

STATE OF HAWAI'I DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION

Annual Summary Report: Year 1



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SNIPP ANNUAL SUMMARY REPORT: YEAR 1

Prepared for

**Hawai'i Department of Transportation
Highways Division**

Prepared by

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EXECUTIVE SUMMARY

The purpose of the Hawai'i Department of Transportation (HDOT) Highways Division Statewide Noxious Invasive Pest Program (SNIPP; Federal Aid Project No. STP 1500(73)) is to implement the HDOT Highways Division's *2012-2022 Statewide Noxious Invasive Pest Program (SNIPP) Strategic Plan* while supporting HDOT's mission to provide safe and efficient travel ways. The *10-Year SNIPP Strategic Plan* was adopted by the HDOT Highways Division in 2012 to guide the division in meeting its responsibilities as a good steward of state lands.

Pursuant to federal resources (L24# HWY-SM 2.1873), funds were made available for the execution of the first year of the *10-Year SNIPP Strategic Plan*. SWCA Environmental Consultants (SWCA) was contracted to implement the first 5 years of the goals, objectives, and tasks outlined in the plan.

The SNIPP project embraces five main themes to aid in the control of invasive species as well as the conservation of native flora and fauna in Hawai'i:

- (1) The prevention of the spread and establishment of invasive species along highway rights-of-way (ROWs)
- (2) Early detection and rapid response to identify, report, and respond to newly detected species before they become a detriment to highway ROWs
- (3) Control and management of already established species to reduce their harmful impacts along state highways
- (4) Restoration using non-invasive or appropriate native plants on highway ROWs that reduce risk from harmful invasive plants
- (5) Community outreach and organizational collaboration with other state agencies, non-profit organizations, and neighboring landowners to ensure long-term solutions for the invasive species problem in Hawai'i

The purpose of this report is to provide an update on the HDOT Highways Division's accomplishments related to the SNIPP project from September 15, 2013, to December 31, 2015. SWCA's work for the first year of the SNIPP project accomplished the tasks outlined below as related to the five main goals listed above (prevention, early detection and rapid response, control and management, restoration, and community outreach and collaboration). The Year 1 budget is provided in Table 1.

Table 1: Year 1 Budget

Task	Amount
Prevention	\$119,031
Early Detection and Rapid Response	\$746,984
Control and Management	\$633,987
Restoration	\$191,925
Community Outreach and Organizational Collaboration	\$277,103
Subtotal	\$1,969,030
Allowances	\$91,359
Total	\$2,060,389

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1. INTRODUCTION

1.1. Invasive Species and the Transportation Sector

Invasive species pose the greatest threat to the environment, economy, health, and well-being of the people of Hawai‘i. Invasive species are defined according to the 1999 Presidential Executive Order (EO) 13112 as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.” Introduced or non-native species arrive in Hawai‘i via many pathways, and become “invasive” when they cause harm. Some of these introductions come to Hawai‘i as hitchhikers on commodities such as nursery stock or cut flowers. Others are stowaways in packing materials and transport equipment. Once in Hawai‘i, pest species may spread via wind, water, or animals and people on fur, feathers, clothing, or vehicles (SWCA Environmental Consultants [SWCA] 2011). Transportation corridors provide opportunities for the movement of invasive species through the landscape. Roadways serve as an avenue for movement and spread of invasive plants and animals (Hodkinson and Thompson 1997; Sullivan et al. 2009). Transport of invasive plant seeds by vehicles is particularly common (von der Lippe and Kowarik 2007). One Australian study found that approximately half of tourist vehicles entering a national park carried weed seeds (Lonsdale 1994). Invasive plants can move from site to site during roadside maintenance operations. Invasive plants can also be introduced to a site during roadside construction, either attached to equipment or through the use of landscape materials. Some landscape plantings have resulted in the inadvertent establishment of invasive species. Invasive species mitigation is expensive but necessary because the impacts of alien invasive species are immense, insidious, and often irreversible. The transportation sector should share part of the burden of managing invasive species because that sector is clearly implicated in the spread and establishment of invasive species across the state. Effective management of invasive species along roadsides is a critical part of any landscape-level effort to address invasive species impacts (SWCA 2011).

1.2. The Cost of Invasive Species

A 2002 Legislative Reference Bureau study titled “Filling the Gaps in the Fight Against Invasive Species” estimated that \$50,000,000 was needed annually to protect Hawai‘i from invasive species (Ikuma et al. 2002). Management of invasive species in Hawai‘i was estimated to cost more than \$150 million per year in 2006, and this figure did not account for hundreds of millions of dollars in indirect losses (SWCA 2011). The Hawai‘i Invasive Species Council (HISC) report to the legislature documented that federal and state agencies spent at least \$40.8 million in 2006 on management of invasive species in Hawai‘i, and estimated that another \$110 million was spent on household and agricultural pest control (HISC 2007). Due to lack of funding, many invasive species problems in Hawai‘i have become exacerbated. Economic damages as a result of invasive species can be colossal. Economic losses as a result of little fire ant (LFA; *Wasmannia auropunctata*) in Hawai‘i County alone are estimated at \$194 million annually (Motoki et al. 2013). This species is of particular concern to Hawai‘i Department of Transportation (HDOT) highway maintenance workers because the LFA can deliver powerful bites, representing a health hazard for highway maintenance crews conducting vegetation maintenance along state rights-of-way (ROWs). Furthermore, economic damages associated with Miconia in Hawai‘i are estimated at \$672 million annually (Burnett et al. 2007). The average annual appropriation of funds allocated to invasive species management from fiscal year 2005–14 was \$1,230,000. Interdepartmental spending on invasive species via the HISC totals \$5,750,000 for 2015 (HISC 2014).

Annually, HDOT spends millions of dollars on new landscape installations. A suite of invasive species cause roadside landscapes to deteriorate and increase maintenance costs by an estimated 5%–10%. Roadside vegetation maintenance costs an average of \$4,800/acre/year, and \$240–\$480 of these costs are

attributable to invasive species management (an estimated \$2.1 million to \$4.2 million statewide). Implementation of proactive measures in this strategy could reduce these costs by 60%–80%, or \$25.2 million to \$41.6 million, annually. Expensive ad hoc responses to specific invasive species also incur significant costs. One example is the recent albizia tree incident on Kaua‘i. HDOT spent \$1 million per mile to remove 1,000 albizia trees; removal of one large tree can cost as much as \$10,000. At other locations statewide, along an estimated 50 miles of road, albizia tree populations are maturing and reaching high densities where they will pose significant safety risk to highway users—potentially imposing \$50 million in management costs (SWCA 2011). In August 2014, Hurricane Iselle uprooted many albizia trees in Puna on Hawai‘i Island, effectively crippling the town and costing the state millions of dollars in cleanup costs.

1.3. The Hawai‘i Department of Transportation Highways Division Statewide Noxious Invasive Pest Program

SNIPP was initiated by the HDOT Highways Division and funded via transportation legislation SAFETEA-LU, Section 6006, which makes funds available for the control of legally declared state and federal noxious weeds and establishment of invasive species. EO 13112 addresses invasive species and directs federal agencies to combat the introduction and spread of plants and animals not native to the United States. The U.S. Department of Transportation’s policy is to fully support the administration’s efforts to prevent the introduction and spread of invasive species. As recipients of federal funds, HDOT is required by EO 13112 to prevent and control the introduction and spread of invasive species. HDOT’s *10-Year SNIPP Strategic Plan* (SNIPP Strategic Plan) is modeled after the National Invasive Species Council (NISC) Strategic Plan (2008), and contributes to the goals of the HISC Strategic Plan. The SNIPP Strategic Plan is consistent with invasive species management and priorities that are now widely accepted by experts nationally and internationally (International Union for Conservation of Nature [IUCN] 2000; NISC 2008; Secretariat of the Pacific Regional Environment Programme [SPREP] 2009; Wittenberg and Cock 2001).

At the heart of HDOT’s SNIPP Strategic Plan is a commitment to mitigate the introduction, spread, and impact of invasive species. A long-term commitment by HDOT and the implementation of SNIPP will provide benefits not only to HDOT, but to the people and environment of Hawai‘i, saving the state millions of dollars annually. SNIPP’s multifaceted approach includes prevention, early detection and rapid response, control and management, restoration, and organizational collaboration.

2. PREVENTION

Prevention is the first line of defense in the effort to protect Hawai‘i from invasive species impacts. Preventing the introduction of alien invasive species is the preferred option as the least expensive and most effective solution. Thus, prevention warrants the highest priority because impacts and associated management costs can be completely avoided if an invasive species is not allowed to establish or spread in areas currently free of the species. The prevention strategies that were employed under SNIPP are listed below.

- a. Laminated flash cards detailing best management practices (BMPs) on preventing the entry and spread of invasive species were created and published for highway maintenance staff. The cards provide field personnel with a compact informational resource that promotes stewardship and can be carried in vehicles at all times. Two hundred sets of color flash cards were printed and distributed to HDOT Highways Division maintenance personnel and contractors on Hawai‘i Island, Kaua‘i, Maui, and O‘ahu during invasive species prevention trainings. Five color, 24 ×

36-inch wall posters were produced for each of the four county district offices for a total of 20 posters. One half-day workshop on the Island of O‘ahu was conducted for HDOT’s key construction contractors. The training was on BMPs for preventing the entry and spread of invasive species during construction and maintenance activities. Eighteen contractors from seven different HDOT Highways Division contracting companies attended the trainings.

- b. *The Ecological Zones and Native Planting List* was created as a guide for HDOT landscape architects, engineers, and contractors to facilitate selection of appropriate native Hawaiian plant species for highway ROW projects on Hawai‘i Island, Kaua‘i, Maui, Moloka‘i, Lāna‘i, and O‘ahu. The benefits of using native plants for roadside revegetation include enhanced soil and slope stabilization, conservation of water, aesthetics, carbon sequestration, weed suppression, and enhanced habitat for native wildlife. When selecting plants for roadside revegetation, it is important to consider what plants are adapted to the conditions in that location. Plants have a better chance of surviving if they are locally adapted to the site being revegetated. The *Ecological Zones and Native Planting List* can help save time and money by guiding HDOT designers, engineers, and contractors to choose the right plants for roadside landscape projects. Native plant lists were developed for each county, detailing plant species appropriate for different ecological zones, including ecological zone maps with state roads. One web-optimized electronic and six hard copies were delivered to the state.
- c. Six half-day BMP and invasive species prevention trainings were conducted on Hawai‘i Island, Kaua‘i, Maui, and O‘ahu for 93 HDOT maintenance staff and 11 contractor staff from seven different HDOT Highways Division contracting companies. The goal of the trainings was to further develop the workforce competencies of highway maintenance personnel through increased knowledge regarding vectors of transport and establishment pathways. The knowledge gained can lead to more regular equipment and vehicular inspections, thereby decreasing the likelihood of transporting and spreading invasive species from one area to the next.

3. EARLY DETECTION AND RAPID RESPONSE

When an invasive species has been detected, steps to mitigate adverse impacts include eradication, containment, and control. Early detection involves identifying an invasive species before it becomes widespread. Rapid response involves either eradication or containment. Early detection of newly introduced invasive species, together with the capacity to take rapid action, is crucial to successful and cost-effective eradication or containment. Examples of the early detection and rapid response strategy are provided below.

- a. Sentinel landscapes can be used as a tool to document newly introduced species before they become widespread. Generally, sentinel landscapes are established adjacent to high-risk areas. For HDOT Highways Division, ports, harbors, airports, and military bases are where invasive species introductions are most likely to occur. Each location has predetermined high-risk species. Vegetation meant to attract high-risk species are established within the sentinel landscape site, which is then monitored. The site acts as an early detection mechanism for high-risk species in high-risk areas, and enables rapid response to the invader before it becomes widespread. Establishing landscapes of this nature has the potential to save the state millions of dollars in management-related costs. A number of sites near major ports on O‘ahu controlled by HDOT Highways Division were reviewed for their suitability. A field inspection of each potential site was conducted, with each location being evaluated against various criteria (i.e., proximity to high-risk area, site access, security, size, ownership, irrigation, and plant species present). Based on the evaluation criteria, two sites were selected: the highway interchange near Nimitz Gate at

Pearl Harbor and the highway interchange at Kaneohe Bay near the Kaneohe Marine Corps Base. A basis of landscape design report and project landscape construction specifications were prepared and submitted to HDOT. These included drawings; construction plans; specifications; cost estimates; and construction details to install irrigation, planting, and other material treatments necessary. The final Plans, Specs, and Estimate will be submitted in Year 2.

- b. Roadside surveys were conducted in each district to identify native and invasive species in highway ROWs. State road surveys in each district included identification and mapping of high-risk roads for invasive species leading to and from high-risk sites such as state airports, state harbors, botanical gardens, plant nurseries, and construction areas. Roadside surveys included areas within 50 meters from the edge of road. Surveys covered 219 miles on Hawai'i Island, 109 miles on Kaua'i, 100 miles on Maui, and 129 miles on O'ahu. Four separate electronic reports in PDF format were submitted that detailed survey findings for each district. The purpose of the roadside surveys were to establish baseline information on the locations of high value natives and invasive species within highway ROWs. Regularly surveying roads leading to high-risk areas helps new introductions be detected early—when there is still a chance for eradication. Surveys also provide information on high-value areas and the threats they face, allowing HDOT to prioritize actions and target efforts to specific locations. Information collected will also provide a benchmark to allow for a more thorough analysis on the effects of actions taken under the SNIPP project. It also allows for a better determination as to whether efforts undertaken to combat invasive species are producing positive outcomes.
- c. Early detection efforts targeting two incipient species were conducted: the coconut rhinoceros beetle (CRB; *Oryctes rhinoceros*) and little fire ant (LFA; *Wasmannia auropunctata*). These efforts included surveying of landscape sites and high-risk areas along highway ROWs. The O'ahu Invasive Species Committee (OISC), HISC, and the Hawai'i Department of Agriculture (HDOA) have declared these species top priorities for early detection and rapid response in Hawai'i. The CRB was first detected on O'ahu in December 2013, and has rapidly spread across the island, with a high potential of spreading to other islands as well. The CRB burrows into the crown of coconut trees, eventually killing them. A similar infestation on Guam in 2007 resulted in the damage or death of nearly 70% of the coconut trees on the island. Establishment of the CRB on O'ahu will likely lead to similar ecological and economic impacts. Initial surveys for the CRB were conducted on highway ROWs surrounding the Honolulu International Airport viaduct off Nimitz Highway. This was done in collaboration with the HDOA and the U.S. Department of Agriculture (USDA). SWCA conducted five additional roadside surveys within Highway ROW between July 17, 2014, and October 30, 2014, covering approximately 80 miles along Fort Weaver Road (Route 76), Iroquois Road (Route 764), Roosevelt Avenue (Route 764), Coral Sea Road (Route 8955), Kualakai Parkway (Route 8930), Veterans Memorial Freeway (H-2), Kamehameha Highway (Route 99), and Kalaniana'ole Highway (Route 72). No known CRB was detected during the surveys.

The LFA was introduced to Hawai'i on landscaping material, and is rapidly spreading throughout the island. The insect is known to cause painful bites, and the spread onto ROWs poses a risk to HDOT landscaping and maintenance personnel—and to the public if exposed to them. Surveys for the LFA were performed in collaboration with the OISC, HISC, and the HDOA. Training was provided by the Hawai'i Ant Lab to ensure that survey methods and data collected were consistent with efforts conducted by other agencies. The establishment of these species has the potential to cause a great deal of harm to all facets of life in Hawai'i, and could result in severe ecological and economic impacts to agriculture and tourism industries. The establishment of these species would likely create increased maintenance costs for removal and replacement of damaged trees as well as eradication efforts. It has the potential harm to employees and the public, and has

the potential to create unsafe conditions on ROWs. LFA Surveys were completed between March 10, 2015 and March 23, 2015 on 10 recently landscaped areas along ROWs, areas where future landscaping is planned, and areas adjacent to known infestations. No LFA was detected at any of the sites surveyed.

- d. Four quarterly electronic pest alert newsletters were developed for and distributed to HDOT staff and contractors. The purpose of the quarterly newsletters is to provide highway maintenance personnel with the most up-to-date information on new invasive species introductions, efforts to prevent their introduction and establishment, and BMPs for prevention and control. Newsletters were distributed electronically and printed and posted on HDOT base-yard bulletin boards. Newsletters have allowed widespread dispersal of information and have raised awareness on invasive species issues.
- e. Pest identification color laminated cards to assist with the identification and early detection of problem species were produced for all four districts (Hawai'i Island, Kaua'i, Maui, and O'ahu). In all, 200 sets of color laminated cards were printed. Pest identification cards were incorporated into invasive species prevention trainings and distributed to all district HDOT highway maintenance staff and contractors during the trainings. Pest identification cards and trainings build capacity of highway maintenance personnel in the HDOT highways division to identify and report problematic species before they become widespread. Highway maintenance personnel equipped with the proper knowledge are in a unique position to make a contribution in the battle against invasive species. Their daily routines can place them in a position to detect new introductions and prevent the establishment and spread of nuisance species.

4. CONTROL AND MANAGEMENT

When prevention, eradication, or containment has failed, the most commonly employed (yet least desirable) option of controlling, managing, or mitigating invasive species impacts is simply finding ways to “live with” the invasive species, taking measures to mitigate their least acceptable impacts. In the case of control and management, this is likely a perpetual effort because reinvasion from unmanaged areas is continuous. Control and management actions are driven by the importance given to mitigating impacts, rather than the simple fact that a species is considered to be invasive. Control is therefore limited to areas or situations where the values humans want to protect are threatened.

- a. Six 2-day workshops were conducted using the *Highway Manual for Sustainable Landscape Maintenance* on Hawai'i Island, Kaua'i, Maui, and O'ahu to 122 HDOT Highways Division maintenance and landscaping staff and 18 contractors from seven different HDOT Highways Division contracting companies. The workshops were developed to increase workforce competencies of the HDOT Highways Division's maintenance and landscaping staff and contractors. Workshop topics included roadside safety and personal protective equipment; temporary traffic control; mowing and edging in landscape maintenance zones (LMZs); rubbish and debris management; pruning trees, palms, shrubs, and hedges; replacing plants in the LMZs; use of pesticides in vegetation maintenance; fertilizer application; irrigation systems; invasive species management; contractor qualifications; reporting; and inspecting. This workshop further builds upon existing knowledge and helps contribute to invasive species management by providing tools to combat invasive species while simultaneously promoting safe, efficient travel ways. For instance, using selective herbicides can provide a competitive advantage to preferential vegetation by inhibiting the growth of nuisance species. This can allow preferential vegetation an opportunity to reclaim space previously occupied by invasive species.

- b. The Maintenance and Professional Track Development training program was developed for two topics: 1) tree crown cleaning, raising, and risk awareness; and 2) pesticide awareness. Five 2-day trainings were conducted on Hawai‘i Island, Kaua‘i, Maui, and O‘ahu. In all, 65 HDOT Highways Division maintenance and landscaping staff attended the pesticide awareness training, with 52 attending the tree crown cleaning, raising, and risk awareness training. This training program was developed to increase the workforce competencies of HDOT Highways maintenance personnel and improve invasive species control and management activities along highway ROWs. The training program further builds upon concepts presented in the *Highway Manual for Sustainable Landscape Maintenance* workshops, but in more detail. The trainings provided landscape supervisors with additional knowledge and tools to consider and deploy against invasive species. They also allow an opportunity to engage experts by visiting problematic field site locations. Equipping highway maintenance personnel with the latest information on successful vegetation management practices and knowledge on how to best establish native (or non-invasive) plant communities along highway ROWs can be a long-term solution to prevent the introduction, establishment, and spread of invasive species—with the added benefit of reduced maintenance costs.
- c. A chapter on Integrated Pest Control was developed for the state and will be integrated into the *Highway Manual for Sustainable Landscape Maintenance*. Integrated pest control incorporates various control methods intended to effectively control pests in the most economic and ecological manner. Integrated pest control programs use current, relevant, and comprehensive information on the lifecycles of pests and their interactions with the environment. This information, in combination with other available pest control methods, is used to manage pests with the most economical means, and with the least possible hazard to people, property, and the environment. Two electronic copies of the chapter, one in PDF format and the other in Adobe InDesign, were delivered to the HDOT Highways Division.
- d. Removal of invasive weeds, preferably while the population is still small and easily controlled, saves time and resources, protects motorists, and benefits both agriculture and native ecosystems. The purpose of this deliverable is to provide a mechanism to ensure that HDOT is able to remove invasive species in a timely manner, ensuring that resources are spent most efficiently, with the ultimate goal of networking HDOT with invasive species management organizations throughout the state that can provide input on and assist with the proactive removal of species that could pose a serious maintenance issue to HDOT in the future.

In all, 6.5 to 7.5 acres of priority invasive species were removed from highway ROWs in the following areas:

- a. Hawai‘i Island:
 - i. Miconia (*Miconia calvescens*) on Māmalahoa Highway (Highway 11) in Volcano
 - ii. Molucca raspberry (*Rubus sieboldii*) on Māmalahoa Highway (Highway 11) in Volcano
 - iii. Smoke bush (*Buddleja madagascariensis*) on Māmalahoa Highway (Highway 11) and Queen Ka‘ahumanua Highway (Highway 19)
 - iv. Dahoon holly (*Ilex cassine*) on Māmalahoa Highway (Highway 11)
 - v. Rubber vine (*Cryptostegia grandiflora*) on Māmalahoa Highway (Highway 11)

- vi. Albizia (*Albizia falcataria*) on Māmalahoa Highway (Highway 11), Ka‘ahumanua Highway (Highway 19), Keaau-Pahoa Road (Highway 130), and Saddle Road (Highway 200)
 - vii. Tree tobacco (*Nicotiana glauca*) along Saddle Road (Highway 200) between mile markers 46 and 51
- b. Kaua‘i:
- i. Calliandra (*Calliandra calothyrsus*) on 1.5 acres of Kuhio Highway (Highway 50) near Halfway Bridge
- c. Maui:
- i. Cat's claw (*Caesalpinia decapetala*) on Kekaulike Avenue (Highway 377) and Hana Highway (Highway 360)
 - ii. Common mullein (*Verbascum thapsus*) on Kula Highway (Highway 37)
 - iii. Ivy gourd (*Coccinia grandis*) on Honoapi‘ilani Highway (Highway 30) and Mokulele Highway (Highway 311)
 - iv. Miconia on Hana Highway (Highway 360)
 - v. Milk thistle (*Silybum marianum*) on Haleakala Highway (Highway 37/378)
- d. O‘ahu:
- i. Small populations of fountain grass (*Pennisetum setaceum*) off Pali Highway (Highway 61) and Farrington Highway (Highway 93)
- e. A General National Pollutant Discharge Elimination System (NPDES) permit application for pesticide usage for the Kaua‘i district was drafted and submitted to the Hawai‘i State Department of Health for approval. The NPDES permit was not approved by the Department of Health and permit areas need to be revised. A training outline was developed for HDOT Highways Division district maintenance and landscaping staff on Kaua‘i. HDOT would apply herbicides to control weeds and other invasive species along guardrails where mechanical removal methods are difficult. The NPDES permit allows pesticide application in sensitive aquatic areas, which helps guardrail be visible and promotes safer driving conditions. Kaua‘i District decided to rescind the application and a revised version of the permit will not be submitted.
- f. The 10-Year Statewide Invasive Species Project Prioritization and Control and Eradication Plan (ISPPCEP) for state roads was drafted. The purpose of the ISPPCEP is to identify the highest priority projects on Hawai‘i state roads that will eliminate, minimize, and/or reduce the harmful impacts of invasive species on HDOT roads and adjacent lands. Invasive species projects (particularly control and management projects) can be difficult and expensive, so it is important to select projects that mitigate and reduce the least-acceptable invasive species impacts to high-priority sites, species, or values. The goal is to aid HDOT in making difficult decisions regarding invasive species by providing a mechanism to inform HDOT of up-to-date priority areas and projects based on surveys and input from internal and external stakeholders, and assist in implementing invasive species control and management projects, thereby maximizing impact while minimizing resource expenditure. One electronic copy of the plan will be delivered in PDF format and posted on the HDOT website in Year 2, once roadside surveys for all state roads are

completed. This will result in a planning and guidelines document that will be available to state managers as a digital file. Remaining funds for this deliverable have been moved to Year 2.

5. RESTORATION

Restoration is the process of restoring degraded or damaged ecological systems. State roads currently serve as vectors for the spread of weedy plants. In a major paradigm shift, roads are being envisioned as a place for native plants to grow and flourish. Restoring roadside vegetation with native plant species also has economic, safety, and aesthetic advantages. The establishment of native plant communities is the best long-term defense against the introduction, establishment, and spread of invasive species. Using native species for restoration reduces maintenance costs associated with the control of problematic invasive species. In the absence of restoration, invasive species control can be ineffective because the control activities often cause disturbances that facilitate further invasive species establishment.

- a. The *10-Year Statewide Native Species Project Prioritization Plan* was developed. This plan outlines HDOT's 10-year vision of native species projects along Hawai'i's highways. The purpose is to provide a framework to effectively design and maintain species projects that will minimize the spread of invasive species to high-value conservation areas; reduce maintenance costs by suppressing problematic invasive species; provide site stabilization; increase ecosystem resiliency; and enhance beautification of Hawai'i's ROWs. The plan identifies high-value conservation areas in proximity to state-owned roads and the highest-priority sites for native species projects in the four districts (Maui, Kaua'i, Hawai'i, and O'ahu). It lists native plant species suitable for out-planting in particular areas, and provides broad management prescriptions for the selected sites to enhance project success. The plan, complete with relevant maps and pictures, was delivered to HDOT as a single digital copy in PDF format.
- b. Landscaping and re-vegetation along HDOT highways involves establishing or reestablishing appropriate plants in areas disturbed by construction and maintenance activities. Roadside landscaping projects with native and/or non-native plants can be challenging. Practical and cost-effective approaches that integrate environmental needs with transportation goals are still being developed for Hawai'i. Consequences of poor or failed highway landscape/revegetation projects can be significant, resulting in erosion and slope failures, water contamination, decreased aesthetics, and costly redesign and revegetation efforts. Therefore it is important to monitor landscape projects to document and evaluate progress, failures, and successes to provide feedback and help to make informed decisions on future projects. Six landscaping projects were chosen for monitoring on highway ROWs on the O'ahu–Hale Kou Interchange, Hale'iwa Interchange, Kailua Road, Mokapu Saddle Road, Makapu'u Restoration, and Wahiawa Slope. A monitoring program and protocol was developed based on discussions with the landscape architect and horticulturalist from HDOT O'ahu district. Measurements associated with plant health and attractiveness collected differed slightly by species and site, and included survival, pest damage, plant height, number of leaves, basal diameter, reproduction, crown spread, percent cover, and maintenance damage. Ten native species and five non-native species were monitored in May, August, and September 2014 at all six sites. A monitoring report detailing findings was drafted and delivered to HDOT as a single digital copy in PDF format.
- c. Seeds were collected for four of five mutually agreed upon native plants. Species that were collected were O'ahu sedge (15,000 seeds), nehe (500 seeds), 'a'ali'i (26,429 seeds), and kawelu (200,000 seeds). An appropriate seed storage facility (Hawai'i Island Native Seed Bank) was

identified on Hawai‘i Island to provide long-term storage for the collections. A portion of the collected seeds were used for the HDOT Highways Division Adopt-A-Highway project at Sandy Beach, with the remaining seeds being cleaned, packaged, shipped, and stored at the Hawai‘i Island Native Seed Bank. Collecting and storing seeds of native plants provides HDOT with a seed source for future landscaping projects. Establishing natives along highway ROWs has the potential to save on maintenance costs, provides an array of environmental benefits, and helps to establish a cultural sense of place. A viability test was conducted for kawelu with a 2% viability rate and therefore will not be used for landscaping projects. Due to difficulties with seed collection, SWCA advised HDOT to discontinue this activity for the future.

- d. Ten state design and construction projects were obtained, complete with drawings. Each project was reviewed, and recommendations for the implementation of BMPs to prevent the introduction and spread of invasive species and to encourage establishment and survival of native species were provided. Invasive species have been known to be transported to new locations via construction equipment and supplies, or through landscape materials. Additionally, recently cleared areas or bare soil are more vulnerable to invasive species establishment and often prevent the establishment of native species as their resilience is compromised. Recommendations for landscaping with native species were provided for each project. Implementing BMPs to prevent the unintentional introduction and spread of invasive species on construction and landscaping projects has the potential to decrease maintenance costs, improve highway safety, and increase the survival rate of native species. Recommendations were compiled into a report and delivered to HDOT as a single digital copy in PDF format.

6. COMMUNITY OUTREACH AND ORGANIZATIONAL COLLABORATION

Invasive species problems are often exacerbated by people, but with recognition of the problem, people will become part of the solution. Understanding and awareness based on information and knowledge are essential for establishing invasive species as a priority issue, which can and must be addressed. Better information and education as well as improved public awareness of invasive species issues by all sectors of society are fundamental to preventing or reducing the risk of unintentional or unauthorized introductions, and to establishing evaluation and authorization procedures for proposed intentional introductions. Control and eradication of invasive species is more likely to be successful if supported by informed and cooperating local communities, government agencies, and appropriate sectors and groups. Sharing of information and research findings is vital to education, understanding, and awareness.

- a. A concept paper complete with a list of recommended professionals appropriate to serve on the SNIPP Advisory Committee was developed and submitted to the HDOT Highways Division. HDOT wants to confirm if an Advisory Committee is necessary. The establishment of an advisory committee consisting of appropriate invasive species personnel from external agencies will provide a resource for SNIPP activities to be vetted. This will provide a mechanism by which multiple experts can provide input, increasing the value of the task in question. Furthermore, it will strengthen relationships, encourage collaboration and sharing of resources, and minimize the duplication of effort promoting wise and efficient use of resources.
- b. A concept paper outlining the goals, objectives, and steps to establishing a weed cooperative in each district (Kaua‘i, O‘ahu, Maui, and Hawai‘i) was created and submitted to HDOT for review. Weed cooperative locations and target species for each district were identified. Major landowners for each location in each district were also identified. A contact letter, letter of agreement, and weed cooperative maps were drafted and submitted to HDOT. It was decided

that the remaining funds for Year 1 be moved to Year 2 because HDOT needed time to determine whether they wanted to move forward with the establishment of weed cooperatives. Weed cooperatives allow for the control and management of a problematic species by leveraging resources and efforts. Major landowners within the weed cooperative area agree to control the problematic species within the confines of their land. This promotes eradication through a low level of effort as reinvasion from adjacent lands becomes minimal. Once the seed bank is eliminated, species are considered eradicated. Relationships were established with the Ko‘olau Mountain Watershed Partnership, the Wai‘anae Mountain Watershed Partnership, the East Maui Watershed Partnership, the West Maui Mountain Watershed Partnership, and the Mauna Kea Watershed Alliance. SNIPP representatives attended watershed partnership meetings and held separate meetings to discuss how the SNIPP project could complement watershed partnership efforts. Discussions, concept papers and planning documents on appropriate areas to conduct weed control and possible outreach program partnerships were identified and explored.

- c. A SNIPP program website was developed, launched, and maintained. The website was used to house, share, and track project-related documents. A media article titled “HDOT Fights Hawai‘i’s No. 1 Threat” was drafted and submitted to HDOT for review. Once reviewed, HDOT decided to not move forward with the article. A proposal relating to Hawai‘i Invasive Species Awareness Week was also developed and submitted to HDOT for review. The importance of public outreach and education cannot be overstated. Informing the community of HDOT efforts to combat invasive species will generate goodwill and support. The public will gain a heightened sense of place, and will apply knowledge gained and assist with efforts to combat invasive species. Through education, the community will incorporate BMPs into their daily routines, and assist with detection, reporting, and eradication of invasive species by becoming engaged.
- d. A comprehensive list of Adopt-A-Highway sponsors by location was obtained from HDOT for O‘ahu. Based on this list, locations were prioritized. A concept paper was developed, submitted, and approved by HDOT. An Adopt-A-Highway site sponsored by the Sierra Club was identified and visited near Sandy Beach along the Kalaniana‘ole Highway. Invasive species were removed and native seeds, previously collected, were germinated, grown, and out-planted at the site. In all, 804 plants from eight different native species were out-planted as part of an effort to restore the ecology of the native sand dune. A 3-month irrigation and maintenance period for the site was undertaken from the time of planting to allow newly planted natives a chance to establish themselves. Upon completion of the irrigation and maintenance period, duties were transferred to the Sierra Club. A second site along Farrington Highway fronting the Hawaiian Electric Company (HECO) hydroelectric power plant that is currently not adopted was explored as another location because HECO expressed interest in adopting it. Site visits were conducted, meetings with HECO representatives were undertaken, and a HECO representative to champion the project was identified. Representatives from SWCA began to assist HECO with the Adopt-A-Highway process; however, sponsorship never came to fruition because HECO was undergoing transitions as a company. SWCA representatives researched and provided alternative sites to HDOT for their consideration. At this juncture, HDOT decided to discontinue further expansion of the SNIPP Adopt-A-Highway program. The Adopt-A-Highway program to include native plant enhancement and weeding is beneficial to HDOT in a myriad of ways. Replacing invasive weeds along roadside corridors with native species is the best long-term solution to managing invasive species. Enlisting Adopt-A-Highway sponsors to help maintain newly established natives and weed out unwanted invasive species has the potential to save the HDOT Highways Division on maintenance costs.

- e. An annual summary report and legislative briefing was prepared and submitted to HDOT detailing SNIPP activities undertaken in Year 1. Ten color copies were printed for the state director and legislators.

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