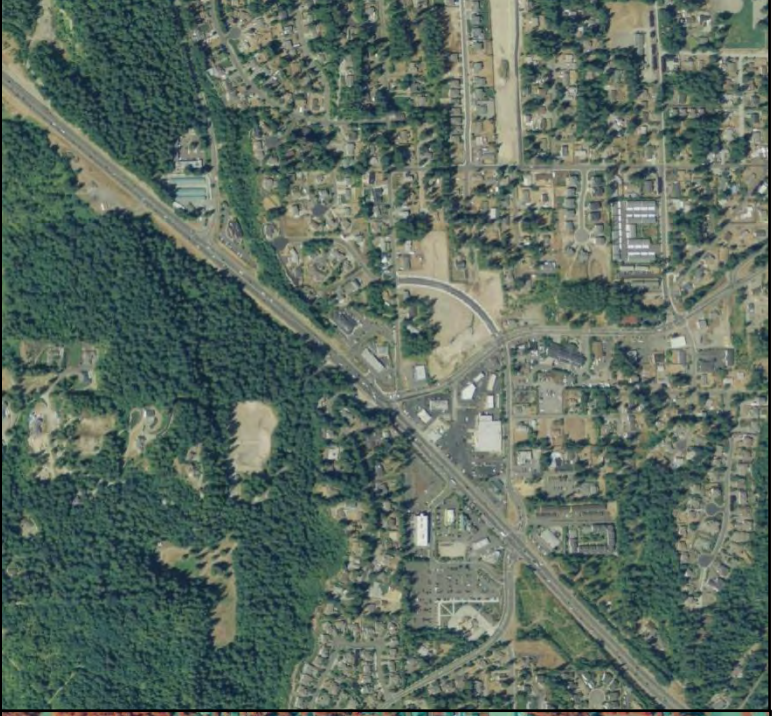

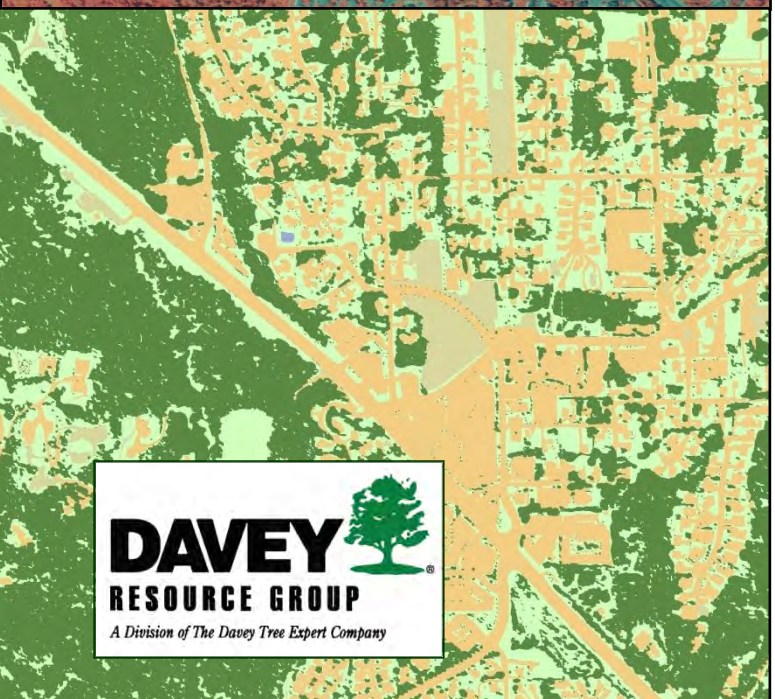

DAVEY RESOURCE GROUP
A Division of The Davey Tree Expert Company

City of Bonney Lake, Washington

Urban Tree Canopy Assessment

March 2011

City of Bonney Lake, Washington

URBAN TREE CANOPY ASSESSMENT

February, 2011

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Executive Summary

Trees and urban forests are vital to the health and sustainability of any community. Located in the lushly forested Pacific Northwest, Bonney Lake recognizes the benefits of trees and the value of urban tree canopy. While long appreciated for their contributions of shade and beauty to our landscapes, science and technology has now made it possible to quantify the environmental benefits to energy savings, cleaner air and water, carbon dioxide reduction, property values, and socio-economics. The Center for Urban Forest Research (**CUFR**) estimates that over a 40 year period 100 urban trees in the pacific northwest provide $202,000 in benefits (Trees in Our City).

As a Tree City, USA with an active **Community Forestry Program**, The City of Bonney Lake has made a commitment to protect and manage the community's tree resources. As a part of this commitment, the City contracted with Davey Resource Group in November 2010 to carry out an urban tree canopy assessment. The purpose of the assessment was to quantify and map existing urban tree canopy as well as impervious surface, open water, pervious surface, and bare soil. High resolution aerial imagery and infra-red technology was used to remotely map tree canopy and land cover over the city limits and adjacent areas planned for future incorporation. The results of the study provide a clear picture of the extent and distribution of urban tree canopy over the Bonney Lake area. The data developed during the assessment becomes an important part of the City's GIS database and provides a foundation for developing community goals and urban forest policies. The primary purpose of the assessment was to establish a benchmark value to measure the success of long-term management strategies over time.

Taking into account the entire study, which included the area within the city limits along with other unincorporated target areas, the assessment found an overall average tree canopy cover of 43%, which is slightly above the canopy goal of 40% suggested by **American Forests** for communities in the Pacific Northwest. Within the current city limits, the canopy cover average is 40%. The potential for tree canopy in the Bonney Lake study area is 75%. However, the population has expanded nearly 80% since 2000. And while growth and development is vital to the economic well-being and sustainability of the community, it can exact a toll on existing trees and forestlands. The study identified 434 acres of tree canopy at high risk for development and deforestation. Without a plan for replacing trees lost to expansion, loss of additional forestlands could significantly reduce overall canopy and the environmental services provided to the community.

Communities across the country are finding themselves in the position of reestablishing their urban forests after significant loss of canopy begins taking a toll on quality of life. Bonney Lake is in the enviable position of being able to preserve tree canopy at nearly ideal levels. Adopting proactive preservation strategies is much more cost-effective then trying to rebuild a healthy, working urban forest. Positive decisions made today can ensure that Bonney Lake remains a vibrant community, a "small town, natural environment", where dreams can soar!

Introduction

The City of Bonney Lake, Washington is located in northwest Pierce County on the southern shores of Lake Tapps, approximately 10 miles southeast of Tacoma, in the verdant and lushly forested Pacific Northwest,. At an elevation of 575 feet, the community enjoys mild temperatures much of the year, ranging from a high of 75° in August to a low of around 30° in January. The average rainfall is around 40 inches a year, falling heaviest from October through April. Residents and visitors enjoy beautiful scenery, idyllic lakes, wooded hillsides, and stunning views of Mount Rainier. Incorporated in 1949, Bonney Lakes' design theme is a "Small Town, Natural Environment" (Bonney Lake Comprehensive Plan).

The City of Bonney Lake recognizes the importance of an urban forest and the value of urban tree canopy. Evidence exists that to be healthy and sustainable, a community must integrate the natural environment into urban development design. Trees and vegetation provide critical environmental services, which in turn affect the quality of life of residents, visitors, and neighboring communities. A Tree City, USA, since 2005, Bonney Lake has an active **Community Forestry Program** within the Community Services Department and a tree protection ordinance (**Municipal Code Chapter 12.24**) that "prohibits defacing or injuring public trees (in City parks or right of ways)".

In an effort to quantify existing urban tree canopy as well as impervious surfaces, surface water, grasslands, and bare soils, the City of Bonney Lake contracted with Davey Resource Group (DRG) in November 2010, to assess the amount and distribution of tree canopy within city limits and adjacent areas planned for incorporation in the future. The primary objective of the assessment was to establish a benchmark value for overall canopy and other land cover.

The amount and distribution of leaf surface area (tree canopy) is the driving force behind the urban forest's ability to produce benefits for the community (Clark et al, 1997). As canopy cover increases, so do the benefits afforded by leaf area. These benefits, which include energy savings, air quality, water quality, and other socio-economic benefits can be quantified for their value to the community. The Center for Urban Forest Research (**CUFR**) estimates that 100 trees in the pacific northwest provide $202,000 in benefits over a 40 year period (Trees in Our City).

The Benefits of Urban Tree Canopy

Urban and natural forests work 24/7 to mitigate the effects of urbanization and development and to protect and enhance life within the community in the following ways:

Energy Savings

Urban trees and forests modify climate and conserve energy in three principal ways:

- **Shading dwellings and hardscape**
- **Transpiration**
- **Wind reduction**

Shade from trees reduces the amount of radiant energy absorbed and stored by hardscape and other impervious surfaces, thereby reducing the heat island effect, a term that describes the increase in urban temperatures in relation to surrounding locations. Transpiration releases water vapor from tree canopies, which cools the surrounding area. Through shade and transpiration, trees and other vegetation within an urban setting modify the environment and reduce heat island effects. Temperature differences of more than 9°F (5°C) have been observed between city centers without adequate canopy cover and more vegetated suburban areas (Akbari et al, 1992).

Trees reduce wind speeds by up to 50% and influence the movement of warm air and pollutants along streets and out of urban canyons. By reducing air movement into buildings and against conductive surfaces (e.g., glass, metal siding), trees reduce conductive heat loss from buildings, translating into potential annual heating savings of 25% (Heisler, 1986).

Reducing energy needs has the added bonus of reducing carbon dioxide (CO_2) emissions from fossil fuel power plants

Well placed trees around a home can save 36% of annual air conditioning costs and 25% of winter heating costs in the pacific northwest.

(CUFR, Trees in Our City)

Air Quality

Urban trees improve air quality in five fundamental ways:

- **Reducing particulate matter (dust)**
- **Absorbing gaseous pollutants**
- **Shade and transpiration**
- **Reducing power plant emissions**
- **Increasing oxygen levels**

They protect and improve air quality by intercepting particulate matter (PM10), including dust, ash, pollen, and smoke. The particulates are filtered and held in the tree canopy where they are eventually washed harmlessly to the ground. Trees and forests absorb harmful gaseous pollutants like ozone (O3), nitrogen dioxide (NO2), and sulfur dioxide (SO_2). Shade and transpiration reduces the formation O3, which is brought on by higher temperatures. In fact, scientists are now finding that some trees may absorb more volatile organic compounds (VOC's) than previously thought (Karl, T. et al; Science NOW). VOC's are a class of carbon-based particles emitted from automobile exhaust, lawnmowers, and other human activities.

100 trees remove 235 pounds of pollutants per year, including 86 lbs of ozone and 84 lbs of particulates.

(CUFR, Trees in Our City)

By reducing energy needs, trees also reduce emissions from the generation of power. And, through photosynthesis, trees and forests increase oxygen levels.

Water Quality

Trees and forests improve and protect the quality of surface waters, such as creeks, rivers, and lakes, by reducing the impacts of stormwater runoff through:

- **Interception**
- **Increasing soil capacity and rate of infiltration**
- **Reducing soil erosion**

Trees intercept rainfall in their canopy, which act as a mini-reservoir (Xiao et al, 1998). During storm events, this interception reduces and slows runoff. In addition to catching stormwater, canopy interception lessens the impact of raindrops on barren soils. Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and snowmelt (McPherson et al, 2002). Each of these processes greatly reduces the flow and volume of stormwater runoff, avoiding erosion and preventing sediments and other pollutants from entering streams, rivers, and lakes.

Urban stormwater runoff is a major source of pollution for surface waters and riparian areas in the Pacific Northwest, threatening salmon and other wildlife as well as human populations. Requirements for stormwater management are becoming more stringent and costly. Reducing runoff and incorporating urban trees in stormwater management planning has the added benefit of reducing the cost of stormwater management, including the expense of constructing facilities necessary to detain and control stormwater, and the cost of treatment to remove sediment and other pollutants.

100 mature trees catch 112,000 gallons of rainwater per year.

(CUFR, Trees in Our City)

Carbon Reduction

Trees and forests reduce atmospheric carbon dioxide (CO_2) in two ways:

- **Directly, through growth and the sequestration**
- **Indirectly, by lowering the demand for energy**

Trees and forests directly reduce CO_2 in the atmosphere through growth and sequestration of CO_2 as woody and foliar biomass. Indirectly, trees and forests reduce CO_2 by lowering the demand for energy and reducing the CO_2 emissions from the consumption of natural gas and the generation of electric power.

As environmental awareness continues to increase, governments and individuals are paying particular attention to climate change and the effects of greenhouse gas emissions. Two national policy options are currently making headlines, the establishment of a carbon tax and a greenhouse gas cap-and-trade system, aimed at reducing atmospheric CO_2 and other greenhouse gases. A carbon tax would place a tax burden on each unit of greenhouse gas emission and would require regulated entities to pay for their level of emissions. Alternatively, in a cap-and-trade system, an upper limit (or cap) is placed on global (federal, regional, or other jurisdiction) levels of greenhouse gas emissions and the regulated entities would be required to either reduce emissions to required limits or purchase emissions allowances in order to meet the cap (Williams et al, 2007).

The concept of purchasing emission allowances (offsets) has led to the acceptance of carbon credits as a commodity that can be exchanged for financial gain. The Center for Urban Forest Research Pacific Southwest Research Station and USDA Forest Service recently led the development of Urban Forest Greenhouse Gas Reporting Protocol (McPherson et al, 2008). The protocol incorporates methods of the Kyoto Protocol and Voluntary Carbon Standard and establishes methods for calculating reductions, provides guidance for accounting and reporting, and guides urban forest managers in developing tree planting and stewardship projects that could be registered for greenhouse gas reduction credits (offsets). The protocol can be applied to urban tree planting projects within municipalities, educational campuses, and utility service areas anywhere in the US.

100 trees remove 23 tons of CO2 per year.

(CUFR, Trees in Our City)

Aesthetics and Socioeconomics

While perhaps the most difficult to quantify, the aesthetic and socioeconomic benefits from trees may be among their greatest gifts, including:

- **Beautification and comfort**
- **Shade and privacy**
- **Wildlife habitat**
- **Opportunities for recreation**
- **A reduction in violent crime**
- **Create a sense of place and history**
- **Reduced reliance on medication and quicker recovery from injury or illness**

Many of these benefits are captured as a percentage of property values, through higher sales prices where individual trees and forests are located.

While some of the benefits of forests are intangible and/or difficult to quantify, such as impacts on psychological health, crime, and violence, empirical evidence of these benefits does exist (Kaplan 1989; Ulrich 1986). However, there is limited knowledge about the physical processes at work and their interactions make quantification imprecise. Exposure to nature, including trees, has a healthy impact on humans, including increased worker productivity, higher test scores, reduced symptoms of ADD, and faster recovery times following surgery. In addition, trees and forests have positive economic benefits for retailers. There is documented evidence that trees promote better business by stimulating more frequent and extended shopping and a willingness to pay more for goods and parking (Wolf, 2007).

Each front yard tree adds 1% to the sales price and large, specimen trees can add 10% or more to property values.

Shoppers pay up to 12% more for goods when healthy trees are part of the landscape.

(CUFR, Trees in Our City)

In addition, trees and forestlands provide critical habitat (foraging, nesting, spawning, etc.) for mammals, salmon, and bird species, as well as limitless opportunities for recreation, offering a healthful respite from the pressures of work and everyday stress.

Calculating Tree Benefits

Communities can calculate the benefits of their urban forest by using a complete inventory or sample data in conjunction with the USDA Forest Service **i-Tree** software tools. This state-of-the-art, peer-reviewed software suite considers regional environmental data and costs to quantify the ecosystem services unique to a given urban forest resource.

Individuals can calculate the benefits of trees to their property by using the **National Tree Benefit Calculator** or with **i-Tree Design**.

Old Growth Forests

With large trees, dense understory, standing deadwood, and layers of debris in various stages of decay, old growth forests provide a unique environment for the complex biological interactions that protect the health of our planet. These mostly undisturbed areas aid in the formation of soil and protect both soil quality and productivity. They support a wide variety of plant life and fungi and provide critical habitat for wildlife, including mammals, birds, and anadromous fish.

Due to their density and biological complexity, old growth forests produce some of the highest benefits by area. They capture, filter, and store more precipitation than typical urban tree canopy and they help to regulate the volume of runoff, protecting the water quality of watersheds and surface waters. They preserve air quality, mitigate climate effects, provide spiritual and cultural resources, and offer unparalleled opportunities for passive recreation.

Old growth forests in the Pacific Northwest are some of the most unique forests on the planet due to the size and age of the trees. Washington's old growth forestlands are among the Earth's most important carbon storing ecosystems (Smithwick et al., 2002). Studies on national parklands in Washington and Oregon found that these forests are storing an average of 644 metric tons of CO_2e[1] per acre (Ingerson et al., 2010). In comparison, all forests throughout the conterminous U.S. store an average of 230 metric tons of CO_2e per acre.

One acre of forestland in the Pacific Northwest can store an average of 644 metric tons of CO_2e

[1] Equivalent CO_2 (CO_2e) is the internationally recognized measure of greenhouse gas emissions, representing the concentration of carbon dioxide (CO_2) that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas, including CO_2 methane (CH_4) and nitrous oxide (N_2O).

Economic Development vs. Urban Tree Canopy Preservation

From incorporation in 1949 to the turn of the century in 2000, the population of Bonney Lake grew from 327 residents to 9,687 residents (Figure 1). The 2010 census reports that the current population of Bonney Lake is 17,374. That's an increase of nearly 80% in just 10 years. While continued growth and development is vital to the social and economic well-being and sustainability of the community, the conservation of sufficient tree and forest canopy is equally vital to the continued livability and attractiveness of the community.

The assessment found that within the overall study area, Bonney Lake currently has an average tree canopy cover of 43.3%. That's just slightly above the 40% recommended by **American Forests**. However, additional canopy has already been lost since the 2009 imagery used in this assessment was captured, including 4.6 acres in the area formerly known as the Washington State University Demonstration Forest. Another 434 acres was identified during the assessment as at risk for development and deforestation. Unfortunately, while it's easy to believe that this resource is unlimited and self-sustaining, the truth is neglecting to provide adequate consideration to the preservation of trees and forests can be a costly oversight. Communities across the country are finding themselves in the position of reestablishing their urban forests after significant loss of canopy begins taking a toll on quality of life. Recognizing the vital function of trees and forests and adopting proactive preservation strategies is much more cost-effective then trying to rebuild a healthy, working urban forest. Smart growth requires consideration of natural resources, and an effective strategy aims to conserve the overall level of tree canopy and associated benefits while supporting growth and development and respecting the rights of property owners to make decisions about their land.

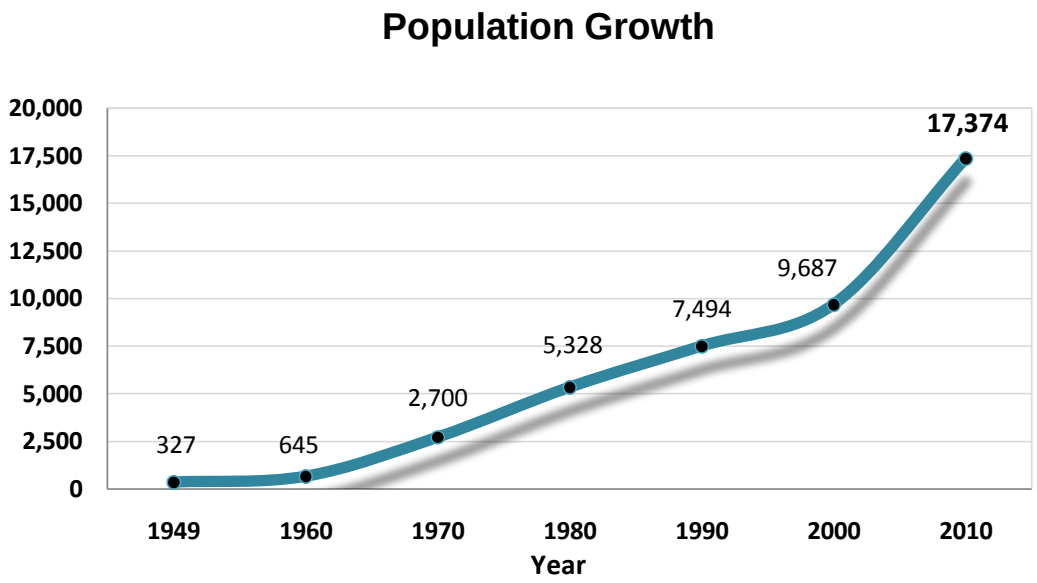


Figure 1. Population growth of Bonney Lake since incorporation in 1949. **(City of Bonney Lake)**

Urban Tree Canopy Assessment

As more communities focus attention on environmental sustainability, community forest management has become increasingly dependent on geographic information systems (GIS) for urban tree canopy mapping and analysis. Understanding the extent and location of existing canopy is a key step to identifying various types of community forest management opportunities. Urban forestry research and applications can provide additional guidance for determining a balance between growth and preservation and aid in identifying and assessing existing forestry opportunities.

Methods and Source Data

Davey Resource Group (DRG) used advanced GIS and remote sensing software to identify and map tree canopy and other land cover within the Bonney Lake project area using 2008 high resolution aerial imagery from the City of Bonney Lake and Pierce County, and National Agricultural Imagery Program (NAIP) 4-band imagery acquired by the United States Department of Agriculture (USDA) in 2009. Canopy and land cover summary statistics were developed using GIS layers provided by both the City and the County. A more detailed description of the imagery and processes used in this assessment can be found in Appendix B.

Remote image analysis is a cost-effective and highly accurate approach to assessing your community's existing tree canopy coverage, in support of responsible tree management, community forest goal-setting, and urban resource planning. The Bonney Lake urban tree canopy assessment provides the following information:

- **Land cover.** Using remote image sensing, the project identified and quantified the extent and location of the following land cover classifications:
  - *Urban tree canopy* (including both trees and shrubs)
  - *Impervious surface* (pavement, buildings, etc.)
  - *Pervious surface* (including grass and low-lying shrubs)
  - *Bare soils*
  - *Open water* (lakes, rivers, etc.)
- **Land Cover by Area and Region.** The assessment identified land cover for the city limits, each of the sub areas, and regions within the city limits.
- **Tree Canopy by Use.** The assessment identified tree canopy cover by use, including parks and open space, right-of-way, city-owned parcels, land use, and zoning.
- **Tree Canopy in Critical Areas.** Critical areas include watersheds, wetlands, slopes >30%, and stormwater management areas.
- **Tree Canopy Development Risk.** The assessment identified areas of protected canopy as well as those areas at high risk of development.

The data developed as a result of this assessment becomes a part of the City's GIS database, and provides a foundation for the development of long-term management goals and allows managers and residents to make informed decisions about budgetary and policy support and management priorities. The analysis also establishes benchmarks for measuring the success of future management strategies.

Project Area

The Bonney Lake urban tree canopy assessment considered all area within the following boundaries (Map 1):

- **City limits of Bonney Lake**
- **Sub-area 1**
- **Sub-area 2**
- **Sub-area 3**
- **Urban**
- **Urban Growth Areas (UGAs)**
- **Other Unincorporated Area**

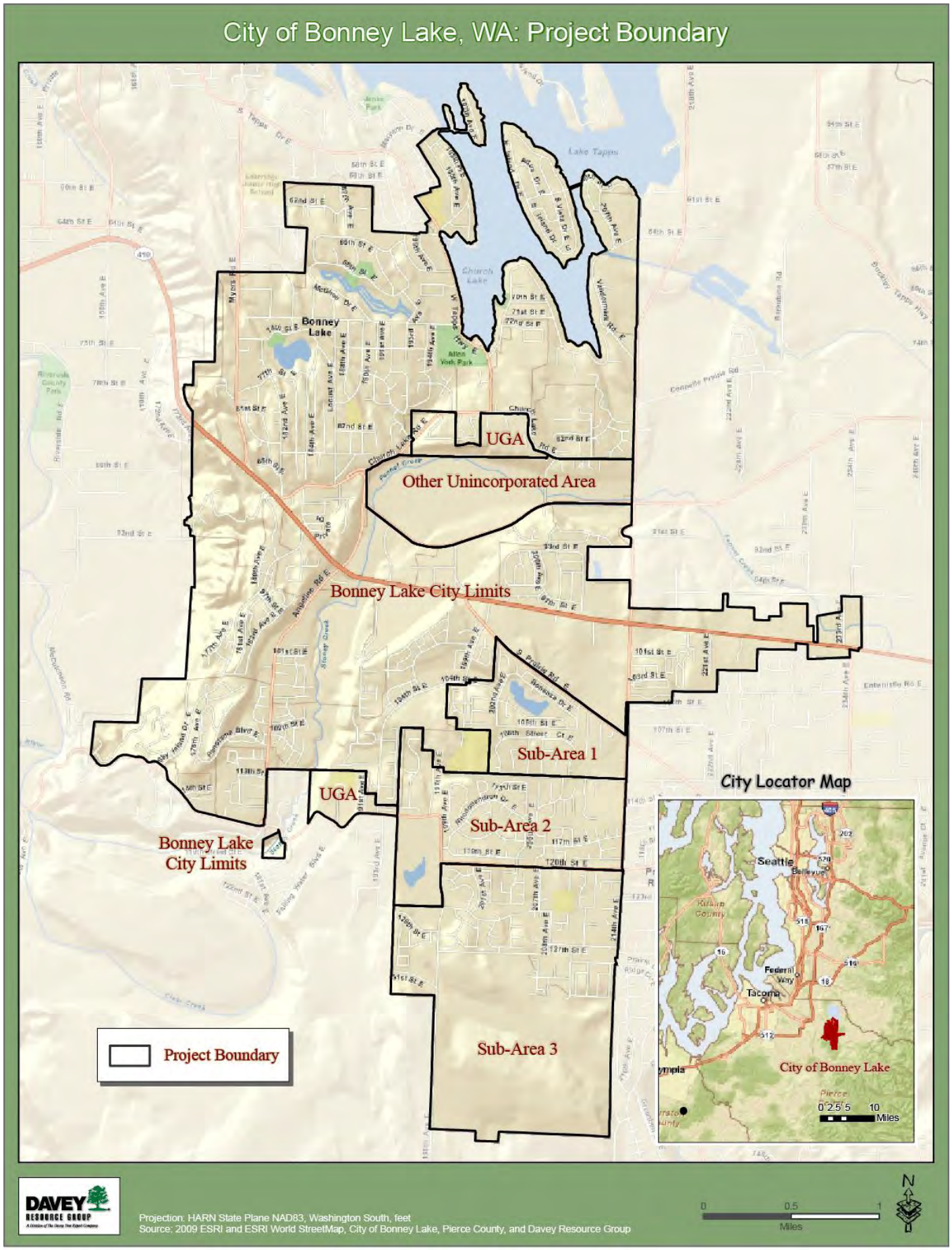
Tree canopy cover, which includes both trees and shrubs, is easy to differentiate from other land cover classifications using NAIP, 4-band aerial imagery with color infrared.

Canopy Goals

Setting a canopy goal is an important step in urban forest management and in ensuring the quality of life and sustainability of a community. Canopy can be expanded and maintained through a variety of means, including preservation, conservation, and new tree plantings on public and/or private lands. Canopy goals can be broad based, or specific to land use, but they should be determined based on the ability of a community to accomplish and sustain the goal. When setting canopy goals, a community should consider how trees and forests contribute to quality of life and how tree and forest canopy can help achieve environmental goals, including federal and local regulations for clean air, water, and stormwater runoff.

In the absence of a specific community goal, **American Forests** suggests average canopy goals based on land use and geographic location. These goals are founded on science-based urban forestry research that allows for the quantification of urban forest benefits and the development of technology to accurately measure the extent and location of tree canopy. For communities in the Pacific Northwest, American Forests suggests the following canopy goals:

- **Average tree canopy (all areas and zones) 40%**
- **Suburban residential zones 50%**
- **Urban residential zones 25%**
- **Central business districts 15%**



Map 1. Project Area Boundary

Chapter 1: Bonney Lake Tree Canopy & Other Land Cover

Land Cover Summary

The Bonney Lake urban tree canopy assessment covered an overall area just over 11 square miles (7,051 acres) including the City of Bonney Lake, Sub-Area 1, Sub-Area 2, Sub-Area 3, Urban Growth Areas (UGAs) and Other Unincorporated Areas (Map 1). Excluding impervious surfaces (1,675 acres) and open water (86 acres), the project area includes 8.3 square miles (5,289 acres) with the potential to support tree canopy. Using remote image sensing and GIS analysis, DRG determined that the following information characterizes land cover within the Bonney Lake project area:

- 4.8 miles^2 (3,051 acres) of overall tree canopy, including trees and woody shrubs, was identified in the land cover assessment, an average tree canopy cover of 43%.
- Considering pervious surfaces (2,143 acres), bare soils (96 acres) and existing canopy (3,051 acres), the canopy potential for Bonney Lake is 75%.
- 2.6 miles^2 (1,675 acres) of overall impervious surfaces, including roads and structures, was identified in the assessment, an average impervious surface cover of 24%
- 3.4 miles^2 (2,143 acres) of overall pervious surfaces, including grass and low-lying vegetation, was identified in the assessment, an average pervious surface of 31%
- 86 acres of open water (not including Lake Tapps) was identified in the assessment, an overall average open water of 1%
- 96 acres of bare soils was identified in the assessment, an average overall bare soil of 1%
- 577 acres of tree canopy is in parks and open space, an average canopy cover of 58%
- 144 acres of tree canopy is in right-of-ways, including both public and private, an average canopy cover of 19%.
- 172 acres of tree canopy is on city-owned parcels, an average canopy cover of 58%
- 199 acres of tree canopy is in wetlands, an average canopy cover of 61%
- The average canopy cover on slopes (>30%) is 38%
- 434 acres of tree canopy is on parcels at high risk of development and deforestation

Overall Land Cover Classification

The overall project area encompasses just over 11 square miles (7,051 acres), including the City of Bonney Lake, Sub-Area 1, Sub-Area 2, Sub-Area 3, Urban Growth Areas (UGA) and Other Unincorporated Areas (Map 1). Land cover classification within the overall area includes the following (Figure 2) (Map 2):

- **43% – Canopy,** 3,051 acres
- **24% – Impervious surfaces,** 1,675 acres
- **31% – Pervious surfaces,** 2,143 acres
- **1% – Open water,** 86 acres
- **1% – Bare soils,** 96 acres

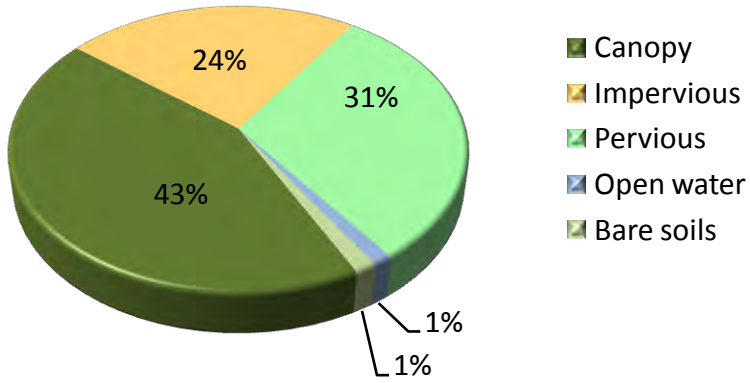


Figure 2. Overall land cover classification

Distribution of Tree Canopy

Within the overall project area, the majority of tree canopy (61%) is within the city limits, followed by 23% in Sub Area 3, and 6% in Sub Area 2. Urban Growth Areas (UGA) contained the least amount of overall tree canopy at 3% (Figure 3).

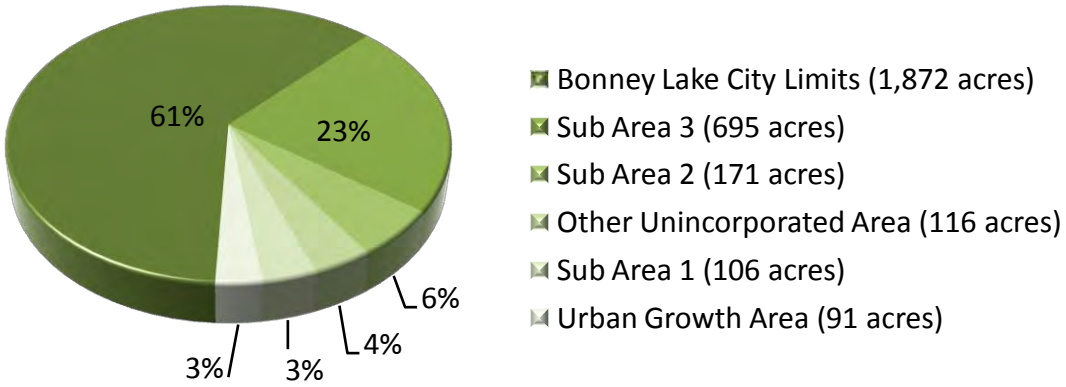
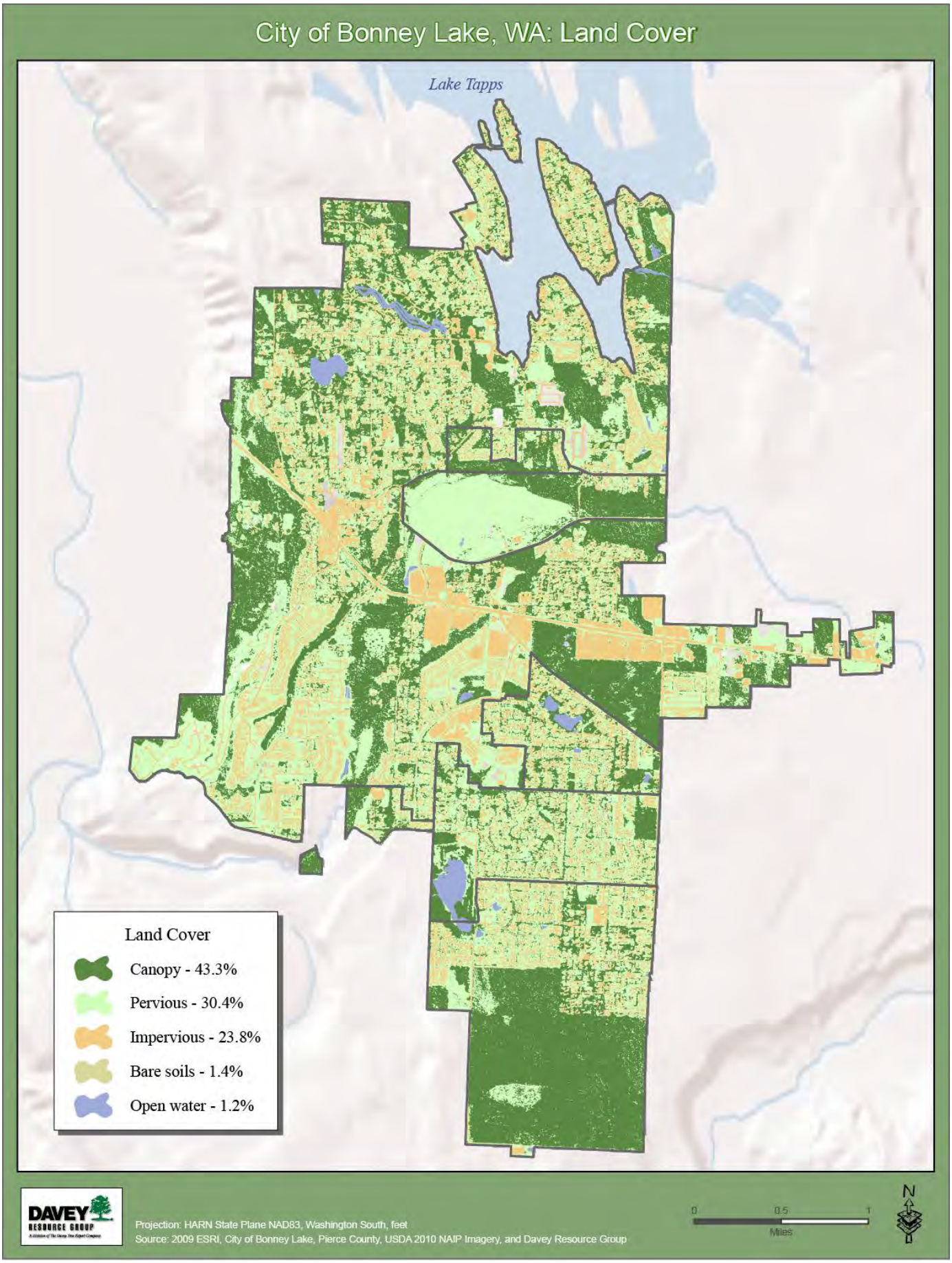


Figure 3. Distribution of tree canopy within the overall project area



Map 2. Land Cover Classification

Chapter 2: Land Cover by Area, Region and Use

Land Cover: Bonney Lake City Limits

The city limits of Bonney Lake encompass an area of 7.3 square miles (4,682 acres). Land cover classification within the city limits includes the following (Figure 4):

- **40% – Canopy,** 1,872 acres
- **27% – Impervious surfaces,** 1,258 acres
- **30% – Pervious surfaces,** 1,420 acres
- **1% – Open water,** 44 acres
- **2% – Bare soils**, 88 acres

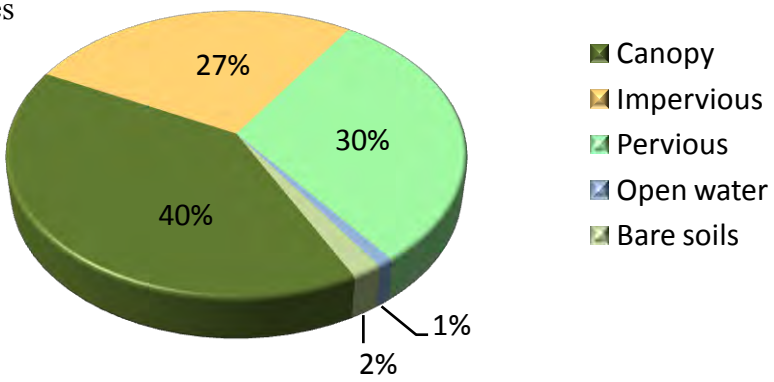


Figure 4. Land cover within Bonney Lake city limits

Tree Canopy Cover by Region

Within the Bonney Lake city limits, the Midtown Region has the highest average canopy cover at 44%, followed by Bonney Lake (Other) with an average canopy cover of 39.7%, and the Eastown Region with an a average canopy cover of 23.8%. The Downtown Region has the lowest average canopy cover at 23.8% (Figure 5) (Map 3).

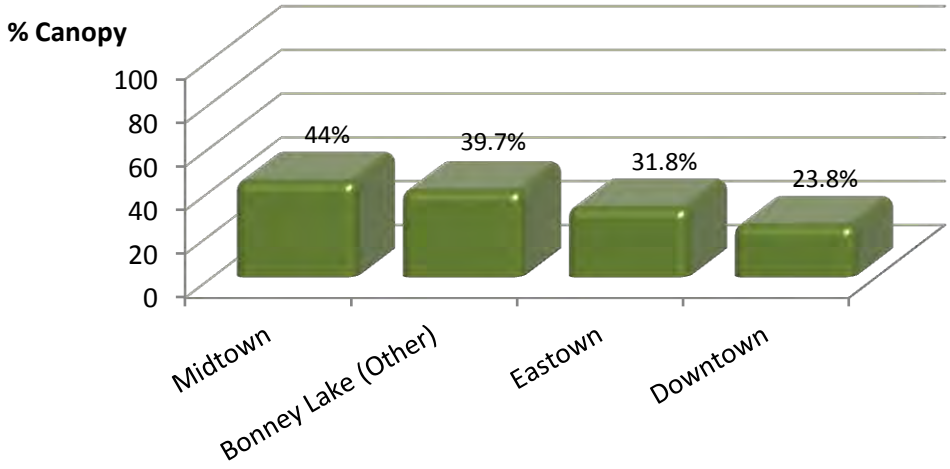
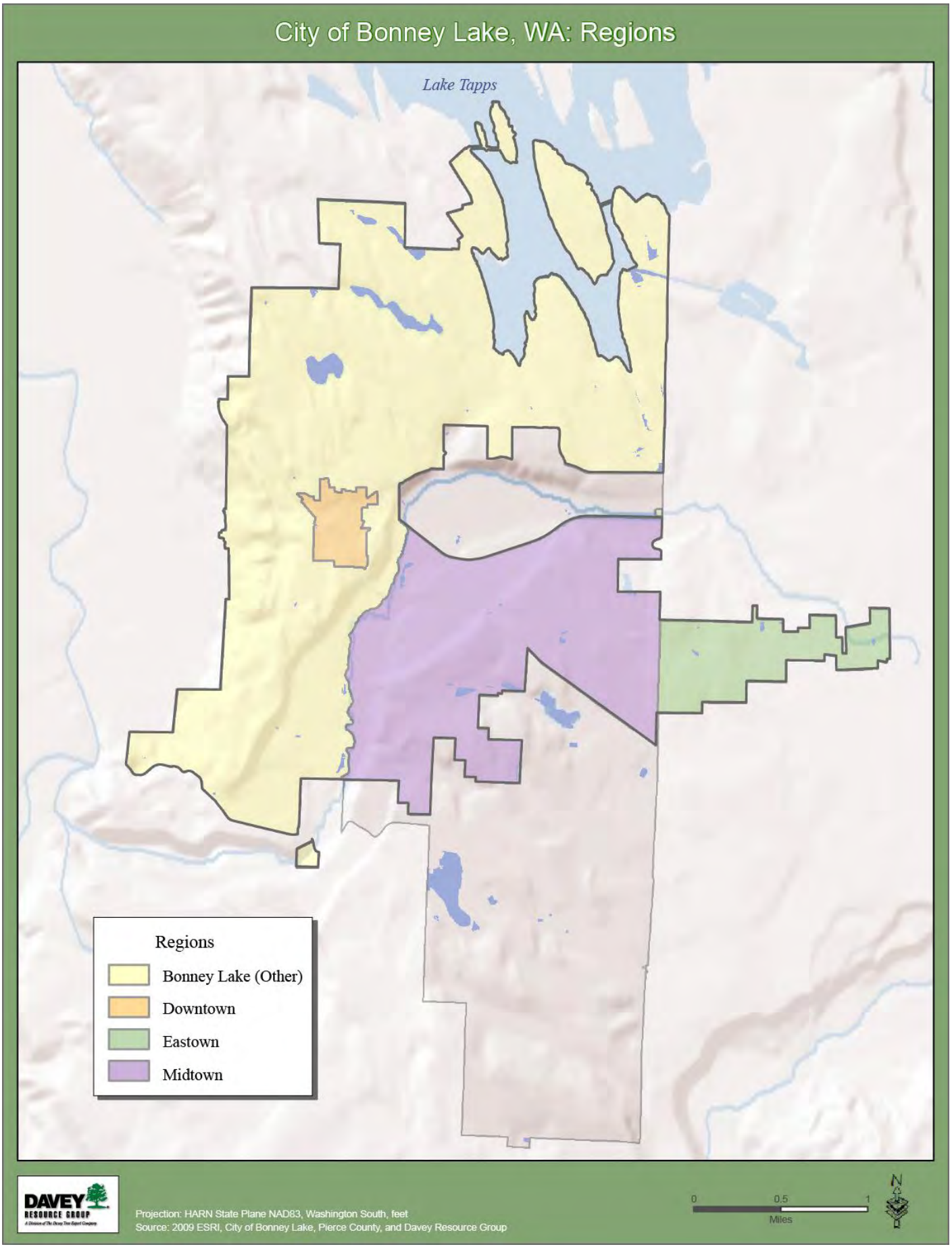


Figure 5. Average tree canopy cover by region



Map 3. Regions Within Bonney Lake City Limits

Landcover: Sub Area 1

Sub Area 1 encompass an area of 293 acres and includes the following land cover classifications (Figure 6:

- **36% – Canopy,** 106 acres
- **30% – Impervious surfaces,** 87 acres
- **30% – Pervious surfaces,** 89 acres
- **4% – Open water,** 11 acres
- **>1% – Bare soils**

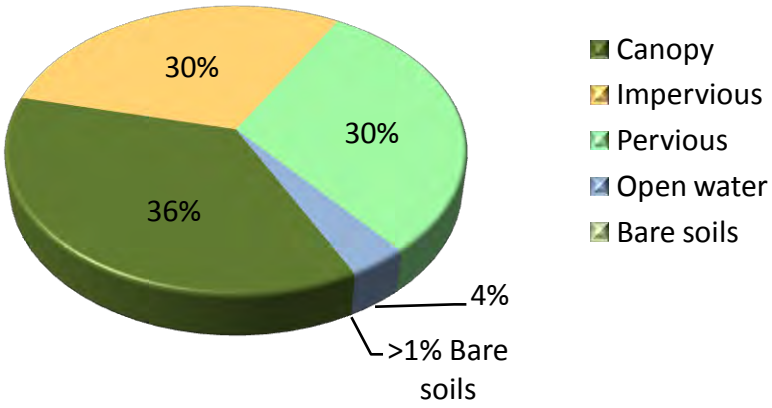


Figure 6. Land cover classification within Sub Area 1

Landcover: Sub Area 2

Sub Area 2 encompass an area of 497 acres and includes the following land cover classifications (Figure 7):

- **34% – Canopy,** 171 acres
- **25% – Impervious surfaces,** 122 acres
- **35% – Pervious surfaces,** 177 acres
- **5% – Open water,** 25 acres
- **>1% – Bare soils,** 3 acres

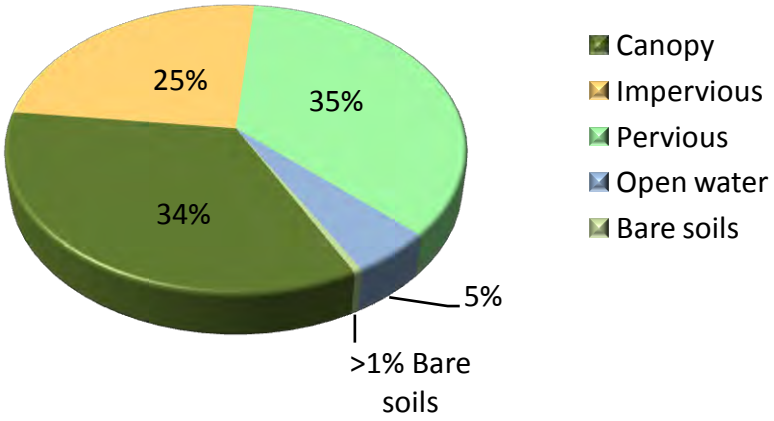


Figure 7. Land cover classification within Sub Area 2

Landcover: Sub Area 3

Sub Area 3 encompass an area of 1,070 acres and includes the following land cover classifications (Figure 8):

- **65% – Canopy,** 695 acres
- **15% – Impervious surfaces,** 162 acres
- **19% – Pervious surfaces,** 207 acres
- **>1% – Open water,** 6 acres
- **>1% – Bare soils**

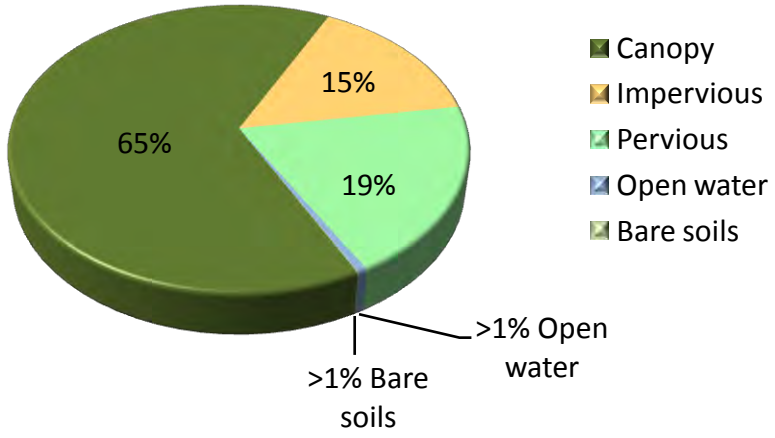


Figure 8. Land cover classification within Sub Area 3

Landcover: Urban Growth Areas (UGA)

Urban Growth Areas encompass an area of 158 acres and includes the following land cover classifications (Figure 9):

- **58% – Canopy,** 91 acres
- **17% – Impervious surfaces,** 27 acres
- **25% – Pervious surfaces,** 40 acres
- **>1% – Open water**
- **>1% – Bare soils**

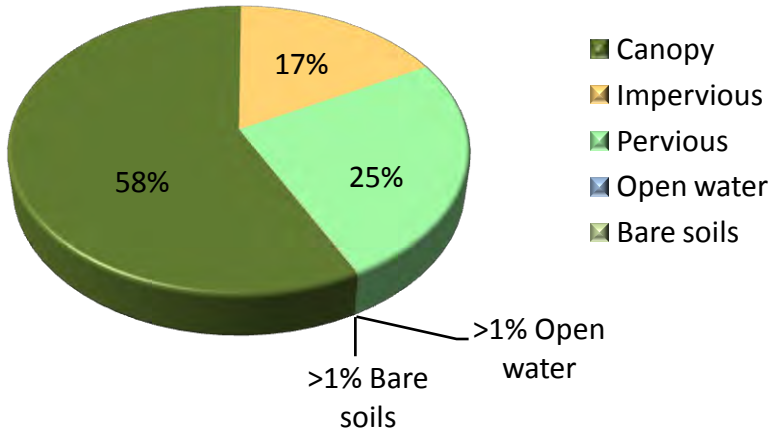


Figure 9. Land cover classification within Urban Growth Areas (UGA)

Landcover: Other Unincorporated Areas

Other Unincorporated Areas encompass an 350 acres and includes the following land cover classifications (Figure 10):

- **33% – Canopy,** 116 acres
- **6% – Impervious surfaces,** 19 acres
- **60% – Pervious surfaces,** 209 acres
- **>1% – Open water**
- **1% – Bare soils,** 5 acres

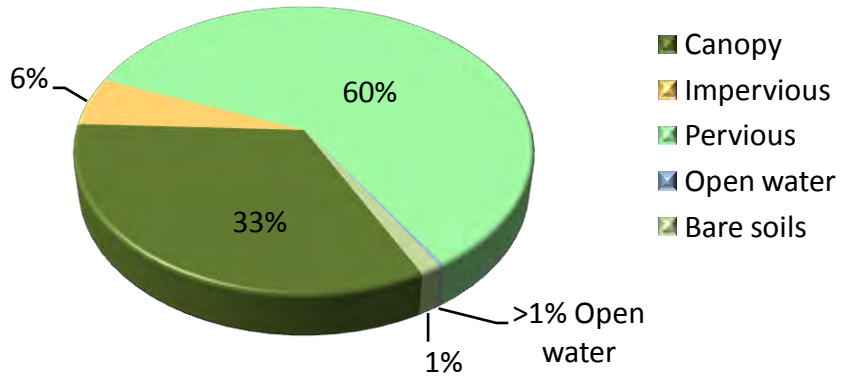


Figure 10. Land cover classification within Other Unincorporated Areas

Average Tree Canopy Cover By Area

Within the overall project area, sub Area 3 has the highest average canopy cover at 65%, followed by UGAs with an average canopy cover of 57.6%, and Bonney Lake city limits with an average canopy cover of 40%. Other Unincorporated Areas have the lowest average canopy cover at 33.2% (Figure 11) (Table 1)

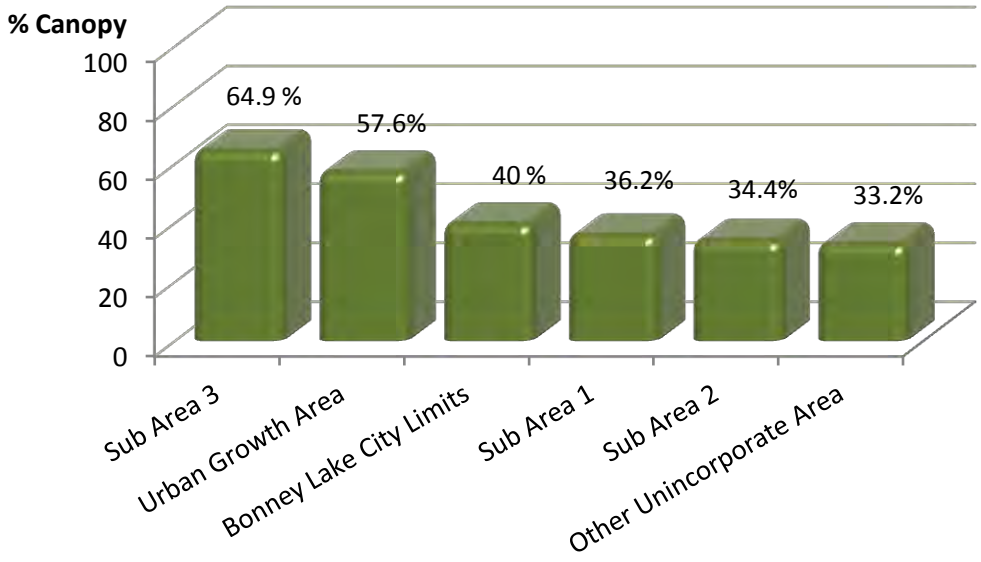


Figure 11. Average tree canopy cover by area

Table 1. Tree canopy and impervious surface by Target Area

Target Area	Total Acres	Canopy Acres	% Canopy	Impervious Acres	% Impervious
Bonney Lake City Limits	4682.33	1872.17	**39.98%**	1258.15	**26.87%**
Sub Area 1	292.65	105.98	**36.21%**	86.81	**29.66%**
Sub Area 2	496.74	170.63	**34.35%**	122.09	**24.58%**
Sub Area 3	1071.30	695.01	**64.88%**	162.32	**15.15%**
Other Unincorporated Areas	350.32	116.29	**33.20%**	19.08	**5.45%**
Urban Growth Area (UGA)	157.68	90.86	**57.62%**	26.74	**16.96%**
Overall Study Area	**7051.02**	**3050.94**	**43.27%**	**1675.19**	**23.76%**

Tree Canopy in Parks and Open Space

Parks and open space areas are generally good locations to augment the urban forest because they often support a higher percentage of tree canopy than other locations. Maximizing trees and forests in parks and open space areas can help offset lower canopy values in higher-density urban areas.

Overall, Bonney Lake has 991.7 acres of parks and open space including (Map 4):

- Parks – 400 acres
- Future Parks – 196 acres
- Schools – 143 acres
- Greenbelts – 110 acres
- Open Space – 97 acres
- Private – 46 acres

There are 577.2 acres of tree canopy in parks and open space areas, for an average of canopy cover of 58.2%.

Greenbelts have the highest average canopy cover at 77.9%, followed by parks at 76.4%, and private facilities at 63.4%. Schools have the lowest average canopy cover at 22.6% (Figure 12)

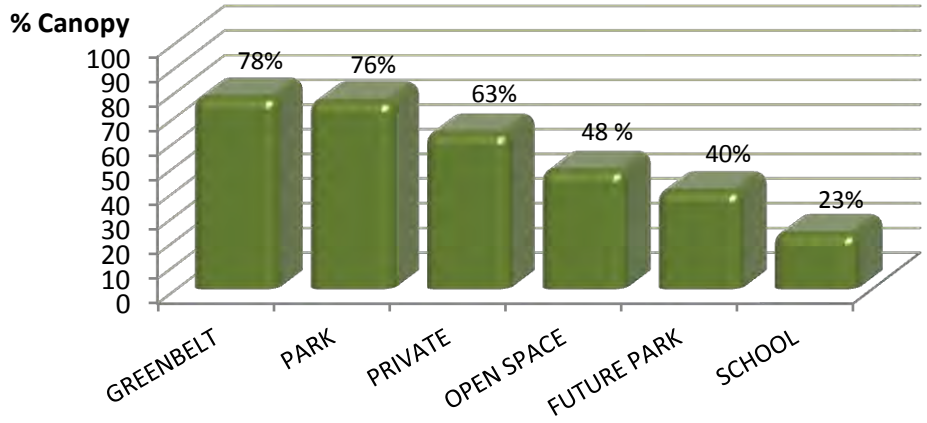


Figure 12. Tree canopy cover by park type

The area formerly known as the Washington State University (WSU) Demonstration Forest is the largest park (144 acres) in Bonney Lake, followed by Fennel Creek Trail Corridor (136 acres), a future park area, and Buckley-Bonney Lake Park (80 acres) (Table 2)

Of parks and open space areas greater than 1 acre, Wilderness Ridge Division 3 Wetland (1.3 acres) has the highest average canopy cover of 96%, followed by the area formerly known as the WSU Demonstration Forest (144 acres) with an average canopy cover of 95%, and Brookwater DIV 1, Phase 1 Greenbelt (5.9 acres) with an average canopy cover of 94% (Table 3).

Panorama Heights Phase 4 Open Space (1.3 acres) has the lowest average canopy cover (0.3%) of parks greater than 1 acres, followed by Panorama Heights Phase 4 Park (1.2 acres) with an average canopy cover of 2.4%, and Highway 410 Golf Driving Range (5.5 acres) with an average canopy cover of 3.4%.

Homeowner associations (HOAs) own the greatest majority (32%) of park and open space area within Bonney Lake, followed by other agencies (25%), and publicly-owned parks and open space at 24%. Less than 5% of parks are private or commercially owned (Figure 13) (Map 4). A complete list of Bonney Lake parks and open space areas, including park type and ownership can be found in Appendix C.

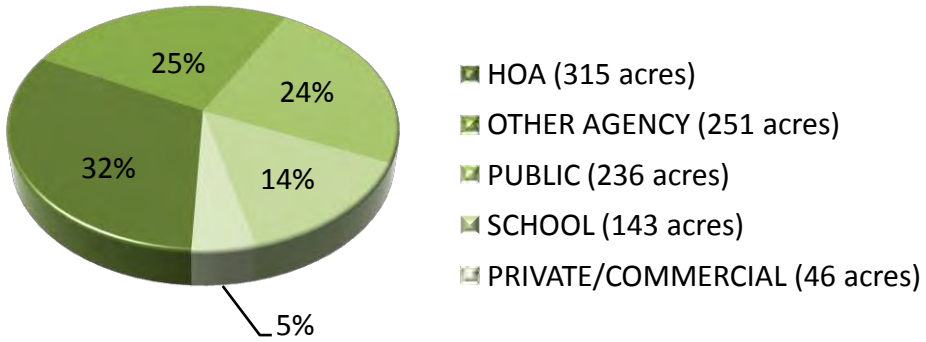


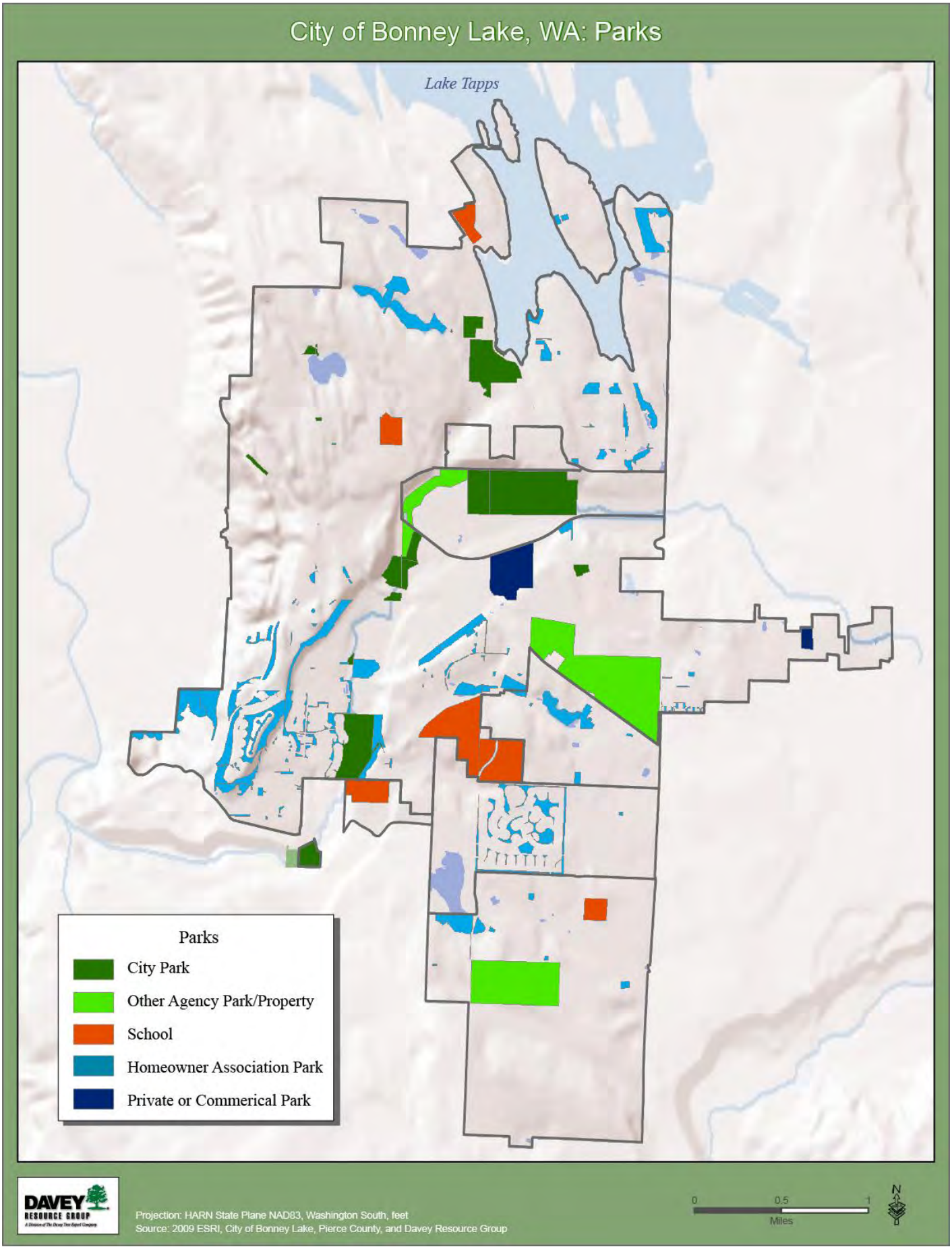
Figure 13. Ownership of parks and open space

Table 2. Top 10 largest parks and open space areas in Bonney Lake

Park/Open Space Name	Owner	Type of Space	Total Acres	Canopy Acres	% Canopy
FORMER WSU DEMO FOREST	OTHER AGENCY	PARK	**144.25**	137.37	95.23%
FENNEL CREEK TRAIL CORRIDOR	OTHER AGENCY	FUTURE PARK	**136.24**	58.09	42.63%
BUCKLEY-BONNEY LAKE PARK	OTHER AGENCY	PARK	**79.62**	71.56	89.87%
BONNEY LAKE HIGH SCHOOL	SCHOOL	SCHOOL	**51.37**	8.25	16.07%
ALLAN YORKE PARK	PUBLIC	PARK	**44.43**	26.46	59.57%
WILLOW BROOK PH 1 PARK	HOA	FUTURE PARK	**44.08**	17.71	40.19%
SWISS SPORTSMEN CLUB OF TACOMA	PRIVATE/ COMMERCIAL	PRIVATE	**40.14**	28.76	71.64%
MOUNTAIN VIEW MIDDLE SCHOOL	SCHOOL	SCHOOL	**37.65**	5.86	15.57%
FENNEL CREEK CORRIDOR OFF SITE MITIGATION	OTHER AGENCY	FUTURE PARK	**21.57**	3.44	15.97%
DEBRA JANE LAKE COMMON AREA	HOA	PARK	**20.12**	5.31	26.37%
All Bonney Lake Parks and Open Space			**991.66**	**577.24**	**58.21%**

Table 3. Top 10 parks and open space areas (>1 acre) with the highest canopy cover (%)

Park/Open Space Name	Owner	Type of Space	Total Acres	Canopy Acres	% Canopy
WILDERNESS RIDGE DIV 3 WETLAND	HOA	OPEN SPACE	1.26	1.21	**96.30%**
FORMER WSU DEMO FOREST	OTHER AGENCY	PARK	144.25	137.37	**95.23%**
BROOKWATER DIV 1 PH 1 GREENBELT	HOA	GREENBELT	5.87	5.49	**93.59%**
FENNEL CREEK ESTATES GREENBELT	HOA	GREENBELT	8.87	8.25	**93.04%**
PANORAMA WEST GREENBELT	HOA	GREENBELT	15.82	14.65	**92.60%**
FENNEL RIDGE ESTATES OPEN SPACE	HOA	OPEN SPACE	9.98	9.17	**91.88%**
BROOKSIDE GREENBELT	HOA	GREENBELT	11.53	10.41	**90.35%**
BUCKLEY-BONNEY LAKE PARK	OTHER AGENCY	PARK	79.62	71.56	**89.87%**
BOHEMIAN ESTATES PARK	HOA	PARK	16.24	14.10	**86.83%**
SKY ISLAND DIV 3 GREENBELT	HOA	GREENBELT	12.98	11.26	**86.76%**
All Bonney Lake Parks and Open Space			**991.66**	**577.24**	**58.21%**



Map 4. Bonney Lake Parks by Ownership

Tree Canopy in Right-of-Ways

Within the study boundary, Bonney Lake has 770 acres of right-of-way (ROW), including 669.6 acres of public ROW and 100.8 acres of private roads. Considering both public and private, there are 144 acres of tree canopy within ROW boundaries, for an overall canopy cover average of 18.7%. Private ROW has the greatest canopy cover average of 22%, followed by public ROW with a canopy cover average of 18.2% (Figure 14)

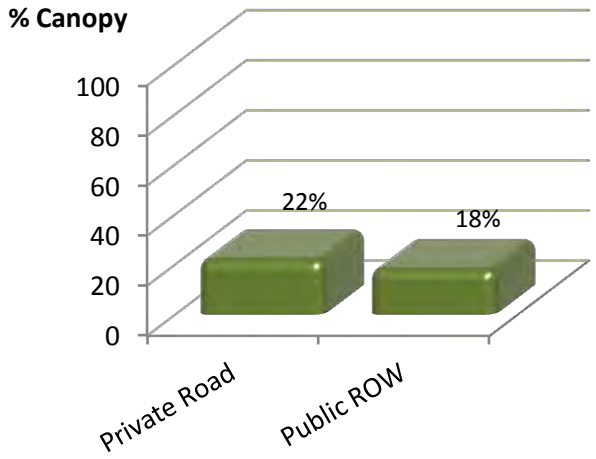


Figure 14. Tree canopy in right-of-ways (ROW)

Tree Canopy on City-Owned Parcels

Bonney Lake includes 298 acres of city-owned parcels with 172 acres of tree canopy. The average tree canopy cover on city-owned parcels is 57.6%.

Elementary school 1 to 6 parcels (3.7 acres) have the highest canopy cover at 95.6%, followed by Well Sites (12 acres) at 92%, and vacant land undeveloped (85 acres) at 82%. Off/Insurance/ Real Estate/ Finance parcels have the lowest canopy cover at 6.5% (Table 4).

Table 4. Tree canopy cover on city-owned parcels

City-Owned Parcels by Land Use	Total Acres	Canopy Acres	% Canopy
COMMERCIAL VACANT LAND	8.06	2.18	27.00%
DRAINFIELDS CATCH BASINS	80.17	23.34	29.10%
DUPLEX 2 UNITS	1.01	0.25	24.70%
ELEMENTARY SCHOOLS 1 TO 6	3.68	3.51	95.60%
GOVERNMENTAL SERVICES	15.58	6.95	44.60%
GRNBELT COMMON AREAS	19.61	10.54	53.80%
LIBRARIES	1.47	0.55	37.30%
MEDICAL OFFICES SERVICES	0.91	0.23	25.30%
MH TITLE ELIM	2.27	1.41	61.90%
OFF INSURANCE REAL ESTATE FINANCE	0.52	0.03	6.50%
PARKS	5.80	3.05	52.70%
RECREATION ACTIVITIES	21.25	13.89	65.40%
RES LND WITH COMM BUILDING	15.37	11.20	72.90%
SINGLE FAMILY DWELLING	13.83	9.29	67.20%
STREET RIGHT OF WAY	2.71	0.33	12.20%
UTILITIES	5.83	1.65	28.30%
VACANT LAND UNDEVELOPED	85.03	69.92	82.20%
WELL SITES	11.87	10.93	92.10%
WETLANDS RECORDED	2.86	2.30	80.30%
Total City-Owned Parcels	**297.80**	**171.55**	**57.60%**

Tree Canopy by Land Use

Considering land use, Vacant land has the highest average canopy cover at 65%, followed by Residential Outbuildings (64.3%), Water Bodies (64.2%), and Open Space/Recreation (63.5%). Commercial/Service lands have the lowest average canopy cover at 14% (Figure 15) (Table 5).

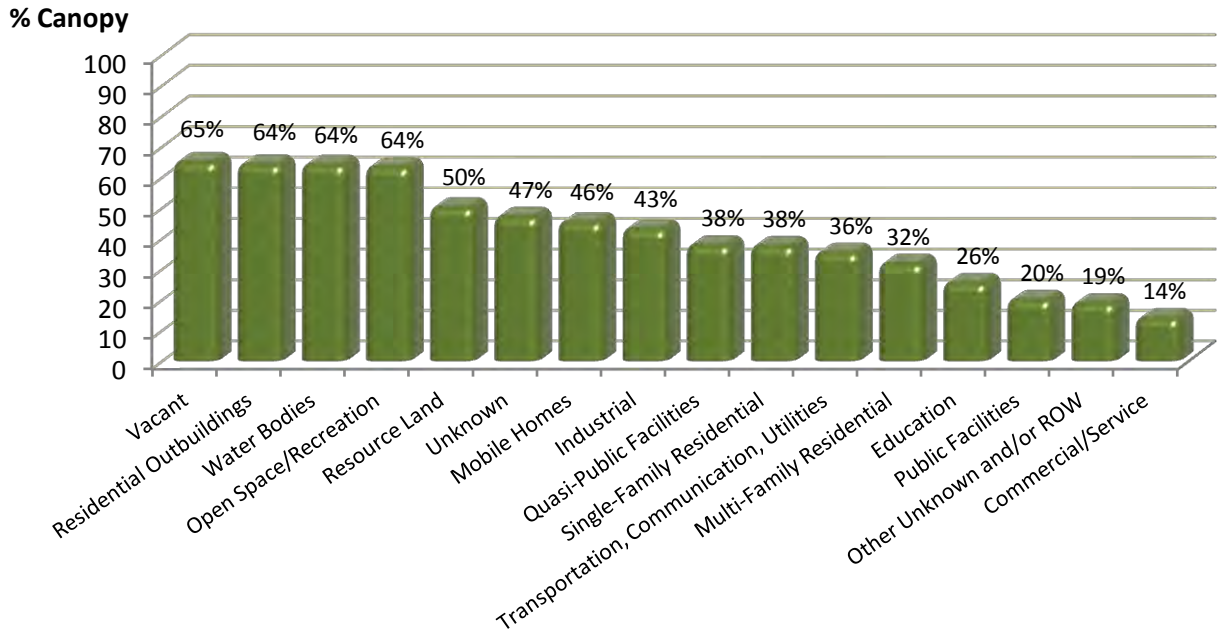


Figure 15. Tree canopy cover by land use

Table 5. Tree canopy and impervious surface by land use

Current Land Use	Total Acres	Canopy Acres	% Canopy	Impervious Acres	% Impervious
Commercial/Service	224.37	31.54	**14.1%**	152.43	**67.94%**
Education	95.07	24.33	**25.6%**	27.45	**28.88%**
Industrial	9.88	4.27	**43.2%**	3.57	**36.18%**
Mobile Homes	500.06	227.57	**45.5%**	109.02	**21.80%**
Multi-Family Residential	48.99	15.63	**31.9%**	17.56	**35.84%**
Open Space/Recreation	242.62	154.12	**63.5%**	14.74	**6.07%**
Public Facilities	55.88	11.24	**20.1%**	29.46	**52.72%**
Quasi-Public Facilities	20.53	7.79	**37.9%**	4.60	**22.41%**
Residential Outbuildings	117.18	75.34	**64.3%**	6.11	**5.21%**
Resource Land	196.36	98.69	**50.3%**	3.30	**1.68%**
Single-Family Residential	2800.26	1055.36	**37.7%**	728.16	**26.00%**
Transportation, Communication, Utilities	158.49	56.30	**35.5%**	18.93	**11.94%**
Unknown	177.28	83.63	**47.2%**	26.62	**15.02%**
Vacant	1576.54	1025.90	**65.1%**	71.70	**4.55%**
Water Bodies	48.78	31.33	**64.2%**	0.14	**0.29%**
Other Unknown and/or ROW	778.73	147.92	**19.0%**	461.39	**59.25%**
Overall Land Use	**7051.02**	**3050.94**	**43.3%**	**1675.19**	**23.76%**

Tree Canopy by Zoning

The Bonney Lake urban tree canopy assessment area included both City and County zoned parcels. Considering all zoning, Master Planned Communities (Pierce County) has the highest average canopy cover at 96%, followed by Parks and Recreation (Pierce County, 88.4%), and Residential/Conservation District parcels (City of Bonney Lake, 75.3%). Downtown Core District (City of Bonney Lake) has the lowest average canopy cover at 5.8% (Figure 16 & 17) (Table 6) (Map 5).

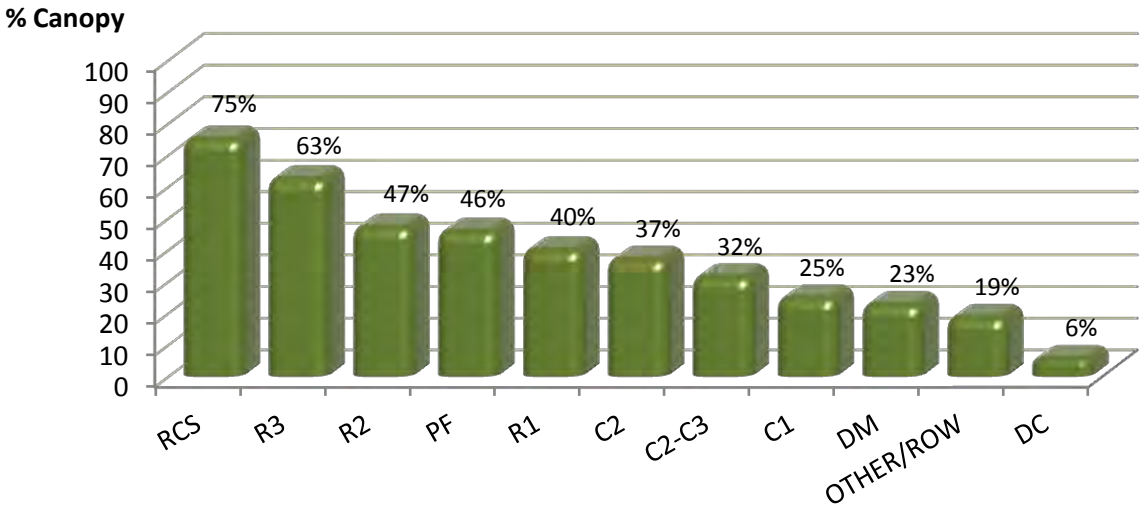


Figure 16. Tree canopy cover by City of Bonney Lake zoning

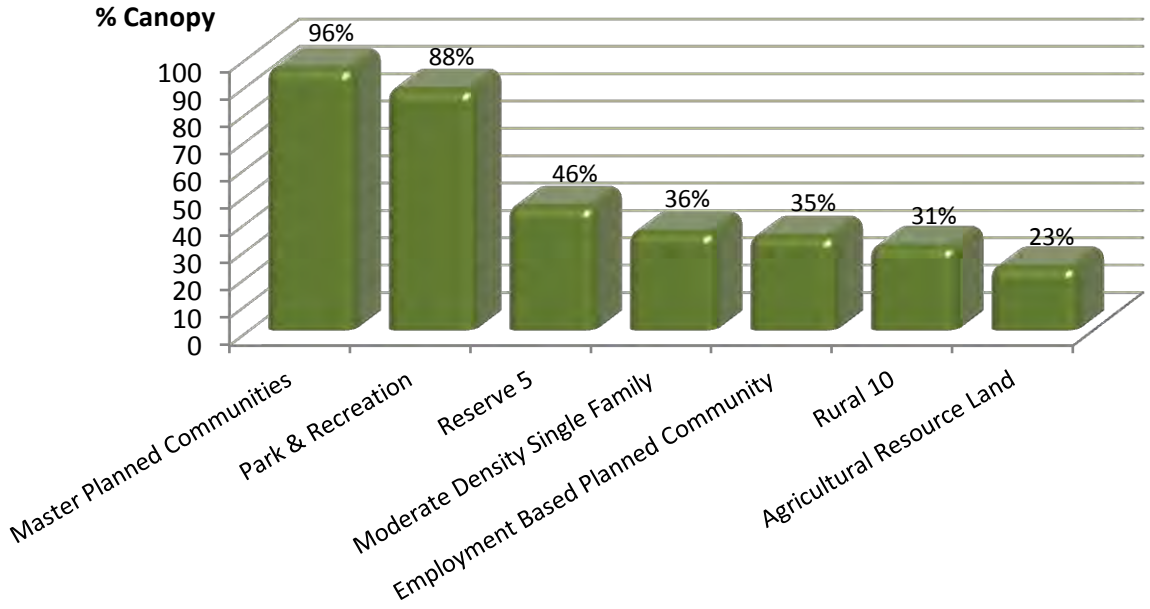
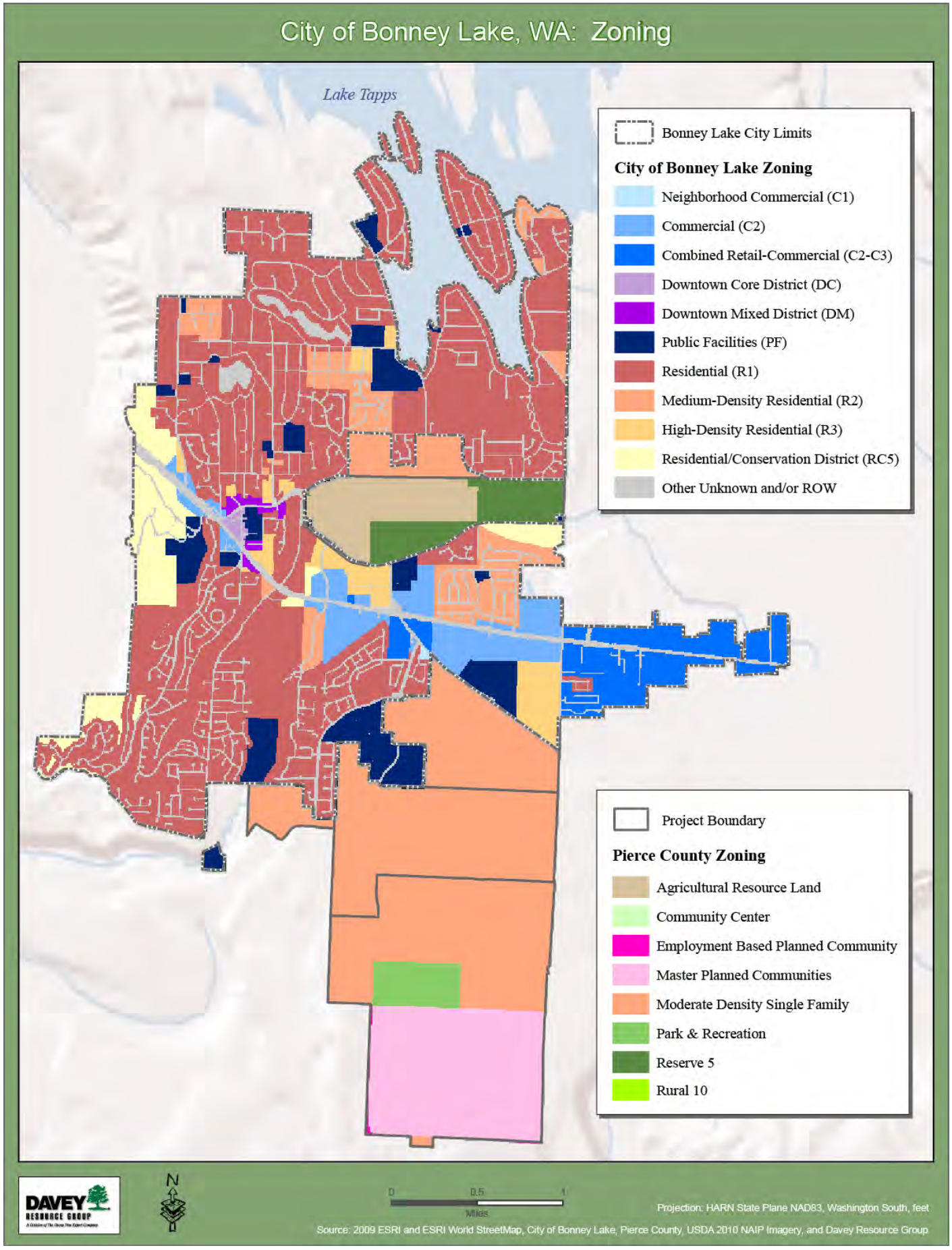


Figure 17. Tree canopy cover by Pierce County zoning (outside of city limits)

Table 6. Tree canopy and impervious surface by zoning

Current Zoning	Total Acres	Canopy Acres	% Canopy	Impervious Acres	% Impervious
City of Bonney Lake Zoning					
Neighborhood Commercial (C1)	2.39	0.60	**25.0%**	0.63	**26.2%**
Commercial (C2)	244.06	90.91	**37.3%**	122.36	**50.1%**
Combined Retail-Commercial, Warehousing & Lighting (C2-C3)	291.68	92.40	**31.7%**	77.79	**26.7%**
Downtown Core District (DC)	8.82	0.51	**5.8%**	7.27	**82.4%**
Downtown Mixed District (DM)	20.82	4.77	**22.9%**	6.31	**30.3%**
Public Facilities (PF)	363.75	167.80	**46.1%**	70.00	**19.2%**
Residential (R1)	2437.44	980.61	**40.2%**	516.02	**21.2%**
Medium-Density Residential (R2)	284.34	134.87	**47.4%**	65.99	**23.2%**
High-Density Residential (R3)	154.93	97.15	**62.7%**	16.62	**10.7%**
Residential/Conservation District (RC5)	245.28	184.62	**75.3%**	4.42	**1.8%**
Other Unknown and/or ROW	633.23	119.22	**18.8%**	372.71	**58.9%**
Total City of Bonney Lake Zoning	**4686.73**	**1873.45**	**40.0%**	**1260.13**	**26.9%**
Pierce County Zoning (outside of Bonney Lake City Limits)					
Agricultural Resource Land	192.68	45.13	**23.4%**	0.22	**0.1%**
Employment Based Planned Community	6.92	2.40	**34.6%**	2.77	**40.0%**
Master Planned Communities	487.46	467.38	**95.9%**	1.87	**0.4%**
Moderate Density Single Family	1438.24	518.75	**36.1%**	390.25	**27.1%**
Park & Recreation	82.38	72.82	**88.4%**	1.45	**1.8%**
Reserve 5	154.46	70.34	**45.5%**	17.46	**11.3%**
Rural 10	2.14	0.66	**30.9%**	1.04	**48.3%**
Total Pierce County Zoning	**2364.28**	**1177.48**	**49.8%**	**415.05**	**17.6%**
Overall Project Area Total	**7051.02**	**3050.94**	**43.3%**	**1675.18**	**23.8%**


City of Bonney Lake, WA: Zoning
Lake Tapps
Bonney Lake City Limits
City of Bonney Lake Zoning
Neighborhood Commercial (C1)
Commercial (C2)
Combined Retail-Commercial (C2-C3)
Downtown Core District (DC)
Downtown Mixed District (DM)
Public Facilities (PF)
Residential (R1)
Medium-Density Residential (R2)
High-Density Residential (R3)
Residential/Conservation District (RC5)
Other Unknown and/or ROW
Project Boundary
Pierce County Zoning
Agricultural Resource Land
Community Center
Employment Based Planned Community
Master Planned Communities
Moderate Density Single Family
Park & Recreation
Reserve 5
Rural 10
DAVEY RESOURCE GROUP
N
0
0.5
1
Miles
Projection: HARN State Plane NAD83, Washington South, feet
Source: 2009 ESRI and ESRI World StreetMap, City of Bonney Lake, Pierce County, USDA 2010 NAIP Imagery, and Davey Resource Group

Map 5. Zoning

Chapter 3: Tree Canopy in Critical Areas

Watersheds and Wetlands

The Bonney Lake urban tree canopy assessment area includes 3 watersheds (WRI) and 328 acres of wetlands (NWI) that play a critical ecological role in the local environment (Map 6).

Watersheds are areas of land where all of the below ground water drains to a single location. A watershed connects all life within its boundaries through a shared system.

Wetlands are areas saturated, much or all of the time, by surface or groundwater that support a variety of vegetation and wildlife. Wetlands play a critical role in water quality, offer opportunities for recreations, and provide unique and vital habitat for fish, water fowl, and other wildlife.

Trees and forest canopy play a role in the protection of watersheds and wetlands by helping to control stormwater flows, increasing soil capacity and infiltration, aiding in bioremediation, and preventing erosion.

In Bonney Lake, the Lower White River Watershed includes 747 acres within the city limits to the north, bounding Lake Tapps. The Mid Puyallup River Watershed covers the largest area (5,769 acres) within Bonney Lake and includes most of the area within the city limits, as well as the Other Unincorporated Area, Urban Growth Areas, Sub Area 1, Sub Area 2, and approximately half of Sub Area 3. The South Prairie Creek Watershed includes 541 acres in the southern half of Sub Area 3.

The South Prairie Creek Watershed has the highest average canopy cover at 89.7%, followed by the Lower White River Watershed (39.9%), and the Mid Puyallup River Watershed (39.3%) (Figure 18).

Wetlands in Bonney Lake have an overall average canopy cover of 60.6%.

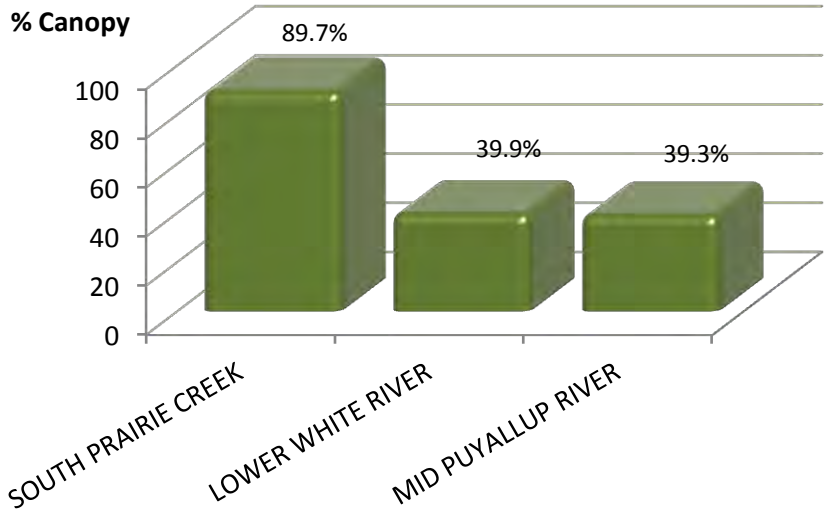
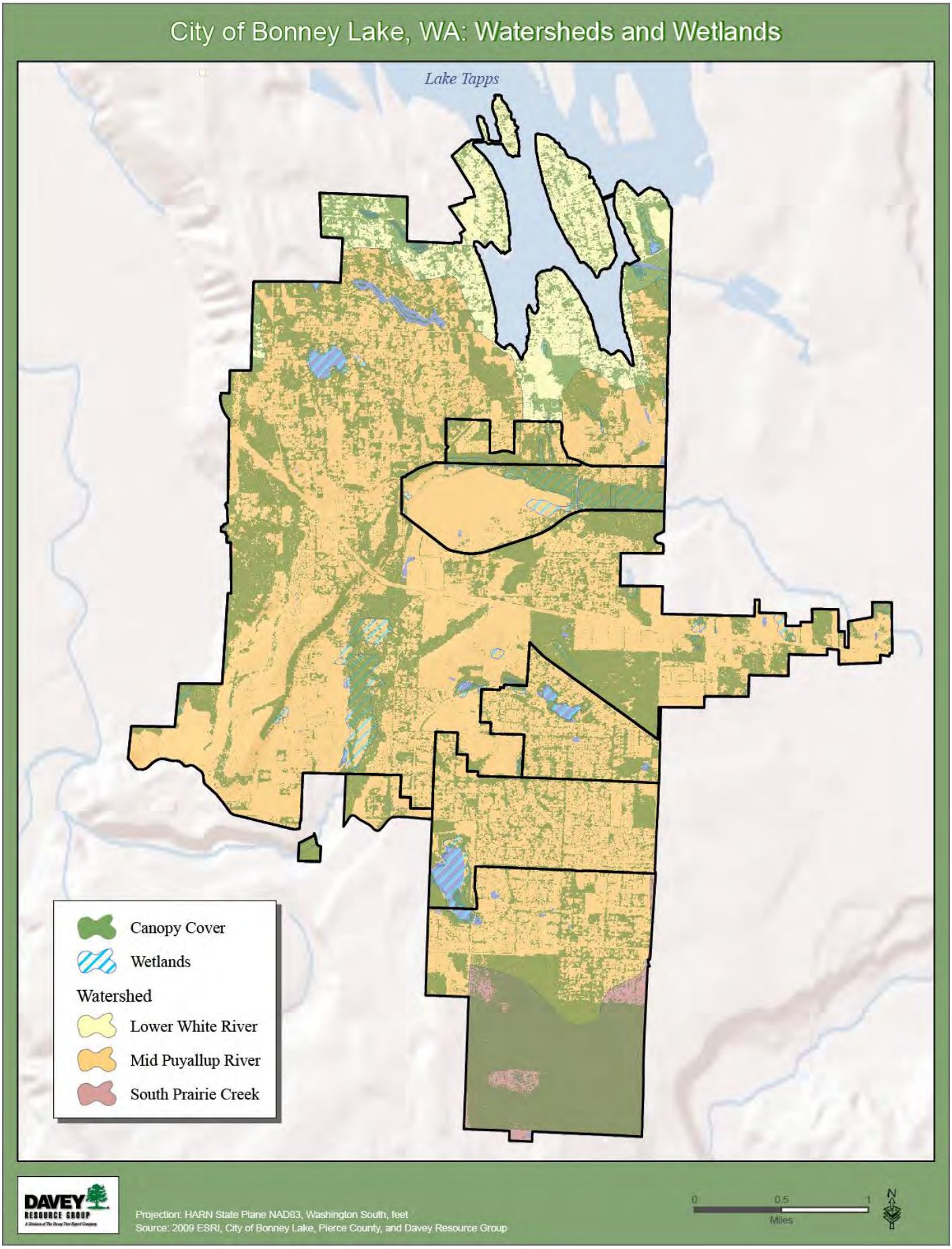
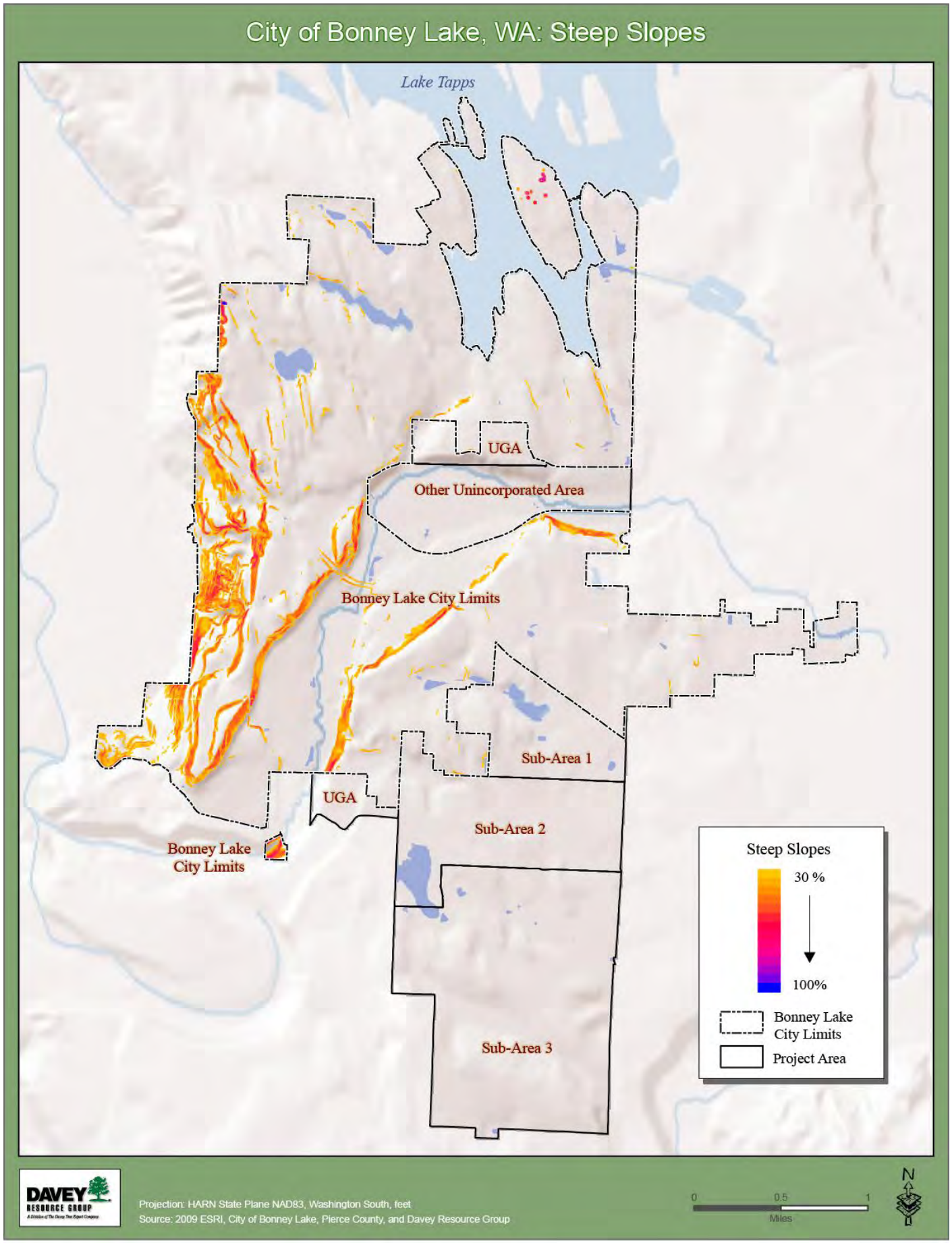


Figure 18. Canopy cover in Bonney Lake watersheds



Map 6. Watersheds and Wetlands



Map 7. Slope Greater than 30%

Slopes >30%

Within the Bonney Lake urban tree canopy assessment area there are 406 acres of sloped land with a 30% slope or greater. Steep slopes are prone to erosion. Trees and other vegetation can help prevent erosion by slowing and capturing stormwater and by increasing soil water holding capacity and infiltration rate. On average, Bonney Lake slopes have an overall canopy cover of 68.3%.

Stormwater Management Areas

According to Federal Clean Water Act regulations, municipalities must obtain a permit for managing their stormwater discharges into water bodies. Each city's program must identify the *best management practices* (BMPs) it will implement to reduce its pollutant discharge. Nationwide, non-point source pollution is one of the biggest contributors to poor water quality. Non-point source pollution occurs when stormwater and snowmelt deposit surface contaminants into surface or ground water. Preventing non-point source pollution and reducing stormwater runoff is becoming a serious environmental concern for many communities.

Trees and forests can be a natural, cost-efficient, and highly effectively part of a stormwater management program. Many communities, including Seattle and Portland, are turning to trees to help solve their stormwater issues in a less costly and more sustainable manner. Engineered and natural stormwater systems that incorporate and take advantage of the natural benefits provided by trees and forests are proving to be more cost-effective and sustainable than traditional detention and treatment methods. While there are many methods and construction designs available for integrating urban trees into stormwater management infrastructure, including pervious pavement systems, suspended sidewalks, structural soils, bioswales, and stormwater tree pits, some of these designs can be costly to implement, preserving natural forest stands and existing trees before, during, and after development can reduce runoff from urban and suburban properties and effectively solve many stormwater issues before they become costly and/or detrimental to the surrounding environment. With an average annual rainfall around 40 inches, the stormwater benefits provided by Bonney Lake's urban tree canopy may be the most critical benefits of all.

To better understand how trees and canopy cover are affecting stormwater management in Bonney Lake, the City created a map of stormwater management areas (SMA). For the purposes of this analysis, an SMA was defined as the total area managed, or served, by a specific stormwater facility or combined infrastructure (e.g., basin, pond, drainage channel, drains, pipes, etc.) as determined by development, sub-division, and/or drainage patterns. The study analyzed a total of 172 stormwater management areas covering 5,194 acres (8.1 square miles) within the Bonney Lake study boundaries (Map 8) (Appendix C). Overall, stormwater management areas have 2,386 acres (3.7 square miles) of canopy for an average canopy cover of 45.9%.

Of the top 10 largest SMAs, Plateau 465 (478 acres) has the highest overall canopy cover at 96%, followed by WSU Forest (149 acres) with a canopy cover of 95%, and Fennel Creek SMA (108 acres) with a canopy cover of 76% (Table 7). Inlet Island (123 acres) has the lowest canopy cover at 29%.

Forty-six (46) SMAs have canopy cover less than 15%. Of these, Ptarmigan Ridge (13 acres) has the lowest canopy cover of 0.4%, followed by Whitehorse Junction (3.7 acres) with a canopy cover of 0.8%, Rite Aid (1.8 acres) with a canopy cover of 1.3%, and Lowes (13 acres) with a canopy cover of 1.3% (Table 8).

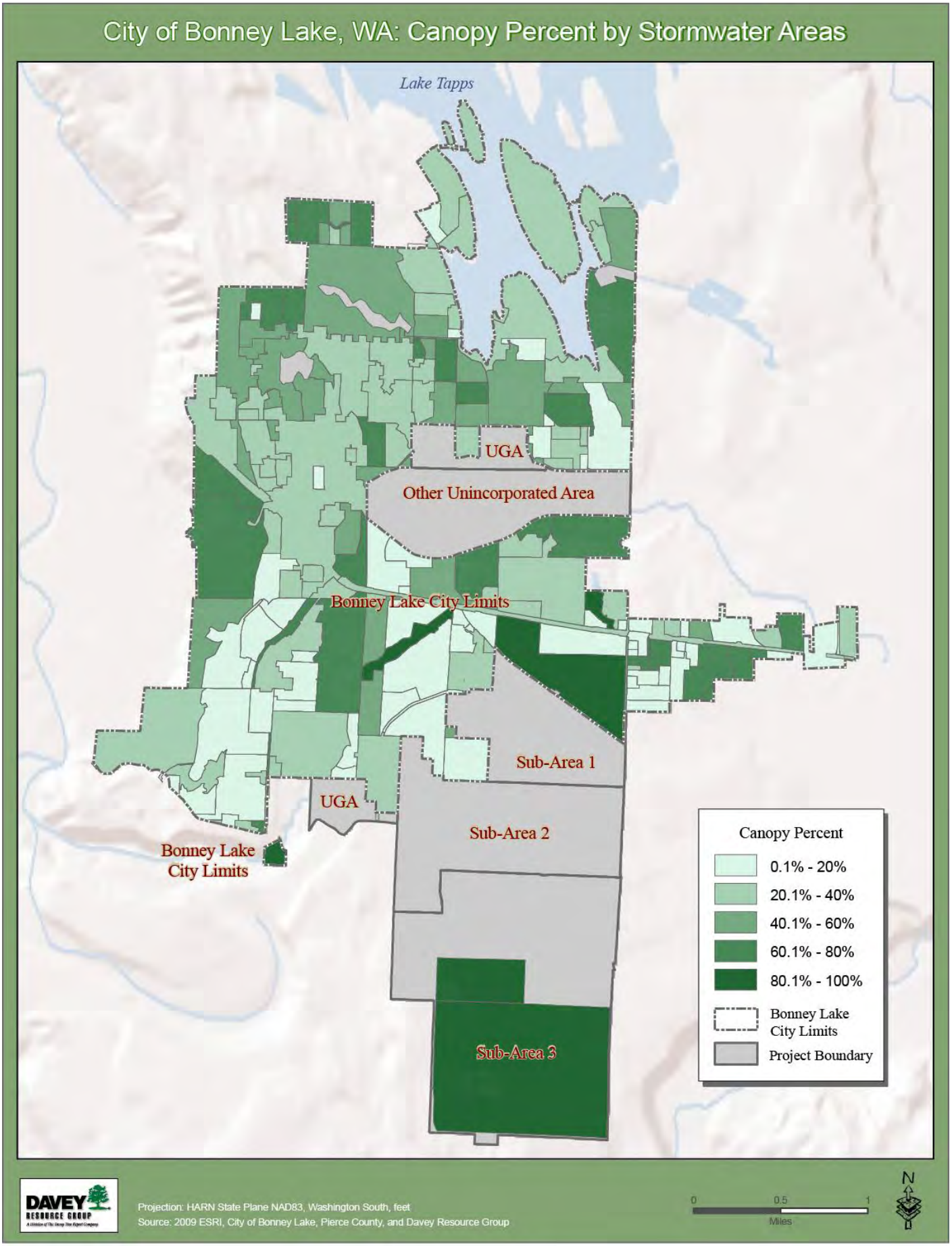
This information can be used to further recognize the contribution of tree canopy within each SMA. Understanding that if common stormwater events are taxing the capacity of a specific SMA, the loss of additional canopy within that SMA should be avoided. In fact, increasing canopy cover by planting additional trees in those SMAs that are consistently exceeding capacity can be an effective solution for augmenting current infrastructure without the need or construction expense of additional facilities.

Table 7. Top 10 largest stormwater management areas

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
PLATEAU 465	477.56	460.52	96.4%
MCDONALD FRUIT TRACTS	242.27	75.56	31.2%
DEBRA JANE LAKE	174.46	82.95	47.5%
WSU FOREST	149.48	142.30	95.2%
SOUTH HILL OFF SR410 W	136.28	100.86	74.0%
PANORAMA WEST	132.82	34.08	25.7%
INLET ISLAND	122.69	35.85	29.2%
SR410 E	117.47	44.59	38.0%
FENNEL CREEK SMA	108.11	82.57	76.4%
CEDARVIEW	104.05	38.63	37.1%
Total Area	**5194.87**	**2385.54**	**45.9%**

Table 8. Stormwater management areas with canopy cover <15%

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
PTARMIGAN RIDGE	13.12	0.05	0.4%
WHITEHORSE JUNCTION	3.71	0.03	0.8%
RITE AID	1.79	0.02	1.3%
LOWES	12.98	0.17	1.3%
MCHUGH PLAZA	1.36	0.03	1.9%
GARDEN MEADOWS	5.36	0.15	2.8%
TOPSOIL, BARK, ETC.	5.39	0.16	3.1%
ALBERTSONS	14.20	0.44	3.1%
KHANE PROPERTY	3.04	0.10	3.3%
SONIC AND DISCOUNT TIRE	4.42	0.16	3.5%
LES SCHWAB TIRE CENTER	1.81	0.06	3.6%
ANDRE'S BAR AND GRILL	1.77	0.07	3.7%
ARMADA/410 LLC	6.71	0.28	4.2%
SUNRISE MANOR	12.98	0.58	4.4%
EAST POINTE	10.03	0.45	4.5%
FRED MEYER PLAT	45.15	2.25	5.0%
CRYSTAL MEADOWS	10.23	0.59	5.8%
SKY ISLAND 2	18.10	1.10	6.1%
INDIGO RIDGE	5.21	0.34	6.5%
WEST TAPPS HWY E	2.55	0.17	6.5%
SKY ISLAND 3	28.35	1.92	6.8%
233RD AV E	1.88	0.13	6.9%
WALMART	35.18	2.68	7.6%
SKY ISLAND 5	47.56	3.65	7.7%
LEGACY PARK	3.72	0.30	8.1%
BONNEY LAKE PLAZA	5.29	0.43	8.2%
LAKE TAPPS DEVELOPMENT	2.44	0.21	8.6%
ASHTON WOODS	62.91	5.65	9.0%
SPIRAEA GLEN	5.06	0.48	9.4%
WILLOW BROOK 2	20.76	2.03	9.8%
174TH AV E	3.66	0.39	10.6%
EASTOWN LLC	23.48	2.79	11.9%
LAKEVIEW TERRACE	14.79	1.77	11.9%
FIR VIEW MANOR	4.68	0.60	12.9%
COPPERFIELD	28.71	3.74	13.0%
FREEDOM RECOVERY CENTER	2.69	0.35	13.1%
CLEARWATER	8.02	1.06	13.2%
QUIET MEADOWS	14.06	1.88	13.4%
PANORAMA HEIGHTS	86.18	11.59	13.5%
CLARK PROPERTY	29.64	4.01	13.5%
STORE IT HERE	6.88	0.97	14.1%
CENTENNIAL STORAGE	3.12	0.44	14.1%
KELLY LAKE RD E	3.11	0.45	14.6%
FENNEL RIDGE 2	5.93	0.87	14.6%
EMERALD HILLS ELEMENTARY	13.70	2.01	14.6%
LUMBERMANS	4.04	0.59	14.7%
Total Area	**5194.87**	**2385.54**	**45.9%**



Map 8. Stormwater Management Areas and Percent Canopy Cover

Tree Canopy Development Risk

As a result of land use, zoning, geology, and/or status some urban tree canopy within the Bonney Lake assessment area is fairly safe and at low risk of removal for construction or development while other areas are at a higher risk (Map 9). Recognizing that risk and understanding the potential effect of canopy loss is important to the development of long-term strategies for urban tree canopy and forest management and for maintaining overall canopy goals within the community.

Tree Canopy at Low Risk for Development

Potential Fish & Wildlife Conservation Area within the Bonney Lake assessment area includes 1,092 acres of land with 538 acres of tree canopy and an average canopy cover of 49.3%. These areas are considered at low risk for development. Planting additional trees in these areas may help offset deforestation in other locations.

Tree Canopy at High Risk for Development

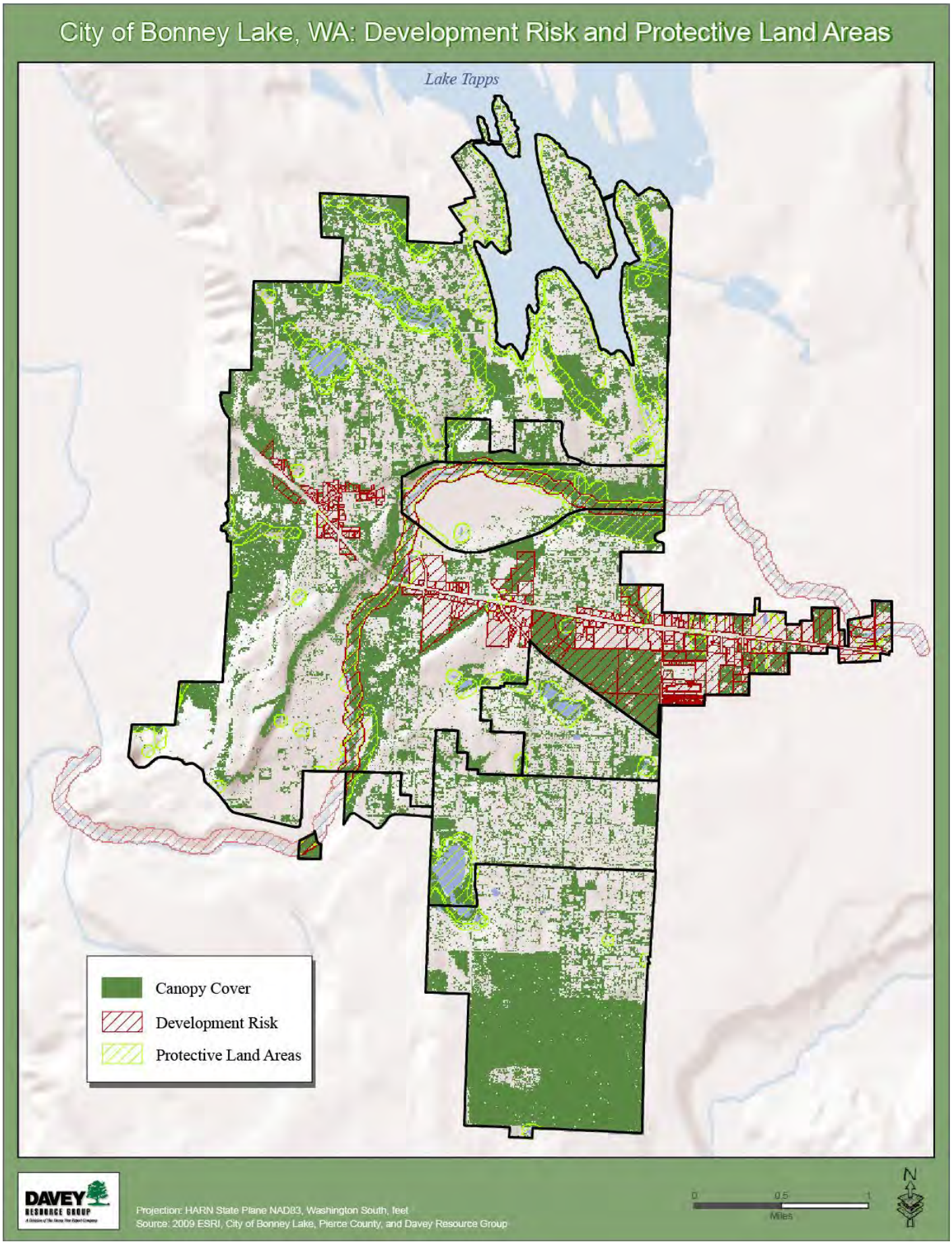
Areas identified as high risk for development and potential deforestation include:

- **Area formerly known as WSU Demonstration Forest**, currently 144 acres with 137 acres of tree canopy,
- **Fennel Creek Trail Corridor,** 190 acres (within the assessment boundary) with 108 acres of tree canopy
- **Commercially zoned parcels,** 568 acres with 189 acres of tree canopy

Together, these parcels total an area of 902 acres and 12.8% of the overall assessment area (Table 9). Total tree canopy on all parcels identified as high risk for deforestation is 434 acres. The area formerly known as the WSU Forest (95% average canopy cover) and the Fennel Creek Buffer (57% average canopy cover) are each heavily canopied. In the absence of additional tree planting within the Bonney Lake assessment area, the loss of canopy from all of these parcels combined (434 acres) would result in a 14.2% reduction in overall tree canopy. Devoid of this canopy, the overall canopy cover in Bonney Lake would drop to 2,617 acres, and an average canopy cover of 37%, below the 40% recommended by American Forests.

Table 9. Tree Canopy at High Risk for Development

Tree Canopy at High Risk for Development	Total Acres	Canopy Acres	% Canopy
Former WSU Demonstration Forest	144 .40	137.37	95.10%
Fennel Creek Buffer (within Bonney Lake City Limits)	190.03	107.66	56.7%
Commercial zoned	567.99	189.20	33.31%
Total at-risk parcels	**902.42**	**433.86**	**48.08%**



Map 9. Development Risk

Conclusion

As a Tree City, USA with a dedicated community forestry program, the City of Bonney Lake is well aware of the importance of trees and urban forests to the health and sustainability of their community. Undertaking an urban tree canopy assessment is further evidence of their ongoing commitment to the protection and effective management of the City's tree resource.

Considering the entire study area, which includes the area within the city limits as well as adjacent unincorporated areas, the current overall average canopy cover is 43%. Within the current city limits, the canopy cover average is 40%. The potential for tree canopy in the Bonney Lake study area is 75%. The population of Bonney Lake has grown by nearly 80% since 2000. Establishing policies now that conserve the overall net canopy and the benefit stream from this important resource, will ensure that it is preserved for current residents and wildlife as well as for future generations.

The assessment establishes a baseline of current tree canopy cover and augments the City's GIS database with a landcover layer that identifies the location and extent of existing canopy. This information provides a foundation for developing community goals and urban forest policies and establishes a benchmark for measuring the success of long-term management strategies over time. Based on information gathered during the assessment as well as strategies being adopted and endorsed by other communities, Davey Resource Group offers the following recommendations:

- **Preserve and enhance overall net canopy.** Considering that Bonney Lake's current overall canopy cover is 43% (40% within the city limits) and the general recommendation for communities in the Pacific Northwest is 40% (American Forests), preserving the current overall net canopy cover is critical. Preserve existing canopy where possible, increase the stocking level for street trees, and maximize canopy in parks and open spaces.
- **Set canopy goals.** Canopy goals can be broad based, or specific to land use. When determining canopy goals, consider the importance of trees and forests to meeting the environmental and quality of life goals of the community. Ideally, tree canopy goals should be adopted as a component of the Urban Forest Master Plan as well as the City's Comprehensive Plan.
- **Ensure that consideration of trees and canopy cover is an integral part of community planning and development.** Encourage development projects to minimize the impervious footprint and maximize greenspace through design. Ensure that the urban forester has a role in planning and zoning processes.
- **Promote trees and tree canopy as an efficient solution to stormwater management.** Consider integrating current and evolving design standards that reduce stormwater runoff and support tree growth and sustainability, including pervious pavement, suspended pavement, linear tree pits, and forested bioswales. Augment tree canopy cover in stormwater management areas, especially areas where common storm events are stressing the current infrastructure. Where possible, increase canopy cover near ponds and basins.

- **Promote community outreach.** Develop materials, presentations, and press releases to promote the importance of trees and canopy to the community. Consider providing an annual report to detail the state of the urban forest, including canopy loss and/or gain.
- **Dedicate 1% of development fees to reforestation.** These fees can be used to support tree planting and reforestation efforts in preservation areas to replace mature canopy lost as a result of development. Additional funds should be considered when requirements for tree replacement exceed the site capacity of a development project.
- **Establish additional preservation areas.** Identify locations where forestlands compliment community design and where they are suitable for preservation and/or reforestation efforts.
- **Increase partnerships and collaborations**. Work with developers and homeowner associations to identify and preserve conservation areas and parklands (example: Fennel Creek Corridor). Collaborate with Audubon, wildlife and sporting enthusiasts, stewardship groups, volunteers, and other government agencies to achieve conservation, maintenance, and reforestation goals.

Ultimately, protecting the urban forest requires a commitment from the entire community. While growth and development are vital to the economic well-being of Bonney Lake, preservation of the urban forest is equally important to ensuring that quality of life expectations are maintained. Adopting proactive preservation strategies that compliment development goals and recognize the rights of property owners will ensure that Bonney Lake remains a vibrant community, a "small town, natural environment", where dreams can soar!

Appendix A: Reference

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Appendix B: Methodology

Image Analysis

With advanced GIS and remote sensing software capabilities, in addition to advances in image acquisition, a top-down canopy assessment approach using remote sensing data is recommended to quantify the extent of tree canopy. Davey utilized an object based image analysis (OBIA) semi-automated feature extraction method to process and analyze current high resolution color infrared (CIR) aerial imagery and remotely-sense data to identify tree canopy cover and land cover classifications. The use of imagery analysis is cost-effective and provides a highly accurate approach to assessing your community's existing tree canopy coverage, which supports responsible tree management, facilitates community forestry goal-setting, improves urban resource planning of healthier and more sustainable urban environments.

Davey acquired ancillary GIS data and 2008 high resolution aerial imagery from the City of Bonney Lake and Pierce County. In addition, National Agricultural Imagery Program (NAIP) 4-band imagery acquired by the United States Department of Agriculture (USDA) in 2009 was also obtained. The NAIP, administered by the USDA's Farm Service Agency, acquired the imagery at a one-meter ground sample distance (GSD) with a horizontal accuracy that matched within six meters of photo identifiable ground control points (www.fsa.usda.gov). Acquired during the agricultural growing season (or leaf on), NAIP imagery provided the base layer for the object based image analysis.

Advanced image analysis method was used to classify, or separate, the land cover layers from the overall imagery. The semi-automated extraction process was completed using Feature Analyst®, an extension of ArcGIS®. Feature Analyst ® uses an object-oriented approach to cluster together objects with similar spectral (i.e. color) and spatial/contextual (e.g. texture, size, shape, pattern, and spatial association) characteristics. The land cover results of the extraction process was post-processed and clipped to each project boundary prior to the manual editing process in order to create smaller manageable and more efficient file sizes. Secondary source data, 2008 high resolution aerial imagery provided by Pierce County, and custom ArcGIS® tools were used to aid in the final manual editing and quality checking and quality assurance processes (QA/QC).

Accuracy Assessment

Two separate QA/QC process were implemented using ArcGIS® to identify, define, and correct any misclassifications or omission errors in the final land cover layer. Manual edits and random plot locations were generated to ensure that the automated mapping and data analysis performed by GIS specialists reflected the true nature and extent of the canopy cover.

A total of two accuracy assessments processes were also performed by randomly generating points within each boundary area for the initial 4-class land cover layer and again by the overall percent of land cover for the entire project area. Using the Random Points in Polygon tool, the first accuracy assessment generated a total of 100 random points for each land cover class with exception of 200 for the City of Bonney Lake area. Two points were thrown out

since it was outside of the project area in the north. The results of the accuracy assessment processes are identified below (Table 9).

The second process randomly generated 200 points for the overall project area by the percentage of land cover (Table 10).

The results of the initial 4-class land cover layer indicated an accuracy rating over 95%. A bare soils land cover class was manually created and clipped out of the initial 4-class land cover layer to create the resulting final 5-class land cover layer.

Table 10. Classification Accuracy by Project Area

Random Points per Land Cover Class Correctly Identified by Area						
Project Area	Canopy	Impervious	OW	Pervious	Total	Overall % Accuracy
Bonney Lake City Limits	49	50	46	46	191	96.46%
Sub Area 1	25	25	25	23	98	98.00%
Sub Area 2	25	25	25	23	98	98.00%
Sub Area 3	25	25	25	25	100	100.00%
Other Unincorporated Area	25	25	25	25	100	100.00%
UGA	24	25	23	21	93	93.00%
Total	**173**	**175**	**169**	**163**	**680**	**97.42%**

Table 11. Classification Accuracy by Percent of Overall Land Cover

Random Points			
Land Cover	Generated	Correctly Identified	% Accuracy
Canopy	86	85	98.84%
Impervious	48	48	100.00%
Open Water (OW)	2	2	100.00%
Pervious	64	64	100.00%
Total Points	**200**	**199**	**99.50%**

GIS Analysis and Final Deliverables

All land cover classes were merged into a final 5-class land cover layer and acreage calculations were generated using ArcGIS® geoprocessing, analysis, and data management tools. Land cover acreages and percentages were calculated for the overall project boundary, the City of Bonney Lake, and 5 additional project areas: Sub-Area1, Sub-Area 2, Sub-Area 3, Urban Growth Areas (UGA), and Other Unincorporated Areas. Canopy summary statistics were also calculated for land use, zoning, parks, and right-of-ways. Additional canopy

assessment and environmental analysis included: protected areas, areas at risk for development, and stormwater basin areas.

The final 5-class land cover layer included:

- Canopy Cover (includes trees and shrubs)
- Impervious surfaces (includes buildings, streets, driveways, parking lots)
- Pervious surfaces (includes: grass and open space)
- Open water
- Bare soils

Appendix C: Tables

Table 12. Complete Listing of Bonney Lake Parks and Open Space Sites

Park/Open Space Name	Owner	Type of Space	Total Acres	Canopy Acres	% Canopy
ALLAN YORKE BOAT LAUNCH	PUBLIC	PARK	0.12	0.00	2.21%
ALLAN YORKE PARK	PUBLIC	PARK	44.43	26.46	59.57%
ANGELINE HEIGHTS GREENBELT	HOA	GREENBELT	0.17	0.15	90.25%
ANGELINE HEIGHTS PARK	HOA	PARK	0.73	0.47	64.03%
ASCENT PARK	PUBLIC	PARK	1.90	0.16	8.17%
ASHTON PLACE PARK	HOA	PARK	0.26	0.04	14.44%
ASHTON VILLAGE OPEN SPACE	HOA	OPEN SPACE	0.21	0.18	85.21%
ASHTON WOODS OPEN SPACE	HOA	OPEN SPACE	0.15	0.06	41.72%
ASHTON WOODS PARK	HOA	PARK	1.00	0.15	15.53%
BOHEMIAN ESTATES PARK	HOA	PARK	16.24	14.10	86.83%
BONNEY LAKE ELEMENTARY SCHOOL	SCHOOL	SCHOOL	12.99	5.01	38.61%
BONNEY LAKE HIGH SCHOOL	SCHOOL	SCHOOL	51.37	8.25	16.07%
BONNEY LAKE SENIOR CENTER	PUBLIC	PARK	0.11	0.00	0.09%
BROOKSIDE 2 COMMON AREA	HOA	OPEN SPACE	0.15	0.03	21.94%
BROOKSIDE 3 OPEN SPACE	HOA	OPEN SPACE	0.31	0.01	2.69%
BROOKSIDE 3 PARK	HOA	PARK	0.07	0.00	0.00%
BROOKSIDE GREENBELT	HOA	GREENBELT	11.53	10.41	90.35%
BROOKSIDE OPEN SPACE	HOA	OPEN SPACE	8.45	4.29	50.70%
BROOKWATER DIV 1 PH 1 GREENBELT	HOA	GREENBELT	5.87	5.49	93.59%
BROOKWATER GREENBELT	HOA	GREENBELT	1.98	1.03	51.96%
BUCKLEY-BONNEY LAKE PARK	OTHER AGENCY	PARK	79.62	71.56	89.87%
CEDAR RIDGE ESTATES DIV 1 PARK	HOA	PARK	10.20	5.33	52.30%
CEDAR RIDGE ESTATES DIV 2 PARK	HOA	PARK	0.19	0.00	1.90%
CEDAR RIGHED ESTATES DIV 1 PARK	HOA	PARK	0.30	0.05	15.98%
CEDARVIEW PARK	PUBLIC	PARK	2.91	0.97	33.20%
CHURCH LAKE WATER FRONT DIV 1 PARK	HOA	PARK	2.56	0.56	21.68%
CLEARWATER GREENBELT	HOA	GREENBELT	0.40	0.28	69.54%
CLEARWATER PARK	HOA	PARK	0.43	0.06	13.95%
COPPERFIELD ESTATES PARK	HOA	PARK	1.35	0.68	50.67%
CRYSTAL MEADOWS OPEN SPACE	HOA	OPEN SPACE	1.26	0.39	30.75%
DEBRA JANE LAKE COMMON AREA	HOA	PARK	20.12	5.31	26.37%
DEBRA JANE LAKE PARK	HOA	PARK	5.97	2.98	49.86%
EAST POINTE OPEN SPACE	HOA	OPEN SPACE	1.68	0.19	11.14%
EAST POINTE PARK	HOA	PARK	0.33	0.07	20.50%
EMERALD HILLS ELEMENTARY SCHOOL	SCHOOL	SCHOOL	11.75	1.10	9.38%
ENCHANTED ESTATES OPEN SPACE	HOA	OPEN SPACE	0.11	0.00	1.28%
FENNEL CREEK TRAIL CORRIDOR	OTHER AGENCY	FUTURE PARK	136.24	58.09	42.63%
FENNEL CREEK CORRIDOR OFF SITE MITIGATION	OTHER AGENCY	FUTURE PARK	21.57	3.44	15.97%
FENNEL CREEK ESTATES GREENBELT	HOA	GREENBELT	8.87	8.25	93.04%
FENNEL RIDGE ESTATES OPEN SPACE	HOA	OPEN SPACE	9.98	9.17	91.88%
FENNEL RIDGE ESTATES PARK	HOA	PARK	0.41	0.28	67.52%
FENNEL RIDGE PUBLIC TRAIL	PUBLIC	PARK	0.54	0.43	79.06%
FOXGLOVE OPEN SPACE	HOA	OPEN SPACE	1.36	1.06	78.20%
FOXGLOVE PARK	HOA	PARK	0.32	0.00	0.44%
GARDEN MEADOWS OPEN SPACE	PUBLIC	OPEN SPACE	0.91	0.73	80.03%
GARDEN MEADOWS PARK	HOA	PARK	0.38	0.11	28.11%
HIGHLAND RIDGE PH 1 PARK	HOA	PARK	0.25	0.05	19.06%

Park/Open Space Name	Owner	Type of Space	Total Acres	Canopy Acres	% Canopy
HIGHWAY 410 GOLF DRIVING RANGE	PRIVATE/ COMMERCIAL	PRIVATE	5.53	0.19	3.41%
INLET ISLAND PARK	HOA	PARK	3.09	0.90	29.31%
KELLY GLADE PARK	HOA	PARK	2.49	2.03	81.45%
LAKE BONNEY BOAT LAKE	PUBLIC	PARK	0.40	0.28	68.62%
LAKE DEBRA JANE PARK	HOA	PARK	8.35	4.19	50.16%
LAKEVIEW TERRACE GREENBELT	HOA	GREENBELT	3.55	2.28	64.26%
LAKEVIEW TERRACE PARK	HOA	PARK	0.36	0.01	3.75%
LIBERTY RIDGE ELEMENTARY SCHOOL	SCHOOL	SCHOOL	10.29	1.22	11.84%
MADRONA POCKET PARK	PUBLIC	PARK	0.37	0.13	35.80%
MOUNTAIN VIEW MIDDLE SCHOOL	SCHOOL	SCHOOL	37.65	5.86	15.57%
NACHES TERRACE GREENBELT	HOA	GREENBELT	5.25	3.76	71.67%
PANORAMA HEIGHTS PH 1 OPEN SPACE	HOA	OPEN SPACE	2.00	0.10	4.95%
PANORAMA HEIGHTS PH 1 PARK	HOA	PARK	0.29	0.03	11.85%
PANORAMA HEIGHTS PH 2 OPEN SPACE	HOA	OPEN SPACE	18.47	8.13	44.01%
PANORAMA HEIGHTS PH 2 PARK	HOA	PARK	0.15	0.00	0.00%
PANORAMA HEIGHTS PH 3 GREENBELT	HOA	GREENBELT	13.65	8.53	62.48%
PANORAMA HEIGHTS PH 4 OPEN SPACE	HOA	OPEN SPACE	1.31	0.00	0.33%
PANORAMA HEIGHTS PH 4 PARK	HOA	PARK	1.21	0.03	2.43%
PANORAMA HEIGHTS PH 5 OPEN SPACE	HOA	OPEN SPACE	0.59	0.01	1.98%
PANORAMA HEIGHTS PH 5 PARK	HOA	PARK	0.17	0.00	0.00%
PANORAMA WEST GREENBELT	HOA	GREENBELT	15.82	14.65	92.60%
PANORAMA WEST PARK	HOA	PARK	14.26	11.12	77.99%
PEACH TREE PLACE PARK	HOA	PARK	0.26	0.14	54.32%
PONDEROSA ESTATES DIVISION 4 LAGOON	HOA	OPEN SPACE	0.14	0.05	31.54%
PONDEROSA ESTATES OPEN SPACE	HOA	OPEN SPACE	15.03	5.63	37.46%
PRAIRIE HILLS PDD PARK	HOA	PARK	0.65	0.00	0.74%
PRAIRIEWOOD PARK	HOA	PARK	1.19	0.35	29.68%
PTARMIGAN RIDGE PARK	HOA	PARK	0.55	0.01	1.64%
RHODENDRON PARK 1 GREENBELT	HOA	GREENBELT	5.09	3.34	65.67%
RHODODENDRON PARK 2 PARK	HOA	PARK	6.96	3.42	49.19%
RHODODENDRON PARK OPEN SPACE	HOA	OPEN SPACE	16.40	12.21	74.44%
SIMMONS PARK	PUBLIC	PARK	1.52	1.23	80.84%
SKY ISLAND DIV 1 OPEN SPACE	HOA	OPEN SPACE	0.15	0.04	24.18%
SKY ISLAND DIV 1 PARK	HOA	PARK	0.95	0.14	14.45%
SKY ISLAND DIV 2 GREENBELT	HOA	GREENBELT	0.56	0.04	7.59%
SKY ISLAND DIV 3 GREENBELT	HOA	GREENBELT	12.98	11.26	86.76%
SKY ISLAND DIV 4 GREENBELT	HOA	GREENBELT	4.08	2.32	56.82%
SKY ISLAND DIV 5 GREENBELT	HOA	GREENBELT	3.90	0.91	23.29%
SKY ISLAND GREENBELT	HOA	GREENBELT	0.10	0.07	70.26%
SKY ISLAND PARK	HOA	PARK	0.95	0.14	14.45%
SKY STONE PARK	HOA	PARK	4.47	3.22	72.10%
SPRINGHAVEN GREENBELT	HOA	GREENBELT	11.34	8.69	76.68%
SPRINGHAVEN PARK	HOA	PARK	0.46	0.14	31.12%
SWISS SPORTSMEN CLUB OF TACOMA	PRIVATE/ COMMERCIAL	PRIVATE	40.14	28.76	71.64%
TIMBER RIDGE ESTATES DIV 3 PARK	HOA	PARK	3.01	0.91	30.28%
TIMBER RIDGE ESTATES PARK	HOA	PARK	0.34	0.05	14.91%
VICTOR FALLS	PUBLIC	OPEN SPACE	14.61	9.21	63.06%
VICTOR FALLS ELEMENTARY	SCHOOL	SCHOOL	19.39	10.97	56.60%
FORMER WSU DEMO FOREST	OTHER AGENCY	PARK	144.25	137.37	95.23%
WEMBLEY PARK SOUTH	HOA	OPEN SPACE	1.57	0.49	31.30%

Park/Open Space Name	Owner	Type of Space	Total Acres	Canopy Acres	% Canopy
WHITEHORSE JUNCTION PARK	HOA	PARK	0.12	0.00	1.71%
WILDERNESS RIDGE DIV 3 WETLAND	HOA	OPEN SPACE	1.26	1.21	96.30%
WILLOW BROOK PH 1 PARK	HOA	FUTURE PARK	44.08	17.71	40.19%
WILLOW BROOK PH 2 OPEN SPACE	HOA	OPEN SPACE	5.32	1.63	30.64%
WILLOW BROOK PH 2 PARK	HOA	PARK	0.23	0.00	1.44%
WINTERHAVEN GREENBELT	HOA	GREENBELT	5.31	4.58	86.17%
WOODBRIAR VILLAGE OPEN SPACE	HOA	OPEN SPACE	0.61	0.04	7.15%
WOODBRIAR VILLAGE PARK	HOA	PARK	0.13	0.04	26.96%
WOODLAND MEADOWS PARK	HOA	PARK	0.22	0.00	0.31%
All Bonney Lake Parks and Open Space			**991.66**	**577.24**	**58.21%**

Table 13. Complete Listing of Bonney Lake Stormwater Management Areas

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
101ST STCT E	26.16	21.95	83.9%
174TH AV E	3.66	0.39	10.6%
182ND AV E	8.76	6.12	69.9%
185TH AV E	4.75	2.81	59.2%
186TH AV E	3.83	1.09	28.4%
187TH AV E	15.28	8.23	53.9%
191ST AVCT E	27.28	11.29	41.4%
210TH AV E	3.05	1.03	33.7%
214TH AV E	20.64	11.79	57.1%
221ST AV E	38.15	23.39	61.3%
225TH AVCT E	14.93	9.40	63.0%
233RD AV E	1.88	0.13	6.9%
62ND ST E	47.21	35.47	75.1%
75TH ST E	3.86	0.85	22.0%
77TH ST E	10.12	3.74	37.0%
80TH STCT E	13.12	4.35	33.2%
ALBERTSONS	14.20	0.44	3.1%
ALLAN YORKE PARK	19.43	12.44	64.0%
ANDRE'S BAR AND GRILL	1.77	0.07	3.7%
ANGELINE HEIGHTS	7.37	1.76	23.9%
ANGELINE RD E	42.51	29.92	70.4%
ARMADA/410 LLC	6.71	0.28	4.2%
ASHTON WOODS	62.91	5.65	9.0%
BOHEMIAN ESTATES	37.71	22.30	59.1%
BONNEY LAKE BLVD E	20.92	11.26	53.8%
BONNEY LAKE HEIGHTS	74.44	26.91	36.1%
BONNEY LAKE HIGH SCHOOL	52.06	8.30	15.9%

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
BONNEY LAKE MANOR	61.03	17.23	28.2%
BONNEY LAKE MEDICAL PLAZA	4.70	2.07	44.1%
BONNEY LAKE PLAZA	5.29	0.43	8.2%
BONNEY LAKE TOWN CENTER	16.85	2.59	15.4%
BONNIE BRAE	48.25	15.23	31.6%
BROOKSIDE	70.09	10.95	15.6%
BROOKWATER	40.35	8.46	21.0%
C & B REALTY CO & HOUSE	18.02	11.36	63.0%
CEDAR GROVE	35.84	14.70	41.0%
CEDAR HEIGHTS	12.78	5.06	39.6%
CEDAR RIDGE RETIREMENT	6.18	1.26	20.4%
CEDARVIEW	104.05	38.63	37.1%
CEDARVIEW 2	66.72	49.98	74.9%
CENTENNIAL STORAGE	3.12	0.44	14.1%
CHAFFEY HOMES	14.94	11.41	76.3%
CHURCH LAKE PARK	2.56	0.56	21.7%
CHURCH LAKE RD E	30.69	13.58	44.3%
CHURCH LAKE WATERFRONT 1	83.36	23.12	27.7%
CHURCH LAKE WATERFRONT 2	37.97	14.73	38.8%
CITY HALL - BALL FIELD 4	15.66	9.00	57.5%
CLARK PROPERTY	29.64	4.01	13.5%
CLARKS COVE	11.49	3.81	33.1%
CLEARWATER	8.02	1.06	13.2%
COMMERCIAL VACANT LAND	18.52	6.81	36.8%
COPPERFIELD	28.71	3.74	13.0%
CRYSTAL MEADOWS	10.23	0.59	5.8%
DAYS ADD	17.27	5.71	33.0%
DEBRA JANE LAKE	174.46	82.95	47.5%
DEBRA JANE LAKE 2	44.91	16.80	37.4%
DEBRA JANE LAKE 3	18.34	11.67	63.6%
EAST POINTE	10.03	0.45	4.5%
EAST RIDGE	14.31	3.18	22.2%
EASTOWN LLC	23.48	2.79	11.9%
ELHI CREST	14.27	5.41	37.9%
EMERALD HILLS ELEMENTARY	13.70	2.01	14.6%
ENTWHISTLE RD E	3.02	2.23	73.8%
EVERGREEN 2	24.30	7.98	32.8%
FENNEL CREEK SMA	108.11	82.57	76.4%
FENNEL RIDGE	14.31	2.66	18.6%
FENNEL RIDGE 2	5.93	0.87	14.6%
FIR RETREAT	9.93	3.14	31.7%
FIR VIEW	12.68	4.74	37.4%

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
FIR VIEW MANOR	4.68	0.60	12.9%
FOREST GLEN 2	3.91	2.15	54.9%
FOXGLOVE	14.44	4.90	33.9%
FRED MEYER PLAT	45.15	2.25	5.0%
FREEDOM RECOVERY CENTER	2.69	0.35	13.1%
GARDEN ACRES	27.95	18.57	66.4%
GARDEN MEADOWS	5.36	0.15	2.8%
GMG PLAT	81.12	42.15	52.0%
GRANDVIEW	22.38	10.88	48.6%
HIGHLAND RIDGE	2.04	0.32	15.7%
HIGHLAND RIDGE 1	30.98	20.93	67.6%
HIGHWAY 410 GOLF DRIVING	10.72	2.45	22.9%
HILL NW OF SKY ISLAND 5	56.93	31.21	54.8%
HILL SW OF SR410 W	41.37	29.76	71.9%
HILLCREST ESTATES	26.27	9.24	35.2%
HOME DEPOT	15.86	3.26	20.6%
HUST VISTA	7.45	2.18	29.3%
INDIGO RIDGE	5.21	0.34	6.5%
INLET ISLAND	122.69	35.85	29.2%
INTERLAKE ISLAND 1	69.56	20.05	28.8%
INVESTCO WETLANDS	10.85	9.18	84.6%
JUNCTION 192	39.97	6.40	16.0%
KELLEY GLADE	19.27	4.27	22.2%
KELLY CREEK	64.18	21.99	34.3%
KELLY CREEK HEIGHTS	29.44	14.31	48.6%
KELLY CREEK VISTA	15.81	3.47	22.0%
KELLY FARM	1.86	0.96	51.4%
KELLY GLADE	11.52	7.34	63.7%
KELLY GLEN	6.13	1.25	20.3%
KELLY LAKE RD E	3.11	0.45	14.6%
KHANE PROPERTY	3.04	0.10	3.3%
KINGSLEY COURT	5.98	1.38	23.0%
LAKE BONNEY	54.14	28.93	53.4%
LAKE TAPPS CEDAR	79.31	50.22	63.3%
LAKE TAPPS CONDO	4.23	2.67	63.1%
LAKE TAPPS DEVELOPMENT	2.44	0.21	8.6%
LAKEVIEW	21.49	11.10	51.6%
LAKEVIEW TERRACE	14.79	1.77	11.9%
LEGACY PARK	3.72	0.30	8.1%
LES SCHWAB TIRE CENTER	1.81	0.06	3.6%
LOWES	12.98	0.17	1.3%
LUMBERMANS	4.04	0.59	14.7%

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
MADRONA ADD	5.69	3.35	58.8%
MAPLE POINT	22.88	6.91	30.2%
MAZATLAN RESTAURANT	12.29	9.58	77.9%
MCDONALD FRUIT TRACTS	242.27	75.56	31.2%
MCHUGH PLAZA	1.36	0.03	1.9%
MORIARTY PROPERTY	14.85	8.04	54.1%
MOUNTAIN VIEW	3.29	0.76	23.1%
MOUNTAIN VIEW MID SCHOOL	39.90	6.90	17.3%
MOUNTAIN VISTA	17.57	6.06	34.5%
MYERS RD E	76.38	41.36	54.1%
MYSTERY WOOD HEIGHTS	7.63	3.85	50.5%
NACHES TERRACE	16.84	3.23	19.2%
PACIFIC PARADISE	5.22	2.12	40.6%
PACIFIC PRIDE	1.31	0.27	20.6%
PANORAMA HEIGHTS	86.18	11.59	13.5%
PANORAMA HEIGHTS 2	21.06	8.26	39.2%
PANORAMA WEST	132.82	34.08	25.7%
PARK LAKE 1	8.85	2.73	30.8%
PARKSIDE SOUTH	21.74	10.31	47.4%
PLATEAU 465	477.56	460.52	96.4%
PONDEROSA WATER TANKS	2.53	1.20	47.4%
PROPOSED REGIONAL PARK	79.63	71.56	89.9%
PTARMIGAN RIDGE	13.12	0.05	0.4%
QUIET MEADOWS	14.06	1.88	13.4%
RAINIER VISTA	34.24	10.46	30.6%
RETREAT ON LAKE TAPPS 1	6.43	2.07	32.2%
RHODES LAKE RD E	5.25	1.35	25.6%
RITE AID	1.79	0.02	1.3%
ROSE HEIGHTS	20.56	12.36	60.1%
SANDY CORNER	2.12	0.75	35.4%
SKY ISLAND 1	27.52	5.47	19.9%
SKY ISLAND 2	18.10	1.10	6.1%
SKY ISLAND 3	28.35	1.92	6.8%
SKY ISLAND 4	4.98	0.75	15.1%
SKY ISLAND 5	47.56	3.65	7.7%
SONIC AND DISCOUNT TIRE	4.42	0.16	3.5%
SOUTH HILL OFF SR410 W	136.28	100.86	74.0%
SOUTH PRAIRIE RD E	2.17	0.60	27.4%
SPIRAEA GLEN	5.06	0.48	9.4%
SPIRAEA GLEN DIVISION I	17.90	3.44	19.2%
SPRINGHAVEN	60.97	10.21	16.8%
SR410 E	117.47	44.59	38.0%

Stormwater Management Areas	Total Acres	Canopy Acres	Overall %
STORE IT HERE	6.88	0.97	14.1%
SUNRISE MANOR	12.98	0.58	4.4%
SUNSET CHIROPRACTIC	8.66	4.62	53.3%
SUNSET PARTNERS LLC	5.49	1.64	29.9%
SWISS PARK	40.14	28.76	71.6%
TOPSOIL, BARK, ETC.	5.39	0.16	3.1%
VACANT COMMMERCIAL 214TH	6.27	4.58	73.1%
VACANT LAND	3.32	2.42	72.7%
VALLEY VIEW	8.08	2.28	28.3%
VICTOR FALLS	9.68	9.21	95.2%
VILLA ESTATES	17.00	5.88	34.6%
WALMART	35.18	2.68	7.6%
WEST TAPPS HWY E	2.55	0.17	6.5%
WHITEHORSE JUNCTION	3.71	0.03	0.8%
WILLOW BROOK 1	96.69	28.51	29.5%
WILLOW BROOK 2	20.76	2.03	9.8%
WINTERHAVEN	9.63	5.52	57.3%
WOODBRIAR VILLAGE	3.05	0.77	25.2%
WSU FOREST	149.48	142.30	95.2%
Total Area	5194.87	2385.54	45.9%