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## VALUATION OF RECREATIONAL BEACH QUALITY AND WATER QUALITY MANAGEMENT STRATEGIES IN OAHU

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Dr. Michael Reed, Director of Graduate Studies

VALUATION OF RECREATIONAL BEACH QUALITY AND WATER QUALITY  
MANAGEMENT STRATEGIES IN OAHU

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THESIS

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A thesis submitted in partial fulfillment of the requirements for  
the degree of Master of Science in Agricultural Economics in  
the College of Agriculture at the University of Kentucky

By

Jerrod Penn

Director: Dr. Wuyang Hu,

Professor of Agricultural Economics

Lexington, Kentucky

2013

## ABSTRACT OF THESIS

### VALUATION OF BEACH DAYS AND WATER QUALITY MANAGEMENT STRATEGIES IN OAHU

Hawaii's pristine ocean and tropical environment is a keystone of Hawaii tourism and the state economy. Water pollution from stormwater and development threatens the beach quality to both residents and tourists. In order to understand the lost nonmarket value, we assess changes in quality of beach characteristics including water and sand quality, swimming safety conditions, and congestion using a Discrete Choice Experiment of recreational beach users. Further, we study willingness to pay (WTP) for water management strategies in Hawaii using another discrete choice experiment, including structural and nonstructural Best Management Practices, testing, monitoring, and educational efforts.

Using a mixed logit model, beach quality results suggest similar preferences among resident and tourists. Both groups consistently have higher WTP to avoid poor quality levels versus obtaining excellent levels. Additionally, water quality is the single most important attribute. For the policy discrete choice experiment, both parties exhibit similar ranking of WTP to initiate water quality management strategies, with improved testing methods followed by education having the highest WTP. Lastly, we use Benefit-Cost analysis to find that all significant management strategies may be viable, since WTP is greater than the predicted cost of implementation based on expert opinion of Hawaiian policy leaders.

KEYWORDS: Beach, recreation, willingness to pay, water quality, discrete choice experiment

Jerrod Penn

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VALUATION OF BEACH DAYS AND WATER QUALITY MANAGEMENT STRATEGIES  
IN OAHU

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## Table of Contents

List of Tables .....	iv
List of Figures.....	v
Chapter 1 Introduction.....	1
Chapter 2 Study Background.....	2
2.1 Hawaii Tourism .....	2
2.2 National Stormwater Pollution and Management.....	5
2.3 Hawaii Stormwater Pollution and Management .....	6
Chapter 3 Literature Review.....	11
3.1 Revealed Preference Methods.....	11
3.2 Stated Preference Methods .....	12
3.3 Criticisms of Stated Preference Methods.....	14
Chapter 4 Research Framework.....	17
4.1 Econometric Model.....	17
4.2 Discrete Choice Experiment Construction.....	22
Chapter 5 Discrete Choice Experiment and Survey Design .....	26
5.1 Discrete Choice Experiment Attributes .....	26
5.2 Data Collection and Survey Design .....	33
Chapter 6 Descriptive Statistics .....	34
Chapter 7 Beach Valuation Results .....	36
Chapter 8 Water Quality Management Results .....	41
Chapter 9 Willingness to Pay and Policy Benefit-Cost Analysis .....	44
9.1 Willingness to Pay .....	44
9.2 Benefit-Cost Analysis .....	48
Chapter 10 Conclusions and Implications .....	51
Appendices .....	54
Appendix I: Resident Survey .....	54
Appendix II: Tourist Survey .....	72
References.....	89
Vita .....	96

## List of Tables

Table 2.1: Historical Trends in Hawaii and Oahu Tourism.....	4
Table 2.2: January 2004- January 2013 Oahu or Statewide Brown Water Advisories.....	6
Table 2.3: Fiscal Year 2009 Existing and Proposed Water Management Strategies.....	9
Table 5.1: Recreational Beach Attribute Description .....	27
Table 5.2: Description of Water Quality Management Choice Experiment Attribute Levels .....	31
Table 6.1: Sample Descriptive Statistics.....	35
Table 7.1: Conditional Logit Results of Recreational Beach Choice Experiment.....	37
Table 7.2: Mixed Logit Results of Recreational Beach Choice Experiment .....	39
Table 8.1: Conditional Logit Model of Water Quality Management Choice Experiment.....	41
Table 8.2: Mixed Logit Model of Water Quality Management Choice Experiment .....	42
Table 9.1: Mean and 95% Confidence Intervals of Marginal Willingness to Pay for Beach Attributes .....	46
Table 9.2 Mean and 95% Confidence Intervals of Marginal Willingness to Pay for Stormwater Management Policies.....	47

## List of Figures

Figure 2.1: Oahu Public Beach Access Points.....	2
Figure 4.1: Example photo from Loomis & Santiago (2013).....	25
Figure 5.1: Example Scenario from Valuation Choice Experiment .....	28
Figure 5.2: Example Scenario from Policy Choice Experiment.....	32
Figure 9.1 Comparison of Cost to Implement Stormwater Management Policies and corresponding Willingness to Pay .....	49



## **Chapter 1 Introduction**

Throughout the United States, major storm events significantly contribute to beach closures and advisories. From 2007 to 2010, 22.5% of all closures and advisories in the United States were the result of stormwater runoff (Dorfman & Rosselot, 2008, 2009, 2010, 2011). In Hawaii, stormwater runoff is particularly hazardous, where advisories can be for entire islands, or in some cases the entire state. Heavy rainfall in Hawaii can lead to preemptive “Brown Water Advisories”, which were responsible for 98% of all beach closures and advisories from 2007 to 2010 (Dorfman & Rosselot, 2008, 2009, 2010, 2011). Degraded or closed beaches may have considerable effects on the well-being and economy of the state.

The purpose of this study is to identify the value of beach amenities to Hawaii tourists and residents. We establish this by investigating the value of a trip to an Oahu beach and associated attributes using a predominately pictorial discrete choice experiment (DCE). We ascertain the value of a day at the beach by estimating the marginal value, which can serve as a willingness to pay measure, for particular beach attributes. Additionally, we utilize a discrete choice experiment to find level of support financially for multiple strategies to mitigate stormwater management strategies on Oahu.

The structure of the paper is as follows: Chapter 2 outlines the state of stormwater pollution and management in Hawaii, specifically Oahu, Chapter 3 reviews various methods of environmental economics used to value beaches, Chapter 4 describes the research framework of the discrete choice experiment approach used in this study, and Chapter 5 provides the discrete choice experiment design and data collection mechanism. Chapter 6 describes summary statistics of resident and tourist samples. Chapter 7 presents the results of the discrete choice experiment of valuation of Oahu beaches. The results of the stormwater management elicitation results are in Chapter 8. The associated willingness to pay estimates and Benefit-Cost Analysis are presented in Chapter 9. Finally, we conclude with remarks and implications of the study in Chapter 10.

## Chapter 2 Study Background

### 2.1 Hawaii Tourism

Tourism has been a major contributor to Hawaii's Gross State Product (GSP) since roughly World War II. Hawaii maintains about 400 public beaches along 300 miles of Pacific Coastline (Dorfman & Rosselot, 2011). On Oahu alone, there are over 200 publicly accessible shoreline access points, as shown in Figure 1<sup>1</sup>. A national award for the best beach in America has been bestowed by Dr. Stephen P. Leatherman, of Florida International University for 22 years. Of these, twelve of Hawaii's beaches have received this recognition (Leatherman, 2012).

**Figure 2.1: Oahu Public Beach Access Points**



As such, Hawaii's pristine beaches and surrounding marine environments are the crux of Hawaii tourism, an integral component of the Hawaiian economy. Historical figures provided in Table 2.1 elucidate the importance of tourism in Hawaii and the island of Oahu. According to the Hawaii Tourism Authority (HTA), in 2011, an average of 185,824 visitors<sup>2</sup> per day were present in Hawaii, spending approximately \$179 per day (Table 1, HTA, 2011). Among those who

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<sup>1</sup> Obtained at [http://hawaii.gov/dbedt/gis/maps/oahu\\_shoreline\\_access.jpg](http://hawaii.gov/dbedt/gis/maps/oahu_shoreline_access.jpg). This information is produced by NOAA and the City & County of Honolulu based on GIS data, which can be explored at <http://cchnl.maps.arcgis.com/apps/OnePane/gpx/index.html?appid=0389a0d1ba8642af8f82832d0d25fdc0&webmap=bb2692cf44564637b072fcac2a1bf095>

<sup>2</sup> By air, excludes cruise passengers.

arrived to Hawaii by air, each person visiting Hawaii spent an average of \$1705 per trip and had an average trip length of 9.45 days (Table 1, HTA, 2011).

The island of Oahu is a focal point of Hawaiian tourism, where the capital and major city of Honolulu is located, and many travelers begin their trips. Oahu made up 51.8% of all visitor expenditures throughout Hawaii in 2011 (Table 1, HTA, 2011). On Oahu, there were 88, 979 tourists present per day (Table 6, HTA, 2011), with daily spending of \$192.70 per person (Table 83, HTA, 2011), the second highest average daily spending by island. Waikiki is also located on Oahu, which had an estimated economic effect equal to 8% of Gross State Product (GSP), 10% of all civilian state jobs, and 12% of all state and county taxes for Hawaii (Hawaii Department of Business, Economic Development, and Tourism, 2003). Roughly three-fourths of tourists do not visit other Hawaiian islands, staying exclusively on Oahu (Table 54, HTA, 2011).

While out-of-state visitors are the major driver of tourism dollars and pollution generated within the state, they must share the resources and responsibility to manage Hawaii's unique resources with the local residents. On average, tourists use more water, electricity, and petroleum while producing more solid waste and sewage per Visitor Day. However, in absolute volume, residents used between 2.7 (electricity) and 6.8 (petroleum) times more resources than tourists and produced far more air pollution (Table 3-5, pg. 11-12, R.M. Towill Inc., 2005)<sup>3</sup>. This strain on resources is most ostensible on the island of Oahu. In 2010, roughly 953 thousand Hawaiians resided on Oahu, about 70.1% of the state's population (U.S. Census Bureau, 2012). At the same time, Oahu is 600.74 of 6422.63 square miles (9.35%) of Hawaii's total land area, so is heavily urbanized with 1586.7 persons per square mile versus the state average of 211.8 persons per square mile (U.S. Census Bureau, 2012). Moreover, Honolulu was the eighth most densely populated city in the United States in 2010 (US Census Bureau, 2012).

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<sup>3</sup> An extensive report on the economic and environmental impact of residents and tourists is available from the Hawaii Department of Business, Economic Development & Tourism. An executive summary, full report, and technical report are available at <http://dbedt.hawaii.gov/visitor/sustainable-tourism-project/reports/>.

In order to effectively value and provide resources to protect beach resources, understanding resident opinions and having their input is essential. Resident attitudes are critical in creating hospitable and appealing environments for tourists (D. Davis, Allen, & Cosenza, 1988), and working with residents' desires on tourism development allows for a higher threshold of tourist tolerance (Cooke, 1982). Given the importance of both groups, we focus our valuation on tourists and residents of Oahu.

**Table 2.1: Historical Trends in Hawaii and Oahu Tourism**

<b>Year</b>	<b>5-year Avg.</b>	<b>2011</b>	<b>2010*</b>	<b>2009</b>	<b>2008</b>	<b>2007</b>
<b>HI Visitor Exp. (US\$ millions)</b>	11504.8	12,254.6	11,066.4	9,993.2	11,398.5	12,811.1
<b>Oahu Visitor Exp. (US\$ millions)</b>	5772.4	6,351.4	5,591	5,105.9	5,737	6,076.9
<b>Oahu Daily Census<sup>1</sup> (thousands)</b>	85.1	89.0	86.2	80.3	81.8	88.1
<b>% of HI Visitors</b>	47.8	47.9	48.4	48.7	47.4	46.5
<b>HI Daily Census<sup>1</sup> (thousands)</b>	178.1	185.8	177.9	165.1	172.5	189.4
<b>Average Spending Per trip in Hawaii<sup>1</sup> (US\$)</b>	1649.4	1704.9	1595.2	1552.5	1692.1	1702.5
<b>Average Length of Stay in Hawaii<sup>1</sup></b>	9.37	9.45	9.39	9.38	9.40	9.22
<b>Oahu Daily Spending (US\$)</b>	185.3	192.7	174.9	174.2	198.8	185.9
<b>Oahu total visitor days (millions)</b>	31.1	32.5	31.5	29.3	29.9	32.2
<b>HI total visitor days (millions)</b>	65.3	68.5	65.5	60.3	63.1	69.1
<b>Sources: 2011, 2009, 2008 &amp; 2007 Hawaii Tourism Authority (HTA) Research Report</b> <b>*2010 is revised data from 2011 HTA Research Report</b> <sup>1</sup> Arrivals by air <b>Note: All annual data based on a fiscal year from July 1 through June 30</b>						

## 2.2 National Stormwater Pollution and Management

Managing and mitigating the effects of storm water pollution is a national issue. The U.S. generates an estimated 27.6 billion gallons of stormwater runoff each day, or roughly 10 trillion gallons annually (US Environmental Protecting Agency, 2004, Ch. 4, pg. 12). In 2009, stormwater contamination made up at least 40% of the total warning and advisory days analyzed (Dorfman & Rosselot, 2009). Some local studies have examined the negative economic consequences of stormwater pollution. A case study of water pollution for two recreational beaches in Orange County, CA by Dwight, Fernandez, Baker, Semenza, and Olson (2005) found an estimated \$3.3 million per year in additional economic burden from compromised health including gastrointestinal illness, acute respiratory disease, and ear and eye ailments. There are also aggregate effects of Harmful Algal Blooms (sometimes caused by nutrient/fertilizer rich runoff) within the US, which from 1987 to 1992 were estimated to be \$20 million per year in public health effects and additional \$7 million in tourism and recreational effects (Hoagland, Anderson, Kaoru, & White, 2002).

National municipal stormwater management in the United States began with the Water Quality Act of 1987, which amended the US Clean Water Act<sup>4</sup>. The amendments required cities to be regulated by the previously established National Pollutant Discharge Elimination System (NPDES) permits. Specifically, municipalities must “effectively prohibit non-stormwater discharges into the storm sewers; and “require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering, and such other provisions” (“Water Quality Act,” 1987). Beginning in 1990, NPDES permits required municipal storm sewer systems (MS4) serving populations greater than 100,000 people to reduce pollutants, and was later extended to all MS4s (fewer than 100,000)

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<sup>4</sup> Up until that time the Clean Water Act only covered publicly owned treatment works and industrial wastewater. <http://cfpub.epa.gov/npdes/stormwater/swbasicinfo.cfm>  
<http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm>

in urbanized areas and some MS4's outside of urban areas. For most states, the EPA has granted the state the authority to issue NPDES permits.

### 2.3 Hawaii Stormwater Pollution and Management

The presence of stormwater pollution is well documented for Hawaii. Hawaii's water quality history is featured in the National Resources Defense Council's annual report, "Testing the Waters: A Guide to Water Quality at Vacation Beaches." We use this data as the basis for water quality since the EPA generally does not include pre-emptive rainfall advisories<sup>5</sup>, as have others who studied recreational values of beaches (Kinzelman & McLellan, 2009; Parsons, Kang, Leggett, & Boyle, 2009; Rabinovici, Bernknopf, Wein, Coursey, & Whitman, 2004). Hawaii's Brown Water advisories made up over 69% of all stormwater related warnings throughout the thirty reporting states. A history of the Oahu-wide Brown Water advisories issued since 2004 are listed in Table 2.2.

**Table 2.2: January 2004- January 2013 Oahu or Statewide Brown Water Advisories**

Start Date	End Date	Total Number of Days
Tues 3-2-04	Tues 3-9-04	8
Fri 9-30-05	Tues 10-4-05	5
Wed 11-1-06	Mon 11-6-06	6
Sun 11-4-07	Fri 11-9-07	6
Wed 12-5-07	Thurs 12-15-07	11
Thurs 12-11-08	Mon 12-15-08	5
Mon 12-15-08	Wed 12-24-08	10
Tues 10-6-09	Wed 10-9-09	4
Thurs 12-9-10	Mon 12-13-10	5
Tues 12-28-10	Mon 1-3-11	7
Wed 1-12-11	Thurs 1-20-11	9
Mon 3-5-12	Sun 3-11-12	7
Sun 1-27-13	Tues 1-29-13	3

Data provided by [www.beachwatch.org/Hawaii](http://www.beachwatch.org/Hawaii), which maintains a list of compromised water quality events across the state of Hawaii since September 2005

<sup>5</sup> For a more detailed comparison, visit [water.epa.gov/type/oceb/beaches/upload/national\\_facsheet\\_2011.pdf](http://water.epa.gov/type/oceb/beaches/upload/national_facsheet_2011.pdf) to understand the EPA's process. The NRDC highlights differences to the EPA at [www.nrdc.org/water/oceans/ttw/](http://www.nrdc.org/water/oceans/ttw/).

The Hawaii Department of Health (HDOH) is the permitting authority for all NPDES permits for the state of Hawaii. HDOH has only implemented one MS4 NPDES permit for Oahu, since all other Hawaii municipalities are too small to require regulation. The NPDES permit is granted to the Hawaii Department of Transportation (HDOT), which is responsible for fulfilling most of the requirements of the NPDES through its Oahu and statewide stormwater management plan<sup>6</sup>.

Another principal component of Hawaii water quality management is the mandate to follow the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, which amended the Clean Water Act (BEACH Act, 2000). The BEACH Act stipulated the establishment of national standards and monitoring for coastal recreational waters along public beaches, and authorizes the EPA to grant funds to each state for beach water quality monitoring (Section 319(h) of CWA). Typically, the EPA receives appropriations just less than \$10 million to allocate among all qualifying states, of which Hawaii generally receives approximately \$325,000 per year.

The organization within the Hawaii Department of Health responsible for recreational water quality monitoring supervision is the Clean Water Branch (CWB). The CWB's role is "to protect the public health of residents and tourists who enjoy playing in and around Hawaii's coastal and inland water resources [...] through statewide coastal water surveillance and watershed-based environmental management through a combination of permit issuance, monitoring, enforcement, sponsorship of polluted runoff control projects, and public education" (Clean Water Branch, 2013)<sup>7</sup>. The CWB is also responsible for the preservation and restoration of coastal environments for marine and terrestrial wildlife and the NPDES permit program.

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<sup>6</sup> Hawaii's most recent publicly available SWMP is available at [www.stormwaterhawaii.com/program\\_plan/pdfs/plan\\_march2007.pdf](http://www.stormwaterhawaii.com/program_plan/pdfs/plan_march2007.pdf)

<sup>7</sup> <http://hawaii.gov/health/environmental/water/cleanwater/about/mission.html#Anchor-Program-35882>

Three different types of advisories are currently issued by the CWB. The most common is the Brown Water Advisory which is related to the discharge of storm water into coastal waters. Very infrequently, Sewage Spill Advisories occur which deal with expelled sewage. Lastly, the CWB have High Indicator Bacteria Advisories, when water is unsafe according to the BEACH Act's Single Sample Maximum requirement.

Hawaii's water quality testing standards for recreational marine waters matches the standards set forth by the EPA to comply with the Clean Water Act, §303. The main indicator bacterium used is known as *Enterococci*, which correlates with fecal levels. For public bathing or wading areas within 300 meters of the shoreline, the sample geometric mean of enterococcus content cannot exceed 35 colony forming units (CFU) per 100 milliliters in 5 samples over a month period. No single sample may exceed 104 CFU per 100 milliliters. For recreational marine waters that are tested fewer than five times a month, they must also adhere to no single *Enterococci* sample exceed 35 CFU per 100 milliliters of water. To improve the accuracy of marine water quality monitoring, Hawaii also uses a second indicator bacterium known as *Clostridium perfringens*, shown to be another effective correlate to fecal matter.

Multiple organizations help meet the requirements of the Clean Water Act and the NPDES program through a number of efforts. HDOT is charged with meeting the requirements of the NPDES, which we characterize as preventative measures. The Clean Water Branch is responsible for tracking water quality and communicating advisories to the public, which we consider measures of testing and monitoring. Lastly, education is an effort required by the NPDES. The costs to implement the policies for water quality management for the 2009 fiscal year are detailed in column I of Table 2.3.

Improvements in monitoring and mitigating health risks of stormwater runoff were proposed by the CWB for the fiscal year 2009, outlined in column II of Table 2.3. Each of these



cost estimates was derived from experts<sup>8</sup> within different areas of Hawaii’s government including the Department of Health, Clean Water Branch, Department of Transportation, and Honolulu Airport. For the state of Hawaii, these are the most knowledgeable and well-suited individuals to provide such an estimate. The first two were Structural and Non-Structural Best Management Practices, which constitute augmented preventative measures. The third strategy was to improve testing and monitoring methods used when testing water samples as well as an improved warning and delivery system of water pollution advisories. Finally, an increased educational effort of Hawaii residents and tourists was suggested. Implementing these strategies would have a total cost of approximately \$1.66 million. The corresponding funding increased per proposed strategy can be coupled with the discrete choice experiment results to provide a Benefit-Cost analysis for water quality management strategies. These proposed augmentations in water quality management strategies constitute the attributes of the second discrete choice experiment, described in more detail in 5.2. The final benefit-cost analysis results are displayed in Figure 9.1.

**Table 2.3: Fiscal Year 2009 Existing and Proposed Water Management Strategies**

<b>Water Quality Management Strategy</b>	<b>Existing (\$thousands)</b>	<b>Proposed Increase (\$thousands)</b>	<b>New Total</b>
<b>NPDES Operating Costs</b>	564	--	564
<b>Non-Structural BMP’s<sup>b</sup></b>	696	204	900
<b>Structural BMP’s</b>	--	1,040 <sup>a</sup>	1,040 <sup>a</sup>
<b>Warning &amp; Advisory System</b>	20	124	144
<b>Testing<sup>c</sup></b>	574.1	102.1	676.1
<b>Educational efforts (HDOT)</b>	320 <sup>d</sup>	200	520
<b>Total</b>	2174.1	1670.1	3844.1

<sup>a</sup> Does not include operating or maintenance costs; only materials and installation

<sup>b</sup> Covers enforcement, monitoring, inspecting and permitting for the NPDES

<sup>c</sup> Does not include lab salary, based on testing 51 beaches multiples times per week as is reported in NRDC (2010)

<sup>d</sup> Does not include other federal, state and county departments educational efforts equal to \$1227.3 in funding

<sup>8</sup> In particular, much thanks to Watson Okubo, Randall Wakumoto, Jim Howe, and Lara Kozloff.

The cost of implementation for proposed mitigation strategies from Oahu's agency leaders provides a unique opportunity for our study. While use of discrete choice experiments is extensive, this study contributes by coupling the WTP estimates with the costs, to yield prescriptions for Hawaii policymakers, and can serve as a case study for projects who use similar methods in the future.

## **Chapter 3 Literature Review**

Economists have developed a number of techniques to value environmental and nonmarket goods and services, as well as particular attributes. In general, these methods are broadly separated into Revealed Preference and Stated Preference techniques, based on data used in the valuation analysis. A thorough comparison of the two can be found in Champ, Boyle, and Brown (2003); A. M. Freeman (2003, pg. 23-26).

### **3.1 Revealed Preference Methods**

Revealed Preference (RP) Methods, also known as indirect methods, find values based on actual or observable decisions of consumers that take place in the market. The two most prominent RP approaches are known as the travel cost method and hedonic method, and both have been used frequently in recreational beach use management.

The Travel Cost Method (TCM) studies the frequency and distributions of trips taken, typically to visit outdoor recreational sites such as national parks or scenic areas, and the associated costs of taking such trips. The technique is well outlined in Parsons (2003); Phaneuf and Smith (2006) and A. M. Freeman (2003). TCM has been used extensively in recreational beach valuation. One of the earliest applications to beaches estimated tourists' value of day trips to beaches in Florida at \$34 (Bell & Leeworthy, 1990). On the Pacific Coast, Lew and Larson (2005) used TCM to examine residents' values of San Diego County Beach characteristics and the effect of beach closings. WTP for controllable and natural characteristics such as lifeguards, "activity zones," free parking, beach sand quality and beach length were significant; water quality was not significant. Along the Atlantic Coast, the estimated value of beach visitations in North Carolina for both day-trippers who had net benefits from \$11-\$80, and overnight-trippers who had net benefits between \$11-\$41 (Bin, Landry, Ellis, & Vogelsong, 2005). For the Great Lakes, TCM was used to value changes reductions in the number of beach advisories along Lake Erie beaches (Murray, Sohngen, & Pendleton, 2001). The study found that by reducing beach closures

by one day per year, those who looked up advisory information using news sources prior to arriving at the beach would gain \$24 per year, and those who obtained advisory information from signage posted at the beach would gain \$38 per year in benefits.

The hedonic method is another well-known indirect method of valuing environmental goods and services. Hedonic method has a long history of use both in property value models and wage differential models (Berger, Blomquist, & Sabirianova Peter, 2008; Hoehn, Berger, & Blomquist, 1987). The hedonic method has been used to estimate the economic effects of three beach erosion strategies: armoring, renourishment and shoreline retreat at Tybee Island, GA (Landry, Keeler, & Kriesel, 2003). Furthermore, the hedonic method has shown a high quality beaches and dunes affect property values nearby, but do not affect properties further away (Landry & Hindsley, 2011).

### **3.2 Stated Preference Methods**

Generally, nonmarket goods and services are difficult to observe with no readily identifiable price or market. As a result, Stated Preference (SP) methods are the only alternative available. These values must be ascertained through hypothetical decisions, often embedded in surveys. One of the most widely known and extensively researched is the contingent valuation method (CVM). In CVM, respondents typically are asked to state their willingness to pay (WTP) under hypothetical situations with specified levels of environmental quality in lieu of a functioning market. This is also known as a direct approach. An early use of this method estimated the benefits of outdoor recreation in Maine (R. K. Davis, 1964).

One of the earliest comprehensive overviews of Contingent Valuation Method came from Mitchell and Carson (1989), who define it as simply using “survey questions to elicit people’s preferences for public goods by finding out what they would be willing to pay for specified improvements in them” (pg. 2). CVM has been implemented extensively in multiple forms related to beach recreation. Early on, there were a few applications of iterated dichotomous

choice studies on beach recreation (Bell, 1986; McConnell, 1977). Silberman and Klock (1988) used a CVM bidding game format to value beach nourishment and existence values of beaches for recreational use in New Jersey. Lindsay, Halstead, Tupper, and Vaske (1992) utilized an open-ended bid format in which the respondent provides their WTP for beach erosion control programs.

An early, well-known technique is the single bounded dichotomous choice technique, a referendum “Yes or No” type question to understand nonuse values, endorsed by the NOAA “blue-ribbon” panel as the preferred valuation method (NOAA, 1993). More recent applications of CVM have utilized a theoretically robust method known as the double bounded dichotomous choice (DBDC) approach, originally developed by Hanemann, Loomis, and Kanninen (1991). The DBDC technique has been used to value beach and lagoon preservation among residents of Venice (Alberini, Rosato, Longo, & Zanatta, 2005), determining WTP for additional beach access points along South Carolina beaches (Oh, Dixon, Mjelde, & Draper, 2008), and coastal access in New England (Kline & Swallow, 1998). Criticism of the CVM has led to extensive refinement and new SP techniques that are well adept at valuation under certain circumstances. One such method that has become popular in recent decades is the discrete choice experiment method (DCE).

DCE is a specific type of elicitation format that can offer some advantages over other SP approaches. DCE may be a better approach over other SP techniques when values of individual attributes is important (Bateman et al., 2002) rather than the total value of the environmental good or service. It can be more realistic than the referenda style of CVM for certain nonmarket goods, services, or policies since it can incorporate the decision making process of trading off between multiple profiles with multiple varied characteristics in addition to a status quo option. This seems applicable to Oahu beach users since they may be familiar with multiple beaches and their related characteristics. Early work by Boxall, Adamowicz, Swait, Williams, and Louviere (1996) found that welfare estimates in CVM were many times greater than their DCE counterpart.

A history of DCE in the context of environmental valuation and the traditional CVM is documented in Carson and Czajkowski (2012). An early application of DCE to environmental valuation was completed by Adamowicz, Louviere, and Williams (1994). It has been used in beach applications. Oh, Draper, and Dixon (2010) used DCE to examine the value of additional public beach access points for residents and tourists. Huang, Poor, and Zhao (2007) studied both the positive and negative effects as attributes in a DCE of beach erosion control programs among New Hampshire and Maine residents. Beharry-Borg and Scarpa (2010) considered WTP for tourists (snorkelers and non-snorkelers) in Tobago for different 10 attributes (including payment vehicle) such as coral cover and fish abundance, water quality, as well as congestion and development. Lastly, Eggert and Olsson (2009) considered bathing water quality, cod stocks, and biodiversity in Sweden. The literature on DCE's limitations and usefulness continue to grow as will its application to beach management.

### **3.3 Criticisms of Stated Preference Methods**

In general, a broad criticism of SP methods is their foundation in hypothetical situations and markets to value nonmarket and public goods. This may mean that respondents are unlikely to have well thought-out preferences for public goods and are less cognizant of their own budget constraints. For instance, they may derive utility from yeah-saying or social desirability bias (Andreoni, 1990). The difference between what respondents will actually pay and what they state they will pay in a survey is known as hypothetical bias (HB). Multiple solutions have manifested as checks on SP approaches in two forms, ex ante and ex post corrections.

Historically, the first ex-post solution was a calibration factor. The NOAA Blue Ribbon panel originally suggested a rule of thumb to divide by 2 as a starting point, but other comparisons of actual versus hypothetical have calibrations of 1.28 (List & Gallet, 2001), 3.13 (Little & Berrens, 2004), and 1.35 (Murphy, Allen, Stevens, & Weatherhead, 2005). This calibration factor must be very experiment specific (Fox, Shogren, Hayes, & Kliebenstein, 1998;

List & Shogren, 1998). The other prominent ex--post method is follow-up certainty questions. This approach works by asking how certain or confident the respondent felt about their answer to the valuation question in a follow-up question posed immediately after. Follow-up certainty has numerous support validating its usefulness (Blomquist, Blumenschein, & Johannesson, 2009; Champ, Bishop, Brown, & McCollum, 1997; Vossler, Ethier, Poe, & Welsh, 2003).

Alternatively, hypothetical bias can be mitigated prior to the valuation elicitation and may be a less case-specific technique. One of the most common forms of ex ante mitigation is commonly called “cheap talk” (CT) scripts. Evidence is mixed on the effectiveness of cheap talk scripts depending on how knowledgeable or developed the preferences of the respondent may be (List, 2001; Lusk, 2003), the payment level provided, or characteristics of the Cheap Talk script such as length or neutrality. With regard to DCE as is used in this study, Cheap Talk has also been found to be useful to reduce HB. HB may still be present but is significantly reduced when CT is implemented (Carlsson, Frykblom, & Lagerkvist, 2005). Tonsor and Shupp (2011) used CT before a DCE in a nationwide online survey, which improved mean WTP as well as narrower confidence intervals.

Other ex-ante approaches have been recently developed with relatively short histories of implementation such as consequentiality scripts (Barrage & Lee, 2010; Bulte, Gerking, List, & De Zeeuw, 2005; Carson & Groves, 2007; Herriges, Kling, Liu, & Tobias, 2010; Vossler, Doyon, & Rondeau, 2012), which reminds respondents of the potential binding nature of the valuation project, Bayesian Truth Serum (Barrage & Lee, 2010; Weaver & Prelec, 2012), Real Talk (Alfnes, Yue, & Jensen, 2010), and most recently honest priming (de-Magistris, Gracia, & Nayga, 2013)

There has been some comparison of ex post and ex ante correction efficacy. Whitehead and Cherry (2007) found results that suggest the two methods are complementary to each other and should both be used. Blumenschein, Blomquist, Johannesson, Horn, and Freeman (2007) found that Certainty follow-up questions were effective while Cheap Talk scripts were not to mitigate HB.

Lastly, combining Revealed Preference and SP data offers another alternative. Each method contain strengths and weaknesses that can complement each other in a variety of ways (Whitehead, Pattanayak, Van Houtven, & Gelso, 2008), which can improve the precision of parameter and welfare estimates in simulations (Kling, 1997) as well as field tests (Earnhart, 2002). An early, well-known combination was by Adamowicz et al. (1994). Combined data has been used to value improvements in recreational water quality (Hanley, Bell, & Alvarez-Farizo, 2003) and in recreational water quantity (Eiswerth, Englin, Fadali, & Shaw, 2000). Whitehead, Dumas, Hill, and Buerger (2008) combined travel cost and contingent behavior for better estimates of improved beach width and access.

Arguments on the worth of SP methods continues (Carson, 2012; Haab, Interis, Petrolia, & Whitehead, 2013; Hausman, 2012), but SP techniques have overcome many critiques and have become a mainstay of empirical work in environmental economics (Carson, 2011). While contention remains, SP approaches continue to be heavily utilized in the realm of environmental and resource economics. We use the well-developed Discrete Choice Experiment approach to ascertain values related to the quality and maintenance of Oahu's beaches. While other studies of beach valuation exists that use RP methods such as Travel Cost and Hedonic, a SP method such as ours is more appropriate to study preferences not available on the market or outside the range of what is currently available such as water and sand quality.

Using these methods, we can contribute to the literature of beach valuation and management by understanding potential differences in residents and tourists. Further, as far as we know, we believe this is first example to use DCE to understand preferences for water quality management strategies that can help inform funding allocation decisions based on tourist and resident preferences. Our goal is to understand tourist and resident values for beaches, and strategies to protect beach quality.



## **Chapter 4 Research Framework**

### **4.1 Econometric Model**

Discrete Choice experiments (DCE) were first proposed and implemented by Louviere and Hensher (1982) and Louviere and Woodworth (1983). In numerous cases, this may also be known as Conjoint Analysis or Choice-based Conjoint (CBC) analysis, though the former label is considered inaccurate (Louviere, Flynn, and Carson, 2010). This short summary is built on the work of Train (2009), Louviere, Hensher, and Swait (2000), and Hensher, Rose and Greene (2005).

A DCE can be analyzed by using a conditional logit model. The individual typically must make one discrete choice among a number of alternatives, which often may include a status quo or “select neither,” or both option. DCE relies on Lancaster’s (1966) characteristics theory of value, which states that utility derived from goods originate from their multiple characteristics and not the good itself.

The economic foundation of DCE and many environmental economic studies is Random Utility Model (RUM) theory as in (1). The theory dictates that the utility derived from a good or service is determined by the separate utilities derived from attributes, rather than the good/service itself, that make up the sum of total utility. The respondent selects the most preferred alternative of those presented. In order for the respondent’s choice to coincide with standard economic theory, two conditions are required according to Carson and Groves (2007): 1) that the respondent believes their responses can potentially affect decisions and outcomes of the agency or policymaker, and 2) the respondent must have an interest in which outcome is provided by the agent or policymaker. Vossler et al. (2012) posit and find evidence that respondents provide truthful answers if they believe their decisions and answers have a substantial likelihood of affecting outcomes. With these conditions, choices in DCE can be understood with economic theory.

Specifically, DCE analysis relies on choosing the utility maximizing option in each choice experiment scenario based on random utility modeling (RUM). An individual,  $i$  must evaluate the utility associated with  $j=1, 2, \dots, J$  alternatives in the  $t$ -th choice set, which can be represented by  $U_{ijt}$ . We expect that within a given group of alternatives known as a choice set, individuals select the beach alternative that maximizes utility. Utility is an independent, random variable that can be separated into the given level of characteristics represented by vector  $X_{ijt}$ , the unknown parameter vector  $\beta$ , and the random component  $\varepsilon_{jt}$  (McFadden, 1973).

$$U_{ijt} = X_{ijt}\beta + \varepsilon_{jt} \quad (1)$$

If the error term is (initially) assumed to be a (Gumbel) Largest Extreme Value Type-I as well as independently and identically distributed, it takes the form of a closed-form, analytic solution conditional logit model, which utilizes Maximum Likelihood Estimation as in equation 2 (McFadden, 1973).

$$Prob_{ijt} = \frac{\exp(X_{ijt}\beta)}{\sum_{k=1}^J \exp(X_{ikt}\beta)} \quad (2)$$

An inherent property of the Conditional Logit model is the independence of irrelevant alternatives (IIA), a restrictive assumption that says the introduction of a new alternative will not affect the relative probability of selecting among the previously available options. The idea was first introduced with the famous “Red Bus, Blue Bus”<sup>9</sup> example provided by McFadden (1973). Later on, tests of the IIA assumption were introduced (Hausman & McFadden, 1984).

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<sup>9</sup>Suppose a commuter can choose to ride a red bus or drive their own car and that probability of using either is .5. IIA says that the introduction of a blue bus should not change the relative odds of selecting the previous car or red bus options, so that each option has a .33 probability of selection. Realistically, color should not affect the likelihood of electing to drive a car and the probability would be .5 to drive the car, .25 to ride the red bus and .25 to ride the blue bus, a violation of IIA.

The parameter estimates ( $\beta$ ) measure the effect of a change of an attribute on the likelihood of selecting an alternative. To be consistent with a utility maximizing framework, coefficients are inherently divided by  $\sigma$ , known as the scale parameter, which means that systematic determinants of utility are scaled by the variance (i.e.  $\beta/\sigma$ ) of unobserved utility within the conditional logit model. Within one dataset, it is intractable to separately estimate the scale parameter, and often  $\sigma$  is omitted in scholarly work. If there are two or more datasets, one can measure the scale parameter of additional data as a proportion of one selected dataset to test if scale heterogeneity is significantly different across data, as in Swait and Louviere (1993). A separate approach using nested logit models ascertains the same relative scale information between datasets by Hensher and Bradley (1993).

Empirically, these tests provide evidence to support or reject pooling datasets. Pooling is potentially useful since it produces more efficient estimates with additional degrees of freedom within the same model, allows for realistic modeling by combining revealed and SP data, or pooling segments of a sample that are suspected to be different into a single dataset.

One can test the appropriateness of pooling data with the Swait-Louviere test (a two-step modified likelihood-ratio test), but is only appropriate if IIA holds or equivalently if the conditional logit model is correct. As we will shortly show, there is strong evidence in the recreational beach DCE and water quality management DCE that the Swait-Louviere test cannot be effectively used to formally test scale differences. Instead, we allow for different scales by separating the models of residents and tourists.

Other models such as the mixed (also known as random parameters) logit model, equation 3, (Revelt & Train, 1998), heterogeneous extreme value logit, (specifically the nested logit) (McFadden, 1981) models can overcome the IIA assumption. Previously,  $\beta$  was assumed to be equal across all respondents. To allow for variation in taste of various attributes, mixed logit introduces a probability density function for the coefficient of the presumed heterogeneous attributes,  $h(\beta)$ . While decreasing assumptions of the model is beneficial, the actual benefit of

ascertaining heterogeneous preferences to improve marginal values and understand preferences is still undetermined (Carlsson, Frykblom, & Liljenstolpe, 2003).

$$Prob_{ijt} = \int \frac{\exp(X_{ijt}\beta)}{\sum_{k=1}^J \exp(X_{ikt}\beta)} h(\beta) d(\beta) \quad (3)$$

Due to normalization from the scale parameter, direct interpretation of the parameter estimate is not feasible except for statistical significance and relative magnitude to other attributes. After estimation, we can interpret  $\beta$  as the scaled marginal utility for a particular attribute. For example, the negative of the payment vehicle coefficient is interpreted as the scaled marginal utility of income. After total differentiation, one can interpret implicit values of the attributes included in the DCE as willingness to pay (WTP) estimates by dividing the environmental attribute  $\beta_{Attribute}$  by the opposite of the marginal value of the payment vehicle as in equation (4) (Adamowicz et al., 1994). Deriving WTP by dividing by the coefficient of the payment vehicle cancels out the presence of the scale parameter, so comparison of model results based on WTP is acceptable.

$$Marginal\ WTP_{Attribute} = -\frac{\beta_{Attribute}}{\beta_{Price}} \quad (4)$$

A number of techniques can test for significant differences in WTP among sample cohorts of interest to the researcher (outlined in Poe, Giraud, and Loomis (2005)). For the comparison of tourists and residents, we rely on the discrete, empirical convolutions approach developed by Poe, Severance-Lossin, and Welsh (1994). The method produces an approximate distribution of the difference between two random variables,  $\hat{X} - \hat{Y}$ , assuming the maximum of  $\hat{X}$  is greater than or equal to  $\hat{Y}$ . Based on large sample properties, the estimated values of  $\hat{X}$  and  $\hat{Y}$ , are consistent, which yields a one-tailed test. In our case, the  $\hat{X}$  and  $\hat{Y}$  are the mean WTP generated from equation 4. In the mixed logit model, we assume all random parameter attribute

levels were normally distributed, so scaling the mean and standard deviation by the fixed price coefficient (assumed to be constant) is also normally distributed. A useful result used in the formulation of the Convolutions test using the ‘mded’ package in R.

As supplements, we rely on two other approaches. The first is a straightforward test is to compare confidence intervals. If the groups’ confidence intervals do not overlap, then they are considered significantly different. We utilize the Krinsky-Robb (1986) method to obtain Confidence intervals of WTP<sup>10</sup>, which constructs an empirical distribution based on the model’s parameter and covariance matrix estimates and assumes a standard normal distribution. One could also assume scale homogeneity across groups, and then run a model that combines data. In our case, combined data means we can test for systematic differences of tourists and residents by introducing an interaction of every attribute level with the variable tourist. Except for significant differences between tourists and residents, all other model results are omitted.

Additionally, equation 4 is only appropriate in consideration of marginal WTP. If instead we are interested in total WTP, using equality 4 can lead to large disparities in estimated WTP (see Lancsar and Savage (2004) or Hensher, Rose, and Beck (2012)). A separate approach developed by Hanemann (1984) also provides changes in welfare based on variation in bundles of attribute levels. The measure utilizes the log-sum approach as in equation 5, and can be interpreted as Compensating Variation.

$$CV = -\frac{1}{\beta_{Price}} \left[ \ln \left( \sum_{j=1}^J \exp(V_j^1) \right) - \ln \left( \sum_{j=1}^J \exp(V_j^0) \right) \right] \quad (5)$$

$V_j^1$  is the bundle of attribute levels after a change has been implemented while  $V_j^0$  is the bundle of prior to the change in attributes and  $\beta_{Price}$  is the same coefficient estimate of the payment vehicle, often called the marginal utility of income. This approach is particularly useful in calculating the

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<sup>10</sup> We recognize that other techniques such as bootstrapping the delta method are also available. See Hole (2007) for additional detail.

share of alternatives listed in a simulation such as the impact to existing beach resorts if of a new beach destination is opened nearby or the value of beach if it has to be shut down. We will however focus on the marginal values in this study. By doing so, we assume that few beaches are readily available to beachgoers with the attributes under consideration.

#### **4.2 Discrete Choice Experiment Construction**

Constructing choice experiments comes from the tradition of experimental design familiar to statisticians and natural/biological science researchers. An in depth explanation is provided by Louviere et al. (2000) and Kuhfeld (2005). Consider the situation where there are five attributes, each with two levels such as a car that either is equipped or not equipped with power windows, power locks, air conditioner, a cd player, and a sunroof. The enumeration of all possible combinations of attributes is  $2^5$ , or 32. Completing a comparison of all enumerations is known as a full factorial design and has valuable statistical properties such as estimating the effect of attribute levels independent of other attributes. However, as the number of attributes and levels within each attribute increase, the number of possible combinations will grow rapidly. In a practical empirical application of DCE, using a full factorial design is difficult since the time for respondents to complete the entire choice experiment would be too long (Green & Srinivasan, 1990). Furthermore, a full factorial estimates all possible effects, which may not even be valuable to the researcher. Louviere et al. (2000, p. 94) suggested that third or higher-order interactive effects account for low proportion of variance explained and can often be ignored.

A popular alternative is called fractional factorial design which uses only a subset of combinations from the full factorial enumeration. Statistical properties desired by the researcher can help dictate the particular list of chosen combinations of attributes. Popular choices among practitioners include D-efficient and A-efficient optimal designs, which correspond to minimizing the determinant and trace of the design matrix (Kanninen, 2002; Scarpa & Rose, 2008). Other efficiency measures proposed in the literature included G-efficiency and V-efficiency (Kessels,

Goos, & Vandebroek, 2006). Time to complete the DCE is dramatically reduced using fractional factorial, but statistical information on interactions of two or more effects may be lost. While fractional factorial design may not provide as much information as a full factorial design, it has become the predominant method of most DCE users.









Other methods exist (outlined extensively by Chrzan and Orme (2000) and Sawtooth Software (2013). This study's DCE's follow a "randomized design," available in the "Choice-Based Conjoint" product, developed by Sawtooth Software, and the recommended approach when using a Computer-assisted Personal Interview (CAPI) (Pinnell, 2005), as in this study. Evidence suggests randomized designs are nearly as efficient as fixed designs in symmetric choice experiments (when all attributes have the same number of levels) and more efficient in asymmetric choice experiments (when attributes have various numbers of levels) (Mulhern, 1999). Chrzan and Orme (2000) found similar results that randomized designs were optimal or nearly optimal in almost all scenarios. Furthermore, because the alternatives in each DCE scenario are computationally generated, randomized designs can eliminate order and psychological context effects that may be present in fixed designs (Day et al., 2012; Sawtooth Software, 2013). The drawback of a randomized design is the potential necessity to compare answer reliability across respondents with at least one fixed scenario (Pinnell, 2005) by using the same attribute levels across all respondents for comparison. In our case, the third and sixth (of ten) choice scenarios in both the beach and policy choice experiments were fixed.

A fundamental design to choice experiments is the selection of attributes and their levels, which should be selected based on theory, demand, policy relevance, reality, and measurability. Some focus has recently examined how the attributes are conveyed in the survey. Historically, choice experiments relied on tables of text to compare alternatives as in Hu, Boehle, Cox, and Pan (2010). Few studies contained pictorialized levels of attributes. Two studies used a pictorial approach to study the WTP and dissatisfaction of off-shore wind farms (Álvarez-Farizo & Hanley, 2002; Ladenburg & Dubgaard, 2007). M. L. Freeman and Dunford (2003) had one "oceanview"

attribute that used photo such as rocky or sandy shorelines and the presence of shipwrecks of five total attributes. Beharry-Borg and Scarpa (2010) used pictures to describe attribute levels for coral cover, but the remaining nine were described in a traditional written format. In all of these cases, the pictorial manipulations are limited to four photos at most, but none with photo manipulations per alternative in each scenario of the choice experiment. An extensive use of pictorial choice experiments was by Bateman, Day, Jones, and Jude (2009), who use “virtual reality choice experiments.” They find that compared to conventional, numeric choice experiment communication, visually communicated DCE led to higher acumen by respondents with less judgment error, and thus, improved measurement of preferences. Recently, Loomis and Santiago (2013)’s study of recreational beach qualities displayed four separate photos per alternative to communicate either a status-quo or improved level of each attribute, shown in Figure 4.1. Each of our study’s attribute levels were communicated almost exclusively through computer-altered pictures.



**Figure 4.1: Example photo from Loomis & Santiago (2013)**

Attribute	Base Condition	Condition A
Tide/Waves		
Trash		
Crowding		
Water Clarity		
Additional Travel Cost to Visit with Condition A		SZZ more per trip
Would you spend the additional travel costs with these Conditions at the Beach?		YES NO

## **Chapter 5 Discrete Choice Experiment and Survey Design**

### **5.1 Discrete Choice Experiment Attributes**

This study contains two separate DCE's. The first values recreational aspects of Oahu beaches. The second DCE elicited preferences of various management strategies to monitor and mitigate stormwater pollution and associated water quality.

In the first experiment, beach attributes and levels were developed and selected with the primary goal of understanding recreational beach choice for swimming and wading. Their formulation was based on a number of sources including correspondence with the Clean Water Branch within the Hawaii Department of Health, the city and county of Honolulu Ocean Safety and Lifeguard Services, previous scholarly work (Mak & Moncur, 1998; Mourato, Georgiou, Ozdemiroglu, Newcombe, & Howarth, 2003; Murray et al., 2001; Oh, Dixon, & Draper, 2006), and focus group participation and feedback.

The attributes of the beach valuation are water quality (4 levels), sand quality (4 levels), congestion (3 levels), safety (3 levels), and round trip fuel costs (5 levels); described in detail. Beach valuations typically utilize entrance, parking, or user fees (Beharry-Borg & Scarpa, 2010; Eggert & Olsson, 2009; Oh et al., 2010), but the culture of Hawaiian residents dictated an alternative payment vehicle. Needham, Collins, Connor, and Culnane (2008) found that the most highly rated attribute at a popular Oahu Beach Park was no entrance fee at 94%, while clean ocean water second at 82%. They also found that no beach entrance fee were significantly more important to Hawaiian residents compared to tourists. The issue is not trivial, with rallies occurring on Oahu opposing the termination of public access and the implementation of parking fees on Hawaii beaches (Cole, 2008).

Considerable attention has been given to the effects of the payment vehicle on WTP results. Wisner (2007) found differences in WTP for renewable energy based on if it was publicly or privately funded, as well as if funding was a collective effort or voluntary contribution. Morrison, Blamey, and Bennett (2000) studied payment vehicle bias, first defined by Mitchell

and Carson (1989), “where the payment vehicle is either misperceived or is itself valued in a way not intended by the researcher.” Consequently, it is crucial to identify a consumer-accepted payment vehicle for the successful implementation of any SP method in a particular region. So while round trip fuel costs may not be ideal, it guards against respondents potentially rejecting the hypothetical market posed relative to the institution of entrance fees.



**Table 5.1: Recreational Beach Attribute Description**

<b>Attribute</b>	<b>Level</b>
<b>Sand Quality</b>	<b>Excellent</b> – A white all sand beach
	<b>Good</b> – A light tan beach composed of 75% sand and 25% foreign materials
	<b>Average</b> – A dark tan/light brown beach composed of 50% sand and 50% foreign materials
	<b>Poor</b> – A brown/gray beach composed of 75% foreign materials and 25% sand
<b>Water Quality</b>	<b>Excellent</b> – A beach with clear, aqua colored water and the probability of becoming ill from wading occurs in 5 out of every 1000 healthy adults
	<b>Good</b> – A beach with water that has visible particles floating in otherwise clear water, blue in color and the probability of becoming ill from wading occurs in 12 out of every 1000 healthy adults
	<b>Average</b> – A beach with cloudier water affecting visibility, green in color and the probability of becoming ill from wading occurs in 19 out of every 1000 healthy adults
	<b>Poor</b> – A beach with murky water, brownish in color and the probability of becoming ill from wading occurs in 25 out of every 1000 healthy adults
<b>Water entry/ swimming safety</b>	<b>Not Safe</b> – Lifeguard deems conditions safe for the majority of beach recreationists
	<b>Safe</b> – Lifeguard deems conditions safe for experienced beach recreationists
	<b>Very Safe</b> – Lifeguard deems conditions not safe to enter for any recreationists
<b>Congestion</b>	<b>Good</b> – The beach has ample open space, and little noise
	<b>Average</b> – The congestion and noise at the beach are present but do not hamper the experience
	<b>Below Average</b> – The beach is overcrowded and extremely noisy
<b>Round trip cost of gasoline</b>	\$0, \$5, \$10, \$15, \$20

Again, unique to our study is the magnitude and detail of information communicated in the choice experiment via computer-augmented pictures. As depicted in Figure 5.1, except for the risk of illness and round trip cost of fuel, *each* level of all of the attributes are presented visually in great detail without supplemental text. Respondents must decide almost entirely on visual cues, different from most previous work which used both visual and text depictions of attribute levels as references or supplements. The risk of illness is incorporated as text below the stylized pictures such that poor water quality is associated with a 2.5% chance of becoming ill, average water quality is 1.9%, good water quality is 1.2%, and excellent water quality is .5%.

**Figure 5.1: Example Scenario from Valuation Choice Experiment**


Suppose that you could only choose from the beach trips below. Which would you prefer?  
Check the button below your choice.

		
Probability of becoming ill from swimming occurs in 5 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 25 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 12 out of every 1000 healthy adults.
Round trip travel cost of gasoline is \$5	Round trip travel cost of gasoline is \$15	Round trip travel cost of gasoline is \$20

Would you really go to the beach you chose above?

Yes  
 No

**Next** 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

7

Respondents were only included in the beach valuation DCE if they agreed that they considered themselves recreational beach users, which is defined as the intention to sunbathe and swim in the ocean for at least a half an hour. While it is true that people who may not actually use the beach can still have positive values for water quality, sand quality, etc., our goal is to focus on

more direct recreational use<sup>11</sup>, rather than focus on non-use values. To help solidify participants' preferences, each respondent rated the importance of the five attributes of the DCE prior to participating in the DCE. Furthermore, an example DCE scenario was provided to help clarify the respondent's role prior to the beginning of the actual DCE.

Each respondent completed ten scenarios within the choice experiment, and each scenario contained three alternatives. The DCE does not incorporate an opt-out/no-choice alternative common in choice experiment designs<sup>12</sup>. This study follows Brazell et al.'s (2006) dual response method (most similar to Kallas and Gil (2012)), in which the respondent immediately answers yes or no to a follow-up question of their prior choice in the DCE scenario. We convert this dual-response answer into fourth, no-choice/opt-out alternative, akin to an unforced choice experiment.

The second choice experiment focuses on policy to improve stormwater management, especially the chance of illness from swimming in coastal waters in Hawaii. The attributes and levels are described in Table 5.2. They were developed with input from the Hawaii Clean Water Branch, the Division of Environmental Quality, the Department of Environmental Services of the City and County of Honolulu, engineers and experts in stormwater runoff control, the literature (Kinzelman & McLellan, 2009; Murray et al., 2001; Obropta & Kardos, 2007; Weiss, Gulliver, & Erickson, 2007), and focus group feedback.

In addition to the payment vehicle, there were a total of five attributes in the policy DCE. Each contained two levels: a status-quo level that follows the current amount of services rendered per attribute, and an augmented level that corresponds to the proposed increases recommended by Hawaii policymakers. The payment vehicle contained 4 levels, yielding a total of 128 ( $2^5 4^1$ ) possible combinations. A sample choice experiment scenario is in Figure 5.2.

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<sup>11</sup> In Lew and Larson (2005), water quality was one of only two attributes not significant in the conditional logit results. The authors speculate that since less than a third of the sample actually engaged in a water-based activity, many beach goers' values were not affected by water quality.

<sup>12</sup> Refer to Kallas and Gil (2012) for a comprehensive review of the implications of including an opt-out alternative.

Prior to beginning the policy DCE, respondents were given information stormwater pollution and its connection to beach recreation. The CAPI survey informed respondents of current federal and Hawaii regulations and gave a description of the policy and management strategies currently in place as well as their share of the annual budget. Additionally, the effect on respondents was described for each of the policy strategies at the new augmented level. As before, respondents saw an example DCE scenario, then could begin the actual DCE. For additional insight, refer to the appendices which contain the resident and tourist surveys.

**Table 5.2: Description of Water Quality Management Choice Experiment Attribute Levels**

Attribute	Levels
<b>Non-structural BMPs</b>	<p><b>Current level</b> – Enforcement of policies to reduce stormwater runoff. Monitoring and maintenance of existing BMPs, e.g. street sweeping.</p> <p><b>Augmented Level</b> – Increasing <i>non-Structural BMP</i> efforts such as enforcement of current policies, and monitoring and maintenance of existing BMPs.</p>
<b>Structural BMPs</b>	<p><b>Current level</b> – The County issues permits in planning stage. Majority implemented in new private construction activities, no public funds.</p> <p><b>Augmented Level</b> – Publicly funded, new installations; retro-fit at existing high volume run-off areas.</p>
<b>Advisories &amp; Warnings</b>	<p><b>Current level</b> – DOH issued advisories through local news broadcasts and a hotline service; use of pre-emptive warnings and/or “Brown Water Advisories” regarding excessive rainfall.</p> <p><b>Augmented Level</b> – Development and implementation of more apparent warnings and advisories, similar to advisories used by the County’s Ocean Safety Division.</p>
<b>Testing</b>	<p><b>Current level</b> – Methods take at least 24 hours to process results following sampling.</p> <p><b>Augmented Level</b> – Implementing testing methods that could provide results within 2-3 hours following sampling.</p>
<b>Education</b>	<p><b>Current level</b> – Efforts include public education programs that describe how the public can reduce beach water pollution, e.g. Storm Drain Stenciling Project, and Public Service Announcements.</p> <p><b>Augmented Level</b> – Implementing more public education programs that describe how the public can reduce beach water pollution.</p>
<b><u>Payment Vehicle</u> Household Annual Wastewater Fee (Resident)</b>	<b>\$0 \$5 \$10 &amp; \$15</b>
<b>Honolulu Airport Transit Fee (Tourist)</b>	<b>\$0 \$1 \$5 &amp; \$10</b>

Given underlying differences of residents and tourists, it was appropriate to have different payment vehicles, both with four levels each. Tourists encountered increases in the


Honolulu Airport transit fee, while residents consider increases in their sewer usage official “Lifeline Allowance” base charge, or more commonly the household annual wastewater fee.


**Figure 5.2: Example Scenario from Policy Choice Experiment**

**Suppose that you could only choose from the beach management policies below. Everything else being the same, which would you prefer?**

Check the button below your choice.

<b>Increasing Non-Structural BMP efforts</b>	<b>Current Non-Structural BMP efforts</b>	<b>Current Non-Structural BMP efforts</b>
<b>Installations of retro-fit Structural BMPs</b>	<b>Current Structural BMP efforts</b>	<b>Installations of retro-fit Structural BMPs</b>
<b>Current Warning/Advisory efforts</b>	<b>More apparent warnings/advisories</b>	<b>More apparent warnings/advisories</b>
<b>Testing/Monitoring results available within 2 to 3 hours after sampling</b>	<b>Testing/Monitoring results available in approximately 24 hours after sampling</b>	<b>Testing/Monitoring results available within 2 to 3 hours after sampling</b>
<b>Current educational efforts</b>	<b>Increasing education efforts</b>	<b>Current educational efforts</b>
<b>Payment of \$10 added to the airport fee</b>	<b>Payment of \$1 added to the airport fee</b>	<b>Payment of \$5 added to the airport fee</b>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Next** 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

16

One key difference in this DCE is that an opt-out/no-choice alternative was not included. In this situation, using a forced choice is more appropriate since tourists and residents in Hawaii cannot exit the market for stormwater and water quality management policies. That is, by residing or visiting Hawaii, each respondent pays the government imposed fee and consumes the services of the water quality management, so including an opt-out alternative is not appropriate (Hensher et al., 2005; Kanninen, 2007). Consequently, it also means that while marginal WTP for improvements is still achievable, identifying total WTP is infeasible.

As shown in the survey instrument (Appendix II), all of the information presented in Table 5.1 and Table 5.2 regarding non-payment vehicle attributes was presented in the same detail to the respondents prior to the DCE. Further, respondents were informed of the current



annual household wastewater fee for residents (\$15.06), and Honolulu airport transit fee for tourists (\$4.50).

## **5.2 Data Collection and Survey Design**

Two versions of the survey instrument were developed for tourists and residents reflecting slight variation in question content, wording, and the appropriate payment vehicles in the choice experiments. Each survey contained choice experiments on recreational beach values and preference for storm water/water quality management strategies, a number of questions related to recreational preferences, and concluded with socio-demographic inquiries.

To have a strong representation of both tourists and residents, the survey was fielded in five locations around Oahu. A professional survey firm distributed the survey from late September to mid-October 2009, requiring that each respondent be at least 18 years old and a citizen of the United States<sup>13</sup>. Potential respondents were approached by survey workers inquiring for their participation in a twenty to thirty minute self-administered, computer-based survey, specifically for educational and environmental purposes only. Those who agreed were escorted to a designated survey area to complete the survey. For completing the survey, each respondent was offered a \$10 Starbucks gift card.

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<sup>13</sup> The five year average from 2007 to 2011, approximately 26.8% of all tourists were not from the United States (Hawaii Tourism Authority 2007, 2008, 2009, 2010, 2011). Any conclusions about the value of beach visits do not apply to tourists from abroad.

## **Chapter 6 Descriptive Statistics**

The samples are fairly representative of their respective populations, as seen in Table 6.1. The stormwater policy DCE analyzes the responses of 400 tourists and 317 completed demographic information. The beach DCE is smaller since its participation was contingent on tourists designating themselves as recreational beach users, yielding 341 responses. The sample of tourists is well-educated and earns a higher income relative to the general U.S. population. This is unsurprising since Hawaii's remote location means traveling to Hawaii is likely more expensive than visiting other vacation destinations. Our sample's intended length of time on Oahu is comparable to historical records, with 53% of respondents intending to stay for 3 to 7 days and another 37% intending to stay more than one week.

In total, 411 residents participated in the survey. Of these 400 were used in the policy DCE, and after removing nonrecreational beach users, 329 residents were used in the choice experiment, with 371 completing socioeconomic information. On average residents were slightly younger and had lower household incomes than an average Hawaii household.

**Table 6.1: Sample Descriptive Statistics**

<b>Characteristics</b>	<b>Hawaii Historical Average<sup>1</sup></b>	<b>Resident Sample</b>	<b>Tourist Sample</b>	<b>US Historical Average<sup>1</sup></b>
<b>Median Household Income (2007-11) <sup>2</sup></b>	\$67, 116	\$56,930	\$75,932	\$52,762
<b>Refused/Ignored Income Question</b>		19.7%	11.5%	
<b>Female</b>	49.9%	52.6%	48.3%	50.8%
<b>Age 25 or older, Associate Degree or More</b>	39.1%	59.1%	68.8%	36.3%
<b>Age 18-25</b>	10.99%	30.7%	27.8%	11.23%
<b>Age 55 or Older</b>	27.8%	12.4%	16.9%	25.5%
<b>Days on Oahu<sup>2</sup></b>			8.0	7.37
<b># of socioeconomic Responses</b>		371	373	
<b>Either DCE</b>		404	401	
<b>Beach DCE</b>		329	351	
<b>Policy DCE</b>		400	397	
<sup>1</sup> Based on information from HTA and the US Census				
<sup>2</sup> Based on midpoint of each available response. Refer to Appendices for more detail.				

## **Chapter 7 Beach Valuation Results**

To estimate the conditional and mixed logit models, as well as the corresponding WTP values, Stata 12 was used. We separate each of the attribute levels into binary-coded indicator variables to allow for different magnitudes of coefficient estimates in predicting beach choice. The reference categories for each attribute are average water quality, average sand quality, average congestion, and safe for experienced swimmers. As mentioned earlier, in the beach choice experiment, we include the dual response as a fourth-opt out alternative, which we interpret as an “Opt-Out” alternative specific constant. While we could study demographic effects through the use of interactions, with the attribute levels to produce systematic effects on how attributes affect selection, we focus our results on the effect of attributes themselves, such that all other characteristics are held constant. Results from the recreational beach Conditional logit model can be seen in Table 7.1.

**Table 7.1: Conditional Logit Results of Recreational Beach Choice Experiment**

<u>Attribute</u>	<u>Resident Coefficient</u>	<u>Tourist Coefficient</u>
	<u>Estimates</u>	<u>Estimates</u>
<b>Opt-Out Constant</b>	-.603** (.097)	-.933** (.096)
<b>Round Trip Travel Cost</b>	-.028** (.004)	-.030** (.004)
<b>Poor Sand Quality</b>	-.456** (.074)	-.574** (.071)
<b>Good Sand Quality</b>	.235** (.066)	.195** (.060)
<b>Excellent Sand Quality</b>	.416** (.067)	.355** (.064)
<b>Poor Water Quality</b>	-.882** (.091)	-1.073** (.091)
<b>Good Water Quality</b>	.469** (.068)	.554** (.063)
<b>Excellent Water Quality</b>	1.155** (.066)	1.247** (.062)
<b>Very Congested</b>	-.510** (.063)	-.317** (.058)
<b>Little Congestion</b>	.279** (.053)	.218** (.050)
<b>Unsafe Waters</b>	-.708** (.064)	-.631** (.060)
<b>Very Safe Waters</b>	.262** (.051)	.301** (.048)
	Pseudo $\rho^2$ =.224 n=3115	Pseudo $\rho^2$ =.274 n=3510
<b>n is the total number of scenarios completed by all respondents.</b>		
<b>**p-value&lt;.01 *p-value&lt;.05; Standard Errors in parentheses</b>		
<b>Note: The base category of each attribute is Average Quality</b>		

Each attribute level is statistically significant, and maintained the anticipated sign. Round trip travel cost had the expected negative sign, indicative of the marginal utility of money, so that as cost of the alternative increases the respondent is less likely to choose that beach alternative. The negative sign of the opt-out constant is interpreted as the dissatisfaction with the inability to go to the beach at the average reference category levels for both groups. Said differently, the opt-out constant is disutility to “do nothing,” implying a preference for policy change. Finally, the significance of all attribute levels provides strong evidence of respondent cognizance for the attributes portrayed visually.

The difference in magnitude between coefficient estimates indicate a clear separation of how the attribute levels affected the likelihood of choosing a specific alternative. Beach users are significantly less likely to choose alternatives with below average sand quality, below average water quality, overcrowded beaches, and unsafe conditions for entering the water. Likewise, respondents are partial to good and excellent water quality, good and excellent sand quality, less congestion, and very safe swimming conditions. While swimming safety conditions are moderately important, changing the frequency of favorable conditions is difficult without large-scale engineering projects. Additionally, differences in magnitude between attribute levels follow theory. Specifically, the likelihood of selecting an alternative with good water (sand) quality is not as great as the likelihood of selecting an alternative with excellent water (sand) quality, all else equal.

Separate mixed logit models for residents and tourists were estimated as reported in Table 7.2, based on 500 Halton draws. The model was formulated to include random parameters (i.e. 10 parameter estimates) for the attribute levels, assuming a normal distribution of individual parameters. The standard deviation of the random parameters for residents and tourists are all statistically significant. This indicates that there is significant heterogeneity in the preferences among tourists and residents to various attribute levels in the DCE. The significant standard deviations provide evidence to reject the validity of the conditional logit model since heterogeneity suggests that the IIA assumption is erroneous.

**Table 7.2: Mixed Logit Results of Recreational Beach Choice Experiment**

<u>Attribute</u>	<u>Residents</u>		<u>Tourists</u>	
	<u>Coefficient</u>	<u>Std. Dev.</u>	<u>Coefficient</u>	<u>Std. Dev.</u>
<b><u>Fixed Parameters</u></b>				
<b>Opt-Out Constant</b>	-.800** (.134)		-1.034** (.121)	
<b>Round Trip Travel Cost</b>	-.051** (.006)		-.051** (.005)	
<b><u>Random Parameters</u></b>				
<b>Poor Sand Quality</b>	-.889** (.137)	1.223** (.156)	-.985** (.119)	1.038** (.138)
<b>Good Sand Quality</b>	.331** (.106)	.655** .151	.270** (0.087)	.435** (.133)
<b>Excellent Sand</b>	.720** (.110)	.747** (.139)	.569** (.092)	.441** (.163)
<b>Poor Water Quality</b>	-2.062** (.210)	1.820** (.215)	-2.363** (.237)	2.025** (.217)
<b>Good Water Quality</b>	.661** (.111)	1.037** (.120)	.826** (.093)	.625** (.113)
<b>Excellent Water Quality</b>	1.720** (.141)	1.938** (.148)	1.873** (.111)	1.181** (.110)
<b>Very Congested</b>	-1.015** (.120)	1.115** (.130)	-.678** (.105)	1.213** (.113)
<b>Little Congestion</b>	.401** (.102)	1.219** (.108)	.201* (.085)	.972** (.096)
<b>Unsafe Waters</b>	-1.526** (.147)	1.559** (.148)	-1.152** (.121)	1.401** (.133)
<b>Very Safe Waters</b>	.419** (.101)	1.308** (.112)	.405** (.086)	1.102** (.096)
	n=3115		n=3510	
	Pseudo $\rho^2$ = .320		Pseudo $\rho^2$ = .337	
<b>n is the total number of scenarios completed by all respondents</b>				
**p-value<.01, *p-value,.05				
Note: The base category of each attribute is <i>Average Quality</i>				
Standard Errors reported in parentheses.				

Mixed logit parameter estimates are similar to conditional logit results. Water quality was still the single greatest indicator of choosing a particular alternative, both as a determinant of increases and decreases in social welfare (excellent water and below average water quality, respectively). Conversely, the rank (in absolute value) of parameter estimates in the conditional and mixed models' results did change modestly. Mixed logit results indicate that poor water quality has the greatest effect on the probability of selecting a beach, followed by excellent water

quality. This emphasizes that improving water quality as described in the choice experiment is the most important means to improve welfare of tourists and residents.

For both groups, good sand quality, very safe waters, and only minor congestion had the least effect on affecting respondent choice. Each attribute's "bad" levels have a greater effect on respondent choice than the respective "good" levels. For example, the effect of unsafe swimming conditions is greater than the presence of very safe conditions, and poor sand quality is relatively more important than excellent or good sand quality. Said differently, beach choice was consistently affected more by users' desire to avoid bad attribute levels rather than to obtain good attribute levels.

Consequently, this indicates that the deleterious effect of one day with brown water advisories in Oahu is harmful to tourists' satisfaction with their trip to Hawaii. Residents also have similar feelings in that bad beach days are 'more memorable' than good ones. The chance of all negative attribute levels occurring simultaneously though seems remote. For instance, a day in which a brown water advisory is issued may indicate poor water and sand quality, but it is also the least likely day to have beachgoers. Additional comparison of tourists and residents using WTP estimates are explored within the Benefit-Cost analysis in Chapter 9.



## Chapter 8 Water Quality Management Results

Similar analysis was conducted for the water management DCE for residents and tourists. We consider both a conditional and the subsequent necessity of a mixed logit model. Since this an unlabeled DCE with no opt-out constant, we run the conditional logit with two alternative specific for the left and right alternatives, as in Table 8.1. This controls for the potential of “left-right” bias, the tendency for respondents to select the alternative furthest left (right) the most (least) frequently.

**Table 8.1: Conditional Logit Model of Water Quality Management Choice Experiment**

<u>Attribute</u>	<u>Resident Coefficient</u>	<u>Tourist Coefficient</u>
<b>Left Alternative Constant</b>	-.264** (.040)	-.271** (.041)
<b>Right Alternative Constant</b>	-.343** (.041)	-.280** (.041)
<b>Wastewater Fee</b>	-.072** (.003)	
<b>Airport Fee</b>		-.108** (.005)
<b>Non-Structural BMP's</b>	.158** (.036)	.162** (.037)
<b>Structural BMP's</b>	.030 (.036)	.081* (.037)
<b>Warning &amp; Advisory System</b>	.144** (.036)	.155** (.037)
<b>Water Quality Testing</b>	.292** (.037)	.500** (.037)
<b>Education</b>	.276** (.035)	.245** (.036)
	Pseudo $\rho^2$ =.073 n=4000	Pseudo $\rho^2$ = .082 n=3970
<b>**p-value&lt;.01, p-value&lt;.05</b>		
<b>Note: The base category of each attribute is Status quo</b>		

Conditional logit results provide a first glimpse of resident and tourist preferences for augmenting Hawaii stormwater management policies. The significant negative sign of the left and right alternative constants indicates that respondents were most likely to select the middle option, followed by the left alternative, and the right alternative least often. As expected, an increase in the annual wastewater fee (for residents) or Honolulu Airport fee (for tourists) decreases the

probability of a respondent selecting that choice. Almost all proposed management strategies are significant at conventional levels, except for Structural BMP's. Respondents are indifferent to Structural BMP's, and instead are much more likely to select an alternative based on other management strategies included.

We further explore taste variation for water quality using a mixed logit model, as in Table 8.2, based on 500 Halton draws. We continue to use a model with two Alternative Specific Constants for the left and right alternative.

**Table 8.2: Mixed Logit Model of Water Quality Management Choice Experiment**

<u>Attribute</u>	<u>Residents</u>		<u>Tourists</u>	
	<u>Coefficient</u>	<u>Std. Dev.</u>	<u>Coefficient</u>	<u>Std. Dev.</u>
<b><u>Fixed Parameters</u></b>				
<b>Left Alt. Constant</b>	-.282** (.046)		-.292** (.047)	
<b>Right Alt. Constant</b>	-.377** (.048)		-.311** (.048)	
<b>Wastewater Fee</b>	-.089** (.004)			
<b>Airport Fee</b>			-.131** (.006)	
<b><u>Random Parameters</u></b>				
<b>Non-Structural BMP's</b>	.211** (.054)	.664** (.065)	.207** (.052)	.573** (.070)
<b>Structural BMP's</b>	.060 (.052)	.585** (.069)	.107* (.051)	.537** (.071)
<b>Warning &amp; Advisory System</b>	.195** (.051)	.570** (.069)	.205** (.054)	.633** (.069)
<b>Water Quality Testing</b>	.389** (.068)	1.033** (.071)	.644** (.072)	1.097** (.073)
<b>Education</b>	.352** (.048)	.464** (.071)	.309** (.051)	.560** (.068)
	Pseudo $\rho^2 = .110$ n= 4000		Pseudo $\rho^2 = .123$ n= 3970	
<b>**p-value&lt;.01, *p-value&lt;.05</b>				
<b>Standard Error reported in parentheses.</b>				
<b>Note: The base category of each attribute is the current, status quo level.</b>				

Based on conventional significance levels of the coefficient estimates, we see that mixed logit results corroborate initial results of the conditional logit in that all management strategies,

less Structural BMP's, significantly affect respondent choice and significantly negative left and right constants persist. Further, we see that all attributes have significant standard deviations, including structural BMP's, indicative of a heterogeneous preferences and responses among respondents when different attributes are present.

The most attractive and influential management strategy for both groups was increased water quality testing efforts, followed by educational efforts. Improvements in Non-Structural BMP's and the warning & advisory system both had similar, smaller coefficient estimates, which mean that their presence had a smaller effect on respondent choice. In general, these results suggest that within a survey approach, tourists and residents are generally in favor of improving the management and quality for coastal recreation.

## Chapter 9 Willingness to Pay and Policy Benefit-Cost Analysis

### 9.1 Willingness to Pay

The remaining step is to generate WTP estimates from the parameter estimates to understand values for recreational beach amenities and to construct a benefit-cost analysis with policy WTP estimates in conjunction with proposed costs for implementation. Using the results from Tables 7.2 and 8.2 and equation (4), one can acquire the WTP for each attribute found in Table 9.1 and Table 9.2. Ninety five percent confidence intervals of these WTP measures were constructed by the Krinsky-Robb approach (1986) based on 5,000 replications.

We first focus on the WTP results of the Beach DCE. The (absolute) rank of the attribute levels remains the same, but is enumerated in dollars for more facile interpretation. We see that for residents and tourists, WTP is greatest to avoid poor water quality (\$40.41 and \$46.57, respectively) followed closely by attaining excellent water quality (\$33.70 and \$36.91, respectively), reaffirming the earlier notion that water is the most important consideration for a beach day. One may expect the residents' value lost to be lower, since they are presumably more experienced and more likely to be surfers than tourists, possibly considering bigger waves to be more enjoyable. However, when it comes to unsafe water related to bacteria, residents may also have more recognition of dangerous water conditions than the average tourist.

An ideal day at the beach, with excellent sand and water, little congestion and ideal safety conditions, provides residents and tourists roughly \$63.87 and \$60.06, respectively, of value. To avoid a terrible beach day, residents and tourists have a WTP of \$107.65, and \$101.64, respectively. In reality, observing each characteristic simultaneously is unlikely. For example, crowding is likely to occur when beach and water conditions are ideal. A potential day at the beach can provide substantial utility for recreationists, information that may be invaluable in providing incentives to preserve Hawaii's near-shore environments.

As in the Beach DCE, the rank of policy WTP attributes corresponds exactly to model results. We compute the WTP for residents and tourists of the various water quality management

strategies, as in Table 9.2. Recall that Resident WTP is based on the coefficient estimate divided by the negative of the annual wastewater fee while Tourist WTP is based on dividing by the negative of the coefficient for the airport fee. WTP results are further explored in the Benefit-Cost analysis outlined below.

To test for significant differences between residents and tourists, we run the convolutions test developed by Poe et al. (1994) via the ‘mde’ package in the statistical package R. The p-values are in the second-to-last column of the tables, labeled ‘Convolutions test.’ Based on this test, none of the attributes for either model are significantly different. As a supplement, we can examine if the Krinsky-Robb confidence intervals of residents and tourists are overlapping as a criteria for significantly different WTP between the two groups. Under this measure, none of the attribute levels are (remotely) different across the two groups. This result is consistent with the p-values derived from the convolutions approach.

Lastly, a separate, unreported model estimated pooled data of tourists and residents. The model uses an interaction term of tourist with each attribute level to test for differences from residents. It was run as a mixed logit model for the non-price attributes, but inherently imposes equal underlying scale variance across groups, which was relaxed in other models analyzed.

The pooled model results were largely consistent with the results of the other methods stated above. Almost all variables are still not significantly different across residents and tourists. We find some evidence that residents have WTP significantly greater to avoid ‘Very Congested’ beaches compared to tourists within the Beach DCE. Additionally, tourists had WTP significantly higher for water quality testing compared to residents in the policy DCE. Except for these differences, the pooled dataset gives results quite similar to the convolutions and confidence intervals criteria. Overall, we feel most confident in the less restrictive, empirical tests based on convolutions and its corroboration from inspection of the confidence intervals. These results support homogenous preferences across the two groups, but with considerable in-group variation.

**Table 9.1: Mean and 95% Confidence Intervals of Marginal Willingness to Pay for Beach Attributes**

<b>Attribute</b>	<b>Resident WTP</b>	<b>95% CI</b>	<b>Tourist WTP</b>	<b>95% CI</b>	<b>Convolutions test</b>
<b>Poor Sand Quality</b>	-17.43	-24.44, -11.79	-19.41	-25.81, -14.24	0.4673
<b>Good Sand</b>	6.48	2.30, 10.60	5.33	1.90, 8.63	0.4721
<b>Excellent Sand</b>	14.12	9.18, 19.75	11.21	7.23, 15.63	0.4438
<b>Poor Water Quality</b>	-40.41	-52.95, -30.73	-46.57	-59.49, -36.10	0.4471
<b>Good Water</b>	12.96	8.41, 19.02	16.29	12.15, 21.51	0.4505
<b>Excellent Water</b>	33.70	26.25, 43.91	36.91	30.13, 45.75	0.4675
<b>Very Congested</b>	-19.90	-26.96, -14.16	-12.96	-17.73, -8.67	0.4116
<b>Little Congestion</b>	7.85	3.77, 12.49	3.97	0.62, 7.64	0.4507
<b>Unsafe Waters</b>	-29.91	-39.99, -22.22	-22.70	-29.91, -16.92	0.4392
<b>Very Safe Waters</b>	8.20	4.27, 12.68	7.97	4.65, 11.77	0.4887
<b>Confidence Intervals are based on Krinsky-Robb approach</b>					
<b>Convolutions P-value column based on Poe convolutions test conducted in R using mded package</b>					
<b>Pooled p-value based on t-tests of interactions of the attribute level with an indicator variable of tourists in a combined data of tourists and residents</b>					

**Table 9.2 Mean and 95% Confidence Intervals of Marginal Willingness to Pay for Stormwater Management Policies**

<b><u>Attribute</u></b>	<b><u>Resident WTP</u></b>	<b><u>95% CI</u></b>	<b><u>Tourist WTP</u></b>	<b><u>95% CI</u></b>	<b><u>Convolutions test</u></b>
<b>Non-Structural BMP's</b>	2.36	1.12, 3.55	1.58	.76, 2.36	0.4481
<b>Structural BMP's</b>	0.67	-0.41, 1.71	.82	.10, 1.52	0.4928
<b>Warning &amp; Advisory System</b>	2.18	1.12, 3.37	1.57	.80, 2.42	0.4762
<b>Water Quality Testing</b>	4.35	2.91, 5.81	4.92	3.88, 6.04	0.4829
<b>Education</b>	3.93	2.83, 5.02	2.36	1.59, 3.14	0.4132
<b>Confidence Intervals are based on Krinsky-Robb approach</b>					
<b>Convolutions P-value column based on Poe convolutions test conducted in R using mded package</b>					
<b>Pooled p-value based on t-tests of interactions of the attribute level with an indicator variable of tourists in a combined data of tourists and residents</b>					

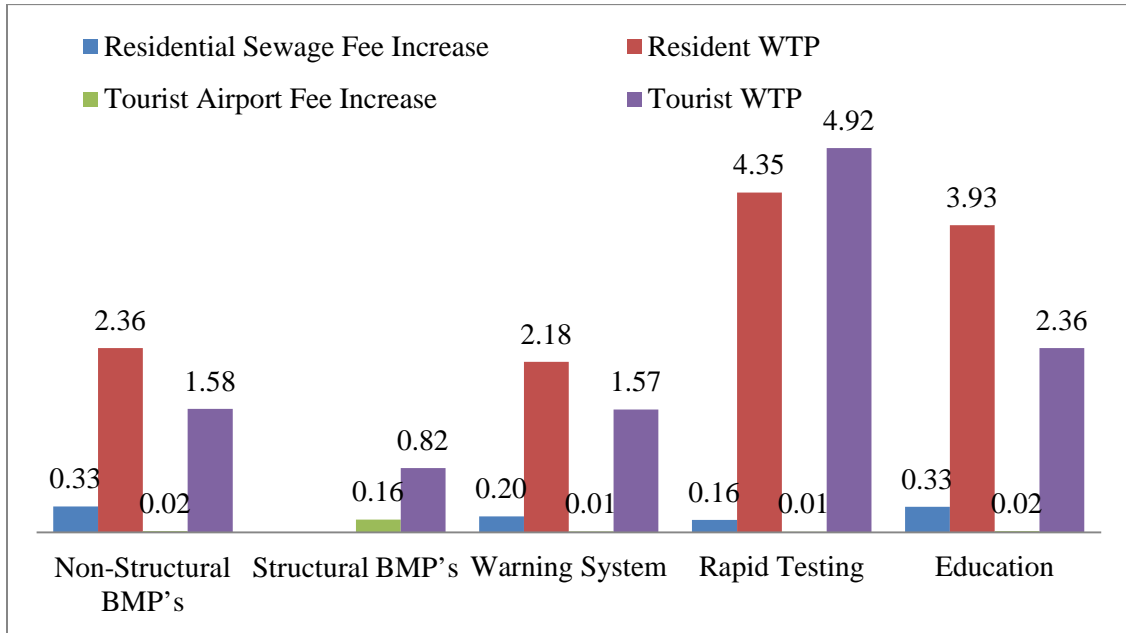
## **9.2 Benefit-Cost Analysis**

To know if more water quality management is a worthwhile pursuit we consider a brief Benefit-Cost analysis. We ascertain costs for the proposed stormwater policy expansions for prevention, monitoring, and education of stormwater management, which were based on expert opinion from interviews of several directors within Oahu's government. These cost estimates can be coupled with the results of the Policy DCE and corresponding WTP to offer an analysis on the perceived benefit of water quality strategies by residents and tourists, relative to the expected expenses, a benefit-cost analysis.

In order to estimate the cost per resident and tourist, we divide the expense of implementing each strategy (i.e. the DCE attributes) so that half is of total costs are paid by residents and half by tourists. Even though the household (residence) and individual (tourist) payment vehicles are different, we can account for these differences to understand the benefit of pursuing water quality management strategies. Residential costs are based on the 2007-2011 estimate of 307,248 occupied housing units on Oahu (U.S. Census Bureau, 2007-2011), which is analogous to the household wastewater fee currently paid by residents. The remaining half of expenses is divided by 6,944,399, the average number of visitor flight arrivals from 2007 to 2011 (Hawaii Tourism Authority, 2007-2011), again most akin to the tourist payment vehicle, Honolulu Airport fee.



**Figure 9.1 Comparison of Cost to Implement Stormwater Management Policies and corresponding Willingness to Pay**



In 2009 (when survey was conducted) there were 6,420,448 total arrivals by air. Additionally, Honolulu’s airport fee was \$4.50 at the time. In 2009, each Hawaii household pays \$15.06 per year for sewage utility fee.

The red and mauve columns are graphical representations of Table 9.2’s information on resident and tourist WTP information, respectively. The blue and green columns are the calculated costs to residents and tourists for proposed increases as suggested by agency leaders in Oahu. The figure makes it apparent that WTP is tremendously greater than the cost of implementation. The costs per person are trivial relative to the WTP to implement these strategies. Structural BMP’s, which include physical installations to reduce the volume and flow of stormwater, did not significantly affect residents’ probability of selecting an alternative, nor WTP. As a result, we allocate the entire cost of implementation to tourists instead of dividing by two as for the other strategies (i.e. \$.16 rather than \$.08). Residents’ total WTP to implement all strategies is \$11.25, versus the total cost of \$.21. Tourists faced a greater cost of \$1.02 due to the smaller of households, but still had WTP much greater at \$12.82.

From a critical perspective, one may conjecture that the fictitious decision-making process elicits hypothetical bias. We consider this by applying a conservative calibration factor of 3.13 from Little and Berrens (2004). Even under this circumstance, the WTP for every (significant) policy is greater the cost of implementation. Similarly, if we suppose that costs are five times greater than what was provided by experts, almost all strategies should still be pursued for residents and tourists.

## Chapter 10 Conclusions and Implications

The purpose of this study is to understand the preferences and tradeoffs of both residents and tourists for recreational beach attributes and policies to mitigate and detect harmful waters related to stormwater pollution. We accomplish both goals utilizing a Discrete Choice Experiment of Oahu residents and tourists. Concerning the recreational Beach DCE, we find that all of the attributes and their levels are statistically significant at conventional levels, which includes sand quality, water quality, levels of beach congestion, and swimming safety conditions. The results suggest that for both residents and tourists, the likelihood of selecting an alternative (and the subsequent WTP) is most affected by avoiding unpleasant levels rather than obtaining superb levels for all attributes. In the mixed logit analysis, we find that the likelihood of selecting an alternative is significantly different across respondents, i.e. significant variance in the parameter attributes. This supports evidence against IIA, though the parameter estimates of both DCE's are quite similar and robust across for models.

For residents and tourists, water quality, communicated both aesthetically and as a health risk, was significant at all levels and the most important feature of beach recreation, first to avoid poor water quality, followed by obtaining excellent water quality. This result is consistent with Beharry-Borg and Scarpa (2010), who found WTP to avoid increased rates of ear infection as greater than the WTP to obtain decreased rates of ear infection. Conversely, this study's highest WTP to improve from poor to average water quality at approximately \$45 is still less than the \$54 estimated by Loomis & Santiago (2013). Our result is dissimilar to Eggert and Olsson (2009) who found water quality to have the smallest marginal WTP. It may be that water quality was conveyed in their study by the percentage of days of excessive foreign contaminants, whose implications may be less cognizant in the minds of respondents. Water's importance to recreational users is a promising result in that water quality can be mitigated and be greatly affected by stormwater policy.

The importance and WTP of “bad” levels was consistently greater than “good” levels within particular attributes. This would seem to provide evidence and study for prospect theory (Kahneman & Tversky, 1979). The difficulty is the qualitative nature of each attribute and level such that rigorous, quantitative study for prospect theory is intractable. Nevertheless, the greatest benefits to society coincide at least generally with diminishing marginal utility.

In the second choice experiment, we find that tourists and residents have a positive stated WTP for water quality management strategies, except for residents’ indifference to Structural BMPs. Both groups are most in favor of faster test results of water quality followed by increased educational efforts. The implementation of Nonstructural BMP’s and a new warning and advisory system were less influential on choice, but still significantly affected policy choice. As in the first DCE, mixed logit results suggest that the likelihood of selecting an alternative with the presence a particular attribute was significantly different across respondents via significant standard deviations of the random parameters.

An unexpected result of the policy DCE is respondents’ disinterest in structural best management practices such as sediment basins that reduce and slow the volume of stormwater runoff. These physical structures will provide relatively explicit and tangible benefits relative to some of the management strategies whose benefits are less well known. For instance, it would be difficult to identify actual behavioral change of residents and tourists if more education dollars were spent.

Except for structural BMP’s, we find that the cost of implementation for the various strategies is lower than the stated WTP to adopt the strategies. The most valued management strategy was more rapid water quality testing, especially for tourists, followed by education. It is seems unclear if there are underlying preferences of the consumer that motivate the particular outcomes. For example, if respondents were driven by personal benefit, it would follow that water quality testing *and* an improved warning system would have prominence, relative to BMP’s

and education, which are public goods. It may be that more explicit communication and recognition of the benefits from each strategy would provide further insight into preferences.

Lastly, using various tests, few variables were significantly different across tourists and residents. It may please leaders to know that their efforts for beach protection and policy strategies will benefit their residents and tourists nearly equitably, with both groups have the same ordinal preferences both across and within attributes. This is encouraging since government resources can be spent on the same efforts rather than segmenting into each groups desires. If policymakers were to make tailored policies, they ought to focus on crowding for residents and water quality testing for tourists.

The results are not without limitation though. As before, total value of policy is infeasible due to the inability to opt-out. If one were to estimate aggregate economic values though, it seems reasonable that the measured benefits are a lower bound since improved beach recreational quality or improved water quality management strategies would induce increased visits by tourists and residents. Further, there is difficulty to compare economic values of the two groups based on the different payment mechanisms and fundamental differences of the two groups such as number of days or time spend at the beach. Lastly, it may be that the importance of water quality relative to other features is due to its pictorial *and* written description that draws more attention of the respondent.

Policymakers should move forward with implementation to protect coastal waters, mitigate stormwater pollution, and increase recreational value to patrons. The results signify that Oahu residents and tourists value their beaches and recognize the importance to invest in marine quality protection. Policymakers are equipped to advance strategies that appear most useful from the perspective of policymakers, residents, and tourists.

## **Appendices**

### **Appendix I: Resident Survey**

Aloha Oahu Resident:

We are conducting a survey of local residents and tourists at Oahu beaches to better understand users' attitudes and perceptions about these beaches. You will be asked questions regarding your trips to Oahu beaches and to make choices about different situations relative to Oahu beaches and their management. Your answers to the survey questions are very important to us.

You have been randomly selected to be a participant. The survey requires about 20-30 minutes to complete. If at any time you have a question about the survey, please do not hesitate to ask the survey team member. To compensate you for your time and participation, upon completion of the survey you will be offer a \$10 Starbucks card.

No known risks are associated with this research. Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

You may be assured of complete confidentiality. The questionnaire has an identification number for data management quality only. Your name will never be placed on the questionnaire itself, and all names will be destroyed as soon as the data collection is complete.

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Linda Cox at the University of Hawaii at (808) 956-7602. Additionally, all future study results will be available to view at [www.ctahr.hawaii.edu/CoxL](http://www.ctahr.hawaii.edu/CoxL). If you have any questions or concerns about your rights as a research participant, please contact the University of Hawaii Committee on Human Studies at (808) 956-5007.

Finally, we appreciate your willingness to consider our request and we thank you in advance for your help in understanding visitor needs and preferences at Oahu beach locations.

---

Aloha Oahu Resident,

Thank you again for your willingness to help us understand visitor needs and preferences at Oahu beach locations.

---

Please click on the "Next" button to continue.

Next 

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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1

For research purposes, "Recreation Beach Use" is a visit to a beach with the intention to sunbathe and swim in the ocean for a period of time of no less than half an hour. Also, "Swimming Activity" for this survey is entrance into the ocean and immersing at least half of your body in the water.


Would you consider yourself a **Recreation Beach User** ?

---

- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

---

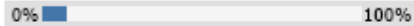
2

Do you often go swimming during a beach visit?

- Yes
- No

Select one answer and click "Next" to continue.

Next 

0%  100%


Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

3

When you visit the beach how would you rate the following on your choice of which beach to visit for **recreation beach use**? Please use a scale of 1 to 5, with 1 being not important and 5 being very important.

	Not important				Very important
	1	2	3	4	5
Round trip travel cost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water entry/swimming safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Congestion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of sand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select one rating for each row and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

4



---

**Think about your current and recent visitations to Oahu beach destinations for the purpose of sunbathing, recreational beach activities, and swimming/wading in the water.**

If a factor is not mentioned (i.e., weather or height of surf,...) please assume it would be the same for each beach and only consider the differences between the choices and attributes listed. There are no 'right' or 'wrong' answers, we would like to know what beach characteristics you like or dislike.

Each of the following questions offers three different Oahu beach descriptions at a time. Please indicate the beach you like the most. Next indicate whether you would actually visit that beach.

---

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

---

Here's an **example**:

Suppose that you could only choose from the beach trips below. Which would you prefer?  
Check the button below your choice.

		
Probability of becoming ill from swimming occurs in 5 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 25 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 19 out of every 1000 healthy adults.
Round trip travel cost of gasoline is \$20	Round trip travel cost of gasoline is \$0	Round trip travel cost of gasoline is \$5



If you choose this beach click  
this circle

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

Suppose that you could only choose from the beach trips below. Which would you prefer?  
Check the button below your choice.

		
Probability of becoming ill from swimming occurs in 5 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 25 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 12 out of every 1000 healthy adults.
Round trip travel cost of gasoline is \$5	Round trip travel cost of gasoline is \$15	Round trip travel cost of gasoline is \$20

Would you really go to the beach you chose above?

- Yes  
 No

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

7

Do you think the color of the water indicates the probability of incurring an illness?

- Yes  
 No

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.


8

Which of these activities do you take part in and how frequently?

	Never	A few times a year	At least one visit per month	2 to 5 visits per month	Over 5 visits per month
Swimming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recreational Beach Use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Snorkeling/Scuba	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wind Surfing/Kite Boarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Surfing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beach Volleyball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select all that apply and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

How would you rate the importance of the following beach amenities?

	Very Unimportant 1	Unimportant 2	Neutral 3	Important 4	Very Important 5
Presence of lifeguards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Picnic area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Paved parking area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrooms/showers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rentals for ocean recreation activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select one rating for each row and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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### **Stormwater Runoff Management and Beach Recreation**

Stormwater runoff is rain that rinses over roads, rooftops, and other impervious surfaces, and carrying pollutants into surface waters. Examples of pollutants include: oil, grease, heavy metals, pesticides, fertilizers and animal wastes. These pollutants can be a source of illness to recreational users. We are interested in how stormwater runoff management affects the way you value Oahu beaches for beach recreation.

Current Federal sources estimate that 19/of every 1000 healthy adults contract gastrointestinal (stomach) illnesses from recreating in coastal waters. Hawaii's testing standards are the same as the National testing standards set by the Environmental Protection Agency. In addition, Hawaii also test's for a second fecal indicator. The state's bacteria indicators of disease are:

- › **Enterococcus** - warnings are issued when results exceed single-sample maximum of 104 cfu/100 ml and a geometric mean standard of 35 cfu/100 ml; and
- › **Clostridium perfringens** - warnings are issued when results exceed 50 cfu/100 ml.

Testing takes at least 24 hours to process. These standards do not eliminate the risk of illness. The beach monitoring program prioritizes sampling based on the risk of illness to swimmer use level of the beach.

Hawaii's Department of Health does not have the authority to close beaches in response to storm water runoff. Instead, advisories are issued through local news broadcasts and/or a hotline service. The state also issues pre-emptive warnings and/or "Brown Water Advisories" when excessive rainfall occurs.

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Please click on the "Next" button to continue.



Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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**Current** coastal recreational water quality management efforts include:

**Preventative Measures** to reduce the amount of storm water runoff into coastal waters, using Best Management Practices (BMPs) such as:

*Non-Structural BMPs*

- › Enforcement of policies to reduce stormwater runoff
- › Monitoring and maintenance of existing BMPs, e.g. street sweeping

*Structural BMPs*

› Installations such as sediment basins and/or manufactured systems, which slow, decrease the volume of and filter sediment of stormwater runoff. Currently, permits are issued by the County when a structural BMP is planned to be constructed. Majority of Structural BMPs implemented in new private construction activities, not supplemented by public funds.

**Testing and Advisory Policies** described above to forecast and indicate coastal water quality to the public

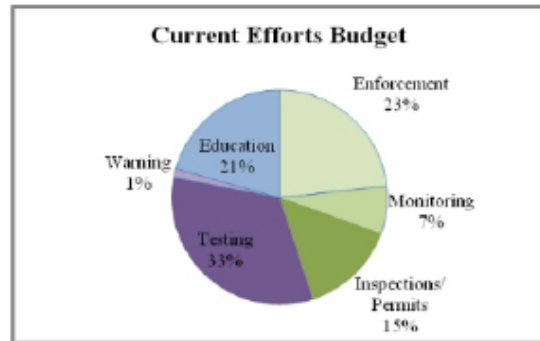
*Warnings/Advisories*

- › Advisories are issued through local news broadcasts and/or a hotline service
- › State also issues pre-emptive warnings and/or "Brown Water Advisories" when excessive rainfall occurs

*Testing/Monitoring*

- › Testing methods take at least 24 hours to process results following sampling

**Education Efforts** which implement public education programs that describe how the public can reduce beach water pollution, e.g. Storm Drain Stenciling Project, and Public Service Announcements



\* Data obtained from City and County of Honolulu, Division of Environmental Quality Dept. of Environmental Services, Storm Water Quality Branch & State of Hawaii Department of Health Monitoring and Analysis Section Clean Water Branch

Please click on the "Next" button to continue.

Next



Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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**Additional** coastal recreational water quality management options can be as follows:

**Preventative Measures** that could be undertaken by the County to decrease the amount of stormwater polluted runoff entering coastal waters:

- 7 Increasing Non-Structural BMPs efforts such as permitting, enforcement of current policies, monitoring and maintenance of existing BMPs.
- 7 Installations by the County, thus publicly funded, of retro-fit Structural BMPs at existing areas identified as major sources of stormwater pollution.

**Testing and Advisory Policies** that could be undertaken by the County to decrease coastal water users' probabilities of incurring an illness:

*Warnings/Advisories*

- 7 Development and implementation of more apparent warnings and advisories, similar to advisories used by the County's Ocean Safety Division

*Testing/Monitoring*

- 7 Implementing testing methods that could provide results within 2-3 hours following sampling

**Education Efforts** which could be implemented by the County to increase knowledge about the effects of polluted stormwater runoff:


- 7 Implementing more public education programs that describe how the public can reduce beach water pollution.

To effectively enact more coastal recreational management options requires increasing the budgets of State and County agencies. A payment in the form of an increase in Residential base charge wastewater fees currently **\$15.06** per household/year would have to be charged with any scenario other than the current status quo.

---

Please click on the "Next" button to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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Each of the following questions shows three different **beach management policy descriptions** at a time. Please read the policy descriptions carefully and indicate the one you like the most on each page.

There are no 'right' or 'wrong' answers; only your personal preferences. Some descriptions may look better to you than others; we want to know what you think.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

14

Here's an **example**:

**Suppose that you could only choose from the beach management policies below. Everything else being the same, which would you prefer?**

Check the button below your choice.

Current Non-Structural BMP efforts	Increasing Non-Structural BMP efforts	Increasing Non-Structural BMP efforts
Current Structural BMP efforts	Installations of retro-fit Structural BMPs	Installations of retro-fit Structural BMPs
Current Warning/ Advisory efforts	More apparent warnings/ advisories	Current Warning/ Advisory efforts
Testing/Monitoring results available in approximately 24 hours after sampling	Testing/Monitoring results available within 2 to 3 hours after sampling	Testing/Monitoring results available in approximately 24 hours after sampling
Increasing education efforts	Current educational efforts	Current educational efforts
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.


15

Suppose that you could only choose from the beach management policies below. Everything else being the same, which would you prefer?

Check the button below your choice.

Increasing Non-Structural BMP efforts	Current Non-Structural BMP efforts	Current Non-Structural BMP efforts
Installations of retro-fit Structural BMPs	Current Structural BMP efforts	Installations of retro-fit Structural BMPs
Current Warning/Advisory efforts	More apparent warnings/advisories	More apparent warnings/advisories
Testing/Monitoring results available within 2 to 3 hours after sampling	Testing/Monitoring results available in approximately 24 hours after sampling	Testing/Monitoring results available within 2 to 3 hours after sampling
Current educational efforts	Increasing education efforts	Current educational efforts
Payment of \$15 added to household Annual Wastewater fee	Payment of \$5 added to household Annual Wastewater fee	Payment of \$10 added to household Annual Wastewater fee

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

16

The following questions ask for some important information about your household. Remember, your answers are completely confidential. This information is for statistical purposes only.

Which of the following includes your age?

- 18 to 25 years old
- 26 to 35
- 36 to 45
- 46 to 55
- 55 or older
- Refuse to answer

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

17

What is your annual household income?

---

- Less than \$15,000
  - \$15,000 to \$29,999
  - \$30,000 to \$44,999
  - \$45,000 to \$59,999
  - \$60,000 to \$74,999
  - \$75,000 to \$89,999
  - \$90,000 to \$104,999
  - \$105,000 to \$119,999
  - \$120,000 or more
  - Don't know
  - Refuse to answer
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.

18

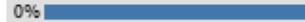
Please indicate your gender.

---

- Male
  - Female
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.

19

What level of schooling do you have?

---

- High School Degree
  - College Degree
  - Graduate Degree
  - None of the above
  - Refuse to answer
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.

20

Are you or have you ever been member of an environmental organization?

---

- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.


21

Prior to taking this survey were you aware of the issue of storm water pollution affects on coastal water quality?

- 
- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

22

Would you support a ban on smoking on all Oahu beaches?

- 
- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%


Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

23

If the chances of incurring an illness from bathing in Oahu's coastal water were decreased, would you use the beach more often?

- Yes
- No

Select one answer and click "Next" to continue.

Next 

0%  100%


Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.


24

How much more would you use Oahu's beaches per year?

- Less than 5% more
- 5% to 14% more
- 15% to 24% more
- 25% or more
- Don't know

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

25

Would you support a County Storm Water Maintenance Utility fee?

- Yes
- No

Select one answer and click "Next" to continue.


Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.

26

What is your residential zip code?

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.

27

## **Appendix II: Tourist Survey**

Aloha Oahu Visitor:

We are conducting a survey of local residents and tourists at Oahu beaches to better understand users' attitudes and perceptions about these beaches. You will be asked questions regarding your trip and to make choices about different situations relative to Oahu beaches and their management. Your answers to the survey questions are very important to us.

You have been randomly selected to be a participant. The survey requires about 20-30 minutes to complete. If at any time you have a question about the survey, please do not hesitate to ask the survey team member. To compensate you for your time and participation, upon completion of the survey you will be offered a \$10 Starbucks card.

No known risks are associated with this research. Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

You may be assured of complete confidentiality. The questionnaire has an identification number for data management quality only. Your name will never be placed on the questionnaire itself, and all names will be destroyed as soon as the data collection is complete.

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Linda Cox at the University of Hawaii at (808) 956-7602. Additionally, all future study results will be available to view at [www.ctahr.hawaii.edu/CoxL](http://www.ctahr.hawaii.edu/CoxL). If you have any questions or concerns about your rights as a research participant, please contact the University of Hawaii Committee on Human Studies at (808) 956-5007.

Finally, we appreciate your willingness to consider our request and we thank you in advance for your help in understanding visitor needs and preferences at Oahu beach locations.



---

Aloha Oahu Visitor,

Thank you again for your willingness to help us understand visitor needs and preferences at Oahu beach locations.

---

Please click on the "Next" button to continue.

Next 

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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1

For research purposes, "Recreation Beach Use" is a visit to a beach with the intention to sunbathe and swim in the ocean for a period of time of no less than half an hour. Also, "Swimming Activity" for this survey is entrance into the ocean and immersing at least half of your body in the water.

Would you consider yourself a **Recreation Beach User** ?

---

- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

---

2

Do you often go swimming during a beach visit?

- Yes
- No

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

3

When you visit the beach how would you rate the following on your choice of which beach to visit for **recreation beach use**? Please use a scale of 1 to 5, with 1 being not important and 5 being very important.

	Not important 1	2	3	4	Very important 5
Round trip travel cost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water entry/swimming safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Congestion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of sand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select one rating for each row and click "Next" to continue.

Next 

0%  100%

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4

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**Think about your current and recent visitations to Oahu beach destinations for the purpose of sunbathing, recreational beach activities, and swimming/wading in the water.**

If a factor is not mentioned (i.e., weather or height of surf,...) please assume it would be the same for each beach and only consider the differences between the choices and attributes listed. There are no 'right' or 'wrong' answers, we would like to know what beach characteristics you like or dislike.

Each of the following questions offers three different Oahu beach descriptions at a time. Please indicate the beach you like the most. Next indicate whether you would actually visit that beach.

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Next 



Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

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Here's an **example**:

Suppose that you could only choose from the beach trips below. Which would you prefer?  
Check the button below your choice.

		
Probability of becoming ill from swimming occurs in 5 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 25 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 19 out of every 1000 healthy adults.
Round trip travel cost of gasoline is \$20	Round trip travel cost of gasoline is \$0	Round trip travel cost of gasoline is \$5



If you choose this beach click this circle

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
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Suppose that you could only choose from the beach trips below. Which would you prefer?  
Check the button below your choice.

		
Probability of becoming ill from swimming occurs in 5 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 25 out of every 1000 healthy adults.	Probability of becoming ill from swimming occurs in 12 out of every 1000 healthy adults.
Round trip travel cost of gasoline is \$5	Round trip travel cost of gasoline is \$15	Round trip travel cost of gasoline is \$20

Would you really go to the beach you chose above?

- Yes  
 No

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
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7

How did you learn about which beaches to visit?

- Concierge/Hotel service desk  
 Guide book/Website  
 Other visitors  
Other (please specify:)

Select all that apply and click "Next!" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
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8

Do you think the color of the water indicates the probability of incurring an illness?

- Yes  
 No

Select one answer and click "Next" to continue.

Next 

0%  100%

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9

How would you rate the importance of the following beach amenities?

	Very Unimportant 1	Unimportant 2	Neutral 3	Important 4	Very Important 5
Presence of lifeguards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Picnic area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Paved parking area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restrooms/Shower	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rentals for ocean recreation activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select one rating for each row and click "Next" to continue.

Next 

0%  100%

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10

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### **Stormwater Runoff Management and Beach Recreation**

Stormwater runoff is rain that rinses over roads, rooftops, and other impervious surfaces, and carrying pollutants into surface waters. Examples of pollutants include: oil, grease, heavy metals, pesticides, fertilizers and animal wastes. These pollutants can be a source of illness to recreational users. We are interested in how stormwater runoff management affects the way you value Oahu beaches for beach recreation.

Current Federal sources estimate that 19/of every 1000 healthy adults contract gastrointestinal (stomach) illnesses from recreating in coastal waters. Hawaii's testing standards are the same as the National testing standards set by the Environmental Protection Agency. In addition, Hawaii also test's for a second fecal indicator. The state's bacteria indicators of disease are:

- 1 **Enterococcus** - warnings are issued when results exceed single-sample maximum of 104 cfu/100 ml and a geometric mean standard of 35 cfu/100 ml; and
- 1 **Clostridium perfringens** - warnings are issued when results exceed 50 cfu/100 ml.

Testing takes at least 24 hours to process. These standards do not eliminate the risk of illness. The beach monitoring program prioritizes sampling based on the risk of illness to swimmer use level of the beach.

Hawaii's Department of Health does not have the authority to close beaches in response to storm water runoff. Instead, advisories are issued through local news broadcasts and/or a hotline service. The state also issues pre-emptive warnings and/or "Brown Water Advisories" when excessive rainfall occurs.

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**Please click on the "Next" button to continue.**



Please ask for assistance from a survey team member if needed.  
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**Current** coastal recreational water quality management efforts include:

**Preventative Measures** to reduce the amount of storm water runoff into coastal waters, using Best Management Practices (BMPs) such as:

*Non-Structural BMPs*

- 1 Enforcement of policies to reduce stormwater runoff
- 1 Monitoring and maintenance of existing BMPs, e.g. street sweeping

*Structural BMPs*

1 Installations such as sediment basins and/or manufactured systems, which slow, decrease the volume of and filter sediment of stormwater runoff. Currently, permits are issued by the County when a structural BMP is planned to be constructed. Majority of Structural BMPs implemented in new private construction activities, not supplemented by public funds.

**Testing and Advisory Policies** described above to forecast and indicate coastal water quality to the public

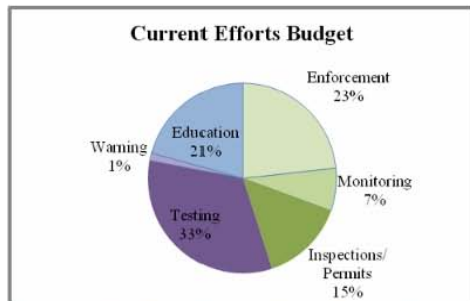
*Warnings/Advisories*

- 1 Advisories are issued through local news broadcasts and/or a hotline service
- 1 State also issues pre-emptive warnings and/or "Brown Water Advisories" when excessive rainfall occurs

*Testing/Monitoring*

- 1 Testing methods take at least 24 hours to process results following sampling

**Education Efforts** which implement public education programs that describe how the public can reduce beach water pollution, e.g. Storm Drain Stenciling Project, and Public Service Announcements



\* Data obtained from City and County of Honolulu, Division of Environmental Quality Dept. of Environmental Services, Storm Water Quality Branch & State of Hawaii Department of Health Monitoring and Analysis Section Clean Water Branch

Please click on the "Next" button to continue.



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**Additional** coastal recreational water quality management options can be as follows:

**Preventative Measures** that could be undertaken by the County to decrease the amount of stormwater polluted runoff entering coastal waters:

- 1 Increasing Non-Structural BMPs efforts such as permitting, enforcement of current policies, monitoring and maintenance of existing BMPs.
- 2 Installations by the County, thus publicly funded, of retro-fit Structural BMPS at existing areas identified as major sources of stormwater pollution.

**Testing and Advisory Policies** that could be undertaken by the County to decrease coastal water users' probabilities of incurring an illness:

*Warnings/Advisories*

- 1 Development and implementation of more apparent warnings and advisories, similar to advisories used by the County's Ocean Safety Division

*Testing/Monitoring*

- 1 Implementing testing methods that could provide results within 2-3 hours following sampling

**Education Efforts** which could be implemented by the County to increase knowledge about the effects of polluted stormwater runoff:

- 1 Implementing more public education programs that describe how the public can reduce beach water pollution.

To effectively enact more coastal recreational management options requires increasing the budgets of State and County agencies. A payment in the form of an addition to the Honolulu Airport transit fees currently \$4.50 per person would have to be assessed with any scenario other than the current status quo.

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**Please click on the "Next" button to continue.**



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Each of the following questions shows three different **beach management policy descriptions** at a time. Please read the policy descriptions carefully and indicate the one you like the most on each page.

There are no 'right' or 'wrong' answers; only your personal preferences. Some descriptions may look better to you than others; we want to know what you think.

Next 



Please ask for assistance from a survey team member if needed.  
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Here's an **example**:

**Suppose that you could only choose from the beach management policies below. Everything else being the same, which would you prefer?**

Check the button below your choice.

Current Non-Structural BMP efforts	Increasing Non-Structural BMP efforts	Increasing Non-Structural BMP efforts
Current Structural BMP efforts	Installations of retro-fit Structural BMPs	Installations of retro-fit Structural BMPs
Current Warning/ Advisory efforts	More apparent warnings/ advisories	Current Warning/ Advisory efforts
Testing/ Monitoring results available in approximately 24 hours after sampling	Testing/ Monitoring results available within 2 to 3 hours after sampling	Testing/ Monitoring results available in approximately 24 hours after sampling
Increasing education efforts	Current educational efforts	Current educational efforts
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

Next 



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**Suppose that you could only choose from the beach management policies below. Everything else being the same, which would you prefer?**

Check the button below your choice.

Increasing Non-Structural BMP efforts	Current Non-Structural BMP efforts	Current Non-Structural BMP efforts
Installations of retro-fit Structural BMPs	Current Structural BMP efforts	Installations of retro-fit Structural BMPs
Current Warning/Advisory efforts	More apparent warnings/advisories	More apparent warnings/advisories
Testing/Monitoring results available within 2 to 3 hours after sampling	Testing/Monitoring results available in approximately 24 hours after sampling	Testing/Monitoring results available within 2 to 3 hours after sampling
Current educational efforts	Increasing education efforts	Current educational efforts
Payment of \$10 added to the airport fee	Payment of \$1 added to the airport fee	Payment of \$5 added to the airport fee
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Next 

0%  100%

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16

The following questions ask for some important information about your household. Remember, your answers are completely confidential. This information is for statistical purposes only.  
How long do you plan to visit the island of Oahu?

- 
- Less than 3 days
  - 3 to 7 days
  - 1 to 2 weeks
  - More than 2 weeks
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

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17

Which of the following includes your age?

- 18 to 25 years old
- 26 to 35
- 36 to 45
- 46 to 55
- 55 or older
- Refuse to answer

Select one answer and click "Next" to continue.

Next 

0%  100%

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18

What is your annual household income?

- Less than \$15,000
- \$15,000 to \$29,999
- \$30,000 to \$44,999
- \$45,000 to \$59,999
- \$60,000 to \$74,999
- \$75,000 to \$89,999
- \$90,000 to \$104,999
- \$105,000 to \$119,999
- \$120,000 or more
- Don't know
- Refuse to answer

Select one answer and click "Next" to continue.

Next 

0%  100%

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19

Please indicate your gender.

- Male
- Female

Select one answer and click "Next" to continue.

Next 

0%  100%

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of Hawaii at 808-956-7602.

20

What level of schooling do you have?

- High School Degree
- College Degree
- Graduate Degree
- None of the above
- Refuse to answer

Select one answer and click "Next" to continue.

Next 

0%  100%

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of Hawaii at 808-956-7602.

21

Are you or have you ever been member of an environmental organization?

- 
- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

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of Hawaii at 808-956-7602.

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22

Prior to taking this survey were you aware of the issue of storm water pollution affects  
on coastal water quality?

- 
- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University  
of Hawaii at 808-956-7602.

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23

Would you support a ban on smoking on all Oahu beaches?

- 
- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

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of Hawaii at 808-956-7602.

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24

If the chances of incurring an illness from bathing in Oahu's coastal water were decreased, would you use the beach more often?

- 
- Yes
  - No
- 

Select one answer and click "Next" to continue.

Next 

0%  100%

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25

How much more would you use Oahu's beaches during your visit?

- Less than 5% more
- 5% to 14% more
- 15% to 24% more
- 25% or more
- Don't know

Select one answer and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
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26

What is your residential zip code?

If you are a tourist, what is your Oahu zip code for this visit?

Type zip code and click "Next" to continue.

Next 

0%  100%

Please ask for assistance from a survey team member if needed.  
For questions or problems about this study, please contact Dr. Linda Cox at the University of Hawaii at 808-956-7602.

27



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- Whitehead, J. C., Dumas, C. F., Hill, J., & Buerger, B. (2008). Valuing beach access and width with revealed and stated preference data. *Marine Resource Economics*, 23(2), 119.
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- Wiser, R. H. (2007). Using contingent valuation to explore willingness to pay for renewable energy: a comparison of collective and voluntary payment vehicles. *Ecological Economics*, 62(3), 419-432.

## Vita

### Jerrod Penn

#### Education

- Cumulative Graduate GPA: 4.0  
Agricultural Economics, University of Kentucky  
Major Professor: Wuyang Hu wuyang.hu@uky.edu
- BA Economics *Suma Cum Laude* GPA 3.94 08/10
- BA Political Science *Cum Laude* with a focus in global political economy 08/10  
Minor Business Administration & Food and Resource Economics  
Political Science Certificate in International Relations  
University of Florida, Gainesville, FL  
Undergraduate Advising Professor: Lisa House lahose@ufl.edu

#### Teaching Experience (4 point scale)

- Main Instructor, AEC 300 “Economic Perspectives of Current Environmental Issues”  
Spring 2014
- Main Instructor, AEC 300 “A Competitive Edge to Ag Economics”  
Fall 2012 & 2013  
Fall 2012, 10 students, Value of course 3.9, Quality of teaching 3.9
- Co-Instructor, AEC 580, Agricultural Economics Special Topics (3 times)  
Spring 2011, 2012 & 2013

#### Academic Service

- Research Assistant, Agricultural Economics, Univ. of Kentucky 08/10-Present
- Academic Quiz Bowl Coach, Agricultural Economics, Univ. of Kentucky 08/10-Present
- Teaching Assistant, Food and Resource Economics, Univ. of Florida 05/10-08/10
- Pharmacology Technician, Dept. of Pharmacology, Univ. of Florida 01/10-08/10
- Research Intern, Food and Resource Economics Dept., Univ. of Florida 05/09-08/10

#### Intended Specialties

- Nonmarket Valuation and Stated Preference Methods
- Environmental and Recreational Economics
- Economic Issues within Urban Entomology

#### Academic Awards

- Univ. of Kentucky Student Government Academic Excellence Scholarship for a Graduate Student 2013, \$1000
- Univ. of Kentucky College of Agriculture Gamma Sigma Delta Outstanding Master’s Student Award 2012



- Univ. of Kentucky Graduate School 2012-13 & 2013-14 Daniel R. Reedy Quality Achievement Award, \$6000
- National Champion Quiz Bowl Team at the 2010 National Agricultural and Applied Economics Association (AAEA) Annual Meeting, Denver, CO
- 2<sup>nd</sup> Place Quiz Bowl Team at 2010 Southern Agricultural Economics Association (SAEA) Annual Meeting, Orlando, FL
- 5<sup>th</sup> Place Quiz Bowl Team at the 2009 National Agricultural and Applied Economics Association Annual Meeting, Milwaukee, WI
- 2<sup>nd</sup> Place Best Chapter, Univ. of Florida National Agri-Marketing Association (NAMA) Team at 2010 NAMA Meeting in Kansas City, MO
- Univ. of Florida Anderson Scholar of Distinction
- Member, Omicron Delta Epsilon, Economics Honor Society

### **Working Papers** (\*Indicates undergraduate students advised)

- Penn, J., Hu, W., Bastin, S., and S. Saghaian. An Exploratory Content Analysis and Comparison of Commercial and Banner Advertisements during online Children's Television Programming. Under Review.
- Penn, J. and H.M. Sandberg. Agricultural and Resource Economics Ph.D. Students: Who are They and What Do They Want? Under Review.
- Penn, J., Maynard L. and D. Brown. The Economic Impact of Bed Bugs within the Hospitality Industry. In submission.
- Penn, J. and W. Hu. Economic Implications of Non-Point Source Water Pollution in Hawaii Tourism.
- Penn, J., Hu, W., Cox, L. and L. Kozloff. Resident and Tourist Preferences for Stormwater Management Strategies in Oahu.
- Penn, J. and H.M. Sandberg. Motivation, Preparation and Attitudes of Agricultural and Resource Economics Master's Students. In preparation.

### **Conference Proceedings**

- Penn, J., Sandberg HM., McFadden B., Nyaupane NP., and G. Ferro. 2014. Agricultural Economics Graduate Training: Distinguishing the Expectation, Effort, and Experience to Succeed in Master's or Ph.D. Programs. Accepted organized symposium at SAEA, Dallas, TX. Feb 1-4.
- Penn, J., Hancock, A\*, Hu, W. and R. Lee. Human Behavioral Effects to Augment Electricity Production of Fitness Center Cardio Equipment. Accepted poster presentation to the 2013 meeting of the Association for the Advancement of Sustainability in Higher Education (AASHE), Nashville, TN, Oct 6-9.
- Penn, J, Hu W, and L Maynard. 2013. "Undergraduate Learning Through Research and On-Campus Consulting: A Multi-Course Experience." Invited track paper presentation at the annual meeting of the AAEA, Washington, DC. Aug. 4-6.
- Penn, J & HM Sandberg. 2013. "The Attitudes and Expectations of Graduate Students in Agricultural Economics: A National Survey." Accepted paper presentation at the annual meeting of the AAEA, Washington, DC. Aug. 4-6.
- Hu W, Penn J, and L Cox. 2013. "Enhancing Conjoint Analysis with Respondents' Self-Constructed Preferred Alternative: Application in Choices of Dolphin Excursions." Paper presented at the annual meeting of the SAEA, Orlando, FL. Feb 2-5.
- Penn J, Sandberg HM, Barnett B, Leatham D, and M Wetzstein. 2013. Organizer, Moderator, and Participant of "A Matter of Opinion: The perspective and experience of Graduate Students versus

Graduate Coordinators in Agricultural Economics.” Accepted organized symposium at SAEA, Orlando, FL. Feb 2-5.

- Penn J, Maynard L, and D Brown. 2012. “Bed Bug Anxiety: Travelers’ Willingness to Pay to Avoid Them.” Paper presented at the annual meeting of the Entomological Society of America 2012, Knoxville, TN, Nov. 11-14.
- Hancock A, Hardin D, Hatfield RS, McLaughlin A, Penn J, and W Hu. Sustainability at the University of Kentucky: Student Opinion and Willingness to Pay. Accepted presentation to the 2012 annual meeting of the Kentucky Economics Association. Georgetown, KY, Oct. 26.
- Penn J, Hu W, Cox L, and L Kozloff. 2012. Resident and Tourist Preferences for Stormwater Management Strategies in Hawaii with a Cost-Benefit Analysis.” Accepted poster at AAEA 2012, Seattle, WA, Aug. 12-14.
- Penn J, Gillespie J, Sandberg HM, and L Kompaniyets. 2012. Organizer, Moderator, and Participant of “Graduate Degrees in Agricultural Economics: Expectation and Preparation.” Accepted organized symposium at SAEA, Birmingham, AL. Feb. 4-7.
- Penn J. 2012. Organizer and moderator of “Legends vs Academic Bowl Champions.” Invited exhibition at SAEA, Birmingham, AL. Feb. 4-7.
- Penn J, Hu, W, Cox L, and L Kozloff. 2012. “Beach Quality and Recreational Values: A Pictorialized Stated Preference Analysis.” Paper presented at the annual meeting of the SAEA, Birmingham, AL. Feb 4-7.
- Penn J, Staley D, Smith C, and S Saghayan. 2011. “Advertising Content Analysis of Online Children’s Television Programming” Accepted poster at AAEA 2011, Pittsburgh, PA, July 24-26.
- J Penn. 2011. “Bed Bug Anxiety among Travelers.” Accepted poster at the annual University of Kentucky Interdisciplinary Conference, Lexington, KY, April 1.
- Ragusa J, and J Penn. 2011. “The Changing Dynamics of Career Patterns Into the U.S. Senate, 1957-2008.” Accepted paper at the annual meeting of the Southern Political Science Assoc., New Orleans, LA, Jan. 6-8.
- Penn, J, Matopoulos A, and L House. 2010. “Response to Out of Stock Produce and its Underlying Economic Considerations.” Paper presented at the annual meeting of the SAEA, Orlando, FL, Feb. 6-9.

### **Journal Reviewer**

- Ecological Economics
- Canadian Journal of Agricultural Economics

### **Professional Memberships**

- Agricultural and Applied Economics Association
- Southern Agricultural Economics Association
- Association of Environmental and Resource Economists
- Entomology Society of America

### **Other Work**

- Invited speaker, Ken Haynes Ph.D. Insect Behavior/Chemical Ecology Entomology Lab, Department of Entomology, University of Kentucky. April 2012.
- Hancock, A.\*, Hardin, D., Hatfield, R.S., McLaughlin, A. and J. Penn. Supervised by W. Hu. Student Sustainability Survey Report. May 2012.

## **Funding**

- Penn, J. and W. Hu. \$7855. University of Kentucky Arboretum Project. University of Kentucky's Student Sustainability Council.
- Penn, J. and W. Hu. \$6320. Faculty and Staff Sustainability Survey. University of Kentucky's Student Sustainability Council.
- Penn, J., and Y. Kusonose. \$750. Research Activity Award for International Web Seminar Series. University of Kentucky's College of Agriculture.
- Georgia-Pacific Foundation. \$3000 (Unsuccessful).
- Penn, J., Hancock, A., Lee, R., and W. Hu. \$2890 (Grant and In-kind). University of Kentucky's Johnson Fitness Center, University of Kentucky Dining Services, and the University of Kentucky's Student Sustainability Council.
- Penn, J., Hu, Wuyang and A. McLaughlin. \$5460. Student Sustainability Survey. University of Kentucky's Student Sustainability Council.
- Penn, J., Hu, Wuyang and A. McLaughlin. \$1000. Service Learning Mini-Grant. University of Kentucky's Office of Undergraduate Education.
- Penn, J and J. Schieffer. \$500. Research Activity Award for Web Seminar Series. University of Kentucky's College of Agriculture.
- Penn, J. \$2000 Scholarship: Mechanized Citrus Harvesting Feasibility. Food and Resource Economics Dept, University of Florida

## **Other Academic Services**

Student Sustainability Council, University of Kentucky

Director of Development (2012-2013), At-Large Member (2011-2014)

- Oversee the distribution of \$150,000+ budget each year
- Implement multiple initiatives to improve sustainability knowledge and attitudes such as outdoor recycling programs, community gardens, composting initiatives on the university campus
- Develop institutional protocols to improve the efficacy of the Student Sustainability Council's allocation of the Environmental Stewardship Fee

President's Sustainability Advisory Committee, University of Kentucky

Student Representative (2011-2013)

- Engaged in administrative level decisions concerning sustainability and the environment for the University of Kentucky including The Sustainability Tracking, Assessment & Rating System (STARS) from AASHE
- Member, Education and Research Working Group
- Member, Planning Administration and Engagement Working Group

University of Kentucky Agricultural Economics Graduate Student Organization

President 2013-2014, Vice-President 2012-2013, Treasurer 2011-2012, Secretary-Treasurer 2010-2011

- Graduate Student Representative of Agricultural Economics Faculty meetings and initiatives
- Started and coordinate a web seminar series of international Agricultural Economists presentations at the University of Kentucky including presentations from professors in Italy, Denmark, Greece, Austria, and Brazil
- Responsible for generating \$4500 in revenue on behalf of graduate students from various fundraisers
- Created and managed an academic fund and volunteer opportunity between Ag Economics graduate students and the UK College of Agriculture International Programs

Instructor, SAS Software Workshop, University-wide for the Quantitative Initiative for Policy and Social Research (QIPSR), University of Kentucky

Instructor (JMP) and Teaching Assistant (Stata, SAS, and R) for Software Workshops, Agricultural Economics, University of Kentucky

**Work Experience**

Business Services Intern 01/09-04/09  
Gainesville Area Chamber of Commerce, Gainesville, FL

Executive Store Intern 05/08-07/08  
Target Corporation, Orlando, FL

Supervisor 07/05-01/09  
CBJ Valet Enterprises, Orlando, FL