Puget Sound Urban Tree Canopy and Stormwater Management

A Collaborative Approach to Improved Stormwater & Urban Forest Management

2019 Urban Forest Symposium
May 21, 2019
UW Center for Urban Horticulture
Learning Objectives

• INSIGHT into opportunities & challenges facing our region’s urban forests and waterways

• OPEN EVALUATION & discussion of the tools available to manage our trees & stormwater through the lens of pilot communities & management scenarios

• A VISION & A PLAN for collaboration and shared responsibility for stewardship of the Puget Sound’s natural resources, communities, wildlife & people
Thank you to our Funding Partners

- US EPA National Estuary Program
- USDA Forest Service Urban & Community Forestry Program
- WA Dept. of Ecology
- WA Dept. of Natural Resources
- King Conservation District
Speaker & Team Introductions

**BRANDY REED**
Director of Strategic Partnerships
King Conservation District
- 22 years of Natural Resource Stewardship & Education experience
- Passionate about helping people learn about the natural environment & conservation
- Project Director

**LANCE DAVISSON**
Owner / Principal Consultant
The Keystone Concept
- Over 18 years natural resource management across the US (public & private)
- Leadership: former PNW ISA President & National Urban & Community Advisory Council Chair
- Project Management / Facilitation & Urban Forestry

**REBECCA DUGOPOLSKI**
Associate Engineer
Herrera Environmental
- Over 13 years of stormwater management experience
- Specializes in stormwater planning, design, monitoring & maintenance
- Project Management, WWHM Modeling, Stormwater technical expertise

**IAN HANOU**
CEO & Founder at Plan-It Geo
- Over 17 years in the urban forest industry including planning, GIS Assessment and urban tree canopy assessment
- iTree Hydro Modeling, GIS & Urban Forestry technical expertise

**SCOTT MACO**
Director of Research & Development
The Davey Institute
- Over 19 years in the Urban Forest Industry
- Leads development of iTree Suite of Tools
- iTree Developer, Project Stakeholder & Collaborator
**Puget Sound Urban Forestry & Stormwater Project**

### WHAT

- Infrastructure (Gray vs Green)
- Resilient & Functional Landscapes (pervious vs impervious, deciduous vs evergreen)

### HOW

- Stakeholder Investment: A Team Approach
- Modeling - stormwater & urban forestry
- Industry & literature review

### WHY

- Quality of life - healthy & active lifestyles, thriving economies
- Thriving ecosystems - wildlife, habitat, functioning systems

*Image credits: SeaStock, M. Glashchenko, American Rivers*
BRANDY REED
Director of Strategic Partnerships King Conservation District

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Puget Sound Urban Tree Canopy and Stormwater Management
A Report Comparing USDA Forest Service i-Tree Hydro and Washington State Department of Ecology Western Washington Hydrology Model
Trees and Stormwater - Our Objectives

• Engage urban forest and stormwater management professionals in a discussion about the role of urban tree canopy and forests in stormwater management.

• Further explore the relationship between trees and stormwater management by comparing two prominent hydrology models.
  - Collaborative evaluation of models
  - Recommendations for using models
  - Develop and distribute resources
  - Present findings at regional symposia
Project Accomplishments

- Tree Canopy Assessments
- i-Tree Hydro and WWHM Analysis and Comparison
- Technical Report
- Collaboration Handbook (in development)
Tree Canopy Assessment - Kirkland
Tree Canopy Assessment & Planning

Tree Canopy Assessments
• Pilot City Tree Canopy Assessments
• Other KC Jurisdiction Tree Canopy Assessments

Canopy Planner Subscription
• Algona
• Auburn
• Bellevue
• Black Diamond
• Bothell*
• Burien
• Clyde Hill*
• Covington
• Des Moines
• Hunts Point*
• Issaquah(underway)
• Kenmore
• Kent
• Kirkland*
• Maple Valley
• Mercer Island
• Newcastle
• Normandy Park
• Renton
• SeaTac
• Tukwila
• Woodinville
• Yarrow Point*

https://pg-cloud.com/KingCD-Cities/
4 Pilot Communities
- City of Snohomish
- City of Kirkland
- City of Kent
- City of Tacoma

2 Models Evaluated
- i-Tree Hydro
- WWHM

4 Spatial Scales
- City
- Drainage Basin
- Neighborhood
- Site
# Model Analysis and Comparison

## 3 Management Scenarios Evaluated

<table>
<thead>
<tr>
<th>Management Scenario</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Conditions</td>
<td>Base Case</td>
</tr>
<tr>
<td>Tree Canopy Loss</td>
<td>1A. Present Tree Canopy Stormwater Benefit</td>
</tr>
<tr>
<td></td>
<td>1B. Partial Tree Canopy Loss</td>
</tr>
<tr>
<td>Development</td>
<td>2A. Build Out with Tree Preservation</td>
</tr>
<tr>
<td></td>
<td>2B. Build Out without Tree Preservation</td>
</tr>
<tr>
<td>Tree Canopy Increase</td>
<td>3A. Tree Canopy Increase: Over Pervious Area</td>
</tr>
<tr>
<td></td>
<td>3B. Tree Canopy Increase: Over Impervious Area</td>
</tr>
</tbody>
</table>

- **Tree Canopy Loss**
- **Development**
- **Tree Canopy Increase**
Key Findings

1. Canopy Loss, Benefit Loss
2. Canopy over Impervious Surfaces
3. Tree Retention during Development
4. Higher Canopy, Greater Benefit
5. Runoff Volume Comparison
Key Findings

Key Finding 1
Replacing tree canopy is replaced (Scenarios 1A, 1B, 2A and 2B) with any other land cover type (herbaceous, shrub, impervious) increases runoff volume.

Retain and plant trees wherever possible (overhanging impervious areas, increasing canopy over pervious areas) to reduce stormwater runoff volume and pollution loads.

Photo Credit: National Association of Conservation Districts
Key Findings

Key Finding 2
Increase in tree cover over impervious surfaces (Scenario 3B) results in decreased runoff volumes.

Plant trees to overhang impervious surfaces for high stormwater runoff and pollution reduction benefits

Key Findings

Key Finding 3
Development that includes tree retention (Scenarios 2A/2B) results in reduced runoff volume compared with development without tree retention.

Retain existing trees during new development and redevelopment for higher stormwater runoff and pollution reduction benefits.
Key Finding 4
Areas with higher existing tree canopy coverage experience a lower magnitude of runoff volume increase when tree canopy is reduced.

City Scale Results

<table>
<thead>
<tr>
<th>Mgmt. Scenario</th>
<th>Cases</th>
<th>i-Tree</th>
<th>WWHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development</td>
<td>2A (-5% TC)</td>
<td>TRV: +2%</td>
<td>TRV: +1%</td>
</tr>
<tr>
<td></td>
<td>2B (-10% TC)</td>
<td>TRV: +3%</td>
<td>TRV: +2%</td>
</tr>
</tbody>
</table>

Snohomish 23% TC

Kirkland 37% TC

<table>
<thead>
<tr>
<th>i-Tree</th>
<th>WWHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRV: +0.5%</td>
<td>TRV: +2%</td>
</tr>
<tr>
<td>TRV: +2%</td>
<td>TRV: +5%</td>
</tr>
</tbody>
</table>

Retain and expand tree and forest canopy cover wherever possible for maximum stormwater runoff reduction benefit.
Key Findings

Key Finding 5
In nearly all modeled scenarios, i-Tree Hydro yielded lower runoff volume outputs than WWHM.

When used alone, i-Tree Hydro may understate the contribution of Puget Sound tree canopy toward reducing stormwater runoff and pollution.
Model Recommendations

**i-Tree Hydro**

Use at a landscape scale (drainage basin or city-wide) when exploring stream or river hydrology responses with detailed urban vegetation inputs and land cover changes over large areas.

<table>
<thead>
<tr>
<th>i-Tree</th>
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</thead>
<tbody>
<tr>
<td>• Suite of tools developed by the USDA Forest Service and the Davey Institute</td>
</tr>
<tr>
<td>• Vegetation-specific hydrology model</td>
</tr>
<tr>
<td>• Predict stream flows and water quality at a landscape scale</td>
</tr>
<tr>
<td>• Intended audience: forestry managers and communities</td>
</tr>
<tr>
<td>• Other i-Tree tools that evaluate stormwater benefits: i-Tree Eco and i-Tree Landscape</td>
</tr>
</tbody>
</table>

*Source: i-Tree Tools Website*

www.itreetools.org/hydro/
**Model Recommendations**

**WWHM**

Use at a **site scale** (individual parcel or neighborhood) when sizing flow control and water quality treatment **BMPs and facilities**, or when applying Ecology’s **flow control credits** for tree planting and/or tree retention (BMP T5.16).

**WWHM**

- Developed by Clear Creek Solutions and funded by Ecology
- Used to size flow control and water quality treatment BMPs and facilities
- Focused on western Washington
- Intended audience: planners, engineers, developers and managers

*Source: WA Dept of Ecology website*

[https://ecology.wa.gov](https://ecology.wa.gov)
Moving Forward with Tree Canopy

Multiple Benefits Approaches

• Maintain existing trees and expand canopy by planting new trees

• Design and maintain multi-beneficial landscapes with vegetation layers, including trees

• Plan, design and develop GSI that integrates trees
Trees and Stormwater Collaborative

- City of Kent
- City of Kirkland
- City of Seattle
- City of Snohomish
- City of Tacoma
- Futurewise
- King Conservation District
- King County Cities Climate Collaborative
- King County One Million Trees Initiative
- King County Stormwater Section
- The Nature Conservancy
- Pierce Conservation District
- Pierce County
- Puget Sound Conservation District Caucus
- Puget Sound Partnership
- Snohomish Conservation District
- Snohomish County
- Stewardship Partners
- The Russell Family Foundation
- USFS / Davie Institute i-Tree Development Team
- Washington Stormwater Center
- WA Department of Ecology
- WA Department of Natural Resources
Assessing Urban Forests with i-Tree

Scott Maco, The Davey Institute
i-Tree: Demonstrating That Trees Pay Us Back!
i-Tree...12+ years later

“Putting USFS Urban Forest science into the hands of users”

- Public Domain science
- Based on peer-reviewed research
- Technical support
- Continuously improved

i-Tree is a set of free tools built on science that:

- Quantifies the benefits and values of trees around the world.
- Aids in tree and forest management and advocacy.
- Shows potential links to tree and forest health.
- Are based on peer-reviewed, USDA Forest Service Research and Public domain.

Global i-Tree Symposium June 16-19, 2019 Syracuse

www.itreetools.org
i-Tree: a benefit-based approach....

What is the value of a tree?

Structure  Function  Values
Then and Now:

4 desktop & 9 web apps

i-Tree Hydro
i-Tree Eco
i-Tree Canopy
i-Tree Landscape
i-Tree Design
i-Tree Planting
i-Tree Species
i-Tree MyTree

Nowak
UFORE
Urban forest Effects Model

McPherson
STRATUM v.3.4

Bloniarz
MOBILE COMMUNITY TREE INVENTORY
Core program:

- **i-Tree Eco assesses:**
  - Structure
  - Function
    - Energy
    - Air
    - Carbon
  - Value ($)
  - Management needs
    - Pest risk
    - Tree health
  - Custom Tasks
    - Forecasting
    - Cost-Benefit Ratio
Rapid Reports = Summarized Data
Understanding the effects of trees

🌳 London Plane

- 29% of all trees
- 67% of all leaf area
- 59% of annual CO2 sequestration

CO₂ Sequestration
Victoria Business Improvement District, London

Credit: London, Victoria and Treeconomics
**Value of Resource at Risk**

**Emerald Ash Borer**

*Structural Impacts:*
- 17.3% Canopy Loss
- 587,000 ash trees
- $221 million structural damage

*Functional Impacts:*
- $243,785 less pollutant removal
- $138,000 less energy savings
- $2.6 million reduction in storm water benefits

Milwaukee Eco Assessment
i-Tree Canopy

Helps estimate:
- % Tree cover
- Pollution removal
- CO₂ sequestration
- Carbon storage
How can I use Canopy?

- Establish baseline
- Monitor change:
  - Pest & disease
  - Land development
- Historical change analysis
  - Google Earth
Recent Tree Cover Change in U.S. Cities

Tree Cover %

Year 1

Year 2
i-Tree Landscape: i-Tree’s best kept secret
Exploring at the Community Scale
Comparative analysis by block group
Inform Community Decisions and City Priorities

Low Existing Canopy Density and
Low Existing Canopy Density and Low Avoided Runoff
Low Existing Canopy Density and High Pollutant Emissions (PM2.5)
...and more

- Pest risk
- Surface temperature
- Projected temperature change by 2060
- Value of sequestered carbon
- Value of air pollution removal
- Importance to drinking water
- Wildfire potential
- Maximum UV index
i-Tree Design

- Parcel level analysis of individual trees
- Google Maps-based

- Quick & easy
- Web accessible by all
How does i-Tree Design work?

1. Enter an address
2. Draw building footprints (for energy benefits)
3. Add trees (existing or proposed)
Using i-Tree Design to assess 341 trees planted on redeveloped retention ponds.
Project Tree Benefits for Redevelopment Project
341 trees planted at Mandolin Gardens...

will provide $118,200 worth of benefits over the next 20 years ...and growing

Benefits in 2014 = $1,676

Benefits in 2034 = $11,682
341 trees planted at Mandolin Gardens...

will intercept **11.1 million gallons of stormwater** worth **$67,000** over the next 20 years
Project tree benefits over time from a mass planting.

planting.itreetools.org
Web version replaces previous desktop version
- And ready for Mobile – smartphone or tablet!

New features
- Hardiness zones
- Pest / Host
- Invasive designation

species.itreetools.org
i-Tree MyTree - new

🎉 i-Tree on the go!
➢ Running on the i-Tree Design engine

www.itreetools.org/MyTree
Getting started: online resources

www.itreetools.org

- How-to videos
- Documentation
- Online tools
- Support
- Examples
- Downloads
- Your stories
i-Tree: Your portal for assessing the ecosystem services of trees and forests

Visit us at:  www.itreetools.org
Technical Support:  info@itreetools.org
Scott Maco:  scott.maco@davey.com

Thank You!
Project Handbook

REBECCA DUGOPOLSKI, Associate Engineer
Herrera Environmental, Inc

- Over 13 years of stormwater management experience
- Specializes in stormwater planning, design, monitoring & maintenance
- Project Management, WWHM Modeling, Stormwater technical expertise
Handbook Overview

• Introduction

• Benefits of Trees

• Stormwater Management Benefits and Challenges of Urban Trees in the Puget Sound Region

• Collaboration Tools and Actions

• Conclusions

• References and Additional Resources
Handbook Overview

• Introduction
  • Overview and Purpose
  • Defining Urban Tree Canopy, Its Roles and Uses
# Handbook Overview

- **Benefits of Trees**
  - Human Health and Quality of Life Benefits
  - Ecological and Environmental Benefits
  - Economic Benefits

<table>
<thead>
<tr>
<th>Human Health and Quality of Life</th>
<th>Ecological and Environmental</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Aesthetics and livability</td>
<td>• Wildlife habitat</td>
<td>• Reduced energy costs</td>
</tr>
<tr>
<td>• Air quality</td>
<td>• Water quality protection</td>
<td>• Increased property values</td>
</tr>
<tr>
<td>• Connection to nature</td>
<td>• Stormwater runoff reduction</td>
<td>• Lower stormwater retention costs</td>
</tr>
<tr>
<td>• Recreation</td>
<td>• Carbon sequestration</td>
<td>• Green industry job creation</td>
</tr>
<tr>
<td>• Reduced stress</td>
<td>• Climate resiliency</td>
<td></td>
</tr>
<tr>
<td>• Noise buffer/privacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• etc.</td>
<td></td>
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</tr>
</tbody>
</table>
Handbook Overview

• Stormwater Management Benefits and Challenges of Urban Trees in the Puget Sound Region
  • Quantifying Stormwater Benefits of Urban Trees
  • Retaining and Planting Trees for Stormwater Management
  • Overcoming Challenges to Integrating Trees in Green Stormwater Infrastructure
Handbook Overview

• Collaboration Tools and Actions

Primary Audience: Urban Forestry and Stormwater Professionals

Secondary Audience: Policy Makers and Implementers

Tertiary Audiences: Property Owners, Builders/Developers, Property Owners, Property Owners

Tertiary Audiences: Primary Audience, Secondary Audience, Tertiary Audiences
Handbook Overview

• Collaboration Tools and Actions
  • Current Understanding
  • Common Ground
  • Gaps
  • Topics of Conversation
  • Actions
  • Resources
Collaboration Tools and Actions Discussion
Next Steps & Project Contacts

- **Final Stakeholder Meetings**
- **Gather feedback on collaboration & tools**

**May/June 2019**

- **Final content & design of Project Handbook**

**June/July 2019**

- **Launch KCD Urban Forestry & Stormwater Project website**

**July / August 2019**

Questions, comments, feedback
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(206) 787-8261
rdugopolski@herrerainc.com