CITY OF WOODINVILLE
TREE BOARD AGENDA
REGULAR MEETING WEDNESDAY, MARCH 14, 2012 4:30 PM

• Johan Luchsinger, Chair • Olga Bonilla • Jey Manickam • Thomas L Quigley

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4:30 **1. CALL TO ORDER**

4:32 **2. APPROVE AGENDA IN CONTENT & ORDER (INTRODUCTIONS)**

4:35 **3. PUBLIC COMMENTS/GUEST SPEAKER**

4. PUBLIC HEARING - None

4:40 **5. PLANNING DIRECTORS REPORT**

6. APPROVAL OF MINUTES - None

7. NEW BUSINESS

4:50 a. Study Session: Arbor Day & 2012 Tree Board Public Outreach Efforts

5:10 b. Study Session: 2012 Tree Board Work Program

8. UNFINISHED BUSINESS -

5:25 a. Study Session: Continued Review of the 1998 Community Urban Forestry Plan – Review Vision Statement and 21 Goals of the Plan

5:40 **9. TREE BOARD SCHEDULE**

5:45 **10. PUBLIC COMMENTS**

5:50 **11. ADJOURNMENT**

(Note: The agenda may be rearranged or changed at the beginning of the meeting, with a consensus of Tree Board members present.)

Issue Date: March 12, 2012

Staff Contact: Hal Hart, Development Services Director, halh@ci.woodinville.wa.us

Faxed to: News Media
E-mailed to: Tree Board
Publish: Not published
Post: 1) In-House, 2) Post Office & 3) Website

CITY OF WOODINVILLE, CALKINS ROOM
17301 133RD AVE. NE, WOODINVILLE, WA 98072

NEXT REGULAR MEETING APRIL 11, 2012, 4:30 PM

CITY OF WOODINVILLE, WA

REPORT TO THE PLANNING COMMISSION

17301 133rd Avenue NE, Woodinville, WA 98072
WWW.CI.WOODINVILLE.WA.US

Staff Report

To: Tree Board **Date:** March 14, 2012
From: Hal Hart, Development Services Director HHH
Subject: 2012 Tree Board Public Outreach Efforts

Background:
The City of Woodinville's Tree Board engages in a series of public outreach events on an annual basis. Over the past three years, this has consisted of at least a City sponsored "Arbor Day Event", a booth at the Bothell – UW Garden Fair, and photo opportunities with Sammamish River Stewards and City Council.

The Washington State Department of Natural Resources encourages cities to find creative ways to involve their community and to provide them with updated and useful information regarding urban forestry issues.

See Attachment A to this staff report for City of Woodinville 2012 Volunteer Opportunities.

2012 Outreach and Public Participation Proposal:

2012 Events	March	April	May	June	July	August
Arbor Day		Thursday April 26th 2012 We could have a Proclamation Read at Council – and Hold a Tree Planting event of some kind around that time.				
Earth Day		Thursday April 22, 2012				
Spring Events			Sustaina Mania – Bothell Centennial Park			
Summer Events					Wed Night Concerts	Wed Night Concerts

Arbor Day – What can we do as a Tree Board over the Long Term?
On Arbor Day, people are encouraged to plant and care for trees. A wide range of events are organized to promote Arbor Day around the Puget Sound Area. These include: communal tree planting ceremonies; proclamations by city governments; exhibitions and educational activities on trees and their importance to local communities and the planet as a whole; and fairs, musical performances and open days in garden centers.

Schools are encouraged to plan lessons around the theme of trees. Arbor Day awards are, also, presented to individuals and organizations across the United States and around the world. These are awarded for outstanding service to trees, forestry, or related ecological themes.

Brain Storm Events:

- Idea – Work with the Sammamish River Stewards – Plant Trees at a key area along the Sammamish
- Booth – Outreach to the community – perhaps Molbak's on that day
- Offer a 30 minute to 45 minute talk/discussion on a selected/topic.

Examples of Arbor Day Events in Neighboring Cities

City of Bothell

April 21, 2012 - 10:00 AM North Creek Trail, just north of 228th at 29th Dr

All Ages Welcome! The City of Bothell's annual Arbor Day Celebration will be held on Saturday, April 21 at 10 AM. This year there will be approximately 300 trees to plant along North Creek just north of 228th St. at approximately 29th Drive SE (by the arched foot bridge). If you are bringing a group, please contact us (425.486.7430) so we can be sure to provide plenty of refreshments. If possible, bring your own gloves and shovels. A limited number of shovels will be available to share.

City of Kirkland

Volunteers are needed to help out at the city's annual Arbor Day celebration and forest restoration at Cotton Hill Park on Nov. 14 from 9 a.m. to noon. With the help of Mayor James Lauinger, volunteers will plant native trees and shrubs. Tools, gloves, and light refreshments are provided. The park is located at 110th Ave. N.E. and N.E. 98th Street.

Attachments:

Attachment A: City of Woodinville 2012 Volunteer Opportunities

Attachment A

CITY OF WOODINVILLE

2012 VOLUNTEER OPPORTUNITIES

Please contact Volunteer Coordinator @ 425-877-2272 with questions and interest

All prospective volunteers must complete required volunteer paperwork available at City Hall.

Date	Event	Day of Week	Time	Location	Address / Directions	Purpose	Appropriate for Minors	# of vols needed
Receptionist On-Going	Volunteer Concierge Program	During Regular Office Hours	Varies	City Hall	17301 133rd Avenue NE	Assist with receptionist duties	No, 21+	12
Park Maintenance Assistance On-Going	Help maintain our parks and landscaped areas	All	Varies	Throughout the City	Call Brenda Eriksen for additional information	Maintain Parks System	No, 18+	Varies
January 14 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Woodin Creek site	Along the Sammamish River Trail S. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
February 11 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Woodin Creek site	Along the Sammamish River Trail S. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
March 10 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Little Bear Creek site	Along the Sammamish River Trail N. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
March 31	City Celebration	Saturday	11:30am-4pm	tbd	Call Brenda Eriksen for additional information	Community Event	yes, 16+	10
April 14 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Little Bear Creek site	Along the Sammamish River Trail N. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
April	Arbor Day Event	Saturday	10 am to 2 pm	TBD		Habitat Restoration	All Ages (under 14 w/adult)	100
May / June	Downtown Planters - Summer Planting	Any	9 am - Noon	Available for Group Adoption				
May 12 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Woodin Creek site	Along the Sammamish River Trail S. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
June 9 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Woodin Creek site	Along the Sammamish River Trail S. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
July 14 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Little Bear Creek site	Along the Sammamish River Trail N. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
August 11 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Little Bear Creek site	Along the Sammamish River Trail N. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
September 8 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Woodin Creek site	Along the Sammamish River Trail S. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
September	Salmon Watchers Program Training	Thursday	7:00 - 9:00 pm	Woodinville City Hall	contact Deb Crawford 425-489-2700	Training for Salmon Watchers	16+	10
October	Downtown Planters - Fall Planting	Any	9 am - Noon	Available for Group Adoption				
October 13 (monthly project day)	Sammamish ReLeaf / SRS	Saturday	10 am to Noon	Woodin Creek site	Along the Sammamish River Trail S. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	50
November 10 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Little Bear Creek site	Along the Sammamish River Trail N. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20
December 8 (monthly project day)	Sammamish River Stewards	Saturday	10 am to Noon	Little Bear Creek site	Along the Sammamish River Trail N. of Wilmot Park	Habitat Restoration	All Ages (under 14 w/adult)	20

Wilmot Park is located at 17301 131st Avenue NE, Woodinville

Saturday, May 19, 2012, 9am - 3pm

Sustainamania

a NATIONAL PUBLIC WORKS WEEK event

A fun filled FREE event for people of all ages.

Come learn about how you can be more sustainable everyday.

FREE

Event Activities

- Kid's Activity
- Goat Cam
- Tour a LEED Bothell Facility
- Walk through the Wetland
- Adopt a Native Plant
- Learn about Bothell's History
- Meet the Public Works Director
- Join us for the Pesticide Forum
- Climb into a City Vehicle

Speakers & Forums

9am: Opening Ceremony

10am: Director Erin Leonhart

11am: Ladd Smith

Noon: Environmental Movie Trailers & kid's can come make a cup of edible dirt.

1pm: Pesticide Forum

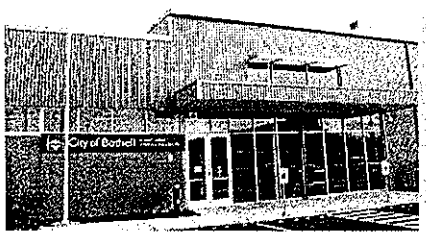
2pm: Director Erin Leonhart

Booths

- Recycle Toss
- Landmark Preservation Board Pet Waste Toss
- Meet a Goat
- Water Conservation
- FOG
- Energy Reduction
- Bothell History Museum

Brought to you by

City of Bothell, City of Woodinville, and grants from King County Solid Waste Division and WA Department of Ecology Coordinated Prevention Grants



Public Works Operations Center - 21233 20th Avenue SE, Bothell, WA 98021

Visit Sustainamania.org for more information

Hand Out By Hal @ 3-14-12 Tree Bd

King County EcoConsumer

EcoConsumer News & Media
EcoConsumer Blog
EcoConsumer Earth Day Detox
Waste Calculator
About Us
Request a Green Speaker
EcoConsumer on Facebook
EcoConsumer on Twitter
Green World Cup
Green Holidays
Contacts
Calendar
FAQs
Links

About Us

Tom Watson's Bio

Tom Watson
King County's EcoConsumer

Tom Watson manages the EcoConsumer public education program for King County Solid Waste Division. As part of this effort, Tom writes a column for *The Seattle Times* and appears on local TV including regular EcoConsumer segments on the KOMO4 TV news. He is also a frequent radio guest, including weekly appearances on KOMO Newsradio (AM 1000 and FM 97.7).

In his work with King County, Tom has been involved in a wide range of projects and research on waste prevention, packaging, junk mail reduction, natural gardening, reuse, toxics reduction, electronics recycling, greening the home and product stewardship. He also manages King County's Green Holidays program, and as part of his job for the County he coordinates the National Waste Prevention Coalition.

Tom gives dozens of presentations every year locally, regionally and nationally, from the Seattle Green Festival, to the National Recycling Coalition conference, to the WaterWise Garden Faire in Covington.

Prior to joining the County, Tom was a writer and contributing editor for Resource Recycling magazine. He has also been a reporter and editor for several daily and weekly newspapers. Tom has a horticulture background as well, and has worked for Swanson's Nursery in Seattle and other nurseries on the West Coast.

He lives in Seattle's Central District with his wife Linda. They enjoy walking around the city together, and Tom feels lucky to live close enough to walk to work. Their daughter Genna attends the University of Washington.

King County's Role

King County Solid Waste Division has a multi-pronged approach to environmental protection:

- Public education, which includes King County EcoConsumer and dozens of other projects and programs.
- Working with the business sector to encourage them to take responsibility for the environmental impacts of their products and services. This is known as product stewardship.
- Offering collection opportunities for recyclable or reusable items when possible, at our transfer stations or through partnerships.
- Providing waste disposal services with the highest standards and lowest environmental impact possible.

King County's EcoConsumer project deals with the environmental impacts of our purchasing decisions and daily activities. In addition to the Solid Waste Division, a number of other King County agencies offer programs and resources to help King County residents balance consuming and conserving.

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King County Solid Waste Division
King Street Center 201 S. Jackson Street, Suite 701, Seattle, Washington 98104
206-296-4466, 1-800-325-6165 ext. 64466 (outside the local calling area M-F 8:30 a.m. - 4:30 p.m.), TTY Relay: 711
Fax: 206-296-0197
Send us your comments online.

Updated: Mar. 29, 2010

Links to external sites do not constitute endorsements by King County.
By visiting this and other King County Web pages,
you expressly agree to be bound by terms and conditions of the site.
The details.

Green Event Booth List

Recycle Toss		sabrina.combs@ci.bothell.wa.us	Green, Black, and Blue bins for tossing materials.	Open booth with 1 chair
Surface Water Management Plan	Andy Loch	andy.loch@ci.bothell.wa.us	Information on the program, rules, and other information	1 table and 1 chair
Sustainable Bothell	Melissa McGinn	melissarmcginn@gmail.com		
Sustainable Seniors	Brittany Caldwell		Senior Resource Committee will work with Sabrina to put together items.	1 table and 1 chair
Touch a Truck (City of Bothell)	Ted Stonebridge	ted.stonebridge@ci.bothell.wa.us	Utility Trucks, Vactor Truck, and Sewer Truck with camera	
Tour (PWOC)	Clark Meek	clark.meek@ci.bothell.wa.us	Facility tour about 20-30 minutes in length	1 table shared with Wetland tours and 1 chair
Tour (Wetland)	Adam Fletcher	adam.fletcher@ci.bothell.wa.us	Wetland tour about 20-30 minutes in length. Sign up table should include a laptop for allowing people to see the Wetland Game on facebook by UWB students/facility.	1 table shared with PWOC tours and 1 chair
Touch a Truck (Waste Management)	Bob Eichhorn	reichhorn@wm.com	CNG solid waste truck with garbage, recycling, and food/yard debris containers	
Urban Farming Expert UW Bothell Compost Benches and Worm Bins	Tyson Kemper		BMCs, WMCs, chickens at home, experts	1 table and 1 chair
Volunteers (Office Staff)	Sabrina Combs	sabrina.combs@ci.bothell.wa.us	No staffing at booth. Info sheets on big events like this one. Card with link to info on front and 3 easy steps on back	1 table and no chair
Volunteers (Restoration Events)	Janet Geer	janet.geer@ci.bothell.wa.us		
Water Conservation	Joe Phan	joe.phan@ci.bothell.wa.us	Dye tabs, water conservation books,	
Wetland Tours	Adam Fletcher	janet.geer@ci.bothell.wa.us	Tours every 30 minutes. Native plant Adopt a plant program. Plants provided by Janet.	1 table and 1 chair
WM Recycling Info Booth	Katherine Mantz	kmantz@wm.com	Snohomish and King County recycling guide books, giveaway item, food scrap pails (provided by Woodinville and Bothell about 100 each), food scrap information, coloring books for kids activities (150 copies),	They provide WM booth and we provide 4 tables and 2 chairs
Worm Boxes/Compost Bins (UWB)				

Distributed By Hal at 3-14-12 Tree Board Meeting

Green Event Booth List

All Battery Sales & Service	Jack Bradbury	jack@allbatterysalesandservice.com	Examples on corroding batteries and cause and effect in the environment. Plus, the amount of material that is recyclable.	
Biodiesel			Standard or General and collection containers	
Build a worm bin				
Cistern for Grey Water	Dan Peddy/Matt Smith			
Collection Items	Sabrina Combs	sabrina.combs@ci.bothell.wa.us	CFL bulbs, batteries, document destruction	
Earth Friendly Recycling	Rex Yang			
Ecotools Building Engineering	Steve Morikawa	Steven.Morikawa@ci.bothell.wa.us		
FOG (Fats, Oils, and Greases)	Dan Peddy	dan.peddy@ci.bothell.wa.us	Brochures, sink strainers,	1 table and 1 chair
Goat Cam at Centennial Parks	Joy Johnston			
Natural Landscaping	Adam Fletcher	adam.fletcher@ci.bothell.wa.us	This is what the City does compared to this is what you (homeowner) can do. Adam showcase workplan. Janet provide Natural Yard Care materials.	
Herb Boxes				
Illicit Discharge	Kristin Terpstra	kristin.terpstra@ci.bothell.wa.us		1 table and 1 chair
In Harmony	Ladd Smith			
Kid's Activity	Janet Geer	janet.geer@ci.bothell.wa.us	Bothell Cool bags and materials inside for students.	
Landmark Preservation Board	Mark Nihart	mbnihart@comcast.net		

Green Event Booth List

Bothell Museum	Mark Nihart	mbnihart@comcast.net	The focus is historical Landmark sustainability aligned with historical social history sustainability: Not just a preserved historical landmark but a landmark with a preserved human story. The focus is historical Landmark sustainability aligned with historical social history sustainability: Not just a preserved historical landmark but a landmark with a preserved human story.	
Mason Bees Master Gardners Master Recyclers and Composters Natural Pest Control for Molds and Moss				
Ops PPE	Ted Stonebridge	ted.stonebridge@ci.bothell.wa.us	Safety equipment information and display. Staff wearing them and explaining them (vest, glasses, hats, shoes, etc.), also samples of open manhole and flagging. PW Week stickers.	
Sustainability of the Body	Steve Dahl	steve.dahl@ci.bothell.wa.us	City of Bothell Parks and Recreation classes	1 table and 1 chair
Pet Licensing	Debra Murdock, Animal Control Officer	Debra.Murdock@ci.bothell.wa.us	Pet Ordinance, Licensing information, etc.	1 table and 1 chair
Pet Waste Toss	Janet Geer	janet.geer@ci.bothell.wa.us	Materials borrowed from City of Lake Forest Park by Janet Geer. Candy/Sucker to hand out as prize.	Open booth with 1 chair
Pipers Creek Nursery			Native plant sales	
Puget Sound Starts Here/Drain Rangers	Janet Geer	janet.geer@ci.bothell.wa.us		2 tables and 1 chair
Hazardous Materials	Sabrina Combs	sabrina.combs@ci.bothell.wa.us	Return medicine program, wastemobile, make your own cleaner recipe cards	1 table and 1 chair
Rain Barrel Coupons	Amy Ensminger	AmyE@ci.woodinville.wa.us	Info on purchasing rain barrels and possible giveaway	1 table and 1 chair
Raised Planters Demo				

CITY OF WOODINVILLE, WA

REPORT TO THE PLANNING COMMISSION

17301 133rd Avenue NE, Woodinville, WA 98072
WWW.CI.WOODINVILLE.WA.US

Staff Report

To: Tree Board **Date:** March 14, 2012
From: Hal Hart, Development Services Director
Subject: 2012 Tree Board Work Program

Background:

Each year the Tree Board develops a proposed work program. The proposed work program for 2012 -2013 is as follows:

A. Proposed Work Program Items 2012-2013 (These items can be prioritized).

Priority:

_____ Create specific criteria for tree groves in various public settings. This should include drawings as well as incorporating the ideas into code/standards etc., where it would be beneficial to the City of Woodinville in the development process.

_____Improve and update the criteria for drought tolerant plantings along roadways and open space areas

_____Work with the Planning commission to develop open spaces in a natural way consistent with the NW Woodland character concepts

_____Create specific public advisory materials demonstrating tree groves within a public setting

_____Identify and prioritize opportunities to enhance existing publicly owned critical area parcels in the City of Woodinville

_____Prioritize and map the areas for enhancement spending of funds consistent with other plans (WRIA/Shoreline Master Program/PRO Plan), as well as the City of Woodinville's Urban Forestry Plan

_____Make recommendations for property acquisitions to implement the Comprehensive Plan goals and objectives, both citywide and downtown

_____Recommend professional service contract amount to achieve the Above-mentioned goals and objectives

B. Other Related Issues:

_____Review Comprehensive Plan Strategies, make recommendations as to the future changes

_____Review Comprehensive Plan Elements for consistency with the plan and regulations governing tree protection

C. Proposed Tree Board Citizen Outreach Program:

_____Annual Arbor Day Activities

_____Spring Garden Fair Participation (or equivalent)

_____Other outreach activities into the community

1. Discussion of outreach objectives
2. Opportunities
3. Passive Outreach Opportunities
    a. Summer concerts at the Park
    b. Educational materials at Farmers Markets
    c. Others

_____Annual updating of Public Information

D. Proposed Tree Board Work Program Cycle:

First Quarter:

Plan Outreach Events for the Year
Review Work Program and Provide Recommendation
Review Community Urban Forestry Plan

Second Quarter:

Third Quarter:

Fourth Quarter:

CITY OF WOODINVILLE, WA

REPORT TO THE PLANNING COMMISSION

17301 133rd Avenue NE, Woodinville, WA 98072
WWW.CI.WOODINVILLE.WA.US

Staff Report

To: Tree Board **Date:** March 14, 2012

From: Hal Hart, Development Services Director HH

Subject: 2012 Tree Board Continued Review of the 1998 Community Urban Forestry Plan - Review Vision Statement and 21 Goals of the Plan

Background:

Adopted in 1998 under Ordinance No. 228, the City adopted Community Urban Forestry Plan to address the City's Urban Forest needs and to help the city maintain its Northwest Woodland Character. During the adoption process the City held two "Open Houses" to gain public views on the topic. In addition, the Tree Board's work went to the City Planning Commission and then to the City Council for review and public hearing.

The Plan was designed around the Vision Statement of the City of Woodinville's Land Use Plan (See Attachment A).

Part IV of the Community Urban Forestry Plan are the Goals and Policies, which implement the Plan. The goals are listed below:

Goal CUF- 1 To provide a balance between development and the natural environment through voluntary measures, then incentives, and finally as a last resort, regulations.

Goal CUF -2 To work towards no net loss of the overall community urban forest cover; in the long term, measurable gain.

Goal CUF-3 Enhance the overall canopy of the community urban forest to create significant shade corridors in the City.

Goal CUF-4 To provide for opportunities to increase "green spaces" to create an enhanced balance of people, nature, and economic development.

Goal CUF-5 To encourage tree and vegetation planting that increases environmental benefits including energy savings, noise reduction, cleaner air and water, and protection from the elements.

Goal CUF-6 To enhance the natural habitat where appropriate for wildlife, salmon, and other aquatic wildlife and animals with particular focus on endangered species

Goal CUF-7 To achieve a sustainable community urban forest through diversity of species and ages to safeguard the forest's overall health and to enhance scenic beauty.

Goal CUF-8 To experience a well maintained, healthy community urban forest including all tree and plant areas on private and public property.

Goal CUF-9 To ensure that tree and plant maintenance programs keep up with the growth of the community urban forest.

Goal CUF-10 To encourage neighborhood identify and character that includes the community urban forest.

Goal CUF-11 To create inviting commercial and public areas that include safety measures in design and maintenance that also attract citizens, shoppers, and visitors.

Goal CUF-12 To promote screening from freeways and other developments.

Goal CUF-13 To soften hard edges of structures and paved areas by retaining and adding trees and plants in existing and new development.

Goal CUF-14 To select appropriate trees and plants for retention and planting at the time of development including native species.

Goal CUF-15 To ensure parks and city streets provide shade corridors that include trees and plants.

Goal CUF-16 To preserve and enhance a distinctive tree canopy on the valley walls of the City.

Goal CUF-17 To encourage and maintain a balance between tree lined streets and safe utility corridors.

Goal CUF-18 To enhance the community urban forest so that its value increases annually.

Goal CUF-19 To achieve active participation of the community in tree related activities by involving citizens, community groups, and non-profit organizations in the care and enhancement of the community urban forest.

Goal CUF-20 To increase the awareness and importance of the benefits of the community urban forest among local business owners, residents, and developers.

Goal CUF-21 To encourage consistency with other adopted Plans to achieve citywide goals.

City of Woodinville
Community Urban Forest

III. VISION STATEMENT

In the Year 2015, Woodinville's community urban forest is a reflection of the City's health, well-being and livability. We have upheld scenic beauty as an important natural resource and we have preserved our Northwest woodland character. The community urban forest has been sustained and encouraged, creating a balance of nature, people and economic development.

Our citizens experience daily the environmental benefits of trees. Our trees provide cleaner air and water by removing pollutants from the air and reducing runoff; protect streams with shade for survival of salmon and other aquatic habitats; and line our streets to offer shade and protection from the elements.

A distinctive tree canopy remains on our valley walls. We have encouraged the tree canopy on our neighboring valley walls. Trees provide screening for residential areas from freeways, commercial, and industrial areas and soften our city structures. Our parks and city streets are lined with trees and protected with shade. Our pleasant environment attracts citizens and visitors to a growing and attractive business community. People frequent business districts where trees and plants provide shade to help save energy, reduce noise, and soften the hard edges of structures and paved areas.

Appropriate trees and plants are selected for retention and planting at the time of development so that the community urban forest is full of diverse tree and plant species and ages. There is a continued commitment to plant more trees, understory plants, and ground covers annually to contribute to the community urban forest, an investment that grows in value each year.

The city trees and plants are expertly maintained by well-trained professional staff. From their example Woodinville's residents expect and receive the best tree planting and care. Public spaces are clean, attractive, and well maintained. Woodinville citizens encourage and participate in the planting and maintenance of the community urban forest. The citizens are guided by priorities that value the community urban forest.

We have achieved a healthy, sustained community urban forest. It is carefully managed and cared for which contributes to the economic and environmental well-being of the city and benefits all our citizens. The Woodinville community respects and honors its trees and plants. Our Northwest woodland character has been preserved giving Woodinville a special sense of place.

City of Woodinville Tree Canopy Assessment

University of Washington Extension
Geographic Information Systems
Certificate Program, 2008-2009

Vance Julien, Leigh Holcombe, Nicolas Eckhardt

Provided & distributed by Tom Grigley at Tree Bd 3-14-12 meeting

Acknowledgements

The team members would like to thank the following individuals who contributed to this project with their guidance and support:

City of Woodinville

Debra Crawford
Erin Martindale
Adam Urbaniak
Sarah Ruether

University of Washington
GIS Certificate Program

Tom Nolan
Harvey Arnone
Jaime Crawford
Joe Brentin
Matthew Wilson
Stephen Hyde

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1. ABSTRACT

This GIS project is an assessment of the total percentage of urban tree cover within the city limits of Woodinville, Washington. It was conducted from January to June 2009 through the University of Washington Extension, Geographic Information Systems certificate program, in cooperation with the City of Woodinville and the Woodinville Tree Board. This project specifically addresses urban tree coverage through aerial photography over a roughly 6 square mile area.

In order to determine a tree cover percentage for the city, a vectorized raster layer was developed by digitizing a 2007 aerial photograph of Woodinville. Digitizing was accomplished by overlaying a grid of uniform square cells onto the photograph. Within each cell, tree cover percentage was evaluated and assigned a numerical value between 0 and 100, in increments of 5. The resulting vectorized raster layer calculated tree coverage within the city limits boundary at 36%.

To further analyze tree coverage for specific areas of the city, the primary resultant grid was subdivided into smaller assessment grids. The subdivided grids included eleven well-defined neighborhoods and four re-combined zoning districts. A grid analyzing tree type for the entire city was also produced. The project deliverables included maps, charts, tables, and a written report. Also included is specific methodology for re-creating each of these grids (and additional custom grids) for the purposes of analyzing either tree coverage or tree type.

2. INTRODUCTION

It is generally understood and appreciated that trees within our communities provide both beauty and function. In fact, urban forests, and the chain of life that they support, are a vital component of any community. The necessity to protect, manage, and improve urban forests where possible has become an important function in effective community and city planning. The Washington State Legislature in 2008 affirmed this position through their "Evergreen Communities Act" (HB 2844). One of the statements in this act reads, "The legislature finds that the preservation and enhancement of city trees and urban and community forests are one of the most cost-effective ways to protect and improve water quality, air quality, human well-being, and our quality of life."

With this in mind, the city of Woodinville is making significant efforts to responsibly address urban forests and tree canopy cover in their city planning. They have already met the standards to become a certified Tree City USA organization and have designated a Tree Board to oversee a specific Work Plan for 2008-2009. This plan recognizes that Woodinville is losing its tree canopy cover at a substantial rate due to urban development and illegal tree cutting. From these activities the city is concerned that tree canopy loss

will contribute to the degrading of all normally functioning ecosystems, of which the trees are a vital component.

As one of the first steps to remedying this situation, the Woodinville Tree Board's work plan calls for a GIS analysis project of the tree canopy cover. The analysis is based on an aerial photograph of the city taken on April 3, 2007. This analysis project effectively assesses current conditions of the tree cover, and provides a basis for next planning steps.

3. PROJECT PLANNING

A. ORGANIZATION

The project was organized around five planning phases. The phases were chronologically ordered according to logical progression. Each member participated in all phases, roughly within the parameters of their respective roles. For each month of the project a status report was generated to keep the project on track and document all project activities. The monthly reports also served as a feedback mechanism for class instructors who advised during the project. The five phases were as follows:

1. Research and investigate other tree canopy assessment projects and studies to review various methodologies and procedures used in similar circumstances.
2. Consult with remote imaging specialists as well as the Washington State Department of Natural Resources. Attend sessions of the DNR Technical Advisory Committee formed to address the Evergreen Communities Act.
3. Experiment with and evaluate different digitizing techniques for use with aerial photography. Select best digitizing process.
4. Conduct digitizing of the aerial photo, followed by quality control measures and analysis of the data.
5. Produce final deliverables package including maps, tables, charts and a written report documenting all methodology and procedures.

Phase three was particularly highlighted in the plan, as it was recognized to be the greatest challenge and vital to the success of the project. All digitizing methods considered needed to meet certain minimum requirements. These included:

- All digitizing needed to be accomplished within the time period of approximately 6 weeks.
- The task of manual digitizing within that time frame, had to be achievable by the limited number of 3 project members.
- Digitizing needed to be highly detailed and accurate.
- Digitized tree cover needed to be comprehensive over the entire city, not merely a sampling of selected areas.
- Methodology of digitizing needed to have the ability to be easily replicated for future use.

B. REVIEW OF LITERATURE

In order to select an effective method of digitizing that met all these requirements, the first phase of the project involved researching and investigating other projects and studies regarding tree canopy assessments. It was important to determine what approach others had used in their assessments, whether those approaches could be replicated, and explore all options and variables involved. While many studies and projects were investigated, two in particular seemed most relevant.

The first, a project conducted by a Washington DC based not-for-profit called Casey Trees, was outlined in a 2006 report. Their website describes this program as a group dedicated to restoring, enhancing, and protecting the tree canopy in the greater Washington DC area. One of the comprehensive plans for their assessment project was to determine the extent of the District's tree canopy at a sufficient level of detail to establish tree canopy goals for neighborhoods across the city. While this project encompassed assessments of many different ecological aspects including stormwater runoff and "green roofs," the measuring of the tree canopy was a major component. This was accomplished both by individual street tree survey inventories and high resolution satellite data.

Another study consulted for this project was from 2006, and was titled, "A method for locating potential tree-planting sites in urban areas: A case study of Los Angeles, USA." Conducted by researchers at UC Davis and the Center for Urban Forest Research, this study developed criteria to identify locations for possible tree planting. Within a GIS software environment, a computer program was developed to search, test, and locate potential tree planting sites around the Los Angeles area. The computer program made its assessment by "planting" virtual trees in suitable areas. Land cover data in the base map used for locating potential tree-planting sites was derived from remote sensing data. Specifically, the imagery used for the LA study was collected by Quickbird satellite at various times from 2002-2005. Although this was not a tree canopy assessment per se, it was an assessment of ground cover over an urban environment and included many elements also present in the Woodinville project.

To further gather background and investigative information, project members attended two meetings of the Washington State Department of Natural Resources, Technical Advisory Committee. This committee of forestry, planning, and GIS professionals was formed to address requirements of the Washington state legislature's 2008 Evergreen Communities Act. It was hoped that the methodology selected for the City of Woodinville tree assessment could parallel that used by the Washington State DNR for consistency with already established state-wide procedures. However, the ultimate recommendation of the committee was for the use of remote imaging or satellite data, which was not an option in the Woodinville project.

Despite this recommendation, the information gathered from these meetings, and those of the Casey Trees and Los Angeles studies, among others, was useful. It helped to distinguish between two related, yet quite different approaches to urban tree management: street tree inventories and tree canopy coverage assessments. Since the

Woodinville project was not an inventory of trees, but rather an assessment of overall tree coverage, a method of digitizing needed to be found that could mimic the results of satellite data which seemed best suited for use in coverage assessments. Moreover, if the end results of the assessment using another methodology could rival that of satellite data, it should lend the kind of validity to the outcome inherent to remote image sensing.

The final aspect of information gathering involved direct consultation with several experts and professionals in the fields of forestry, remote image sensing, urban planning, photogrammetry, and of course, Geographic Information Systems. These experts provided valuable insights into the various methodologies, techniques, and processes used in projects of this type. Their advice and recommendations were used to evaluate the best approach to the project, considering overall resources and requirements. While these sources did indicate that the prevailing methodology used in tree canopy assessments was high resolution satellite data, their information left open the possibility of achieving somewhat similar results with other methods.

C. PROPOSED METHODS

Following the review of literature and information obtained, there were six different analysis methods which were considered. The first was the windshield survey. A windshield survey involves making a cursory examination of the study area based on pre-defined criteria. Often, as the name implies, it is done quickly, from the seat of a moving car – however, a windshield survey can also be done with great care. For a tree canopy assessment, a team of analysts would likely drive around the city with a GPS and estimate the boundaries of large continuously forested areas. The benefits of such a scenario are clear -- a pair of volunteers could complete an initial assessment over the course of a weekend. Unfortunately, a windshield survey would severely underestimate the canopy because it is unable to take into account inaccessible private lands, and unsuited to the survey of sparsely forested suburban areas. Because this analysis method did not meet the city's expectations of accuracy and thoroughness, it was very early abandoned.

Another analysis method considered was the inventory survey. There are two types of inventory survey: the sample and the complete. A sample inventory survey is an ideal companion to a windshield survey. After plotting forested areas, the analysis team would enter the area and inventory the properties of a representative sample of individual trees, including estimated height, diameter at breast height (DBH), and taxonomy. A complete inventory would assess the properties of every individual tree. In regards to city tree planning and protection, a complete inventory would be the perfect ideal -- each tree could be separately tracked and judged. However, such an ideal is unrealistic. A complete inventory would take uncountable man-hours, and would likely be unsustainable. The sample inventory has its own merits, but in the end is just as rough as a windshield survey.

The third analysis method considered is by far the most commonly used for this type of project – remote sensing. Remote sensing involves the use of satellite images as the basis

for analysis. Because all object classes have a unique spectral signature (the amount of energy they reflect at given frequencies), it is possible to program a computer to analyze a satellite image. With time and patience, one could theoretically train the analysis computer to find individual trees by species, if the data was spatially and spectrally rich enough. The primary drawback to remote sensing analysis is upfront cost. Images with the spatial and spectral resolution required for accurate analysis are enormously expensive, often costing thousands of dollars per hectare. The cost of image processing software and personnel training can also be formidable. Of course all remote image analysis requires extensive ground-truthing to verify its results. The main benefit, though, is that once the results have been ground-truthed, they are scientifically repeatable and mathematically defendable. Remote sensing is by far the least subjective analysis method available, but it can be difficult for a small municipality to justify the cost.

Satellite imaging is not the only form of remote sensing. Aerial photo analysis, also known as photogrammetry, is also considered a part of remote sensing. Features identified in an aerial photo can be drawn in a map, and then analyzed independently of the photo.

The fourth method of analysis considered involved sketch digitizing. Through the use of a Wacom digital pen tablet and the free ArcSketch extension, continuous stands and individual trees were traced directly over the aerial photo, creating polygons which could later be analyzed. The primary drawbacks of this method were based on the fact that the project required the team to divide the work of digitizing evenly among the members. Not every team member had a pen tablet, and although the sketching could be done with a mouse, there would be an obvious quality difference among the results. The steadiness of each individual's hand would also be a factor leading to diverse results. Although all survey methods involve some level of subjectivity, the sketch method was the only one that involved physical subjectivity.

A fifth method, similar to sketch digitizing was dubbed "mixed type" digitizing. In an attempt to standardize the drawing of features over the aerial photo, it was decided to use a point to denote individual trees, and regular polygons to denote continuous stands. The points would later be buffered with a circular polygon which approximated the tree's canopy breadth. After all the trees were drawn, they could then be analyzed. One benefit of this method was that it could be expanded very easily. For example, a street tree inventory could be tied to the appropriate polygons. Although this concept had many merits, it required too much time to be spent at the individual tree level. The project's limited resources required some method of automating either the analysis, or the digitization, or both.

The sixth and final analysis method considered was grid indexing. Grid indexing is often used as a sample or ground-truthing technique. A grid of evenly sized cells, much like a sheet of graph paper, is overlaid onto the aerial photo. From there, sample areas can be picked using a 'dartboard' method, or some sort of predefined counting algorithm. A similar type of analysis is actually practiced in remote sensing – each pixel of the image is analyzed independently, and the resulting raster grid is then analyzed as a whole. Our

idea was to create a grid which covered the city in appropriately sized cells and then assign an analysis value to each cell. The results would be more subjective than a traditional remote sensing analysis, because the analysis relied on human interpretation, but it avoided the flaws of the other manual methods, which involved looking at each tree individually. Additionally, the creation of the grid itself could be automated, saving critical time.

Of all the methods available, grid indexing seemed to offer the most efficient use of time and resources. First of all, it utilized the already available and highly detailed aerial photo, which was a valuable central resource in several city projects. Also, the drawing of the grid could be automated, which minimized the subjectivity of feature creation. And finally, the individual cell analysis could be done quickly by multiple independent analysts, taking advantage of limited time and resources. As it turned out, the final grid could also be used creatively for interesting products and results.

Although the resultant grid was composed of vector polygons, the effect of the polygonal topology simulated a raster. This allowed the final product to be easily converted back and forth from a raster to a vector, and allowed a variety of different analyses to be run.

4. METHODOLOGY

A: PROCESS

The first step in the project work phase was to create the digitization grid. This was accomplished using a developer sample code called DS Map Book. DS Map Book acts as an extension to ArcGIS, and its primary purpose is to create an index map for a multiple-page map set. The resulting grid, heretofore referred to as the 'index grid', is effectively a large group of square polygons, each having a unique identifier. The city boundary (including the UGA) was used to constrain the extent of the grid, which created just enough grid cells to fill the city area. The calculated dimensions of the grid cells were $1/8^{th}$ inch by $1/8^{th}$ inch on the screen at a scale of 1:5000. At the digitizing scale of 1:500, this represented an area nearly an inch square on the screen. The actual real life area of each grid cell was 2712.67 square feet, with a side length of 52.08 feet.

Once the index grid had been created, three additional fields were added to the database. The first was called 'TC_Percent', which was the field reserved for the tree cover percentage. In this case, percentage refers to the ratio times 100, making it a more obvious human number. It was decided that tree cover would be estimated in multiples of five, because less discrete numbers would have been impossible to validate, and multiples of ten would have ignored the natural fractions of ¼ and ¾. The second added field was 'TC_Type', the tree cover type. The three possible values were 'C' denoting coniferous, 'D' denoting deciduous, and 'M' denoting mixed type. It is important to note that these values represented existence, not a majority type. If a single branch from a deciduous tree extended into a cell dominated by coniferous trees, the cell was labeled as having mixed

type. The third field was called 'TC_Flag', and was used exclusively by the digitizing team to mark cells that demanded extra attention. For further information on the fields and attributes of the index grid, please see the Appendix.

Aerial Photo Preparation

As a rule, aerial photographs tend to be very dark, and have strong shadows. In order to make the process of digitization easier, a graphics program called Adobe Photoshop was used to color-correct the images. Photoshop is an industry benchmark for graphics and photography, and its ability to deal with the geographically rectified images (geotiffs) used in ArcGIS can be expanded with a software plug-in called Geographic Imager from Avenza Systems.

The first step was an Auto Levels filter, which creates a binned histogram based on the lightest and darkest values in the image, and then equalizes the intermediate values. This filter makes the colors of the image look more natural. The next step was to readjust the Levels for each color channel -- red, green, and blue. This partially undoes the effects of the previous step as it denormalizes each channel in order to enhance it. The values of the red and blue were decreased by 0.90 and 0.95, respectively, and the green value was increased by 1.10. These values were chosen on the fly for their result: an unnatural image in which plants stood out. In order to reduce the shadows, a third adjustment was made – the contrast was increased by 30% and the brightness was increased by 20%. The final result was a set of image tiles which the team determined was easier to analyze. It is important to remember that the adjusted aerial photos were only a step in the digitization process, and should not be considered part of the final deliverables.

Digitization Process

In order to maximize the efficiency of the time spent on the digitization, the cells of the index grid were divided equally among the three team members. Each member would digitize their own cells individually, and then the tables would be recombined before quality control proceeded. Before beginning, two steps were taken to ensure that each digitizer was being as objective as possible. The first step was a digitizing test. A random string of 25 cells was chosen from a suburban area of the city, and each team member evaluated the cells separately. When the results were compared, it was found that there was a high degree of similarity and agreement between digitizers. The second step was to draw up a series of standard guides illustrating some common situations (**see Figure 1**).

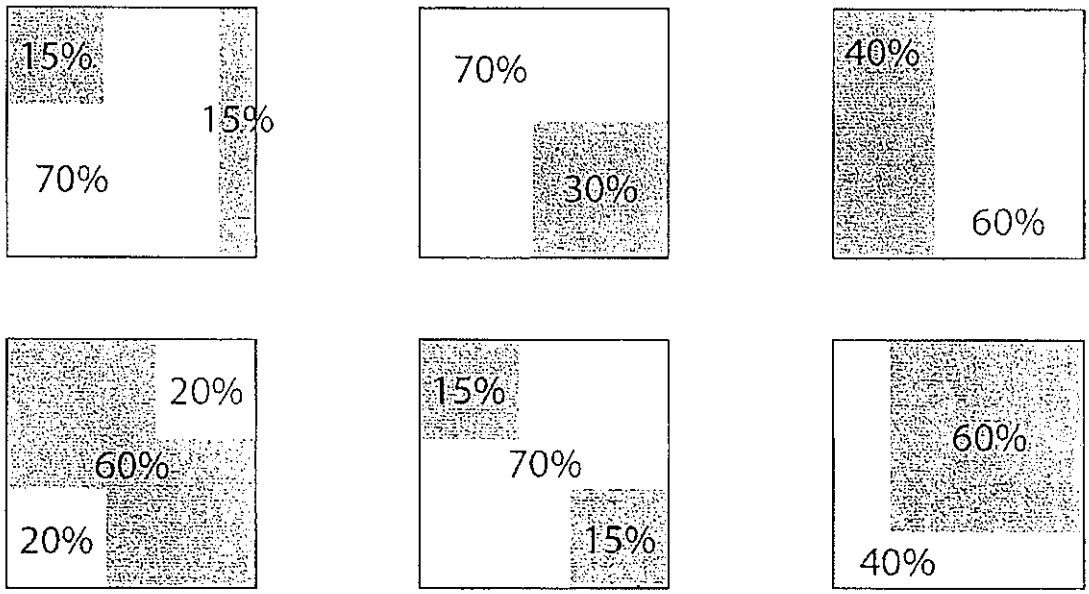

Figure 1 – These boxes represent various combinations of area percentages which were likely to be encountered during the digitization process.

Based on the 6-inch pixel resolution of the aerial photo, and the level of detail the team thought the photo warranted, it was decided to do the analysis at a 1:500 scale. The actual work of digitizing was more tedious than difficult. When a cell is selected in ArcMap, a tiny cross appears in the center, making it easy to estimate percentages from a four-quarter perspective. Other techniques, such as combination and subtraction, helped to mentally reorganize the trees in a cell, making it easier to name a percentage. The task is well-suited to those with excellent spatial cognition skills (someone who is good at estimating distances). Of course, as with all endeavors, the process became easier over time. Although digitizing speed is relative to the density of trees in the focus area, a fair estimate is 250 cells per hour. Using that value, it was estimated that approximately 260 hours were spent on the digitization – a significant proportion of the overall time spent on the project.

Once the digitization was completed, the three parts of the index grid were recombined. At that point, the quality control phase of the project could begin.

B: QUALITY CONTROL

Following the digitizing phase of the project, all combined data was subjected to a number of methods of quality control. The first method employed was to conduct data integrity checks within the attribute table. Search commands combed the tree cover

percentage column to discover any numerical values that were not listed in increments of five. Any errors discovered were reevaluated within the appropriate grid cell and assigned the correct percentage value. A similar check was made within the tree type column, to discover any values that were not labeled correctly. Attributes falling outside the appropriate designations were also reevaluated and reassigned. This quality control method was best suited to weeding out typographical errors.

The second quality control measure taken was to conduct ground-truthing within the project boundary area. Using the aerial photo and overlay grid displayed on a laptop computer, the project team drove to a number of selected sites with the intention of visually inspecting and comparing actual tree cover with the corresponding grid cells and underlying aerial photo. A Garmin Nuvi 650 was used to determine correct geographical location in the field. All sites observed confirmed correct assessments of tree percentage and type, i.e. that trees had been correctly differentiated from bushes, scrub, and open fields. This quality control method was most important as a validation of our photographic interpretation skills.

As stated previously, the index grid included a method of flagging questionable cells. The third quality control measure involved clearing those flags. This practice was largely an effort of teamwork, and the results were the products of consensual agreement. After the ground-truthing expedition, most of the tree vs. non-tree questions were decidedly easier to answer.

The fourth quality control measure was another database search. This time, the team searched for cells with 0% tree coverage adjacent to cells with 100% tree coverage. It was surmised that such an occurrence would be unlikely in nature, and was most likely an additional typographic error. As we found out, though, such an occurrence is rather common within the city. This is easily explained by the interaction between the regularity of the digitizing grid and the regularity of the street grid – a large number of cell boundaries coincided with abrupt roadway edges. However, a few actual errors were found, and all the cells in the surrounding area were reevaluated.

The fifth quality control measure instituted was a random sampling of the entire index grid. The selection of cells to be error-checked was determined by the use of a so-called 'dartboard method', in which cells were chosen pseudo-randomly from the entire grid. In order to increase the apparent randomness while insuring equal coverage over the entire city, the grid was sampled at the neighborhood level. The city of Woodinville is divided into eleven separate neighborhoods, each of which covers a geographically or municipally distinctive area. Our goal with the dartboard selection was to make sure that each part of each neighborhood was adequately represented in the sample. In total, 127 cells were sampled (**see Plate 1**). Because of the neighborhood sampling, the sample density was higher at the nexuses of multiple neighborhoods. Using the following standardized equation, the team was able to determine the sampling size error.

$$\text{Sampling Error} = \sqrt{\frac{p(100-p)}{n}}$$

p = sample percentage
n = sample size

Based on a population size of 65,250 and a sample size of 127, the calculated sampling error was +/- 3.8%. Once the sample cells had been chosen, they were evaluated for correctness by group consensus, and the evaluation was compared to the original results, with consistent success.

The sixth and final quality control measure was an evaluative comparison between photo data and analysis data. After the data had been completely classified and a preliminary thematic map had been prepared, it became immediately clear that the digitization had been highly accurate due to the direct comparison of vectorized raster cells to tree coverage in the photo. The spatial distribution of tree coverage between the preliminary map and the aerial photo was highly correlated. In many parts of the city, roadcuts and power line right-of-ways can be seen on the preliminary data map. This assured the project team that the digitization was complete, and that analysis could begin.

C: ANALYSIS

After the quality control phase of the methodology had been completed, the analysis phase began. Due to the nature of the project, tree cover analysis is a percentage based on area. The first step in the analysis process was to decide which area was to be analyzed. Because of the simplicity and adaptability of this project, any area can be used, as long as the correct files are available.

For the purposes of this project, three area categories were chosen -- neighborhoods, zones, and jurisdictions. Jurisdictional and neighborhood boundaries were already available in the Woodinville GIS library. Although zone boundaries were not available, the process of extracting zones from the parcel database was a fairly straightforward process of selecting records based on the value in the zoning field.

To keep the process simple, the analysis team decided to analyze zones by type, rather than by unique value. Therefore the various residential zones were combined into one main zone. Industrial zones and commercial zones were also separately recombined, and parks and public lands were merged into a single zone. Although tree cover analysis can be done at a parcel level, experience shows that large continuous areas lend themselves to more accurate analysis.

Once an analysis area had been chosen, the next step was to clip the index grid to the area of interest. This was done by using the Clip tool within ArcGIS. The clipping process removes cells outside the selected area, and reshapes the cells along the area's border. Any area which can be defined by a closed polygon can be used as the clipping path. Because the clip operation creates a new file, this can be done over and over again without changing the original index grid. The results of the clip were used in the next step, which was to calculate the areas of each cell. Before the clip operation, the cell area had been held constant. After the clip, cells along the border of the polygon were reshaped, and their areas must be accurately calculated. ArcGIS contains a function which accomplishes this. It creates a new copy of the file that has a new field, which is the area of the cell in square feet. Once the areas have been calculated, the clip file can be either saved or deleted.

The final step in calculating the tree cover was to add a field to the table to hold the tree cover area results. Once the field has been created, it must be populated with the formula to calculate its value.

The value is the area of the cell multiplied by the percentage of tree cover in the cell. This gives the area of tree coverage in square feet for each cell. Once this is done, the processes for extracting the total areas and tree cover percentages for the entire area of interest is a simple process which can be done in a matter of seconds. **Table 1** shows the results for each of the chosen analysis areas, both by area and by percentage. For more detailed technical information about the analysis process, please refer to the appendix.

Area Name	Total Area	Tree Coverage Area	Percent
Neighborhood East Wellington	22595046.24	9874834.75	43.70
Neighborhood Lower Westridge	13440621.88	8460282.84	62.95
Neighborhood North Industrial	12726961.76	1584062.78	12.45
Neighborhood Reinwood Leota	12876935.00	7336954.78	56.98
Neighborhood Tourist District	5447911.55	954606.34	17.52
Neighborhood Town Center	13753251.62	2636505.94	19.17
Neighborhood Upper Westridge	11678804.53	4110140.68	35.19
Neighborhood Valley Industrial	9051928.95	744799.52	8.23
Neighborhood West Wellington	14815643.99	9414035.95	63.54
Neighborhood Wedge	11273959.66	4252840.74	37.72
Neighborhood Woodinville Heights	6516589.44	3219802.24	49.41
Zoning Business	14323446.02	1598005.53	11.16
Zoning Industrial	23428703.38	3008791.64	12.84
Zoning Public	9271102.40	3687777.35	39.78
Zoning Residential	89704631.95	44670911.10	49.80
Zoning UGA	15663767.39	1869562.57	11.94
Overview with UGA	173928017.17	59333245.74	34.11
Overview without UGA	157945745.79	57353116.04	36.31

Table 1 – Spreadsheet showing final area statistics in square feet, and corresponding percentage.

Although the tree cover statistics themselves can be very useful, the data becomes more vivid and explicable when it is thematically mapped. Thematic mapping involves classifying the data, in this case tree cover percentage or type, by some category or value. The artistic methods of the output maps are based largely on the classification scheme used. With regard to tree cover percentage, there are 21 unique values available (0-100, in multiples of 5), so creating more than 21 classes would be extraneous.

Of the many possible ways to classify the data, the project team chose a simple 3-class scheme corresponding to the graduated categories high, medium, and low. There are a number of automated methods for choosing which values correspond to which class, but the data histogram showing value frequency (**see Figure 2**) suggested that a manual method would be simplest. The classification scheme for this project used the values from 0-15% for low, 20-90% for medium, and 95-100% for high.

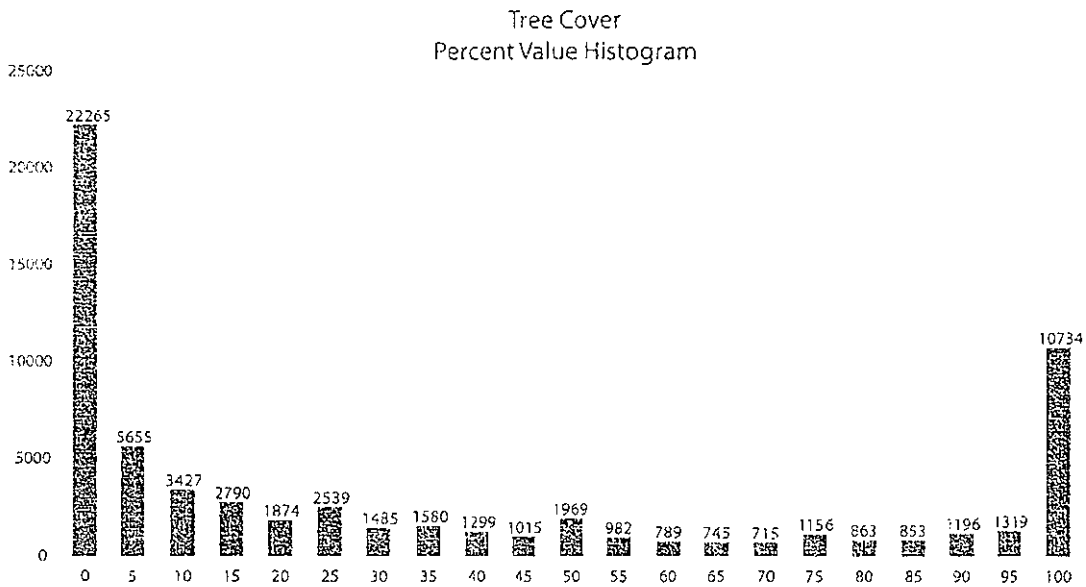

Figure 2 – Histogram showing counts of unique tree cover percent values. Note that counts for 0% and 100% comprise half the total cells. Also notice spikes at natural divisions, 25%, 50% and 75%.

As unbalanced as it seems, this scheme gives the most area to the under-represented medium values while still maintaining reasonable definitions for high and low. The colors used for tree cover value representation were chosen from ColorBrewer, a website devoted to appropriate and visually appealing color management. The team felt that the yellow-green sequential color pattern gave an environmentally appropriate feel to the map.

The tree cover type, or composition, data was also divided into three classes, because there were only 3 unique values available, for coniferous, deciduous, and mixed type. Although it gives a sense of urgency, ColorBrewer's yellow-orange-red sequential pattern was used because it was one of the only color schemes that contained great enough difference between categories, yet was visually distinct from the colors selected for the tree cover percentage maps. Even using such a broad color combination it is still somewhat difficult to differentiate between color shades in the map. **(see Plate 8)**. Because of the haphazard and intermixed nature of the data, the tree cover type statistics are easier to see in tables and charts. Both bar graphs (**Figure 3**) and pie charts (**Figure 4**) were produced in MS-Excel, expressly for this purpose.

5. GIS PRODUCTS

The following pages contain the project's charts and graphs as well as a sampling of the color plate maps that were produced as project deliverables. The maps were formatted within a standardized City of Woodinville template frame complete with legend. Each map's title in the lower left corner corresponds to the naming conventions applied in the ArcGIS data sets. Additional map layers such as streets, railroads, and bodies of water were added for reference purposes, but do not pertain to the data created during digitization of the aerial photo. As explained by the histogram, the classification and color scheme for tree cover percentage in all maps used the values from 0-15% for low (yellow), 20-90% for medium (light green), and 95-100% for high (dark green). The projected coordinate system used in all maps was Washington State Plane North.

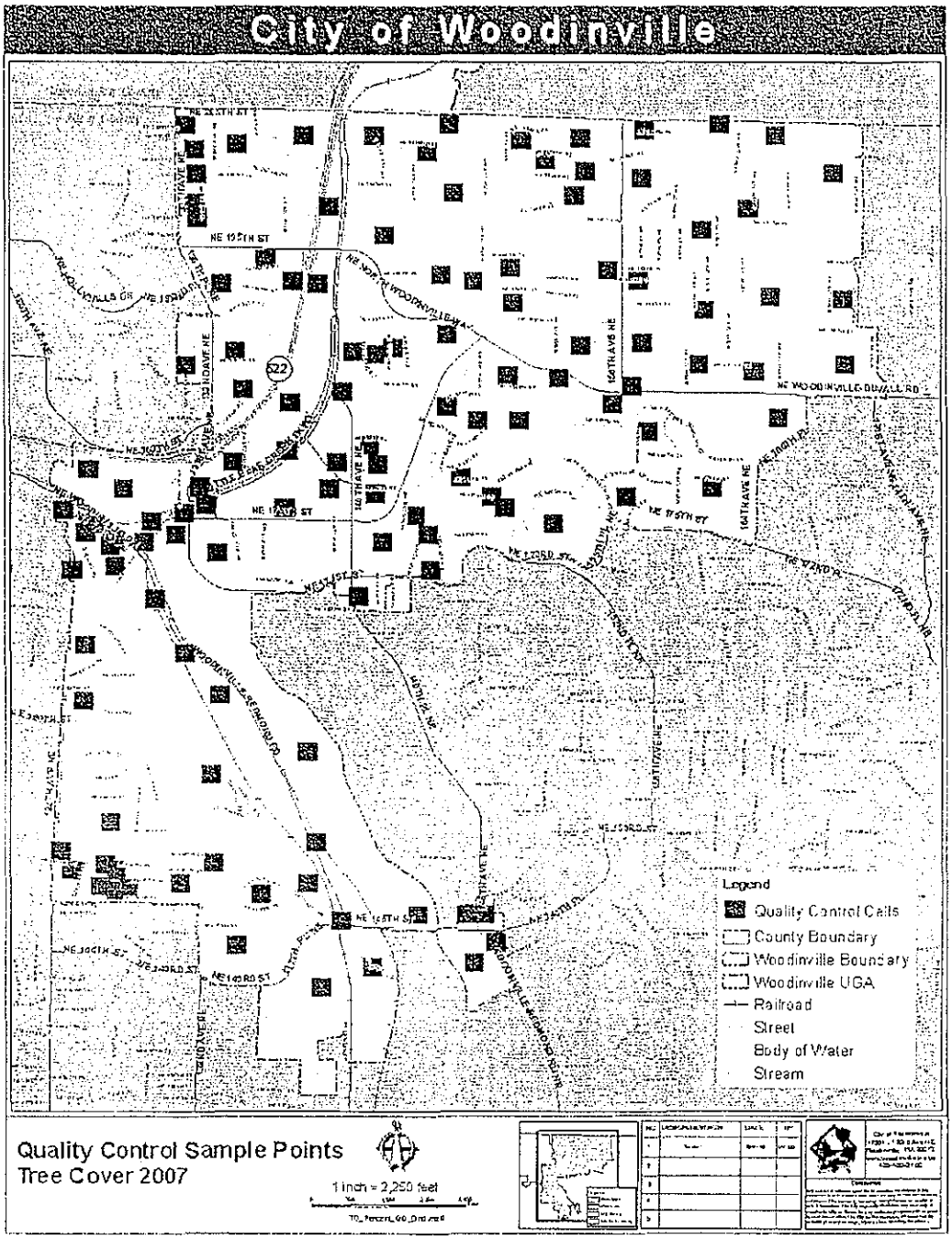

Plate 1 – City of Woodinville quality control sample points. Blue squares indicate cells randomly selected for tree cover percentage confirmation using dart board method.

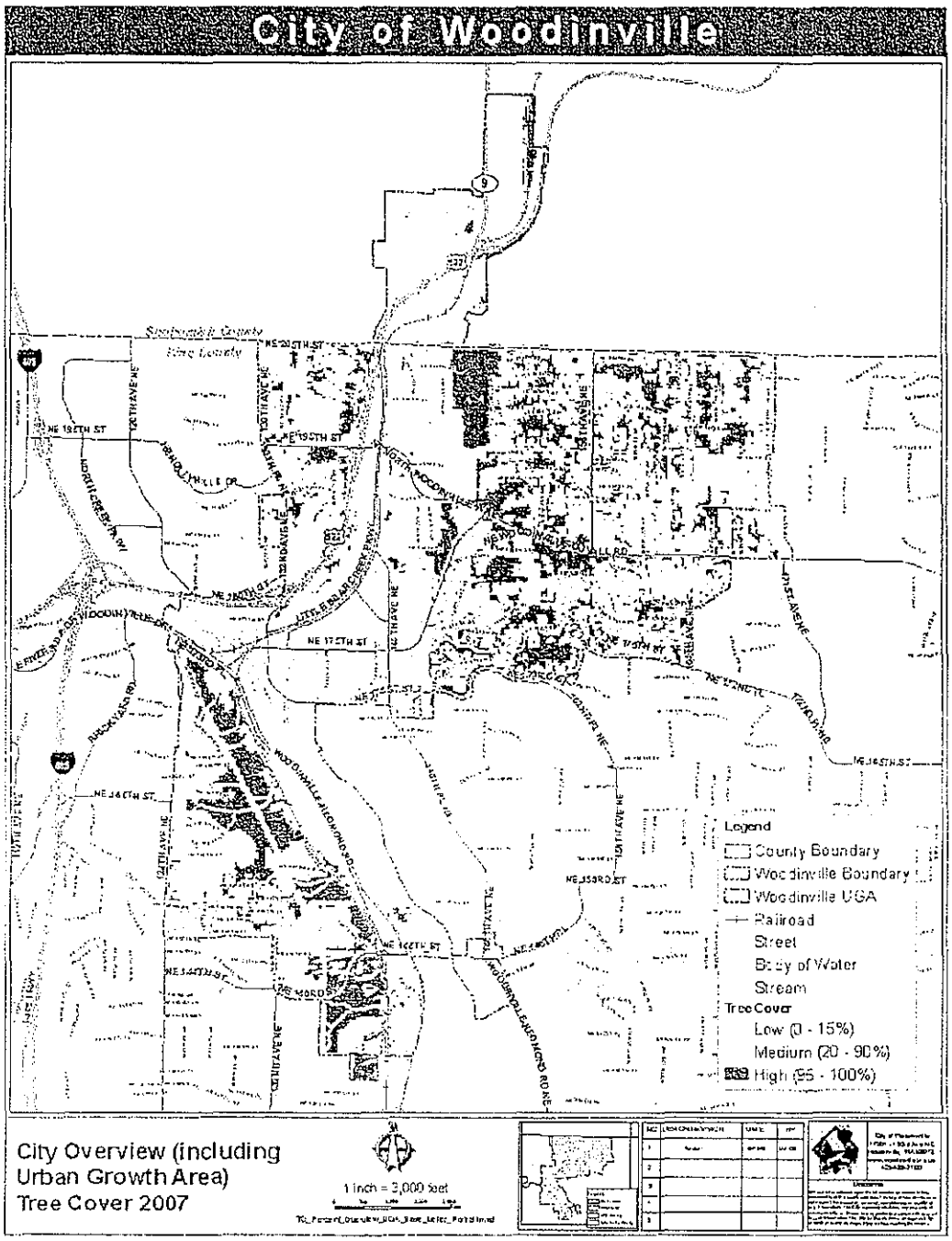

Plate 2 – City of Woodinville tree canopy overview, including urban growth area. Dark green indicates areas of largely continuous tree cover. Tree cover: 34%

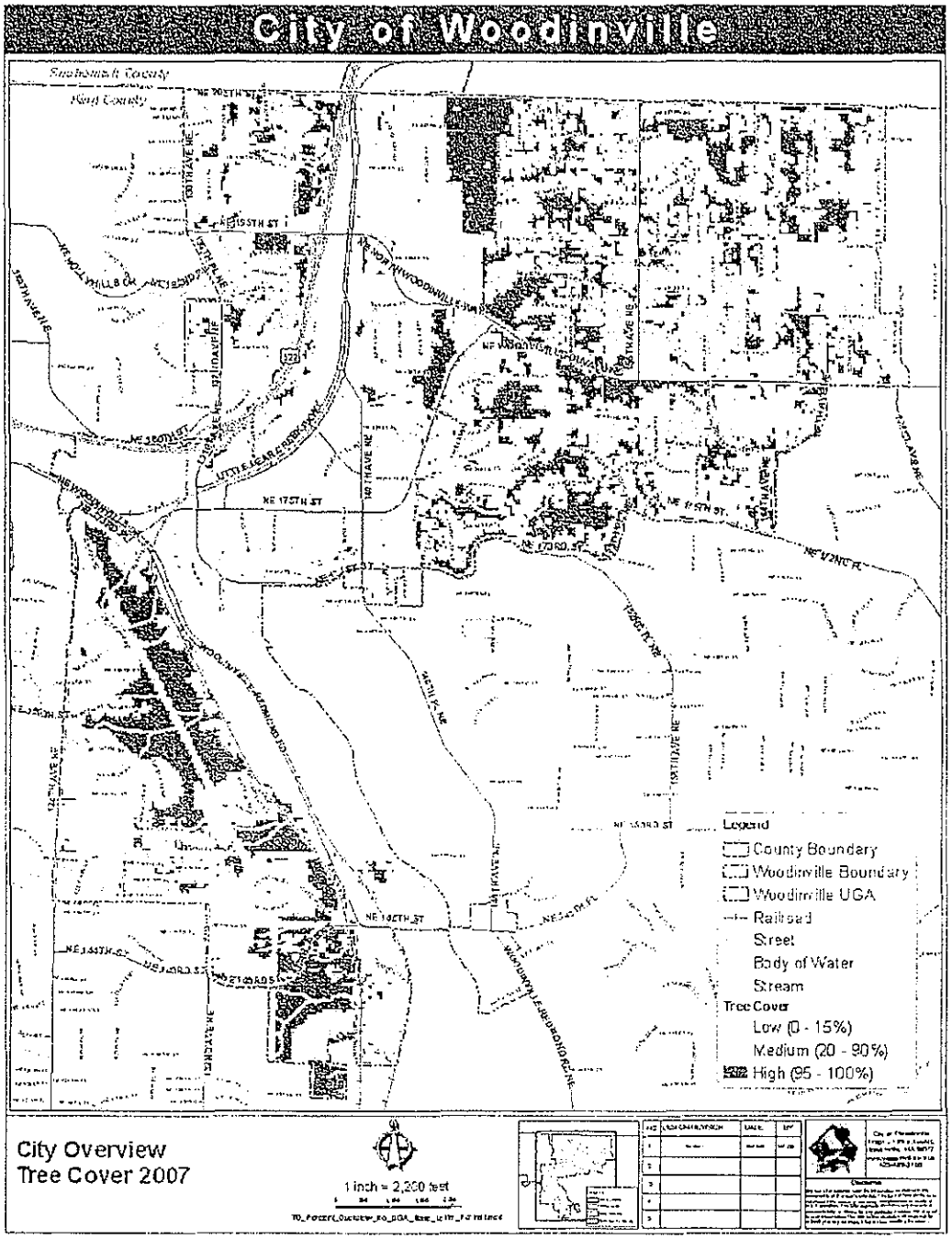

Plate 3 – City of Woodinville tree canopy overview. This view omits the urban growth area. Dark green again indicates areas of largely continuous tree cover. Tree cover: 36%

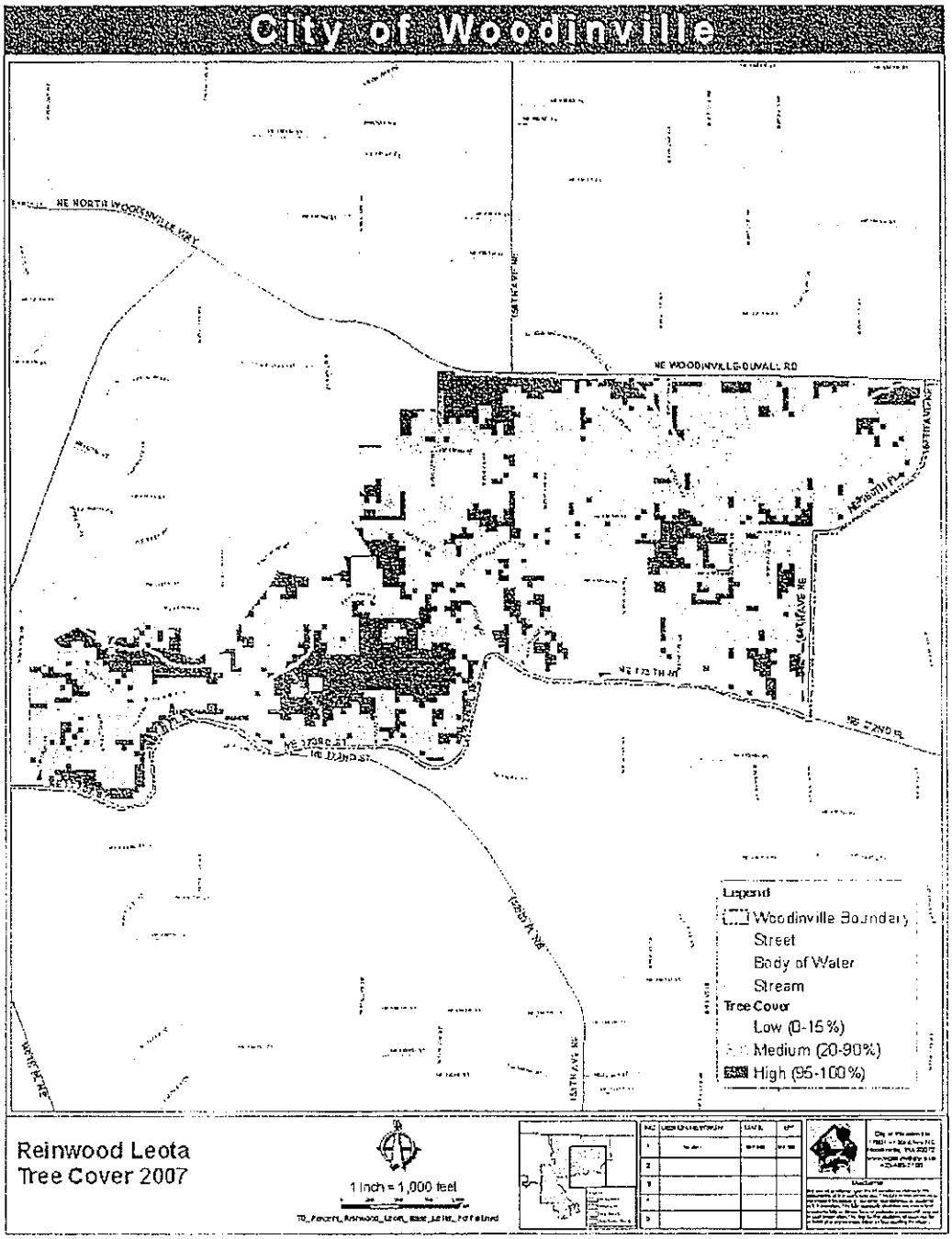

Plate 4 – City of Woodinville, Reinwood Leota residential neighborhood. Note that the area does not include the street right-of-ways. Tree cover: 57%

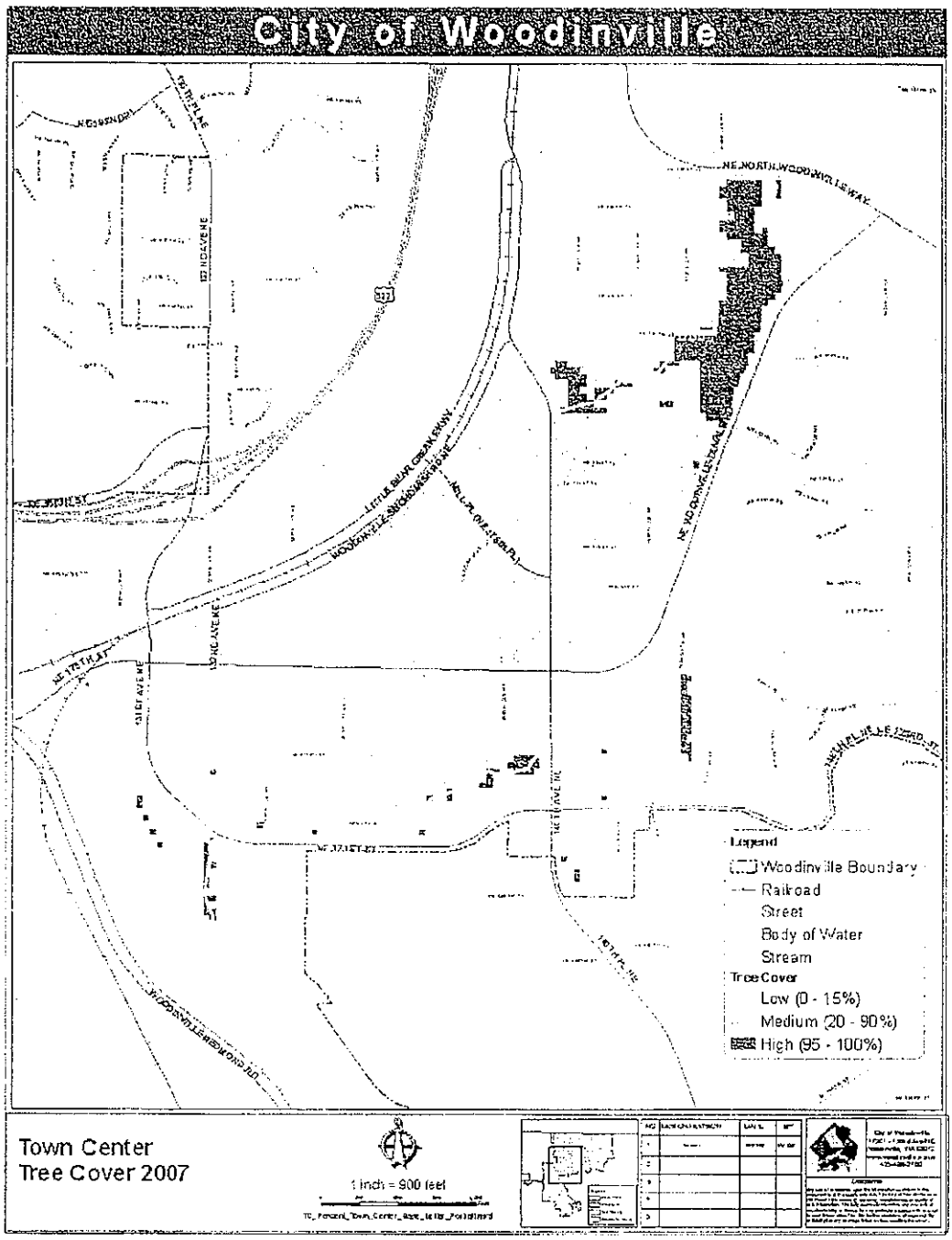

Plate 5 – City of Woodinville, Town Center neighborhood. This downtown largely commercial district contains sparse tree cover. Tree cover: 19%

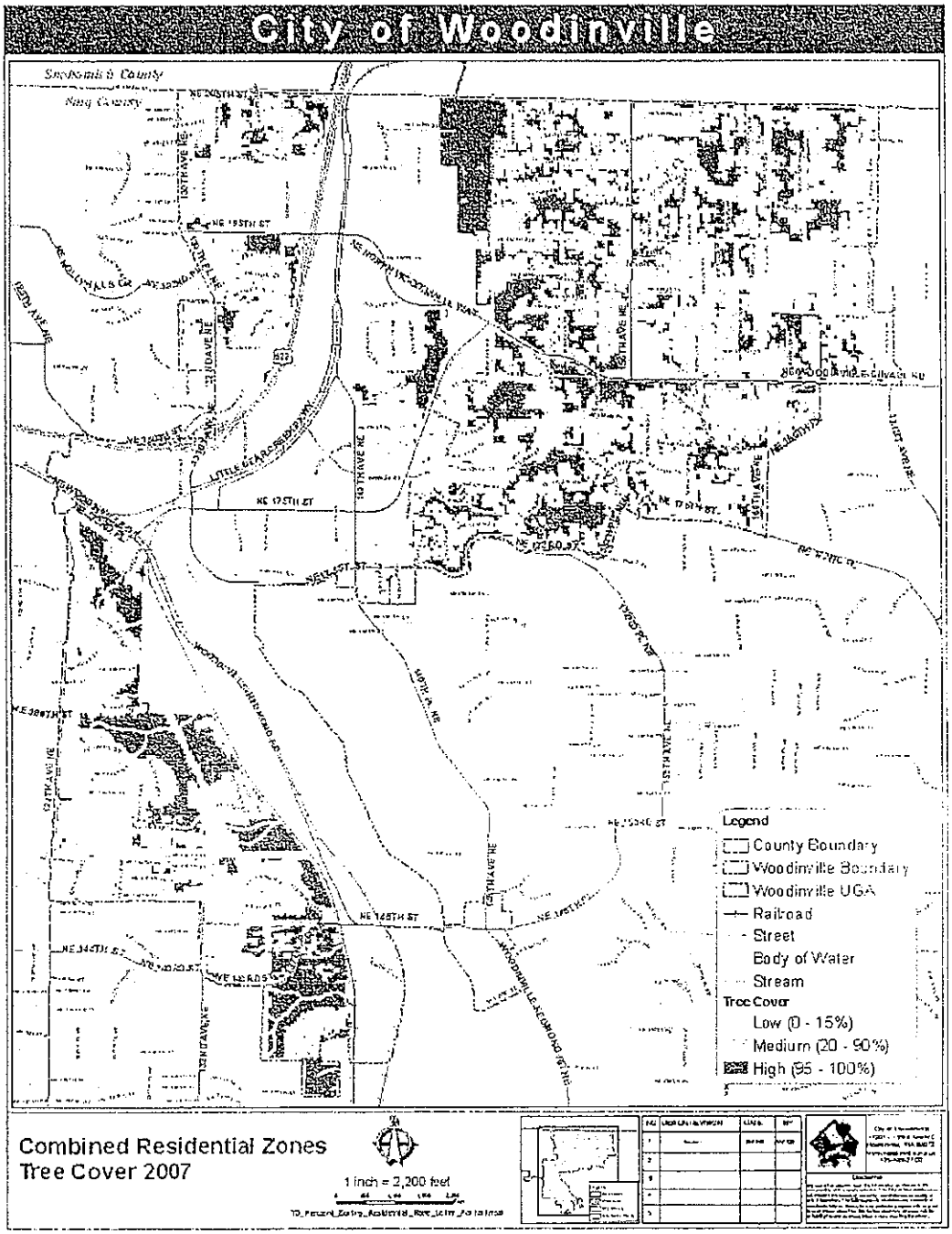

Plate 6 – City of Woodinville, combined residential zones. This map implies that a majority of the city's tree cover is contained within private land. Tree cover: 50%

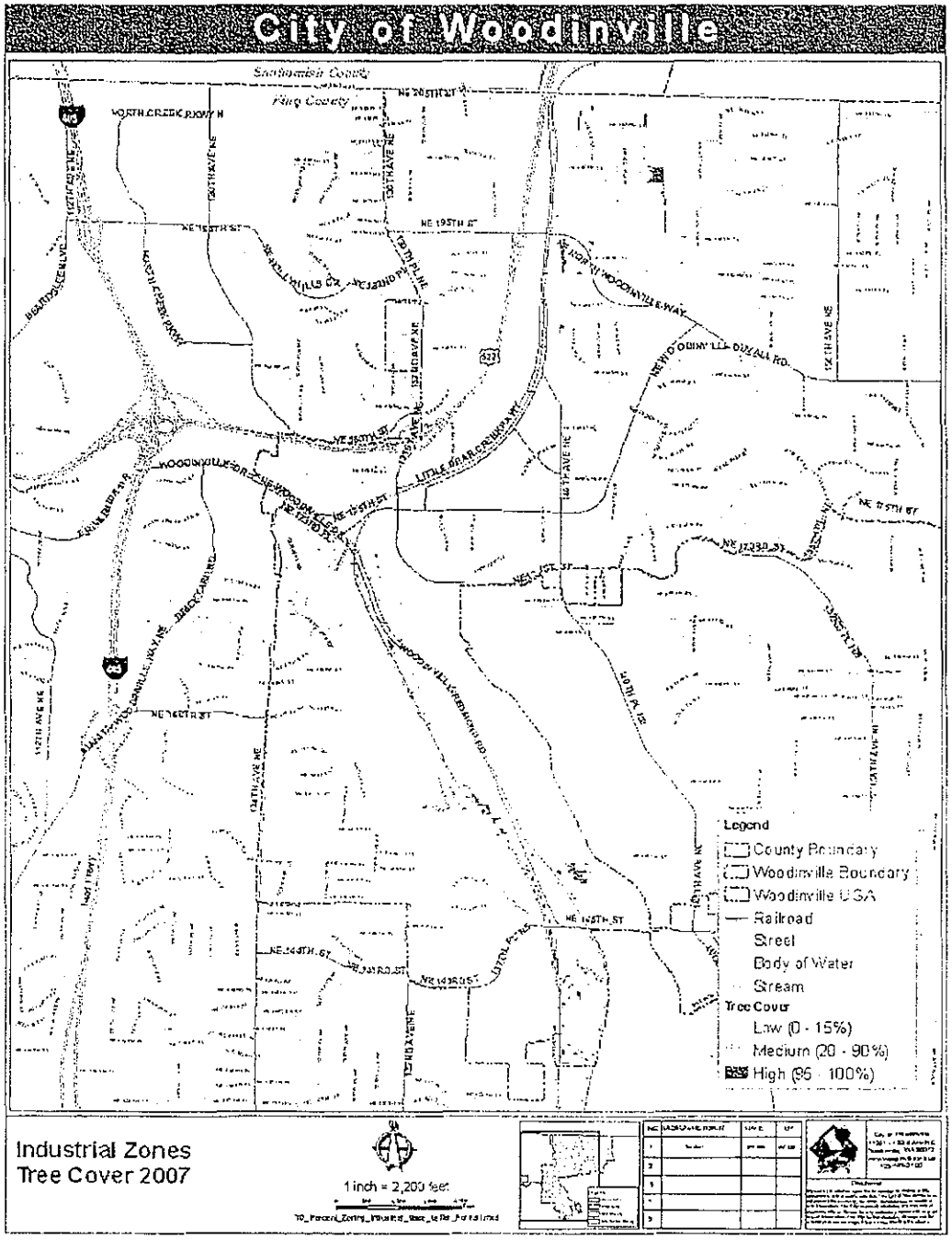

Plate 7 – City of Woodinville, Industrial Zones. This area has a very low percentage of trees, many of which are used as property boundary markers or landscape within large paved areas. Tree cover: 13%

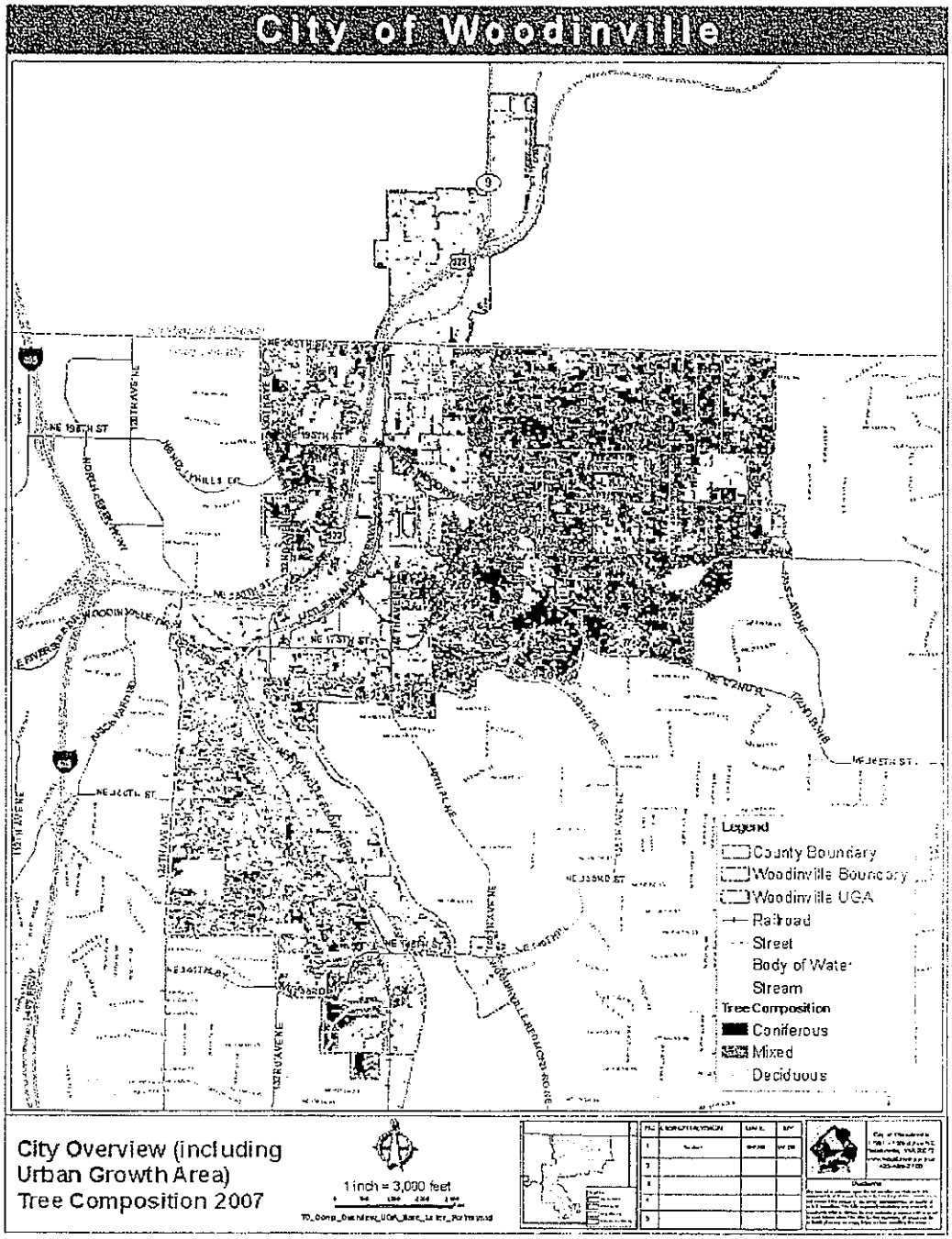

Plate 8 – City of Woodinville tree composition map, including urban growth area. Red color ramp indicates areas of coniferous, deciduous and mixed tree type.

	Coniferous	Deciduous	Mixed	Null
Without UGA	14210	11244	15710	18015
With UGA	14615	12056	16346	22232

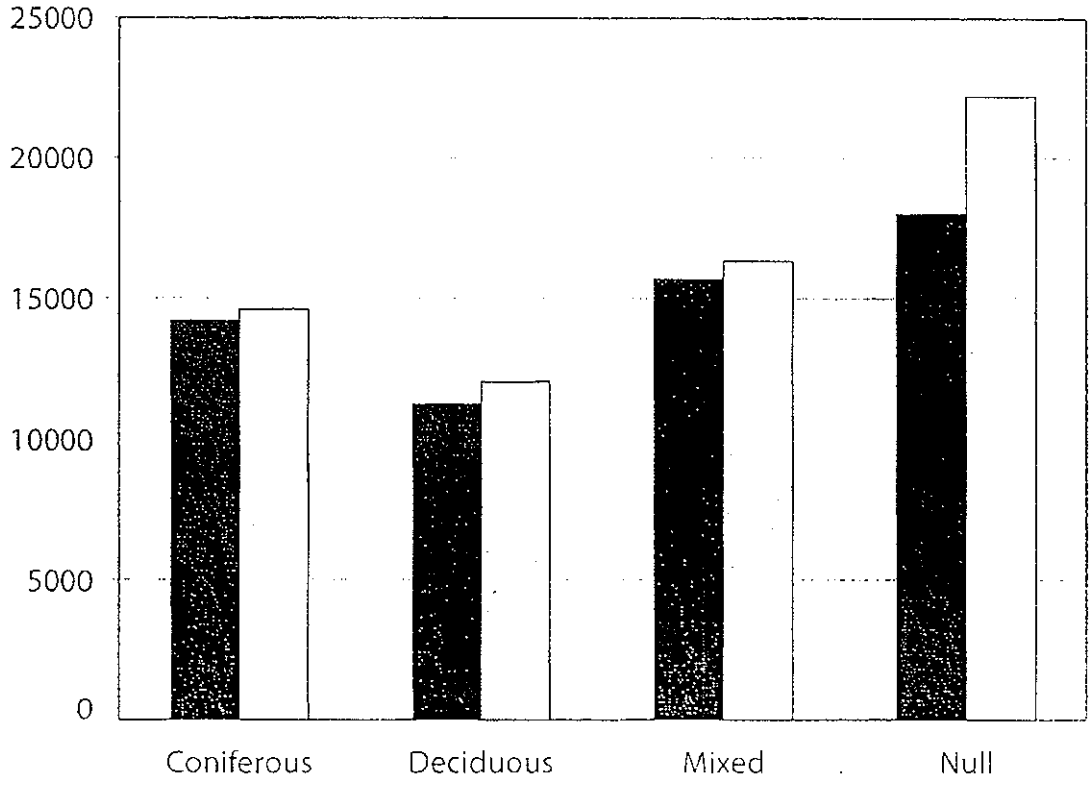

Figure 3 – Bar graph showing number of cells marked as Coniferous-only, Deciduous-only, and Mixed. Includes with UGA and without UGA. Number of Null cells (no tree cover) shown for comparison.

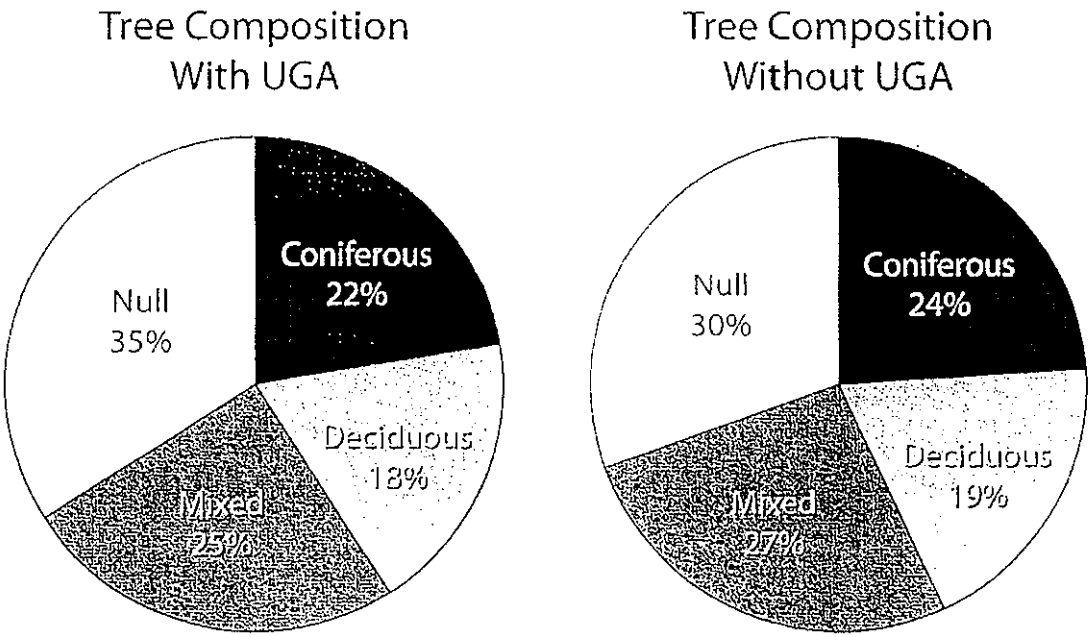

Figure 4 – Pie chart showing percentage of cells marked as Coniferous-only, Deciduous-only, and Mixed. Includes with UGA and without UGA. Percentage of Null cells (no tree cover) shown for comparison.

6. SUMMARY and EVALUATION

This GIS project revolved around one central research goal, to determine the percentage of tree cover within the city limits of Woodinville. This was based on an aerial photograph taken on April 3, 2007. Although two years had elapsed between the time of the photograph and this project, it was deemed to be recent enough to be able to capture an accurate tree cover percentage for the entire city.

The need for this assessment was driven by the fact that the city recognized that its overall tree cover was incrementally being diminished. Ongoing construction and development within the city limits, as well as illegal tree cutting, was gradually and inexorably reducing the amount of natural and original tree cover. If the trend of rapid tree loss continued, the results could be long term damage to the comprehensive and

interconnected ecosystems of the city. To repair such damage would be costly, difficult, and time consuming. Therefore the city had a strong desire to preserve, manage, and improve all their valuable natural resources, including tree cover. This project was one of the efforts that resulted from that position.

Unlike most projects of this type, satellite or remote imaging data was not utilized. Since this was an academic project, no funds were available to secure the most advanced, high resolution satellite data. Also, satellite imagery is typically captured over wide areas or "swaths" with the focus being primarily on overall landforms or large forested areas. Except for high resolution, most satellite data is not as effective in producing fine, detailed images of ground cover, including individual urban trees. When satellite imagery is used for urban tree cover analysis, additional effort and expense is necessary to fine-tune the images for clarity and accuracy. The aerial photograph used in this project permitted analysis to be accomplished without the need for purchasing expensive satellite data, and even more importantly, allowed precise and detailed analysis of trees within the confines of an urban environment, without extensive fine tuning of the image.

By not utilizing satellite imagery, the challenge for this project remained to select a methodology for effectively and comprehensively digitizing the aerial photograph. Several methods were considered, including windshield surveys, tree inventory surveys, sketch digitizing, and mixed type digitizing. All these methods were rejected for various reasons, as none of them adequately met the digitizing requirements for this project.

As a result, a unique approach was devised, termed "grid indexing." This method prescribes the overlay of a predefined square grid pattern onto the aerial photo within a GIS mapping software environment. The resulting layered combination allows percentages of tree cover to be assigned through visual inspection of the photograph within a raster-like cell structure. The grid indexing method perfectly met the digitizing requirements for this study, could be accomplished at virtually no cost, and produced a highly detailed and accurate vectorized raster data layer of 65,250 cells that could be easily analyzed at multiple levels. The grid allowed easy identification of areas of tree cover as well as individual trees no more than a few feet high. Even though the aerial photo was taken in early April before most deciduous trees set their leaves, even small trees with bare branches could be correctly identified.

The data images produced from the digitizing showed a direct correspondence with the tree cover displayed in the photograph. To achieve the most effective display of the data, tree cover amounts as determined by cell value were grouped into low, medium, and high categories. A yellow-green color gradient was used to portray these values, with white being used for cells that contained no tree cover at all.

Following digitizing and display of the data, the results were analyzed and calculations performed on the dataset which yielded a score of 34% tree cover for the entire city of Woodinville. This direct result was significant, as it was the primary purpose of the entire project and answered the central question posed by the city.

Other analyses included similar calculations for each separate neighborhood area within Woodinville, as well as four combined zoned areas: residential, business, industrial, and schools & parks. For each defined neighborhood or zone, a percentage of tree cover was calculated.

The final calculation performed on the data was for tree composition. Each cell that contained tree cover was coded according to the type of trees it contained: coniferous only, deciduous only, or a mix of both. Of those three groups, the largest category, mixed, comprised 25% of all cells that contained tree cover. This was followed by coniferous-only at 22% and deciduous-only at 18%.

Post analysis evaluations of this project argue that the methods employed and results achieved were significant because the project utilized a grid system to effectively analyze and digitize tree cover over an entire city without the need for any satellite data. This was due to the unique approach of dramatically enlarging the application of DS Mapbook. In other applications using DS Mapbook, grid indexing is typically only used as a utility to sample very small city block-sized areas, but in this project that methodology was expanded significantly to cover approximately six square miles. That fact alone makes the relatively simple technique of grid indexing to calculate tree cover percentages a valuable and useful tool with much merit. It is highly recommended for any community, organization or business which desires an economical, yet highly effective and reliable method to calculate tree cover, or assess any kind of ground cover that is recognizable using aerial photography. In an academic or classroom setting it is an excellent method for students or volunteers to assess aerial photos and gain experience with GIS software, photogrammetry analysis, database management, and statistical calculation. When used by communities, it serves as an effective tool to help balance the ongoing expansion and change of new development and construction with responsible urban forest and ecosystem management.

7. APPENDIX

Attribute Table Field Guide
This guide is a reference documentation of the fields present in the attribute table. Most of the information available here can also be found by using ArcCatalog or ArcMap.

FID
FID field is a non-unique object identifier. The integrity of this field is maintained internally by ArcGIS, and it will be renumbered if any table records are added or dropped. This field should not be modified.

Type: Object ID

Shape
Shape field is a description of the object's geometry. In the index grid, the value in this field will be "Polygon"; in the centroid grid, the value will be 'Point'. The integrity of this field is maintained internally by ArcGIS, and it will be automatically updated if the geometry type is modified. This field should not be modified.

Type: Geometry

GRID_ID
GRID ID field contains a unique object identifier. The object identification is a concatenation of the ROW_NUM and COL_NUM fields, with the ROW_NUM value transformed into a two character string. This field was created by DS Map Book, and can be useful for maintaining the integrity of the attribute table. This field can be deleted at the end user's discretion, but should only be modified or recalculated from a clean copy.

Type: String
Length: 50

ROW_NUM
ROW NUM field contains an object identifier that is unique to each row of the grid. It is recalculated as a two character string and then concatenated with the COL_NUM to create the GRID_ID. This field was created by DS Map Book, and can be useful for maintaining the integrity of the attribute table, and for doing analysis at a row level. This field can be deleted at the end user's discretion, but should only be modified or recalculated from a clean copy.

Type: Long
Precision: 9

COL_NUM
COL NUM field contains an object identifier that is unique to each column of the grid. It is concatenated with the ROW_NUM to create the GRID_ID. This field was created by DS Map Book, and can be useful for maintaining the integrity of the attribute table, and for doing analysis at a column level. This field can be deleted at the end user's discretion, but should only be modified or recalculated from a clean copy.

Type: Long
Precision: 9

PLOTSCALE

PLOTSCALE field is an unused reference created by DS Map Book. It should only have a single value, 5000 (which is an artifact of the grid creation). This field can be deleted at the end user's discretion, and can easily be rebuilt or recalculated.

Type: Double
Precision: 18
Scale: 11

TC_Percent

TC Percent field was created manually and contains a tree cover value estimated by the project team. The value is a percent, meaning that its mathematical value for use in calculations is $x/100$. The value has a range between 0 and 100, and only contains multiples of five. The values in this field represent the bulk of the work done by the project team. This field should only be modified or recalculated from a clean copy.

Type: Short
Precision: 4

TC_Tr_Type

TC Tr Type field was created manually and contains a tree cover descriptor estimated by the project team. The only allowed values are 'C' (coniferous), 'D' (deciduous), 'M' (mixed), and null. The values in this field represent the bulk of the work done by the project team. This field should only be modified or recalculated from a clean copy.

Type: String
Length: 25

TC_Flag

TC Flag field was created manually and used internally by the project team to mark cells of interest. It should not contain any values, and can be deleted at the end user's discretion.

Type: String
Length: 10

F_AREA

F AREA field was created and calculated by the ArcGIS "Calculate Areas" tool. In a raw, unclipped version of the grid, all the values should be identical. Otherwise, the values on the borders of the grid will have variable areas. The value in this field represents the area of the grid cell, in square feet. This field can easily be rebuilt or recalculated.

Type: Double
Precision: 0
Scale: 0

TC_Sqft

TC Sqft field was created manually and calculated by formula. The formula can be expressed using SQL by the following equation:

```
[TC_Sqft] = [F_Area] * [TC_Percent] / 100
```

This can be restated as "the cell's area multiplied by the tree cover percentage, divided by 100". As stated above, the value in TC_Percent is a percentage expression, which must be divided by 100 to be used in an equation. The value in this field represents the area of the grid cell covered by trees, in square feet. This field can easily be rebuilt or recalculated.

Type: Double
Precision: 0
Scale: 0

PROCESS METHOD of GRID ANALYSIS

There are four simple steps which must be followed to produce statistically analyzable grids from the index grid. A number of sample analysis grids have already been produced by the project team, using a number of common analysis areas, such as neighborhoods and zones. By following the steps within this section, it will be possible for the end user to not only recreate these sample grids, but construct new grids as well.

The first step in the process is to clip the index grid to a boundary. Any polygon can be used, even a simple rectangle. The City of Woodinville already has a number of simple polygons that can be used for this purpose, including city and neighborhood boundaries. In order to use the city's zoning information, it is necessary to do some preliminary extraction work, but once that has been done, the clip process is fairly straight forward. Some suggestions for further analysis: delineated wetlands, stream buffers, and very large parcels. To perform this step, use the Clip tool in ArcToolbox, which can be found by the following path: `Analysis Tools > Extract > Clip`. The input feature will be the index grid, and the clip feature will be the chosen boundary polygon. This tool requires the designation of an output file, which will be used for the next step.

The second step of the process is to calculate the areas of the clipped grid cells. This is a fairly simple action, best accomplished by using the Calculate Areas tool in ArcToolbox. The tool can be found by the following path `Spatial Statistics Tools > Utilities > Calculate Areas`. The input feature will be the clipped grid, and an output feature designation is required. The resulting areas will be in a new field called F_AREA, which is populated by data of type 'double'. The area values represent square feet.

The third step of the process is to create a new field which will hold the tree cover areas. This step can be completed in a variety of different ways. It is possible to add a new field to the table using ArcCatalog or ArcMap. There is also a tool within ArcToolbox which can be found by the following path: `Data Management Tools > Fields > Add Field`. The ArcToolbox method may be preferable if this process is to be automated using a script or model. In this project the team created the field with a data type of 'double' in order to match the F_AREA field. The name of this field in the

sample grids is TC_Sqft, since it will eventually contain the square footage of tree cover in the cell.

The fourth step of the process is to populate the new field with tree cover area values. This can be accomplished using the field calculator in ArcMap or ArcCatalog, or with the ArcToolbox tool which can be found at the following path: `Data Management Tools > Fields > Calculate Field`. The intended result is to multiply the value from F_AREA by the value in TC_Percent, and then divide by 100. The syntax for declaring this equation varies based on the method used to enter it. The correct syntax when using the field calculator is:

```
[TC_Sqft] = [F_AREA] * [TC_Percent] / 100
```

This will give the value in square feet of the estimated tree cover for each cell.

The fifth and final step of this process is to extract the statistics. There are a number of different ways to do this, but the simplest way is to right-click on the TC_Sqft field in the attribute table view and choose 'Statistics'. It is simple to extract means, sums, and standard deviations from the resulting dialog box, which can then be used in a spreadsheet or report. To derive total tree cover percentages, compare the summary from TC_Sqft to the summary for F_AREA. For a summary of the statistics produced by the project team using the sample grids, see **Table 1**.

8. REFERENCES

Miles G. Logsdon, PhD – University of Washington professor, specialist in remote sensing applications. http://boto.ocean.washington.edu/staff_pages/miles/

Duncan Munro – Seattle Public Utilities, specialist in remote sensing applications. http://gis.esri.com/library/userconf/proc05/papers/pap2024.pdf

L. Monica Moskal, PhD – University of Washington professor, specialist in remote sensing applications. http://faculty.washington.edu/lmmoskal/

Washington State Department of Natural Resources – Technical Advisory Committee. http://www.dnr.wa.gov/researchscience/topics/urbanforestry/pages/rp_urban_eca.aspx http://www.dnr.wa.gov/ResearchScience/Topics/UrbanForestry/Pages/rp_urban_eca_tac.aspx

Washington State Evergreen Communities Act – HB 2844 http://www.cted.wa.gov/site/1126/default.aspx http://apps.leg.wa.gov/billinfo/summary.aspx?bill=2844&year=2007

Casey Trees – Urban Tree Canopy Goals, APA National Conference, April 18, 2007. http://www.caseytrees.org

"A method for locating potential tree-planting sites in urban areas: a case study of Los Angeles, USA." By Chunxia Wu, Qingfu Xiao, and E. Gregory McPherson http://www.treesearch.fs.fed.us/pubs/30226

ESRI – ArcGIS – http://www.esri.com/software/arcgis/arcview/index.html

DS Mapbook – http://edndoc.esri.com/arcobjects/9.2/cpp_vb6_vba_vcpp_doc/com_samples_docs/cartography/map_production/dsmapbook/9d2dafa6-fcae-4e3d-bd27-1f242b216452.htm

ColorBrewer – http://www.personal.psu.edu/cab38/ColorBrewer/ColorBrewer_intro.html

Avenza Geographic Imager – http://www.avenza.com/geographicimager

Adobe Photoshop – http://www.adobe.com/products/photoshop/photoshop/

Staff Report

TO:	TREE BOARD
FROM:	ERIN MARTINDALE, SENIOR PLANNER
SUBJECT:	TREE BOARD 2010 WORK PLAN
FOR MEETING OF:	DECEMBER 2, 2009

The DRAFT Tree Board Work Plan for 2010 is presented in Attachment A.

The Work Program is intended to provide direction to the Tree Board and staff regarding work items throughout the year. As an evolving document, the City Council may modify the work program throughout the year.

By the end of 2009 or the first meeting in 2010, the Tree Board will have completed the following items of work:

1. Update the Tree Protection Regulations. This was adopted by the City Council on December 1, 2009.
2. Assessment of Tree Canopy. This report was prepared by students from the University of Washington, and is under review today by the Tree Board.
3. Update the Plant Species List. This work item is expected to be completed by the first meeting in January.
4. Participation in Arbor Day/Earth Day Celebration and Spring Garden Fair.
5. Monitoring of the Tree Protection Regulations (ongoing).

There were several items on the 2009 Work Plan that are proposed to be completed as part of the 2010 Work Plan, including the finalization of the tree tribute program, review and update of the heritage tree program, and expansion of educational opportunities, that are expected to be completed by the end of 2010.

Attachments: A – DRAFT Tree Board 2010 Work Plan

Attachment A

Project Purpose/Description	CUFP Goal	Schedule	Priority
Update Woodinville Plant Species List **Purpose:** Provide a guide for applicants on tree selection. **Project Description:** Review and update the current Plant Species List. The Tree Protection Regulations (adopted in March 2009) include information on canopy size and 5-year growth rates that is not currently on the List.	CUF-7.4, CUF-14.1, CUG-14.2	Tree Board review and update: by 1/10 Production: 2/10-6/10	1
Advise Street Tree Plans **Purpose:** Provide planting guide for City streets. **Project Description:** The Tree Board will advise staff and Council, as well as other involved Boards and Commissions, on selection of street tree species by street.	CUF-10.1, CUF-15, CUF-15.1, CUF-15.2, CUF-15.3	Tree Board review complete by 12/10	2
Tree Tribute Grove Program **Purpose:** To give citizens a public means with which to pay tribute to others, while promoting the value of the trees in public the landscape. **Project Description:** Establish procedures/process for the tree tribute program; identify possible sites; design and produce plaques and publicity.	CUF-4.B	Complete program by 7/1/10	3
Monitor New Tree Protection Regulations **Purpose:** To provide feedback on the effectiveness of the new (adopted in March 2009) Tree Protection Regulations **Description:** Report on tree removals, new developments, Tree Fund. Provide recommendations to Council on Fund expenditure for 2011 budget.	CUF-1, CUF-2, CUF-3. CUF- 4, CUF-5, CUF -6, CUF-7, CUF-8, CUF-10, CUF-11, CUF-12, CUF-13, CUF-14, CUF 15, CUF-16, CUF 21	Ongoing Report quarterly Provide recommendation to Council on Tree Fund money as part of 2011-2012 budget process	4
Heritage Tree Program **Purpose:** To denote and preserve valuable historical, natural landmarks as public assets. **Description:** Install plaques to mark existing Heritage Trees, revive brochure.	CUF – 7.3 CUF – 7	Ongoing	5
Education Program **Purpose:** To promote voluntary tree retention, planting, care amongst public planners, businesses, property owners and	CUF – 1, CUF – 2.3 CUF-18, CUF 20	Ongoing Spring Garden Fair: March 2010	6

developers. **Description:** Expand educational outreach to citizens, staff, council, commissioners and developers about the value and care of trees in the urban environment. Possible participation in Garden Day, Sammamish River Stewards, scout troops, honor society at schools, etc.		Sammamish ReLeaf: Spring and Fall events 2010	
Tree City USA **Purpose:** Promote the value of trees for healthy urban habitats. **Description:** Participate in Arbor Day celebrations, and Tree City USA programs.	CUF -20.B	Arbor Day celebration: 4/30/10 Tree City USA Deadline: 12/31/10	7

Updated: March 13, 2012

	2012 TREE BOARD PROPOSED AGENDA ***Subject to Change***	
01/11/12	REGULAR MEETING - CANCELLED	4:30 PM
02/8/12	REGULAR MEETING - CANCELLED	4:30 PM
03/07/12	REGULAR MEETING Study Session: Study Session: Arbor Day & 2012 Tree Board Public Outreach Efforts Study Session: 2012 Tree Board Work Program Study Session: Continued Review of the 1998 Community Urban Forestry Plan – Review Vision Statement and 21 Goals of the Plan	4:30 PM
04/11/12	REGULAR MEETING Study Session: Tree Board By-Laws Study Session: Continued Arbor Day & 2012 Tree Board Public Outreach Efforts Study Session: Continued Review of the 1998 Community Urban Forestry Plan – Review Vision Statement and 21 Goals of the Plan	4:30 PM
05/09/12	REGULAR MEETING	4:30 PM
06/13/12	REGULAR MEETING	4:30 PM
07/11/12	REGULAR MEETING	4:30 PM
08/8/12	REGULAR MEETING	4:30 PM
09/12/12	REGULAR MEETING	4:30 PM
10/10/12	REGULAR MEETING	4:30 PM
11/14/12	REGULAR MEETING	4:30 PM
12/12/12	REGULAR MEETING	4:30 PM
	REGULAR MEETING	4:30 PM
	REGULAR MEETING	4:30 PM