

Technical Assessment: Litter, Solid Waste and Storm Water Management Systems in Honolulu, Hawaii

Final Report

December 2016

Environmental Resources Planning, LLC



ER PLANNING

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Executive Summary

Environmental Resources Planning, LLC (ER Planning) was asked to conduct a comprehensive study of the solid waste and stormwater management systems, particularly as they relate to litter control and diversion opportunities in Honolulu.

The goals of this study were to identify specific, actionable and sustainable strategies for improving and integrating litter control functions with the solid waste and stormwater management systems. From this study, partnerships can be formed with industry, government, NGOs and academia to better address the issue of litter in the environment. This Executive Summary is a synopsis of that study and its findings.

Trash entering stormwater systems and waterways from litter on streets and roadways has become an issue of concern for communities worldwide, particularly as population levels continue to grow. For Honolulu, this issue is exacerbated since Oahu is an island.

Litter results from two distinctive problems: (1) deliberate or intentional littering, and (2) careless or negligent littering (such as items that fall off of uncovered trucks). Litter cleanups by themselves are not sufficient to address these problems. Outside of volunteer efforts, cleanups are by far the most expensive form of litter reduction.

Evaluating Litter in Honolulu

In order to evaluate litter in Honolulu, 396 miles of roadways, beaches and parks throughout Oahu were visually surveyed in April 2015 with a focus on areas within the Census County Division (CCD) of Honolulu. Additionally, an extensive walking survey of beaches and parks was conducted as well.

Our field crews have characterized and quantified litter on more than 21 million square feet of areas adjacent to roadways and recreational areas. This includes noting ambient conditions and analyzing the potential sources of litter at each site. Based on recurring patterns, inferences could be made regarding the sources of litter and inductive litter sourcing guidelines were developed. This methodology was used to identify the likely sources of litter throughout Oahu based on litter observed during this survey.

Two indices were established as components of a trial model to compare the relative impact of different litter sources. Scores were assigned using a scale of 1 to 10, where 1 would indicate a very low impact and 10 would indicate the highest possible impact.

Litter Visibility Index

The Litter Visibility Index analyzes each litter source based on the prevalence of that source and its negative impact on a community's viability as a tourist destination, its desirability for economic development and as a place to live. As shown in Table ES-1, the highest visibility is litter from public trash receptacles without lids.

Table ES-1 – Litter Visibility Index

Litter Source	Score	Percent
Public Trash Receptacles w/o Lids	8.5	14%
Overfilled Trash Receptacles	7.0	11%
Bulk Trash Setouts	6.5	11%
Tent Camps	6.5	11%
Pedestrians	6.0	10%
Inadequate Capacity	6.0	10%
Uncontainerized Trash	5.5	9%
Insufficiently Tarped/Untarped Vehicles	5.0	8%
Illegal Dumping	4.0	7%
Motorists	4.0	7%
Outside Storage	2.0	3%
Total	61.0	100%

Waterways Threat Index

The Waterways Threat Index analyzes litter’s potential impact on stormwater systems and the marine environment. As shown in Table ES-2, litter from tent camps (many of them set up directly in the canal) poses the largest threat to waterways. These findings provide an opportunity to prioritize sources and help identify where the best resources can be most effectively applied to reduce litter posing threats to waterways.

Table ES-2 – Waterways Threat Index

Litter Source	Score	Percent
Tent Camps	8.5	17%
Inadequate Capacity	7.5	15%
Public Trash Receptacles w/o Lids	7.0	14%
Motorists	5.5	11%
Pedestrians	5.0	10%
Insufficiently Tarped/Untarped Vehicles	4.5	9%
Overfilled Trash Receptacles	4.0	8%
Illegal Dumping	3.0	6%
Bulk Trash Setouts	2.0	4%
Uncontainerized Trash	2.0	4%
Outside Storage	1.0	2%
Total	50.0	100%

Conclusions and Observations

The conclusions below reflect observations based on the April 2015 litter survey conducted by ER Planning as well as in-depth conversations with local officials and local scientists.

1. Open-topped trash receptacles without lids were observed to be a source of litter in parks and recreational areas throughout Oahu.
2. Open-topped trash receptacles without lids are a potential source of litter in residential areas. The City has already successfully implemented a program to replace some of these receptacles with carts having integrated lids.
3. Loose bags of garbage were set out across Honolulu (and throughout Oahu), creating litter from torn bags.
4. Loosely stored construction waste was observed on properties close to the canal. As trash attracts trash, it was not a surprise that loose trash and garbage bags were later set on top of this construction waste.
5. Bulk trash setouts are placed at the curb well before scheduled collection days. Partly for that reason, bulk trash pickups seem to lag significantly. Thus, these piles of bulk trash quickly become public dump sites as loose trash is added to them.
6. Some highway litter originates from untarped or insufficiently tarped trash collection trucks. This trash lined certain areas of major roads where these vehicles travel to HPOWER.
7. Windblown trash from litter receptacles was a problem at some small beaches as well as at some overlooks. These areas typically had no picnic areas and experienced high winds.
8. Tent camps create large amounts of litter that fall directly into the canals. Much of this litter will subsequently make its way into the marine environment. This was observed to be a problem along Kapalama Canal.
9. A high number of uncovered storm water channels and canals are the source of trash and litter entering the marine environment.

Based on the conclusions and observations, a number of recommendations such as adding lids to trash cans, litter abatement training, and working in partnerships with local restaurants and businesses come to the forefront.

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Section 1

Introduction

Honolulu is one of the most desirable tourist destinations in the world, filled with stunning beaches, some with crystal clear water. Other parts of Honolulu feature dramatic lookout views from the mountainous areas. Yet, concerns about litter and trash in Honolulu have begun to grow as an undercurrent of litter-related issues is threatening Honolulu's way of life and economic well-being.

Environmental Resources Planning, LLC (ER Planning) was asked to conduct a comprehensive study of the solid waste and stormwater management systems, particularly as they relate to litter control and diversion opportunities in Honolulu.

The goals of this study were to identify specific, actionable and sustainable strategies for improving and integrating litter control functions with the solid waste and stormwater management systems. From this study, partnerships can be formed with industry, government, NGOs and academia to better address the issue of litter in the environment.

The recommendations will help Honolulu meet their Municipal Separate Storm Sewer Systems (MS4) permit requirements by providing efficient ways of reducing the amount of trash entering the MS4. They will also suggest ways to improve the net revenues of the current recycling program.

This report includes detailed documentation of the study conducted along with photographic support (included in the Appendices) representing its findings.

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Section 2

Quantifying the Impacts of Litter on Roadsides and Waterways in Honolulu

Identifying the Sources of Litter in Honolulu – Trial Model

The nature and distribution of litter reflect a range of behavioral issues as well as weaknesses in the solid waste and stormwater management infrastructures. Litter can impact a community in numerous ways, depending on the underlying cultural and historical backdrops, as well as on the local demographic, economic and environmental conditions. Effective litter abatement can only be achieved by understanding the sources of litter and correlating litter observed to these sources.

Development of the Litter Sourcing Methodology

Field crews under our supervision have surveyed more than 21 million square feet of areas adjacent to roadways as well as beaches and other recreational areas across North America. These surveys comprised the detailed characterization and quantification of all littered items observed. In addition, 396 miles of roadways, beaches and parks throughout Oahu were also visually surveyed in April 2015 with a focus on areas within the Census County Division (CCD) of Honolulu.

Based on this cumulative field experience observing litter as well as noting ambient conditions and the potential sources of litter at each site, recurring patterns began to emerge. This allowed inferences to be made regarding the most likely sources of litter within each site.

Over time, this observation-correlation approach has allowed field crews to use context clues when determining the likely sources of litter. This includes using a source proximity analysis that takes into account ambient conditions. It also allows field crews to examine the impact of factors and indicators known to affect littering. The geographical diversity and time intervals between these surveys have helped to validate the applicability of this approach.

To ensure that these patterns were analyzed in a scientific context, research methods in anthropology and archaeology used to examine diverse cultures and their remnants were explored. These methods, along with investigative principles used in crime scene forensics, where relevant, were applied to the development of this litter sourcing methodology¹.

¹ This sourcing methodology does not evaluate marine debris originating from sources such as Asia, South America or the U.S. mainland as those sources are beyond the authority of Honolulu to address.

Once that was completed, a set of inductive litter sourcing guidelines was developed and refined. This methodology was used in the trial model identifying the likely sources of litter throughout Oahu.

Litter can originate from a variety of sources, which may impact communities in different ways. In order to examine such impacts, this study identifies and defines the sources of litter observed in Honolulu as follows:

- 1. Bulk trash setouts** – large items such as furniture and appliances designated for bulk trash collection, but left on the sidewalk for a week or longer.
- 2. Tent camps** – temporary outdoor shelters where excessive amounts of litter were observed.
- 3. Illegal dumping** – intentionally disposed trash where multiple bags and/or bulk trash were observed not in the context of an expected collection (e.g., in canals, along rural roadways, under bridges, etc.).
- 4. Insufficiently tarped vehicles** – when refuse vehicles, dump trucks, open-top tractor trailers or other vehicles transporting solid waste drive along highways untarped or with their tarps torn, open or not properly in place. This category also includes uncovered pickup trucks.
- 5. Outside storage** – where residents store items outside and loose items of trash were observed.
- 6. Overfilled trash receptacles** – where residential or commercial trash receptacles and/or dumpsters were overfilled or uncovered so much that spillage could easily occur.
- 7. Pedestrian litter** – items such as beverage cups or fast food receptacles littered intentionally by pedestrians.
- 8. Motorist litter** – items such as beverage cups or fast food receptacles littered intentionally by motorists or cyclists.
- 9. Public trash receptacles without lids** - where public trash receptacles in parks and beaches had no cover to prevent windblown litter. This category also includes litter created by persons carelessly browsing through unlidded trash receptacles for HI-5 beverage containers.
- 10. Uncontainerized trash** – bags of trash that were loosely set out, but not in a trash receptacle. This includes uncontainerized construction/demolition debris as well as trash or recyclables spilled before or during the collection process.
- 11. Inadequate capacity** – when the available number of residential trash receptacles in parks and beaches is not sufficient to handle the amount of trash generated.

This study proceeds to analyze the impact of these sources through the establishment of two indices. These indices were established as components of a trial model to compare the relative impact of different litter sources.

1. Litter’s visibility as an indicator for a community’s state of well-being.
2. Litter’s physical impact upon stormwater systems and waterways.

Rating estimates were used to gauge the relative impacts of litter sources in this study. A volumetric survey of litter by source, based on this approach, would yield more precise results.

In order to conduct this analysis, a field team of two experienced litter professionals conducted a detailed visual survey of litter throughout the island of Oahu in April 2015. The purpose was to determine the likely sources of litter observed along highways and city streets, on beaches and in recreational areas. In addition, the proximity and pathways to waterways were noted.

Based on litter observed during that visual survey, taken in conjunction with more than a decade of experience in the field, the principal investigator established a Litter Visibility Index and a Waterways Threat Index. Scores were assigned utilizing a scale of 1 to 10, where 1 would indicate a very low impact and 10 would indicate the highest possible impact.

Litter Visibility Index

Each source of litter noted above was assigned a score on a Litter Visibility Index to reflect both the prevalence of that source and its negative impact on a community’s viability as a tourist destination, as well as on its desirability for economic development and as a place to live. In short, this group of factors may be referred to as the litter’s visibility. The results are shown in Table 1.

Table 1– Litter Visibility Index

Litter Source	Score	Percent
Public Trash Receptacles w/o Lids	8.5	14%
Overfilled Trash Receptacles	7.0	11%
Bulk Trash Setouts	6.5	11%
Tent Camps	6.5	11%
Pedestrians	6.0	10%
Inadequate Capacity	6.0	10%
Uncontainerized Trash	5.5	9%
Insufficiently Tarped Vehicles	5.0	8%
Illegal Dumping	4.0	7%
Motorists	4.0	7%
Outside Storage	2.0	3%
Total	61.0	100%

As indicated, the Litter Visibility Index considers litter observed by source and calculates its impact. As shown in Table 1, the highest visibility is litter from public trash receptacles

without lids in recreational areas. This source's high score was due to the pervasive use of such trash receptacles throughout Honolulu. Tent camps also scored high due to the high visibility of litter generated from these camps, particularly along Kapalama Canal. The score for tent camps would likely be higher if these camps continue to grow and become more pervasive without sufficient waste management in place.

Another highly visible source of litter is caused by overfilled trash receptacles as shown in Figure 1. Large amounts of trash and litter that are so clearly visible are likely to have a negative effect on local tourism revenues and economic development efforts, as well as on community well-being.

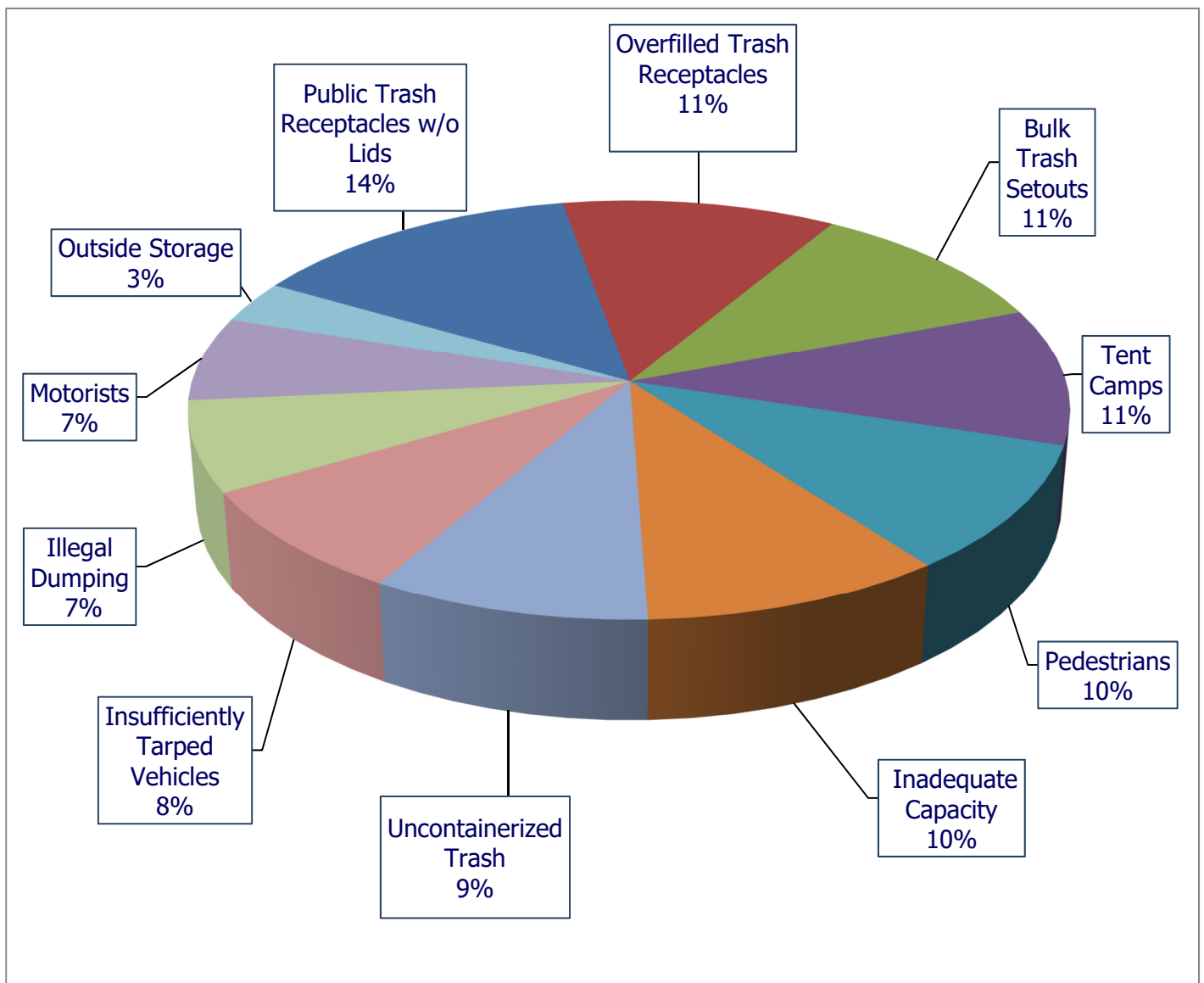


Figure 1 – Litter Visibility Index

Waterways Threat Index

The second impact evaluated was the Waterways Threat Index, which analyzes litter's potential impact on stormwater systems and the marine environment. This index takes into account the likelihood that litter from the identified sources will eventually make its way into the stormwater system and/or waterways. Thus, the index considers the proximity of these litter sources to these water-related systems.

Lighter items that are windblown, such as food and beverage service items, can enter waterways more easily than heavier items. Thus, while bulk trash setouts that remain at the street for an extended period of time are more visibly offensive, they are less likely to make their way into storm drains and waterways. Such items, when found in canals, are usually the result of illegal dumping rather than bulk trash setouts, which thus have a lower score as a direct threat to waterways. Litter observed within the properties of Honolulu's harbor tenants also present a direct threat to waterways.

As shown in Table 2, tent camps (many of them set up directly on the canal) pose the largest threat to waterways. The second largest threat to waterways is inadequate capacity, since the loose trash was observed in parks directly adjacent to waterways.

Table 2 – Waterways Threat Index

Litter Source	Score	Percent
Tent Camps	8.5	17%
Inadequate Capacity	7.5	15%
Public Trash Receptacles w/o Lids	7.0	14%
Motorists	5.5	11%
Pedestrians	5.0	10%
Insufficiently Tarped/Untarped Vehicles	4.5	9%
Overfilled Trash Receptacles	4.0	8%
Illegal Dumping	3.0	6%
Bulk Trash Setouts	2.0	4%
Uncontainerized Trash	2.0	4%
Outside Storage	1.0	2%
Total	50.0	100%

Figure 2 presents a graphical representation of the threat posed to waterways by the various litter sources identified for this study. Note the significant impact of inadequate capacity and tent camps.

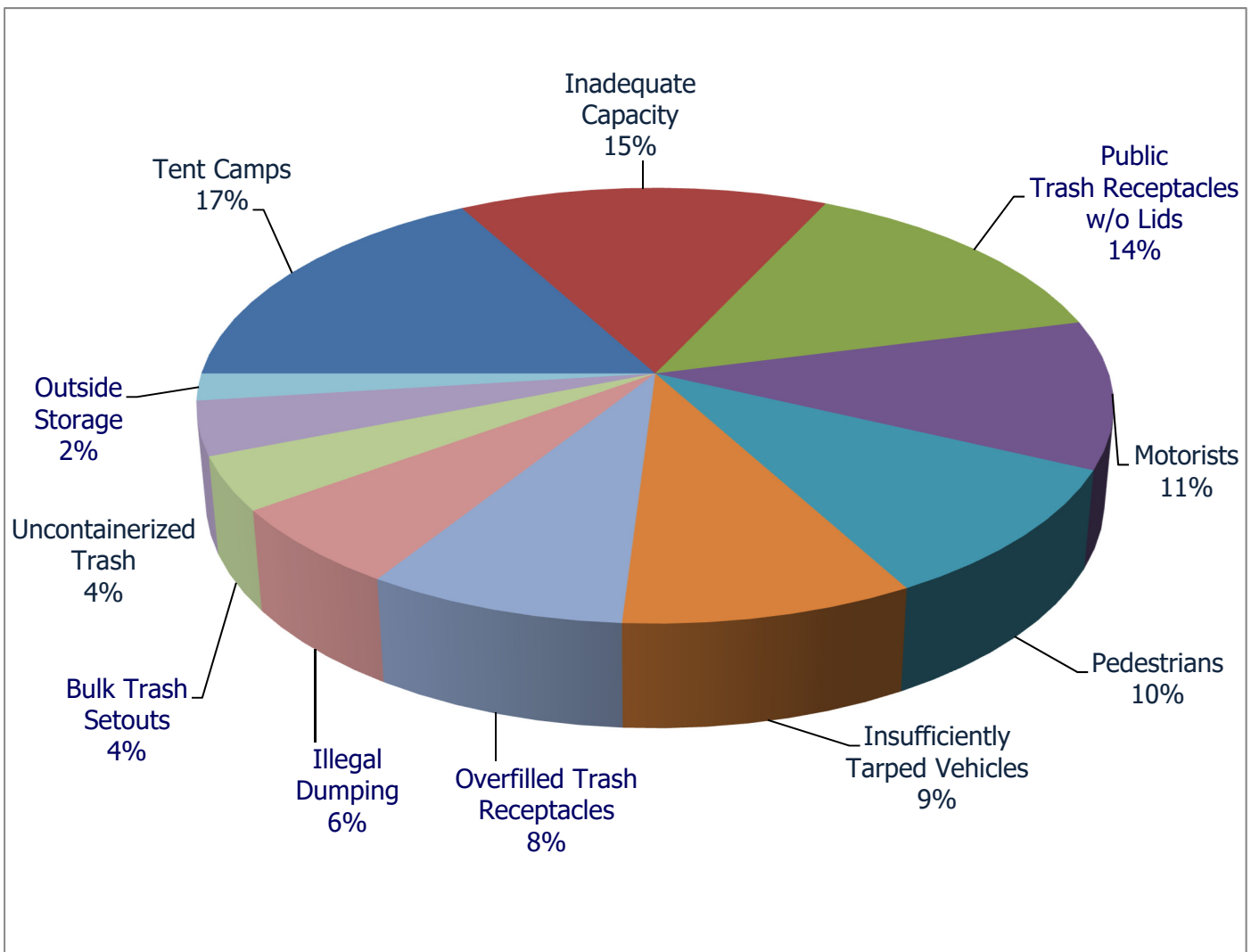


Figure 2 – Waterways Threat Index

Summary of Index Data

Each of these litter-related indices provides insights into the threats posed to the City’s environment and economic prosperity. Implementing actionable litter prevention strategies will help protect the vitality and well-being of Honolulu and its tourism industry, which will, in turn, help ensure that the local government has the funding needed to maintain the environmental resources unique to Honolulu.

Actionable recommendations to address these threats are provided separately with a focus on those that can be most easily implemented. These strategies will be effective tools for both litter abatement and strengthening Honolulu’s resilience as a community. Some of the recommendations would include: ensuring that all trash cans are lidded, requiring all loose trash to be containerized, and providing litter abatement and enforcement training.

Section 3

Current Litter Management Program

The City notes that it currently addresses litter in four elements:¹ The first three are discussed in Section 4. The fourth element, Maintenance of Structural Controls, is addressed in Section 6 (Stormwater Management).

1. Street Sweeping. Street sweeping is scheduled for all major streets in industrial, commercial and residential areas on a regular basis. Residential areas are generally swept during the day, while commercial and industrial areas are normally swept during the night. Halawa (Honolulu), Kaneohe, Kailua and Pearl City Districts are mechanically swept, while Wahiawa, Waianae, Waialua and Laie Districts are manually swept.

The City reports the following data for their street sweeping program:

Table 3 – Street Sweeping - Miles Swept

District	Mechanical	Manual
Halawa (Honolulu)	19,210	16
Pearl City	799	0
Wahiawa	0	11
Waianae	0	3
Waialua	27	73
Laie	0	0
Kaneohe	173	0
Kailua	2,780	24
Total	22,989	127

In addition to the miles of roads swept shown in Table 3, manual street sweeping also includes 67,950 square feet in Laie and 110,346 square feet in Wahiawa that the City does not include in its miles swept data.²

However, Honolulu’s 2013 MS4 Compliance Audit noted that street sweeping activities had significantly decreased and listed this as a potential permit violation. In its 2013 Annual Report, the City agreed to work on addressing this issue.³

Enhanced street cleaning can help function as a litter removal strategy regardless of other litter reduction measures currently in place. “Frequent street cleaning can dramatically reduce the quantity of street litter reaching the drainage system – even where there is a generally adequate refuse removal service”.⁴

A New York City study of street cleaning practices found that augmenting baseline street cleaning (mechanical sweeps twice per week) with manual sweeping of each blockface

six days a week reduced floatable litter 42 percent by count, 51 percent by volume and 64 percent by weight.⁵

The County of Los Angeles identified Street Sweeping (including parking lots) as a moderate cost/high benefit BMP that was easy to implement.⁶

It is important for supervisors to ensure that street litter is never flushed or swept into stormwater drains as this would contribute to litter found in marine environments.

2. Roadside Litter Pickup. The City reports that roadside litter removal is performed as needed, using available City resources. As a public service, this task is performed on unimproved roadways, where abutting property owners are not responsible for roadside maintenance.

Table 4 shows the number of roads scheduled for litter pickups as of FY13:

Table 4 – Number of Roads Scheduled for Litter Pickups

District	No. of Roads
Halawa (Honolulu)	7
Pearl City	18
Wahiawa	4
Waianae	22
Waialua	9
Laie	7
Kaneohe	6
Kailua	16
Total	89

Incentivizing and promoting high-profile programs such as the Adopt-A-Highway program can help ingrain the value of clean roadways into all parts of the community. Litter cleanups of all types help to reduce intentional littering,⁷ while allowing litter levels to build up sends a message that keeping roadways clean is not a high priority for the community.

While the City is not responsible for and does not schedule litter cleanups on State roadways, litter along these roadways could easily make its way onto City roadways. Thus, it is in the City's interest to coordinate cleanup strategies and schedules with the State when possible.

3. Litter Container Servicing. The City notes that more than 1,000 litter receptacles located throughout Oahu are emptied at least once per week.⁸ Their 2013 Annual Report noted 77,125 bags of litter were collected from these litter receptacles from FY10-FY13.

Section 4

Litter Receptacles

The use of well-designed litter receptacles as a means of reducing litter in U.S. cities has been studied for more than 100 years. These studies continue to yield consistent findings regarding the need and efficacy of these receptacles as an essential tool in litter abatement programs.

A meeting of the American Public Health Association (APHA) in 1913 pointed out the need for municipalities to provide a sufficient number of conveniently located litter receptacles along with the enforcement of anti-littering ordinances.⁹ These same conclusions were reiterated by former APHA secretary, Homer Calver in 1959.¹⁰

The Management and Behavioral Science Center at the University of Pennsylvania in tested the effectiveness of litter receptacles placed in strategic locations in multiple cities and found that, well-designed litter receptacles reduced litter by 14.7-16.7 percent in urban settings and by 28.6 percent along highways.¹¹

Dr. Scott Geller and other researchers have replicated similar results in subsequent studies.^{12 13} As importantly, follow-up studies have shown that twice as much litter is properly disposed of in well-designed litter receptacles compared to typical litter receptacles.¹⁴

Strategically positioning litter receptacles also reduces littering rates. The City of Long Beach, CA placed approximately 2,450 litter receptacles in business areas, at bus stops, in parks, in marinas, and along beachfronts to control incidental litter.¹⁵ In one year, more than 290 tons of trash were collected from 450 of these receptacles located on residential and commercial streets.¹⁶

For litter receptacles to effectively reduce litter they must be maintained in a timely manner. Overflowing receptacles that are not maintained in a timely manner create litter. Public-private partnerships can help alleviate the costs of properly maintaining and emptying litter receptacles before they become overfilled.

SD-32 (Outdoor Trash Storage) of the City and County of Honolulu Storm Water Best Practice Manual recommends that municipalities and counties "Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers."¹⁷ Open-topped trash receptacles without lids are a major source of litter in parks, recreational areas and nonresidential areas.

These all highlight the importance of placing well-designed receptacles in strategic locations in order to reduce litter. Selecting and testing effective litter receptacles for Honolulu is discussed in Section 9 – Optimal Litter Receptacles in Parks.

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Section 5

Honolulu Stormwater Management

Maintenance of Structural Controls

The City notes that its storm drain lines, manholes and inlets/catch basins are scheduled for inspection and maintenance on a priority basis. Certain lines are designated as self-cleaning, so that trash can be easily collected downstream. Each of the inlets and catch basins is scheduled for inspection, maintenance and/or cleaning on an as-needed basis, but at least once during the term of the MS4 Permit currently in place. Additionally, certain structural controls are built and scheduled for regular maintenance by the appropriate City, State or private entity.

The City's debris basins are scheduled for annual inspection and maintenance on a priority basis. Although designed as flood control basins, they are also designed to retain trash. In addition, the City notes that it has installed debris booms in drainage canals such as Ulehawa Channel, Ewa Channel and the canal adjacent to Ala Wai Driving Range.

In 2013, the City reported the following existing City-owned structures in their stormwater system as shown in Table 5:

Table 5 – City-Owned Stormwater System Structures

Structure Type	FY13
Manholes	13,987
Catch Basins	27,392
Grated Inlets	3,119
Inlets/Outlets	5,179
Total Structures	49,677
Pipes/Culverts (feet)	61,438
Outfalls	2,623
Detention Basins	752

Note that Outfalls are included in the Inlets/Outlets total. Detention Basins include flow-through based water quality controls.

NPDES Permit Requirements

The City and County of Honolulu's Stormwater Management NPDES permit (HI S000002), as issued in 2012 and as renewed in 2015, requires specific measures to address stormwater trash. The Plan includes the following elements:

1. Public Education and Outreach

The City is required to implement public education and outreach programs to help the general public understand their role in reducing polluted runoff.

2. Illicit Discharge Detection and Elimination

The City notes that it is working to implement this program that detects and eliminates illegal connections and illicit discharges to the storm drainage systems by conducting field screening, investigations, enforcement, Spill Prevention Control and Countermeasure Plans (SPCCs).

3. Construction Site Runoff Control

The City notes that it is working to continue implementing a construction site management program to help reduce the discharge of pollutants from all construction sites. This will be accomplished by updating their drainage standards, updating the Best Management Practices Manual and conducting soil and erosion control inspections.

4. Post-construction Stormwater Management in New Development and Redevelopment

The City notes that it is working to continue implementing a program to address stormwater runoff from new development and redevelopment projects that result in a land disturbance of one or more acres.

5. Pollution Prevention/Good Housekeeping

The City notes that it is developing and implementing a plan to reduce pollutants from all City-owned facilities, roads, parking lots, municipal waste facilities, and the City's MS4. BMP Program plans are setup for debris, chemical applications, erosion control and municipal facilities.

6. Industrial and Commercial Activities Discharge Management Program

The City notes that it is developing and implementing an industrial and commercial discharge management plan to reduce the discharge of pollutants from all industrial and commercial facilities and activities that discharge into the City's MS4.

As of 2011, the Department of Facility Management (DFM) scheduled the maintenance of more than 1,000 litter receptacles in Honolulu at least once weekly and notes that the volume of trash collected is recorded.¹⁸ However, this information was not available at the time this report was written and it is not certain to what extent this data is tracked.

NPDES Short-Term Plan

The goal of the Short-Term Plan, as set forth in the City's 2012 NPDES permit HI S000002, was to reduce the Baseline litter load by 50 percent in three steps:

1. Trash Hotspot Assessment

A Trash Hotspot Assessment (THA) report had been scheduled for completion by June 30, 2019. This assessment was to be conducted in three phases, targeting waterbodies of most concern in Phase I. Additional waterbodies were scheduled for Phase II and Phase III. Streams and other waterbodies specifically assessed for trash were listed in the State's 2014 annual report to US-EPA.¹⁹

2. Trash Hotspot Reductions

Trash load reductions in identified hotspot areas were to be quantitatively determined through implementation of the following trash removal steps:

1. Physical steps will be measured and weighed (e.g. adopt-a-stream, street sweeping, etc.).
2. Non-physical steps will be assigned trash load credits (e.g. advertising, etc.).

The City projected that the short-term 50% baseline load reduction requirement would be achieved through this strategy without the need for new control measures. The deadline for meeting the 50% Baseline Load reduction was set for the end of FY 2023.

3. Baseline Load Study

A four-year Baseline Load Study had been scheduled to begin in June 2012 to quantitatively determine the City's trash Baseline Load as of this date. Monitoring sites (30) would be based on four criteria: land use, drainage area, access and trash loads.

NPDES Long-Term Plan

Following completion of the Short-Term Plan, a Long-Term Plan to achieve a 100 percent reduction in the Baseline Load by 2034 was scheduled to be put in place through the enactment of the following two steps:

1. Develop an Implementation Plan: identify specific activities and control measures to comply with the 100% Baseline Load reduction.
2. Implement a Monitoring Plan: describe the monitoring and tracking necessary to demonstrate reduction effectiveness of the control measures.

The 2015 Final NPDES Permit for the Department of Environmental Services reiterated the requirements for the Short-Term Plan, the Long-Term Plan and the Trash Hotspot Assessment.²⁰ The current status of these strategic measures is uncertain at this time.

Evaluation of Stormwater Program Elements

The City reported the following results for certain elements required by their NPDES permit. These updates from the revised permit are listed below.²¹

1. Honolulu's Implementation & Monitoring Plan for North Fork Kaukonahua Stream WLA had committed to street sweeping in the Upper Kaukonahua area.

Initial street sweeping, conducted on July 2-3, 2012 to determine baseline conditions, estimated that one cubic yard of trash was collected from the lower area and that no trash was collected from the upper area. It is uncertain whether further street sweeping was conducted.

2. During inspection and maintenance of the Grandview Pump Station, the City reported that approximately four 55-gallon bags of debris are collected monthly. None of the debris collected was deemed trash.
3. Drainage structures of the Upper Kaukonahua Watershed, excluding drain lines, were inspected and cleaned between July 25, 2012 and August 1, 2012. While the upper area yielded no trash during this period, the lower area yielded two cubic yards of material, of which 20 percent was deemed trash.

The information in this section was based on available documents. Some element modifications may not have been available at the time this report was written.

Notes

¹ Trash Reduction Plan. City and County of Honolulu National Pollutant Discharge Elimination System (NPDES) Permit No. HI S000002 - Final. June 2012. City and County of Honolulu Dept. of Environmental Services. Kapolei, HI.

² MS4 Program Compliance Audit. City and County of Honolulu, Oahu, Hawaii. Conducted by US-EPA, Region 9, Water Division. San Francisco, CA. September 2013.

³ Ibid.

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Section 6

Factors Underlying Littering in Honolulu

Litter – Community Well-Being Indicator

Litter functions as both an indicator of community well-being and as a potential gateway to community decline. Litter is the most visible form of community and environmental decay, but perhaps the most easily neglected.

Trash entering stormwater systems and waterways from litter on streets and roadways has become a growing issue of concern for communities worldwide, particularly as population levels continue to grow. For Honolulu, this issue is exacerbated since Oahu is an island.

Litter always tells a story that can only be properly understood once it is studied in context. It is a snapshot revealing evidence of effects with correlating causes - and thus sources - that can be determined. Some litter results from sources such as untarped pickup trucks and insufficiently secured trash collection vehicles. Other litter is the result of carelessness, apathy or reactance.

The presence of litter is a bellwether for quality of life in a community. As noted in George Kelling's landmark theory about "Broken Windows" as a measure of a community's self-image, signs of blight such as litter are early invitations to further community decay²². Nowhere is littering more visually offensive, and the problem greater, than in coastal communities.

Many of those who litter consider their bad habit to be harmless, but litter has a number of negative impacts on quality of life. It impacts Honolulu's environment by threatening the island's natural beauty and diminishing water quality.

As importantly, it impacts the local economy, as litter can affect tourism desirability and thus local business and government revenues. Lower revenues will mean fewer City resources available to address litter abatement. When cleanup costs are added to this, the financial impacts of litter are even greater.

The types of items littered in waterways represent a variety of manufactured products and waste, but they all share something in common. Somewhere in the process, these materials were handled carelessly or maliciously, contributing to marine debris.

Litter results from two distinctive problems: (1) deliberate or intentional littering, and (2) careless or negligent littering (such as items that fall off of uncovered trucks). Litter cleanups by themselves are not sufficient to address these problems. Outside of volunteer efforts, cleanups are by far the most expensive form of waste management.

Effective litter prevention programs will have clear, positive impacts on the City's economy, environment and quality of life. The litter assessment conducted as part of this study will provide a baseline from which to measure progress toward these goals.

Honolulu – Local Dynamics

Honolulu, the main gateway to Hawaii, is a consolidated city-county entity, coterminous with the island of Oahu. It is simultaneously a city (a municipal corporation) and a county (an administrative division of the State of Hawaii). Thus, it has the powers and responsibilities of both. The consolidated City and County has a population of 953,207, while the Census County Division (CCD) known as the City of Honolulu has a population of 390,738.²³

Oahu, shown in Figure 3, is the third largest of the Hawaiian Islands with a land area of 597 square miles. At its largest dimensions, Oahu is 44 miles long and 30 miles across with 227 miles of shoreline. Honolulu, the state capital of Hawaii, is located on the southeast coast of the island.



Source: USGS

Figure 3 – Map of Oahu

The southern part of Oahu includes the urban and downtown portions of Honolulu, while other parts of the island are comprised of suburban and rural communities as well as a variety of industrial facilities and retail stores.

Oahu was first settled by Polynesians about 1500 years ago. The early 20th century saw a large wave of Asian immigrants, especially Japanese, who now account for a high proportion of the population. An American presence in Oahu began with business interests in the early 19th century, followed by military interests starting in the late 19th century. The U.S. military continues to have a significant presence in Honolulu and is a notable component of the local economy.

All of these demographics act as cultural overlays that factor into local environmental attitudes and mindsets.

Economics of Living in Honolulu

Some of the City's litter has its roots in the economics of living in Honolulu. While the Median Household Income in Honolulu is 24 percent higher than the U.S. average, it has the third highest cost of living of the 27 top Metropolitan Statistical Areas (MSAs) tracked by the Bureau of Labor Statistics.

The price of an average house in Honolulu reached an all-time high in 2014.²⁴ Since wages have not kept pace, housing has become harder to afford, particularly for residents with lower incomes. This dynamic inevitably leads to decreased non-housing consumption and, thus, to lower tax revenues for the City.²⁵

The CCD Honolulu has the eighth lowest income inequality index of all U.S. cities using what is known as the Gini Coefficient. CNNMoney notes that while Honolulu looks like one of the best cities in this regard, the high cost of living there "can make life even more difficult for the poor".²⁶ The article notes that the average income for the bottom 20 percent is \$17,800.

This impact is clearly reflected in the portion of income required for housing. The National Low Income Housing Coalition ranks Honolulu as the second most expensive metropolitan area in the entire U.S. with regard to the portion of housing wage required for rent and utilities of a two-bedroom unit.²⁷ Renters in Honolulu - on average - pay 72 percent of their income on housing and utilities.²⁸

The impact of such a low income in Honolulu is unique within the U.S. Furthermore, Hawaii is remote enough that residents cannot easily travel to other areas where job opportunities may be available. For the same reason, when residents lose their jobs, without a support system, it would be easy for these families to fall off the grid and difficult to get back on the grid.

Unsheltered homelessness in the U.S. has decreased over the past seven years, but has increased in Honolulu for the fifth consecutive year.²⁹ Chronic homelessness in the U.S. decreased by 2.5 percent from 2013 to 2014, but increased in Hawaii by 7.6 percent.³⁰

The number of unsheltered homeless on Oahu has grown by double digits for each of the past three years. This number increased by 19 percent between 2014 and 2015. In addition, 39 percent of unsheltered chronically homeless individuals are living in downtown Honolulu.³¹

Honolulu consistently ranks in the top 25 U.S. cities for most favorable climate and has the least seasonal temperature change of any U.S. city.³² This and the more affordable cost of tent living may suggest why some residents have set up tent camps along canals and other areas.³³

However, trash discarded into the canal from these tent camps poses significant litter and marine debris challenges that will also affect the vitality of Honolulu's tourism industry. The trash generated by these tent camps, especially those on Kapalama Canal, falls directly into the Canal, which leads to the Harbor.

Litter's Role in Honolulu's Tourism Industry

Tourists worldwide seek out coastal areas as a refuge from the increasingly fast pace of life, and Honolulu has some of the world's most stunning and accessible beaches. Yet, the very sanctuary tourists seek is threatened, not simply by litterers, but by inadvertent acts of littering from sources such as insufficiently secured trash collection vehicles and trash receptacles without tops.

While litter represents blight along roadways and in all types of aquatic environments, it is most visible to tourists and residents when found on beaches.

This is germane because tourism is Honolulu's largest industry and hosts more than 5.1 million visitors in 2013 that spent more than 35 million tourist days there. This constitutes almost half (47 percent) of all visits to Hawaii³⁴. In addition, Oahu had slightly more than half of all visitor expenditures in Hawaii (51 percent).

Most visits to Oahu (91 percent) are considered pleasure-related trips. Almost two-thirds of visitor days in Hawaii are represented by tourists from the U.S. mainland.³⁵ There are more arrivals from California (38 percent) than any other U.S. state.³⁶

This suggests that Honolulu has unique attributes for it to draw so many visitors from California, a state that, itself, has more coastline mileage than all of the Hawaiian Islands.³⁷

Honolulu faces two types of threats to its sustainable tourism: (1) financial, and (2) environmental.

Tourism is particularly vulnerable to weak financial cycles, which affect tourist travel more quickly and deeply than other industries. When these weak cycles occur, tourism expenditures tend to drop. This results in lower revenues for local businesses and fewer financial resources for Honolulu to cope with issues affecting the community's economic vitality.

Environmental issues affect tourism in subtler ways. A small amount of litter may not influence tourism destination choices. However, at a certain point, increased litter does negatively influence these decisions in ways that have already been clearly quantified.³⁸
³⁹ In times of financial downturns, these impacts will become even more evident.

It then becomes important to recognize the underlying drivers of local litter. One of the direct drivers of litter threatening Honolulu's waterways is ad hoc tent communities, a familiar concept playing out uniquely in Honolulu.

Notes

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Section 7

Importance of Enforcing Litter Laws

Consistent enforcement of litter laws is an important tool that will help residents, businesses and tourists understand that the well-being of the community is a high priority for Honolulu.

Issuing citations with fines and publishing the names of those issued citations will address this type of misconduct directly. It will also deter other violators and, along with court-ordered litter cleanups, will help remedy the harm caused by littering.⁴⁰

Lack of support for meaningful enforcement of litter ordinances will very likely result in administering these laws lightly (and thus ineffectively) or not administering them at all. Failing to issue littering citations or failure of the courts to uphold these citations becomes highly facilitative since there is a lack of deterrence against littering. In such cases, violators would have no motivation to change their behavior.⁴¹ Enforcement of litter ordinances facilitates behavior change.

Institution of the recently created environmental courts in Hawaii can act as a supportive arm to both code enforcement and law enforcement officials if it is understood that reducing fines will blunt any general deterrent effect of litter-related ordinances.⁴²

For every citation that is issued for littering, numerous littering incidents occur unobserved. This is why it is important to issue citations for littering that is observed. This sends a clear message that enforcement officers take litter violations seriously and that the community considers littering unacceptable behavior.

Issuing littering citations to motorist violators provides law enforcement officers with the opportunity to inspect a violator's license and registration in addition to checking for potential criminal violations.

Stopping litter violators can also provide enforcement officers with the opportunity to educate drivers and their passengers about the importance of related issues such as properly securing loads in open-bed trucks.

When monitoring litter (or illegal dumping) hot spots, maximum residual deterrence is reached when officers spend 15 minutes at these hot spots on a random and intermittent (and thus, unpredictable) basis "so that potential offenders recognize a greater cost of offending in these areas because police enforcement could increase at any moment".⁴³

District six issued 12 criminal litter citations in 2014.⁴⁴ Since the problem of littering in Honolulu appears to be growing, an increase in the number of citations issued will likely lead to a decrease in litter.

Current Litter Statutes

Littering in Honolulu can be addressed, in part, by the following statutes placed into law.

State of Hawaii

HI Revised Statute §291C-131: Requires vehicles driven on highways to properly secure their loads. Violators are subject to possible suspension of vehicle registration and/or a driver's license and fines of \$250-\$500 (first violation), \$500-\$750 (second violation) or \$750-\$1,000 (subsequent violation).

HI Revised Statute §291C-132: Drivers of vehicles from which littering onto any highway occurs may be fined \$100-\$500 in addition to litter cleanup or community service of four hours (first violation) or eight hours (subsequent violation).

HI Revised Statute §339-4: Drivers of vehicles from which littering in public and private areas occurs may be fined \$100-\$500 in addition to litter clean up or community service of four hours (first violation) or eight hours (subsequent violation).

HI Revised Statute §708-829: Criminal (knowingly) littering is punishable by four hours of litter cleanup or community service (first offense) and eight hours of litter cleanup or community service (second offense) and a fine of \$500-\$1,000.

These penalties and community service requirements can function as deterrents to littering, if they are applied as written.

City and County of Honolulu

Chapter 9, Article 2.4: Leaving spillage caused during refuse collection is punishable by a fine of \$1,000.

Chapter 13, Article 3: Littering on any public conveyance can result in a fine of up to \$100.

Chapter 15, Article 13: Highway vendors who fail to keep their area litter-free are subject to a fine of up to \$1,000 and up to 30 days in jail as a petty misdemeanor criminal offense (Haw. Rev. Stat. §§ 706-640, 706-663). Subsequent violations can also result in business license suspension.

Chapter 15, Article 18.10: Prohibits littering on bicycle paths. Under Sec. 15-26.9, violators are subject to fines of \$15-\$100 (first violation), \$15-\$200 (second violation), \$15-\$500 (subsequent violation).

Chapter 29, Article 4: Prohibits littering in public areas and allows any individual designated by Parks and Recreation to fill the role of enforcement officer. Violators are assessed the cost or removal and any associated administrative costs and may pay a

criminal fine not to exceed \$500 per offense and/or a civil fine not to exceed \$500 per day while the violation persists.

Chapter 29, Article 4 also provides important tools that the City can use to deter littering.⁴⁵

It includes a broad definition that allows any individual designated by Parks and Recreation to fill the role of enforcement officer. Parks are continually monitored by department staff. This provides a significant opportunity to address littering when it is observed and will act as an effective deterrent to littering.

The City should request and monitor litter-related enforcement activities. This will help ensure that the level of enforcement is significant enough to act as a deterrent to littering. It will also help them to determine its effectiveness.

Hawaii Dept. of Health - Litter-Related Regulations

Hawaii Dept. of Health (HI-DOH) also lists a number of regulations (Chapter 11-58.1) that require solid waste management facilities to design methods for controlling litter. In addition to any penalties specified, violations can put a facility's permit at risk. HI-DOH regulations also reference provisions of RCRA and the Clean Water Act and the applicable requirements of those laws, including NPDES, to permittees operating in Hawaii, so that permit violations may also be subject to action from agencies such as US-EPA and US-DOJ.

§11-58.1-04 (i)(1)(B)(ii): Solid Waste Management Facilities shall employ suitable means to prevent solid wastes from scattering and for control of litter. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-15(b)(1) and (2): MSW landfills must cover disposed waste at the end of each operating day to control blowing litter. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-20(d)(4): Solid waste incinerators and RDF processing facilities must design methods to control litter and maintain a neat and orderly appearance. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-31(b)(2)(C): Transfer stations must design methods to control litter and maintain a neat and orderly appearance. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-32(b)(2)(C): Recycling and material recovery facilities must design methods to control litter and maintain a neat and orderly appearance. Under HRS §342H-9, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense. Under HRS §342G-71, as a civil, administrative or criminal action, violators are also subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-33(b)(2)(C): Solid waste salvage facilities must design methods to control litter and maintain a neat and orderly appearance. Under HRS §342H-9, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense. Under HRS §342G-71, as a civil, administrative or criminal action, violators are also subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-41(b)(2)(C): Composting facilities must design methods to control litter and maintain a neat and orderly appearance. Under HRS §342H-9, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense. Under HRS §342G-71, as a civil, administrative or criminal action, violators are also subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-42(b)(2)(D): Remediation facilities must design methods to control litter and maintain a neat and orderly appearance. Under HRS §342H-9, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense. Under HRS §342G-71, as a civil, administrative or criminal action, violators are also subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-51(b)(2)(C): Special waste landfills must design methods to control litter. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-52(b)(3)(A): Medical waste treatment and disposal facilities must include an engineering report in their permit that addresses methods to control litter. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-53(a): Foreign solid waste generated by carriers which left foreign ports and their first port of entry to the U.S. is Hawaii must comply with procedures for treatment and disposal of foreign solid waste per USDA Title 7, Chapter III, Part 330.400 (Sub-part on Garbage regulations). Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

§11-58.1-54(b)(3): Used oil transport and recycle facilities design must consider methods to control litter. Under HRS §342J-9, as a civil, administrative or criminal action, violators are also subject to a fine of not more than \$25,000 for each separate offense². Each day of violation constitutes a separate offense.

§11-58.1-55(b)(3): Innovative technologies in the treatment and disposal of solid wastes must design methods to control litter. Under HRS §342H-9, as a civil action, violators are subject to a fine of not more than \$10,000 for each separate offense. Each day of violation constitutes a separate offense.

Under HRS §342J-9, as a civil or criminal action, violators are subject to a fine of not more than \$25,000 for transportation, treatment, storage, disposal, abandonment of hazardous waste or used oil without a permit or false statements or representations regarding the same³. Each day of violation constitutes a separate offense.

² "Any person who knowingly:

(1) Transports any hazardous waste to a storage, treatment, or disposal facility that does not have a permit pursuant to section 342J-5 to treat, store, or dispose of that particular hazardous waste;

(2) Treats, stores, or disposes of hazardous waste without first having a permit pursuant to section 342J-5, or who violates any term or condition of a permit or variance issued pursuant to this chapter;

(3) Transports, treats, stores, disposes of, recycles, causes to be transported, or otherwise handles any used oil or used oil fuel in violation of any rules adopted pursuant to this chapter relating to used oil or used oil fuel;

(4) Makes a false statement or representation in any application, label, manifest, record, report, permit, or other document filed, maintained, or used, for purposes of compliance with this chapter, including compliance with any rules adopted pursuant to this chapter relating to used oil or used oil fuel; or

(5) Abandons or causes to be abandoned any hazardous waste, used oil, or used oil fuel; shall be subject to criminal penalties. Violations of paragraphs (3) and (4) are misdemeanor offenses. In addition to any other sentence, a person who violates paragraph (3) or (4) may be ordered to pay a fine not to exceed \$25,000 for each day of each violation.

Violations of paragraphs (1), (2), and (5) are class C felonies. In addition to any other sentence, a person who violates paragraph (1), (2), or (5) may be ordered to pay a fine not to exceed \$25,000 for each day of each violation. For purposes of this subsection, "abandon" means the act of deserting or leaving behind a hazardous waste, used oil, or used oil fuel."

³ Ibid.

Notes

⁴⁰ Fiscal Year 2014 EPA Enforcement and Compliance Annual Results. Prepared by the Office of Enforcement and Compliance Assurance. U.S. Environmental Protection Agency. December 18, 2014.

⁴¹ The "Deterrence Trap" In The Federal Fining of Organizations: A Research Note. Gary S. Green, Madhava Bodapati. Criminal Justice Policy Review. Vol 10, No. 4/99, pp. 547-599.

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⁴³ Police and the Microgeography of Crime – Scientific Evaluations on the Effectiveness of Hot Spots and Places – David Weisburd and Cody W. Telep. Inter-American Development Bank. Institutions for Development Sector. Institutional Capacity of the State Division. Technical Note No. IDB-TN-630. February 2014.

⁴⁴ Honolulu Police Department. Annual Report. 2014.

⁴⁵ City and County of Honolulu. Office of Council Services. Revised Ordinances of Honolulu 1990. Chapter 29. Retrieved from: https://www.honolulu.gov/rep/site/ocs/roh/ROH_Chapter_29__.pdf

Section 8

Conclusions and Observations

The conclusions reflect observations based on the April 2015 litter survey conducted by ER Planning as well as in-depth conversations with local officials and local scientists.

1. Open-topped trash receptacles without lids were observed to be a source of litter in parks and recreational areas throughout Oahu.
2. Open-topped trash receptacles without lids are a potential source of litter in residential areas. The City has already successfully implemented a program to replace some of these receptacles with carts having integrated lids.
3. Loose bags of garbage were set out across Honolulu (and throughout Oahu), creating litter from torn bags.
4. Loosely stored construction waste was observed on properties close to the canal. As trash attracts trash, it was not a surprise that loose trash and garbage bags were later set on top of this construction waste.
5. Bulk trash setouts are placed at the curb well before scheduled collection days. Partly for that reason, bulk trash pickups seem to lag significantly. Thus, these piles of bulk trash quickly become public dump sites as loose trash is added to them.
6. Some highway litter originates from untarped or insufficiently tarped trash collection trucks. This trash lined certain areas of major roads where these vehicles travel to HPOWER.
7. Windblown trash from litter receptacles was a problem at some small beaches as well as at some overlooks. These areas typically had no picnic areas and experienced high winds.
8. Tent camps create large amounts of litter that fall directly into the canals. Much of this litter will subsequently make its way into the marine environment. This was observed to be a problem along Kapalama Canal.
9. Uncovered storm water channels and canals in Honolulu allow trash and litter to enter the marine environment.

Based on the conclusions and observations, a number of recommendations such as adding lids to trash cans, litter abatement training, and working in partnerships with local restaurants and businesses come to the forefront.

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Section 9

Optimal Trash Receptacles in Parks

Pilot Project

The source of litter that was assigned the highest score on the Litter Visibility Index was Public trash receptacles without lids. These are trash receptacles, located in parks and on beaches, without any type of cover to prevent windblown litter. The field team that conducted a walking survey of beaches and parks throughout the Honolulu area observed a considerable number of these trash receptacles overflowing, which not only causes litter to collect in the vicinity of the cans, but also allows litter to become windblown.

Since many parks in Honolulu are adjacent to waterways as are all its beaches, much of the windblown litter could easily enter waterways and become marine debris. Thus, it is not surprising that such trash receptacles without lids were also assigned a high score on the Waterways Threat Index.

The pervasive use of trash receptacles without lids throughout Honolulu was the reason that this litter source scored high on both Indices. Fortunately, the problems created by this litter source are also the ones most easily remedied: these trash receptacles could be fitted with lids that allow litter to be put in easily, but do not allow litter to blow out. Another option would be to replace these trash receptacles with receptacles that have built-in lids.

Based on this data, a pilot study is proposed that would:

1. Identify the optimal type of trash receptacle for use in two recreational areas adjacent to beaches in Honolulu.
2. Replace all existing unlidded trash receptacles in the pilot sites with covered receptacles.
3. Conduct quarterly litter surveys in the pilot sites to determine the amount of litter reduction.

Pilot sites selected for testing and monitoring will be a park adjacent to a beach. The entity responsible for park maintenance should be a stakeholder that is willing and able to be a partner in this project.

The type of litter receptacle selected for testing as part of this pilot project to optimize litter reduction will have the following features:

Design: trash symbol, attached lid that is easily opened
Color: Millstone, Sandstone or Black
Materials: Durapol or concrete body with a zinc coated steel liner
Capacity: 95 gallon

Up to 100 of these receptacles will be placed in the pilot site. For each area, all unlidded receptacles will be replaced by lidded receptacles. Outside baskets for deposit of HI-5 receptacles will be attached to each litter receptacle. A flexible storage rack could optionally be provided that would allow for the collection of flattened recyclable boxes.

Testing the Effectiveness

The effectiveness of lidded trash receptacles will be evaluated utilizing a statistically-based methodology specifically adapted for this project.

Monitoring and Evaluation

Immediately before new litter receptacles are installed, a baseline survey of litter in the selected sites will be conducted with follow-up surveys scheduled quarterly. The proposed methodology was designed specifically for measuring litter in recreational areas, especially around litter receptacles, and to credibly determine the rate of change in observed litter between follow-up surveys. Keep Honolulu Beautiful volunteers will be trained on use of this methodology, so that they can conduct this survey quarterly with oversight from one of ER Planning's staff.

Criteria

A litter surveying methodology is needed that can accurately measure the effectiveness of both lidded trash receptacles and improved recyclables containers. The criteria for designing this methodology were:

- 1. Statistically-Based:** It must have a statistical basis for these surveys to stand scrutiny and provide meaningful data.
- 2. Multiple Parameters:** It should have two different means of measurement that, in combination, will provide an accurate depiction of changes in the rate of litter over time.
- 3. Accepted:** Elements of the methodology should already be in use by groups in other communities.
- 4. Simple:** The methodology should be easy for volunteers to understand and use accurately.
- 5. Easy to Replicate:** This methodology should be usable by groups in other communities.

Approach

A count of litter by item type is the most statistically robust and reproducible method of measuring litter. In addition to a count, litter as a visible offense can also be measured by its volume.

Volume can be determined most accurately by measuring natural density. Natural density is an application of bank density, a concept used in the construction and landfill industries, but is a more descriptive and intuitive term. For example, soil, when loosened, weighs about 2,800 lbs./cubic yard, while compacted soil weighs about 4,100 lbs./cubic yard. However, soil in its natural state weighs about 3,400 lbs./cubic yard.

The goal of a volumetric survey is to reflect the density of litter in its natural state rather than compacted or left completely loose. Thus, using natural density will yield the true volume of litter more precisely than loose or compacted measurements.

Measuring natural density can be applied through practices already used - by placing littered items in a trash bag and measuring the degree of fullness ($\frac{1}{4}$ full, $\frac{1}{2}$ full, $\frac{3}{4}$ full, completely full). Note how intuitive and simple this process is compared to other methods, such as using buckets rather than bags. This type of method is widely used by numerous groups, including FoLAR's litter surveys, supported by ACC. Taking the additional step to measure four levels of fullness will provide more precise data. In addition, the count will provide a check-and-balance to the measure of volume.

Methodology

A litter audit of the entire recreational site will be conducted. This litter survey will involve four steps, each one observed and certified by a site supervisor:

1. Photograph Receptacles: Prior to collecting litter at the site, photographs will be taken capturing an area extending four feet in any direction from each trash receptacle. This will provide a visual benchmark of litter around trash receptacles for comparison to quarterly follow-up surveys.

2. Litter Collection: Two volunteers, using safety gloves and wearing safety vests, will conduct this portion of the survey. One person will only collect trash littering an area extending four feet in any direction from each trash receptacle. A second person will collect all other trash littering the remaining area of the recreational site. Each person will deposit these items inside separately labeled plastic garbage bags. Materials suspected to be medical or hazardous waste will be photographed separately and documented, but not collected. If such materials are observed, the proper authorities will be notified.

3. Fullness of Bagged Litter: All bags of littered items collected will be brought to a central area of the site. Bags of litter accumulated near receptacles will be kept and analyzed separately from other bags of litter. Bags will be completely filled before using another bag. Thus, the only bags that may be partially filled are the final bags for litter around receptacles and for litter from the remainder of the site. Only these final bags will be characterized and documented based on their level of fullness ($\frac{1}{4}$ full, $\frac{1}{2}$ full, $\frac{3}{4}$ full, completely full). The amount of any medical or hazardous waste observed will be estimated and recorded separately.

4. Litter Characterization: Once the degree of fullness for the final bags of litter has been recorded, a tarp will be placed on the ground in a secure location not subject to the elements. Each littered item will be characterized by its material type and composition; then recorded. After each item is recorded, it will be placed in a second trash bag to ensure that it does not become wind-blown litter. Litter accumulated near trash receptacles will be analyzed separately from litter found in all other areas of the recreational site. Then, the data from both areas of the site will be summarized.

5. Disposal: When this process has been completed, the collection of all bagged litter for appropriate disposal will be coordinated by the site supervisor. Copies of all forms will be provided to the project manager and will be stored by the site supervisor for future review.

The resulting data will serve as a baseline. These same areas will be surveyed once each quarter for the coming year in order to measure progress in litter abatement achieved. The data will be analyzed and the results will note the extent to which statistically significant reductions in litter have been achieved.

Section 10 References

Note: 350 documents consisting of more than 15,000 pages were reviewed for the writing of this report. The documents listed below represent those that were cited in this report.

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Section 11

Firm Qualifications

Environmental Resources Planning, LLC (ER Planning) focuses exclusively on litter surveys and litter-related research. Field crews under our supervision have surveyed more than 21 million square feet of roadways and recreational areas in a number of states and cities throughout North America and for Keep America Beautiful (KAB), including the following litter surveys:

- Anacostia Watershed Litter Survey (2015)
- Rhode Island Litter Survey (2014)
- Texas Statewide Litter Survey (2013)
- Toronto, ON Citywide Litter Survey (2012)
- Oakland, CA Citywide Bag Litter Survey (2012)
- San Francisco, CA Citywide Bag Litter Survey (2012)
- Washington, DC Citywide Bag Litter Survey (2012)
- Maine Statewide Litter Survey (2010)
- New Hampshire Statewide Litter Survey (2010)
- Vermont Statewide Litter Survey (2010)
- KAB National Litter Survey and Cost Study (2009)
- Georgia Statewide Litter Survey (2006)
- Tennessee Statewide Litter Survey (2006)
- Santa Monica, CA Citywide Beach Litter Survey (2005)
- Malibu, CA Citywide Beach Litter Survey (2005)
- New Jersey Statewide Litter Survey (2004)

The firm's roots date back more than 100 years when Mr. Stein's family opened their first recycling facility. His litter-related work began with a KAB affiliate project in 1986.

Mr. Stein's litter studies and research have been featured in National Geographic magazine, Time magazine and the New York Times as well as on ABC's Good Morning America and NPR.

He was invited, as a subject-matter expert, to participate in a study on community resilience and resource optimization conducted for the President.

Mr. Stein earned his B.Sc. Cum Laude in Environmental Studies from Syracuse University and SUNY College of Environmental Science and Forestry (SUNY-ESF) studying Waste



Management and Environmental Law while interning with the NYS Department of Environmental Conservation. He also earned his M.Sc. in Natural Resource Policy and Management there.

He was awarded a scholarship by New York SWANA for his Master's thesis research, examining the impacts of public policy intervention on maintaining sustainable recycling markets. He also began a doctorate-level program at SUNY-ESF that focused on identifying underlying cultural influences on littering behavior.

Mr. Stein has also studied forensics and uses archaeological and anthropological research methods and crime scene forensic principles to link litter, stormwater trash and marine debris to their most likely sources.

In addition, Mr. Stein has been active in numerous activities and writing related to litter, stormwater trash and marine debris including, most recently:

- MOOC Marine Debris Course – Leadership Track (2015)
- Florida Litter Prevention Program – Advisor (2014)
- International Adopt-a-Highway Association – Evaluation of Survey Data and Provide Recommendations for Data Enhancement (2014) – Advisor, pro bono
- California State Water Board - Technical Assessment of Statewide Water Quality Plans to Control Stormwater Trash (2014), Project Manager and Lead Author
- Florida Litter Prevention Program, Advisor (2014)
- San Francisco Water Board - Presentation on Measuring Trash TMDL Compliance and Load Reductions (2013), Author and Presenter
- World Ocean Council – Research Marine Debris and Waste Reduction Project – research, pro bono (2012)
- Ocean Conservancy - Beach Litter Survey Methodology Enhancements (2011) - Advisor, pro bono
- National Litter Forum - Restoring Our Communities, Organizer, Speaker (2011)
- KAB - Community Appearance Index (2007-08), Project Manager and Lead Author
- KAB - International Litter Research Forum (2007), Invitation-Only Attendee
- KAB - Litter: Literature Review, Project Manager and Lead Author (2007)
- Potomac Watershed Initiative Trash Monitoring Protocol Subcommittee - Survey Design Advisor, pro bono (2006-2007)
- Ocean Conservancy's National Marine Debris Monitoring Program - Survey Director for Chincoteague Island Site, pro bono (2006-2007)

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