

Issue 4. Urban and Community Forestry

Overview

In an article titled “High Heat” in *National Geographic* magazine, the authors stated that “the world will feel different in 2100, when average temperatures will have risen by several degrees. Every kind of landscape that humans inhabit will be affected: urban, suburban, rural, mountains, plains, and coasts.”¹ The article discusses how trees in urban areas can help by providing shade and lowering surface temperatures of walls and buildings by more than 23°F. Reflective “cool roofs” can block up to 65% of the sun’s radiation. Reflective and permeable pavements in urban areas can lower surface summer temperatures that otherwise can reach close to 108°F.

Trees are a critical component of our cities and a dynamic resource. Research indicates that healthy trees can lessen impacts associated with the built environment by reducing stormwater runoff, energy consumption, heat islands, and air pollutants. Trees improve urban life, making Hawai‘i a more enjoyable place to live, work, and play, while mitigating the city’s environmental impact.²

Trees make a city livable. As Geoffrey Donovan, a forester at the Pacific Northwest Research Center, has stated, “There is something fundamental about the human condition and exposure to the natural environment; cities make that problematic, and perhaps trees are one way of allowing



Figure 4.1. The 2015 Kaulunani staff and council members, October 2015.

us to survive in these environments.”³ The Hawaiian urban landscape is a complex mosaic of urban land uses, agriculture, undeveloped upland areas, invasive species, social geographies, recreation, and tourism—all competing in an island landscape.⁴

Hawai‘i’s Urban and Community Forestry Program, Kaulunani, is funded by the U.S. Department of Agriculture (USDA) Forest Service (FS) and the Division of Forestry and Wildlife (DOFAW) in

Hawai‘i. The program is managed in partnership with DOFAW and the non-profit (501C3) Smart Trees Pacific (STP), which delivers the Kaulunani program. The Kaulunani Council acts in an advisory capacity to DOFAW and the Kaulunani program. The council is a diverse group of professionals representing a broad sector of fields relating to urban forestry, including arboriculture, planning, forestry, landscape architecture, environmental law, and landscape industry.

Since its inception 1992, Kaulunani has awarded more than \$2.6 million to more than 400 organizations across the state in the form of cost-share grants, which were matched with \$7.1 million in cash and in-kind contributions. The key to the success of this program is the blend of partners, people, and projects. Kaulunani found that important indicators of successful urban forestry projects include advanced planning, strong leadership, volunteer commitment, community involvement, interagency partnership, appropriate plant selection, proper horticultural procedures and maintenance, and a demonstrated commitment to social and environmental change.

Kaulunani’s Mission Statement

Balance the urban and natural environment by encouraging, empowering and equipping the people of Hawai‘i to Mālama the trees in our ‘āina.

Population and Land Use

Hawai‘i encompasses approximately 4.1 million acres distributed over the Main Hawaiian Islands and the unpopulated Northwestern Hawaiian Islands.⁵ Of this acreage, 48% is designated as conservation, 47% as agriculture, 5% as urban, and less than 0.5% as rural. The total resident populationⁱ and de facto populationⁱⁱ of Hawai‘i, as of July 1, 2014, were approximately 1.4 million and 1.5 million, respectively.⁵ Hawai‘i’s resident population of nearly 1 million is concentrated on the island of O‘ahu, particularly in the Honolulu urban core. The other islands are primarily composed of small towns and rural communities.

Hawai‘i’s Urban Realm

Urban forestry is about tree management in any area influenced and used by the urban population.⁶ Urban forest stewardship is critical to our forests and reefs.¹ Our islands’ ecosystems are more dramatically and intricately connected than those on continents. Because of

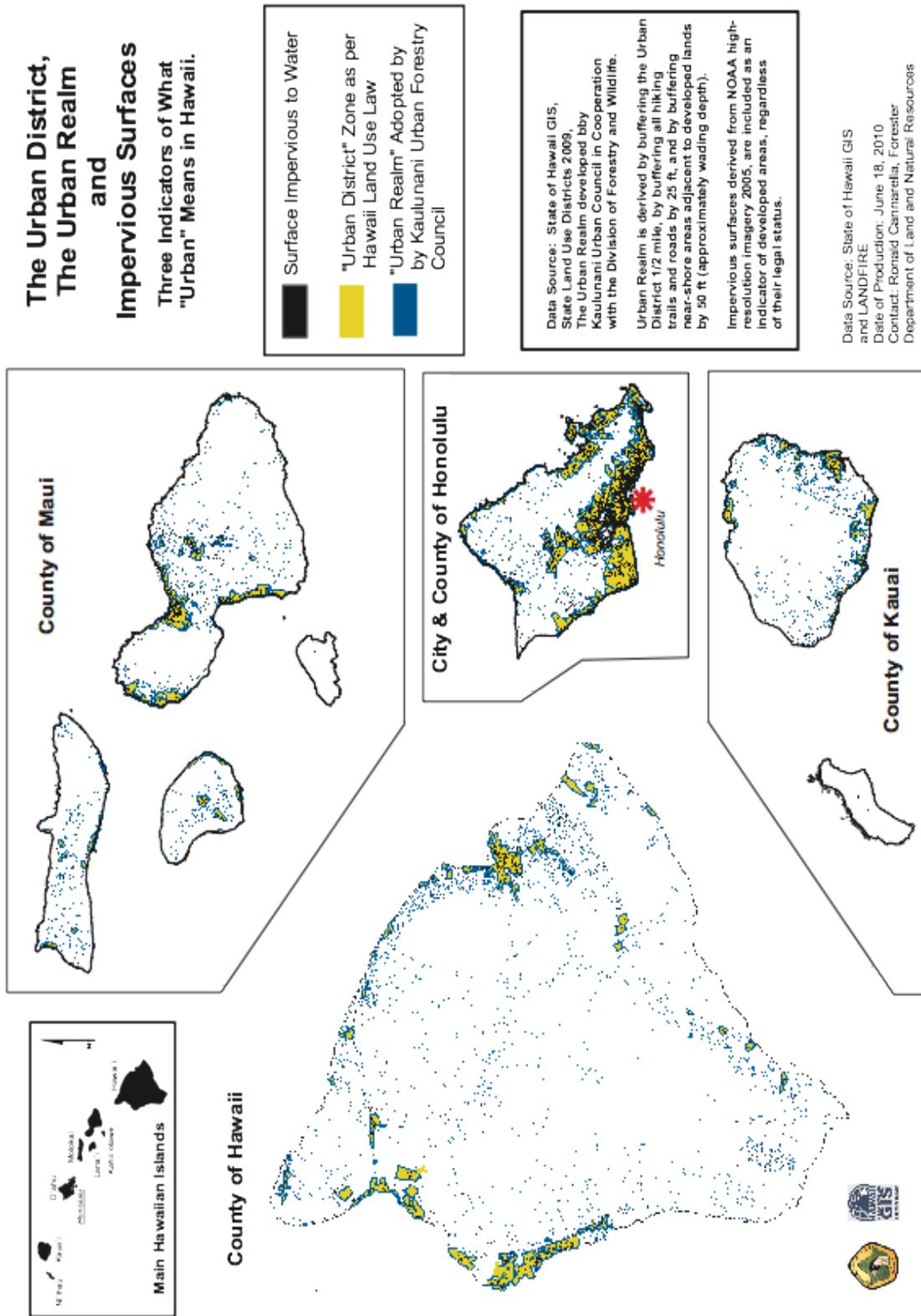
ⁱ The resident population is defined as the number of persons whose usual place of residence is in an area, regardless of physical location, on the estimate or census date. It includes military personnel stationed or homeported in the area and residents temporarily absent, but excludes visitors present.

ⁱⁱ The de facto population is defined as the number of persons physically present in an area, regardless of military status or usual place of residence. It includes visitors present but excludes residents temporarily absent, both calculated as an average daily census.

these tight connections, integrating urban forest issues into landscape and island-wide management efforts is necessary.

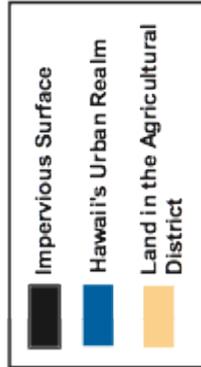
Urban forestry issues span from the mountains to the sea and include watersheds, stormwater runoff, sea level rise, cooling, tree care, fire and forest health, improved management of the trees, support for enforced ordinances to improve the health of the urban canopy, and education to citizens and government about the value of our urban trees.

Map 4.1 shows the impervious surfaces, including roads and buildings, and the urban realm where people live, work, and play and where urban forestry is mainly focused. The proximity of urban areas to agricultural areas and to *makai* resources (Map 4.2) is the main reason why urban forestry must be considered when prioritizing land management of upland and lowland resources of the island.



Map 4.1. The urban realm in Hawai'i.

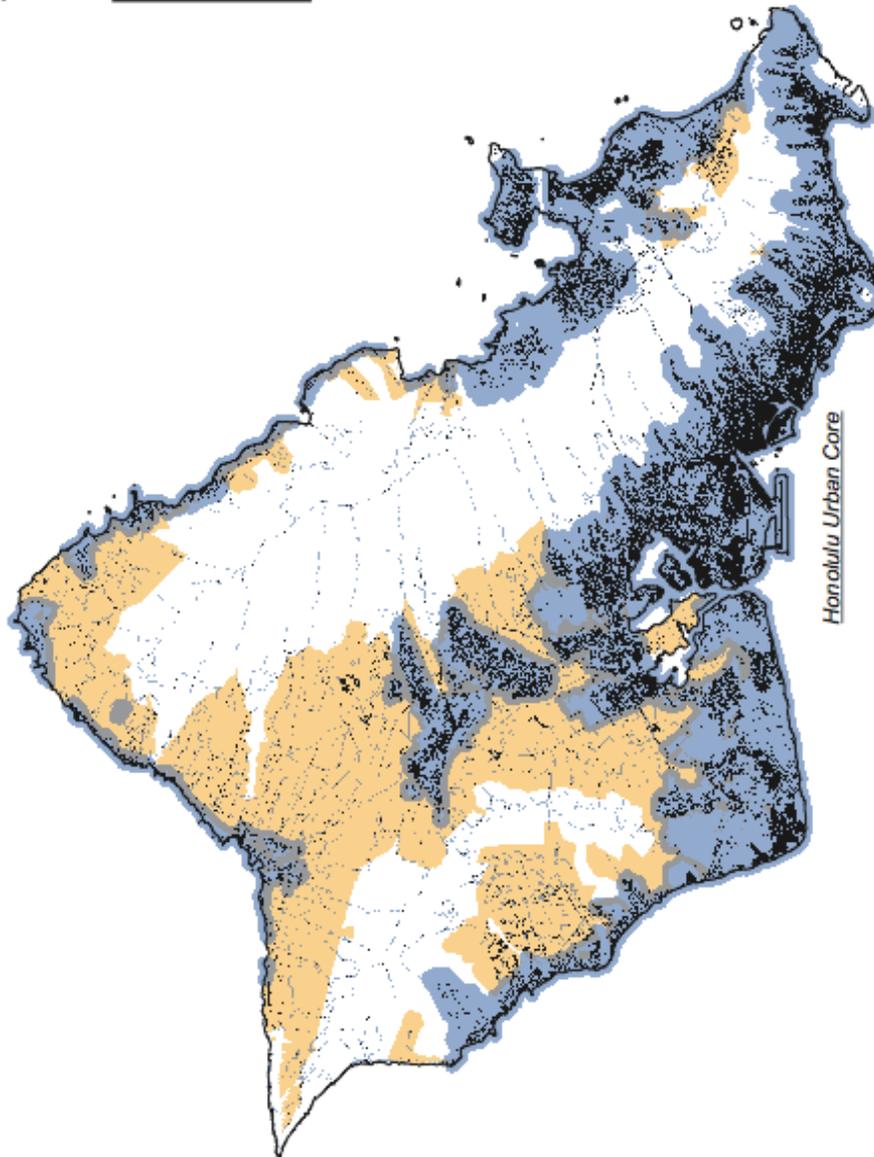
**Urbanized Areas and
the Agricultural District
Island of Oahu**



Data Source: State of Hawaii GIS, State Land Use Districts 2009. The Urban Realm developed by Kaunani Urban Council in Cooperation with the Division of Forestry and Wildlife.

Urban Realm is derived by buffering the Urban District 1/2 mile, by buffering all hiking trails and roads by 25 ft, and by buffering near-shore areas adjacent to developed lands by 50 ft (approximately wading depth).

Impervious surfaces derived from NOAA high-resolution imagery 2005, are included as an indicator of developed areas, regardless of their legal status.



Data Source: State of Hawaii GIS
Date of Production: June 18, 2010
Contact: Ronald Camarella, Forester
Department of Land and Natural Resources



Map 4.2. Map of the Island of O’ahu showing impervious surfaces, including roads and buildings; the urban realm where people live, work, and play; and the agricultural district.

Benefits

Urban forests, whether public or private, offer a multitude of benefits. Research indicates that healthy trees can decrease negative impacts of urbanization while improving human health. Trees and plants buffer wind and noise and generally are recognized as positive influences on health and well-being. Trees are one of the natural world's most efficient multi-taskers. Trees can reduce energy costs, cool "heat islands" by providing shade, sequester carbon, trap pollutants, and slow storm runoff. The right tree in the right place can provide beauty, shady shelter from the sun, food, soil stabilization, increased property values, and conservation and cultural benefits.

Honolulu's Street Trees

Hawai'i's urban forest is a mixture of young and mature canopies. In 2006, Kaulunani funded an assessment of Honolulu's urban trees using the *Street Tree Resource Analysis Tool for Urban Forestry Managers* (STRATUM) to gather baseline data on benefits of urban trees in tropical settings. STRATUM data from 43,817 street trees were analyzed by the Center for Urban Forest Research, Pacific Southwest Research Station. Hawai'i's urban trees were found to provide extensive environmental benefits. For example, the annual environmental benefits were calculated at \$90 per tree, and each tree provides \$2.98 in benefits for every \$1 spent on tree care. The replacement value of urban trees was calculated at \$1,665 per tree.² The report identified benefits such as electricity savings and climate effects, carbon storage, air pollution removal, and rain interception.

Value of a Tree in the Tropical Urban Forest

In a study called *The Value of a Tree in the Tropical Region*, researchers found that a large tree in the tropical region will provide \$4,180 in environmental and other benefits over its lifetime. That is a 300% return on investment. The study states, "Over 40 years, 100 large public tropical trees' total costs are \$138,160 and the total benefits are \$418,440. The 40-year net benefit is \$280,280."

In 2012, FS awarded a western competitive grant for the Hawai'i *Urban Tree Canopy Assessment* (UTC) of 250 square miles from Kāne'ohe to Kalaehoa on O'ahu (Figure 4.2). The assessment covered 15,274 acres of tree canopy, representing 20% of all land in the urban zone. An additional 53% (40,984 acres) of the urban zones could theoretically be modified to accommodate tree canopy. Of the 53%, 18% was classified as possibly impervious and 35% as possibly vegetated (Figure 4.3). Possibly vegetated areas, or areas with grass and shrubs, are more conducive to establishing new tree canopy, but establishing tree canopy in areas classified as possibly impervious will have a greater impact on water quality and summer temperatures.

The primary data sources were Light Detection and Ranging (LiDAR) data acquired in 2009 and Worldview-2 satellite imagery acquired in 2010.⁴

In 2014, the National Oceanic and Atmospheric Administration released a comparable set of LiDAR photographs of O‘ahu. This LiDAR data set gives us an opportunity to reassess our efforts to increase the urban canopy. In 2015, FS funded a second project to update the land cover geographic information system layer, identify the differences between the current and previous UTC, and provide a written assessment report. This project is slated for completion by December 2016.

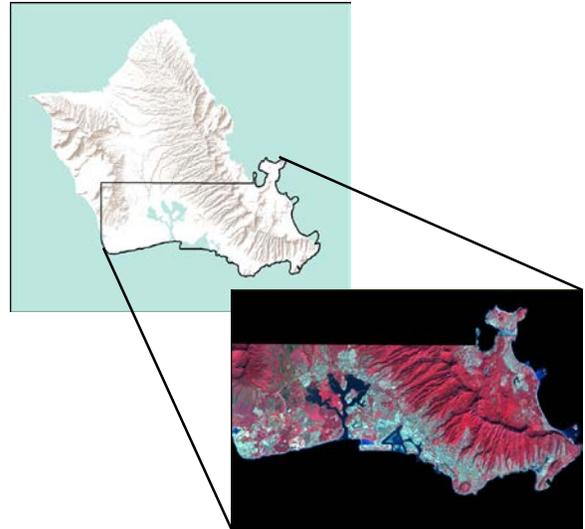


Figure 4.2. Urban tree canopy assessment in O‘ahu from Kāne‘ohe to Kalaeloa. Red areas indicate tree canopy cover.



Figure 4.3. Results of urban tree canopy assessment on O‘ahu: existing canopy cover (top right), vegetated and potential for canopy cover (left center), and impervious surfaces (bottom right).

Tree City USA and Tree Campus USA

Classification as a Tree City USA is the standard for excellence in urban forestry recognized by the Arbor Day Foundation. Hawai‘i has doubled the number of Tree City USA communities to eight. Additionally, University of Hawai‘i at Mānoa for the last 4 years has been recognized as a Tree Campus USA.

To qualify as a Tree City USA, a community must have (1) a tree board or department, (2) a tree care ordinance, (3) a community forestry program with an annual budget of at least \$2 per capita, and (4) an Arbor Day observance and proclamation.

Table 4.1. Tree City USA communities of Hawai‘i.

Tree City USA Community	Number of Years of Recognition
Āliamanu Military Reservation	3
Fort Shafter	3
Helemano Military Reservation	3
City and County of Honolulu	34
Joint Base Pearl Harbor Hickam	16
County of Maui	38
Schofield Army Base	6
Wheeler Army Airfield	3

Priority Areas and Issues in the Urban Forest

In 2009, the Kaulunani Council and key stakeholders identified important urban forestry issues throughout the state. In 2015, the council and stakeholders found that while some of the specifics changed, such as new invasive species threats and greater storm incidence, the overall issues and concerns of urban forestry identified in 2009 did not change. They are climate change, education and outreach, emergency management, health and well-being, invasive species, ordinances and legislation, urban tree care, water quality and green infrastructure, and wildland urban interface.

Federal Priorities for Urban and Community Forestry

- Mitigate and adapt to climate change.
- Protect and improve air and water quality.
- Conserve energy.
- Reduce the impacts of land use change, fragmentation, and urbanization on forest landscapes.
- Improve community health and well-being.

- Build urban forest resilience and mitigate the impacts of invasive pests and catastrophic events.

Climate Change

Present Conditions and Trends

According to the National Urban and Community Forestry Advisory Council report to the Secretary of Agriculture *Catastrophic Storms and the Urban Forests*, a storm's impact on the urban forest is a national problem, and its consequences affect our urban forests and our communities.² Moreover, the percentage of population living in coastal areas (53%) and the rising number of predicted high-intensity storms has created highly vulnerable coastal areas.

To begin to address these concerns, Kaulunani, in partnership with FS, the University of Hawai'i at Mānoa, and Spatial Informatics Group, has initiated several projects that investigate the effects of storms on the coastline in Hawai'i and other Pacific Islands. Some goals of these projects are (1) conducting a literature review of coastal/storm research, (2) identifying the type of vegetation that may survive tsunami and storm surge events, (3) gathering information on vegetation that grows near the shore in Hawai'i given different environmental factors, and (4) examining whether past or existing vegetation has an effect on mitigating beach erosion related to wave impact. Two completed projects are described in more detail below.

Effectiveness of Vegetation for Mitigating the Coastal Impact Related to Storm Surge and Tsunamis

A tsunami in 2009 inundated the southern coast of Upolu Samoa, killing more than 140 people and causing extensive property damage. In January 2010, a team was sent to make observations in Upolu to search for interactions between the tsunami and coastal vegetation. The team's observations lend support to the hypothesis that coastal vegetation mitigates the effects of a tsunami through several mechanisms: (1) coastal vegetation forms a physical barrier to an incoming wave, which may result in reduced damage to structures and reduced erosion; (2) coastal vegetation builds elevation at the coast by trapping organic matter and sand, and it provides a vertical escape for people trapped in the wave; and (3) coastal vegetation acts as a filter that prevents coral, ships, and debris carried by the wave from moving inland, where it can be destructive to people and property, and it prevent things from being carried out to sea and onto sensitive reefs.

Deflecting the Wave: Using Coastal Vegetation to Mitigate Tsunami and Storm Surge

A second project, "Deflecting the Wave: Using Coastal Vegetation to Mitigate Tsunami and Storm Surge," developed, based on the observations in Upolu, a method for restoring coastal areas primarily using native Hawaiian species. It also evaluated the effectiveness of this method and its effects on wave power and erosion. In particular, this project tested a planting method for

establishing native plants after removal of *Casuarina equisetifolia* at Bellows Air Force Station in Waimānalo, O‘ahu. Results verified the effectiveness of using a temporary windscreen to protect against wind and salt spray. The final report also documents the irrigation system used on the project, includes photographs with a timeline of the establishment of the plantings, presents ground coverage and dry matter data collected 1 year after planting, and provides recommendations on native plants and their planting zones for coastal planting and landscaping in Hawai‘i.

Gaps, Issues, and Concerns

“Issue 5: Climate Change/Sea Level Rise” addresses the various issues and concerns relative to climate change in Hawai‘i. Regarding urban forestry, one of the biggest concerns is that there is little or no recognition that trees and vegetation can be used to mitigate sea level rise. Other concerns are:

- increased risk to urban forests associated with an increase in frequency and severity of storms,
- increase in temperature and consequent changes to tree line in coastal areas,
- lack of projects aimed at reducing runoff and coastal erosion associated with sea level rise, and
- lack of effort to preserve and encourage maintenance of shoreline vegetation.

Strategies to Address Gaps

- Overlay UTC (possible urban forest) maps with sea level rise/inundation maps for the Hawaiian Islands to assist with strategically planting trees to mitigate impacts of storms and increased wave action associated with climate change.
- Prioritize trees for protection using the existing UTC analysis.
- Gain a better understanding of the suitability of specific trees for varying climate zones in the Hawaiian Islands.
- Gain a better understanding of the potential of specific trees to mitigate effects of climate change (e.g., flooding and saltwater intrusion).
- Communicate environmental urban ethics.
- Gain a better understanding of the resilience of specific trees under varying scenarios of temperature, rainfall, inundation, and so on.

Education and Outreach

Present Conditions and Trends

Urban forestry activities, celebrated on Earth Day and Arbor Day, are well received and involve public, private, and nonprofit partners. Kaulunani has been celebrating Arbor Day for 21 years.

[Arbor Day in Hawai'i](#) officially falls on the first Friday in November, and traditionally most of the Arbor Day celebrations and tree giveaways across the state take place on the Saturday after Arbor Day. In 2015, 5,595 trees were given out at 10 sites across the state. Kaulunani awarded \$29,052 to five organizations that was matched by \$176,769 in cash and in-kind contributions.

In 2013, Kaulunani launched a speaker series called *Learning @ Lunch* to encourage a better understanding of urban forestry, its benefits, and how it relates to other forestry and land management issues. The program is now expanding to include a Holiday Tree Walk to engage citizens in the urban forest, and select Kaulunani council meetings for a broader audience now open with a speaker and informative presentation. In 2015, for example, we invited experts from the University of Hawai'i to discuss climate change and how it relates to the urban forest. Kaulunani also launched an *e-newsletter* that introduces relevant topics in the urban forest, giving the community the opportunity to learn more about current issues, invasive species, and tree-related events, such as Arbor Day.



Figure 4.4. Arbor Day in Hawai'i.

Gaps, Issues, and Concerns

In 2009, the urban forestry stakeholders expressed concern about the lack of an overall marketing initiative regarding increasing awareness about urban trees and their benefits. In 2015, this issue continued to be a top concern of the Kaulunani Council and other stakeholders because many urban residents view trees as a nuisance rather than a benefit. Educational goals and gaps considered by the stakeholders covered a range of topics and addressed multi-tiered audiences. Marketing campaigns were suggested for policy makers, state agencies, and decision makers, as well as for homeowners and others in the community. Educational messaging on the benefits of trees, highlighted in the poster presented in Figure 4.5, needs a broader distribution to a wide range of audiences, including residents, homeowners, and policy and decision makers.

Strategies to Address Gaps

- Develop a broad marketing campaign to increase understanding of the importance of urban trees and vegetation and improve public perception of the value of trees, including ecosystem services and other benefits, such as health, food, cooling, and protection of the coastal strand.

- Ensure that informational material intended for policy makers, state agencies, and decision makers focuses on the *Right Tree/Right Place* and the economic and community values of urban forests.
- Begin a dialogue with homeowners and others in the community about urban forest values and needs.
- Develop stronger partnerships to increase public interest in the urban forest and to leverage possible marketing efforts. Potential organizations to partner with include Aloha + Challenge; Hawai'i Tourism Authority; local foundations; county planning, permitting, and development agencies; DOFAW; Livable Communities Hawai'i; FS; the State Department of Transportation; the U.S. Department of Housing and Urban Development; and the U.S. Environmental Protection Agency.

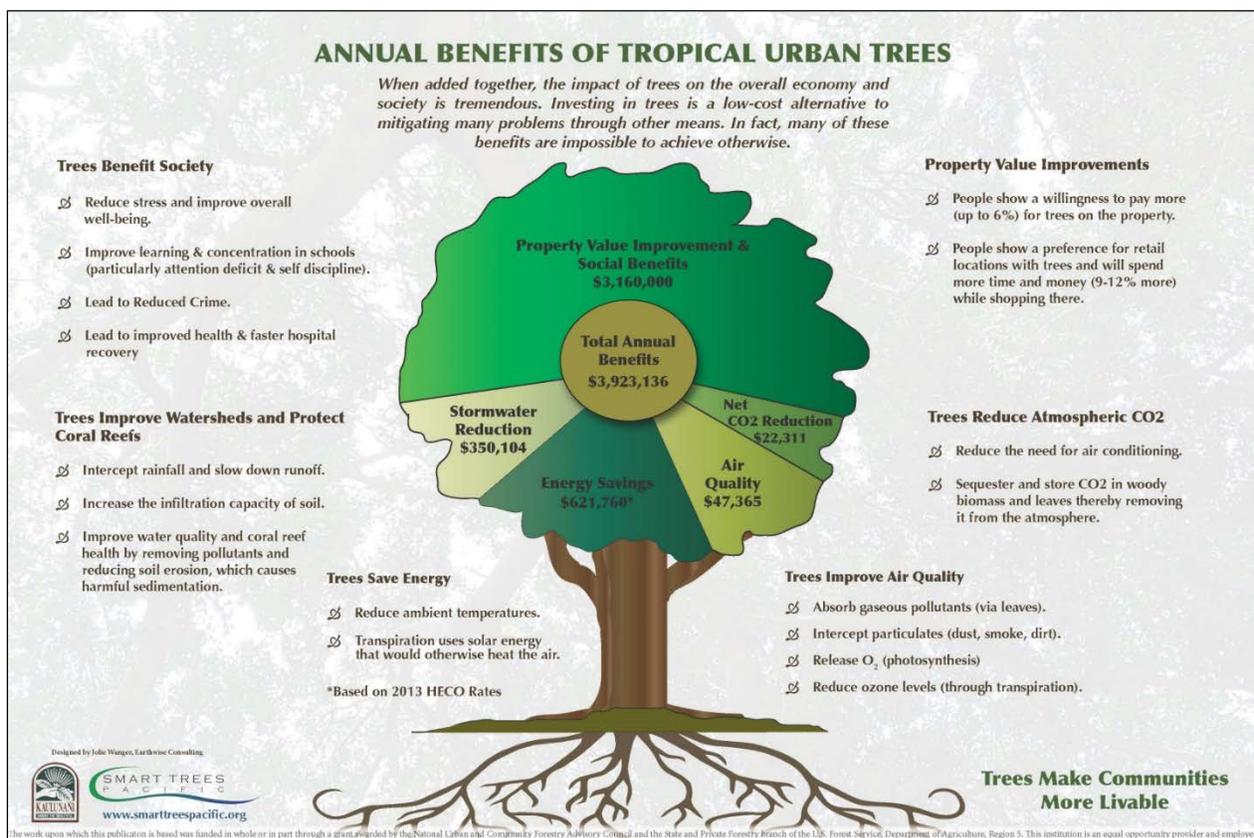


Figure 4.5. The poster, prepared by Kaulunani, illustrates the annual benefits of tropical urban trees.

Emergency Management

Present Conditions and Trends

It should not come as a surprise that we are in a new era of catastrophes.⁷ There is a concentration of more people and assets in hazardous areas while at the same time new

vulnerabilities and new hazards are emerging.³ In fact, 91% of Americans live in places at a moderate-to-high risk of earthquakes, volcanoes, tornadoes, wildfires, hurricanes, flooding, or high-wind damage according to an estimate calculated for TIME Magazine by the Hazards and Vulnerability Research Institute at the University of South Carolina.

To increase the understanding of urban forestry and emergency management, in 2009, STP (organization that delivers the Kaulunani Program) received an FS National Urban and Community Forest Advisory Council grant to develop the [*Urban Forestry Emergency Operations Planning Guide*](#) for storm response. This user-friendly guide provides urban forestry professionals with concrete approaches to use when preparing for natural disasters that affect the urban forest. The guide covers planning, safety, communications, contracts, incident command, inventory, mutual aid agreements, training, vegetative debris, vulnerability, how to conduct a vulnerability assessment, and resources.

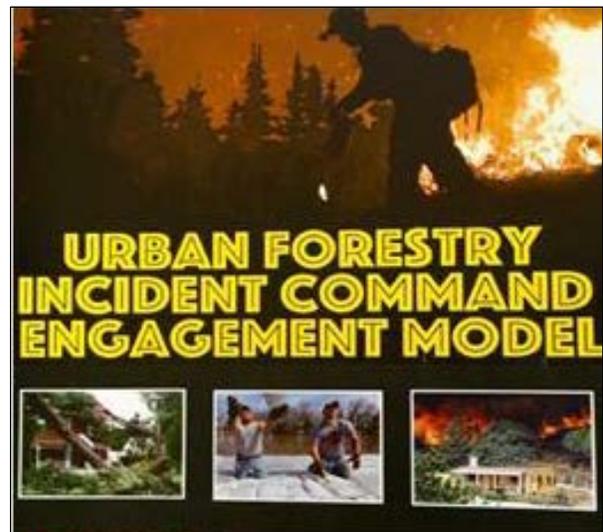


Figure 4.6. Information poster on Smart Tree Pacific’s (Kaulunani’s) project— Urban Forestry Incident Command Engagement Model.

A second federal grant was awarded to STP to develop the *Urban Forestry Incident Command Engagement Model* (UFICEM). Urban foresters need an understanding of the Incident Command System (ICS) and National Incident Management System (NIMS) to be fully integrated in the emergency management systems that provide readiness in advance of events and can greatly reduce response burden and resulting recovery time, effort, and cost.

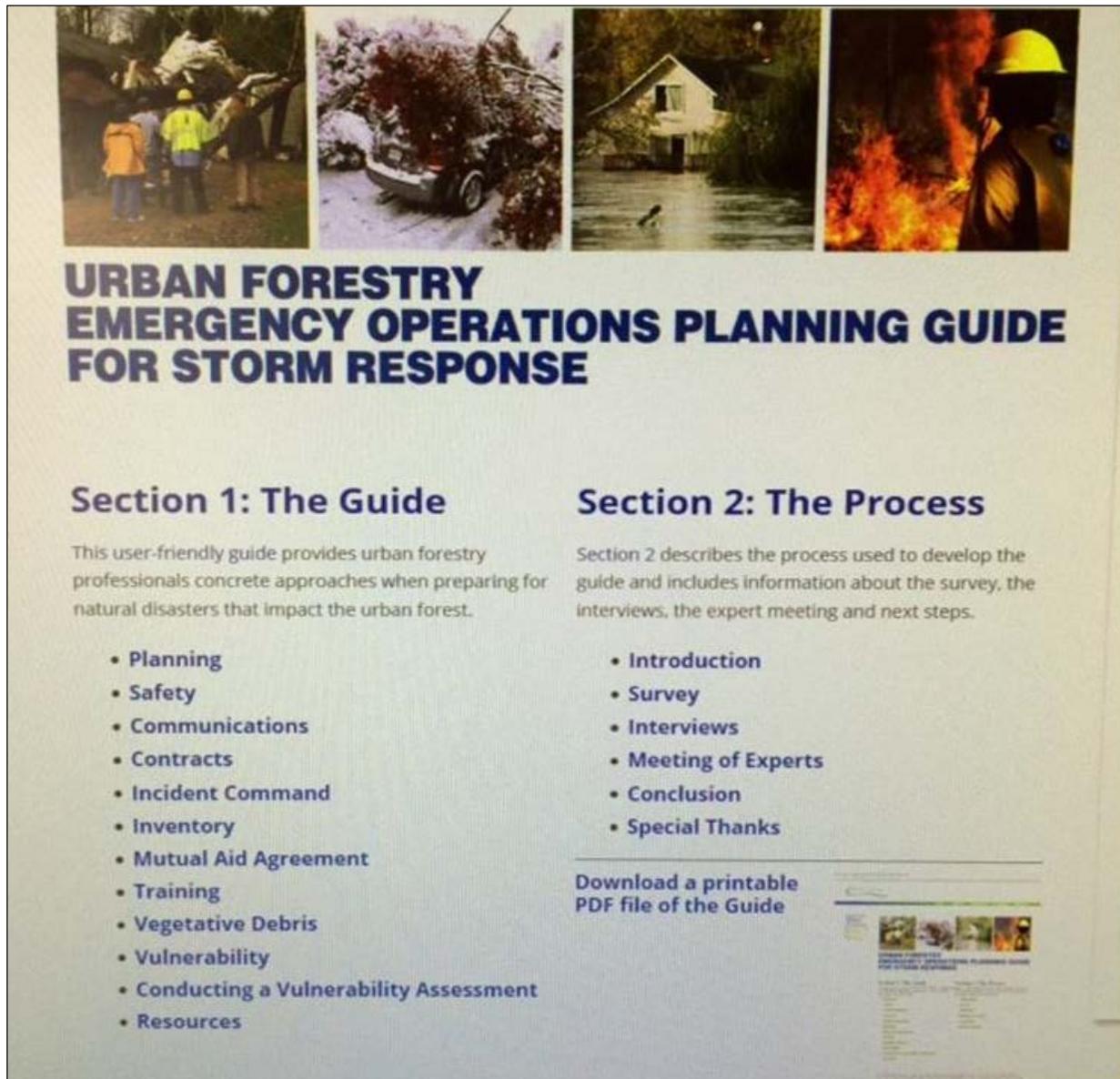
A “Storm Resilient Communities Summit” was hosted by STP in conjunction with partners XLUR8, FS, the California Department of Forestry and Fire Protection Urban and Community Forestry Program, and Davey Trees on August 3, 2015, at the California Endowment Center in Los Angeles, California. The purpose of the summit was to present the model to policy makers, municipal professionals, non-profit tree groups, and other interested parties for feedback on the UFICEM. The purpose was to help urban foresters gain budgetary and other “whole community” support for their tree responsibility program through the incident command engagement model.

Gaps, Issues, and Concerns

Urban foresters need an understanding of ICS and NIMS to be fully integrated in the emergency management systems.

Strategies to Address Gaps

- Integrate the UTC and ICS and storm preparedness. For example, identify the risk of albizia trees to roadways and utilities.
- Seek additional funding to create opportunities for emergency managers, policy makers, non-profits, and urban foresters to discuss how urban foresters can provide expertise to emergency managers.



The poster features four images at the top: workers in safety gear, a car covered in snow, a flooded house, and a firefighter. Below the images is the title 'URBAN FORESTRY EMERGENCY OPERATIONS PLANNING GUIDE FOR STORM RESPONSE'. The poster is divided into two sections: 'Section 1: The Guide' and 'Section 2: The Process'. Section 1 lists topics like Planning, Safety, and Vulnerability. Section 2 lists the development process steps like Introduction, Survey, and Interviews. A link to download a PDF is provided at the bottom right.

URBAN FORESTRY EMERGENCY OPERATIONS PLANNING GUIDE FOR STORM RESPONSE

Section 1: The Guide

This user-friendly guide provides urban forestry professionals concrete approaches when preparing for natural disasters that impact the urban forest.

- Planning
- Safety
- Communications
- Contracts
- Incident Command
- Inventory
- Mutual Aid Agreement
- Training
- Vegetative Debris
- Vulnerability
- Conducting a Vulnerability Assessment
- Resources

Section 2: The Process

Section 2 describes the process used to develop the guide and includes information about the survey, the interviews, the expert meeting and next steps.

- Introduction
- Survey
- Interviews
- Meeting of Experts
- Conclusion
- Special Thanks

Download a printable PDF file of the Guide

Figure 4.7. Information poster prepared by Smart Trees Pacific for its project—[Urban Forestry Emergency Operations Planning Guide](#).

Health and Well-Being

Present Conditions and Trends

Urban forests offer a multitude of benefits. Research indicates that healthy trees can decrease negative impacts of urbanization while improving human health. Trees and plants buffer wind and noise and generally are recognized as positive influences on health and well-being. In fact, public health officials and healing centers, such as hospitals, are now starting to plan for urban nature as an important contribution to disease prevention and health promotion. Simply being able to see trees, parks, and gardens while in the city has been scientifically linked to faster healing in hospitals, reduced mental and physical stress, better student performance in school, and better attention to tasks while at work.⁴

Parks, green spaces, and trees are more than the “lungs of the city” or “pollution scrubbers.” They affect our everyday moods, activities, and emotional health. They improve our quality of life in ways that are sometimes understood and often underestimated. Whether we are active in urban nature (planting trees, growing gardens) or passively encounter city green (such as a stroll through a park), we experience personal benefits that affect how we feel and function. Proof of psychological and social benefits gives us more reasons to grow greener in cities!⁵

Gaps, Issues, and Concerns

Many of the health and well-being issues overlap with proper tree care and education and outreach in the urban forest, such as:

- social justice and limited efforts to plant trees in lower income areas,
- lack of access to fruit trees and other trees for food,
- not planting trees strategically so that they can be used effectively to cool schools and heat islands in urban areas,
- lack of recreational hiking trails in and around urban areas,
- increased runoff of pollutants in waterways and oceans related to lack of natural erosion control measures like raingardens, and
- lack of food security—continued dependence of Hawai‘i to import nearly 80–90% of its food.

Strategy to Address Gaps

- Strategically plant urban trees to help improve the health and well-being in our communities by addressing social inequalities; plant more trees in low-income neighborhoods, increase access to fruit trees, reduce heat islands and cool urban schools, create more tree-lined urban trails, and help slow down stormwater runoff.

Invasive Species

Present Conditions and Trends

The Hawaiian Islands are at risk from the introduction of animals, plants, and diseases. It is estimated that 10,000 species have been introduced to Hawai‘i. The vast majority of them are non-invasive and not harmful; however, some (approximately 200 species) have become environmentally harmful. With more than 250,000 species of plants in the world and several thousand more insect species and with the high volume of goods imported to the islands, Hawai‘i is constantly under threat from the establishment of new invasive species. More than 85% of the invasive plant species found in the natural areas in Hawai‘i were intentionally introduced.⁶ In addition, invasive pests and disease can cause devastating effects not only on natural areas but also on urban trees. For example, the coconut rhinoceros beetle has been damaging and killing coconut and other palm species that are prevalent and an important part of the urban forest (*see “Issue 2: Forest Health,” for more details*).

Weed Risk Assessment Working Group

In 2001, Kaulunani hosted a gathering of urban foresters, botanists, conservationists, and educators to discuss the relationship between invasive species in urban areas and those found in upland wild areas. This collaborative working group recommended an integrated course of action to reduce the negative impacts of invasive species on the native ecosystems. The Hawai‘i-Pacific Weed Risk Assessment (HP-WRA) was developed with the intent of identifying plants that pose a high weed risk in Hawai‘i and on other Pacific Islands. By the time this urban forestry project was completed in 2004, more than 600 plants had been analyzed and given a weed risk score. Presently, the HP-WRA is widely used and recognized as a tool to predict the potential of a plant to become invasive in Hawai‘i and other Pacific Islands. To date, more than 1,600 plants have been screened by the HP-WRA.¹⁴

Plant Pono

Kaulunani funded two projects to create and update the Plant Pono website, www.plantpono.org, which provides general information on plants and suggests alternative non-invasive plants that can be used in place of some commonly used but invasive landscape plant species. The website also promotes the use of the HP-WRA as an objective, science-based predictive tool. It also provides access to invasive plant experts in Hawai‘i so that visitors to the site can make good planting decisions. Legal issues (federal and state) and other challenges hinder efforts to identify or regulate the importation and sale of invasive plants in Hawai‘i. That is why initiatives like Plant Pono that promote the voluntary use of non-invasive plants in the urban and natural areas are important.

Erythrina Gall Wasp and Other Pests

In 2005, the *Erythrina* gall wasp was first detected in Hawai‘i in O‘ahu’s urban realm, which subsequently led to widespread death of *Erythrina* trees. Within 6 months, the wasp had spread to all the major Hawaiian Islands, severely affecting various species of *Erythrina*, including the native *wiliwili* (*E. sandwicensis*), which was a common urban street tree. The University of Hawai‘i, along with collaborative partners from the Department of Agriculture, Department of Land and Natural Resources, Kaulunani, and FS, conducted trials using different cultural and chemical treatments to control the gall wasp.

Currently, we share information about any new threats through our readership of the *Kaulunani News*. Kaulunani stepped in to support the education effort on the coconut rhinoceros beetle by funding educational materials and door hangers. The Kaulunani Council meeting on the Island of Hawai‘i in 2014 was specifically focused on albizia, *Molucca albizia* (see “Issue 2: Forest Health”) with key researchers and site visits to inform the council and see the devastating impact of this tree species on the urban areas.

Gaps, Issues, and Concerns

Early detection of pests at harbors and airports is our first line of defense against invasive species in Hawai‘i. However, early detection and rapid response of invasive species in the urban realm, before they have had a chance to spread to our neighboring native ecosystems, is necessary to prevent their spread and avoid further economic and environmental damage.

Strategies to Address Gaps

- Mitigate impacts of the introduction and spread of invasive species in the urban forest and on native ecosystems by supporting educational outreach through the Kaulunani newsletter, Learning at Lunch, and other avenues.
- Engage the landscaping and urban forestry industry in reducing the importation of non-native potentially invasive plants.

Ordinances and Legislation

Present Conditions and Trends

There are numerous ordinances and laws regarding trees; however, landscape industry partners have indicated a concern about enforcement. Existing ordinances regarding urban forestry are poorly understood and a concerted effort to promote their understanding and identify Existing ordinances are poorly understood as they impact urban forestry and may benefit from a concerted effort to understand and identify gaps and model ordinances that could be adopted.

Gaps, Issues, and Concerns

There is increasing conflict between urban land use and trees (such as trees shading solar panels), leading to removal of large trees or increased tree topping. There are no regulations on tree removal (for example, requiring a replacement plan when trees are removed from public schools and libraries). This is leading to fewer large trees in urban areas.

In addition, there is a lack of regulation and enforcement of existing legislation and a need for new and revised landscape/stormwater management ordinances and legislation. For example, there are no incentives (e.g., tax credits for homeowners and property owners) to plant and maintain trees, install green infrastructure, and remove impervious surfaces.

Strategies to Address Gaps

- Bring knowledgeable people together to identify gaps and strategies that relate to urban forestry issues (e.g., advisory council, task force).
- Compile information about existing ordinances, rules, and laws and make it readily available to the public and the industry.
- Work with urban forestry leaders, Tree City/Campus USA communities, and government partners to establish tree canopy goals for municipalities or other entities.

Urban Tree Care

Present Conditions and Trends

In their paper, *A Model of Urban Forest Sustainability*, Clark et al. state that “Urban trees and forests are considered integral to the sustainability of cities as a whole. Yet sustainable urban forests are not born, they are made. They do not arise at random, but result from a community-wide commitment to their creation and management”¹⁵

An urban tree’s life span is very short, and often trees are planted in small spaces and are poorly irrigated. Monocultures have become the norm, trees are often topped, and there is a lack of knowledge about basic tree pruning or a comprehensive county tree planting program. A diverse pallet of trees that is properly pruned can provide a community with benefits for many years.

Cultural respect for trees is an important social norm in Hawai‘i because trees not only provide food and shelter but also are an integral part of cultural and spiritual traditions. The use of native trees and culturally important trees in urban areas has improved, and there is some state legislation in place that requires the planting of native trees around public buildings whenever possible. There is a lack of integration of traditional knowledge relating to urban trees and a need to develop a culturally appropriate strategy for restoring balance.

Although an inventory of trees exists for areas such as Schofield Army Base, the island of Lāna‘i, and certain Department of Transportation roads, there is no inventory of trees used by counties of Hawai‘i. Lack of inventories can hinder efforts to model, plan, and manage the urban forest. Kaulunani received funds for a pilot inventory project using citizen forestry. The goal is to develop an inventory and mapping tool for the pilot area that is easy to use, transferable or collaborative, and based on a simple list of parameters necessary to manage the urban forest and calculate ecosystem services. The pilot area selected is in the UTC assessment area of interest so that we can maximize our understanding of the urban canopy by integrating the two. The goal is to include diverse stakeholders in the project.

Gaps, Issues, and Concerns

Although best management practices for the proper management and care of trees in the urban realm have been implemented, they are often inconsistently applied in both the public and private sector. There is a need for education and outreach about how to take care of trees over a tree’s lifetime, incentives to implement trees as part of the transportation system, an expanded palette of trees used for landscaping, training in proper tree selection, planting the right tree in the right place, and an increase in number of large-canopy trees.

Strategies to Address Gaps

- Support tree inventory projects.
- Educate and train landscape industry workers, as well as the general public, about planting the right tree in the right place and about proper tree care.
- Support and incentivize the use of native Hawaiian tree species to increase tree species diversity in the urban realm, and provide opportunities for the integration of Hawaiian cultural practices in the urban realm.

Water Quality and Green Infrastructure

Present Conditions and Trends

Urbanization is occurring at a rapid pace. Water quality and quantity are affected by urbanization. Development practices have resulted in an increase in impervious surfaces. Roads, buildings, and parking lots prevent rainwater from soaking into the ground. This increases the volume and speed of water runoff, increases erosion, and washes pollutants through storm drains into streams and eventually into the ocean.¹⁶ De-vegetation, topsoil erosion, and soil compaction have led to more frequent flooding. Strategically planting and maintaining trees in urban areas can positively affect all of these factors.

In 2013, Kaulunani and STP received funding for the *Applied Stormwater Practices at Hāmākua Marsh, Kailua, Hawai‘i* project. This ongoing project will demonstrate how investment in



Figure 4.9. Raingardens being established as part of Kaulunani’s applied stormwater management project.

Gaps, Issues, and Concerns

There is a need to better integrate Hawai‘i’s green infrastructure with its gray infrastructure and hardscapes. Hawai‘i needs to proactively include green infrastructure and trees in the planning phase of project development. Important concerns include providing adequate space for trees, connecting green areas to the flow of water, and designing and maintaining plantings to maximize net benefits over the long term.²

Strategies to Address Gaps

- Determine which trees provide the most water quality/evapotranspiration benefits and which trees are most resilient.
- Use the UTC to identify areas most appropriate for planting trees to improve water quality.
- Work together with a broader network of partners to give trees a predominant role in green infrastructure.

Wildland Urban Interface

Present Conditions and Trends

In general, the Wildland Urban Interface (WUI) is the zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels. DOFAW has identified Communities at Risk (CARs) based on vegetation type, climate regimes, and fire history. The WUI for Hawai‘i is identified as a 1-mile buffer around these CARs irrespective of their high, medium, or low risk to wildfires (*see Map 3.1 in “Issue 3: Wildfire”*). An increase in

residential and commercial development near wildland areas has increased the WUI in Hawai‘i. Also, there is a strong correlation between frequency of ignition and human population¹⁷ (see *Figure 3.2 in Issue 3*), which tends to be higher in developed areas. Because the vegetation in the wildlands of the WUI mostly comprises invasive fire-prone grasses, fires started in the developed areas are carried rapidly and intensely by these fine fuel loads, thereby increasing the risk of wildfires to urban communities.

Gaps, Issues, and Concerns

DOFAW’s priority areas for wildfire include CARs and the WUI. DOFAW engages homeowners in the WUI via the Firewise Communities Program. This program was born out of the National Firewise Communities Program, which is designed to encourage homeowners, community leaders, and others to take actions to protect people, property, and natural resources from the risk of wildfires before a wildfire starts. Although this program has been active in Hawai‘i since 2002, there is only one community in Hawai‘i, Kohala by the Sea, on Hawai‘i Island, that is recognized as a National Firewise Community. As identified in *Issue 3: Wildfire*, additional efforts are needed to alleviate wildfires in the WUI and increase the number of nationally recognized Firewise communities in Hawai‘i.

Strategies to Address Gaps

- Collaborate with organizations such as the Hawai‘i Wildfire Management Organization to increase the number of nationally recognized Firewise communities in Hawai‘i, particularly those CARs that fall within the urban realm.
- Reduce invasive grass fuel loads in the WUI by supporting projects that contribute to replacing these fire-prone grasslands with more fire-resistant tree species.
- Incorporate the message of fire safety into various Kaulunani education and outreach programs.

Strategy Matrix for Issue 4: Urban and Community Forestry

Strategies for Issue 4: Urban and Community Forestry

Urban and Community Forestry: Education and Outreach Efforts								
Long-Term Strategy	Priority Landscape Areas	Secondary Issues Addressed	Program Areas That Contribute	Key Stakeholders	Resources Available & Partners	Measures of Success	Supports National Objectives	Supports Hawai'i Environmental Literacy Plan Goals
<p>Increase the public perception of the value and benefits of urban trees.</p> <p>Develop and coordinate outreach opportunities and a marketing campaign designed to increase the public perception of the benefits of the urban forest.</p> <p>Support conservation education.</p>	See State-Wide Urban Realm Map; Industry.	<p>Forge stronger partnerships to increase public interest in the urban forest; promote Arbor Day, Learning at Lunch, Tree Walks, build urban forest resilience by investing community in a greater appreciation of its value; focus on the industry, school age students, public, and tourists.</p> <p>Learn about climate change issues and mitigation technologies elsewhere in the Pacific.</p>	<p>Hawai'i Tourism Authority, UH, DLNR-DOFAW, AAA, DOE, Hawai'i Islands Land Trust, Trust for Public Lands, ASLA, counties.</p> <p>UCF, CE, FSCG, counties , FSCG, UCF grants, UH, C&C, AAA.</p>	<p>Hawai'i residents, policymakers, Hawai'i Tourism Authority, DOH, DOT, counties.</p> <p>Practitioners, scientists, nonprofits, governments, Hawai'i Tourism Authority.</p>	<p>Nonprofits, Smart Trees Pacific, HFIA, HISC, CGAPS, TOC.</p> <p>Use UCF grant for inventory.</p> <p>Private/stakeholder donations, SOPAC, YCC, DOFAW EE, HFIA, SAF, FSCG, HEEA.</p>	<p>Integrated surveys and other means to gather metrics at education events such as Arbor Day; use of pilot Citizen Forestry project to explore attitudes toward trees, identification and catalog of records of participation at events and their affiliations.</p> <p>Support for the execution, dissemination and/or implementation of the State HELP.</p>	<p>1.2</p> <p>2.2</p> <p>3.1</p> <p>3.2</p> <p>3.4</p> <p>3.6</p> <p>3.7</p>	<p>1.2</p> <p>3.4</p> <p>All goals in HELP</p>
Urban and Community Forestry: Climate Change Impacts to Urban Forests								
Long-Term Strategy	Priority Landscape Areas	Secondary Issues Addressed	Program Areas That Contribute	Key Stakeholders	Resources Available & Partners	Measures of Success	Supports National Objectives	Supports Hawai'i Environmental Literacy Plan Goals
<p>1. Identify how trees can be used to build urban forestry resilience.</p> <p>Investigate how trees and plants are a measure of protection in coastal areas vulnerable to storms.</p> <p>Use the UTC and other technology to identify where sea level rise and inundation is a concern and where to plant trees to mitigate sea level rise.</p>	Hawai'i Urban Realm and global tropical islands.	Gain a better understanding of how trees and plants are best suited to mitigate the effects of climate change in the urban forest, including coastal areas.	State, UCF, competitive grants, donations, foundations, CZM, NOAA, NRCS, HFIA, AAA, FS PSWRs.	UH, State, counties, UCF, Hawai'i Tourism Authority.	Military, UH, FHUF, DOFAW, Sea Grant, Blue Line Project, Surfriders, UH CTAHR, CZM, GreenBlue Bog – Sustain-ability in the Urban Forest, United Nations-Climate Change.	<p>Investigation and education of how trees protect coastal areas.</p> <p>Identification of which species can survive and thrive in coastal areas to reduce impacts and protect the coastline.</p> <p>Use of the UTC to increase the urban tree canopy.</p>	<p>3.1</p> <p>3.2</p> <p>3.4</p> <p>3.6</p> <p>3.7</p>	

Strategies for Issue 4: Urban and Community Forestry

<p>2. Urban Tree Care: Advocate for a more sustainable urban forest by promoting the use of practical tools such as inventory, tree care training, model ordinances and rules, and education and outreach.</p> <p>Compile information about existing ordinances, rules and laws and make it readily available to the public and industry.</p>	<p>See State-Wide Urban Realm Map.</p>	<p>Increase Tree City USA and Tree Campus USA communities.</p>	<p>UCF, AAA, FS, HI, municipalities, LICH, UH, NADF, Western State Foresters, ISA, SAF.</p>	<p>Municipalities, UH, State, arborists, landscapers, community.</p>	<p>NADF, ISA, SMA, UH, Arboretums, Botanical Gardens, Counties, nonprofits, STP, TNC, TOC, APWA good practice documents, UW, Stevens Point Urban Forestry Self-Assessment Tool, UCF grant, donations, foundations, APWA good practice documents</p>	<p>An increase in urban tree care training.</p> <p>An increase in Tree City/Tree Campus USA communities, completion of pilot inventory and measurement of results.</p> <p>Compilation and accessibility of a list of tree ordinances in Hawai'i, made available at the website.</p> <p>Dissemination of information about ordinances, rules and laws.</p>	<p>1.2 3.1 3.2 3.4 3.6</p>	<p>1.2 1.4 2.2.d</p>
<p>3. Water Quality and Green Infrastructure: Work with a broad network to give trees a predominant role in green infrastructure.</p> <p>Investigate which trees provide the greatest resiliency and water quality benefits.</p> <p>Use the UTC Assessment to identify areas most appropriate for planting trees to improve water quality and resilience.</p>	<p>See State-Wide Urban Realm Map.</p>	<p>Water quality, reduced runoff and sedimentation on near shore coral reefs</p>	<p>Counties, planners, government, NGOs, community, landscapers, arborists, designers, developers, CCH.</p>	<p>Counties, State, private landowners.</p>	<p>Parks, nonprofits, friends, HISC, CGAPS, schools, env. ed. orgs.</p>	<p>More trees used in green infrastructure plantings.</p> <p>Improved knowledge of which trees are resilient and provide the highest-water quality benefits.</p> <p>Opportunity index maps for strategic tree planting.</p>	<p>3.1 3.4 3.7</p>	<p>1.2 1.4 2.2.d</p>

Strategies for Issue 4: Urban and Community Forestry

<p>4. Emergency Management: Increase the understanding of urban forestry and emergency management by building urban forestry resilience through storm preparedness and planning.</p>	<p>Hawai'i Urban Realm Map</p>	<p>Integrate urban forestry into emergency management system.</p>	<p>States, FS, foundations, donations, private sector.</p>	<p>Private sector, States, APWA, Public Works, municipalities, nonprofits, arborists, FEMA.</p>	<p>State, federal, private stakeholders, grants, donations</p>	<p>Increased education opportunities for urban foresters and emergency managers to engage. Development of pilot project to test urban forestry ICS engagement model. Number of known urban foresters who have a seat at the emergency management table.</p>	<p>1.2 2.2 3.3 2.4 3.6 3.7</p>	
<p>5. Invasive Species: Mitigate impacts of invasive species from the urban forest on native ecosystems by supporting educational outreach and reducing importation of potentially invasive species.</p>	<p>See State-Wide Urban Realm Map and WUI.</p>	<p>Support Forest Health efforts to mitigate and reduce invasive species in the urban forest.</p>	<p>State, UCF, competitive grants.</p>	<p>Private nurseries, UH, colleges, botanical gardens, ASLA, DLNR, DOFAW, HISC</p>	<p>State, federal, UH, CGAPS; use UCF grant for inventory. Private/stakeholder donations, SOPAC, DOFAW, HFIA, SAF, FSCG.</p>	<p>Support of educational opportunities through Kaulunani newsletter, learning at lunch, and other avenues.</p>	<p>1.2 2.2 3.3 3.6 3.7</p>	<p>1.2 2.2</p>
<p>6. Health and Well-Being: Strategically plant urban trees to help improve health and well-being in communities.</p>	<p>See State-Wide Urban Realm Map.</p>	<p>Decrease negative impacts of urbanization, improve human health, reduce heat islands, cool schools, create more tree-lined urban trails, increase access to fruit trees, and address social inequalities by planting more trees in low-income neighborhoods.</p>	<p>DOH, counties, DOE, UH, DLNR, DOFAW, AAA, nonprofits, FS, community groups, Blue Line Project Hawai'i.</p>	<p>DOH, counties, community, nonprofits.</p>	<p>UTC, Coastal Readiness projects, Blue Line Project.</p>	<p>Increased canopy and number of trees, increase in measurable ecosystem services.</p>	<p>1.2 3.1 3.2 3.4 3.6 3.7</p>	

Strategies for Issue 4: Urban and Community Forestry

Key:

AAA = Aloha Arborists Association

APWA = American Public Works Association

ASLA = American Society of Landscape Architects

CCH = Conservation Council for Hawai'i
CGAPS = Coordinating Group on Alien Pest Species

CTAHR = College of Tropical Agriculture and Human Resources

CZM = Coastal Zone Management

DLNR = Department of Land and Natural Resources

DOE = U.S. Department of Energy
DOFAW = Division of Forestry and Wildlife

DOH = Department of Health

DOT = Department of Transportation

EE = Environmental Education

env. ed. orgs. = environmental education organizations

FEMA = Federal Emergency Management Agency

FHUF = Friends of Hawai'i Urban Forest

FS = U.S. Forest Service

FSCG = Forest Service Competitive Grants

HEEA = Hawai'i Environmental Education Alliance

HELP = Hawai'i Environmental Literacy Plan

HFLA = Hawai'i Forest Industry Association

HI = Hawai'i

HISC = Hawai'i Invasive Species Council

ISA = International Society of Arboriculture

LICH = Landscape Industry Council of Hawai'i

NADF = National Arbor Day Foundation

NGOs = nongovernmental organizations

NOAA = National Oceanic and Atmospheric Administration

NRCS = Natural Resources Conservation Service

PSWRS = Pacific Southwest Research Station

SAF = Society of American Foresters

SMA = Special Management Area

SOPAC = Special Operations Command Pacific

STDP = Special Technology Development Program

STP = Smart Trees Pacific

TNC = The Nature Conservancy

TOC = The Outdoor Circle

UCF = Urban and Community Forestry Program

UH = University of Hawai'i

UTC = Urban Tree Canopy

UW = University of Washington

WUI = wildland/urban interface

YCC = Youth Conservation Corps

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