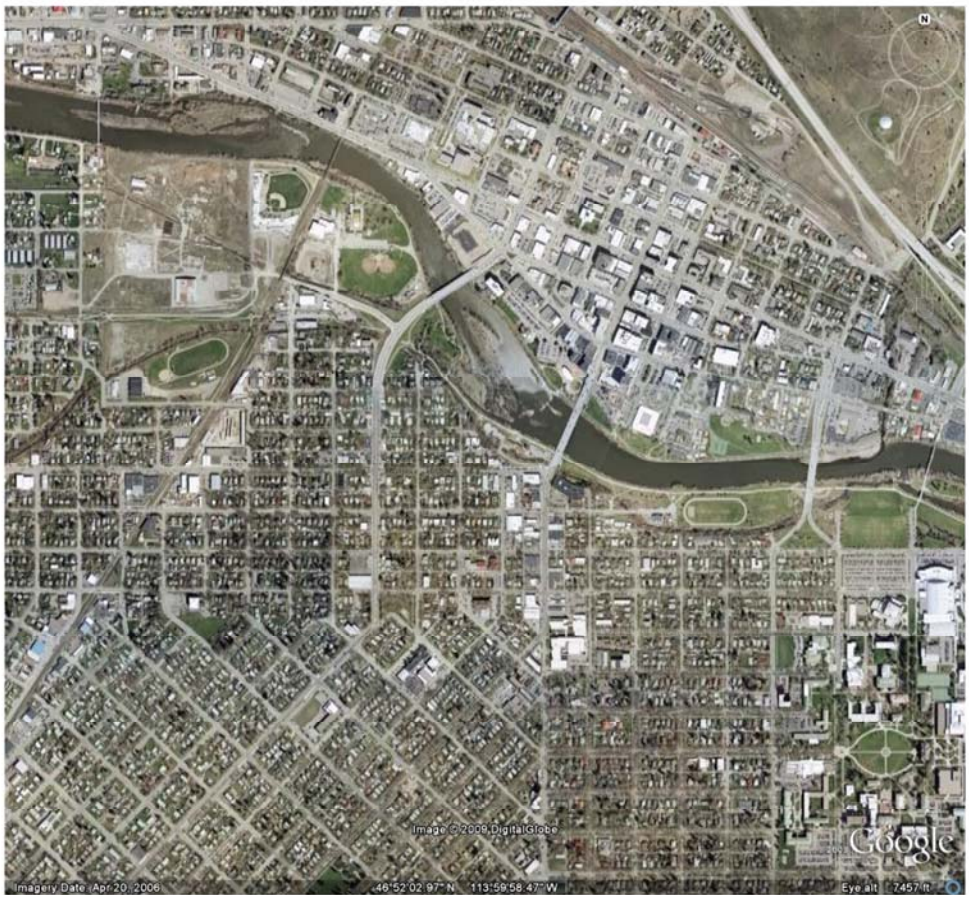
Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. MT-11; Tables MT-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Montana (Table MT-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 98.1 million trees
- 18.7 million metric tons of C stored ($426.4 million value)
- 617,000 metric tons/year of C sequestered ($14.1 million value)
- 12,760 metric tons/year total pollution removal ($106.5 million value)
  - 368 metric tons/year of CO removed ($517,700 value)
  - 550 metric tons/year NO_2 removed ($5.4 million value)
  - 8,099 metric tons/year of O_3 removed ($80.2 million value)
  - 1,050 metric tons/year of SO_2 removed ($2.5 million value)
  - 2,688 metric tons/year of PM_{10} removed ($17.8 million value)

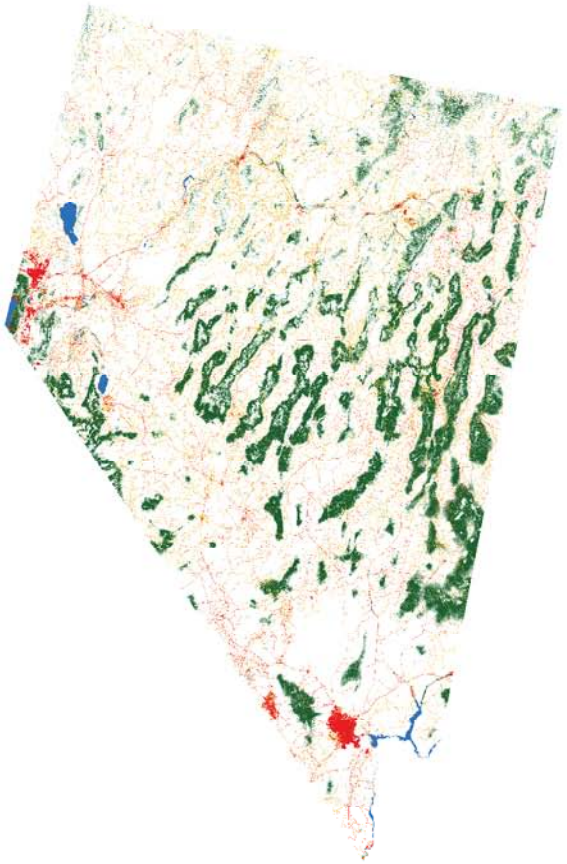


Summary

The data presented in this report provide a better understanding of Montana's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

These data establish a baseline to assess future change and can be used to understand:

- Extent of the urban and community forest resource
- Variations in the resource across the State
- Magnitude and value of the urban and community forest resource
- Urban growth in Montana
- Implications of policy decisions related to urban sprawl and urban and community forest management



NEVADA'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Nevada comprises about 2.8 percent of the state land area in 2000, an increase from 1.8 percent in 1990. Statewide tree canopy cover averages 5.6 percent and tree cover in urban or community areas is about 3.1 percent, with 8.1 percent impervious surface cover and 3.3 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Nevada has an estimated 11.5 million trees, which store about 2.2 million metric tons of carbon ($50.2 million), and annually remove about 72,000 metric tons of carbon ($1.6 million) and 1,590 metric tons of air pollution ($12.4 million) (Table NV-1).

Tables NV-2 through NV-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table NV-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Nevada		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	1,998,257	1,828,646	1,850,812	n/a
	1990	1,201,833	1,061,444	1,056,610	n/a
	% Change (1990-2000)	66.3	72.3	75.2	n/a
	% Total population (2000)	100.0	91.5	92.6	n/a
Total area	km^2 (2000)	286,350.9	1,409.3	7,786.8	7,950.1
	km^2 (1990)	286,350.9	889.0	5,194.6	5,303.8
	% Change (1990-2000)	0.0	58.5	49.9	49.9
Land area	km^2 (2000)	284,923.7	1,406.3	7,674.3	7,837.3
	% Land area (2000)	100.0	0.5	2.7	2.8
	km^2 (1990)	284,923.7	886.9	5,135.5	5,244.3
	% Land area (1990)	100.0	0.3	1.8	1.8
	% Change (1990-2000)	0.0	58.6	49.4	49.4
Population density (people/land area km^2)	2000	7.0	1,300.3	241.2	n/a
	1990	4.2	1,196.8	205.7	n/a
	% Change (1990-2000)	66.3	8.7	17.2	n/a
Tree canopy cover (2000)	km^2	16,027.5	42.4	237.8	240.2
	% Land area	5.6	3.0	3.1	3.1
	Per capita (m^2/person)	8,020.7	23.2	128.5	n/a
	% Canopy green space [d]	5.6	4.7	3.4	3.3
Total green space (2000) [e]	km^2	283,686.0	899.8	7,065.0	7,200.3
	% Land area	99.6	64.0	92.1	91.9
Available green space (2000) [f]	km^2	267,660.0	858.6	6,828.5	6,961.4
	% Land area	93.9	61.1	89.0	88.8
Impervious surface cover (2000)	km^2	1,238.1	506.5	609.4	637.1
	% Land area	0.4	36.0	7.9	8.1
	Per capita (m^2/person)	619.6	277.0	329.2	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	2,000,000	11,300,000	11,500,000
	Carbon				
	Carbon stored (metric tons)	n/a	400,000	2,200,000	2,200,000
	Carbon stored ($)	n/a	$9,100,000	$50,200,000	$50,200,000
	Carbon sequestered (metric tons/year)	n/a	13,000	71,000	72,000
	Carbon sequestered ($/year)	n/a	$296,000	$1,619,000	$1,642,000
	Pollution				
	CO removed (metric tons/year)	n/a	8	47	47
	CO removed ($/year)	n/a	$11,700	$65,900	$66,600
	NO_2 removed (metric tons/year)	n/a	40	227	229
	NO_2 removed ($/year)	n/a	$400,300	$2,244,900	$2,267,800
	O_3 removed (metric tons/year)	n/a	89	500	506
	O_3 removed ($/year)	n/a	$884,000	$4,957,000	$5,008,000
	SO_2 removed (metric tons/year)	n/a	10	55	55
	SO_2 removed ($/year)	n/a	$23,700	$132,800	$134,200
	PM_{10} removed (metric tons/year)	n/a	132	741	748
	PM_{10} removed ($/year)	n/a	$873,500	$4,898,600	$4,948,400
	Total pollution removal (metric tons/year)	n/a	280	1,570	1,590
	Total pollution removal ($/year)	n/a	$2,200,000	$12,300,000	$12,400,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

Figure NV-1.—Urban or community land in 2000; urban area relative to community boundaries.

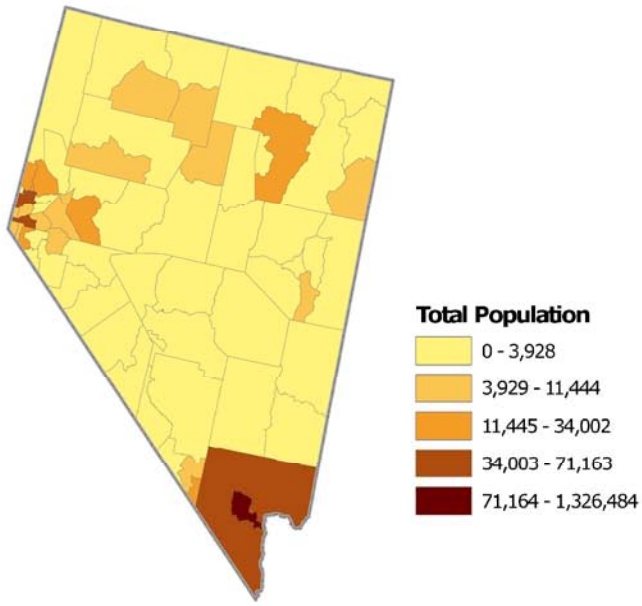


Figure NV-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Nevada increased 66.3 percent, from 1,201,833 in 1990 to 1,998,257 in 2000 (Table NV-1). In Nevada, 91.5 percent of the State's population is in urban areas (Fig. NV-1), and 92.6 percent of the population is within communities (Fig. NV-2).

Urban and Community Land

Urban land comprises 0.5 percent of the land area of Nevada, while lands within communities make up 2.7 percent of the State (Fig. NV-1). Between 1990 and 2000, urban area increased 58.6 percent, while community land increased from 1.8 to 2.7 percent (Table NV-1). Urban area in Nevada is projected to increase to 2.2 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. NV-3; Tables NV-2 through 4).

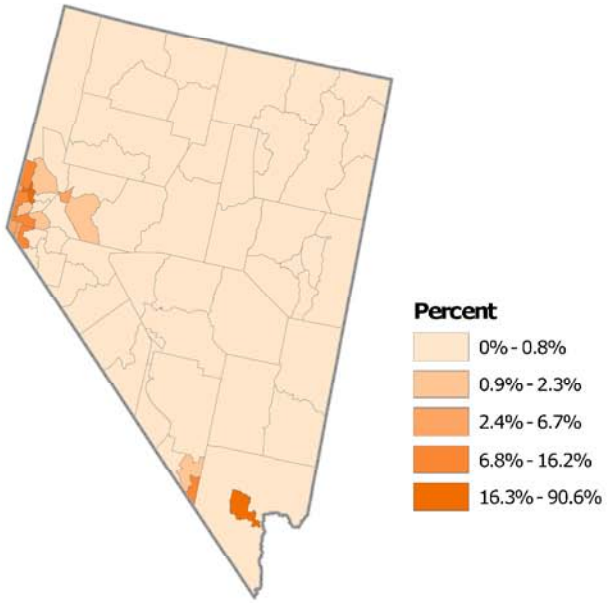


Figure NV-3.—Percent of county subdivision area classified as urban land in 2000.

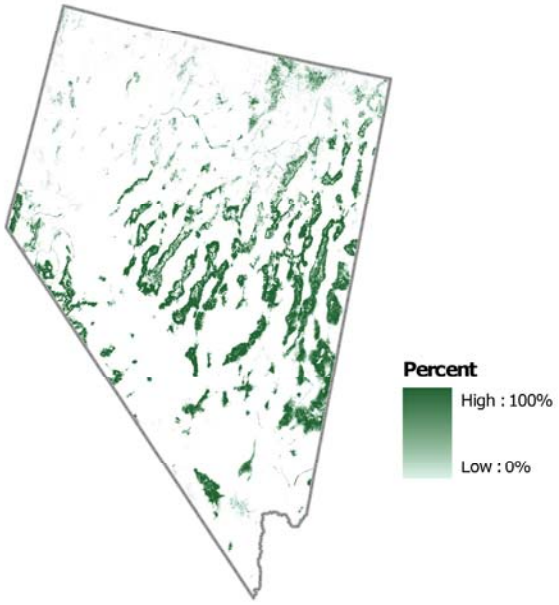


Figure NV-4.—Percentage tree canopy cover.

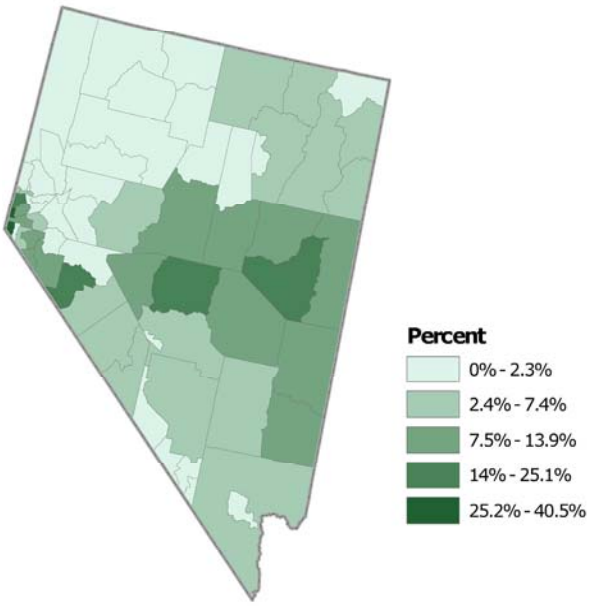


Figure NV-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Nevada averages 5.6 percent (Fig. NV-4), with 99.6 percent total green space, 5.6 percent canopy green space, and 8,020.7 m^2 of canopy cover per capita. Average tree cover in urban areas in Nevada was 3.0 percent, with 64.0 percent total green space, 4.7 percent canopy green space, and 23.2 m^2 of canopy cover per capita. Within community lands in Nevada, average tree cover was 3.1 percent, with 92.1 percent total green space, 3.4 percent canopy green space, and 128.5 m^2 of canopy cover per capita (Table NV-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. NV-5 through 6; Tables NV-5 through 7).

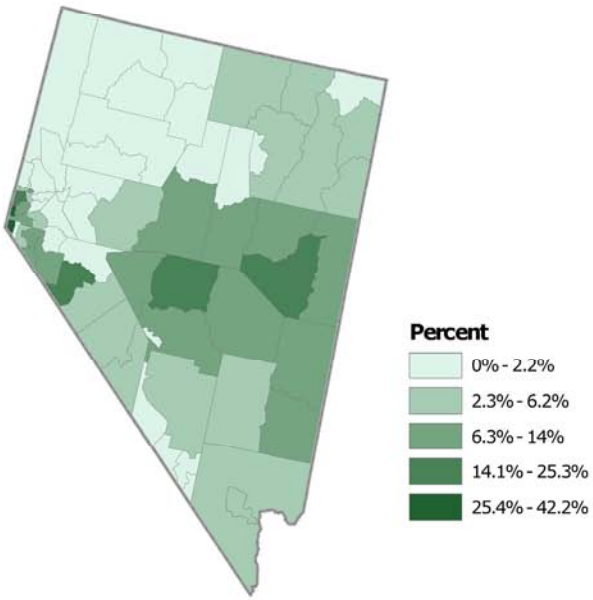


Figure NV-6.—Percentage tree canopy green space in county subdivisions.

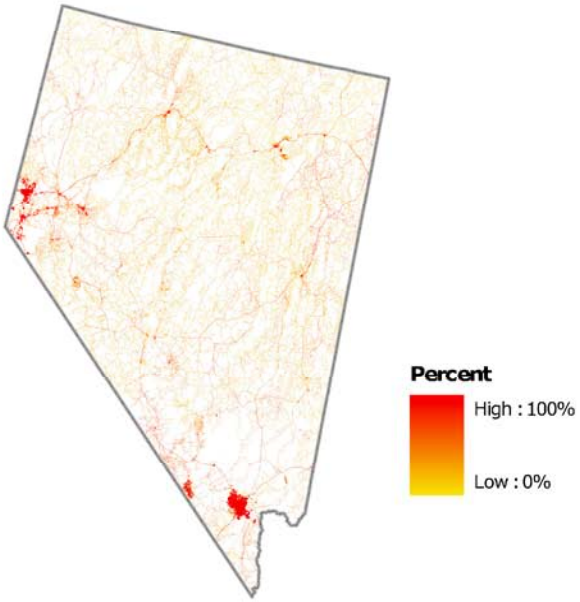


Figure NV-7.—Percentage impervious surface cover.

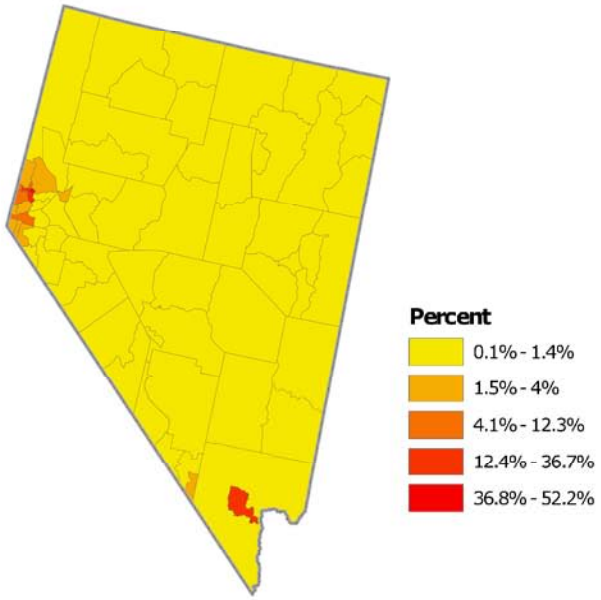


Figure NV-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Nevada is 0.4 percent of the land area (Fig. NV-7), with 619.6 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 36.0 percent, with 277.0 m^2 of impervious surface cover per capita. Within community lands in Nevada, average impervious surface cover was 7.9 percent with 329.2 m^2 of impervious surface cover per capita (Table NV-1). Impervious surface cover varied across the State (Fig. NV-8; Tables NV-5 through 7).

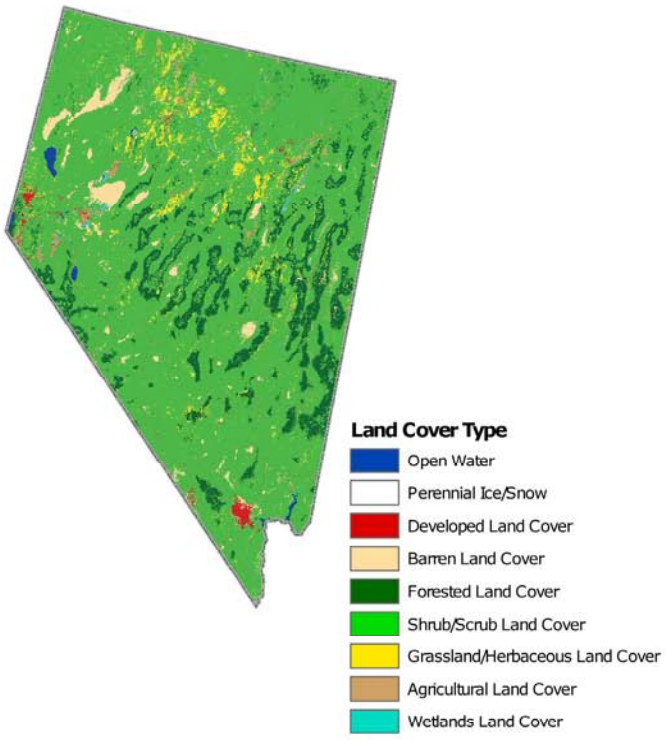


Figure NV-9.—Classified land cover.

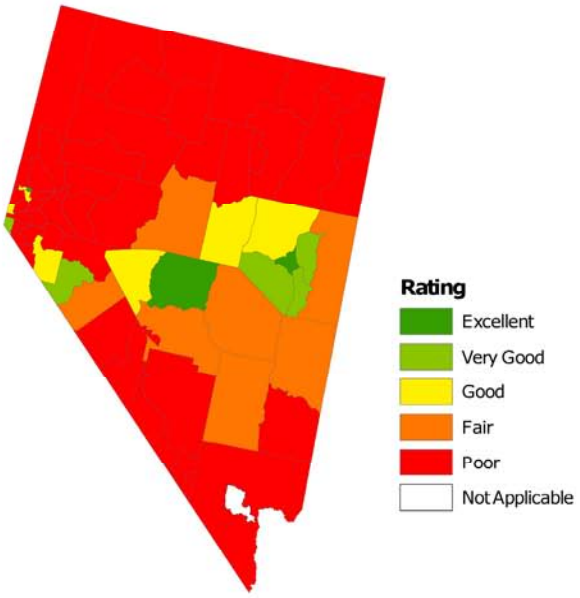


Figure NV-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Nevada's land cover is dominated by scrub/shrub land (Fig. NV-9). The characteristics as a percent of the total land area in Nevada are (Tables NV-8 through 10):

- Scrub/Shrub – 79.8 percent
- Forested – 11.1 percent
- Grassland – 3.5 percent
- Barren – 3.1 percent
- Agricultural – 1.4 percent
- Developed – 0.9 percent
- Wetland – 0.2 percent

Relative Comparisons of Tree Cover

Out of the 71 Nevada communities, six received a rating of excellent and 51 received a rating of poor (Table NV-12). Of the 72 county subdivisions, three had a rating of excellent and 49 were rated poor (Fig. NV-10, Table NV-13); and out of 17 counties, one was given a rating of excellent and eight were given a rating of poor (Table NV-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. NV-10; Tables NV-11 through 14).

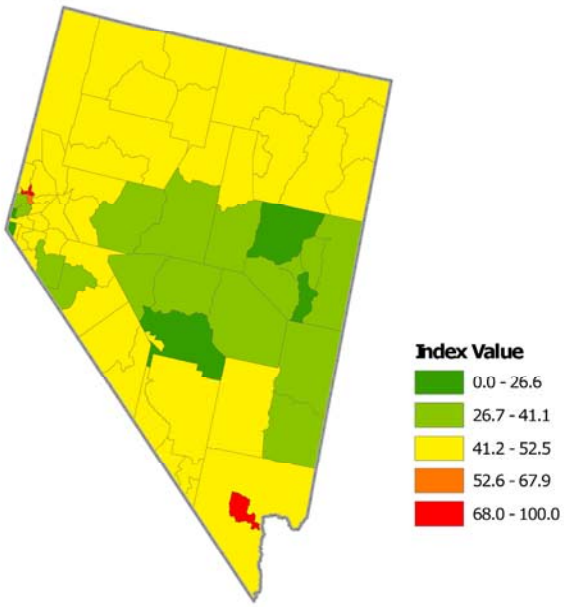


Figure NV-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

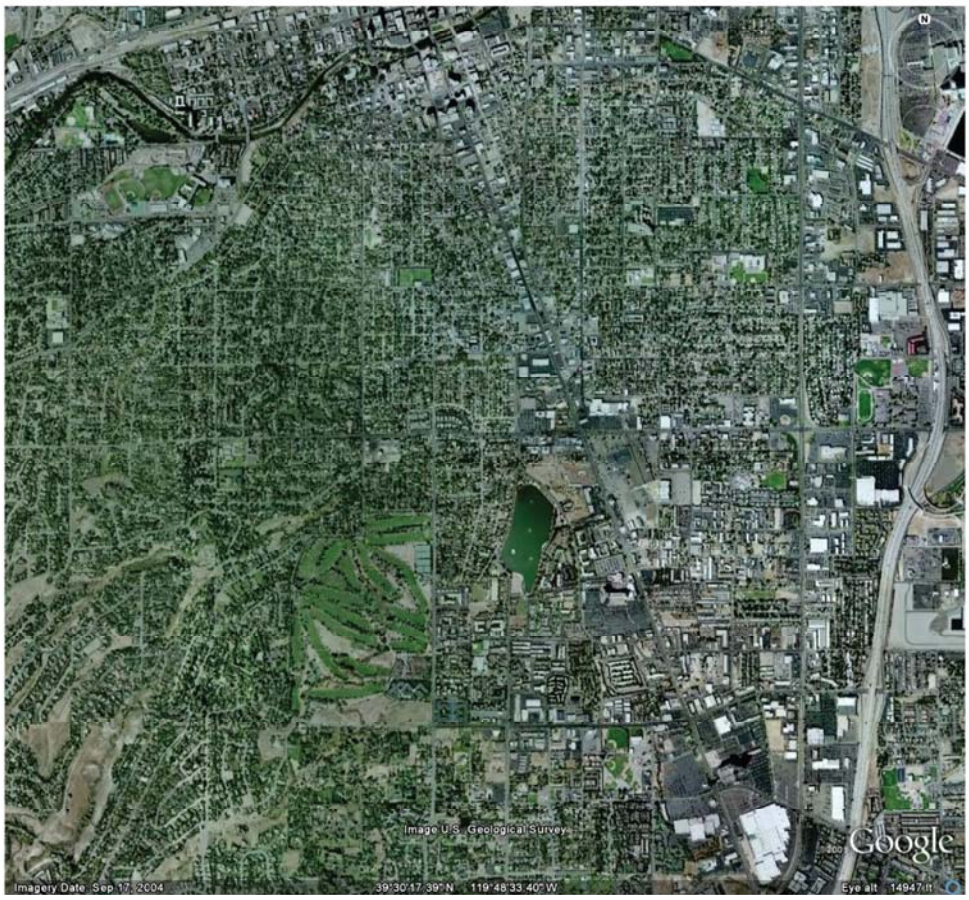
Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. NV-11; Tables NV-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Nevada (Table NV-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 11.5 million trees
- 2.2 million metric tons of C stored ($50.2 million value)
- 72,000 metric tons/year of C sequestered ($1.6 million value)
- 1,590 metric tons/year total pollution removal ($12.4 million value)
  - 47 metric tons/year of CO removed ($66,600 value)
  - 229 metric tons/year NO_2 removed ($2.3 million value)
  - 506 metric tons/year of O_3 removed ($5.0 million value)
  - 55 metric tons/year of SO_2 removed ($134,200 value)
  - 748 metric tons/year of PM_{10} removed ($4.9 million value)



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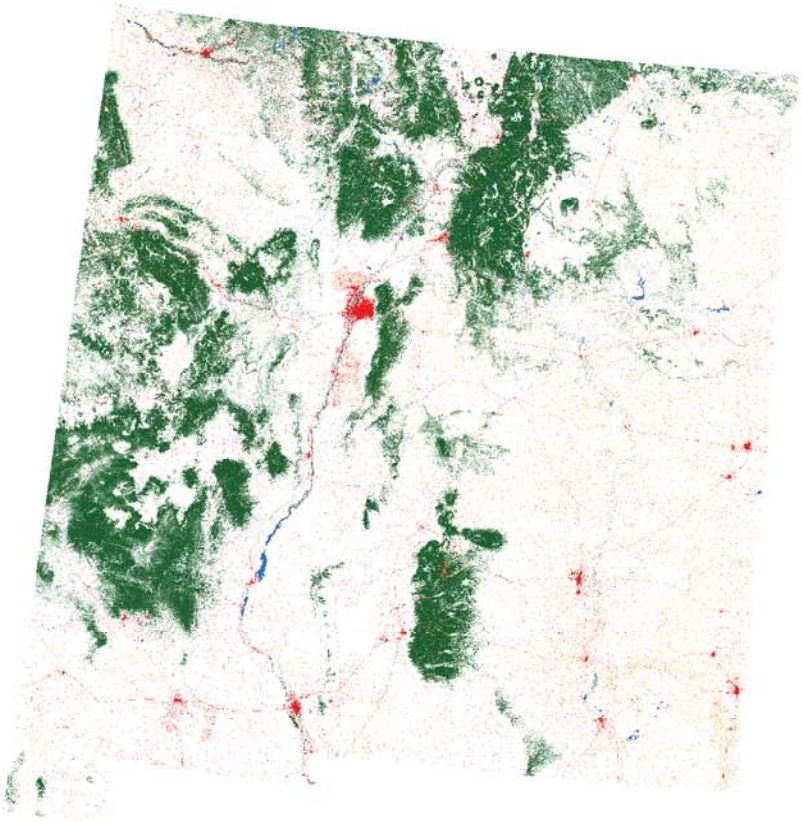
- Variations in the resource across the State
- Magnitude and value of the urban and community forest resource
- Urban growth in Nevada
- Implications of policy decisions related to urban sprawl and urban and community forest management



NEW MEXICO'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in New Mexico comprises about 1.7 percent of the state land area in 2000, an increase from 1.1 percent in 1990. Statewide tree canopy cover averages 11.3 percent and tree cover in urban or community areas is about 7.6 percent, with 7.5 percent impervious surface cover and 8.2 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in New Mexico has an estimated 19.0 million trees, which store about 3.6 million metric tons of carbon ($82.1 million), and annually remove about 120,000 metric tons of carbon ($2.7 million) and 2,950 metric tons of air pollution ($24.2 million) (Table NM-1).

Tables NM-2 through NM-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table NM-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

New Mexico		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	1,819,046	1,363,501	1,369,588	n/a
	1990	1,515,069	1,105,651	1,116,925	n/a
	% Change (1990-2000)	20.1	23.3	22.6	n/a
	% Total population (2000)	100.0	75.0	75.3	n/a
Total area	km^2 (2000)	314,915.3	1,952.2	4,854.0	5,306.9
	km^2 (1990)	314,915.3	1,495.6	3,169.8	3,472.9
	% Change (1990-2000)	0.0	30.5	53.1	52.8
Land area	km^2 (2000)	314,264.3	1,945.2	4,823.4	5,273.8
	% Land area (2000)	100.0	0.6	1.5	1.7
	km^2 (1990)	314,264.3	1,491.4	3,151.5	3,452.7
	% Land area (1990)	100.0	0.5	1.0	1.1
	% Change (1990-2000)	0.0	30.4	53.0	52.7
Population density (people/land area km^2)	2000	5.8	700.9	283.9	n/a
	1990	4.8	741.3	354.4	n/a
	% Change (1990-2000)	20.1	-5.4	-19.9	n/a
Tree canopy cover (2000)	km^2	35,566.8	106.8	377.5	398.8
	% Land area	11.3	5.5	7.8	7.6
	Per capita (m^2/person)	19,552.4	78.3	275.6	n/a
	% Canopy green space [d]	11.4	6.6	8.5	8.2
Total green space (2000) [e]	km^2	313,334.0	1,620.7	4,455.3	4,879.6
	% Land area	99.7	83.3	92.4	92.5
Available green space (2000) [f]	km^2	277,769.0	1,515.2	4,079.2	4,482.2
	% Land area	88.4	77.9	84.6	85.0
Impervious surface cover (2000)	km^2	930.8	324.6	368.1	394.1
	% Land area	0.3	16.7	7.6	7.5
	Per capita (m^2/person)	511.7	238.0	268.7	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	5,100,000	18,000,000	19,000,000
	Carbon				
	Carbon stored (metric tons)	n/a	1,000,000	3,400,000	3,600,000
	Carbon stored ($)	n/a	$22,800,000	$77,500,000	$82,100,000
	Carbon sequestered (metric tons/year)	n/a	32,000	113,000	120,000
	Carbon sequestered ($/year)	n/a	$730,000	$2,576,000	$2,736,000
	Pollution				
	CO removed (metric tons/year)	n/a	16	58	61
	CO removed ($/year)	n/a	$23,000	$81,200	$85,800
	NO_2 removed (metric tons/year)	n/a	78	274	290
	NO_2 removed ($/year)	n/a	$769,100	$2,717,800	$2,871,500
	O_3 removed (metric tons/year)	n/a	382	1,350	1,426
	O_3 removed ($/year)	n/a	$3,783,000	$13,369,000	$14,125,000
	SO_2 removed (metric tons/year)	n/a	42	147	156
	SO_2 removed ($/year)	n/a	$101,100	$357,300	$377,600
	PM_{10} removed (metric tons/year)	n/a	274	967	1,022
	PM_{10} removed ($/year)	n/a	$1,809,800	$6,395,300	$6,756,900
	Total pollution removal (metric tons/year)	n/a	790	2,800	2,950
	Total pollution removal ($/year)	n/a	$6,500,000	$22,900,000	$24,200,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

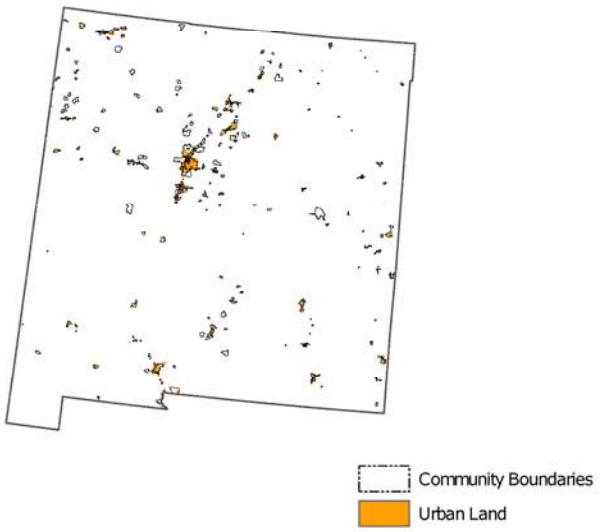


Figure NM-1.—Urban or community land in 2000; urban area relative to community boundaries.

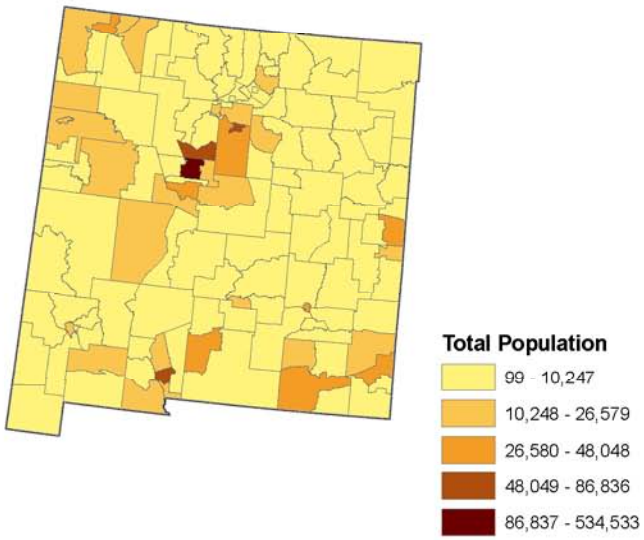


Figure NM-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in New Mexico increased 20.1 percent, from 1,515,069 in 1990 to 1,819,046 in 2000 (Table NM-1). In New Mexico, 75.0 percent of the State's population is in urban areas (Fig. NM-1), and 75.3 percent of the population is within communities (Fig. NM-2).

Urban and Community Land

Urban land comprises 0.6 percent of the land area of New Mexico, while lands within communities make up 1.5 percent of the State (Fig. NM-1). Between 1990 and 2000, urban area increased 30.4 percent, while community land increased from 1.0 to 1.5 percent (Table NM-1). Urban area in New Mexico is projected to increase to 2.1 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. NM-3; Tables NM-2 through 4).

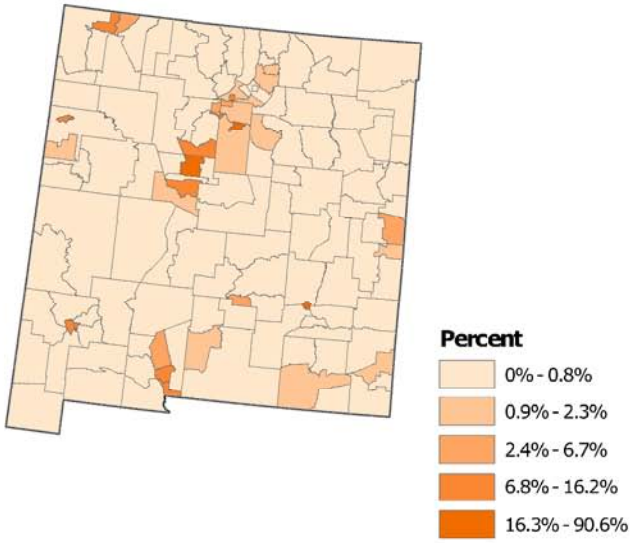


Figure NM-3.—Percent of county subdivision area classified as urban land in 2000.

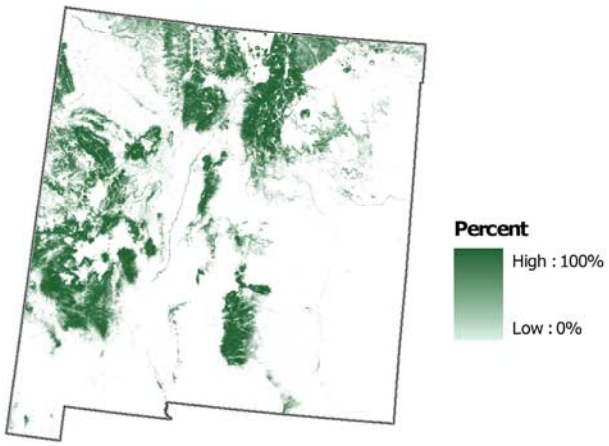


Figure NM-4.—Percentage tree canopy cover.

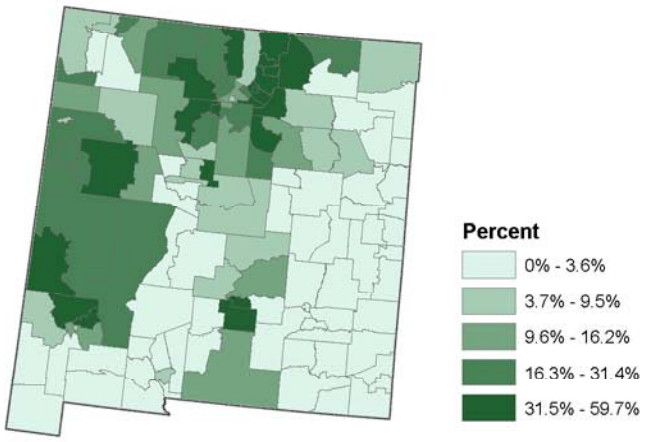


Figure NM-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in New Mexico averages 11.3 percent (Fig. NM-4), with 99.7 percent total green space, 11.4 percent canopy green space, and 19,552.4 m^2 of canopy cover per capita. Average tree cover in urban areas in New Mexico was 5.5 percent, with 83.3 percent total green space, 6.6 percent canopy green space, and 78.3 m^2 of canopy cover per capita. Within community lands in New Mexico, average tree cover was 7.8 percent, with 92.4 percent total green space, 8.5 percent canopy green space, and 275.6 m^2 of canopy cover per capita (Table NM-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. NM-5 through 6; Tables NM-5 through 7).

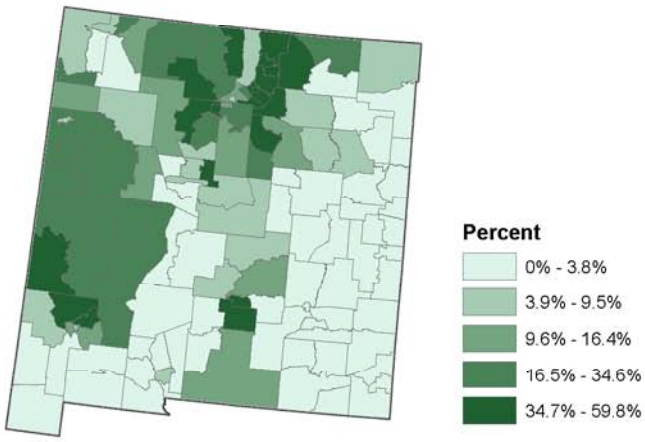


Figure NM-6.—Percentage tree canopy green space in county subdivisions.

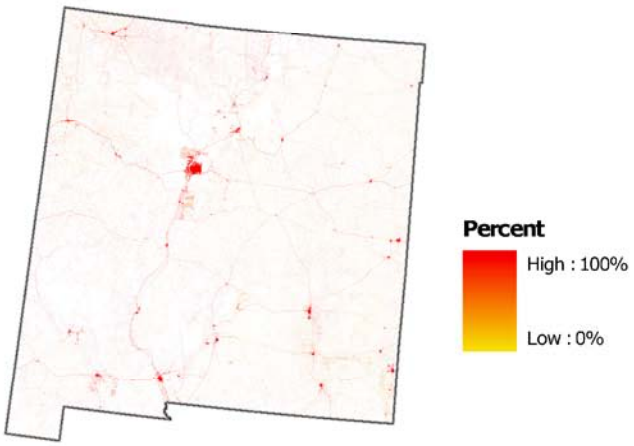


Figure NM-7.—Percentage impervious surface cover.

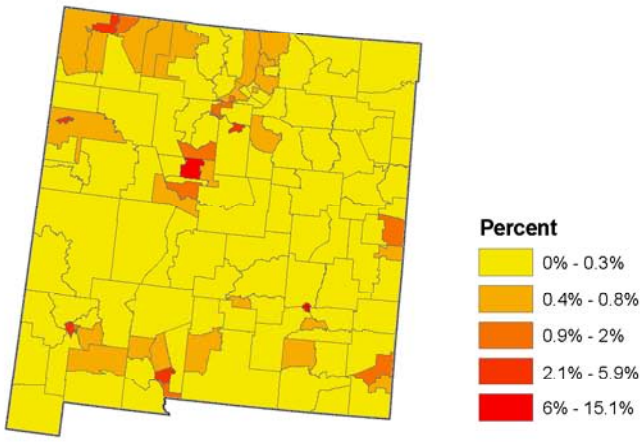


Figure NM-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in New Mexico is 0.3 percent of the land area (Fig. NM-7), with 511.7 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 16.7 percent, with 238.0 m^2 of impervious surface cover per capita. Within community lands in New Mexico, average impervious surface cover was 7.6 percent with 268.7 m^2 of impervious surface cover per capita (Table NM-1). Impervious surface cover varied across the State (Fig. NM-8; Tables NM-5 through 7).

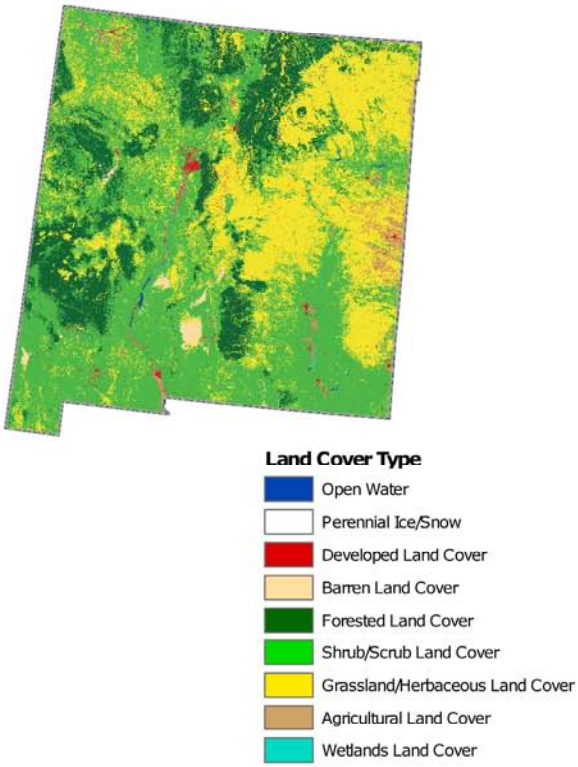


Figure NM-9.—Classified land cover.

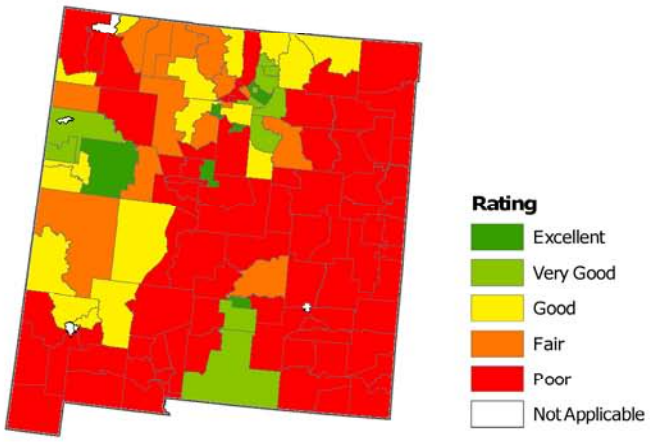


Figure NM-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

New Mexico's land cover is dominated by scrub/shrub land (Fig. NM-9). The characteristics as a percent of the total land area in New Mexico are (Tables NM-8 through 10):

- Scrub/Shrub – 48.5 percent
- Grassland – 30.6 percent
- Forested – 16.7 percent
- Agricultural – 2.0 percent
- Developed – 1.1 percent
- Barren – 1.1 percent
- Wetland – 0.1 percent

Relative Comparisons of Tree Cover

Out of the 234 New Mexico communities, 19 received a rating of excellent and 175 received a rating of poor (Table NM-12). Of the 130 county subdivisions, seven had a rating of excellent and 76 were rated poor (Fig. NM-10, Table NM-13); and out of 33 counties, five were given a rating of excellent and 16 were given a rating of poor (Table NM-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. NM-10; Tables NM-11 through 14).

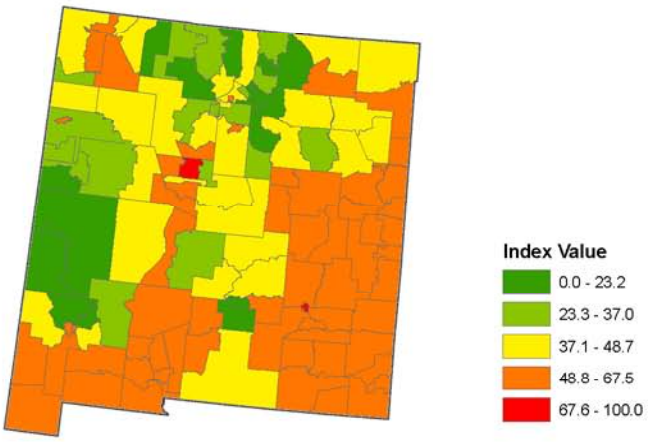


Figure NM-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

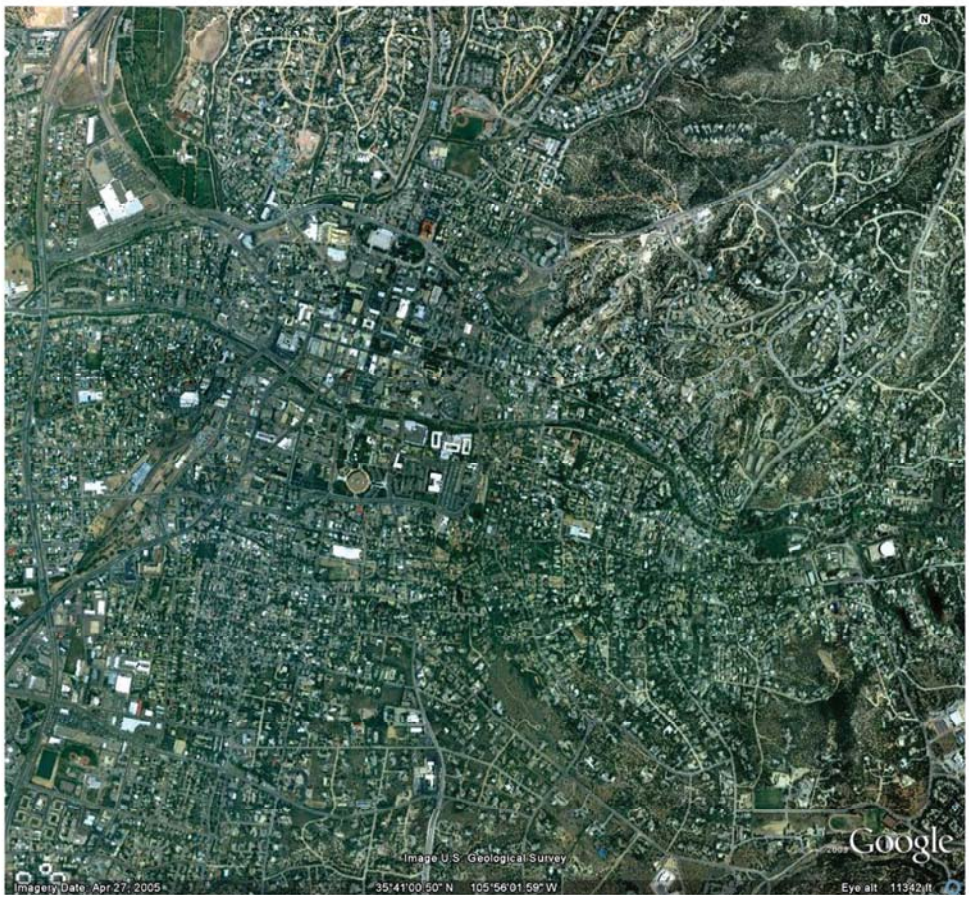
Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. NM-11; Tables NM-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in New Mexico (Table NM-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 19.0 million trees
- 3.6 million metric tons of C stored ($82.1 million value)
- 120,000 metric tons/year of C sequestered ($2.7 million value)
- 2,950 metric tons/year total pollution removal ($24.2 million value)
  - 61 metric tons/year of CO removed ($85,800 value)
  - 290 metric tons/year NO_2 removed ($2.9 million value)
  - 1,426 metric tons/year of O_3 removed ($14.1 million value)
  - 156 metric tons/year of SO_2 removed ($377,600 value)
  - 1,022 metric tons/year of PM_{10} removed ($6.8 million value)

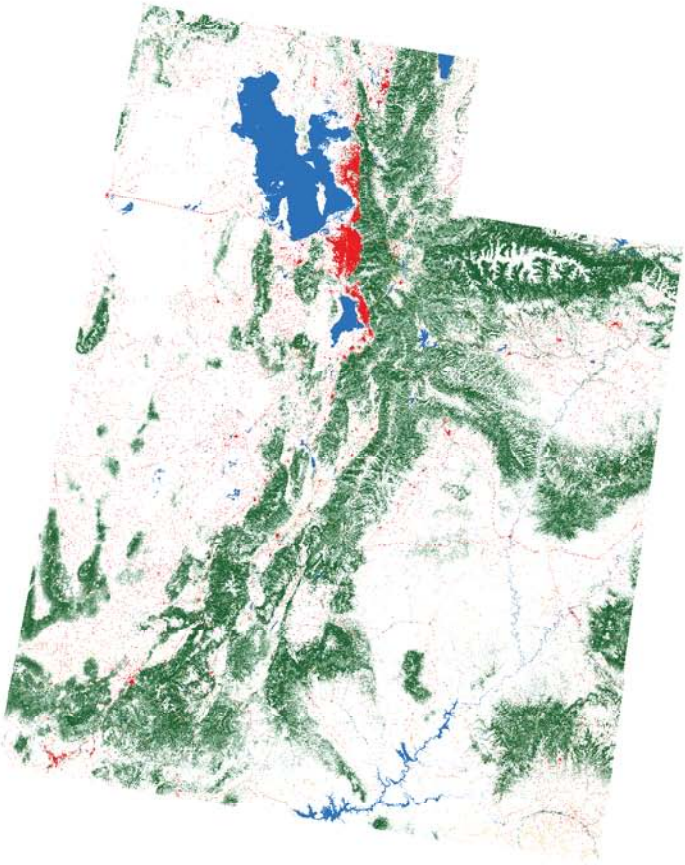


Summary

The data presented in this report provide a better understanding of New Mexico's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

These data establish a baseline to assess future change and can be used to understand:

- Extent of the urban and community forest resource
- Variations in the resource across the State
- Magnitude and value of the urban and community forest resource
- Urban growth in New Mexico
- Implications of policy decisions related to urban sprawl and urban and community forest management



UTAH'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Utah comprises about 2.8 percent of the state land area in 2000, an increase from 1.9 percent in 1990. Statewide tree canopy cover averages 11.7 percent and tree cover in urban or community areas is about 8.6 percent, with 11.1 percent impervious surface cover and 9.6 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Utah has an estimated 24.3 million trees, which store about 4.6 million metric tons of carbon ($104.9 million), and annually remove about 153,000 metric tons of carbon ($3.5 million) and 3,990 metric tons of air pollution ($33.2 million) (Table UT-1).

Tables UT-2 through UT-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

Table UT-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Utah		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	2,233,169	1,970,344	2,103,981	n/a
	1990	1,722,850	1,499,081	1,347,938	n/a
	% Change (1990-2000)	29.6	31.4	56.1	n/a
	% Total population (2000)	100.0	88.2	94.2	n/a
Total area	km^2 (2000)	219,887.0	1,788.2	5,873.5	5,998.9
	km^2 (1990)	219,887.0	1,448.6	3,944.7	4,083.3
	% Change (1990-2000)	0.0	23.4	48.9	46.9
Land area	km^2 (2000)	213,005.2	1,786.1	5,811.4	5,936.6
	% Land area (2000)	100.0	0.8	2.7	2.8
	km^2 (1990)	213,005.2	1,447.1	3,913.0	4,051.5
	% Land area (1990)	100.0	0.7	1.8	1.9
	% Change (1990-2000)	0.0	23.4	48.5	46.5
Population density (people/land area km^2)	2000	10.5	1,103.2	362.0	n/a
	1990	8.1	1,035.9	344.5	n/a
	% Change (1990-2000)	29.6	6.5	5.1	n/a
Tree canopy cover (2000)	km^2	24,842.0	240.7	499.9	508.8
	% Land area	11.7	13.5	8.6	8.6
	Per capita (m^2/person)	11,124.1	122.2	237.6	n/a
	% Canopy green space [d]	11.7	19.1	9.7	9.6
Total green space (2000) [e]	km^2	211,867.0	1,258.8	5,167.4	5,279.9
	% Land area	99.5	70.5	88.9	88.9
Available green space (2000) [f]	km^2	187,030.0	1,022.6	4,672.2	4,775.8
	% Land area	87.8	57.3	80.4	80.4
Impervious surface cover (2000)	km^2	1,137.8	527.3	644.0	656.7
	% Land area	0.5	29.5	11.1	11.1
	Per capita (m^2/person)	509.5	267.6	306.1	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	11,500,000	23,800,000	24,300,000
	Carbon				
	Carbon stored (metric tons)	n/a	2,200,000	4,500,000	4,600,000
	Carbon stored ($)	n/a	$50,200,000	$102,600,000	$104,900,000
	Carbon sequestered (metric tons/year)	n/a	72,000	150,000	153,000
	Carbon sequestered ($/year)	n/a	$1,642,000	$3,420,000	$3,488,000
	Pollution				
	CO removed (metric tons/year)	n/a	36	74	76
	CO removed ($/year)	n/a	$50,300	$104,400	$106,300
	NO_2 removed (metric tons/year)	n/a	274	570	580
	NO_2 removed ($/year)	n/a	$2,719,100	$5,645,900	$5,746,800
	O_3 removed (metric tons/year)	n/a	819	1,701	1,731
	O_3 removed ($/year)	n/a	$8,113,000	$16,846,000	$17,147,000
	SO_2 removed (metric tons/year)	n/a	53	109	111
	SO_2 removed ($/year)	n/a	$127,600	$265,000	$269,800
	PM_{10} removed (metric tons/year)	n/a	708	1,469	1,496
	PM_{10} removed ($/year)	n/a	$4,680,700	$9,719,000	$9,892,600
	Total pollution removal (metric tons/year)	n/a	1,890	3,920	3,990
	Total pollution removal ($/year)	n/a	$15,700,000	$32,600,000	$33,200,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

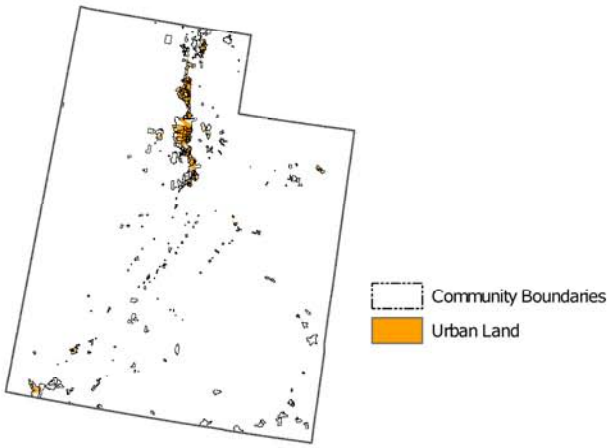


Figure UT-1.—Urban or community land in 2000; urban area relative to community boundaries.

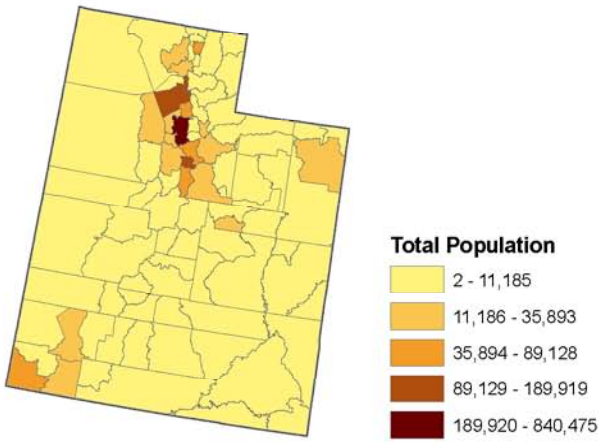


Figure UT-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Utah increased 29.6 percent, from 1,722,850 in 1990 to 2,233,169 in 2000 (Table UT-1). In Utah, 88.2 percent of the State's population is in urban areas (Fig. UT-1), and 94.2 percent of the population is within communities (Fig. UT-2).

Urban and Community Land

Urban land comprises 0.8 percent of the land area of Utah, while lands within communities make up 2.7 percent of the State (Fig. UT-1). Between 1990 and 2000, urban area increased 23.4 percent, while community land increased from 1.8 to 2.7 percent (Table UT-1). Urban area in Utah is projected to increase to 2.5 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. UT-3; Tables UT-2 through 4).

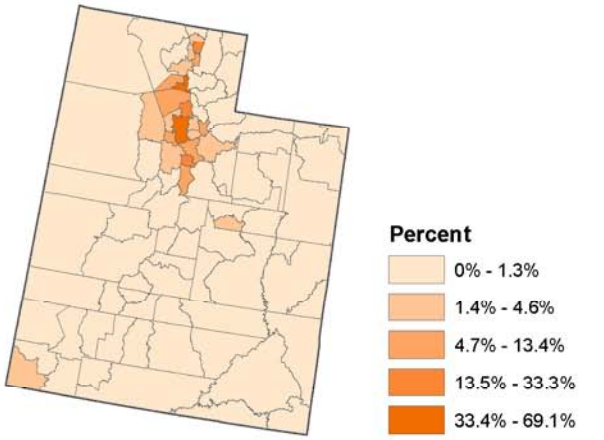


Figure UT-3.—Percent of county subdivision area classified as urban land in 2000.

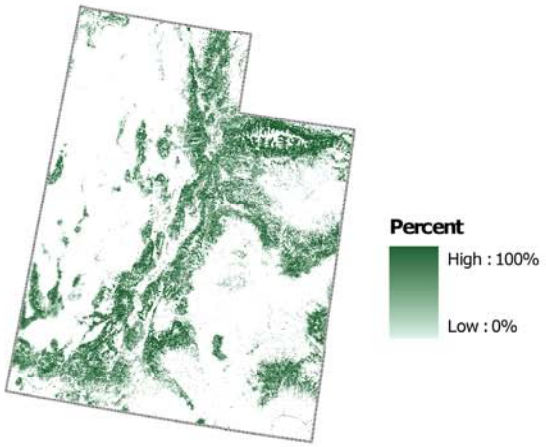


Figure UT-4.—Percentage tree canopy cover.

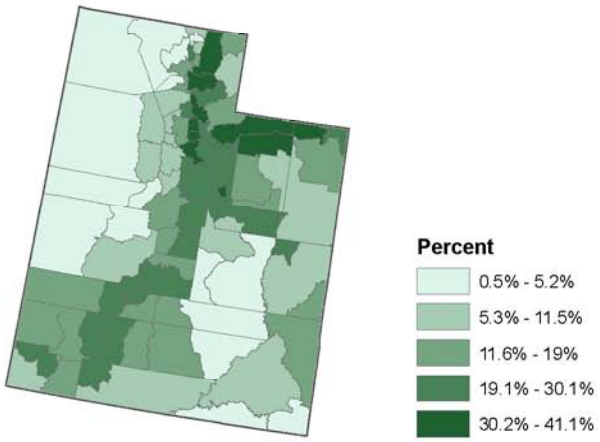


Figure UT-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Utah averages 11.7 percent (Fig. UT-4), with 99.5 percent total green space, 11.7 percent canopy green space, and 11,124.1 m^2 of canopy cover per capita. Average tree cover in urban areas in Utah was 13.5 percent, with 70.5 percent total green space, 19.1 percent canopy green space, and 122.2 m^2 of canopy cover per capita. Within community lands in Utah, average tree cover was 8.6 percent, with 88.9 percent total green space, 9.7 percent canopy green space, and 237.6 m^2 of canopy cover per capita (Table UT-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. UT-5 through 6; Tables UT-5 through 7).

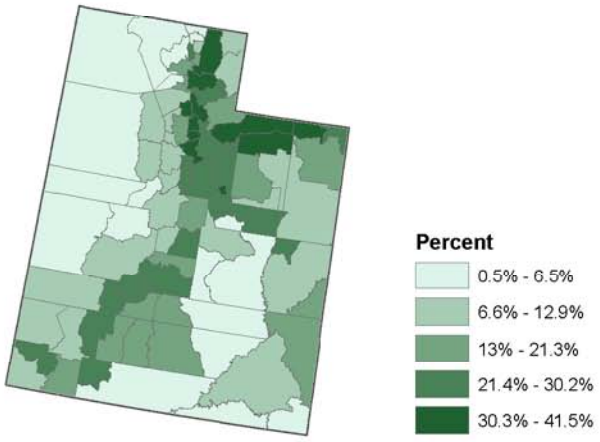


Figure UT-6.—Percentage tree canopy green space in county subdivisions.

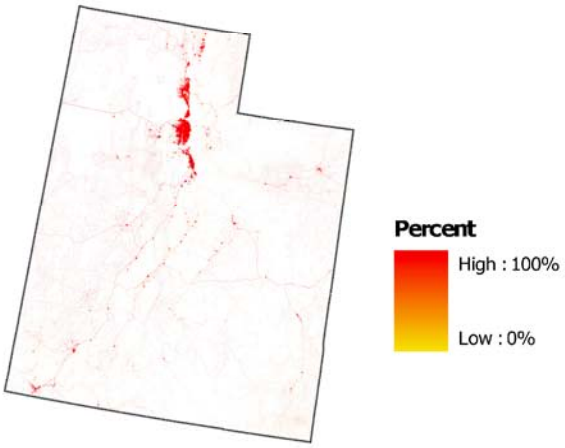


Figure UT-7.—Percentage impervious surface cover.

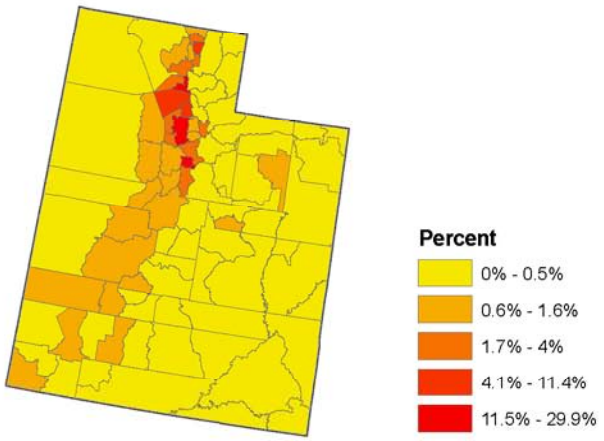


Figure UT-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Utah is 0.5 percent of the land area (Fig. UT-7), with 509.5 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 29.5 percent, with 267.6 m^2 of impervious surface cover per capita. Within community lands in Utah, average impervious surface cover was 11.1 percent with 306.1 m^2 of impervious surface cover per capita (Table UT-1). Impervious surface cover varied across the State (Fig. UT-8; Tables UT-5 through 7).

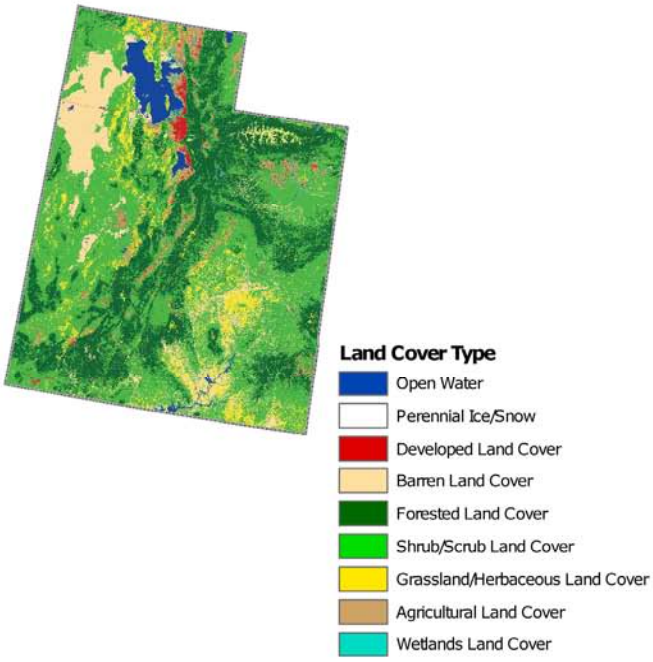


Figure UT-9.—Classified land cover.

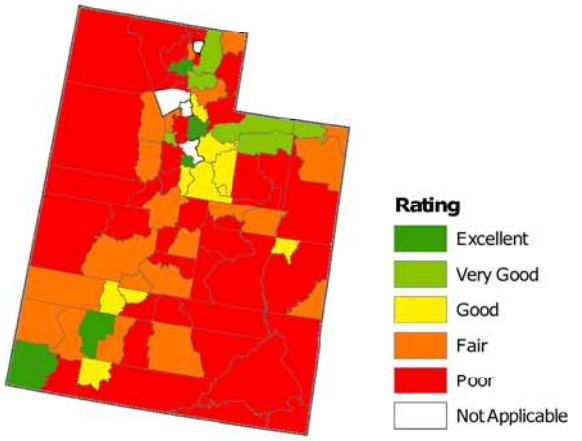


Figure UT-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Utah's land cover is dominated by scrub/shrub land (Fig. UT-9). The characteristics as a percent of the total land area in Utah are (Tables UT-8 through 10):

- Scrub/Shrub – 50.7 percent
- Forested – 25.8 percent
- Barren – 10.9 percent
- Grassland – 6.8 percent
- Agricultural – 4.0 percent
- Developed – 1.6 percent
- Wetland – 0.3 percent

Relative Comparisons of Tree Cover

Out of the 289 Utah communities, 21 received a rating of excellent and 192 received a rating of poor (Table UT-12). Of the 90 county subdivisions, eight had a rating of excellent and 41 were rated poor (Fig. UT-10, Table UT-13); and out of 29 counties, four were given a rating of excellent and 13 were given a rating of poor (Table UT-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. UT-10; Tables UT-11 through 14).

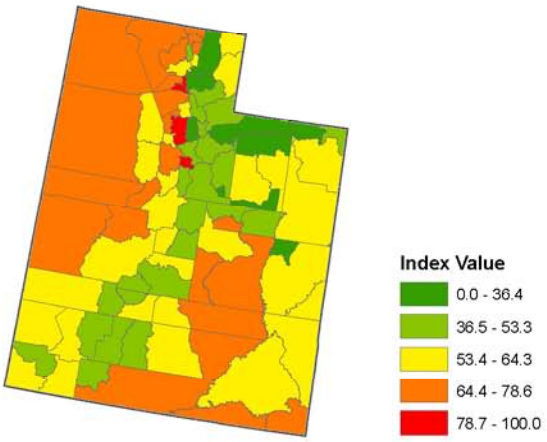


Figure UT-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

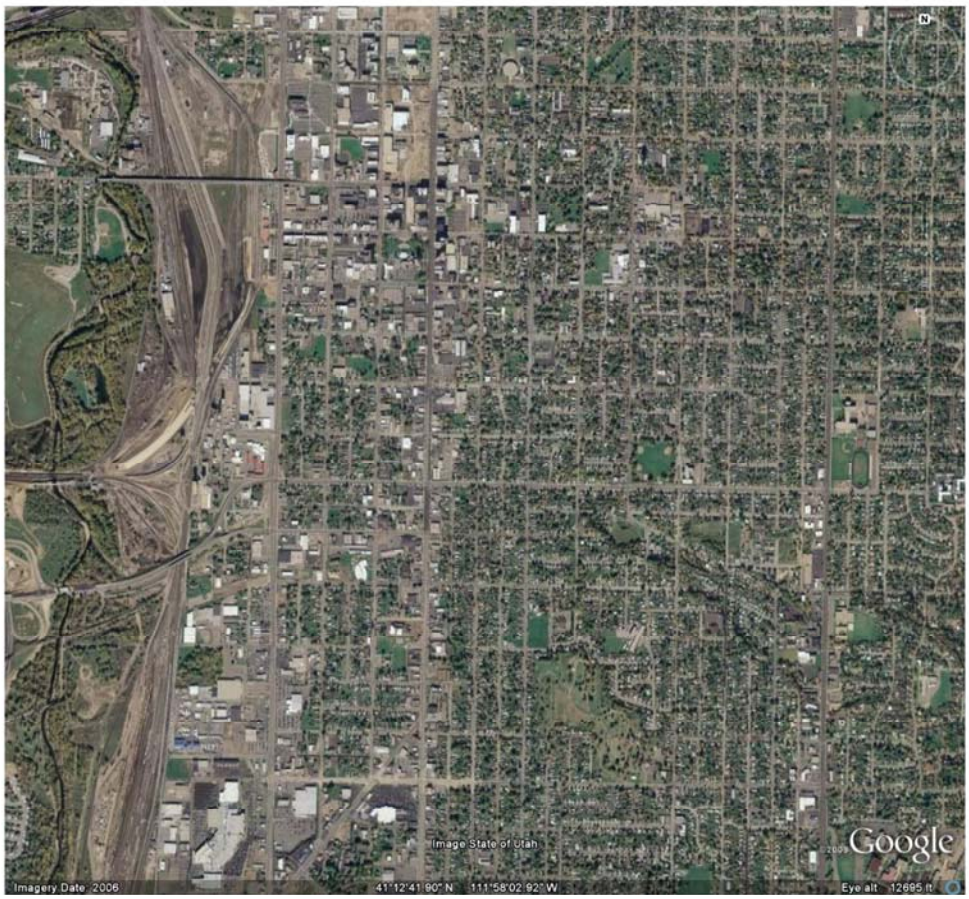
Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. UT-11; Tables UT-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Utah (Table UT-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 24.3 million trees
- 4.6 million metric tons of C stored ($104.9 million value)
- 153,000 metric tons/year of C sequestered ($3.5 million value)
- 3,990 metric tons/year total pollution removal ($33.2 million value)
  - 76 metric tons/year of CO removed ($106,300 value)
  - 580 metric tons/year NO_2 removed ($5.7 million value)
  - 1,731 metric tons/year of O_3 removed ($17.1 million value)
  - 111 metric tons/year of SO_2 removed ($269,800 value)
  - 1,496 metric tons/year of PM_{10} removed ($9.9 million value)



Summary

The data presented in this report provide a better understanding of Utah's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

These data establish a baseline to assess future change and can be used to understand:

- Extent of the urban and community forest resource
- Variations in the resource across the State
- Magnitude and value of the urban and community forest resource
- Urban growth in Utah
- Implications of policy decisions related to urban sprawl and urban and community forest management

Table WY-1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Wyoming		Statewide	Urban [a]	Community [b]	Urban or Community [c]
Population	2000	493,782	321,344	384,961	n/a
	1990	453,588	294,635	339,445	n/a
	% Change (1990-2000)	8.9	9.1	13.4	n/a
	% Total population (2000)	100.0	65.1	78.0	n/a
Total area	km^2 (2000)	253,336.0	438.3	4,783.7	4,872.1
	km^2 (1990)	253,336.0	419.9	1,073.0	1,177.5
	% Change (1990-2000)	0.0	4.4	345.8	313.8
Land area	km^2 (2000)	251,962.8	436.9	4,763.4	4,851.5
	% Land area (2000)	100.0	0.2	1.9	1.9
	km^2 (1990)	251,962.8	418.8	1,068.6	1,172.5
	% Land area (1990)	100.0	0.2	0.4	0.5
	% Change (1990-2000)	0.0	4.3	345.8	313.8
Population density (people/land area km^2)	2000	2.0	735.5	80.8	n/a
	1990	1.8	703.5	317.7	n/a
	% Change (1990-2000)	8.9	4.6	-74.6	n/a
Tree canopy cover (2000)	km^2	24,017.6	22.8	596.9	599.7
	% Land area	9.5	5.2	12.5	12.4
	Per capita (m^2/person)	48,640.1	70.8	1,550.6	n/a
	% Canopy green space [d]	9.6	7.0	13.0	12.8
Total green space (2000) [e]	km^2	251,244.0	326.1	4,598.1	4,678.2
	% Land area	99.7	74.6	96.5	96.4
Available green space (2000) [f]	km^2	227,227.0	304.3	4,002.3	4,079.6
	% Land area	90.2	69.6	84.0	84.1
Impervious surface cover (2000)	km^2	719.1	110.8	165.3	173.3
	% Land area	0.3	25.4	3.5	3.6
	Per capita (m^2/person)	1,456.3	344.8	429.3	n/a
Urban tree benefits (2000)	Estimated number of trees	n/a	1,100,000	28,500,000	28,600,000
	Carbon				
	Carbon stored (metric tons)	n/a	200,000	5,400,000	5,500,000
	Carbon stored ($)	n/a	$4,600,000	$123,100,000	$125,400,000
	Carbon sequestered (metric tons/year)	n/a	7,000	179,000	180,000
	Carbon sequestered ($/year)	n/a	$160,000	$4,081,000	$4,104,000
	Pollution				
	CO removed (metric tons/year)	n/a	1	29	29
	CO removed ($/year)	n/a	$1,600	$40,700	$40,900
	NO_2 removed (metric tons/year)	n/a	29	752	755
	NO_2 removed ($/year)	n/a	$283,900	$7,449,300	$7,483,700
	O_3 removed (metric tons/year)	n/a	40	1,054	1,059
	O_3 removed ($/year)	n/a	$398,000	$10,445,000	$10,494,000
	SO_2 removed (metric tons/year)	n/a	11	284	286
	SO_2 removed ($/year)	n/a	$26,300	$689,400	$692,600
	PM_{10} removed (metric tons/year)	n/a	46	1,196	1,202
	PM_{10} removed ($/year)	n/a	$301,600	$7,912,600	$7,949,200
	Total pollution removal (metric tons/year)	n/a	130	3,320	3,330
	Total pollution removal ($/year)	n/a	$1,000,000	$26,500,000	$26,700,000

[a] Urban land is based on population density and was delimited using the United States Census definitions of urbanized areas and urban clusters. [b] Community land is based on jurisdictional or political boundaries of communities based on United States Census definitions of incorporated or census designated places. [c] Urban or communities is land that is urban, community, or both. Communities may include all, some, or no urban land within their boundaries. [d] Canopy green space is the tree canopy cover divided by total green space. [e] Total green space (TGS) is total area – impervious surface cover – water. [f] Available green space (AGS) is total green space – tree canopy cover (if the calculated value is less than 0, then value set at 0).

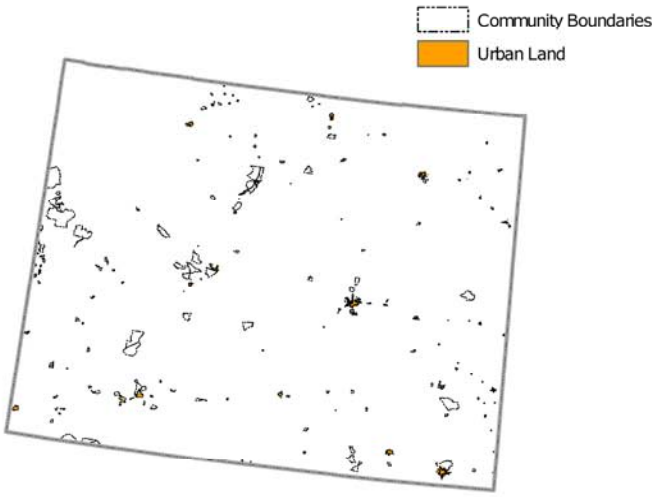


Figure WY-1.—Urban or community land in 2000; urban area relative to community boundaries.

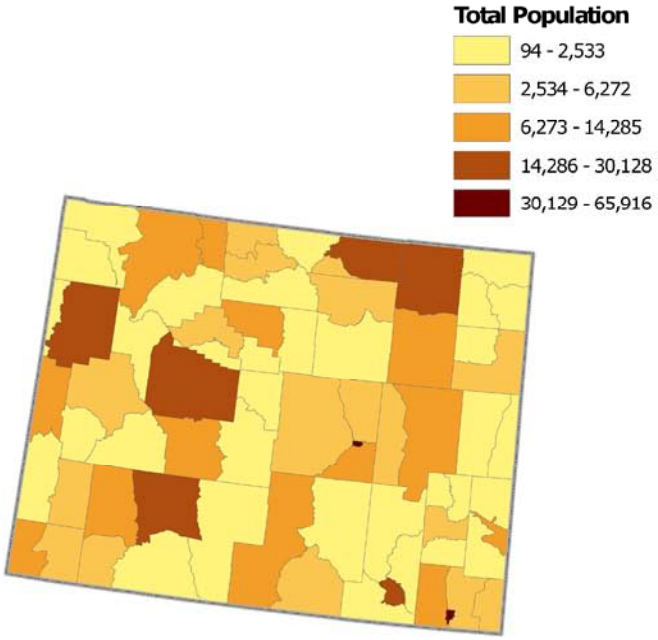


Figure WY-2.—2000 population within county subdivision boundaries.

Human Population Characteristics and Trends

The population in Wyoming increased 8.9 percent, from 453,588 in 1990 to 493,782 in 2000 (Table WY-1). In Wyoming, 65.1 percent of the State's population is in urban areas (Fig. WY-1), and 78.0 percent of the population is within communities (Fig. WY-2).

Urban and Community Land

Urban land comprises 0.2 percent of the land area of Wyoming, while lands within communities make up 1.9 percent of the State (Fig. WY-1). Between 1990 and 2000, urban area increased 4.3 percent, while community land increased from 0.4 to 1.9 percent (Table WY-1). Urban area in Wyoming is projected to increase to 0.6 percent by 2050, based on average urban growth pattern of the 1990s (Nowak and Walton 2005). Both urban land (attaining minimum population density) and community land (political boundaries) increased from 1990 to 2000. The percentages are calculated using the total (water and land) area of the geopolitical units derived from U.S. Census cartographic boundary data. Percent urban land varied across the State (Fig. WY-3; Tables WY-2 through 4).

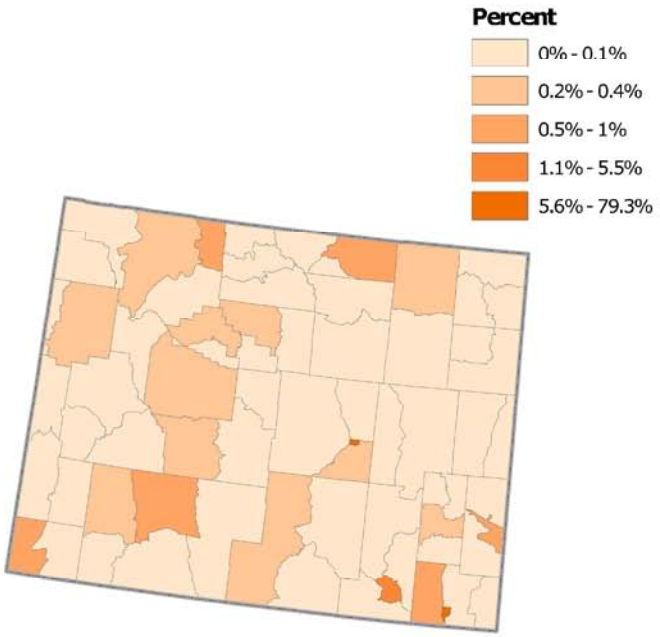


Figure WY-3.—Percent of county subdivision area classified as urban land in 2000.

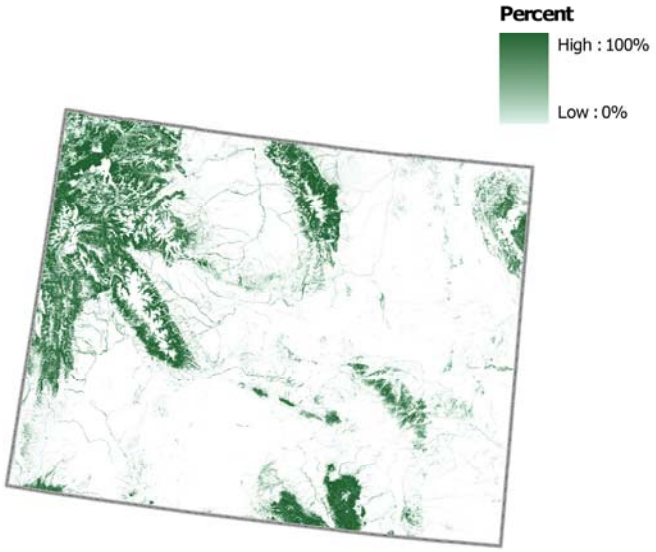


Figure WY-4.—Percentage tree canopy cover.

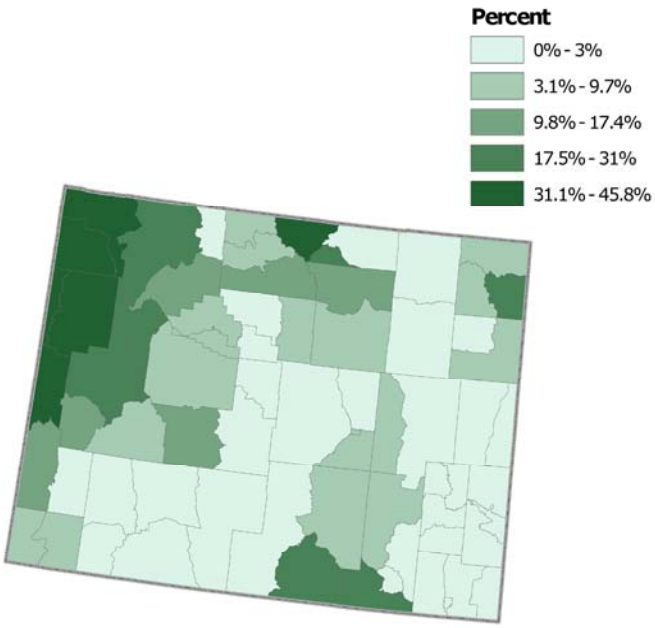


Figure WY-5.—Percentage tree canopy cover within county subdivisions.

Tree Canopy Cover Characteristics

Tree canopy cover in Wyoming averages 9.5 percent (Fig. WY-4), with 99.7 percent total green space, 9.6 percent canopy green space, and 48,640.1 m^2 of canopy cover per capita. Average tree cover in urban areas in Wyoming was 5.2 percent, with 74.6 percent total green space, 7.0 percent canopy green space, and 70.8 m^2 of canopy cover per capita. Within community lands in Wyoming, average tree cover was 12.5 percent, with 96.5 percent total green space, 13.0 percent canopy green space, and 1,550.6 m^2 of canopy cover per capita (Table WY-1). Tree canopy cover, canopy green space, and tree cover per capita varied among communities, county subdivisions, and counties (Fig. WY-5 through 6; Tables WY-5 through 7).

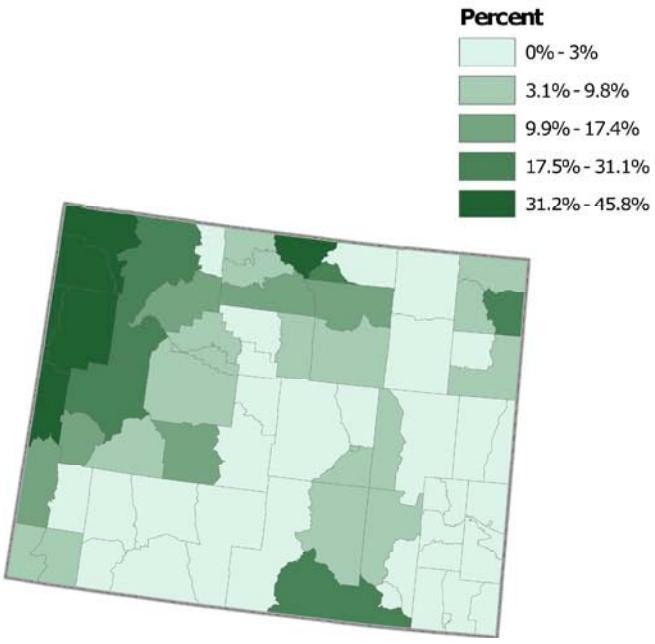


Figure WY-6.—Percentage tree canopy green space in county subdivisions.

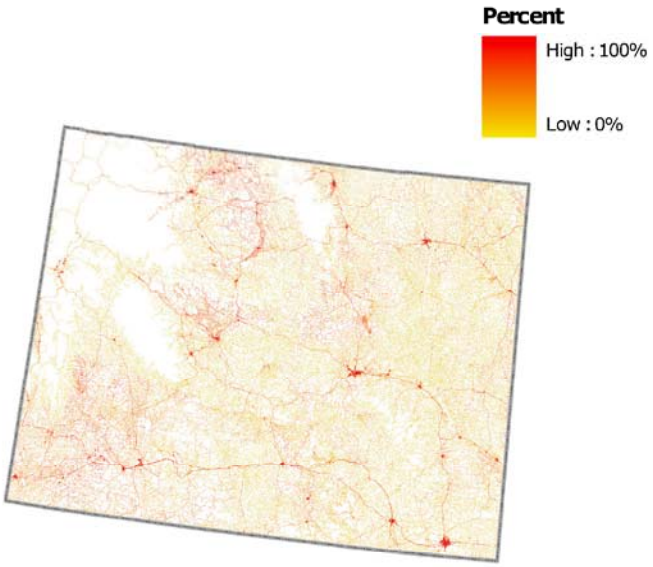


Figure WY-7.—Percentage impervious surface cover.

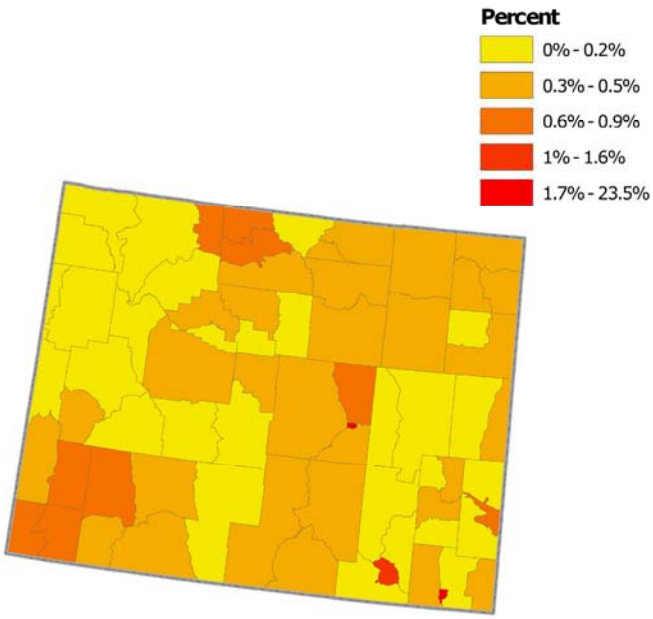


Figure WY-8.—Percentage impervious surface cover within county subdivisions.

Impervious Surface Cover Characteristics

Average impervious surface cover in Wyoming is 0.3 percent of the land area (Fig. WY-7), with 1,456.3 m^2 of impervious surface cover per capita. Average impervious surface cover in urban areas was 25.4 percent, with 344.8 m^2 of impervious surface cover per capita. Within community lands in Wyoming, average impervious surface cover was 3.5 percent with 429.3 m^2 of impervious surface cover per capita (Table WY-1). Impervious surface cover varied across the State (Fig. WY-8; Tables WY-5 through 7).

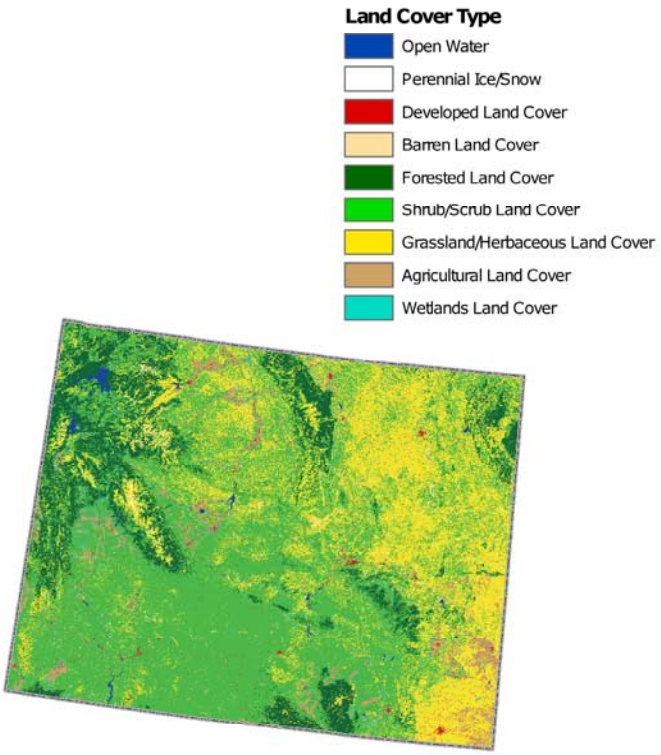


Figure WY-9.—Classified land cover.

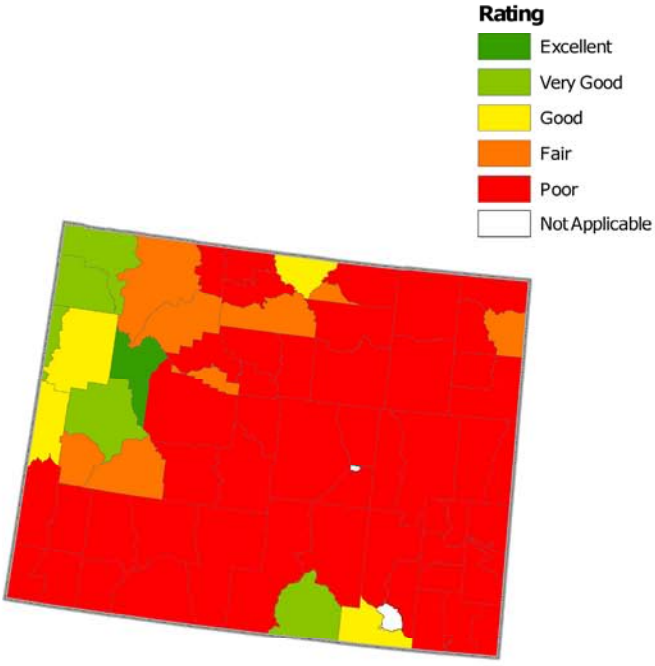


Figure WY-10.—Relative comparisons of tree cover for county subdivisions.

Classified Land-cover Characteristics

Wyoming's land cover is dominated by scrub/shrub land (Fig. WY-9). The characteristics as a percent of the total land area in Wyoming are (Tables WY-8 through 10):

- Scrub/Shrub – 52.0 percent
- Grassland – 28.5 percent
- Forested – 12.7 percent
- Agricultural – 3.9 percent
- Wetland – 1.0 percent
- Barren – 1.0 percent
- Developed – 0.8 percent

Relative Comparisons of Tree Cover

Out of the 198 Wyoming communities, nine received a rating of excellent and 137 received a rating of poor (Table WY-12). Of the 71 county subdivisions, one had a rating of excellent and 51 were rated poor (Fig. WY-10, Table WY-13); and out of 23 counties, two were given a rating of excellent and 13 were given a rating of poor (Table WY-14). Variability of assessment scores is a product of the difference in land-cover distributions and the percentage of canopy cover within the population density classes and mapping zones (Fig. WY-10; Tables WY-11 through 14).

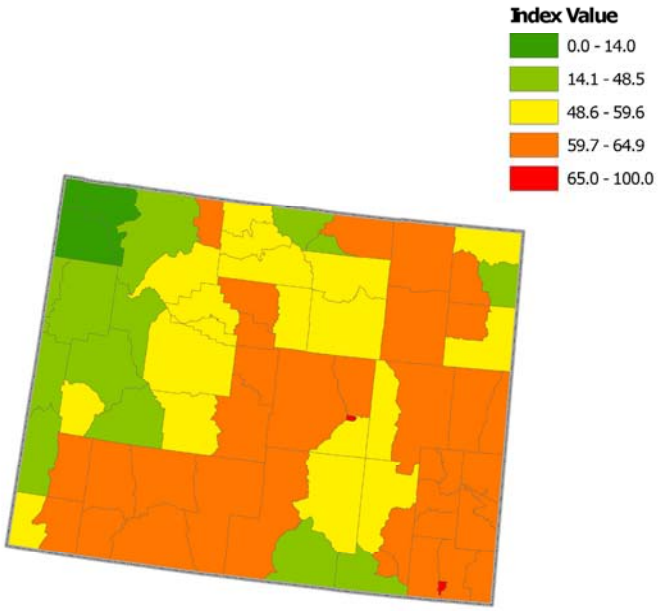


Figure WY-11.—Planting priority index for county subdivisions. The higher the index value, the greater priority for planting.

Priority Areas for Tree Planting

Priority areas for planting tend to be highest in more urbanized areas due to higher population density (Fig. WY-11; Tables WY-15 through 17). These index values can also be produced using high resolution cover data to determine local planting priority areas (e.g., neighborhoods).

Urban Tree Benefits

The following forest attributes are estimated for the urban or community land in Wyoming (Table WY-1). These are rough estimates of values. More localized data are needed for more precise estimates, but these values reveal first-order approximations.

- 28.6 million trees
- 5.5 million metric tons of C stored ($125.4 million value)
- 180,000 metric tons/year of C sequestered ($4.1 million value)
- 3,330 metric tons/year total pollution removal ($26.7 million value)
  - 29 metric tons/year of CO removed ($40,900 value)
  - 755 metric tons/year NO_2 removed ($7.5 million value)
  - 1,059 metric tons/year of O_3 removed ($10.5 million value)
  - 286 metric tons/year of SO_2 removed ($692,600 value)
  - 1,202 metric tons/year of PM_{10} removed ($7.9 million value)

Summary

The data presented in this report provide a better understanding of Wyoming's urban and community forests. This information can be used to advance urban and community forest policy and management that could improve environmental quality and human health throughout the State.

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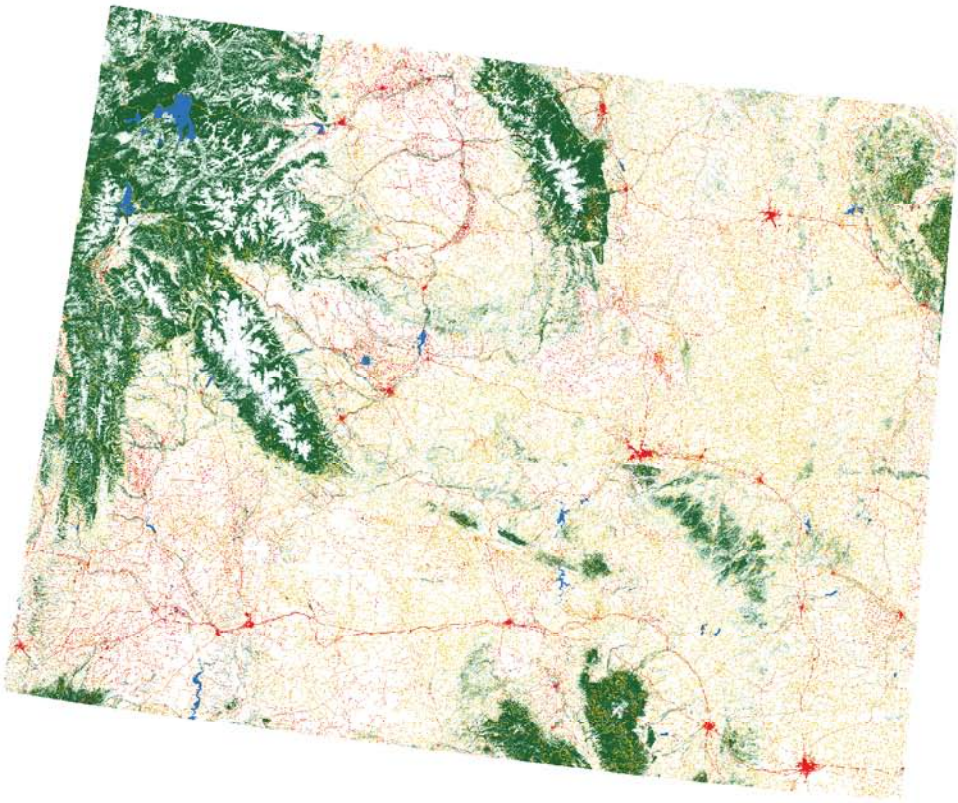

WYOMING'S URBAN AND COMMUNITY FORESTS

Statewide Summary

Urban or community land in Wyoming comprises about 1.9 percent of the state land area in 2000, an increase from 0.5 percent in 1990. Statewide tree canopy cover averages 9.5 percent and tree cover in urban or community areas is about 12.4 percent, with 3.6 percent impervious surface cover and 12.8 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Wyoming has an estimated 28.6 million trees, which store about 5.5 million metric tons of carbon ($125.4 million), and annually remove about 180,000 metric tons of carbon ($4.1 million) and 3,330 metric tons of air pollution ($26.7 million) (Table WY-1).

Tables WY-2 through WY-17 are not printed in this report but are available on the CD located on the inside back cover and at http://nrs.fs.fed.us/data/urban.

APPENDIX

Urban Forest Data: States of the Mountain Region

The following tables are generated to support state reports on urban and community forests of the Mountain states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. For specific state data tables use the CD accompanying this publication and search within the regional or state folder, or go to: http://www.nrs.fs.fed.us/data/urban.

State Specific Tables:

Table 1.—Statewide summary of population, area, population density, tree canopy and impervious surface land cover, and urban tree benefits in urban, community, and urban or community areas.

Table 2.—2000 population characteristics, population change (1990-2000), and percent of land classified as urban within communities.

Table 3.—2000 population characteristics, population change (1990-2000), percent of land classified as urban or as communities within county subdivisions.

Table 4.—2000 population characteristics, population change (1990-2000), percent of land classified as urban or as communities within counties.

Table 5.—Tree canopy and impervious surface cover characteristics by community.

Table 6.—Tree canopy and impervious surface cover characteristics by county subdivision.

Table 7.—Tree canopy and impervious surface cover characteristics by county.

Table 8.—Land area, tree canopy cover, and available green space distributed within generalized land cover categories for communities.

Table 9.—Land area, tree canopy cover, and available green space distributed within generalized land cover categories for county subdivisions.

Table 10.—Land area, tree canopy cover, and available green space distributed within generalized land cover categories for counties.

Table 11.—Statistical summary of mapping zone values used to calculate urban and community forestry assessment.

Table 12.—Urban and community forestry assessment by community.

Table 13.—Urban and community forestry assessment by county subdivisions.

Table 14.—Urban and community forestry assessment by counties.

Table 15.—Planting priority index for communities.

Table 16.—Planting priority index for county subdivisions.

Table 17.—Planting priority index for counties.

Nowak, David J.; Greenfield, Eric J. 2010. **Urban and community forests of the Mountain region: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming.** Gen. Tech. Rep. NRS-63. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 78 p. [Includes CD-ROM].

This report details how land cover and urbanization vary within the states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming by community (incorporated and census designated places), county subdivision, and county. Specifically this report provides critical urban and community forestry information for each state including human population characteristics and trends, changes in urban and community lands, tree canopy and impervious surface cover characteristics, distribution of land-cover classes, a relative comparison of urban and community forests among local government types, determination of priority areas for tree planting, and a summary of urban tree benefits. Report information can improve the understanding, management, and planning of urban and community forests. This data is reported for each state on the CD provided in the back of this book and may be accessed by state at: http://www.nrs.fs.fed.us/data/urban.

KEY WORDS: urban forestry, tree cover, impervious cover, classified land cover, ecosystem services, urbanization

Capitalizing on the strengths of existing science capacity in the Northeast and Midwest to attain a more integrated, cohesive, landscape-scale research program

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