CARBON DIOXIDE DYNAMICS IN STREAMS ENTERING KANEOHE BAY, HAWAI`I

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Abstract

The open ocean is now largely a sink of atmospheric carbon dioxide (CO_2), promoting ocean acidification. Because the CO_2 dynamics of coastal regions are complex, it remains unclear whether such areas act as a net sink or source of CO_2. For this study, Kaneohe, Ahuimanu, and Waiahole Streams were compared with the Coral Reef Instrumented Measurement and CO_2 Monitoring Platform-2 (CRIMP-2) buoy during baseline and storm conditions. The compiled results provide data including total alkalinity, dissolved inorganic carbon, nutrients, pCO_2, and CO_2 fluxes. Conclusions addressed the potential effects from land use change in the watershed and the effects of groundwater on stream carbon system. This work examined connections between the streams and Kaneohe Bay and their roles as net sources or sinks of CO_2 to the atmosphere during baseline and storm conditions. The concepts explored as well as the results can be applied to other tropical and subtropical high islands.

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Chapter 1
Introduction

Increased emission of anthropogenic carbon to the atmosphere is a growing concern because of its role in climatic change. Recent work has shown that the open ocean, previously a source of carbon dioxide (CO_2) to the atmosphere, is now largely a sink of atmospheric CO_2; this promotes a concern widely referred to as ocean acidification (Doney *et al*., 2009, Gattuso and Hansson, 2011). As a result of such concerns, studies to evaluate relationships between atmospheric CO_2 and the carbonic acid system in seawater have proliferated, as have studies on the effects of higher partial pressure of CO_2 (pCO_2) on biotic systems. Because the CO_2 dynamics of coastal regions can be quite complex, it remains unclear whether this important area of the world ocean acts as a net sink or a net source of CO_2 (Guo *et al.*, 2012).

Coastal regions occupy about 20% of the total land area on earth and more than 50% of the global human population lives within 200 km of the coastline (Burke *et al.*, 2001). Coastal regions have been heavily populated throughout history, due in large part to the abundance of resources and the ease of transporting goods and people from one place to another. As these coastal regions become more urbanized, they are increasingly affected by human activities (Wolanski, 2007). Modifications to vegetative coverage and other changes associated with development, e.g., increases in impervious surface coverage affect the surrounding watershed infrastructure and function. Such changes may be manifested in increased runoff, higher stream peak flows, and greater sediment and nutrient loadings to receiving waters, which may in turn lead to eutrophication of such coastal waters (Mann and Lazier, 2009).

Estuaries are important coastal geological features that provide an essential connection between land and sea. They are defined as "*a semi-enclosed body of water that has a free connection with the open ocean and wherein salt water is diluted with fresh water from land drainage*" (Mann and Lazier, 2009). Tides and waves from the ocean as well as freshwater, sediment and nutrient inputs from streams and rivers all may influence the biogeochemistry of estuaries. Estuaries are also generally nutrient-enriched and productive environments that are heavily influenced by land runoff.

During rain storm and the consequent runoff that increase streamflow, streams behave as point sources of various materials to coastal waters. Streams transport freshwater, particulate matter, and nutrients to the coastal ocean. Increased precipitation also enhances the weathering of rocks and other substrates, the products of which are then mobilized by storm runoff and ultimately transported by streams and rivers to the ocean.

The weathering of siliceous rocks has been shown to significantly sequester carbon from the atmosphere (e.g., Dessert *et al*., 2003; Bianchi, 2007) thereby playing a notable role in the global carbon cycle. Basalt, which hosts high concentration of silicate minerals, displays five to ten times higher weathering rates than granite (Dessert *et al*., 2003) and similarly affects the carbon cycle. Increased rainfall and higher temperatures significantly enhance weathering processes (Fortner *et al*., 2012).

The bicarbonate ion (HCO_3^-) is an important constituent of natural waters, including seawater. Bicarbonate is one of the products of weathering; bicarbonate concentrations typically increase in stream and river waters as they flow across landscapes and approach the ocean. In addition to natural sources derived from the erosion of soils and rocks; HCO_3^- can also be added to fresh water from anthropogenic sources such as the dissolution of channelized streams and rivers (Allan and Castillo, 2007; Nelson *et al*., 2013). In turn, HCO_3^- is one of the more prevalent constituents at Earth surface conditions that affect dissolved inorganic carbon (DIC) and the total alkalinity (TA) of the ocean (Allan and Castillo, 2007).

In aquatic systems, the equation for DIC:

$$DIC = HCO_3^- + CO_3^{-2} + CO_2 \quad \textbf{1}$$

accounts for the carbon present as bicarbonate (HCO_3^-), carbonate (CO_3^{-2}), and carbon dioxide (CO_2) in solution. Stream and river discharge transport the majority of DIC as CO_2 from respiration in surface water to the open oceans (Worrall and Lancaster, 2005). Bicarbonate and carbonate, however, play important roles in biological processes. They are key reactants in the secretion of calcium carbonate skeletons for corals and also buffer seawater against changes in pH (Libes, 2009). Living organisms in the ocean are susceptible to sudden changes in pH and with the addition of anthropogenic CO_2 to the ocean; such buffering is crucial to protect ecosystems from sudden changes (Gattuso and Hansson, 2011). The ability of the ocean to buffer a solution is reflected in its alkalinity.

Total alkalinity, as stated by Dickson (1981), is "*the number of moles of hydrogen ion equivalent to the excess of proton acceptors (bases formed from weak acids with a dissociation constant* $K \leq 10^{-4.5}$*, at 25 °C and zero ionic strength) over proton donors (acids with* $K > 10^{-4.5}$*) in one kilogram of sample.*" The following equation defines total alkalinity as:

$$TA\ (\mu mol/kg) = [HCO_3^-] + 2[CO_3^{-2}] + [B(OH)_4^-] + [HPO_4^{-2}] + 2[PO_4^{-3}] + [H_3SiO_4^-] + 2[H_2SiO_4^{-2}] + [NH_3] - [H^+] + [OH^-] + [\text{other conjugate bases of weak acids}] \quad \mathbf{2}$$

However, the majority of the alkalinity in seawater dervies from carbonate alkalinity as shown in the following equation:

$$\text{Carbonate Alkalinity } (\mu mol/kg) = [HCO_3^-] + 2[CO_3^{-2}] \quad \mathbf{3}$$

which considers only bicarbonate and carbonate concentrations. The remaining alkalinity is contributed principally from borate and, to a much lesser extent, other minor species. Notice that while CO_2 contributes to the overall DIC in solution, it does not impact alkalinity (directly). Alkalinity is impacted indirectly by CO_2 through the formation of HCO_3^- by the reaction between CO_2 and water to form carbonic acid and the subsequent dissociation of carbonic acid. The following equations illustrate the reaction between gaseous CO_2 and water:

$$CO_2\ (g) \leftrightarrow CO_2\ (aq) \qquad \text{Keq: } 2 \times 10^{-3} \quad \mathbf{4}$$

$$CO_2\ (aq) + H_2O \leftrightarrow H_2CO_3 \qquad \text{Keq: } 1.2 \times 10^{-5} \quad \mathbf{5}$$

$$H_2CO_3 \leftrightarrow HCO_3^- + H^- \qquad \text{Keq: } 4.5 \times 10^{-7} \quad \mathbf{6}$$

$$HCO_3^- \leftrightarrow CO_3^{-2} + 2H^- \qquad \text{Keq: } 4.7 \times 10^{-11} \quad \mathbf{7}$$

As shown, water and aqueous CO_2 combine to make carbonic acid. This weak acid partially dissociates into bicarbonate and a hydrogen ion, as shown in equation 4. If the free hydrogen ions is not neutralized a decrease in pH will be observed (Libes, 2009). Bicarbonate can further dissociate into carbonate and two hydrogen ions as shown in equation 5. Carbonate is then used in calcification whereby calcium and carbonate are precipitated and CO_2 is released. This release of CO_2 seems counterintuitive, however. Furthermore, the majority of calcification occurs during the daytime when productivity dominates over respiration, so the CO_2 released from calcification is generally negligible to the total CO_2 balance during the day (Gattuso and Hansson, 2011). Overall, changes in the concentrations of bicarbonate and carbonate ions affect the alkalinity of seawater and its capacity to buffer against sudden pH changes (Libes, 2009).

Concentrations of CO_2 in surface waters are influenced by various processes. These include but are not limited to the rate of diffusion of atmospheric CO_2 into the water, microbial metabolism of organic matter, and the influx of groundwater (Hoover and Mackenzie, 2009). Although photosynthesis and respiration also influence levels of CO_2 in water, groundwater inputs to rivers can have a much greater impact on the concentration of CO_2 than photosynthesis and respiration.

Groundwater, characterized as any water below the Earth surface, is an important component of the hydrological cycle. In Hawaii, more than half of all freshwater used comes from groundwater and domestic water is almost entirely supplied by groundwater (Gingerich and Oki, 2000). Groundwater discharge occurs downstream from recharge areas, and anywhere the water table intersects the Earth's surface, it may create a form of surface water flow. The persistent flow of streams and rivers during dry periods, known as base flow, is mainly maintained by groundwater input, although in Hawaii there is also a relatively consistent contribution from runoff in the high moutains. Antecedent conditions in the surrounding soils, for example with respect to the extent and frequency of infiltration of rain by the land surface, also impact the availability of groundwater that can infiltrate the stream (Peterson *et al*., 2009). Groundwater is typically low in oxygen and rich in CO_2 due to microbial respiration as water flows through the hyporheic zone in soils. Outgassing of CO_2 is, nonetheless, often unable to eliminate all the CO_2 that brought in to the system from the respiration of land derived organic matter. As a result, partial pressures of CO_2 (pCO_2) in riverine waters are often two to five or more times that of the atmosphere (Allan and Castillo, 2007).

Estuaries, the interface between the ocean and streams/rivers, function to recycle and process particles, organic carbon, and nutrients introduced by streams and rivers through both biological and physical means before delivery to the open ocean (Polunin, 2008). The freshwater input from streams is less dense than the salty ocean water causing the fresher water to remain closer to the surface in estuaries. As freshwater flows out to sea, nutrients and particulate matter are transported with the water until flow slows down enough for settling to occur. When the tide flows in, the nutrients and particulate matter may be transported back into the estuary. Such recycling allows for estuaries to retain materials transported from land for extended periods of time, resulting in an enhanced potential for estuaries to become eutrophic. As populations near coastal regions continue to increase, more pollutants, including nutrients derived from anthropogenic acitivity, will be transported to estuaries (Laws, 2000).

Estuaries are being transformed by both industrial and residential development. Population increases in coastal regions increase risks for environmental degradation, reductions in water quality, species diversity and habitat (Wolanski, 2007). In particular, nutrient inputs from excessive fertilization of agricultural lands may have had marked impacts on estuaries and the coastal zones (e.g., Caraco, 1995; Mackenzie *et al*., 2012; Rabalais, 2004). Thus, estuaries around the world are affected by increased nutrient loading and sediment input that typically lead to a net heterotrophic system with low dissolved oxygen and high concentrations of CO_2, for example as exhibited in the Scheldt Estuary in Northwestern Europe (Middleburg *et al*., 2011). The Mississippi River, which transports very high nutrient loads, sediment runoff, and bicarbonate into the Gulf of Mexico creates hypoxic and anoxic conditions across a broad section of the northern Gulf of Mexico throughout the year (Rabalais *et al*., 2004; Mayorga, 2008).

In Hawaii, Kaneohe Bay serves as a good example of what can happen to a coastal water body that receives high nutrient and suspended particle inputs. The best known example of adverse impacts to Kaneohe Bay from excessive inputs of nutrients and suspended particles is the period between the 1950s to late 1970s during which outfalls dumped (primary and secondary treated) sewage into the bay; subsequently sewage discharge inputs was redirected to the open ocean (Smith *et al*., 1981). The nutrient and particulate inputs to the bay caused drastic changes in the community structure of the bay, transforming it from a coral dominated system to an algal dominated system (Smith *et* al., 1981). There have been many studies in Kaneohe Bay in the subsequent decades to quantify and understand the impacts that increased nutrient loads have caused in the bay (e.g., Hunter and Evans, 1995; Laws and Allen, 1996; Stimson *et al*., 2001; Ringuet and Mackenzie, 2005; DeCarlo *et al*., 2007; Drupp *et al*., 2011).

More recent studies have examined how Kaneohe Bay might be affected by the increase in anthropogenic carbon in the atmosphere and in the water (Fagan and Mackenzie, 2007; Drupp *et al*., 2011; in press; Massaro *et al*., 2012). These studies have consistently shown that Kaneohe Bay is a net annualized source of CO_2 but that it can also temporarily change to be a sink of this greenhouse gas during storms events (Drupp *et al*., 2011; Massaro *et.al*., 2012).

Although various studies have looked at how changes in CO_2 dynamics occur within the bay itself, none has specifically examined the biochemistry of surface water inputs from the surrounding watershed to determine how they affect biogeochemical processes taking place in the bay. Because estuaries provide a critical connection between land and sea, it is important to understand the biogeochemical cycling of carbon at this coastal interface. Such insights can provide information on how these regions contribute to the global carbon cycle. Addressing this lack of information in coastal waters of Hawaii, specifically in Kaneohe Bay, is one important goal of this study.

The focus of this study was to investigate the effects of stream inputs on the carbon system in Kaneohe Bay during both periods of low flow and following high precipitation (storm) events. Storm runoff contributes large quantities of freshwater, nutrients, and particulate matter to the coastal waters. There is, therefore, a potential for changes in the carbonate system of the bay to be influenced by the increased runoff and its constituents. In addition, this study was designed to investigate how urbanization and land use change in watersheds might impact the carbon system dynamics in the streams and how they differ spatially and temporally.

This study is built on several hypotheses. The null hypothesis is:

- H_0: There are no spatial and temporal differences in carbon system parameter concentrations and speciation in stream waters entering Kaneohe Bay.

It is expected that the null hypothesis will be rejected. Working hypotheses of the study are:

- H_1: During baseline conditions, there is a decrease in the pCO_2 of water in the estuaries as stream water mixes with ocean water.

- H_2: During storm events, there is a large increase in the pCO_2 of stream water due to the input of high CO_2 charged groundwater that is not evident during baseline conditions and a concomitant large extent of degassing of CO_2 to the atmosphere.

Chapter 2

Methods

I. Study Site

Kaneohe Bay, on the windward side of Oahu, is the largest sheltered embayment in Hawaii (DeCarlo *et al*., 2007). The bay system covers approximately 52 km^2, containing numerous patch reefs, fringing reefs, and is guarded to the northeast by a barrier reef and to the west by the Koolau Mountains, which plunge steeply toward the bay (Nelson *et al*., 2013). Orographic precipitation dominates in Hawaii with the northeastern (windward) flanks of mountains receiving the majority of the precipitation (Ward and Elliot, 1995; Giambelluca *et al*., 2011). From the precipitous slopes of the Koolau Mountains eleven primary streams flow into the three sections of Kaneohe Bay: the northern, the central, and the southern sectors (Figure 1).

Although the bay experiences mixed semi-diurnal tides that influence its circulation, the major forces driving circulation in Kaneohe Bay are wave driven circulation for the northern and central sectors and advection in the southern sector (Lowe *et al*., 2009a). Consequently, the residence time of water in the Bay is highly variable. Water in the northern and central sectors has a residence time of a day or less, due to a direct connection with channels connecting with the open ocean and at strong trade wind driven flow of water over the barrier reef. The southern sector has a residence time of a week to more than one month due to reduced access to the open ocean because of sheltering by Coconut Island (Moku o Loe) and the Mokapu Pennisula (Bathen 1968; Ostrander *et al.* 2008; Lowe *et al*. 2009b). In addition, predominant northeasterly trade winds can cause a gyre like current to flow alongshore that helps to flush the southern sector and leads to a reduction in residence time. However, during "Kona" storms, the mountains surrounding the southern sector of the bay shelter it from southerly winds, reducing circulation in the southern sector and increasing its residence time (Lowe *et al*., 2009a).

There is a long history of agriculture in Kaneohe. Polynesians have inhabited the island for at least 1500 years (Fu, 2009) and Hawaiians who first settled in the Kaneohe area grew taro and farmed fish along it's shores. Kaneohe, before western contact, was

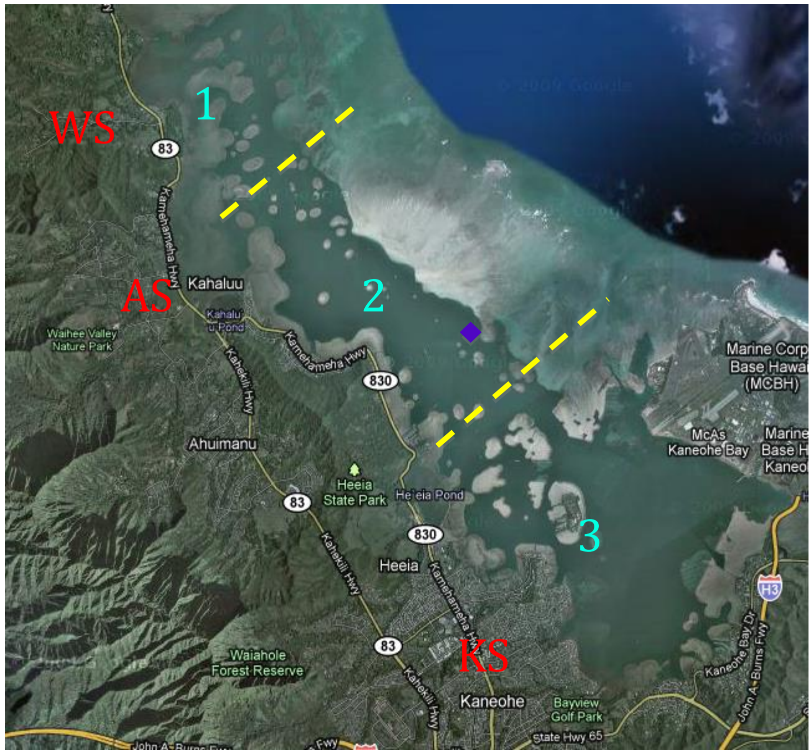


Figure 1. Aerial photograph of Kaneohe Bay, Oahu, Hawaii. The bay is separated into three different sectors by dashed yellow lines determined by physical parameters. Waiahole Stream (WS) is located in the northern sector, which is indicated by 1. Ahuimanu Stream (AS) is in the central sector, which is indicated by 2, and Kaneohe Stream (KS) is in the southern sector, which is indicated by 3. The purple diamond represents the location of the CRIMP-2 buoy. (Google Earth)

said to be one of the largest Hawaiian settlements with more than 2,000 people living within nine ahupua`a. Ahupua`a are a type of land classification the Hawaiians used, much like our modern watersheds, that range from the mountains to the sea, and were governed in such a way that they allow residents to manage and utilize the natural resources within its boundaries. Although ahupua`a generally coincide with modern watershed boundaries, that is not always the case (State of Hawaii, 1992). From the 1880s to 1920s, small taro cultivations changed to large rice plantations, which have a higher water demand and required more irrigation ditches.

As more foreigners settled in other parts of the island, there was an increase in water demand on the leeward side of Oahu. In order to meet this need, a large project was initiated to divert water from Waiahole Stream to the leeward side of Oahu. In 1916, when the Waiahole Tunnel Ditch system was completed, it was estimated that up to 60% of the original flow to Kaneohe Bay was being diverted (State of Hawaii, 1992). In the years following, there were many land use changes in the Kaneohe area (see Figure 2) from pineapple plantations to livestock production and finally to an urban development. This started changing Kaneohe, especially the southern watersheds, from a rural agricultural settlement to the present day urban environment. Starting in the 1940s, channelization of many of the tributaries and streams in the urbanized areas of Kaneohe began, to prevent flooding and damage to homes and infrastructure (Laws and Roth, 2004).

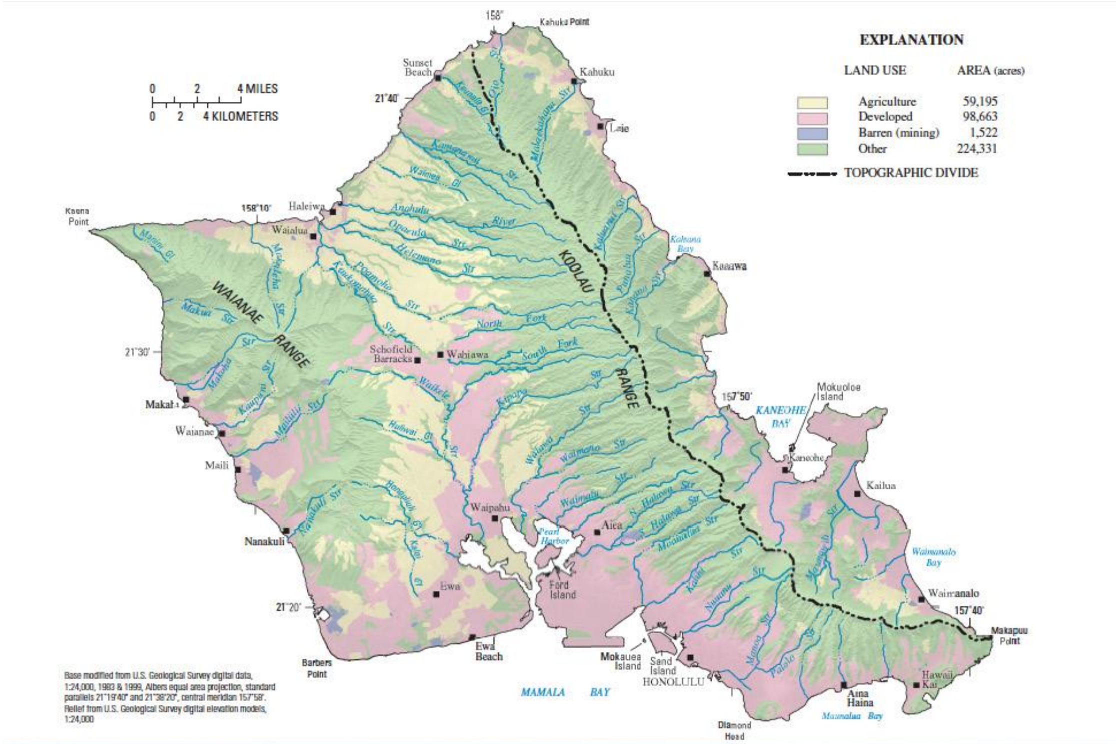


Figure 2. Land use on the island of Oahu as of 1998. (Klasner and Mikami, 2003)

By the 1980s, there was a 60% increase in the population of Kaneohe to about 50,000 people from that existing during the 1940s (State of Hawaii, 1992). After almost a century of land use change, the majority of the southern end of Kaneohe Bay had been developed into a combination of light industrial and residential zones, although more northern parts of the area were not subject to as extensive development as Kaneohe Town. The area near Ahuimanu (Figure 2) is much less developed with residential zones dotting the coastline, while Waiahole remains largely undeveloped and still hosts mostly agricultural endeavors (Klasner and Mikami, 2003). Currently, Kaneohe Stream is heavily channelized, draining a highly urbanized watershed into the southern portion of Kaneohe Bay: in contrast, Waiahole Stream is not channelized and drains an agricultural and conservation watershed into the northern part of Kaneohe Bay. Ahuimanu Stream has characteristics in between the former two and is partially channelized and drains an agricultural/residential watershed into the central part of Kaneohe Bay.

In this study, three streams are of primary interest: Kaneohe Stream, Ahuimanu Stream, and Waiahole Stream (Figure 1). Kaneohe Stream, flows into the southern sector, is partially channelized and drains a highly urbanized watershed. Ahuimanu Stream flows into the central sector, is heavily channelized and drains a moderately urbanized watershed. Waiahole Stream, feeds into the northern sector, has a natural stream channel and drains a rural/agricultural watershed. During storm events, southeasterly winds generally force ocean water upstream from the mouth of Kaneohe Stream and to a lesser extent at Ahuimanu Stream. These three streams constitute a gradient of channel modification and land use that should lead to a spatial heterogeneity in the distribution of inorganic carbon system parameters.

The precipitation in the watersheds that feed these streams can be as high as 200 cm/year (Giambelluca *et al*. 2011) but may also vary substantially from year to year and/or from watershed to watershed. The gradients in land use and in geographic/climatic conditions that characterize these streams enable a characterization of how flow into Kaneohe Bay from streams subjected to different land use and channel modifications affects bay waters and influence the response of coastal waters to land-derived inputs.

II. Field Methods

To establish baseline conditions for each stream, samples were collected at roughly monthly intervals over a two-year period. The sampling program was also carried out after rainstorm events totaling 5 cm or more of precipitation within a 24-hour period to determine how ocean conditions respond to high stream flow events. A similar sampling program was undertaken at the Coral Reef Instrumented Measurement and CO_2 Monitoring Platform-2 (CRIMP-2) station, located on the landward edge of the barrier reef in the central sector as a means of comparing marine conditions to freshwater conditions (Massaro *et al.*, 2012). Each of the three streams was sampled at three locations to describe the evolution of water chemistry over the transition from fresh to saline. These locations included an upstream site where salinity was near zero; the second was nearer to the stream mouth where despite relatively low salinities, estuarine mixing and more temporal variability existed, and a third site near the stream mouth with near marine salinity values (Figure 3).

Water samples of Kaneohe Bay waters were collected on a nearly monthly interval for the determination of TA and DIC, chlorophyll-a (chl-a) and nutrients. Surface samples for TA and DIC were collected in 300 mL borosilicate glass (BOD) bottles from within ten centimeters of the surface at each station. Bottles were rinsed three times with surface water prior to sample collection from a clean 5-gallon bucket to ensure sample homogeneity. The sample was immediately poisoned using 200 μL of saturated mercuric chloride ($HgCl_2$). Bottles were sealed using non-silicone based stopcock grease and a rubber band and clip to prevent biological productivity changes to the sample and gas exchange with the atmosphere. Samples for chl-a and nutrient analyses were collected using a 1L Nalgene bottle and kept on ice in the dark to retard microbial activity until return to the laboratory for processing, which occurred within 24 hours following collection.

Profiles of water quality parameters were acquired *in situ* using an YSI 6600 V2 Sonde at each station (Carney *et al.*, 2002). Parameters measured include depth, temperature, conductivity (salinity), pH, turbidity, chlorophyll fluorescence, and dissolved oxygen concentrations. The sonde was calibrated in the laboratory following manufacturer guidelines (http://www.epa.gov/region1/lab/reportsdocuments/wadeable/methods/Sonde.pdf) the day prior to sampling, and set to take measurements every two seconds.

III. Laboratory Methods

TA was determined using a modified Gran titration following the procedures outlined by Dickson (2007). Samples were filtered prior to analysis using 1.2 μm pore size Whatman GF/C filters to remove any sediment or carbonate mineral particles that might interfere with alkalinity measurements. Samples were maintained at a constant temperature of 25°C ± 0.1°C in a temperature-controlled bath during titrations, with about 100 ml of sample titrated in duplicate or triplicate, depending on precision. Certified reference standards provided by Andrew Dickson (SIO) were titrated at the beginning, during the middle, and at the end of each day to verify the accuracy of the analysis. Deionized water was used as a blank at the beginning and end of the testing period.

Figure 3. Aerial photograph of Kaneohe Stream (A), Ahuimanu Stream (B), and Waiahole Stream (C) with showing station locations indicated by the red numbers. Station 1 corresponds to near fresh water endmember conditions; station 3 corresponds to near seawater salinities. (Google Earth)

Titrations were performed with a computerized Metrohm Titrando 905, which increments small additions of 0.05 N HCl as the titrant. The titrant acid was standardized using certified reference standards provided by Andrew Dickson (SIO). The Metrohm pH probe was calibrated and its slope verified before each testing period using NBS buffers 4 and 7 kept at a constant temperature of 25°C ± 0.1°C.

DIC was analyzed by coulometry following procedures outlined by Dickson (2007). Nineteen milliliters of sample were injected into a Vindta 3D #55, acidified using reagent grade 10% phosphoric acid and run through a UIC CM5015 coulometer to determine the total inorganic carbon. The precision of measurements was evaluated by periodic duplicate or triplicate analyses on randomly selected samples. Certified reference standards provided by Andrew Dickson (SIO) were analyzed at the beginning, in the middle, and at the end of a set of analyses in addition to substandards created from low nutrient seawater collected from the HOT site at Station ALOHA to evaluate the accuracy of measurements.

Samples for nutrient analyses were filtered using 1.2 μm Whatman GF/C filters that were pre-rinsed using HCl and deionized water, and kept frozen until analyzed by minor modifications of standard colorimetric methods described by Strickland and Parsons (1972). Nutrient samples were submitted to the School of Ocean and Earth Science and Technology Laboratory for Analytical Biogeochemistry (SLAB) for analysis. The previously weighed filters were also retained to determine the total suspended solids (TSS) concentrations of the samples. Filters were dried at 60^{o}C to a constant weight, the weight of particles recorded to the nearest 0.1 mg, then wrapped in aluminum foil and stored until needed for any further analysis.

For Chl-a analysis, aliquots of 70 mL of water samples were filtered through 0.4 μm and 8 μm Nucleopore filters (to examine the distribution of various size classes of phytoplankton) and frozen at 4°C until analysis by fluorometry as described by Strickland and Parsons (1972).

Parameters of the CO_2-carbonic acid system (pCO_2, pH, bicarbonate, carbonate and calcite saturation state) were derived from TA and DIC using the CO2sys program developed by Lewis and Wallace (1998) at the Brookhaven National Laboratory Department of Atmospheric Sciences. The CO2sys program computes standard CO_2

system parameters and carbonate saturation states using fundamental carbon chemistry. Constants were chosen according to the Guide to Best Practices for Ocean Acidification Research and Data Reporting by Riebesell *et al.* (2010). Carbonic acid dissociation constants were from Mehrbach et al. (1973), as refit by Dickson & Millero (1987). The total scale was used to calculate pH and calculations derived by Dickson (1990) were used for potassium hydrogen sulfate.

IV. Ancillary data from other sources

Stream discharge data for Waiahole Stream were obtained from a gaging station operated by the US Geological Survey. Stream discharge data for Ahuimanu Stream were not available during the time the study occurred. However, historical discharge rates from January 1995 to October 2005 were taken from a flow meter in Kahaluu Stream, which is adjacent to Ahuimanu Stream and related to historical rainfall rates in the same area. This relationship allowed for estimation of the discharge rates during the study period. Ahuimanu and Kahaluu Streams merge upstream from station 1 (Figure 4); as such, inferred discharge rates were doubled to account for the increased streamflow from the two streams. For Kaneohe Stream, data of streamflow discharge were also unavailable for the period of this study; therefore historical discharge and rainfall data were taken from the same period as mentioned above and a linear regression used to infer present discharge. Rainfall data for the Luluku and Ahuimanu Streams were obtained from the Kamooalii and Kahaluu rain gauges, respectively, operated by the National Weather Service Weather Forecast Office. These rainfall data are collected at 15-minute intervals using the tipping bucket method (Figure 5). Wind speed and direction data were taken from the National

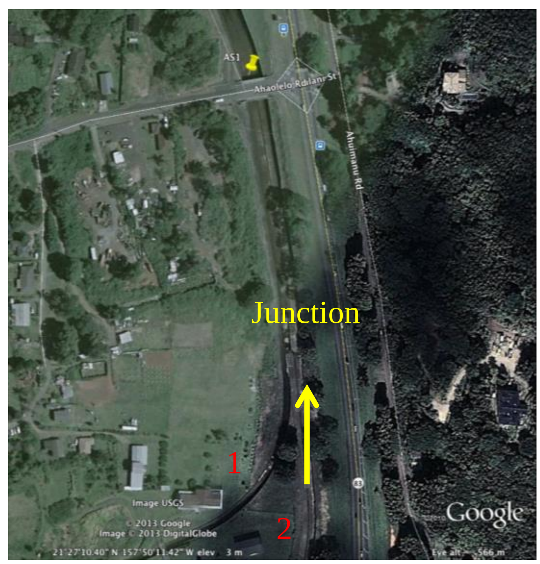


Figure 4. Aerial photograph of Ahuimanu Stream (2) and Kahalu`u Stream (1) indicating the direction of flow (yellow arrow) and the junction where they connect into one stream.

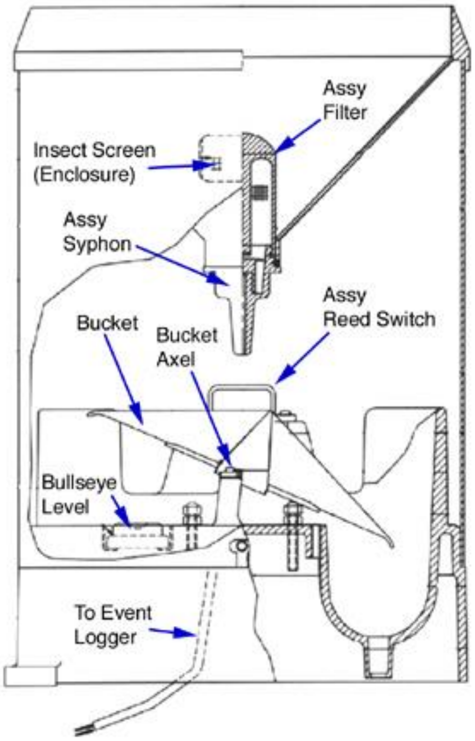


Figure 5. Diagram of a tipping bucket rain gauge similar to that used by the USGS to measure precipitation. www.ictinternational.com.au

Oceanic and Atmospheric Administration (NOAA) Climate Data Center for the gauges located on Coconut Island within Kaneohe Bay. Tide data for Kaneohe Bay were taken from NOAA's Tides and Currents website (http://tidesandcurrents.noaa.gov/).

Chapter 3

Results

Baseline samples were collected during normal (i.e., dry) conditions on a nearly monthly basis from September 2010 to June 2012 at the nine sampling sites (Figure 2) of the three streams and their estuaries. Samples also were collected at the CRIMP-2 buoy site near the Sampan Channel and the barrier reef; to provide data from sites not affected directly by rainfall derived variability observed within and affronting the stream channels. General biogeochemical changes in water conditions are described for these events. Baseline conditions were sampled 13 times between September 2010 and May 2011, henceforth referred to as Season 1, and nine times between June 2011 and June 2012, henceforth referred to as Season 2. Sampling of streams and estuaries also occurred the morning after storm events of >5 cm of rainfall in a 24-hour period. Samples were collected at the CRIMP-2 buoy site during all samplings. Seven storms were sampled during the study period with three storms occurring during Season 1 and four storms occurring during Season 2.

Total rainfall over the two years of this study is shown in Table 1.

Table 1. Average total rainfall for related watersheds during study period.

	Total Rainfall (cm)	
Watershed	**Season 1** (Sept 2010 – May 2011)	**Season 2** (Jun 2011 – Jun 2012)
Ahuimanu	178	195
Luluku	186	212
Waiahole	148	119

Average daily rain gauge totals for each watershed are depicted in Figure 6. The green arrows indicate days during which sampling occurred. Season 1 coincided with a strong La Niña period lasting until about May 2011 (Smith *et al.*, 2012). During Season 1, the total rainfall values for Ahuimanu, Luluku, and Waiahole Streams were 178.46 cm, 185.50 cm, and 147.68 cm respectively. A weaker La Niña started during Season 2, lasting until about March 2012 (Smith *et al.*, 2012). During Season 2, the rainfall values for the Ahuimanu, Luluku, and Waiahole Streams were 194.92 cm, 212.17 cm, and 118.75 cm respectively.

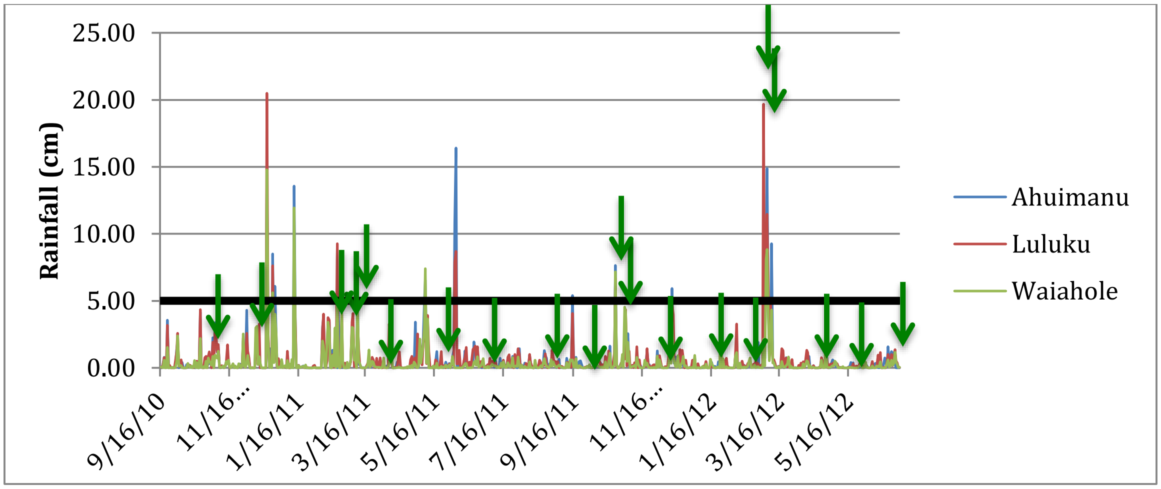


Figure 6. Average daily rainfall (in cm) for each watershed during the study period. Thick black line indicates storm sampling threshold. Green arrows indicate a sampling event.

Stream discharge rates were inferred from rainfall data for Kaneohe and Ahuimanu Streams based on historic rainfall data from the USGS and the corresponding stage/discharge relationships. At Luluku Stream, a relationship was developed between rainfall and discharge data (Figure 7) recorded between October 1, 1995 and October 10, 2005 using the existing USGS stage/discharge data, where:

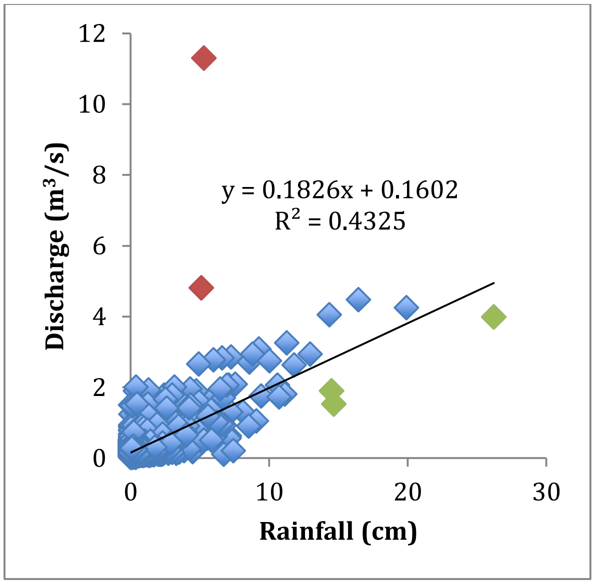
$$Q_L \text{ (discharge in m}^3\text{/s)} = 0.1826 \times \text{(rainfall in cm)} + 0.1602 \quad \textbf{8}$$

The two red outlying points above the regression line in Figure 3 corresponded to large storm events that had particularly large discharge rates. The green outlying points under the regression correspond to the first major storms of a season.

A linear relationship was developed similarly for Ahuimanu Stream (Figure 8), where:

$$Q_A \text{ (discharge in m}^3\text{/s)} = 2.568 \times \text{(rainfall in cm)} + 1.6247 \quad \textbf{9}$$

There was a greater incidence of scattered outlying points for Ahuimanu, but no obviously discernible pattern to the scattering of either particularly large storm events (red points) or first storm events of the season (green points).



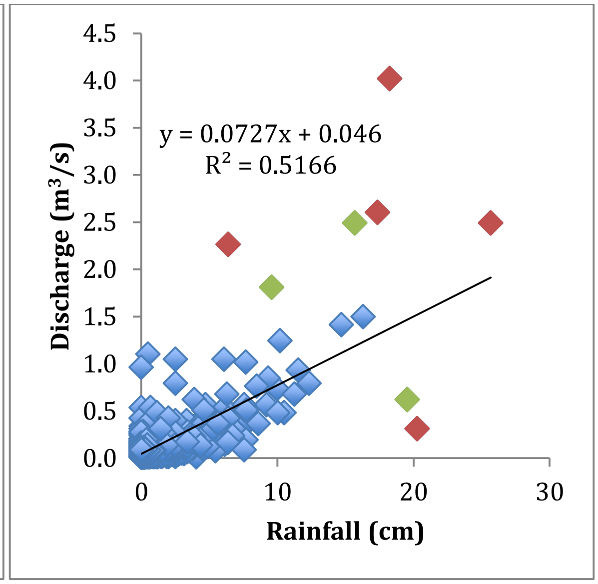


Figure 7. Discharge versus rainfall data for Luluku Station from 1/1/95 to 10/10/05. Red points refer to large (>5 cm) storm events while green points correspond to first storm of the season events.

Figure 8. Discharge versus rainfall data for Kahaluu Station from 1/1/95 to 10/10/05. Red points refer to large (>5 cm) storm events while green points correspond to first storm of the season events.

Inferred discharge rates during the study period for each stream are depicted in Figure 9. Individual points represent discharge for each stream, determined from rainfall data during the study period using the stage/discharge relationships described above.

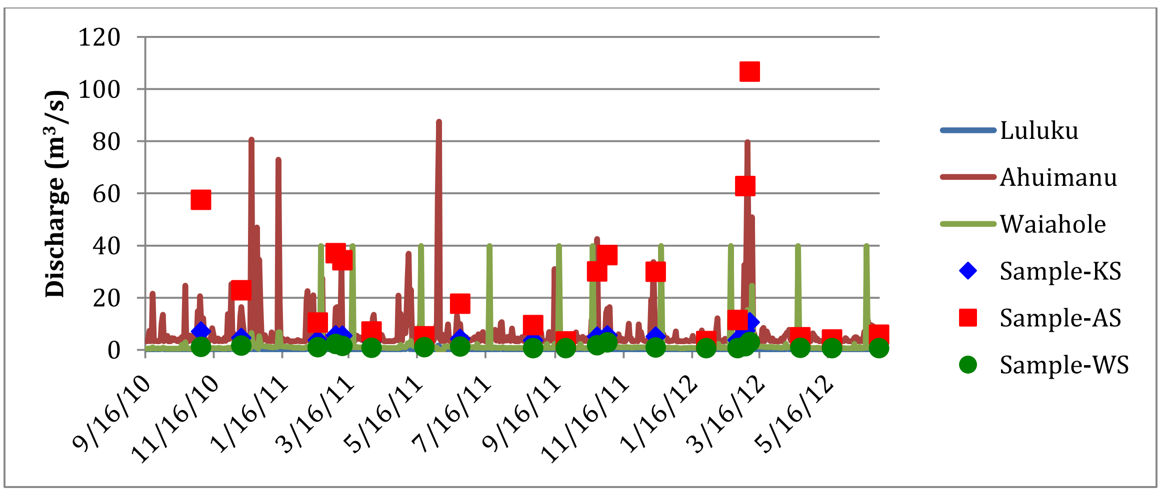


Figure 9. Inferred stream discharge (in m^3/s) during the study period. Individual points indicate sampling events.

I. Wind

The wind directions during the time of study are shown in Figure 13. Most of the time, winds come from the NE or E, in association with trade winds. When large, low pressure systems are located to the north of Hawaii, winds often shift to a more southwesterly direction, which is locally referred to as 'Kona Winds'. The number of occurrences of trade and Kona winds during the study period is indicated in Figure 14. Northeasterly trade winds, however, dominate in Hawaii (Blumenstock and Price 1967; Giambelluca 2005), as observed during the current study.

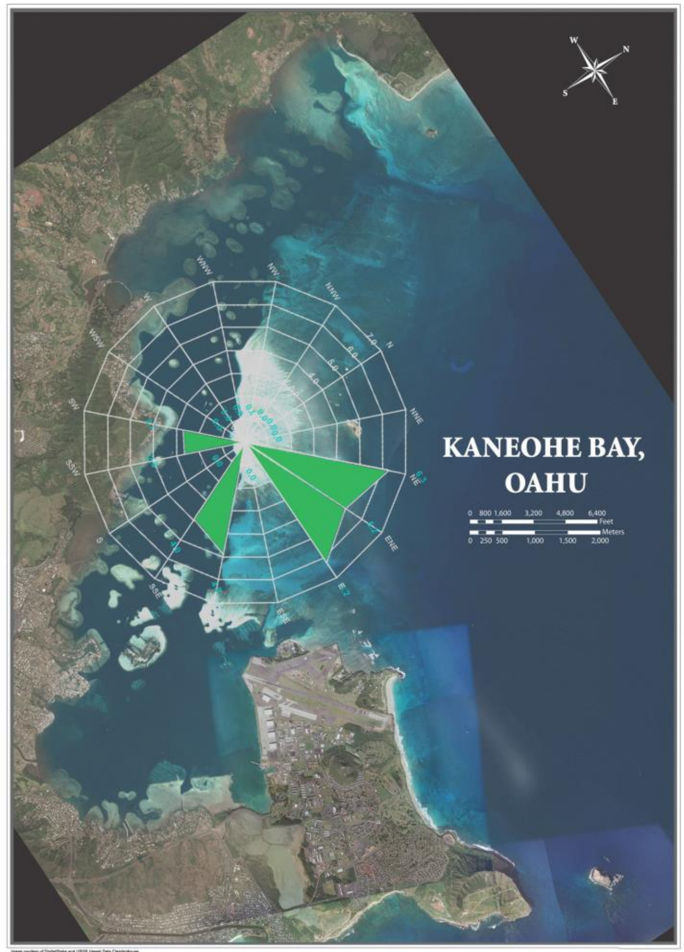


Figure 60. Wind direction and wind speed (in m/s) recorded for days sampled in relation to geographic locations in Kaneohe Bay.

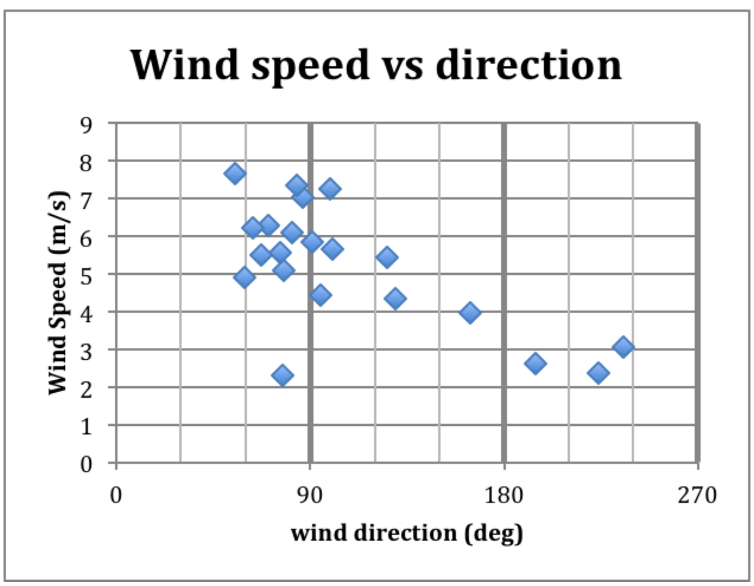


Figure 11. Wind speed (in m/s) and direction in degrees recorded for each day sampled.

II. Kaneohe Stream – Baseline Conditions

The field measured data derived from the YSI 6600 Sonde can be found in Appendix A. Data for other field measured parameters are presented in Table 2. Examining salinity versus depth, all three stations show profiles of salinity increasing with depth at low salinities; at higher salinities, the salinity profiles have little variation with depth (Figure 10).

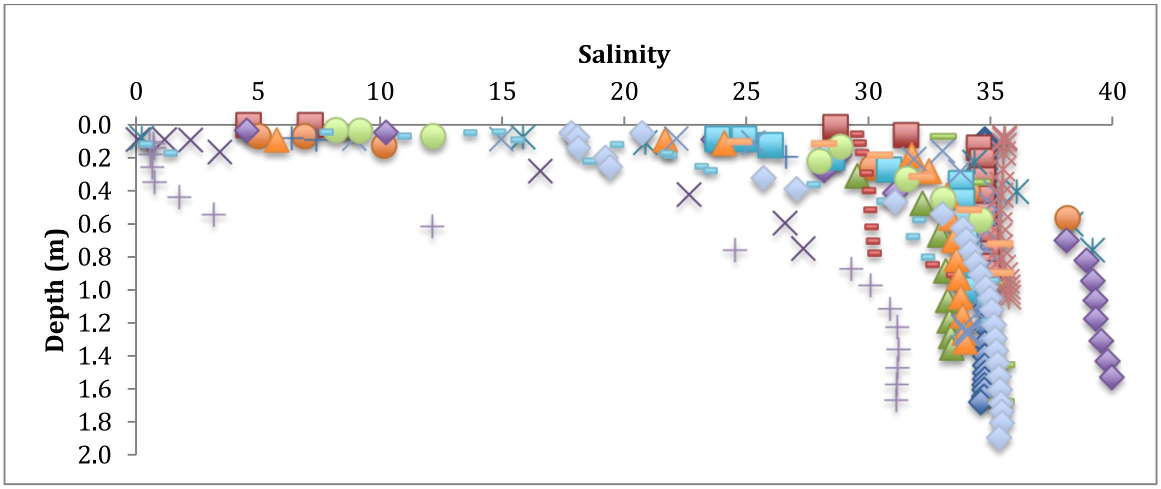


Figure 12. Salinity profiles in ppt for Station 2 affronting Kaneohe Stream with each symbol representing different sampling dates.

The average water temperature at station 1 was 24.1±1.5°C and increased by half a degree to 25.6±1.2°C at station 2 and station 3 at 25.2±1.6°C (Table 2). Salinity had an average range from 2.7±1.9 ppt at station 1 to 16.4±11.7 ppt at station 3. Total suspended solids decreased in average concentration from 56±123 mg/L at station 1 to 36±18 mg/L at station 3. Chlorophyll-a increased somewhat from average concentrations of 2.7±2.9 µg/L at station 1 to 3.6±277 µg/L at station 3.

Water chemistry parameters for Kaneohe Stream are presented in Table 2. TA increased in average concentration from 1400±192 µmol/kg at station 1 to 1755±334 µmol/kg at station 3. DIC showed average concentrations that increased from 1385±182 µmol/kg at station 1 to1670±278 µmol/kg at station 3. Average concentrations of all inorganic nutrient parameters mentioned above decreased from station 1 to 3. DIN ranged from 14.2±3.9 µmol/L to 12.1±8.5 µmol/L, phosphate (DIP) ranged from 0.47±0.14 µmol/L to 0.35±0.18 µmol/L, and silicate ranged from 292±107 µmol/L to 148±102 μmol/L respectively. The DIN:DIP ratio for all baseline samples from Kaneohe Stream had an average value of 32±10 (Table 2).

Table 2. Data of all parameters collected, measured, and calculated at each station for Kaneohe Stream during baseline and storm events.

KS	Baseline			Storm 1			Storm 2			Storm 3		
Parameter	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
TA (μmol/kg)	1400 ± 192	1485 ± 171	1755 ± 334	964	937	941	486	493	626	789	802	794
DIC (μmol/kg)	1385 ± 182	1486 ± 170	1670 ± 278	969	924	951	1260	506	631	827	802	830
pCO_2 (μatm)	844 ± 642	1364 ± 1138	1117 ± 1696	591	382	723	22190	545	485	1151	432	1136
HCO_3^- (μmol/kg)	1348 ± 201	1402 ± 192	1545 ± 277	930	885	911	487	482	604	777	770	781
CO_3^{2-} (μmol/kg)	128 ± 264	38 ± 42	90 ± 63	17	25	14	0	5	10	6	16	6
ΩCa	2.64 ± 4.26	1.12 ± 1.15	2.44 ± 1.68	0.18	0.55	0.39	0	0.07	0.27	0.04	0.16	0.14
ΩAr	0.85 ± 0.77	0.64 ± 0.77	1.49 ± 1.04	0.11	0.32	0.22	0	0.04	0.16	0.03	0.1	0.08
Chl-a (μmol/kg)	2.7 ± 2.0	2.4 ± 2.7	3.6 ± 4.7	1.2	1.0	1.6	5.2	6.3	4.9	0.5	0.5	0.4
TSS (μmol/kg)	57 ± 123	38 ± 38	36 ± 18	30	27	30	425	143	48	20	17	17
Temp (°C)	24.1 ± 1.5	24.6 ± 1.2	25.2 ± 1.6	21.3	22.6	22.7	24	24.1	24.4	20.7	21.3	21.1
Salinity (ppt)	2.7 ± 1.9	5.5 ± 3.7	16.4 ± 11.7	0.3	1.0	2.0	0.3	0.3	1.7	0.2	0.3	1.2
pH	7.6 ± 0.6	7.7 ± 0.3	7.8 ± 0.4	7.7	7.9	7.7	5.9	7.5	7.7	7.4	7.8	7.4
DIN (μmol/L)	14 ± 3	14 ± 4	12 ± 8	22	21	17	9	9	8	21	20	16
P (μmol/L)	0.47 ± 0.14	0.48 ± 0.14	0.35 ± 0.18	0.97	0.81	0.80	1.25	1.58	1.38	1.04	1.03	1.01
Si (μmol/L)	292 ± 107	255 ± 95	148 ± 102	258	227	248	77	45	21	199	149	183

Calculated parameters for water samples from Kaneohe Stream can also be found in Table 2. There was an average pCO_2 concentration of 844±642 µatm at station 1 with an increase to 1364±1138 µatm at station 2 and a subsequent decrease at station 3 to 1117±1696 µatm. Bicarbonate also exhibited increasing average concentrations from 1348±201 µmol/kg at station 1 to 1545±277 µmol/kg at station 3. Carbonate showed an average concentration at station 1 of 128±264 µmol/kg, while there was a large decrease to 38±42 µmol/kg at station 2 followed by an increase at station 3 to 90±63 µmol/kg. The saturation state of calcite (Ω_{Calc}) had similar average concentrations of 2.6±4.3 at station 1 and 2.4±1.7 at station 3. There was a decrease observed at station 2 from the other two stations to 1.1±1.3 during baseline events. The saturation state of aragonite (Ω_{Arag}) showed an average concentration at station 1 of 0.9±0.8. There was a decrease in average concentration to 0.6±0.8 at station 2 followed by an increase to 1.5±1.0 at station 3. There were large differences in average pH between stations with a general increase in pH from station 1 at 7.6 to station 3 at 7.8 (Table 2).

III. Ahuimanu Stream – Baseline Conditions

Field data collected via the YSI Sonde is given in Appendix A, other field data are presented in Table 3. Ahuimanu Stream showed similar salinity profiles as Kaneohe Stream, i.e., little variation in salinity profiles at higher salinities (Figure 11).

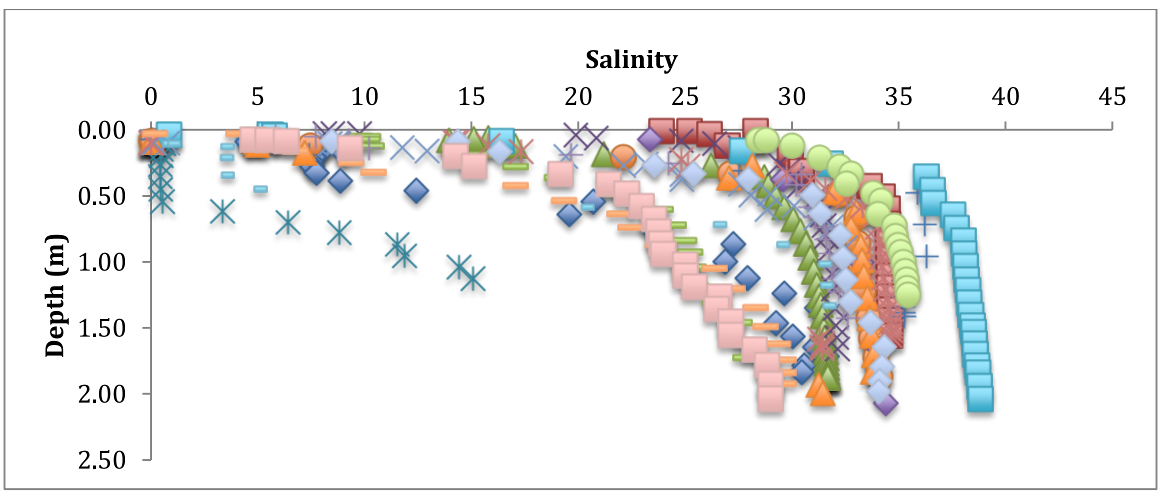


Figure 13. Salinity profiles in ppt at Station 2 affronting Ahuimanu Stream with each symbol representing a different sampling date.

During baseline conditions (Table 3), the average water temperature at station 1 (26.3±4.0°C) was higher than stations 2 and 3 (24.5±1.9°C and 24.8±1.9°C, respectively). Salinity increased from 0.08 ppt at station 1 to 18.9 ppt at station 3. Chl-a had an average concentration of 3.1±2.4 µg/L at station 1 followed by a decrease to 2.1±1.9 µg/L at station 2. Sequentially, there was an increase in average chlorophyll-a concentration to 4.1±7.5 µg/L at station 3. The average TSS concentration for station 1 was 31±52 mg/L, which followed by a decrease to 29±20 mg/L at station 2. In addition, there was an increase in the average TSS concentration at station 3 to 47±38 mg/L.

Water chemistry parameters for Ahuimanu Stream determined in the laboratory are presented in Table 3. The average TA concentration increased from station 1 at 1327±277 µmol/kg to station 3 at 1831±251 µmol/kg. The average DIC concentrations also increased from station 1 at 1252±154 µmol/kg at station 1 to 1717±192 µmol/kg. The average DIN concentration decreased 17.8±28.3 µmol/L at station 1 to 5.3±4.2 µmol/L at station 3 and average phosphate concentrations of 0.37±0.21 µmol/L at station 1 followed by an increase to 0.49±0.26 at station 2 before decreasing to 0.23±0.16 µmol/L at station 3. The average silicate concentration also decreased from 369±120 µmol/L at station 1 to 172±106 µmol/L The DIN:DIP ratio was 39±53, which was slightly higher and much more variable than found in Kaneohe Stream during all baseline events (Table 3).

Calculated parameters for Ahuimanu Stream are also presented in Table 3. A decrease in pCO_2 concentrations was observed from 1791±5793 µatm at station 1 to 622±276 µatm at station 3. Average bicarbonate concentrations increased from 1054±242 µmol/kg at station 1 to 1601±163 µmol/kg at station 3. Carbonate had an average concentration of 133±89 µmol/kg at station; this was the highest of the three stations. A decrease to 41±33 µmol/kg was observed at station 2 followed by an increase to 97±48 µmol/kg at station 3. The Ω_{Calc} appeared to have a higher average concentration at station 1 of 1.79±1.97 than at station 2, which showed a decrease to 1.20±0.79. In contrast, station 3 displayed an increase in Ω_{Calc} concentration to 2.60±1.12. Likewise, the Ω_{Arag} showed similar fluctuating concentrations as Ω_{Calc}, where station 1 showed a higher concentration of 1.08±1.15 than station 2, where the concentration decreased to 0.75±0.51. Station 3 showed the highest concentration of the three stations at 1.62±0.76.

Large differences were observed between the average pH of water samples of the three stations for all baseline samples. Station 1 displayed the highest average pH concentration of7.9±0.8, while a decrease was observed at station 2 of 7.5±0.3 followed by an increase at station 3 to 7.8±0.2 (Table 3).

Table 3. Data of all parameters collected, measured, and calculated at each station for Ahuimanu Stream during baseline and storm events.

AS	Baseline			Storm 1			Storm 2			Storm 3		
Parameter	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
TA (µmol/kg)	1327 ± 277	1576 ± 282	1831 ± 251	1141	1286	1227	586	1398	1259	603	1164	1427
DIC (µmol/kg)	1253 ± 154	1552 ± 237	1717 ± 192	1458	1353	1293	577	1501	1260	683	1227	1439
pCO_2 (µatm)	1792 ± 5793	1037 ± 327	622 ± 276	9039	2081	2249	258	3640	1081	2184	1998	1263
HCO_3^- (µmol/kg)	1054 ± 242	1475 ± 216	1601 ± 163	1138	1267	1209	552	1376	1203	599	1146	1374
CO_3^{2-} (µmol/kg)	133 ± 89	41 ± 33	97 ± 48	2	9	9	16	9	23	2	8	23
ΩCa	1.79 ± 1.97	1.19 ± 0.79	2.59 ± 1.12	0.01	0.20	0.25	10.07	0.26	0.69	0.01	0.24	0.71
ΩAr	1.08 ± 1.15	0.75 ± 0.51	1.62 ± 0.76	0.01	0.12	0.14	0.05	0.16	0.40	0	0.14	0.41
Chl-a (µmol/kg)	3.1 ± 2.4	2.1 ± 1.9	4.2 ± 7.5	1.2	0.2	0.4	2.5	2.4	0.4	2.2	0.3	0.5
TSS (µmol/kg)	31 ± 52	29 ± 20	47 ± 38	4.7	10	10	62	48	48	14	18	32
Temp (°C)	26.3 ± 4.0	24.4 ± 1.9	24.8 ± 1.9	23.6	21.9	21.8	26.1	24.6	24.6	21.4	22.0	22.1
Salinity (ppt)	0.8 ± 1.4	10.9 ± 8.1	18.9 ± 10.3	0.1	1.0	2.0	0.1	14.7	11.3	0.1	3.5	8.2
pH	7.9 ± 0.8	7.5 ± 0.3	7.8 ± 8.2	6.7	7.3	7.3	7.9	7.1	7.6	7.0	7.3	7.6
DIN (µmol/L)	18 ± 28	14 ± 18	5 ± 4	32	24	84	12	17	20	19	12	22
P (µmol/L)	0.37 ± 0.21	0.49 ± 0.26	0.23 ± 0.16	0.29	0.39	0.73	1.98	1.02	1.19	0.52	0.47	0.61
Si (µmol/L)	369 ± 120	263 ± 107	172 ± 106	427	370	323	146	159	142	168	259	251

IV. Waiahole Stream – Baseline Conditions

Field data from the YSI Sonde is given in Appendix A; data for other parameters are presented in Table 4. Salinity profiles at station 1 did not change with depth, while salinities at stations 2 and 3 showed little variation in salinity profiles at higher salinities (Figure 12).

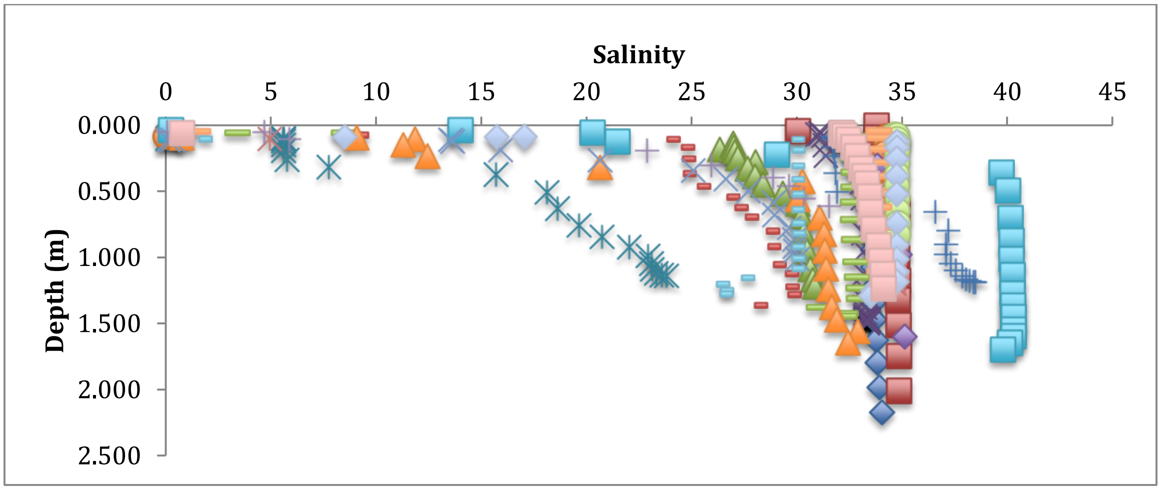


Figure 14. Salinity profiles in ppt at Station 2 affronting Waiahole Stream with each symbol representing a different sampling date.

The average temperature increased from 22.1±2.4°C at station 1 to 24.4±1.4°C at station 3, which was slightly lower than the other two streams. Salinity increased from 0.07 ppt at station 1 to 31.1 ppt at station 3. TSS appeared to increase from 23±47 mg/L at station 1 to 120±78 mg/L at station 3. Chl-a concentrations increased from station 1 to 3; concentrations of 4.4±10.2 µg/L at station 3 compared to average concentrations at the other two stations of 1.2±1.2 µg/L (station 1) and 1.5±1.4 µg/L (station 2).

Water chemistry data for Waiahole Stream can be found in Table 4. TA showed an increase in concentration from 860±139 µmol/kg at station 1 to 1985±201 µmol/kg at station 3. Likewise, there was an observed increased in DIC concentration from 779±67 µmol/kg at station 1 to 1792±148 µmol/kg at station 3. In contrast, a decrease in DIN concentration was observed from 4.2±2.4 µmol/L at station 1 to 0.9±1.2 µmol/L at station 3. Similar decreases in average phosphate concentrations were observed from

Table 4. Data of all parameters collected, measured, and calculated at each station for Waiahole Stream during baseline and storm events.

WS	Baseline			Storm 1			Storm 2			Storm 3		
Parameter	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
TA (µmol/kg)	860 ± 139	1640 ± 213	1985 ± 201	854	965	1115	531	1273	1325	772	1084	1969
DIC (µmol/kg)	779 ± 67	1496 ± 174	1792 ± 148	862	948	1183	566	1462	1338	809	1087	1860
pCO_2 (µatm)	292 ± 244	384 ± 129	527 ± 210	575	351	2186	1016	6237	1439	1103	756	505
HCO_3^- (µmol/kg)	690 ± 196	1376 ± 155	1637 ± 119	827	908	1098	525	1261	1271	761	1041	1745
CO_3^{2-} (µmol/kg)	78 ± 142	108 ± 38	140 ± 39	13	27	7	3	5	21	6	19	98
ΩCa	0.37 ± 0.71	2.88 ± 0.97	3.45 ± 0.89	0.05	0.73	0.22	0.01	0.13	0.57	0.02	0.57	2.75
ΩAr	0.24 ± 0.45	1.79 ± 0.62	2.26 ± 0.61	0.03	0.42	0.13	0.01	0.08	0.35	0.01	0.32	1.64
Chl-a (µmol/kg)	1.3 ± 1.2	1.5 ± 1.4	4.4 ± 10.2	0.03	2.4	0.2	1.4	0.1	3.1	0.1	1.1	1.1
TSS (µmol/kg)	23 ± 47	95 ± 83	120 ± 78	11	34	103	160	286	307	4	95	64
Temp (°C)	22.1 ± 2.4	23.7 ± 1.7	24.4 ± 1.4	21.1	21.1	21.8	21.3	24.0	23.6	20.2	21.6	22.8
Salinity	0.07 ± 0.03	20.8 ± 7.4	31.1 ± 5.8	0.06	2.0	8.0	0.07	19.6	20.3	0.07	7.1	14.7
pH	8.1 ± 0.8	7.8 ± 0.4	7.8 ± 0.3	7.7	8.0	7.2	7.3	6.8	7.4	7.4	7.7	8.0
DIN (µmol/L)	4 ± 2	2 ± 1	1 ± 2	11	6	7	11	8	6	11	8	4
P (µmol/L)	0.69 ± 0.13	0.31 ± 0.16	0.06 ± 0.16	0.62	0.65	0.39	1.48	0.81	0.84	0.57	0.71	0.21
Si (µmol/L)	397 ± 101	148 ± 59	47 ± 52	447	372	236	171	111	164	363	240	39

0.7±0.1 µmol/L at station 1 to 0.06±0.2 µmol/L at station 3. Silicate displayed higher average concentrations at station 1 of 397±101 µmol/L compared to stations 2 and 3 with average concentrations of 148±59 µmol/L and 47±52 µmol/L, respectively. The DIN:DIP ratio of 7.4±6.6 for all baseline events was much lower for Waiahole Stream them observed at other streams (Table 3).

Data for calculated parameters in waters from Waiahole Stream are also presented in Table 4. The average pCO_2 concentrations increased from 292±244 µatm at station 1 to 527±210 µatm at station 3. There were similar increases from station 1 to station 3 for bicarbonate and carbonate concentrations. Bicarbonate increased from 690±196 µmol/kg at station 1 to 1637±119 µmol/kg at station 3, while carbonate increased from 78±142 µmol/kg at station 1 to 140±39 µmol/kg at station 3. Similarly, the average Ω_{Calc} and Ω_{Arag} concentrations increased from station 1 to station 3 during baseline events. The average Ω_{Calc} concentration was 0.37±0.71 at station 1 and increased to 3.5±0.9 at station 3. The Ω_{Arag} concentration at station 1 was 0.2±0.5 and 2.3±0.6 at station 3. Average pH was relatively high at station 1 compared to the other two stations that were very similar during baseline events at all stations from Waiahole Stream (Table 4). At station 1, the pH was 8.1±0.8, while stations 2 and 3 had very similar pH values of 7.8±0.4 and 7.8±0.3, respectively.

V. Kaneohe Stream – Storm Conditions

Field data from the YSI Sonde can be found in Appendix A and other field data are presented in Table 2. The average temperature slightly decreased from baseline to 21.3°C at station 1, while stations 2 and 3 had similar temperatures of 22.6°C and 22.7°C, respectively during Storm 1. In contrast, temperatures during Storm 2 changed little at stations 1 and 2, while station 3 decreased to 24.4°C. Large decreases in temperature were observed during Storm 3 wherein station 1 decreased to 20.7°C and stations 2 and 3 decreased to 21.3°C and 21.1°C, respectively. All stations observed large decreases in salinity compared to baseline with concentrations ranging from 0.3 ppt at station 1 to 2 ppt at station 3 during Storm 1. Likewise, salinities during Storm 2 drastically decreased from baseline conditions ranging from 0.3 ppt at stations 1 and 2 to 1.7 ppt at station 3. Large decreases in salinity compared to baseline were also observed during Storm 3 with a salinity range of 0.16 ppt at station 1 to 1.23 ppt at station 3.

Total suspended solids concentrations decreased from baseline events to 30 mg/L at station 1, 27 mg/L at station 2, and 30 mg/L at station 3 during Storm 1. In contrast, large increases in TSS concentration were observed at stations 1 and 2 where concentrations were 425 mg/L and 143 mg/L, respectively, while there was a slight increase at station 3 to 48 mg/L during Storm 2. Storm 3, in comparison, displayed decreases in TSS compared to baseline where station 1 was 20 mg/L and stations 2 and 3 were each 17 mg/L. Chl-a had average concentrations at all stations that slightly decrease relative to baseline events. Station 1 had 1.2 µg/L with a small decrease observed to 0.9 µg/L at station 2, while station 3 had an increase to 1.6 µg/L. In contrast, there were large increases compared to baseline conditions in chl-a concentrations during Storm 2 with a concentration at station 1 of 5.2 µg/L, followed by 6.3 µg/L at station 2, and 4.9 µg/L at station 3. Storm 3 displayed large decreases in chl-a concentrations compared to baseline conditions ranging from 0.5 µg/L at station 1 to 0.4 µg/L at stations 2 and 3.

Results of laboratory based chemical analyses of water samples collected at Kaneohe Stream during storm events are presented in Table 2. TA decreased from baseline to 964 µmol/kg at station 1 and stations 2 and 3 had similar concentrations of 937 µmol/kg and 941 µmol/kg, respectively during Storm 1. Likewise, drastic decreases in TA compared to baseline conditions were observed during Storm 2 with concentrations ranging from 486 µmol/kg at station 1 to 626 µmol/kg at station 3. Decreases in TA during Storm 3 were not as drastic as was seen during Storm 2 where the concentration at station 1 was 789 µmol/kg, station 2 was 802 µmol/kg, and station 3 was 794 µmol/kg. There were comparable decreases in the DIC concentrations during Storm 1 where station 1 displayed a concentration of 969 µmol/kg, station 2 had a concentration of 924 µmol/kg, and station 3 had an average concentration of 951 µmol/kg compared to baseline conditions. A slight decrease compared to baseline was observed at station 1 during Storm 2 to 1260 µmol/kg, while there were larger decreases shown at stations 2 and 3 with concentrations of 506 µmol/kg and 631 µmol/kg, respectively. Storm 3 displayed smaller decreases in DIC concentrations compared to baseline conditions with concentrations of 827 µmol/kg at station 1, 802 µmol/kg at station 2, and 830 µmol/kg at station 3.

DIN showed slight increases in concentration from baseline at all three stations with an overall decrease in concentration from station 1 to station that ranged from 22.2 µmol/L at station 1 to 16.9 µmol/L at station 3 during Storm 1. In contrast, decreases in

DIN concentrations were observed during Storm 2 where concentrations ranged from 9 µmol/L at stations 1 and 2 to 8 µmol/L at station 3. Contrasted with concentrations observed during Storm 2, large increases were observed during Storm 3 for DIN that ranged from 21 µmol/L at station 1 to 16 µmol/L at station 3. Silicate displayed decreases in concentration during Storm 1 at stations 1 and 2 of 259 µmol/L and 227 µmol/L, respectively, while station 3 showed an increased in concentration to 248 µmol/L from baseline conditions. Storm 2 displayed large decreases in silicate concentrations compared to baseline for all stations ranging from 77 µmol/L at station 1 to 21 µmol/L at station 3. Large decreases were observed during Storm 3 at stations 1 and 2 of 199 µmol/L and 149 µmol/L, respectively, while station 3 showed an increase in silicate concentration to 183 µmol/L compared to baseline conditions. Likewise, phosphate displayed an increase in concentration from baseline conditions that ranged from 0.98 µmol/L at station 1 to 0.80 µmol/L at station 3 during Storm 1. Storm 2 showed large increases in phosphate concentrations compared to baseline where the concentration at station 1 was 1.25 µmol/L, station 2 was 1.58 µmol/L, and station 3 was 1.38 µmol/L. Storm 3 also displayed increases in phosphate concentrations relative to baseline where concentrations ranged from 1.04 µmol/L at station 1 to 1.01 µmol/L at station 3. The DIN:DIP ratio during storms was slightly less than 21±13 during baseline conditions (Table 2).

Data for calculated parameters in water samples collected during storm events at Kaneohe Stream can be found in Table 2. There was an overall decrease in pCO_2 concentrations during Storm 1 that ranged from 591 µatm at station 1 to 723 µatm at station 3. Station 2 displayed a larger decrease in pCO_2 compared to the other two stations to 382 µatm. In contrast to Storm 1, a large increase in pCO_2 was observed during Storm 2 at station 1 with a concentration of 22190 µatm, while stations 2 and 3 exhibited large decreases of 545 µatm and 485 µatm, respectively. Storm 3 showed more variable pCO_2 concentrations compared to baseline conditions where station 1 had an increase in concentration to 1151 µatm, while station 2 exhibited a large decrease to 432 µatm, and station 3 showed a slight increase to 1136 µatm. Bicarbonate also decreased compared to baseline events to 930 µmol/kg at station 1, 885 µmol/kg at station 2, and 911 µmol/kg at station 3 during Storm 1. Likewise, large decreases were observed for bicarbonate during Storm 2 with concentrations of 487 µmol/kg at station 1 and 482 µmol/kg at station 2, while station 3 had a concentration of 604 µmol/kg compared to baseline conditions. In contrast, Storm 3 showed smaller decreases in bicarbonate concentration compared to baseline with stations 1 and 2 having similar concentrations of 777 µmol/kg and 770 µmol/kg, respectively, and station 3 having a concentration of 781 µmol/kg. Similarly, carbonate experienced large decreases in concentration from baseline conditions where station 1 had a concentration of 17 µmol/kg, while station 2 had a larger concentration of 25 µmol/kg and station 3 had a similar concentration to station 1 of 14 µmol/kg during Storm 1. Similar to Storm 1, large decreases in carbonate concentrations were observed during Storm 2 causing station 1 to be completely depleted in carbonate followed by stations 2 and 3 having very low concentrations of 5 µmol/kg and 10 µmol/kg, respectively. Compared to baseline, large decreases in carbonate concentration were observed during Storm 3 with stations 1 and 3 decreasing to 6 µmol/kg each and station 2 decreasing to 16 µmol/kg.

Storm events were associated with large decreases in Ω_{Calc} compared to baseline conditions; station 1 had a concentration of 0.2, station 2 had a concentration of 0.6, and lastly station 3 had a concentration of 0.4 during Storm 1. Furthermore, Ω_{Calc} was depleted at station 1 during Storm 2, while stations 2 and 3 had concentration of 0.1 and 0.3, respectively compared to baseline. In addition, Storm 3 exhibited large decreases in Ω_{Calc} relative to baseline wherein station 1 was 0.04, station 2 was 0.2, and station 3 was 0.1. Similarly, Ω_{Arag} displayed large decreases in concentration from baseline conditions where station 1 had a concentration of 0.1, station 2 had a concentration of 0.3, and station 3 had a concentration of 0.2 during Storm 1. Likewise to Ω_{Calc} during Storm 2, Ω_{Arag} during Storm 2 was also depleted at station 1 with stations 2 and 3 at 0.04 and 0.16, respectively. Storm 3 showed large decreases compared to baseline where station 1 was 0.03, station 2 was 0.10, and station 3 was 0.08. Stations 1 and 2 seemed to increase in pH concentration during Storm 1 to 7.8 and 7.9, respectively, while station 3 displayed a decrease in pH concentration to 7.7 compared to baseline. In contrast, Storm 2 exhibited large decreases in pH that ranged from 5.9 at station 1 to 7.7 at station 3 compared to baseline. Storm 3 showed a decrease in pH to 7.4 at each station 1 and 3, while station 2 showed a slight increase to 7.8 compared to baseline (Table 2).

VI. Ahuimanu Stream – Storm Conditions

Field data obtained with the YSI Sonde can be found in Appendix A and other field measured parameters are shown in Table 3. Station 1 seemed to have a higher temperature at 23.6°C compared to the other stations 2 and 3, which had similar temperatures of 21.9°C and 21.8°C, respectively during Storm 1, however, these temperatures decreased relative to baseline conditions. Temperatures during Storm 2 were relatively similar to baseline conditions at all three stations. In contrast, large decreases in temperature compared to baseline were observed during Storm 3 where station 1 was 21.4°C and stations 2 and 3 were 22.0°C and 22.1°C, respectively. Salinity concentrations also largely decreased from baseline conditions at all stations ranging from 0.1 ppt at station 1 to 2 ppt at station 3 during Storm 1. Salinity decreased compared to baseline conditions at stations 1 and 3 to 0.1 ppt and 11.3 ppt, respectively, while station 2 showed a slight increase in salinity to 14.7 ppt during Storm 2. Storm 3 exhibited large decreases in salinity compared to baseline conditions ranging from 0.1 ppt at station 1 to 8.2 ppt at station 3.

TSS decreased during Storm 1 to 5 mg/L at station 1 and 10 mg/L at stations 2 and 3 compared to baseline conditions. Storm 2 exhibited increases in TSS concentrations compared to baseline that ranged from 62 mg/L at station 1 to 48 mg/L at station 3. In contrast to Storm 2, Storm 3 showed decreases in TSS that ranged from 14 mg/L at station 1 to 32 mg/L at station 3. Similarly to Kaneohe Stream, chl-a seemed to decrease from baseline conditions with station 1 exhibiting the higher concentration of 1.2 µg/L followed by 0.2 µg/L at station 2 and 0.44 µg/L at station 3 during Storm 1. A slight decrease in chl-a concentrations were observed at station 1 to 2.9 µg/L, while station 2 exhibited a slight increase from baseline to 2.4 µg/L, followed by a decrease at station 3 to 0.4 µg/L during Storm 2. A slight decrease at station 1 to 2.2 µg/L was observed during Storm 3, while larger decreases were observed at stations 2 and 3 to 0.3 µg/L and 0.5 µg/L, respectively compared to baseline.

Water chemistry data from samples collected at Ahuimanu Stream during storm events can be found in Table 3. Total alkalinity displayed smaller decreases compared to baseline where station 1 had a concentration of 1141 µmol/kg, station 2 had a concentration of 1286 µmol/kg, and station 3 had a concentration of 1227 µmol/kg during

Storm 1. Storm 2 exhibited more drastic decreases in TA compared to Storm 1 where station 1 was 586 µmol/kg, station 2 was 1398 µmol/kg, and station 3 was 1259 µmol/kg. Storm 3 showed decreases in TA compared to baseline conditions that ranged from 603 µmol/kg at station 1 to 1427 µmol/kg at station 3. Dissolved inorganic carbon also decreased compared to baseline conditions with station 1 having a concentration of 1458 µmol/kg, station 2 had 1353 µmol/kg, and station 3 had 1293 µmol/kg during Storm 1. Large decreases in DIC concentrations were observed during Storm 2 at stations 1 and 3 to 577 µmol/kg and 1260 µmol/kg, respectively, while station 2 showed only a slight decrease relative to baseline conditions to 1501 µmol/kg. Storm 3 showed similar decreases in DIC compared to Storm 2 where concentrations ranged from 683 µmol/kg at station 1 to 1439 µmol/kg at station 3.

There was an increase in DIN concentrations during Storm 1 compared to baseline conditions where station 1 had 32 µmol/L, followed by station 2 with a concentration of 24 µmol/L, and station 3 with a concentration of 84 µmol/L. Storm 2 exhibited decreases in concentration compared to baseline at stations 1 and 2, while station 3 showed an increase with concentrations ranging from 12 µmol/L at station 1 to 20 µmol/L at station 3. In contrast, Storm 3 displayed increases compared to baseline at stations 1 and 3 to 19 µmol/L and 22 µmol/L, respectively, while station 2 showed a slight decrease to 12 µmol/L compared to baseline. There was an apparent decrease in phosphate concentrations during Storm 1 at stations 1 and 2 of 0.29 µmol/L and 0.39 µmol/L, respectively, while there was an increase at station 3 to 0.73 µmol/L compared to baseline conditions. On the other hand, Storm 2 showed large increases in phosphate compared to baseline where the concentration at station 1 was 1.98 µmol/L, station 2 was 1.02 µmol/L, and station 3 was 1.19 µmol/L. In contrast, Storm 3 showed an increase in phosphate compared to baseline at stations 1 and 3 of 0.52 µmol/L and 0.61 µmol/L, respectively, while station 2 showed a slight decrease compared to baseline to 0.47 µmol/L. Silicate displayed an increase in concentration compared to baseline conditions during Storm 1 that ranged from 427 µmol/L at station 1 to 323 µmol/L at station 3. Large decreases in silicate were observed during Storm 2 at stations 1 and 2 where concentrations were 146 µmol/L and 159 µmol/L, respectively, while station 3 showed a slight decrease compared to baseline to 143 µmol/L. A large decrease was observed during Storm 3 at station 1, while a slight decrease was shown at station 2 followed by a large increase of silicate at station 3, where concentrations ranged from 168 µmol/L at station 1 to 251 µmol/L at station 3. The DIN:DIP ratio during Storm 1 also slightly decreased to 37±31 during baseline conditions (Table 3).

Calculated parameters for samples from Ahuimanu Stream during storm events are presented in Table 3. A drastic increase of pCO_2 compared to baseline concentrations during Storm 1 with 9039 µatm at station 1, 2081 µatm at station 2, and 2249 µatm at station 3. Storm 2 exhibited a slight increase at station 1 of 258 µatm compared to baseline, while drastically large increases were observed at stations 2 and 3 where concentrations were 3640 µatm and 1031 µatm, respectively. Large increases in pCO_2 were seen during Storm 3 with concentrations that ranged from 2184 µatm at station 1 to 1263 µatm at station 3 compared to baseline. Bicarbonate showed a slight increase during Storm 1 at station 1 to 1138 µmol/kg, however, there was an observed decrease at stations 2 and 3 to 1267 µmol/kg and 1209 µmol/kg, respectively compared to baseline conditions. During Storm 2, a large decrease in bicarbonate was observed at station 1 to 552 µmol/kg, while stations 2 and 3 show smaller decreases to 1376 µmol/kg and 1203 µmol/kg compared to baseline conditions. Similar decreases of bicarbonate were observed during Storm 3 compared to Storm 2 where the concentration ranged from 599 µmol/kg at station 1 to 1374 µmol/kg at station 3. There was a drastic decrease in carbonate concentrations at all stations during Storm 1 where station 1 had a concentration of 2 µmol/kg and stations 2 and 3 each had 9 µmol/kg compared to baseline conditions. Large decreases were also observed during Storm 2 at all stations where the concentration at station 1 was 16 µmol/kg, station 2 was 9 µmol/kg, and station 3 was 23 µmol/kg compared to baseline. During Storm 3, large decreases were observed at all stations compared to baseline with carbonate concentrations ranging from 2 µmol/kg at station 1 to 23 µmol/kg at station 3.

Both Ω_{Calc} and Ω_{Arag} experienced large decreases in concentration compared to baseline where Ω_{Calc} ranged from 0.01 at station 1 to 0.25 at station 3 and Ω_{Arag} ranged from 0.01 at station 1 to 0.14 at station 3 during Storm 1. Similar decreases in Ω_{Calc} and Ω_{Arag} were observed during Storm 2 where Ω_{Calc} ranged from 0.07 at station 1 to 0.69 at station 3 and Ω_{Arag} ranged from 0.05 at station 1 to 0.4 at station 3 compared to baseline.

The Ω_{Calc} and Ω_{Arag} concentrations experienced large decreases during Storm 3 compared to baseline conditions where Ω_{Calc} ranged from 0.01 at station 1 to 0.71 at station 3, while Ω_{Arag} was completely depleted at station 1 and ranged from 0.14 at station 2 and 0.41 at station 3. Large decreases in pH were observed during Storm 1 where the pH concentration at station 1 was 6.7 and stations 2 and 3 were each 7.3 compared to baseline conditions. During Storm 2, pH at station 1 changed very little compared to baseline, while stations 2 and 3 exhibited decreases to 7.1 and 7.6, respectively. Large decreases were observed during Storm 3 for pH concentrations that ranged from 7.0 at station 1 to 7.6 at station 3 compared to baseline conditions (Table 3).

VII. Waiahole Stream – Storm Conditions

Field data collected with the YSI Sonde can be found in Appendix A and other field data are shown in Table 4. A slight decrease in temperature was observed during Storm 1 with stations 1 and 2 each having a temperature of 21.1°C and station 3 having a temperature of 21.8°C compared to baseline conditions. While stations 1 and 3 showed slight decreases in temperature to 21.3°C and 23.6°C during Storm 2 compared to baseline conditions, station 2 showed a slight increase to 24.0°C. Larger decreases were observed during Storm 3 compared to baseline where temperatures ranged from 20.2°C at station 1 to 22.8°C at station 3. While there was no change in salinity at station 1 relative to baseline, there was drastic decrease in salinity at stations 2 and 3 to 2 ppt and 8 ppt, respectively during Storm 1. Station 1 did not change salinity during Storm 2 compared to baseline, however, unlike Storm 1, there were smaller decreases in salinity observed at stations 2 and 3 compared to baseline that decreased to 20 ppt for each. Likewise in Storm 2, station 1 during Storm 3 did not change salinity compared to baseline, while stations 2 and 3 exhibited large decreases in salinity to 7 ppt and 15 ppt, respectively.

TSS displayed decreases in concentration compared to baseline with a larger decrease observed at station 2 compared to the other two stations. Station 1 had a concentration of 11 mg/L, followed by 34 mg/L at station 2, and 103 mg/L at station 3 during Storm 1. During Storm 2, large increases in TSS were observed at all stations with concentrations ranging from 160 mg/L at station 1 to 307 mg/L at station 3. In contrast, there were large decreases in TSS during Storm 3 where the concentration at station 1 was 4 mg/L, station 2 was 95 mg/L, and station 3 was 64 mg/L. Chl-a showed decreases in concentration compared to baseline at stations 1 and 3 of 0.03 µg/L and 0.2 µg/L, respectively, while there was an observed increase at station 2 of 2.4 µg/L during Storm 1. Slight decreases in chl-a compared to baseline were observed at stations 1 and 3 during Storm 2 where concentrations were 1.4 µg/L and 3.1 µg/L, while station 2 showed a drastic change in concentration to 0.1 µg/L compared to baseline. Storm 3 exhibited large decreases in chl-a compared to baseline where concentrations ranged from 0.1 µg/L at station 1 to 1.1 at stations 2 and 3.

Data from laboratory analyses of water samples collected at Waiahole Stream during storm events are shown in Table 4. TA remained relatively constant at station 1 compared to baseline conditions, while stations 2 and 3 showed large decreases in concentration to 965 µmol/kg and 1115 µmol/kg, respectively during Storm 1. Large decreases in TA were observed during Storm 2 compared to baseline conditions where concentrations ranged from 531 µmol/kg at station 1 to 1325 µmol/kg at station 3. Storm 3 produced smaller decreases in TA compared to Storm 2 where a slight decrease was observed at stations 1 and 3, while a larger decrease was observed at station 2 where concentrations ranged from 772 µmol/kg at station 1 to 1969 µmol/kg at station 3. Dissolved inorganic carbon also decreases in concentration compared to baseline at stations 2 and 3 to 948 µmol/kg and 1183 µmol/kg, respectively, while there was a slight increase at station 1 to 862 µmol/kg during Storm 1. A larger decrease at station 3 compared to the other two stations was observed during Storm 2 for DIC where the concentration at station 3 was 1338 µmol/kg, while stations 1 and 2 were 566 µmol/kg and 1462 µmol/kg. Contrasting, Storm 3 exhibited slight increases for DIC at stations 1 and 3 to 809 µmol/kg and 1860 µmol/kg, while station 2 showed a decrease in concentration to 1087 µmol/kg compared to baseline.

DIN displayed increases in concentration compared to baseline conditions with station 1 having a concentration of 11 µmol/L, station 2 had 6 µmol/L, and station 3 had 7 µmol/L during Storm 1. Storm 2 showed large increases in DIN compared to baseline conditions where concentrations ranged from 11 µmol/L at station 1 to 6 µmol/L at station 3. Storm 3 also displayed large increases in DIN compared to baseline with concentrations ranging from 11 µmol/L at station 1 to 4 µmol/L at station 3. While station 1 showed a slight decrease in phosphate concentration to 0.62 µmol/L compared to baseline conditions, stations 2 and 3 showed a large increase to 0.65 µmol/L and 0.39 µmol/L, respectively during Storm 1. In contrast, Storm 2 showed large increases for phosphate compared to baseline where the concentration at station 1 was 1.48 µmol/L, while stations 2 and 3 had similar concentrations at 0.81 µmol/L and 0.84 µmol/L. Storm 3 displayed a slight decrease for phosphate at station 1 to 0.57 µmol/L, while stations 2 and 3 showed large increases compared to baseline to 0.71 µmol/L and 0.21 µmol/L, respectively. Silicate displayed large increases compared to baseline in concentration during Storm 1 ranging from 447 µmol/L at station 1 to 236 µmol/L at station 3. Comparatively, Storm 2 exhibited decreases at stations 1 and 2 where concentrations were 171 µmol/L and 141 µmol/L, while station 3 showed an increase relative to baseline conditions to 164 µmol/L. Slight decreases were observed during Storm 3 at stations 1 and 3 where concentrations were 363 µmol/L and 39 µmol/L, while station 2 showed a large increase in silicate to 240 µmol/L compared to baseline. The DIN:DIP ratio increased slightly to 13±5 during storm events (Table 4).

Calculated parameters for water samples collected at Waiahole Stream during storm events are presented in Table 4. The concentration of pCO_2 increased compared to baseline at station 1 to 575 µatm, while a slight decrease was observed to 351 µatm at station 2, followed by a large increase observed at station 3 to 2186 µatm during Storm 1. Large increases for pCO_2 compared to baseline conditions during Storm 2 where the concentration at station 1 was 1016 µatm, while a large increase was observed to 6237 µatm at station 2, and 1439 µatm at station 3. Storm 3 exhibited smaller increases for pCO_2 compared to baseline conditions to 1103 µatm and 756 µatm at stations 1 and 2 respectively, while station 3 showed a slight decrease from baseline to 505 µatm. There was an overall increase in bicarbonate concentrations at all stations compared to baseline conditions ranging from 827 µmol/kg at station 1 to 1098 µmol/kg at station 3 during Storm 1. Smaller decreases in bicarbonate compared to Storm 1 were observed during Storm 2 where concentrations ranged from 525 µmol/kg at station 1 to 1271 µmol/kg at station 3. In contrast, slight increases in bicarbonate were observed during Storm 3 at stations 1 and 3 with concentrations of 761 µmol/kg and 1745 µmol/kg, while a slight decrease to 1041 µmol/kg was shown at station 2 compared to baseline conditions. In contrast, carbonate showed drastic decreases in concentration compared to baseline with 13 µmol/kg at station 1, 27 µmol/kg at station 2, and 7 µmol/kg at station 3 during Storm 1. Large decreases were observed during Storm 2 for carbonate with concentrations that ranged from 3 µmol/kg at station 1 to 21 µmol/kg at station 3 compared to baseline conditions. Similarly, large decreases 6 µmol/kg and 19 µmol/kg were shown at stations 1 and 2 during Storm 3 compared to baseline, however, a smaller decrease was seen at station 3 to 98 µmol/kg.

Large decreases in Ω_{Calc} and Ω_{Arag} concentrations were observed during Storm 1. The Ω_{Calc} concentration at station 1 was 0.05, while station 2 was 0.73, and station 3 was 0.22. The Ω_{Arag} was similar to Ω_{Calc} where station 1 was 0.03, station 2 was 0.42, and station 3 was 0.13 compared to baseline conditions. Likewise, large decreases compared to baseline for Ω_{Calc} and Ω_{Arag} were observed during Storm 2 where Ω_{Calc} concentrations ranged from 0.01 at station 1 and 0.57 at station 3 and Ω_{Arag} ranged from 0.01 at station 1 to 0.35 at station 3. Large decreases compared to baseline were observed at stations 1 and 2, while station 3 showed slight decreases during Storm 3 where concentrations for Ω_{Calc} ranged from 0.02 to 2.75 and Ω_{Arag} ranged from 0.01 at station 1 to 1.64 at station 3. There were large decreases relative to baseline for pH at stations 1 and 3 to 7.7 and 7.2, respectively, while there was a slight increase in pH to 8.0 at station 2 during Storm 1. Storm 2 exhibited large decreases for pH compared to baseline conditions where station 1 was 7.3, station 2 was 6.8, and station 3 was 7.4. In contrast, stations 1 and 2 experienced slight decreases for pH compared to baseline to 7.4 and 7.7, while station 3 showed a slight increase to 8.0 (Table 4).

Chapter 4

Discussion

Estuaries are dynamic systems in which it is often difficult to quantify carbon transport from the land to the ocean. Studies that examined carbon transport have shown that streams and rivers deliver significant amounts of carbon to the adjoining coastal ocean (Cao *et al*., 2011). With respect to gas exchange, however, the studies that examined the carbon system in coastal areas have shown them to be net sources of CO_2 to the atmosphere, whereas the open ocean is now largely considered to be a sink of this important greenhouse gas (Doney, 2010).

In Hawaii, only a few studies have examined the carbon system in streams and adjoining bays, and the linkages between them. Although the carbon system within Kaneohe Bay has received substantial attention over the past 20-30 years, the streams entering Kaneohe Bay generally have not. Therefore, this study was motivated by a need to understand carbon fluxes from streams to Kaneohe Bay, and specifically aimed to examine how varying land use in the principal watersheds draining into Kaneohe Bay affects the carbon flux to the bay and it's variability over time. Below, the data I collected over a range of weather (i.e., stream flow) conditions are evaluated so as to elucidate the sources of inorganic carbon in stream channels and estuaries and the processes that control carbon delivery to Kaneohe Bay.

TA and DIC are the two inorganic carbon system parameters that were measured in water samples collected during this study. Streams are key vectors for the transport of both TA and DIC from the land to the coastal ocean. However, because coastal regions are becoming increasingly more populated, the associated changes in land use within the watersheds have altered carbon system dynamics and, therefore, parameters such as TA and DIC (Borges and Gypens, 2010). When streams and rivers are not serving as conduits for overland runoff, here defined as baseline conditions, it would be expected that carbon system parameters ought to reflect both slow in-stream processes (e.g., photosynthesis and respiration) as well as the inputs associated with the water that enters the channel and sustains the base-flow of the stream (e.g., groundwater charged with products of the respiration of soil organic matter). During high intensity rain events, when runoff is particularly abundant in Hawaii and causes both rapid and large increases in stream flow (e.g., Tomlinson *et al*., 2003), carbon concentrations and the distribution of carbon system parameters should reflect the processes that control both the initial carbon content of the input waters and any rapidly occurring in stream processes.

Examination of water collected in the three streams selected for this study provides the opportunity to examine how human activity (i.e., land use changes) impacts the carbon cycling in stream channels and fluxes therefrom. Additionally, a strong gradient in land use exists between Kaneohe Stream, which drains nearly 100% urbanized land, Ahuimanu Stream, which drains a mixed use (urban-rural) watershed, and Waiahole Stream, which drains predominantly conservation and agricultural lands. A commensurate change in stream morphology also exists as a result of channel hardening. The latter thus allows examining of how channel hardening itself also impacts stream processes and carbon system dynamics.

I. Effects of urbanization on carbon system parameters in streams

Generally, both TA and DIC increased downstream during baseline conditions throughout the duration of this study. Higher TA and DIC were observed at the urban streams compared to Waiahole Stream during baseline conditions. The plots showing a linear regression of salinity versus TA for the three streams (Figure 15) reveal that the TA at zero salinity decreases with decreased urbanization. The regression has an intercept of 1340 μmol/kg for Kaneohe (R^2 = 0.68), 1303 μmol/kg for Ahuimanu (R^2 = 0.71), and 883 μmol/kg for Waiahole (R^2 = 0.96) during baseline conditions. The higher TA is likely due in part to increased dissolution of the concrete channels potentially occurring in the urban streams. Stream waters tend to be more acidic compared to bay waters likely causing the dissolution of the concrete. In addition to the slow kinetic rates, the interaction between the concrete and stream water uses CO_2 and releases alkalinity and therefore increases the pH as seen at station 1 of Ahuimanu Stream (Table 2). Alternatively, the lower TA at Waiahole Stream is assumed to be attributable to decreased effects from urbanization compared to the other two streams. However, could the natural humic acids be contributing to the lowered TA by the addition of leaf litter and soils? While this study did not specifically study humic acids, due to the dense riparian vegetation found at Waiahole, it is a possibility that humic acids could be decreasing the TA. In addition to the dissolution of the concrete channels increasing the TA at the urban streams, these two processes could be causing the disparity in TA observed at each stream.

DIC increased downstream from station 1 to station 3 at all streams during baseline conditions. Additionally, higher DIC was observed in urban streams compared to Waiahole Stream. The regression has an intercept of 1357 μmol/kg for Kaneohe (R^2 = 0.53), 1274 μmol/kg for Ahuimanu (R^2 = 0.77), and 810 μmol/kg for Waiahole (R^2 = 0.97) during baseline conditions (Figure 16). The processes described for TA could not be responsible for to the variations in DIC considering both dissolution and introduction of humic acids should reduce constituents of DIC. Stream waters are partially fed by groundwater inputs during baseline conditions, and because there is a higher pCO_2 in groundwater compared to stream or bay waters, the increase in DIC in urban streams may be attributed in part to groundwater inputs. But how could there be an increase in the amount of groundwater transports in urban areas where there are large amounts of impervious surfaces impeding subsurface and surface interactions? While this is somewhat counterintuitive, a study performed by Mayorga (2008) proposed an increase in groundwater and bicarbonate transport in watersheds where there is an increase in land use change. This is consistent with the higher DIC and bicarbonate observed at the urban streams compared to Waiahole Stream. However, another process potentially contributing to an increase in DIC in urban streams is an increased rate of erosion. Mayorga (2008) also concluded that land use change in the watershed was causing an increase in bicarbonate transport. An increase in bicarbonate transport from either erosion or runoff would increase the alkalinity in addition to the DIC. But similarly to groundwater, erosion and runoff of DIC constituents during baseline conditions would be a slow process and may not be able to account for all of the variations between urban and rural streams. There could be a contribution from respiration of organic matter as indicated by the in stream pCO_2. During low flow conditions, organisms breaking down organic matter and respiring could increase pCO_2 and therefore the DIC in streams. Again, this process is slow and over longer periods of low flow this process could impact

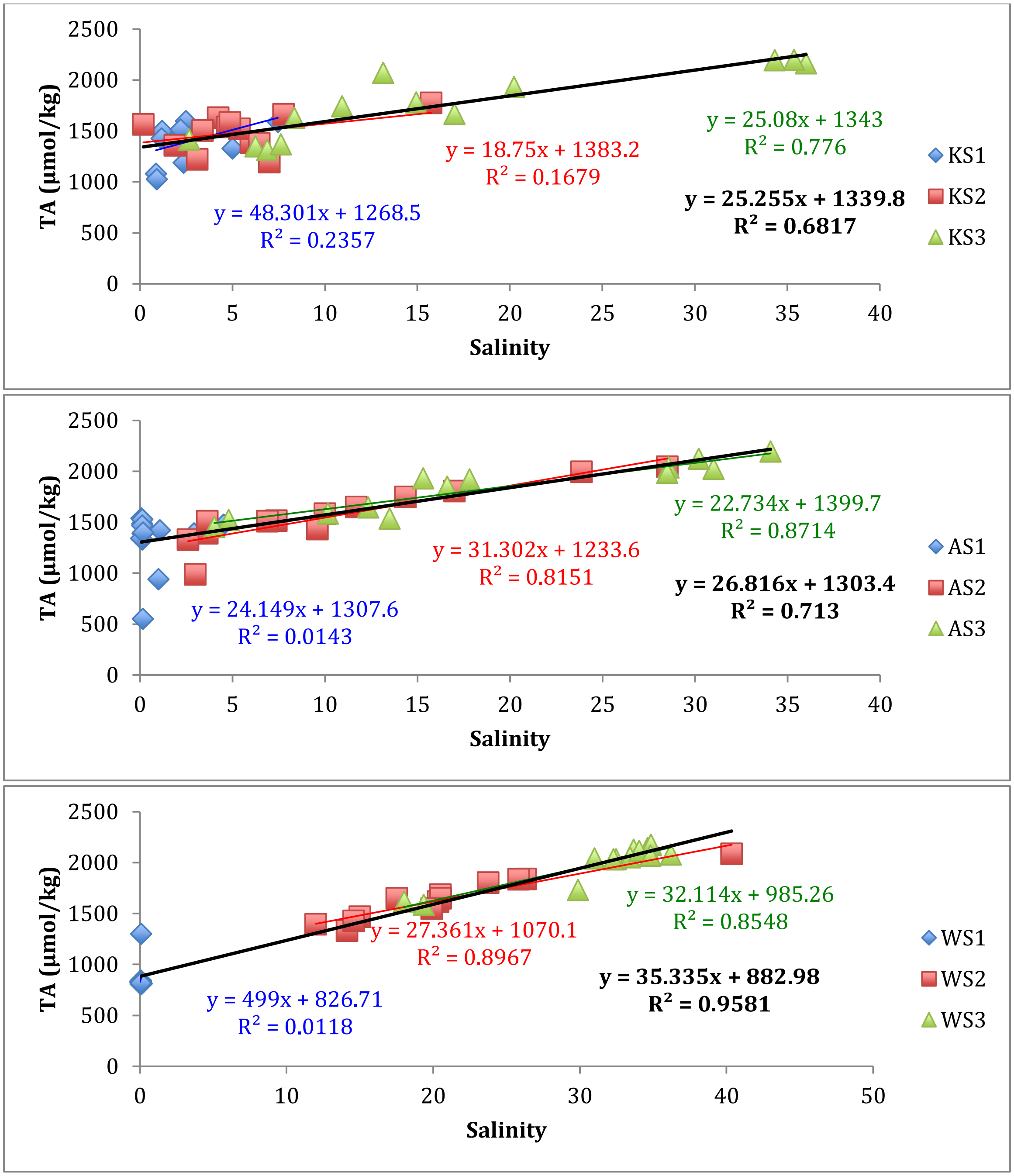


Figure 16. Linear relationship between salinity and total alkalinity (TA) at the three streams during baseline conditions. The top panel is for Kaneohe Stream, the middle panel is for Ahuimanu Stream, and the bottom panel is for Waiahole Stream. Station 1 is represented by the blue diamonds, station 2 is represented by the red squares, station 3 is represented by the green triangles, and the overall stream average for TA is represented by the black trend line. The equations for the regression of the data for each station and the overall average are color coded to match the symbols representing each station.

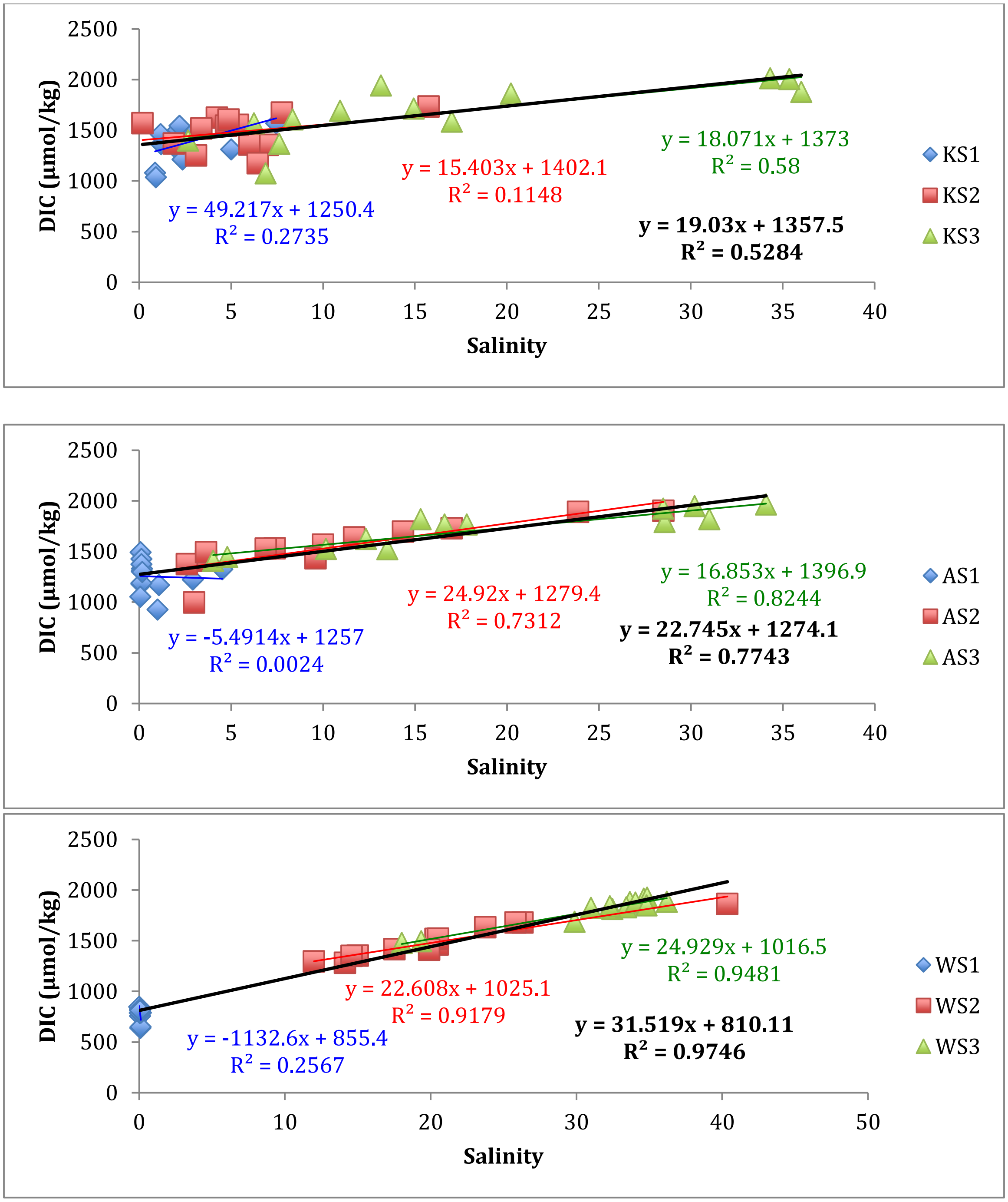


Figure 17. Linear relationship between salinity and dissolved inorganic carbon (DIC) at the three streams during baseline conditions. The top panel is for Kaneohe Stream, the middle panel is for Ahuimanu Stream, and the bottom panel is for Waiahole Stream. Station 1 is represented by the blue diamonds, station 2 is represented by the red squares, station 3 is represented by the green triangles, and the overall average for DIC is represented by the black trend line. The equations for each station and the overall average are color coded to match the symbols representing each station.

in-stream concentrations. And while a detailed discussion on groundwater and its effects on the carbon system are explained further in this chapter, during baseline conditions the combination of all three processes may be significantly impacting the carbon system at the urban streams. Furthermore, examining the relationship between TA and DIC indicates differing processes contributing to the variations in the carbon system parameters. Generally, there was more TA compared to DIC at all stations during baseline conditions. Differences in the DIC/TA relationship were observed between the three streams.

While Kaneohe Stream had the smallest DIC/TA ratio at 0.8 and Ahuimanu Stream had the highest at 0.89, Waiahole had an intermediate value of 0.86 (Figure 17). These small differences in the DIC/TA at the three streams can be attributed to minor contributions from differing processes. One such process is photosynthesis, which takes in CO2, decreasing DIC and could explain the difference between TA and DIC. Further examination of chlorophyll-a and nutrients shows generally an increase from stations 1 to 3 indicating lower abundances of algae in streams than in the estuary. At Kaneohe and Ahuimanu Streams, there was about a 1-2 µg/L higher chl-a concentration compared to Waiahole. Additionally, DIN was on average 10 to 20 µmol/L and phosphate was about

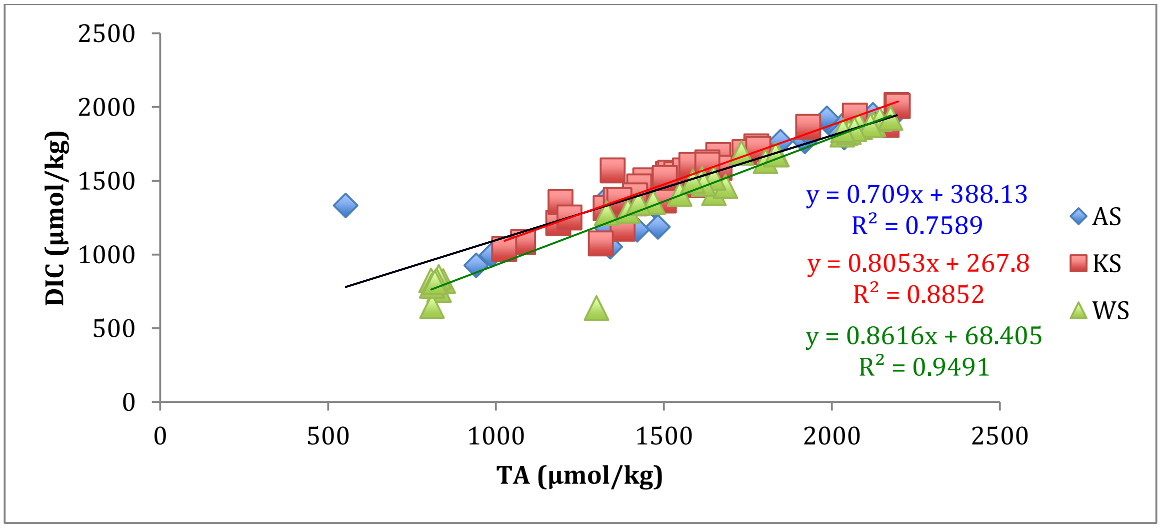


Figure 18. Linear regression analysis of dissolved inorganic carbon (DIC) and total alkalinity (TA) for each stream. Blue diamonds and equation correspond to data from Ahuimanu Stream. Red squares correspond to Kaneohe Stream and green triangles correspond to Waiahole Stream. The equations are arranged the same order, from top to bottom as shown in the legend and color-coded for each stream.

0.1 μmol/L higher than at Waiahole. The higher chl-a concentration in the urban streams could be a combination of land derived inputs and accumulation of benthic algae on the smooth concrete surfaces. But could there be other processes besides photosynthesis that accounts for the variation in the relationship between TA and DIC? Similar to the processes contributing to TA and DIC, dissolution of carbonate minerals is also likely contributing to the variations in the relationship between DIC/TA as was discussed previously. Although this analysis attributes the TA and DIC increases observed at Kaneohe and Ahuimanu Streams to urbanization in those watersheds, other processes not taken into account in this study may also be contributing to the observed variations among these streams.

The variations in the regressions of TA versus DIC between the three streams seen during baseline were not evident during storm events. Decreases in TA and DIC were observed during storm events at Kaneohe and Ahuimanu Streams, while there were only slight changes observed at Waiahole Stream. The regressions for storm flow showed a noticeable decrease in TA at zero salinity (Figure 18), suggesting less of an impact from urbanization occurs due to the shorter residence time of the water in the stream channels. The same decrease seen for TA was also observed for the DIC intercept at zero salinity is observed at Kaneohe and Ahuimanu Streams (Figure 19) during storm events. The increased rainfall inputs associated with storm events are likely caused by a dilution of conservative inorganic parameters such as TA and DIC. The decreases seen at Kaneohe stream were of similar magnitude to that seen at Waiahole Stream (Table 1). Ahuimanu Stream had a similar decrease in TA and DIC but was slightly higher than Kaneohe Stream, potentially due to higher groundwater inputs (Table 2). Additionally, increased stream flow likely caused a decrease in the available reaction time between the concrete and water. Therefore, there was an observed decrease in TA and DIC at the urban streams compared to Waiahole Stream. The combination of decreased reaction time between the concrete and water and the increased rainfall inputs, most likely contributed to the decrease in TA and DIC at the urban streams to similar magnitudes as seen at Waiahole Stream. Furthermore, examining the relationship between TA and DIC during storm conditions shows a coalescing of the trend lines potentially indicating a lessened impact from urbanization (Figure 20). As was discussed previously, a reduction in reaction time

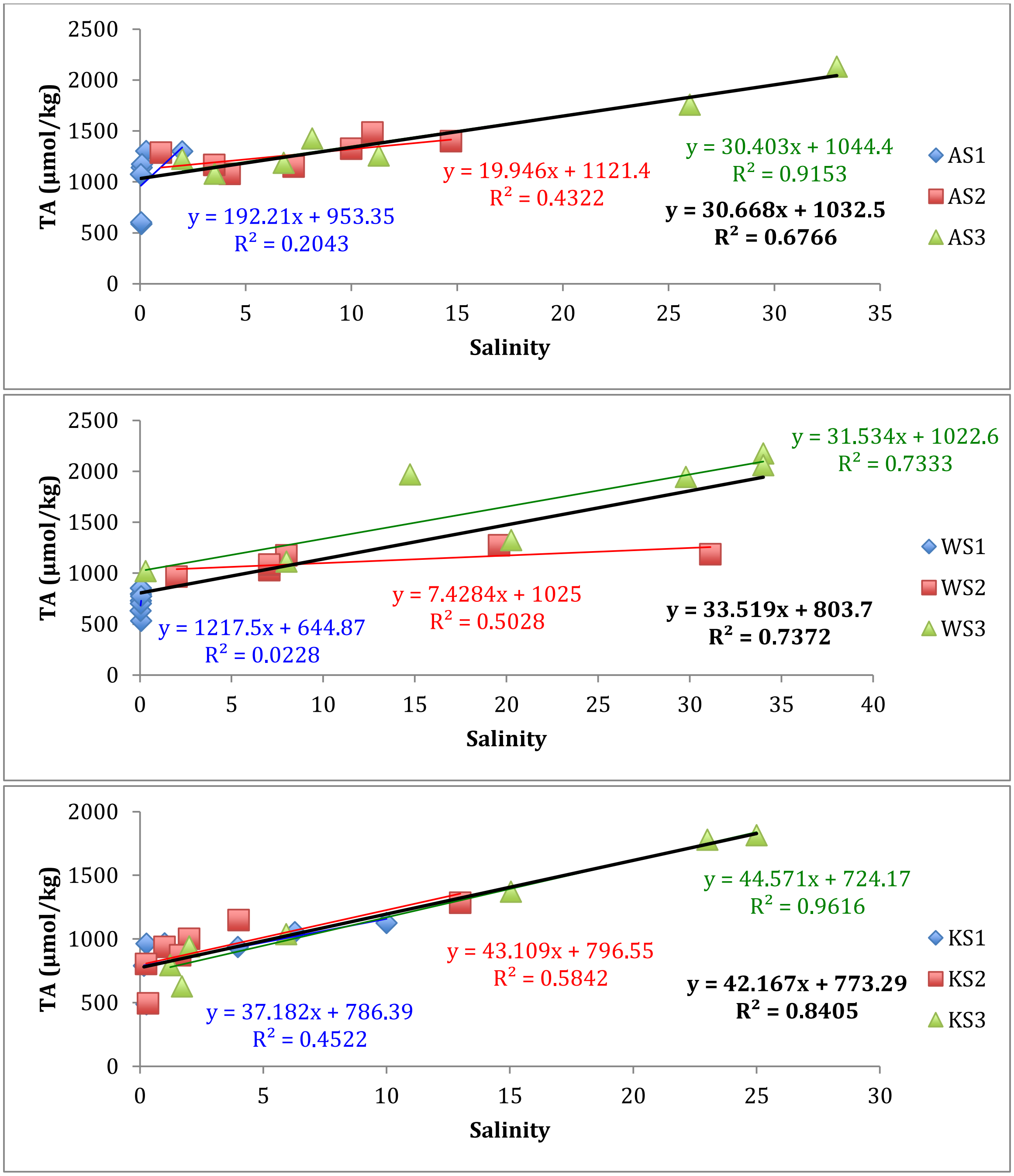


Figure 19. Linear relationship between salinity and total alkalinity (TA) at the three streams during storm conditions. Note the lower intercept values during storms compared to during baseline, reflecting dilution. The top panel is for Kaneohe Stream, the middle panel is for Ahuimanu Stream, and the bottom panel is for Waiahole Stream. Station 1 is represented by the blue diamonds, station 2 is represented by the red squares, station 3 is represented by the green triangles, and the overall average for TA is represented by the black trend line. The equations for the regression of data from each station and the overall average are color coded to match the symbols representing each station.

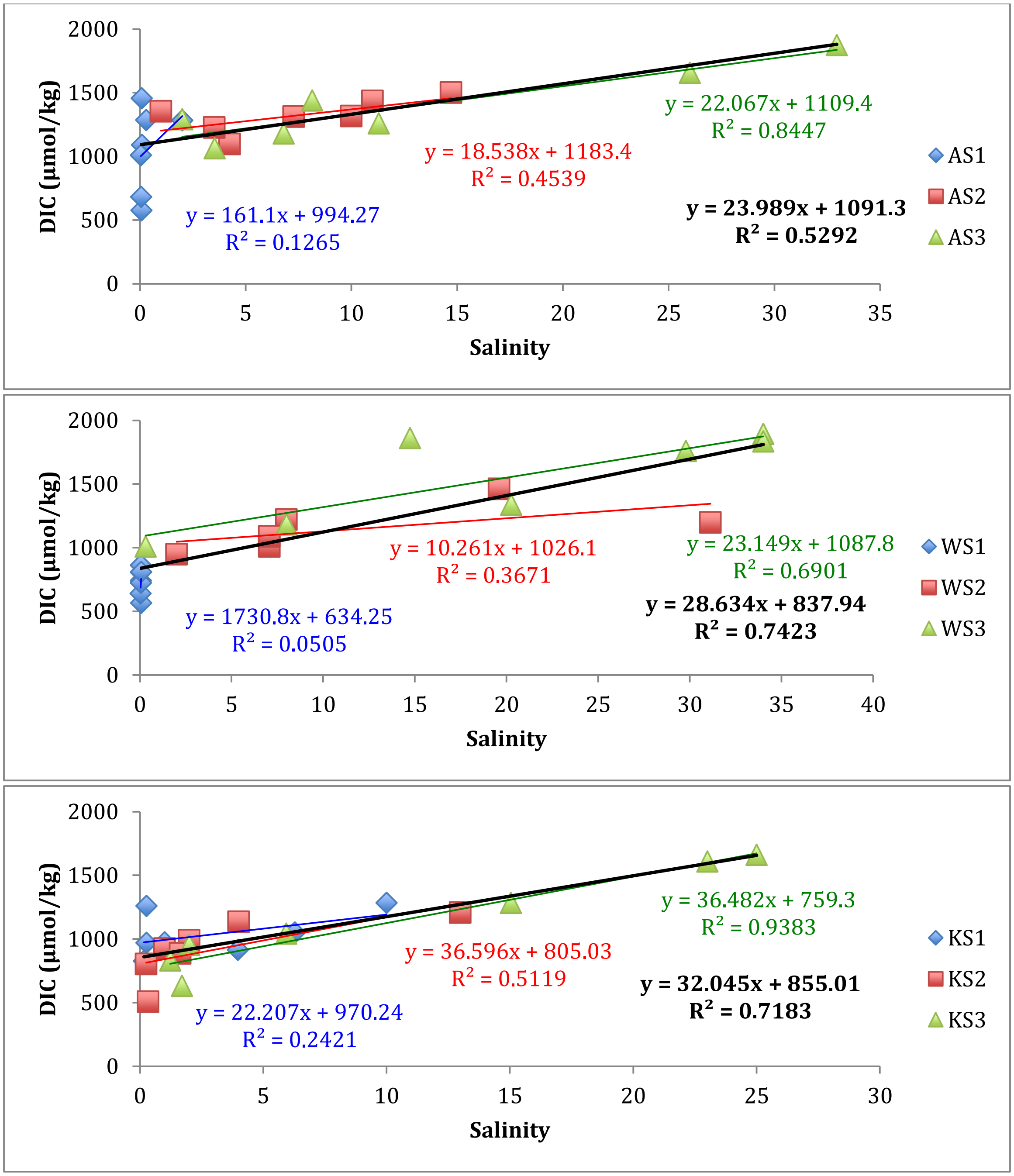


Figure 20. Linear relationship between salinity and dissolved inorganic carbon (DIC) at the three streams during storm conditions. The top panel is for Kaneohe Stream, the middle panel is for Ahuimanu Stream, and the bottom panel is for Waiahole Stream. Station 1 is represented by the blue diamonds, station 2 is represented by the red squares, station 3 is represented by the green triangles, and the overall average for DIC is represented by the black trend line. The equations for each station and the overall average are color coded to match the symbols representing each station.

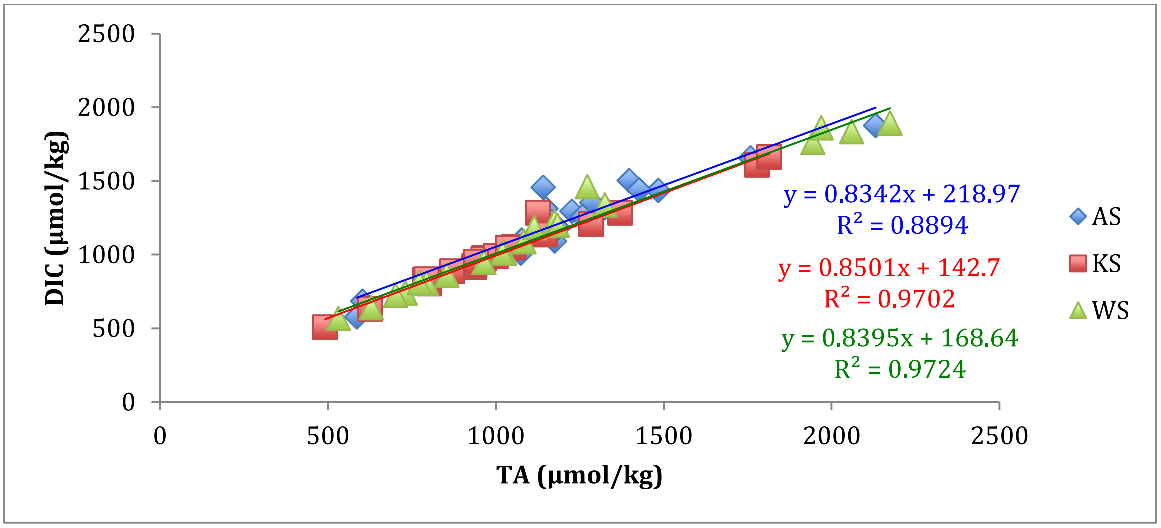


Figure 21. Linear regression analysis of dissolved inorganic carbon (DIC) and total alkalinity (TA) for each stream. Blue diamonds and equation correspond to data from Ahuimanu Stream. Red squares correspond to Kaneohe Stream and green triangles correspond to Waiahole Stream. The equations are arranged the same order, from top to bottom as shown in the legend and color-coded for each stream.

between the concrete and water and the dilution effect from increased rainfall inputs could be the main factor impacting TA and DIC.

The higher flow rates associated with high discharge decrease the residence time of the water in all the stream channels, and reduce the rates of all in-stream reactions. Besides the greater flow associated with an increase in precipitation, manmade structures, such as reservoirs, also release excess water during large storm events. This further dilutes TA and DIC in the streams. One such event occurred during Storm 2, where excess water from the Hoomaluhia Reservoir was released into the Kamoalii Stream, a tributary of Kaneohe Stream. This caused a large decrease in TA and DIC at all three Kaneohe Stream stations. The decreases observed at Kaneohe and Ahuimanu Streams, however, are in contrast to the much more subdued decreases in TA and DIC at Waiahole Stream, despite the large increase in stream flow (Figures 16, 17, 18, and 19). In summary, large changes observed in TA and DIC reflect urbanization and land use change in the watershed between baseline conditions and reflect dilution by increased freshwater flow during storm events.

The TA and DIC values measured during this study were consistent with those reported in prior work done in Kaneohe Bay and elsewhere in Hawaii shown in Table 5.

Similar TA values and a 1:1 relationship between TA and DIC were observed in the Maunawili Watershed in Kailua, where respiration was the dominant process controlling carbon chemistry (Bonnaud 2005), and contrasted with the relationship observed in this study. TA and DIC were generally much higher at the CRIMP-2 buoy than in streams due to several factors. These included more stable conditions in the marine environment; little to no inputs from groundwater, and the close proximity of the CRIMP-2 station to the barrier reef – where vigorous calcification and biological productivity control the distribution of the carbon system parameters. This combined intensified calcification and biological productivity is not a major process impacting the carbon system parameters in streams due to the low abundance of calcifying organisms.

Table 5. Average total alkalinity (TA) from locations around the islands of Hawaii.

Site	TA (µmol/kg)	Reference
CRIMP-2 Buoy	2225	Drupp *et al*. 2012
Kaneohe Stream	1410	Fagan and Mackenzie 2007
CRIMP Buoy	2197	Massaro *et al*. 2012
Wailuku River	793	Paquay *et al*. 2007
Maunawili Stream	1324	Bonnaud 2005
Kaneohe Streams	1539	This study

II. The impacts of groundwater on the distribution of carbon system parameters

Groundwater sources modify stream and bay waters into which they are introduced. Groundwater is characterized by high pCO_2 and nutrients levels and its introduction into streams alters the composition of stream water. Groundwater movement is governed by rain, both high in the mountainous parts of the watershed and lower, nearer to the ocean. Rainfall in Hawaii has a bimodal seasonal pattern, with relatively low precipitation during the summer, in contrast to the winters, which are characterized by extensive rainfall (Giambelluca *et al*., 2011). Because rainfall affects biological and chemical processes besides primary productivity/respiration and calcification/dissolution, its variability is of great interest. In the study area, relatively little precipitation occurs during the summer, often leaving soils dry or under-saturated. At the same time, groundwater slowly traverses down the watershed and infiltrates soils where microbial activity breaks down organic matter and releases inorganic nutrients and CO_2. Typically, base flow is the flow that is maintained by the intersection of the groundwater table with the stream channel. However, with rain occurring year round in Hawaii and the watersheds being characterized as having steep slopes and small basin areas, this creates rocky channels that transport high mountainous runoff in addition to groundwater. Due to this direct connection streams have with groundwater sources, there should be an apparent increase in pCO_2 and nutrients in the streams compared to bay waters.

However, pCO_2 levels Waiahole Stream, were the lowest of the three streams and were below the atmospheric concentrations during the study period. Additionally, nutrients and TSS were also higher at Kaneohe and Ahuimanu Streams compared to Waiahole Stream suggesting the former streams might be subject to greater groundwater inputs. Evidence of greater groundwater inputs are exhibited in the significantly higher pCO_2 values (p-value <0.01) observed at Kaneohe Stream compared to Waiahole Stream whereas no significant difference existed between the pCO_2 of Ahuimanu and Waiahole Streams. The low pCO_2 in Waiahole Stream is likely due to its geography. Unlike Kaneohe and Ahuimanu Streams, Waiahole hosts dense riparian vegetation and is characterized by a rough streambed with lots of rocks and boulders. This roughness leads to more turbulent waters than in the smooth channelized streams that have little to no riparian vegetation and causes greater gas exchange with the atmosphere. Additionally, the residence time of water in a natural stream that meanders is longer than in a straightened and hardened stream channel, which quickly transfers water from the watershed to receiving waters, thereby decreasing the residence time of water in the hardened stream. The turbulent water in natural streams and the longer residence time of water in the stream are likely causing a higher CO_2 gas efflux, therefore decreasing the in stream pCO_2 compared to the urban streams (Butman and Raymond, 2011).

The dense riparian and in-stream vegetation in natural stream channels contributes to removal of CO_2 through photosynthetic activity. Furthermore, as stream water enters the bay, the increase in salinity associated with estuarine mixing lowers the solubility of CO_2 causing gas exchange with the atmosphere through what is known as the salting out effect. Consistent with this hypothesis, the decrease in pCO_2 observed at Kaneohe Stream between Stations 2 and 3 coincides with a sharp increase in salinity, suggesting that CO_2 is evading to the atmosphere. Evidence of this process is also apparent in Ahuimanu Stream between Station 1 and Station 3, with a progressive lowering of pCO_2

downstream coinciding with increasing salinity (Figure 21). While higher temperatures could decrease the solubility of gases in solution, the temperatures observed at Ahuimanu Stream during baseline conditions show a decreasing trend downstream from station 1 that should counter the salinity effect on the solubility of CO_2 in the water. In contrast, a salting out effect either does not occur in Waiahole Stream or some other process is responsible for low pCO_2 and its steady increase downstream.

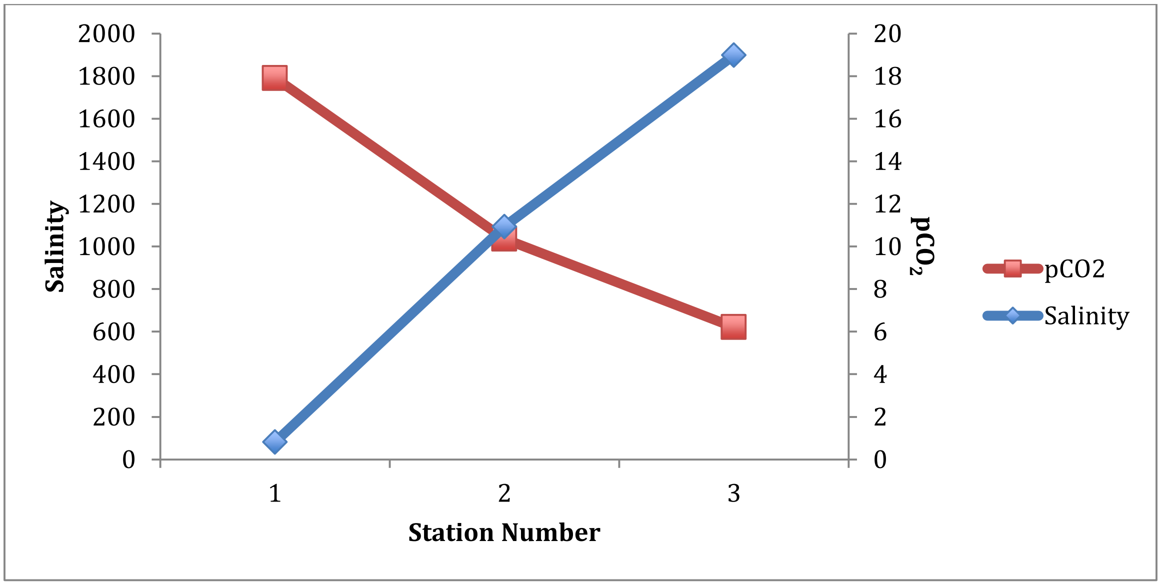


Figure 22. Salinity and pCO_2 in Ahuimanu Stream. As pCO_2 decreases downstream of station 1, the salinity increases, consistent with a salting out effect.

During storm events, rain infiltrates soils and begins to flow as groundwater while becoming enriched with the chemical products of the respiration of organic matter. During this process nutrients and CO_2 accumulate as the water is carried through the soils. If the amount of precipitation is significant to saturate the soils before the storm concludes, the hydrostatic pressure of the groundwater will push the chemically charged groundwater into lower elevation surface channels such as streams (Sobotkova *et al.*, 2011). As this "older" groundwater is pushed out, the "new" groundwater (i.e., recently percolated into the soils) continues to flow down through the watershed. With persistent precipitation, groundwater moves faster through the soils than during baseline conditions, and once the original highly nutrient and CO_2-charged water has been pushed through; there is little time for microbes to further remineralize organic matter. As a result, the concentrations of inorganic nutrients and CO_2 in groundwater should ultimately decrease relative to those observed during baseline conditions.

During storm events, an overall increase in pCO_2 compared to baseline is observed at all stations throughout the study period. The increase in pCO_2, however, could not be attributed to (new) respiration of organic matter due to the slow reaction rates relative to groundwater flow during storms. Hence, the input of “older” highly enriched groundwater into the streams is the more likely source of the elevated pCO_2. It is reasonable that the effects of large groundwater inputs were observed during Storm 2 at Station 1 of Kaneohe Stream and pCO_2 in the stream reached 22,190 μatm (Table 1), the highest recorded during this study. The large pCO_2 of the water at Station 1 caused a noticeable decrease in pH to 5.9 at this station (Table 2). Water collected from Station 2 at this time, however, shows a drastic decrease in pCO_2 relative to Station 1, suggesting a large efflux to the atmosphere. Because of the small difference in salinity between Stations 1 and 2 during this period, however, the efflux of CO_2 cannot be attributed to the salting out effect. Instead, the large CO_2 gradient that exists between the atmosphere and the stream water drives a transfer of gas into the atmosphere. The rate of CO_2 effusion, however, depends in part on wind speed, an important driver of gas exchange as shown in equation 10:

$$F = k\alpha\Delta pCO_2 \qquad \textbf{10}$$

where k is the CO_2 gas transfer velocity, α is the solubility of CO_2 in water at the specified temperature and salinity, and ΔpCO_2 is the difference between atmospheric and seawater pCO_2 concentrations (Weiss, 1974; Liss, 1983; Wanninkhof, 1992). Although the gas transfer velocity, k, is often calculated using the Ho *et al*. (2006) parameterization shown in equation 11:

$$K_{(600)} = (0.266 \pm 0.019)(U_{10})^2 \qquad \textbf{11}$$

where U_{10} is the wind speed measured at (or corrected to) ten meters above sea level, in this work a simplified approach described later in this discussion was used owing to a lack of knowledge of the actual wind speed in the stream channels during the sampling periods.

The pCO_2 values observed during this study are compared to those from prior work in Kaneohe Bay and in several other locations around the world in Table 6. The

pCO_2 (884 μatm) in the Wailuku River in Hilo, Hawaii (Paquay *et* al., 2007), for example, is quite similar to the average (885 μatm) observed at all stations during baseline conditions in this study. Likewise, average pCO_2 values in Kaneohe Stream (800 μatm) reported by Fagan and Mackenzie (2007) were also similar to the average pCO_2 during this study. Additionally, Bonnaud (2005) observed high pCO_2 values in the Maunawili Watershed and Kawai Nui Marsh in Kailua, reaching as high as 70,000 μatm in the marsh and 4,000 μatm in the watershed. High pCO_2 water, influenced by groundwater inputs during storm events, was also reported in the Langat River Watershed in Malaysia, where pCO_2 reached as high as 30,000 μatm (Lee *et al.*, in press).

Table 6. Average baseline pCO_2 from locations in Hawaii and around the world.

Site	pCO_2 (μatm)	Reference
Amazon River	4350	Richey *et al*. 2002
Langat River	4367	Lee *et al*. in press
Maunawili Stream	4039	Bonnaud 2005
Wailuku River	884	Paquay *et al*. 2007
Wailoa Stream	1515	Paquay *et al*. 2007
Crimp-2 Buoy	439	Drupp *et al*. in press
Crimp Buoy	456	Massaro *et al*. 2012
Kaneohe Stream	800	Fagan and Mackenzie 2007
Kaneohe Bay Streams	885	This study

Knowing the rates of exchange (transfer) of carbon between Earth reservoirs is key to understanding the global carbon cycle and the dynamics of gas exchange between the atmosphere and riverine waters constitute an important component that may not have received the attention it deserves. To that end, fluxes of CO_2 between streams and the atmosphere were calculated (see Table 7). It was found that the average fluxes of CO_2 between stream waters and the atmosphere varied both between stations in a given stream and between individual streams. A trend of decreasing CO_2 flux to the atmosphere was observed at Ahuimanu Stream Station 1 and Station 3 during baseline conditions. Additionally, the flux was, on average, two orders of magnitude higher than fluxes calculated for Waiahole Stream. This decreasing trend is indicative of evasion of CO_2 from the streams to the atmosphere well before stream waters enter Kaneohe Bay. Therefore a portion of inorganic carbon carried by streams is not entering the bay in dissolved form as expected but rather is being released directly into the atmosphere. In Kaneohe Stream, however, fluxes at all three stations were of the same order of magnitude. This stream mouth has greater tidal influences than the other streams in this study and also exhibited statistically significant higher fluxes (p-value <0.01) than observed at Waiahole Stream. All stations at both Kaneohe and Ahuimanu Streams were sources of CO_2 to the atmosphere based on the positive flux values calculated from equation 1 used by Lee *et al*. (in press)

$$F = k[(C_{water} - C_{atm}) * \frac{1}{RT}] \quad \mathbf{12}$$

where F is the flux in mol m^{-2} day^{-1}, k is the gas flux constant in m day^{-1}, C is the pCO_2 in the water and the atmosphere in μatm (assuming an average pCO_2 in the atmosphere of 390), R is the ideal gas constant of $8.21 * 10^{-5}$ m^3 atm K^{-1} mol^{-1}, and T is temperature in Kelvins. This equation is different from that used by most researchers studying gas between the ocean and atmosphere, primarily in its lack of a solubility term. However, the gas exchange coefficient, k, used in equation 12 is an estimated value rather than a calculated value representative of the conditions extant at the time of sampling. A gas exchange coefficient value of 1.92 was used here, which is the value for stagnant waters from Richey *et al*. (1990). As stated earlier, the lack of knowledge of wind conditions in the stream channels in Kaneohe does not permit use of Equations 10 and 11.

Considering that equation 12 calculates gas flux for stagnant waters, turbulent and fast moving streams such as those in this study would be characterized by greater exchange between the atmosphere and water, and a gas exchange coefficient 15 times greater than for stagnant waters may be more appropriate for conditions in turbulent streams such as those in Hawaii (Raymond and Cole, 2001). Because Stations 10 and 11 in Waiahole Stream show negative flux values, these areas are sinks for atmospheric CO_2 rather than sources. One possible explanation for this behavior is that the residence time of water travelling down a natural stream bed will be longer than that of water travelling down a straightened concrete channel, thereby allowing more time for degassing of CO_2. Additionally a natural channel is more likely to experience turbulent flow due to the presence of rocks on the stream bed that are not present in a concrete channel. Furthermore, riparian vegetation in a natural stream channel could also remove CO_2 through photosynthesis causing a drop in pCO_2 below the atmospheric value, causing the area to become a sink for CO_2 from the atmosphere. All stations became sources of CO_2 to the atmosphere during storm events, however, with the average fluxes presented in Table 7.

The contributions of streams and rivers to the global carbon budgets are generally underestimated or, worse, not taken into account. Recent studies, however, have suggested that streams and rivers represent an important component of the global carbon budget. Other studies have shown streams and estuaries around the world to contribute differing amounts of CO_2 to the atmosphere annually. Annual fluxes from various places are compared to those found for Kaneohe Bay in Table 8. Kaneohe Bay and its streams have lower CO_2 fluxes to the atmosphere, on average, than large rivers such as the Mississippi or the Langat River in Malaysia. The average areal CO_2 fluxes of Kaneohe and Ahuimanu streams are of similar magnitude to CO_2 fluxes observed in Kaneohe Bay (Fagan and Mackenzie, 2007; Drupp *et* al., 2011; Massaro *et al*., 2012). However, including Waiahole Stream into the average decreases the overall areal CO_2 flux to values observed at the CRIMP-2 buoy on the barrier reef of Kaneohe. It should be kept in mind, however, that considerable uncertainty exists in all these flux estimates owing to potentially inaccurate parameterizations and other assumptions that go into the flux calculations. The difference in the average CO_2 fluxes between the more urban streams (Kaneohe and Ahuimanu) and Waiahole may be indicative of an influence from urbanization on the CO_2 fluxes. Therefore it is important to fully understand the carbon system dynamics in stream and estuarine systems that are urbanized as well as in more natural (unmodified systems) in order to accurately estimate global carbon budgets.

Table 7. Average daily and annual CO_2 fluxes by station and by stream. The daily averages are presented followed by the standard deviations.

	Daily CO_2 Flux by Station			Annual CO_2 Flux by Station			Average CO_2 Flux	Annual CO_2 Flux
Site	**1**	**2**	**3**	**1**	**2**	**3**		
Kaneohe	3.57E-3 ± 5.04E-	7.66E-3 ± 8.97E-3	5.71E-3 ± 1.33E-	1.16	2.49	1.86	5.65E-3 ± 9.62E-3	1.84
Ahuimanu	1.11E-2 ± 4.59E-	5.08E-3 ± 2.58E-3	1.81E-3 ± 2.16E-	3.62	1.65	5.90E-1	6.01E-3 ± 2.62E-2	1.95
Waiahole	-7.74E-4 ± 1.93E-	-5.05E-5 ± 1.01E-3	1.08E-3 ± 1.65E-	-2.52E-1	-1.64E-2	3.50E-1	1.07E-4 ± 1.71E-3	3.48E-2

Table 8. Average annual CO_2 flux from locations in Hawaii and around the world. Positive flux values indicate a flux from the water to the atmosphere.

Site	Average Annual CO_2 Flux	Reference
Amazon River	+66.67	Richey *et al*. 2002
Nyong River	+133	Brunet *et al*. 2009
Mississippi River	+100	Dubois *et al*. 2010
Ottawa River	+16.67	Telmer and Veizer 1999
Langat River	+100	Lee *et al*. in press
York River	+4.39	Raymond *et al*. 2000
Southern Kaneohe Bay	+1.45	Fagan and Mackenzie 2007
CRIMP-2 Buoy	+1.15	Drupp *et al*. in press
CRIMP Buoy	+1.76	Massaro *et al.* 2012
Kaneohe Bay Streams	+1.27	This study

Chapter 5
Conclusion

This study has demonstrated that not one single process controls carbon system dynamics in streams of small tropical mountainous watershed. Rather it is a variety of processes that act in concert and which depend on both the physical and chemical attributes of a given system that ultimately control the pCO_2, alkalinity and dissolved inorganic carbon in these waters. The processes affecting the carbon system in one stream or watershed may impact the carbon system in a slightly different way at another location.

This study is the first, to the best of my knowledge, to have demonstrated urbanization affects DIC and TA in small tropical streams. Their respective values increase as a function of urbanization during low flow conditions because of the relatively long reaction time that occur at such times.

It was also demonstrated that the input of groundwater to the streams examined in this study contribute significantly but to variable extent to the pCO_2 and nutrient concentrations observed in streams, especially during storm conditions. The pCO_2 observed during storms here are comparable to those observed in some very large tropical rivers in other parts of the world and degassing from the streams represents a large loss of carbon to the atmosphere that might otherwise be transported to the coastal ocean.

Finally, the global carbon budget, as it is currently defined, does not consider the contributions from small tropical island streams. This research has shown that the majority of the stations examined were sources of CO_2 to the atmosphere during baseline conditions, while all proved to be sources during storm conditions. Thus, while the atmospheric impacts of individual estuarine systems in small tropical islands may not be important compared to those from large rivers, cumulatively, the carbon fluxes from streams of tropical and subtropical islands around the world may represent a significant and important fraction of the global budget.

Appendices

Appendix 1: Raw water column profile data for Station 1 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 11:34	24.8	0.3	8.0	4.1	2.6	35.0	97.4
11/4/10 11:34	24.8	0.3	8.0	4.0	3.2	35.0	97.4
11/4/10 11:34	24.8	0.3	8.0	4.0	2.7	35.0	97.4
11/4/10 11:34	24.8	0.3	8.0	4.0	2.3	35.0	97.4
11/4/10 11:35	24.8	0.3	8.0	4.0	2.6	35.0	97.4
11/4/10 11:35	24.8	0.3	8.0	4.0	2.5	35.0	97.4
11/4/10 11:35	24.8	0.3	8.0	4.2	2.6	35.0	97.5
11/4/10 11:35	24.8	0.3	8.0	4.4	2.3	0.7	97.3
12/10/10 12:11	21.7	0.0	8.1	1.7	2.8	4.8	89.6
12/10/10 12:11	21.9	0.0	8.1	1.8	2.7	5.1	90.0
12/10/10 12:11	21.9	0.0	8.1	1.8	2.7	4.7	89.9
12/10/10 12:12	21.8	0.0	8.1	1.9	2.6	4.3	89.9
12/10/10 12:12	21.8	0.0	8.1	1.9	2.5	4.5	90.0
12/10/10 12:12	21.8	0.1	7.7	1.7	2.5	11.9	90.8
12/10/10 12:12	22.0	0.4	7.6	1.3	2.6	12.1	91.1
12/10/10 12:12	23.0	0.6	7.7	1.0	2.5	27.5	89.6
12/10/10 12:12	23.3	0.8	7.7	0.9	2.4	34.3	88.2
12/10/10 12:12	23.5	1.1	7.8	0.6	2.3	34.7	87.1
12/10/10 12:12	23.6	1.6	7.9	0.3	2.3	34.7	85.7
12/10/10 12:12	23.6	1.8	7.9	0.1	2.2	34.7	85.2
12/10/10 12:12	23.7	2.1	7.9	0.3	2.2	34.7	84.5
12/10/10 12:12	23.7	2.4	8.0	0.0	2.4	34.7	83.9
12/10/10 12:12	23.7	2.6	8.0	0.4	2.6	34.7	83.4
12/10/10 12:12	23.7	2.8	8.0	0.6	2.8	34.7	83.0
12/10/10 12:12	23.8	2.9	8.0	0.3	3.5	34.7	82.7
12/10/10 12:12	23.8	3.0	8.0	0.6	3.3	34.7	82.5
12/10/10 12:12	23.8	3.0	8.0	0.8	3.1	34.7	82.3
12/10/10 12:12	23.8	3.1	8.0	0.3	2.9	34.7	82.0
12/10/10 12:12	23.8	3.1	8.1	0.2	2.6	34.7	81.7
12/10/10 12:12	23.8	3.1	8.1	8.4	2.4	34.7	81.5
12/10/10 12:12	23.8	3.1	8.1	15.4	2.6	34.6	81.3
12/10/10 12:12	23.8	3.1	8.1	24.8	2.7	34.6	80.9
12/10/10 12:12	23.8	2.9	8.1	30.3	2.8	34.6	80.5
2/16/11 14:56	25.7	0.2	8.6	0.0	2.0	8.6	100.7
2/16/11 14:57	25.4	0.7	7.9	0.0	2.0	24.0	101.0
2/16/11 14:57	25.4	0.7	7.8	0.0	2.0	25.4	101.0

Appendix 1: (Continued) Raw water column profile data for Station 1 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/16/11 14:57	25.4	0.9	7.8	0.0	2.0	26.1	101.0
2/16/11 14:57	25.4	1.2	7.8	9.0	5.5	27.4	101.1
3/10/11 10:44	21.2	0.3	9.2	21.8	2.4	0.1	103.3
3/10/11 10:44	20.7	0.3	9.4	22.2	2.0	0.1	104.1
3/10/11 10:44	20.7	0.3	9.4	22.7	1.9	0.1	104.4
3/10/11 10:44	21.7	0.3	8.9	22.8	2.2	0.5	102.8
3/10/11 10:44	22.4	0.4	8.8	22.7	2.2	0.4	101.4
3/10/11 10:44	22.5	0.6	8.8	23.4	2.1	0.3	101.2
3/10/11 10:44	22.6	0.9	8.7	23.4	2.2	0.4	101.1
4/5/11 10:27	24.1	0.3	8.5	0.0	0.0	0.0	99.9
4/5/11 10:27	23.3	0.3	8.4	0.6	0.5	0.0	102.3
4/5/11 10:27	23.4	0.2	8.4	0.6	0.4	2.2	102.4
4/5/11 10:27	23.6	0.4	8.4	0.6	0.4	2.1	102.2
4/5/11 10:27	23.8	0.7	7.7	0.8	0.6	2.8	102.7
4/5/11 10:27	24.1	0.9	7.7	1.3	0.7	17.5	103.3
4/5/11 10:27	24.4	1.2	7.7	1.9	0.8	24.6	102.5
5/22/11 11:39	24.1	0.2	8.4	0.1	0.0	0.0	0.0
5/22/11 11:39	23.6	0.2	8.4	0.1	0.0	0.0	0.0
5/22/11 11:39	24.9	0.2	8.4	0.0	0.0	2.4	0.0
5/22/11 11:39	25.3	0.5	8.4	0.0	0.0	4.0	0.0
5/22/11 11:39	26.1	1.0	7.6	0.0	0.0	26.3	0.0
6/23/11 12:14	26.2	0.2	8.2	0.1	0.0	0.1	103.6
6/23/11 12:14	26.3	0.2	8.1	0.1	0.0	1.2	103.5
6/23/11 12:14	26.3	0.4	8.1	0.1	0.0	1.5	103.5
6/23/11 12:14	26.3	0.7	7.4	0.1	0.0	26.5	103.5
6/23/11 12:14	26.3	1.3	7.4	0.1	0.0	34.0	103.5
6/23/11 12:14	26.3	1.6	7.5	0.1	0.0	34.1	103.5
6/23/11 12:14	26.5	2.1	7.5	0.0	0.0	34.7	103.2
6/23/11 12:14	26.6	2.4	7.6	0.0	0.0	35.0	103.0
6/23/11 12:14	26.8	2.8	7.6	0.0	0.0	35.0	102.7
8/27/11 9:11	24.4	0.2	11.0	0.2	5.5	0.0	98.1
8/27/11 9:11	24.3	0.2	11.0	0.2	5.5	0.0	98.2
8/27/11 9:11	24.3	0.2	11.0	0.2	5.5	0.0	98.3
8/27/11 9:11	24.5	0.2	11.0	0.2	5.5	4.5	98.0
8/27/11 9:11	24.7	0.2	10.8	0.2	5.5	4.6	97.6
8/27/11 9:11	25.0	0.3	10.6	0.2	5.5	4.7	97.3
8/27/11 9:12	25.1	0.4	10.6	0.1	5.5	4.9	97.1
8/27/11 9:12	25.2	0.5	10.5	0.1	5.5	5.7	97.0

Appendix 1: (Continued) Raw water column profile data for Station 1 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
8/27/11 9:12	25.3	0.7	10.4	0.1	5.5	11.1	96.9
8/27/11 9:12	25.5	0.9	10.2	0.1	5.5	19.5	96.5
8/27/11 9:12	25.9	1.2	10.1	0.1	5.5	26.5	96.0
8/27/11 9:12	26.2	1.4	10.0	0.0	5.5	28.4	95.5
8/27/11 9:12	26.5	1.6	9.9	0.0	5.5	28.8	95.1
8/27/11 9:12	26.8	1.8	9.8	0.0	5.5	29.6	94.7
9/25/11 9:32	24.4	0.3	10.3	0.0	3.4	1.1	100.0
9/25/11 9:32	24.4	0.3	10.1	0.5	5.5	2.3	97.5
9/25/11 9:32	24.6	0.3	10.2	0.5	3.2	0.7	93.2
9/25/11 9:32	27.4	1.0	9.6	0.4	3.4	34.5	94.7
9/25/11 9:32	27.8	2.8	9.6	0.4	3.4	34.7	92.7
10/23/11 11:00	23.9	0.1	8.3	19.5	8.3	0.1	95.5
10/23/11 11:00	24.0	0.1	8.3	59.1	10.1	0.2	92.1
10/23/11 11:00	24.0	0.2	8.3	64.5	10.5	0.2	91.7
10/23/11 11:00	24.0	0.4	8.2	72.0	10.9	0.2	91.5
10/23/11 11:00	24.0	0.7	8.2	80.2	11.3	0.2	91.2
10/23/11 11:00	24.0	0.9	8.2	86.7	11.7	0.2	91.0
10/23/11 11:00	24.0	1.2	8.1	94.3	12.0	0.2	90.8
10/23/11 11:00	24.0	1.6	8.1	100.8	12.2	0.2	90.6
10/23/11 11:00	24.0	2.1	8.0	109.3	12.7	0.4	90.4
10/23/11 11:00	24.0	2.7	7.0	114.9	12.8	0.7	90.3
10/23/11 11:00	24.2	3.2	6.8	117.7	12.6	27.6	90.6
10/23/11 11:00	25.4	3.6	6.9	119.2	12.5	34.8	88.6
10/23/11 11:00	25.6	3.8	7.0	118.1	12.4	35.7	87.7
10/23/11 11:00	25.7	4.0	7.1	122.9	12.6	36.1	86.0
10/23/11 11:00	25.8	4.2	7.2	125.6	12.5	35.9	83.7
10/23/11 11:00	25.8	4.3	7.2	132.5	12.5	35.9	81.4
11/1/11 11:55	25.3	0.3	8.3	7.0	3.9	1.2	98.1
11/1/11 11:55	25.3	0.3	8.1	7.8	3.6	1.1	97.7
11/1/11 11:55	25.3	0.4	8.1	8.0	3.5	1.2	97.6
11/1/11 11:55	25.4	0.6	7.4	6.5	3.5	10.3	97.6
11/1/11 11:55	25.5	0.7	7.6	5.1	3.5	18.8	97.7
11/1/11 11:55	25.7	0.8	7.7	3.9	3.3	22.1	97.4
11/1/11 11:55	25.8	1.0	7.7	2.8	3.1	27.1	96.5
11/1/11 11:55	26.0	1.2	7.8	1.8	3.0	32.3	95.2
11/1/11 11:55	26.2	1.5	7.8	1.0	2.8	33.5	94.0
11/1/11 11:55	26.3	1.9	7.9	0.5	2.7	33.5	92.7
11/1/11 11:55	26.3	2.3	7.9	0.2	2.6	33.5	91.6

Appendix 1: (Continued) Raw water column profile data for Station 1 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/1/11 11:55	26.4	2.6	7.9	0.0	2.5	33.6	90.8
11/1/11 11:56	26.4	3.0	7.9	3.7	2.7	33.8	90.1
12/14/11 11:56	23.2	0.2	8.2	14.9	2.9	0.1	97.2
12/14/11 11:56	23.2	0.3	8.1	14.1	3.7	1.5	97.0
12/14/11 11:56	23.2	0.3	8.1	14.1	3.6	1.6	96.9
12/14/11 11:56	23.2	0.4	8.0	14.1	3.6	1.6	96.9
12/14/11 11:56	23.2	0.7	7.3	14.1	3.6	2.5	96.9
12/14/11 11:56	23.2	0.9	7.2	14.1	3.6	21.4	96.8
12/14/11 11:56	23.3	1.2	7.2	14.1	3.6	28.1	96.7
12/14/11 11:56	23.4	1.4	7.3	14.1	3.6	29.2	96.6
12/14/11 11:56	23.4	1.6	7.4	14.1	3.6	31.9	96.5
12/14/11 11:56	23.5	1.8	7.5	14.1	3.6	32.0	96.5
1/28/12 10:56	22.8	0.3	8.4	0.1	0.9	0.3	98.7
1/28/12 10:57	22.8	0.3	8.2	0.1	17.5	0.8	97.8
1/28/12 10:57	22.9	0.3	8.2	0.0	14.6	3.7	97.4
1/28/12 10:57	23.0	0.3	8.2	0.0	13.1	3.3	97.2
1/28/12 10:57	23.0	0.3	8.1	0.1	11.8	3.2	97.1
1/28/12 10:57	23.1	0.4	8.1	0.1	10.8	3.2	96.9
1/28/12 10:57	23.1	0.5	8.1	0.1	10.0	3.2	96.7
1/28/12 10:57	23.1	0.6	8.0	0.2	9.3	3.2	96.8
1/28/12 10:57	23.1	0.8	7.5	0.4	8.5	4.0	97.3
1/28/12 10:57	23.3	0.9	7.4	0.7	7.9	12.6	97.9
1/28/12 10:57	24.6	1.2	7.5	0.7	7.4	32.6	96.4
1/28/12 10:57	25.2	1.4	7.5	1.4	6.8	34.6	95.0
1/28/12 10:57	25.5	1.7	7.6	2.1	6.3	34.6	93.7
2/25/12 9:16	22.6	0.3	8.1	0.2	1.7	3.3	97.5
2/25/12 9:16	22.6	0.3	8.0	0.2	1.7	7.4	97.5
2/25/12 9:16	22.6	0.3	7.9	0.2	1.7	8.3	97.4
2/25/12 9:16	22.7	0.4	7.8	0.2	1.7	12.0	97.4
2/25/12 9:16	22.9	0.6	7.7	0.1	1.7	24.9	97.0
2/25/12 9:16	23.2	0.7	7.6	0.1	1.7	28.3	96.5
2/25/12 9:16	23.5	0.8	7.6	0.1	1.7	30.5	96.1
2/25/12 9:16	23.8	0.9	7.6	0.1	1.7	31.7	95.7
2/25/12 9:16	23.9	1.1	7.6	0.1	1.7	31.9	95.5
2/25/12 9:16	24.1	1.2	7.7	0.1	1.7	33.8	95.3
2/25/12 9:17	24.2	1.4	7.7	0.0	1.7	34.4	95.2
2/25/12 9:17	24.2	1.6	7.7	0.0	1.7	34.2	95.1
2/25/12 9:17	24.3	1.8	7.8	0.0	1.7	34.2	95.0

Appendix 1: (Continued) Raw water column profile data for Station 1 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 11:58	22.8	0.1	8.7	0.0	1.4	0.3	100.8
3/3/12 11:58	22.6	0.1	8.6	8.4	1.1	0.8	100.8
3/3/12 11:58	22.7	0.1	8.6	14.7	1.4	2.0	100.7
3/3/12 11:58	22.8	0.2	8.6	16.8	1.8	1.5	100.6
3/3/12 11:58	22.9	0.5	8.1	18.5	2.0	1.4	100.4
3/3/12 11:58	22.9	0.7	7.3	16.7	1.9	9.3	100.2
3/3/12 11:58	23.0	1.0	7.3	14.1	1.8	24.0	100.1
3/3/12 11:58	23.1	1.3	7.4	11.6	1.7	31.8	99.1
3/3/12 11:58	23.3	1.6	7.4	9.4	1.7	33.0	97.5
3/3/12 11:58	23.4	2.0	7.5	7.9	1.7	34.3	95.5
3/3/12 11:58	23.5	2.3	7.6	6.5	1.5	34.3	93.6
3/7/12 10:10	20.4	0.4	7.6	31.7	0.0	0.0	103.3
3/7/12 10:10	20.9	0.4	7.7	31.8	0.0	0.2	102.5
3/7/12 10:10	21.0	0.5	7.7	31.8	0.0	0.2	102.4
3/7/12 10:10	21.0	0.6	7.7	31.8	0.0	0.2	102.4
3/7/12 10:10	21.0	0.7	7.7	31.8	0.0	0.2	102.3
3/7/12 10:10	21.0	0.9	7.7	31.8	0.0	0.2	102.3
3/7/12 10:10	21.0	1.1	7.7	31.8	0.0	0.2	102.3
3/7/12 10:10	21.0	1.4	7.3	31.8	0.0	0.3	102.3
3/7/12 10:10	21.1	1.7	7.0	31.8	0.0	0.4	102.3
3/7/12 10:10	21.1	2.0	6.3	31.8	0.0	10.2	102.2
3/7/12 10:10	21.3	2.2	6.4	31.9	0.0	22.2	101.8
4/21/12 11:08	24.0	0.2	8.1	0.1	0.0	0.7	103.3
4/21/12 11:08	24.0	0.2	8.1	0.1	0.0	1.4	103.3
4/21/12 11:08	24.0	0.3	8.1	0.1	0.0	1.4	103.3
4/21/12 11:08	24.0	0.4	8.0	0.1	0.0	1.4	103.4
4/21/12 11:08	24.0	0.8	7.6	0.1	0.0	8.5	103.4
4/21/12 11:08	24.1	1.2	7.1	0.1	0.0	21.3	103.2
4/21/12 11:08	24.2	1.6	7.1	0.1	0.0	30.7	102.9
4/21/12 11:08	25.4	2.0	7.2	0.0	0.0	28.7	101.2
5/19/12 10:47	25.5	0.3	7.7	0.1	2.0	1.6	102.9
5/19/12 10:47	25.4	0.3	7.7	0.1	2.0	1.7	103.0
5/19/12 10:47	25.4	0.4	7.8	0.1	2.0	1.7	103.0
5/19/12 10:48	25.4	0.5	7.3	0.1	2.0	1.8	103.1
5/19/12 10:48	25.4	0.7	7.0	0.1	2.0	8.9	103.0
5/19/12 10:48	25.6	0.9	6.9	0.1	2.0	22.1	102.8
5/19/12 10:48	25.8	1.1	6.9	0.0	2.0	28.3	102.4
5/19/12 10:48	26.0	1.3	7.0	0.0	2.0	31.3	102.1

Appendix 1: (Continued) Raw water column profile data for Station 1 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/19/12 10:48	26.3	1.5	7.1	0.0	2.0	33.0	101.7
5/19/12 10:48	26.4	1.7	7.1	0.0	2.0	33.0	101.5
5/19/12 10:48	26.6	1.8	7.2	0.0	2.0	33.6	101.3
5/19/12 10:48	26.7	2.0	7.3	0.0	2.0	34.9	101.1
5/19/12 10:48	26.8	2.3	7.4	0.0	2.0	34.9	101.0
5/19/12 10:48	26.8	2.6	7.4	0.0	2.0	34.9	100.9
5/19/12 10:48	26.8	2.8	7.5	0.0	2.0	35.0	100.9
5/19/12 10:48	26.8	3.0	7.5	0.0	2.0	35.0	100.9
5/19/12 10:48	26.8	3.1	7.6	0.0	2.0	35.0	100.8
5/19/12 10:48	26.9	3.3	7.6	0.0	2.0	35.0	100.8
5/19/12 10:48	26.9	3.3	7.6	0.0	2.0	35.0	100.8
5/19/12 10:48	26.9	3.5	7.7	0.0	2.0	35.0	100.8
5/19/12 10:48	26.9	3.5	7.7	0.0	0.8	35.0	100.8
6/30/12 13:25	25.7	0.2	8.6	1.1	0.0	1.5	100.8
6/30/12 13:25	25.7	0.2	8.6	1.0	1.4	1.6	100.9
6/30/12 13:25	25.7	0.2	8.6	0.9	1.3	1.5	101.1
6/30/12 13:25	25.7	0.4	8.5	0.9	1.2	2.0	101.3
6/30/12 13:25	25.6	0.5	8.4	0.9	1.5	3.7	101.3
6/30/12 13:25	25.6	0.7	7.5	0.7	2.1	5.8	101.7
6/30/12 13:25	25.6	0.9	7.5	0.5	2.4	19.4	101.6
6/30/12 13:25	25.6	1.1	7.5	0.3	2.6	25.0	101.7
6/30/12 13:25	25.5	1.3	7.5	0.1	3.0	27.6	102.4
6/30/12 13:25	25.5	1.5	7.6	0.1	3.4	29.5	103.6
6/30/12 13:25	25.5	1.7	7.6	0.1	4.0	32.3	104.3
6/30/12 13:25	25.5	2.1	7.7	0.1	4.5	33.3	105.1
6/30/12 13:26	25.6	2.5	7.7	0.0	4.9	33.5	104.5
6/30/12 13:26	25.7	2.8	7.7	0.0	5.2	34.3	102.9
6/30/12 13:26	25.7	3.2	7.8	0.1	5.6	34.5	101.7
6/30/12 13:26	25.8	3.5	7.8	0.1	5.9	34.6	100.0

Appendix 2: Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/11 11:40	24.9	0.3	8.0	61.4	2.4	34.7	96.9
11/4/10 11:40	24.9	0.3	8.0	64.0	2.7	34.7	96.9
11/4/10 11:40	24.9	0.3	7.9	4.1	2.8	0.8	96.6
11/4/10 11:40	24.7	0.3	8.3	19.1	7.3	6.5	95.7
11/4/10 11:40	23.6	0.3	8.2	57.7	11.8	5.9	96.5
11/4/10 11:40	23.6	0.3	8.2	12.7	13.0	6.4	96.1
11/4/10 11:40	23.5	0.3	8.1	12.5	14.7	6.4	95.9
11/4/10 11:40	23.5	0.3	8.1	13.1	14.1	6.5	95.8
11/4/10 11:40	23.5	0.3	8.1	12.9	13.6	6.5	95.8
11/4/10 11:40	23.5	0.3	8.1	12.8	13.1	6.6	95.8
11/4/10 11:40	23.5	0.3	8.0	12.7	12.6	6.4	95.9
11/4/10 11:40	23.5	0.4	8.0	12.7	12.1	6.5	95.9
11/4/10 11:40	23.5	0.3	8.0	12.7	11.7	6.2	95.9
11/4/10 11:40	23.5	0.4	8.0	12.7	11.1	6.0	95.9
11/4/10 11:40	23.5	0.4	8.0	12.8	10.7	6.1	96.0
11/4/10 11:40	23.5	0.4	8.0	13.0	10.5	7.0	96.2
11/4/10 11:40	23.5	0.5	7.9	13.1	10.1	9.1	96.3
11/4/10 11:40	23.5	0.5	7.9	13.2	9.8	9.4	96.1
11/4/10 11:41	23.5	0.5	7.9	13.3	9.6	15.3	96.1
11/4/10 11:41	23.6	0.5	7.9	13.4	9.2	15.4	95.6
11/4/10 11:41	23.7	0.5	7.9	13.5	8.9	15.4	95.1
11/4/10 11:41	23.7	0.5	7.9	13.6	8.6	16.7	94.7
11/4/10 11:41	23.8	0.5	7.9	13.7	8.4	13.0	94.0
11/4/10 11:41	23.8	0.5	7.9	13.6	8.2	9.8	93.4
11/4/10 11:41	23.7	0.5	8.0	13.6	8.1	6.6	93.0
11/4/10 11:41	23.6	0.6	8.0	13.6	8.1	7.4	92.9
11/4/10 11:41	23.6	0.8	8.0	13.7	7.9	8.7	93.2
11/4/10 11:41	23.6	1.1	7.9	13.9	7.8	27.8	93.9
11/4/10 11:41	23.9	1.7	7.8	14.3	7.4	33.7	93.9
11/4/10 11:41	24.2	2.2	7.8	15.4	7.0	34.3	93.2
11/4/10 11:41	24.4	2.9	7.8	16.6	6.4	34.3	92.3
11/4/10 11:41	24.5	3.6	7.8	17.7	6.2	34.3	91.5
11/4/10 11:41	24.6	4.1	7.8	18.7	5.8	34.3	90.8
11/4/10 11:41	24.7	4.6	7.8	19.8	5.5	34.4	90.1
11/4/10 11:41	24.8	5.0	7.8	21.3	5.0	34.4	89.5
11/4/10 11:41	24.8	5.3	7.9	22.3	4.7	34.4	89.2
11/4/10 11:41	24.8	5.6	7.9	23.1	4.6	34.4	89.0
11/4/10 11:41	24.8	5.9	7.9	24.2	4.5	34.4	88.9

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 11:41	24.8	6.3	7.9	25.3	4.2	34.4	88.8
11/4/10 11:41	24.8	6.3	7.9	27.7	4.1	34.4	88.7
11/4/10 11:41	24.8	6.4	7.9	28.6	4.0	34.4	88.5
11/4/10 11:41	24.8	6.8	7.9	31.2	4.0	34.4	88.5
11/4/10 11:41	24.8	7.1	7.9	26.8	4.9	34.4	88.4
11/4/10 11:41	24.9	7.4	7.9	0.2	4.4	30.5	87.9
11/4/10 11:41	25.0	7.5	7.9	0.1	4.1	28.9	85.3
11/4/10 11:41	25.1	7.6	7.9	0.0	3.7	28.6	81.3
11/4/10 11:41	25.3	7.7	7.9	0.0	3.4	28.3	76.8
11/4/10 11:41	25.4	7.8	7.9	0.0	3.1	28.0	71.9
11/4/10 11:42	25.4	7.7	7.9	0.0	2.8	27.9	67.1
11/4/10 11:42	25.3	7.3	7.9	0.0	3.3	27.8	64.1
12/10/10 12:19	22.5	0.2	8.0	1.3	2.4	7.3	82.4
12/10/10 12:19	23.3	0.1	8.0	0.5	2.6	26.9	82.2
12/10/10 12:19	23.3	0.1	8.0	0.4	2.7	27.0	82.1
12/10/10 12:19	23.4	0.1	8.0	0.5	2.6	23.7	81.9
12/10/10 12:19	23.4	0.2	8.0	0.5	2.5	28.1	81.8
12/10/10 12:19	23.4	0.4	8.0	0.4	2.6	32.7	81.8
12/10/10 12:19	23.5	0.8	8.0	0.4	2.6	33.1	81.7
12/10/10 12:19	23.6	1.2	8.0	0.2	2.6	34.8	81.6
12/10/10 12:19	23.7	1.6	8.0	0.1	2.5	34.7	81.4
12/10/10 12:19	23.7	2.1	8.0	0.0	2.5	34.7	81.4
12/10/10 12:19	23.8	2.5	8.0	0.7	2.5	34.8	81.6
12/10/10 12:19	23.8	3.0	8.0	1.9	2.6	34.8	81.9
12/10/10 12:19	23.8	3.3	8.0	9.6	3.2	34.8	82.1
12/10/10 12:19	23.8	3.6	8.1	22.2	3.5	34.8	82.1
2/16/11 15:01	25.7	0.1	8.3	0.0	0.0	4.6	101.3
2/16/11 15:01	25.7	0.1	8.1	0.0	0.6	8.2	97.2
2/16/11 15:01	25.7	0.3	8.0	0.9	0.7	23.2	95.2
2/16/11 15:01	25.6	0.5	7.9	1.9	0.7	17.8	92.0
2/16/11 15:01	25.4	1.0	7.8	2.4	1.1	26.7	85.7
2/16/11 15:01	25.2	1.5	7.7	2.2	1.1	29.6	81.7
2/16/11 15:01	25.1	1.8	7.7	2.2	1.3	31.9	79.8
2/16/11 15:01	25.0	2.4	7.7	2.2	1.5	32.5	78.6
2/16/11 15:01	24.9	2.9	7.7	2.5	1.6	32.6	78.6
2/16/11 15:01	24.9	3.4	7.8	2.7	1.7	32.8	79.0
2/16/11 15:01	24.8	3.9	7.8	3.1	1.7	32.9	79.6
2/16/11 15:01	24.8	4.5	7.8	3.9	1.9	33.0	80.8

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/16/11 15:01	24.8	4.8	7.8	6.7	2.0	33.1	81.7
2/16/11 15:01	24.8	5.1	7.8	7.4	2.2	33.1	82.4
2/16/11 15:01	24.8	5.2	7.8	7.5	2.1	33.2	83.3
2/16/11 15:01	24.8	5.4	7.9	8.4	2.5	33.2	83.7
2/16/11 15:01	24.8	5.5	7.9	14.5	3.1	33.2	83.8
2/16/11 15:01	24.8	5.6	7.9	22.5	3.0	33.3	84.3
2/16/11 15:01	24.8	5.7	7.9	23.3	2.7	33.3	84.4
3/10/11 10:50	22.6	0.3	8.7	1.9	1.2	0.1	101.2
3/10/11 10:50	22.6	0.3	8.7	4.9	1.4	0.3	101.2
3/10/11 10:50	22.6	0.3	8.6	6.1	1.6	0.7	101.0
3/10/11 10:50	22.6	0.4	8.6	7.2	1.6	0.7	100.8
3/10/11 10:50	22.7	0.6	8.5	8.3	1.7	0.5	100.6
3/10/11 10:50	22.7	0.8	8.5	9.2	1.7	0.7	100.3
3/10/11 10:50	22.7	1.1	8.0	9.5	1.7	1.8	100.3
3/10/11 10:50	22.8	1.4	7.3	8.8	1.8	11.0	100.0
3/10/11 10:50	23.1	1.7	7.3	7.8	1.8	22.2	97.3
3/10/11 10:50	24.1	2.0	7.3	7.6	1.8	22.2	91.9
3/10/11 10:50	24.2	2.3	7.3	6.9	2.1	23.9	86.3
3/10/11 10:50	24.2	2.5	7.3	9.5	2.4	25.9	80.0
3/10/11 10:50	24.3	2.7	7.4	12.8	2.6	26.5	74.1
3/10/11 10:50	24.3	2.8	7.4	19.1	3.0	26.6	69.1
3/10/11 10:50	24.4	2.9	7.4	27.8	3.4	26.6	64.8
4/5/11 10:34	23.7	0.3	8.4	2.8	108.4	0.0	96.7
4/5/11 10:34	24.1	0.3	8.3	2.8	108.4	0.1	96.0
4/5/11 10:34	24.2	0.3	8.2	2.8	108.4	16.5	95.9
4/5/11 10:34	24.5	0.4	8.1	2.8	108.4	35.0	95.6
4/5/11 10:34	24.7	0.9	8.0	2.8	108.4	36.0	95.2
4/5/11 10:34	25.0	1.3	7.9	2.8	108.4	37.2	94.8
4/5/11 10:34	25.1	1.9	7.9	2.8	108.4	38.3	94.7
4/5/11 10:34	25.1	2.5	7.9	2.8	108.4	39.0	94.7
4/5/11 10:34	25.1	3.1	7.9	2.8	108.4	39.6	94.7
4/5/11 10:34	25.0	3.8	7.9	2.8	108.4	39.7	94.8
5/22/11 11:49	25.5	0.2	7.9	0.1	0.1	0.1	103.7
5/22/11 11:49	25.5	0.2	7.9	0.1	0.4	0.2	103.2
5/22/11 11:49	25.6	0.2	7.8	0.2	0.7	8.2	103.2
5/22/11 11:49	25.6	0.5	7.8	1.4	1.4	18.0	103.0
5/22/11 11:49	25.8	0.9	7.7	1.4	2.1	37.3	103.2
5/22/11 11:49	26.2	3.6	7.5	0.1	2.6	40.5	102.5

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/22/11 11:49	26.3	4.7	7.5	0.0	3.0	40.4	101.4
5/22/11 11:49	26.3	5.3	7.5	0.0	3.2	40.2	99.4
5/22/11 11:49	26.1	5.9	7.5	0.6	3.2	40.2	95.7
5/22/11 11:49	25.9	6.6	7.5	2.3	3.2	40.2	92.6
5/22/11 11:49	25.7	7.0	7.6	20.2	2.9	40.3	90.6
6/23/11 12:23	26.4	0.2	8.2	0.0	1.5	1.6	103.2
8/27/11 9:23	25.7	0.2	8.7	1.0	1.6	0.6	90.4
8/27/11 9:23	25.7	0.2	8.8	1.0	2.3	4.0	89.9
8/27/11 9:23	25.7	0.2	8.7	0.0	2.1	7.8	89.7
8/27/11 9:23	25.7	0.2	8.6	0.1	2.2	7.9	89.5
8/27/11 9:23	25.7	0.4	8.5	0.3	2.3	8.6	89.7
8/27/11 9:23	25.8	0.7	8.4	0.5	2.3	22.5	89.9
8/27/11 9:23	26.0	1.0	8.3	0.7	2.4	27.9	89.9
8/27/11 9:23	26.3	1.3	8.2	0.8	2.4	28.4	89.4
8/27/11 9:23	26.5	1.6	8.2	0.8	2.6	30.7	88.6
8/27/11 9:23	26.8	1.9	8.2	0.8	2.7	31.3	87.3
8/27/11 9:23	27.0	2.1	8.2	0.8	2.8	31.7	86.2
8/27/11 9:23	27.1	2.4	8.2	0.9	2.9	33.2	85.2
8/27/11 9:23	27.3	2.7	8.2	0.8	3.0	33.6	83.8
8/27/11 9:23	27.4	3.0	8.2	0.8	3.2	33.7	82.5
8/27/11 9:23	27.5	3.2	8.3	0.7	3.3	33.8	81.4
8/27/11 9:23	27.6	3.5	8.3	0.7	3.3	33.9	80.3
8/27/11 9:23	27.6	3.8	8.3	0.6	3.5	34.1	79.6
8/27/11 9:23	27.6	4.2	8.3	0.6	3.8	34.2	79.0
8/27/11 9:23	27.6	4.4	8.3	0.6	3.9	34.2	78.6
8/27/11 9:23	27.6	4.7	8.3	0.7	4.0	34.3	78.2
8/27/11 9:23	27.6	5.1	8.4	1.1	4.1	34.5	77.4
8/27/11 9:23	27.5	5.5	8.4	1.8	4.1	34.6	76.4
8/27/11 9:23	27.5	5.8	8.4	2.4	4.1	34.7	75.3
8/27/11 9:23	27.5	6.1	8.4	3.8	4.4	34.7	73.5
8/27/11 9:23	27.5	6.3	8.4	5.5	4.8	34.0	72.2
8/27/11 9:24	27.5	6.5	8.4	6.4	5.3	34.0	71.1
9/25/11 9:42	25.0	0.2	9.6	0.3	1.4	0.1	93.3
9/25/11 9:42	27.2	0.8	9.2	0.0	1.5	32.1	90.9
9/25/11 9:42	27.9	2.7	9.2	0.0	1.8	35.2	88.3
9/25/11 9:42	27.8	4.3	9.3	0.8	2.2	35.4	84.6
9/25/11 9:42	27.6	5.9	9.3	1.5	2.5	35.5	80.6
10/23/11 11:05	24.1	0.1	8.3	48.7	8.0	0.0	90.0

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
10/23/11 11:05	24.1	0.1	8.3	48.7	8.9	0.3	89.4
10/23/11 11:05	24.1	0.2	8.3	48.7	8.6	0.3	89.1
10/23/11 11:05	24.1	0.4	8.3	46.6	8.6	0.3	88.9
10/23/11 11:05	24.1	0.6	8.3	46.3	8.3	0.3	88.7
10/23/11 11:05	24.1	0.8	8.2	49.9	8.4	0.5	88.5
10/23/11 11:05	24.1	1.3	8.1	51.6	8.2	0.8	88.4
10/23/11 11:05	24.1	1.7	7.5	55.1	8.5	1.4	88.3
10/23/11 11:05	24.2	2.3	7.1	51.9	8.4	9.7	88.3
10/23/11 11:05	25.4	2.8	7.4	48.1	8.1	39.1	87.1
10/23/11 11:05	25.8	3.5	7.6	45.3	7.9	39.7	86.3
10/23/11 11:05	25.8	4.0	7.7	43.3	7.7	39.7	85.2
10/23/11 11:05	25.9	4.4	7.7	42.6	7.4	39.8	84.1
10/23/11 11:05	25.9	4.9	7.7	40.6	7.2	39.9	82.6
10/23/11 11:05	25.9	5.4	7.8	44.1	6.7	40.1	81.4
10/23/11 11:05	25.9	5.8	7.8	45.4	6.5	40.2	80.2
10/23/11 11:05	25.9	6.2	7.8	47.2	7.1	39.0	79.3
11/1/11 12:02	25.6	0.3	8.2	10.6	3.1	0.7	97.2
11/1/11 12:02	25.6	0.3	8.1	10.6	3.0	2.0	96.9
11/1/11 12:02	25.6	0.4	8.0	10.3	3.0	3.3	96.6
11/1/11 12:02	25.6	0.6	7.6	6.9	2.8	8.7	96.7
11/1/11 12:02	25.7	0.8	7.6	3.8	3.1	24.4	97.1
11/1/11 12:02	26.0	1.3	7.7	1.7	3.1	32.9	97.7
11/1/11 12:02	26.2	1.7	7.8	0.7	3.2	34.0	98.0
11/1/11 12:02	26.4	2.2	7.9	0.3	3.5	34.1	98.2
11/1/11 12:02	26.5	2.7	7.9	0.0	3.7	34.2	98.3
11/1/11 12:02	26.5	3.4	7.9	0.0	4.2	34.3	97.6
11/1/11 12:02	26.5	3.9	7.9	0.0	4.5	34.3	96.5
11/1/11 12:03	26.5	4.2	8.0	0.2	4.8	34.4	95.6
11/1/11 12:03	26.5	4.6	8.0	2.7	4.8	34.4	94.2
11/1/11 12:03	26.5	5.0	8.0	7.4	5.4	34.4	92.7
11/1/11 12:03	26.5	5.2	8.0	15.5	5.7	34.5	91.4
11/1/11 12:03	26.4	5.5	8.0	14.0	5.3	32.9	90.3
12/14/11 12:03	23.4	0.3	8.1	21.0	2.6	2.9	98.3
12/14/11 12:03	23.3	0.3	8.1	21.0	2.6	2.6	97.8
12/14/11 12:03	23.3	0.4	8.0	10.7	3.0	4.0	97.7
12/14/11 12:03	23.3	0.6	7.4	6.4	2.8	13.0	97.5
12/14/11 12:03	23.4	1.0	7.5	3.2	2.7	25.7	96.6
12/14/11 12:03	23.4	1.3	7.6	2.0	2.7	31.2	94.3

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/14/11 12:03	23.4	1.7	7.6	1.1	2.6	32.1	91.5
12/14/11 12:03	23.5	2.0	7.7	0.7	2.5	32.5	89.5
12/14/11 12:03	23.5	2.5	7.7	0.2	2.5	32.6	86.3
12/14/11 12:03	23.5	2.8	7.8	0.0	2.6	32.9	84.0
12/14/11 12:03	23.5	3.1	7.8	0.0	2.6	33.1	81.9
12/14/11 12:03	23.5	3.5	7.8	0.1	2.8	33.3	79.8
12/14/11 12:03	23.5	3.8	7.8	0.5	2.8	33.4	77.9
12/14/11 12:03	23.5	4.2	7.8	1.7	3.3	33.5	76.5
12/14/11 12:03	23.5	4.4	7.8	3.7	3.0	33.6	75.1
12/14/11 12:03	23.5	4.7	7.8	5.3	2.7	30.9	73.9
1/28/12 11:02	23.4	0.3	8.2	0.2	1.3	0.1	99.2
1/28/12 11:02	23.3	0.3	8.2	0.2	1.9	0.1	98.1
1/28/12 11:02	23.3	0.3	8.1	0.1	2.5	4.4	97.7
1/28/12 11:02	23.3	0.4	7.6	0.1	2.2	5.2	97.5
1/28/12 11:02	23.4	0.5	7.6	0.8	2.0	10.9	97.8
1/28/12 11:02	23.6	0.7	7.6	0.9	1.9	17.6	97.1
1/28/12 11:02	24.7	0.9	7.6	1.0	1.9	23.8	94.3
1/28/12 11:02	24.9	1.2	7.7	1.1	2.0	28.6	92.1
1/28/12 11:02	25.0	1.4	7.7	1.0	2.1	30.5	90.0
1/28/12 11:02	25.1	1.6	7.8	0.8	2.3	33.6	88.2
1/28/12 11:02	25.1	1.9	7.8	0.7	2.5	33.7	87.0
1/28/12 11:02	25.1	2.2	7.9	0.5	2.6	33.6	86.2
1/28/12 11:03	25.1	2.4	7.9	0.4	2.6	33.7	85.7
1/28/12 11:03	25.1	2.7	7.9	0.3	2.7	34.0	85.5
1/28/12 11:03	25.1	2.9	7.9	0.2	2.7	34.1	85.5
1/28/12 11:03	25.1	3.2	7.9	0.1	2.8	34.3	85.6
1/28/12 11:03	25.0	3.5	8.0	0.1	2.9	34.5	85.9
1/28/12 11:03	25.0	3.8	8.0	0.0	2.8	34.6	86.2
1/28/12 11:03	25.0	4.1	8.0	0.0	3.0	34.7	86.5
1/28/12 11:03	25.0	4.4	8.0	0.0	3.1	34.8	86.7
1/28/12 11:03	24.9	4.6	8.0	0.1	3.2	34.8	86.8
1/28/12 11:03	24.9	4.9	8.0	0.2	3.4	34.8	86.9
1/28/12 11:03	24.8	5.2	8.0	0.3	3.6	34.9	87.0
1/28/12 11:03	24.8	5.5	8.0	0.6	4.0	34.9	86.8
1/28/12 11:03	24.7	5.9	8.0	0.9	4.0	34.9	86.7
1/28/12 11:03	24.6	6.3	8.0	1.1	4.3	34.9	86.4
1/28/12 11:03	24.6	6.7	8.0	1.4	4.5	34.9	86.0
1/28/12 11:03	24.6	7.1	8.0	2.0	4.3	34.9	85.6

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
1/28/12 11:03	24.5	7.4	8.0	3.2	4.2	34.9	85.1
1/28/12 11:03	24.5	7.7	8.0	4.2	4.6	34.9	84.6
1/28/12 11:03	24.5	7.9	8.0	5.4	5.4	34.9	84.1
1/28/12 11:03	24.5	8.0	8.0	8.4	8.2	34.9	83.6
2/25/12 9:22	23.1	0.3	7.9	0.0	2.3	0.2	91.1
2/25/12 9:22	23.2	0.2	7.9	0.1	3.2	19.3	90.3
2/25/12 9:22	23.3	0.2	7.8	0.6	3.1	28.8	90.3
2/25/12 9:22	23.5	0.3	7.8	0.9	3.3	30.8	90.1
2/25/12 9:22	23.6	0.4	7.8	1.0	3.3	31.5	89.6
2/25/12 9:22	23.7	0.5	7.8	0.9	3.2	29.7	88.7
2/25/12 9:22	23.8	0.6	7.8	0.8	3.1	34.5	88.0
2/25/12 9:22	23.8	0.8	7.9	0.8	3.1	35.1	87.4
2/25/12 9:22	23.9	1.0	7.9	0.8	3.1	35.1	86.8
2/25/12 9:22	23.9	1.2	7.9	0.8	3.1	35.2	86.5
2/25/12 9:22	23.9	1.4	7.9	0.7	3.2	35.3	86.2
2/25/12 9:22	23.9	1.6	7.9	0.7	3.2	35.4	85.9
2/25/12 9:22	23.9	1.7	7.9	0.8	3.4	35.5	85.7
2/25/12 9:22	23.9	1.9	7.9	0.9	3.5	35.6	85.2
2/25/12 9:22	24.0	2.0	7.9	1.0	3.8	35.7	84.4
2/25/12 9:22	24.0	2.2	7.9	1.2	4.1	35.8	83.3
2/25/12 9:22	24.0	2.3	7.9	1.2	4.3	35.8	82.4
2/25/12 9:22	24.0	2.4	7.9	1.4	4.3	35.8	80.9
2/25/12 9:22	24.0	2.5	7.9	1.5	4.3	35.8	80.1
2/25/12 9:22	24.0	2.6	7.9	1.6	4.3	35.8	79.1
2/25/12 9:22	24.0	2.8	7.9	1.8	4.4	35.8	77.8
2/25/12 9:22	24.0	2.9	7.9	1.9	4.5	35.8	77.2
2/25/12 9:23	24.0	3.0	7.9	2.0	4.6	35.8	76.4
2/25/12 9:23	24.0	3.2	7.9	2.1	4.7	35.9	75.7
2/25/12 9:23	24.0	3.3	7.9	2.2	4.7	35.9	75.3
2/25/12 9:23	23.9	3.4	7.9	2.2	4.7	35.9	75.2
2/25/12 9:23	23.9	3.5	7.9	2.3	4.6	35.9	75.1
2/25/12 9:23	23.9	3.7	7.9	2.5	4.8	35.9	75.1
2/25/12 9:23	23.9	3.9	7.9	2.8	4.9	35.9	75.1
2/25/12 9:23	23.9	4.1	7.9	3.1	4.8	35.9	75.1
2/25/12 9:23	23.9	4.3	7.9	3.4	4.9	35.9	74.9
2/25/12 9:23	23.9	4.4	7.9	3.8	4.9	35.9	74.7
2/25/12 9:23	23.9	4.6	7.9	4.5	5.3	35.9	74.4
3/3/12 12:02	23.1	0.1	8.5	27.2	2.4	0.0	100.2

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 12:02	23.1	0.1	8.0	27.2	2.4	0.0	100.1
3/3/12 12:02	23.1	0.1	8.0	21.0	2.6	6.8	100.2
3/3/12 12:03	23.1	0.3	7.8	16.0	2.6	12.7	99.9
3/3/12 12:03	23.2	0.4	7.7	10.8	2.3	25.4	99.4
3/3/12 12:03	23.3	0.7	7.7	7.0	2.2	31.9	98.4
3/3/12 12:03	23.4	1.0	7.7	4.8	1.9	33.7	96.7
3/3/12 12:03	23.4	1.2	7.7	3.8	1.9	34.7	94.7
3/3/12 12:03	23.4	1.5	7.8	2.9	1.9	34.7	93.1
3/3/12 12:03	23.5	1.9	7.8	2.2	2.0	34.8	91.6
3/3/12 12:03	23.5	2.3	7.8	1.7	1.8	34.9	90.5
3/3/12 12:03	23.5	2.7	7.9	1.2	1.6	34.9	89.5
3/3/12 12:03	23.5	3.0	7.9	0.9	1.5	35.0	88.7
3/3/12 12:03	23.5	3.4	7.9	0.6	1.5	35.0	88.3
3/3/12 12:03	23.4	3.7	7.9	0.3	1.6	35.0	87.9
3/3/12 12:03	23.4	4.1	7.9	0.1	1.6	35.1	87.6
3/3/12 12:03	23.4	4.4	7.9	0.0	1.5	35.1	87.2
3/3/12 12:03	23.3	4.8	7.9	0.0	1.4	35.1	86.8
3/3/12 12:03	23.3	5.1	7.9	0.0	1.4	35.2	86.5
3/3/12 12:03	23.3	5.6	7.9	0.0	1.2	35.3	86.3
3/3/12 12:03	23.3	6.0	7.9	0.1	1.2	35.3	86.6
3/7/12 10:17	21.3	0.3	8.8	0.0	1.6	0.2	97.2
3/7/12 10:17	21.3	0.4	8.8	2.5	8.7	0.2	98.0
3/7/12 10:17	21.2	0.4	8.8	39.1	7.9	0.7	98.1
3/7/12 10:18	21.2	0.4	8.8	39.4	7.1	0.6	98.2
3/7/12 10:18	21.2	0.6	8.7	39.6	6.4	0.6	98.2
3/7/12 10:18	21.1	0.8	8.7	40.0	6.2	0.6	98.0
3/7/12 10:18	21.1	1.0	8.6	40.0	5.9	0.5	97.9
3/7/12 10:18	21.1	1.2	8.6	40.3	5.8	0.5	97.8
3/7/12 10:18	21.1	1.5	7.7	40.3	5.6	1.1	97.7
3/7/12 10:18	21.1	1.8	7.5	39.4	5.4	2.4	97.7
3/7/12 10:18	21.2	2.0	7.1	36.9	5.1	11.5	98.1
3/7/12 10:18	22.1	2.2	7.2	34.1	4.8	26.6	96.5
3/7/12 10:18	22.5	2.5	7.3	31.3	4.5	24.9	95.8
3/7/12 10:18	22.6	2.9	7.4	28.9	4.2	27.9	94.9
3/7/12 10:18	22.6	3.2	7.5	27.0	3.9	29.1	93.7
3/7/12 10:18	22.7	3.7	7.6	25.5	3.7	30.1	92.5
3/7/12 10:18	22.8	4.1	7.6	23.8	3.4	30.4	91.3
3/7/12 10:18	22.8	4.5	7.7	22.1	3.3	30.5	90.3

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/7/12 10:18	22.9	4.9	7.7	20.5	3.1	30.6	89.5
3/7/12 10:18	22.9	5.4	7.8	19.1	2.9	30.8	88.5
3/7/12 10:18	23.0	5.9	7.8	17.9	2.9	31.0	87.4
3/7/12 10:18	23.0	6.4	7.8	17.1	2.8	31.1	86.4
4/21/12 11:18	23.5	0.2	8.1	0.0	14.2	0.2	100.3
4/21/12 11:18	23.7	0.2	8.0	0.2	11.5	3.1	100.0
4/21/12 11:18	23.8	0.3	8.0	0.3	10.6	3.2	100.0
4/21/12 11:18	23.8	0.5	7.5	0.4	9.7	4.3	99.9
4/21/12 11:18	23.9	0.8	7.4	0.4	9.1	15.1	100.0
4/21/12 11:18	24.1	1.1	7.3	0.5	8.5	22.0	100.1
4/21/12 11:18	24.2	1.4	7.4	0.7	8.0	28.1	100.3
4/21/12 11:18	24.5	1.8	7.4	0.8	7.5	30.5	100.8
4/21/12 11:18	24.8	2.2	7.5	1.0	7.1	31.1	101.1
4/21/12 11:18	25.1	2.5	7.5	1.1	6.9	32.0	100.8
4/21/12 11:18	25.5	2.7	7.6	1.2	6.6	33.8	100.1
4/21/12 11:18	25.8	3.0	7.6	1.2	6.5	34.3	99.6
4/21/12 11:18	26.0	3.2	7.7	1.2	6.2	34.4	99.1
4/21/12 11:18	26.2	3.5	7.7	1.1	6.1	34.4	98.7
4/21/12 11:18	26.3	3.8	7.7	1.1	6.2	34.5	98.7
4/21/12 11:18	26.3	4.1	7.8	1.2	6.4	34.7	98.3
4/21/12 11:18	26.2	4.4	7.8	1.5	6.6	34.8	97.4
4/21/12 11:18	26.2	4.7	7.8	1.9	6.3	34.9	95.0
4/21/12 11:18	26.1	5.0	7.8	2.2	6.3	34.9	91.6
4/21/12 11:18	26.0	5.3	7.8	2.3	6.2	35.0	87.9
4/21/12 11:18	26.0	5.7	7.8	2.4	6.2	35.0	84.9
4/21/12 11:18	25.9	6.0	7.8	2.5	5.9	35.1	82.7
5/19/12 10:55	25.8	0.3	8.2	2.5	0.3	4.4	100.0
5/19/12 10:55	25.8	0.3	7.9	2.5	0.0	6.5	99.6
5/19/12 10:55	25.8	0.4	7.5	2.5	0.4	14.9	100.1
5/19/12 10:55	25.9	0.6	7.5	0.3	0.9	25.4	100.7
5/19/12 10:55	26.0	0.8	7.6	0.1	1.0	32.4	101.7
5/19/12 10:55	26.2	1.2	7.6	0.0	1.2	34.1	102.8
5/19/12 10:55	26.3	1.6	7.7	0.0	1.4	34.9	104.0
5/19/12 10:55	26.3	2.0	7.7	0.0	1.6	34.9	105.1
5/19/12 10:55	26.3	2.4	7.8	0.1	1.6	35.0	105.7
5/19/12 10:55	26.3	2.8	7.8	0.4	1.7	35.1	105.8
5/19/12 10:55	26.3	3.1	7.8	0.7	1.9	35.1	105.0
5/19/12 10:55	26.3	3.5	7.8	0.8	2.2	35.2	103.1

Appendix 2: (Continued) Raw water column profile data for Station 2 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/19/12 10:55	26.2	3.9	7.8	0.9	2.5	35.3	100.8
5/19/12 10:55	26.1	4.4	7.8	1.1	2.7	35.3	98.2
5/19/12 10:55	26.1	4.9	7.8	1.2	2.9	35.4	95.8
5/19/12 10:55	26.0	5.4	7.8	1.4	2.8	35.4	93.4
5/19/12 10:55	26.0	5.9	7.8	1.7	2.9	35.4	91.5
5/19/12 10:55	26.0	6.2	7.8	1.8	3.0	35.4	90.0
5/19/12 10:55	26.0	6.5	7.8	2.1	3.0	35.4	88.8
5/19/12 10:55	25.9	6.7	7.8	2.3	3.1	35.4	87.8
5/19/12 10:55	25.9	7.0	7.8	3.4	3.5	35.4	87.1
6/30/12 13:32	26.4	0.2	8.5	1.3	2.1	2.4	102.5
6/30/12 13:32	26.3	0.2	8.3	1.1	0.9	2.9	102.8
6/30/12 13:32	26.3	0.3	7.8	1.0	1.0	6.0	102.6
6/30/12 13:32	26.3	0.5	7.8	0.9	1.2	9.2	102.3
6/30/12 13:32	26.2	0.8	7.7	0.8	1.9	21.2	102.2
6/30/12 13:32	26.0	1.1	7.7	0.7	2.5	27.9	102.1
6/30/12 13:32	25.9	1.5	7.7	0.7	2.8	28.2	102.2
6/30/12 13:32	25.8	1.8	7.7	0.7	3.3	31.6	103.0
6/30/12 13:32	25.7	2.2	7.7	0.7	3.6	33.0	103.2
6/30/12 13:32	25.7	2.6	7.7	0.5	3.9	33.6	102.9
6/30/12 13:32	25.7	2.9	7.8	0.4	3.9	34.1	103.0
6/30/12 13:32	25.6	3.2	7.8	0.3	3.8	34.3	103.6
6/30/12 13:32	25.5	3.5	7.8	0.2	3.9	34.5	104.0
6/30/12 13:32	25.5	3.8	7.9	0.2	3.8	34.6	104.7
6/30/12 13:32	25.5	4.0	7.9	0.1	3.8	34.7	105.3
6/30/12 13:32	25.5	4.3	7.9	0.1	3.7	34.8	106.1
6/30/12 13:32	25.5	4.6	7.9	0.0	3.7	34.9	106.7
6/30/12 13:32	25.5	4.9	7.9	0.0	3.7	34.9	107.9
6/30/12 13:32	25.5	5.2	8.0	0.0	3.6	35.0	109.3
6/30/12 13:32	25.5	5.5	8.0	0.0	3.5	35.2	111.6
6/30/12 13:32	25.6	5.8	8.0	0.0	3.6	35.2	114.1
6/30/12 13:32	25.6	6.1	8.0	0.0	3.4	35.3	116.2
6/30/12 13:32	25.6	6.5	8.0	0.1	3.3	35.3	117.4
6/30/12 13:32	25.6	6.9	8.0	0.2	3.3	35.3	118.8
6/30/12 13:32	25.5	7.4	8.0	0.3	3.3	35.3	119.3
6/30/12 13:32	25.5	7.8	8.0	0.4	3.5	35.4	117.7
6/30/12 13:33	25.4	8.3	8.0	0.7	3.5	35.3	116.0
6/30/12 13:33	25.4	8.7	8.0	1.1	3.5	35.3	113.7

Appendix 3: Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 11:49	25.3	0.3	8.0	6.3	3.2	34.8	100.8
11/4/10 11:49	25.4	0.3	8.0	6.3	2.9	34.8	101.1
11/4/10 11:49	25.4	0.3	8.0	6.2	2.7	34.8	101.3
11/4/10 11:49	25.3	0.3	8.0	6.2	2.6	34.8	101.4
11/4/10 11:49	25.3	0.4	8.0	6.1	2.5	34.8	101.5
11/4/10 11:49	25.3	0.5	8.0	6.1	2.4	34.8	101.6
11/4/10 11:49	25.3	0.5	8.0	6.1	2.3	34.8	101.6
11/4/10 11:49	25.3	0.7	8.0	6.0	2.1	34.8	101.7
11/4/10 11:49	25.3	0.8	8.0	5.9	2.0	34.8	101.7
11/4/10 11:49	25.3	0.9	8.0	5.9	2.0	34.8	101.8
11/4/10 11:49	25.3	1.0	8.0	5.9	1.9	34.8	101.8
11/4/10 11:49	25.3	1.1	8.0	5.8	1.9	34.8	101.8
11/4/10 11:49	25.3	1.3	8.0	5.9	1.8	34.8	101.8
11/4/10 11:49	25.3	1.5	8.0	5.9	1.7	34.8	101.8
11/4/10 11:49	25.3	1.6	8.0	5.9	1.6	34.8	101.9
11/4/10 11:49	25.3	1.8	8.0	5.9	1.6	34.8	101.9
11/4/10 11:49	25.3	2.1	8.0	6.0	1.5	34.8	102.0
11/4/10 11:49	25.3	2.3	8.0	5.9	1.5	34.8	102.0
11/4/10 11:49	25.3	2.6	8.0	6.0	1.4	34.8	101.9
11/4/10 11:49	25.3	3.0	8.0	6.0	1.4	34.8	101.9
11/4/10 11:49	25.3	3.3	8.0	6.0	1.3	34.8	101.9
11/4/10 11:49	25.3	3.6	8.0	6.0	1.2	34.8	101.9
11/4/10 11:49	25.3	4.0	8.0	6.0	1.2	34.8	101.9
11/4/10 11:49	25.4	4.3	8.0	6.0	1.1	34.8	101.8
11/4/10 11:49	25.4	4.6	8.0	6.0	1.0	34.8	101.8
11/4/10 11:50	25.4	4.8	8.0	6.0	1.2	34.8	101.8
11/4/10 11:50	25.4	4.9	8.0	6.1	1.1	34.8	101.8
11/4/10 11:50	25.4	5.1	8.0	6.1	1.0	34.8	101.8
11/4/10 11:50	25.4	5.2	8.0	6.1	0.9	34.8	101.7
11/4/10 11:50	25.4	5.3	8.0	7.4	1.0	34.8	101.8
11/4/10 11:50	25.4	5.4	8.0	11.8	1.1	34.7	101.7
11/4/10 11:50	25.6	5.5	8.0	28.0	1.1	34.6	101.5
12/10/10 12:23	21.7	0.0	8.4	6.7	2.5	4.6	94.8
12/10/10 12:24	21.6	0.0	8.0	3.7	2.5	7.1	93.1
12/10/10 12:24	22.8	0.0	7.9	2.0	2.2	28.7	92.1
12/10/10 12:24	23.4	0.2	8.0	1.0	2.1	31.6	91.7
12/10/10 12:24	23.5	0.5	8.0	0.4	2.1	34.5	92.1
12/10/10 12:24	23.6	0.7	8.1	0.0	2.1	34.7	92.4

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/10/10 12:24	23.7	1.1	8.1	0.0	2.1	34.7	92.6
12/10/10 12:24	23.7	1.5	8.1	0.3	2.0	34.7	92.5
12/10/10 12:24	23.8	1.8	8.1	0.7	2.0	34.8	92.2
12/10/10 12:24	23.9	2.2	8.1	1.6	2.4	34.8	91.9
12/10/10 12:24	23.9	2.6	8.1	2.6	2.5	34.9	91.7
12/10/10 12:24	24.0	2.8	8.1	12.5	3.6	34.9	91.6
12/10/10 12:24	24.0	3.0	8.2	17.4	4.8	34.9	91.5
12/10/10 12:24	24.0	3.2	8.2	46.5	4.5	34.2	91.4
2/16/11 15:05	25.7	0.5	7.9	0.0	0.7	28.4	82.2
2/16/11 15:05	25.7	0.6	7.9	0.0	0.8	28.4	86.0
2/16/11 15:05	25.8	1.0	7.9	0.0	1.0	29.6	86.8
2/16/11 15:05	25.7	1.6	7.8	0.4	1.1	32.2	87.2
2/16/11 15:05	25.6	2.2	7.9	0.8	1.3	32.9	87.5
2/16/11 15:05	25.4	2.9	7.9	1.3	1.4	33.2	87.8
2/16/11 15:05	25.4	3.5	7.9	3.6	1.6	33.3	88.8
2/16/11 15:05	25.3	3.9	7.9	6.8	1.7	33.3	89.7
2/16/11 15:05	25.3	4.2	7.9	15.6	2.4	33.4	90.7
2/16/11 15:05	25.2	4.4	7.9	42.2	2.4	33.4	91.8
3/10/11 10:54	22.6	0.3	8.4	18.8	3.0	0.1	97.8
3/10/11 10:54	22.7	0.3	8.4	16.5	1.9	1.2	97.3
3/10/11 10:54	22.7	0.3	8.4	16.3	2.0	2.2	97.3
3/10/11 10:54	22.8	0.5	8.3	15.8	2.2	3.4	97.1
3/10/11 10:54	22.8	0.9	7.7	12.3	2.7	16.6	97.1
3/10/11 10:55	23.0	1.4	7.5	9.6	2.7	22.7	96.4
3/10/11 10:55	23.3	2.0	7.5	7.6	2.9	26.6	93.6
3/10/11 10:55	23.7	2.5	7.5	15.0	4.2	27.3	89.0
4/5/11 10:40	24.1	0.3	8.4	0.0	33.9	0.2	93.0
4/5/11 10:40	24.3	0.2	8.1	2.6	16.0	15.8	93.0
4/5/11 10:40	24.4	0.4	8.1	2.6	14.3	20.9	92.9
4/5/11 10:40	24.6	0.7	7.9	2.3	12.4	34.3	92.2
4/5/11 10:40	24.9	1.3	7.9	2.4	11.3	36.1	92.2
4/5/11 10:40	25.1	2.0	7.9	4.3	10.4	38.3	91.8
4/5/11 10:40	25.3	2.5	7.9	25.3	9.9	39.2	91.3
5/22/11 11:56	25.8	0.2	7.7	0.6	1.4	6.9	102.1
5/22/11 11:56	25.7	0.2	7.7	0.1	1.4	5.0	101.4
5/22/11 11:57	25.7	0.4	7.7	0.1	1.4	10.2	101.5
5/22/11 11:57	25.8	0.8	7.6	0.0	1.4	30.2	102.1

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a μg/L	Sal ppt	ODO %
5/22/11 11:57	26.1	1.3	7.5	1.4	1.8	34.1	102.9
5/22/11 11:57	26.9	1.9	7.5	7.3	3.5	38.2	102.5
6/23/11 12:32	26.6	0.3	8.1	7.7	1.6	6.4	101.9
6/23/11 12:32	26.6	0.3	8.0	7.5	1.6	7.4	102.1
6/23/11 12:32	26.6	0.6	7.9	4.9	1.5	26.6	102.1
6/23/11 12:32	26.7	1.2	7.8	3.0	1.5	33.8	101.6
6/23/11 12:32	26.7	1.8	7.8	1.7	1.6	34.5	101.7
6/23/11 12:32	26.7	2.5	7.8	0.7	1.6	34.6	102.7
6/23/11 12:32	26.7	3.1	7.8	0.0	1.5	34.7	104.2
8/27/11 9:34	26.9	0.2	8.1	20.3	1.8	8.4	92.8
8/27/11 9:34	26.9	0.2	8.1	0.0	1.6	8.5	91.9
8/27/11 9:34	26.9	0.2	8.1	0.3	1.6	29.3	91.7
8/27/11 9:34	26.9	0.4	8.2	0.3	1.5	29.4	91.6
8/27/11 9:34	26.9	0.6	8.2	0.5	1.5	29.5	91.6
8/27/11 9:34	26.9	1.0	8.2	0.6	1.6	29.7	91.5
8/27/11 9:34	26.9	1.3	8.2	0.6	1.7	29.8	91.7
8/27/11 9:34	26.9	1.7	8.2	0.5	1.7	29.8	91.7
8/27/11 9:34	26.9	2.0	8.2	0.7	1.7	29.9	91.7
8/27/11 9:34	26.9	2.3	8.2	2.1	2.0	29.9	91.9
8/27/11 9:34	27.0	2.6	8.2	3.5	2.2	30.0	91.9
8/27/11 9:34	27.0	2.8	8.2	4.5	2.3	32.4	91.6
8/27/11 9:34	27.1	3.0	8.2	7.0	2.4	33.2	91.1
8/27/11 9:34	27.2	3.1	8.2	9.7	2.6	33.4	90.2
9/25/11 9:50	27.4	0.2	9.1	0.0	1.7	33.1	90.1
9/25/11 9:50	27.7	1.1	9.1	0.4	1.6	34.5	90.7
9/25/11 9:50	27.8	3.2	9.1	1.3	2.5	35.2	95.4
9/25/11 9:50	27.8	4.8	9.1	3.0	2.8	35.5	96.9
9/25/11 9:50	27.8	5.5	9.1	10.3	20.0	35.5	97.4
10/23/11 11:09	24.3	0.1	7.8	28.0	7.4	4.5	86.8
10/23/11 11:09	24.4	0.1	7.7	27.5	7.4	10.2	86.0
10/23/11 11:09	24.5	0.3	7.7	25.6	7.3	23.7	86.0
10/23/11 11:09	24.8	0.6	7.7	23.3	7.1	28.8	85.9
10/23/11 11:09	25.0	0.9	7.8	21.1	6.8	28.2	85.5
10/23/11 11:09	25.3	1.4	7.8	19.5	6.6	31.1	85.3
10/23/11 11:09	25.4	1.9	7.8	18.7	6.3	33.6	85.1
10/23/11 11:09	25.7	2.3	7.8	17.1	6.2	38.1	85.2
10/23/11 11:09	25.9	2.7	7.9	15.9	6.1	38.9	85.7

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a μg/L	Sal ppt	ODO %
10/23/11 11:09	26.0	3.1	7.9	14.5	5.6	39.2	86.5
10/23/11 11:10	26.1	3.5	7.9	13.4	5.4	39.3	87.5
10/23/11 11:10	26.1	3.9	7.9	12.3	5.3	39.3	88.6
10/23/11 11:10	26.1	4.3	7.9	11.4	5.0	39.5	89.6
10/23/11 11:10	26.2	4.7	7.9	10.3	4.9	39.8	90.2
10/23/11 11:10	26.2	5.0	7.9	9.8	4.9	40.0	90.4
11/1/11 12:09	26.7	0.3	8.0	3.4	1.7	23.8	97.2
11/1/11 12:09	26.8	0.3	8.0	3.4	1.0	24.9	96.6
11/1/11 12:09	26.8	0.4	8.0	2.2	1.2	26.0	96.5
11/1/11 12:09	26.8	0.7	8.0	1.4	1.1	28.5	96.6
11/1/11 12:09	26.9	0.9	8.0	0.8	1.2	30.9	97.1
11/1/11 12:09	27.0	1.2	8.0	0.1	0.9	33.8	98.7
11/1/11 12:09	27.2	1.5	8.0	0.0	1.1	33.8	101.1
11/1/11 12:09	27.3	1.9	8.1	0.0	1.1	33.9	103.1
11/1/11 12:09	27.2	2.3	8.1	0.2	1.2	34.0	104.2
11/1/11 12:09	27.2	2.8	8.1	1.1	1.3	34.1	105.1
11/1/11 12:09	27.0	3.3	8.1	2.0	1.8	34.2	105.3
12/14/11 12:10	23.9	0.3	7.9	3.6	2.1	5.8	94.0
12/14/11 12:10	23.8	0.3	7.9	4.5	1.7	21.7	92.8
12/14/11 12:10	23.8	0.4	7.9	2.9	1.7	24.1	92.5
12/14/11 12:10	23.8	0.6	7.9	1.8	1.8	31.8	92.4
12/14/11 12:10	23.8	0.9	7.9	1.5	1.9	32.5	91.6
12/14/11 12:10	23.8	1.4	7.9	1.0	1.9	33.2	90.6
12/14/11 12:10	23.7	1.9	7.9	0.6	1.9	33.4	89.5
12/14/11 12:11	23.7	2.3	7.9	0.4	2.1	33.5	88.6
12/14/11 12:11	23.6	2.7	7.9	0.2	2.1	33.6	87.2
12/14/11 12:11	23.6	3.0	7.9	0.0	2.2	33.7	86.7
12/14/11 12:11	23.6	3.4	7.9	0.1	2.2	33.8	86.4
12/14/11 12:11	23.6	3.8	7.9	2.5	2.4	33.9	86.3
12/14/11 12:11	23.6	4.1	7.9	9.2	2.9	33.9	86.0
12/14/11 12:11	23.6	4.3	7.9	10.1	3.7	34.0	85.6
1/28/12 11:08	24.5	0.3	8.0	0.0	3.0	22.1	90.3
1/28/12 11:08	24.4	0.3	8.1	0.0	2.4	8.9	89.7
1/28/12 11:08	24.3	0.3	8.1	0.0	2.0	15.0	89.8
1/28/12 11:08	24.3	0.4	8.0	0.1	2.0	25.3	90.5
1/28/12 11:08	24.4	0.5	8.0	0.2	1.9	33.0	90.6
1/28/12 11:08	24.5	0.7	8.0	0.2	1.4	31.9	90.3
1/28/12 11:08	24.6	0.9	8.0	0.0	1.4	33.8	89.8

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
1/28/12 11:08	24.8	1.3	8.0	0.7	1.4	35.2	89.5
1/28/12 11:08	25.0	1.6	8.0	1.1	1.4	35.0	88.8
1/28/12 11:08	25.1	1.8	8.0	1.3	1.7	34.9	88.0
1/28/12 11:08	25.2	2.1	8.0	1.6	1.9	34.9	87.2
1/28/12 11:08	25.2	2.5	8.0	2.0	2.4	34.8	86.6
1/28/12 11:08	25.2	2.8	8.0	3.1	2.8	34.8	86.1
1/28/12 11:08	25.1	3.1	8.0	3.9	3.1	34.9	85.9
1/28/12 11:08	25.1	3.3	8.0	6.0	3.4	34.9	85.7
1/28/12 11:08	25.0	3.4	8.0	7.1	3.9	34.9	85.8
1/28/12 11:08	25.0	3.6	8.0	8.4	4.6	34.9	85.8
1/28/12 11:09	25.0	3.8	8.0	9.6	4.4	34.9	85.9
1/28/12 11:09	25.0	3.9	8.0	11.2	3.9	34.8	85.9
1/28/12 11:09	25.0	4.0	8.0	14.0	3.7	33.9	85.9
1/28/12 11:09	25.0	4.1	8.0	17.7	3.2	34.0	85.8
1/28/12 11:09	25.0	4.1	8.0	22.8	3.0	34.0	85.9
1/28/12 11:09	25.0	4.2	8.0	27.5	2.8	34.1	85.9
2/25/12 9:28	23.9	0.3	8.0	0.0	0.0	35.6	92.6
2/25/12 9:28	23.9	0.2	8.0	0.0	0.5	35.6	91.8
2/25/12 9:28	23.9	0.3	8.0	0.3	0.8	35.6	91.7
2/25/12 9:28	23.9	0.4	8.0	0.2	0.8	35.6	91.4
2/25/12 9:28	23.9	0.6	8.0	0.1	1.0	35.6	91.3
2/25/12 9:28	23.9	0.9	8.0	0.1	1.1	35.5	91.1
2/25/12 9:28	23.9	1.2	8.0	0.0	1.1	35.5	90.7
2/25/12 9:28	24.0	1.4	8.0	0.0	1.2	35.4	90.3
2/25/12 9:28	24.0	1.7	8.0	0.1	1.2	35.4	90.0
2/25/12 9:28	24.0	2.0	8.0	0.0	1.1	35.4	89.8
2/25/12 9:28	24.0	2.2	8.0	0.0	1.2	35.4	89.4
2/25/12 9:28	24.0	2.4	8.0	0.1	1.2	35.4	89.4
2/25/12 9:28	24.0	2.7	8.0	0.4	1.4	35.5	89.0
2/25/12 9:28	24.0	2.8	8.0	1.0	1.6	35.6	88.5
2/25/12 9:28	24.0	3.0	8.0	6.1	2.2	35.6	87.8
2/25/12 9:28	24.0	3.1	8.0	13.3	2.9	35.7	87.2
2/25/12 9:28	24.0	3.2	8.0	17.4	3.3	35.7	86.7
2/25/12 9:28	24.0	3.3	8.0	20.8	4.1	35.7	86.2
2/25/12 9:28	24.0	3.4	8.0	23.1	12.3	35.8	85.8
3/3/12 12:07	23.7	0.1	8.6	4.4	1.6	9.2	97.4
3/3/12 12:07	23.6	0.1	8.1	4.4	1.9	8.2	96.9
3/3/12 12:07	23.6	0.2	7.8	4.0	2.1	12.2	97.4

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 12:07	23.6	0.4	7.9	3.2	2.1	28.9	97.4
3/3/12 12:07	23.7	0.7	7.9	1.3	1.9	28.0	97.6
3/3/12 12:08	23.8	1.1	7.9	0.3	1.8	31.6	97.8
3/3/12 12:08	23.9	1.5	7.9	0.0	1.9	33.1	98.0
3/3/12 12:08	23.9	1.9	7.9	1.1	1.8	34.6	98.5
3/7/12 10:23	21.1	0.3	8.5	0.0	18.5	0.6	96.6
3/7/12 10:23	21.1	0.4	8.3	35.1	6.3	0.7	96.7
3/7/12 10:23	21.1	0.5	8.3	35.2	6.2	0.7	96.9
3/7/12 10:23	21.1	0.6	8.3	35.3	5.9	0.6	97.0
3/7/12 10:23	21.1	0.8	8.2	35.3	5.7	0.7	96.9
3/7/12 10:23	21.1	1.1	8.2	35.4	5.4	0.8	96.9
3/7/12 10:23	21.1	1.4	7.6	35.2	5.2	1.8	97.0
3/7/12 10:23	21.2	1.8	7.1	35.4	5.0	3.2	97.2
3/7/12 10:23	21.2	2.0	7.1	34.5	4.8	12.1	96.9
3/7/12 10:23	21.5	2.5	7.1	31.9	4.5	24.5	96.0
3/7/12 10:23	21.8	2.9	7.2	29.6	4.3	29.3	94.9
3/7/12 10:23	22.0	3.2	7.3	28.0	4.2	30.1	94.1
3/7/12 10:23	22.4	3.7	7.4	25.7	3.8	30.9	92.7
3/7/12 10:23	22.6	4.0	7.5	24.1	3.6	31.2	91.8
3/7/12 10:23	22.7	4.5	7.6	22.8	3.4	31.2	90.7
3/7/12 10:23	22.9	4.8	7.7	21.7	3.2	31.2	89.4
3/7/12 10:23	22.9	5.2	7.7	30.1	3.3	31.2	88.0
3/7/12 10:23	23.0	5.5	7.8	46.3	3.7	31.2	86.5
4/21/12 11:25	24.3	0.1	8.1	0.0	29.9	7.6	101.8
4/21/12 11:25	24.3	0.2	8.1	0.9	23.7	10.8	101.9
4/21/12 11:25	24.4	0.4	7.9	1.4	19.2	19.5	102.2
4/21/12 11:25	24.5	0.6	7.9	1.4	16.5	21.6	102.6
4/21/12 11:25	24.5	0.7	7.9	1.4	14.5	18.3	103.1
4/21/12 11:25	24.6	0.8	7.9	1.6	12.8	22.9	103.3
4/21/12 11:25	24.6	0.6	8.0	1.4	11.6	1.2	103.3
4/21/12 11:25	24.5	0.4	8.1	2.5	20.6	0.2	102.6
4/21/12 11:28	24.6	0.1	8.1	0.8	1.9	14.6	103.4
4/21/12 11:28	24.5	0.2	8.1	0.9	0.7	13.5	103.0
4/21/12 11:28	24.5	0.3	8.1	0.9	0.8	15.4	103.1
4/21/12 11:28	24.5	0.6	8.0	1.3	0.9	21.5	103.2
4/21/12 11:28	24.6	0.9	7.9	1.6	1.1	23.3	103.7
4/21/12 11:28	24.7	1.2	7.9	1.8	1.3	27.5	104.3
4/21/12 11:28	24.9	1.5	7.9	2.0	1.3	30.4	104.6

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
4/21/12 11:28	25.0	1.9	7.9	2.6	1.4	31.8	105.1
4/21/12 11:28	25.1	2.2	7.9	2.8	1.3	31.6	105.4
4/21/12 11:28	25.2	2.6	7.9	3.0	1.3	32.2	105.6
4/21/12 11:28	25.2	3.1	7.9	3.5	1.6	34.9	106.5
4/21/12 11:28	26.2	3.5	7.9	3.9	1.8	34.5	104.9
4/21/12 11:28	26.5	3.9	7.9	6.6	1.9	34.7	103.5
5/19/12 11:02	26.5	0.3	7.9	0.5	7.9	24.7	99.0
5/19/12 11:02	26.7	0.4	7.9	0.5	9.2	28.2	99.4
5/19/12 11:02	26.7	0.6	7.9	0.2	7.8	30.5	99.9
5/19/12 11:02	26.9	1.0	7.9	0.1	6.4	32.2	101.1
5/19/12 11:02	27.0	1.7	7.9	0.0	5.4	34.1	103.0
5/19/12 11:02	27.1	2.4	7.9	0.1	4.7	35.4	105.0
5/19/12 11:02	27.2	2.9	7.9	0.0	4.1	35.4	106.9
6/30/12 13:39	26.5	0.2	8.2	0.4	2.6	20.7	106.1
6/30/12 13:39	26.5	0.2	8.2	0.4	3.8	17.8	108.6
6/30/12 13:39	26.5	0.2	8.2	0.5	3.4	18.1	109.6
6/30/12 13:39	26.5	0.5	8.2	0.8	3.1	18.1	110.3
6/30/12 13:39	26.6	0.6	8.2	0.8	3.2	19.2	110.6
6/30/12 13:39	26.6	0.8	8.2	0.7	3.3	19.4	111.5
6/30/12 13:39	26.5	1.1	8.2	0.6	3.3	25.7	112.0
6/30/12 13:39	26.4	1.3	8.1	0.4	3.4	27.1	112.5
6/30/12 13:39	26.3	1.5	8.1	0.3	3.2	31.1	113.1
6/30/12 13:39	26.1	1.8	8.0	0.2	3.3	33.0	112.8
6/30/12 13:39	26.0	2.1	8.0	0.2	3.2	33.9	112.5
6/30/12 13:39	25.9	2.3	8.0	0.2	3.1	34.0	113.4
6/30/12 13:39	25.8	2.5	8.0	0.2	3.2	34.2	113.5
6/30/12 13:39	25.7	2.7	8.0	0.1	3.3	34.4	115.0
6/30/12 13:39	25.7	3.0	8.1	0.1	3.2	34.6	117.0
6/30/12 13:39	25.8	3.2	8.1	0.1	3.2	34.8	119.7
6/30/12 13:39	25.9	3.4	8.1	0.0	3.2	35.0	122.4
6/30/12 13:39	25.9	3.7	8.1	0.1	3.1	35.1	124.6
6/30/12 13:39	25.9	4.0	8.1	0.2	3.2	35.1	126.5
6/30/12 13:39	26.0	4.3	8.1	0.2	3.1	35.2	128.6
6/30/12 13:39	26.0	4.5	8.1	0.3	3.1	35.2	130.4
6/30/12 13:39	26.0	4.7	8.1	0.4	3.0	35.3	132.2
6/30/12 13:40	26.1	5.0	8.1	0.8	2.9	35.4	134.0
6/30/12 13:40	26.1	5.3	8.2	1.4	2.9	35.4	135.6
6/30/12 13:40	26.1	5.5	8.2	2.0	2.9	35.4	137.0

Appendix 3: (Continued) Raw water column profile data for Station 3 of Kaneohe Stream collected using a YSI 6600 Sonde.

Date/Time	Temp	Depth	pH	Turb	Chl-a	Sal	ODO
M/D/Y	C	ft		NTU	µg/L	ppt	%
6/30/12 13:40	26.2	5.7	8.2	2.5	3.5	35.5	138.0
6/30/12 13:40	26.2	5.9	8.2	6.4	4.3	35.5	139.0
6/30/12 13:40	26.2	6.2	8.2	15.4	5.1	35.4	140.0

Appendix 4: Raw water column profile data for Station 1 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a μg/L	Sal ppt	ODO %
11/4/10 14:01	22.6	0.4	8.1	10.1	2.3	2.2	96.3
11/4/10 14:01	22.6	0.6	7.9	10.0	2.4	2.7	97.1
11/4/10 14:01	22.6	0.8	7.8	10.0	2.5	3.2	97.3
12/10/10 16:07	21.9	0.0	8.4	0.1	2.6	0.4	113.2
12/10/10 16:07	21.8	0.0	8.4	0.0	2.5	0.3	114.6
12/10/10 16:08	21.8	0.0	8.4	0.0	2.5	0.2	114.7
12/10/10 16:08	21.8	0.0	8.5	0.0	2.5	0.2	114.8
12/10/10 16:08	21.8	0.0	8.5	0.0	2.5	0.2	115.0
12/10/10 16:08	21.8	0.0	8.5	0.1	2.3	0.2	115.2
2/16/11 16:32	24.0	0.2	8.6	0.2	0.9	0.0	119.4
2/16/11 16:32	23.9	0.2	8.5	0.1	1.0	0.0	120.6
2/16/11 16:32	24.0	0.2	8.4	0.1	1.0	0.1	121.0
2/16/11 16:32	24.3	0.2	8.4	0.1	0.9	0.2	120.9
2/16/11 16:33	24.5	0.3	8.3	0.1	1.1	0.2	120.7
2/16/11 16:33	24.7	0.4	8.3	0.0	1.1	0.2	120.5
3/10/11 12:22	22.3	0.3	-	0.0	9.1	0.0	127.6
3/10/11 12:22	23.2	0.3	8.2	0.9	10.2	0.1	127.7
3/10/11 12:22	24.2	0.3	8.2	0.3	9.4	0.1	126.3
3/10/11 12:22	24.6	0.4	8.2	0.2	8.4	0.1	126.0
4/5/11 14:02	32.0	0.2	8.6	0.0	2.6	0.8	130.5
4/5/11 14:03	31.9	0.2	8.6	1.0	2.2	1.0	131.6
4/5/11 14:03	31.9	0.3	8.1	1.1	2.9	-	132.1
4/5/11 14:03	31.8	0.6	8.0	8.4	3.7	-	131.3
4/5/11 14:03	31.6	1.0	8.0	16.0	4.7	-	129.0
5/22/11 13:34	29.3	0.2	8.5	0.0	1.7	0.1	133.5
5/22/11 13:34	29.3	0.2	8.5	1.4	1.8	0.1	135.3
5/22/11 13:34	29.3	0.2	8.5	1.6	1.7	0.1	137.1
5/22/11 13:34	29.3	0.2	8.5	1.3	1.9	0.1	137.4
5/22/11 13:34	29.3	0.4	8.6	1.9	1.7	0.1	138.3
6/23/11 14:10	21.9	0.3	8.3	151.6	2.5	0.1	96.6
6/23/11 14:10	21.9	0.3	8.3	148.7	3.0	0.1	96.3
6/23/11 14:10	21.9	0.3	8.3	147.6	3.1	0.1	96.1
6/23/11 14:10	21.9	0.4	8.3	146.5	3.3	0.1	95.9
6/23/11 14:10	21.9	0.5	8.3	146.1	3.4	0.1	95.8
8/27/11 14:35	31.8	0.3	8.8	2.5	3.1	2.4	111.9
8/27/11 14:35	31.8	0.3	8.9	0.9	2.1	2.4	111.8
8/27/11 14:35	31.8	0.5	8.9	1.1	2.2	3.3	111.9

Appendix 4: (Continued) Raw water column profile data for Station 1 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a μg/L	Sal ppt	ODO %
8/27/11 14:35	31.7	0.8	8.6	0.0	2.5	-	111.2
8/27/11 14:35	31.5	1.1	8.3	6.8	5.3	-	109.4
9/25/11 12:50	31.4	0.2	-	0.0	0.0	1.1	123.3
9/25/11 12:50	31.3	0.7	8.6	0.6	1.9	-	123.0
10/23/11 12:27	26.1	0.1	8.2	43.3	4.5	0.0	108.9
10/23/11 12:27	26.1	0.1	8.2	43.3	4.2	0.0	109.9
10/23/11 12:27	26.1	0.1	8.2	48.3	8.2	0.1	110.3
10/23/11 12:27	26.1	0.2	8.2	46.7	7.6	0.1	110.4
10/23/11 12:27	26.1	0.4	8.3	46.6	7.5	0.1	110.8
10/23/11 12:27	26.1	0.5	8.3	46.6	7.0	0.1	111.1
10/23/11 12:27	26.1	0.7	8.3	45.8	6.7	0.1	111.3
10/23/11 12:27	26.1	0.9	8.3	46.1	6.6	0.1	111.4
10/23/11 12:27	26.1	1.0	8.3	45.8	6.5	0.1	111.5
11/1/11 13:23	24.4	0.3	-	1208.3	4.3	0.0	106.6
11/1/11 13:23	24.3	0.3	8.4	1207.6	2.7	0.0	109.1
11/1/11 13:23	24.4	0.3	8.5	0.0	2.2	0.1	110.2
11/1/11 13:23	25.6	0.3	8.5	1.2	2.0	0.1	109.5
11/1/11 13:23	25.6	0.3	8.6	0.5	2.2	0.1	110.6
11/1/11 13:23	25.7	0.3	8.7	0.4	2.0	0.1	111.5
11/1/11 13:23	25.7	0.3	8.7	0.4	1.9	0.1	112.6
1/28/12 12:24	27.1	0.4	-	0.0	1.8	0.1	132.8
2/25/12 12:30	25.0	0.2	-	0.0	1.1	0.0	104.3
2/25/12 12:30	25.0	0.2	-	0.0	2.8	0.0	111.7
2/25/12 12:30	25.0	0.2	-	10.5	3.7	0.1	113.2
2/25/12 12:30	27.0	0.2	-	6.7	3.8	0.1	113.6
2/25/12 12:30	27.2	0.2	-	7.4	4.1	0.1	115.6
2/25/12 12:30	27.2	0.2	-	7.0	4.3	0.1	117.7
2/25/12 12:30	27.3	0.2	-	7.5	4.2	0.1	119.5
3/3/12 9:22	22.6	0.2	8.1	0.8	0.7	0.0	116.0
3/3/12 9:23	22.5	0.2	8.1	0.8	0.7	0.0	117.4
3/3/12 9:23	22.5	0.2	8.1	0.8	0.0	0.1	117.9
3/3/12 9:23	23.6	0.2	8.2	0.0	0.3	0.1	116.8
3/3/12 9:23	23.7	0.2	8.2	0.0	0.2	0.1	116.9
3/3/12 9:23	23.7	0.2	8.3	0.0	0.4	0.1	117.2
3/3/12 9:23	23.8	0.2	8.3	0.4	0.4	0.1	117.5
3/3/12 9:23	23.8	0.2	8.4	0.3	0.4	0.1	118.0
3/3/12 9:23	23.8	0.2	8.4	0.3	0.4	0.1	118.2

Appendix 4: (Continued) Raw water column profile data for Station 1 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 9:23	23.8	0.3	8.4	0.4	0.6	0.1	118.3
3/3/12 9:23	23.8	0.3	8.4	0.3	0.6	0.1	118.3
3/3/12 9:23	23.8	0.4	8.4	0.3	0.6	0.1	118.4
3/3/12 9:23	23.8	0.4	8.4	0.3	0.6	0.1	118.4
3/3/12 9:23	23.8	0.5	8.4	0.3	0.5	0.1	118.5
3/7/12 9:03	21.2	0.3	7.6	327.1	14.7	0.1	101.9
3/7/12 9:03	21.4	0.3	7.6	0.0	22.2	0.0	101.9
3/7/12 9:03	21.4	0.3	7.6	196.3	23.1	0.1	101.9
3/7/12 9:03	21.5	0.3	7.6	291.2	23.3	0.1	102.0
3/7/12 9:03	21.5	0.3	7.6	72.8	21.6	0.1	101.9
3/7/12 9:04	21.5	0.3	7.6	21.5	20.1	0.1	102.0
3/7/12 9:04	21.5	0.3	7.6	24.4	18.6	0.1	102.0
3/7/12 9:04	21.5	0.4	7.6	23.0	17.2	0.1	102.0
3/7/12 9:04	21.5	0.4	7.6	22.8	16.0	0.1	102.2
3/7/12 9:04	21.5	0.4	7.6	22.5	14.8	0.1	102.2
4/21/12 9:40	26.3	0.3	8.4	0.1	1.8	0.1	124.3
4/21/12 9:40	26.3	0.3	8.5	0.1	1.5	0.1	125.9
4/21/12 9:40	26.3	0.3	8.5	0.2	1.9	0.1	126.5
4/21/12 9:40	26.3	0.3	8.5	0.0	1.8	0.1	127.1
4/21/12 9:41	26.3	0.4	8.5	0.0	2.0	0.1	127.5
4/21/12 9:41	26.3	0.3	8.5	0.6	2.0	0.1	128.0
4/21/12 9:41	26.3	0.3	8.5	1.1	2.1	0.1	128.3
4/21/12 9:41	26.3	0.4	8.5	0.8	2.2	0.1	128.6
4/21/12 9:41	26.3	0.4	8.5	0.7	2.1	0.1	128.9
5/19/12 11:23	25.3	0.3	8.0	0.2	1.8	-	111.2
5/19/12 11:23	25.3	0.3	8.0	0.0	1.1	-	114.0
5/19/12 11:23	25.3	0.3	8.0	0.0	0.5	-	114.7
6/30/12 13:05	25.6	0.2	8.1	0.0	6.0	-	106.0
6/30/12 13:05	25.5	0.2	8.1	0.0	6.0	-	106.0
6/30/12 13:05	25.5	0.2	8.1	0.0	6.0	-	106.0
6/30/12 13:05	25.5	0.4	8.1	0.0	6.0	-	106.0

Appendix 5: Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 13:53	23.1	0.3	8.5	13.3	2.3	5.1	97.3
11/4/10 13:53	22.9	0.3	8.4	13.0	2.4	4.7	97.3
11/4/10 13:53	22.8	0.3	8.4	12.7	2.4	4.5	97.2
11/4/10 13:55	23.1	0.6	8.2	24.0	7.0	9.0	44.8
11/4/10 13:55	23.0	0.6	8.2	18.0	6.5	7.9	53.9
11/4/10 13:55	23.0	0.5	8.2	15.3	6.1	7.8	59.4
11/4/10 13:55	22.9	0.6	8.2	14.4	5.7	7.7	64.4
11/4/10 13:55	22.9	0.7	8.2	17.4	5.4	7.6	68.8
11/4/10 13:55	22.9	0.8	8.1	16.7	5.2	7.5	72.6
11/4/10 13:55	22.9	0.9	8.1	16.3	4.9	7.6	76.0
11/4/10 13:55	22.9	1.1	8.1	15.9	4.7	7.8	78.8
11/4/10 13:55	22.9	1.3	8.0	15.6	4.5	8.9	81.2
11/4/10 13:55	23.0	1.5	8.0	15.2	4.3	12.4	83.1
11/4/10 13:55	23.1	1.8	7.9	14.9	4.3	20.7	84.4
11/4/10 13:55	23.2	2.1	7.9	14.5	4.3	19.6	85.2
11/4/10 13:55	23.4	2.4	7.9	14.3	4.2	23.4	85.7
11/4/10 13:55	23.5	2.8	7.9	14.2	4.2	27.3	86.1
11/4/10 13:55	23.6	3.3	7.9	16.2	4.2	26.9	86.6
11/4/10 13:55	23.7	3.7	7.9	17.7	4.4	27.9	87.3
11/4/10 13:55	23.8	4.1	7.9	21.9	4.6	29.6	87.4
11/4/10 13:55	24.1	4.4	7.9	21.8	4.8	31.2	85.9
11/4/10 13:55	25.1	4.8	7.9	22.3	4.9	29.3	81.9
11/4/10 13:55	25.2	5.1	7.9	23.4	4.9	30.0	78.0
11/4/10 13:55	25.2	5.4	7.8	25.1	5.0	31.1	73.8
11/4/10 13:55	25.3	5.6	7.8	23.4	5.2	31.6	68.2
11/4/10 13:55	25.4	5.9	7.8	21.4	5.5	30.6	62.9
11/4/10 13:55	25.5	6.0	7.8	19.6	5.7	30.5	59.3
12/10/10 16:21	23.6	0.0	8.1	0.0	5.4	28.3	94.1
12/10/10 16:21	23.5	0.0	8.1	0.0	3.6	23.9	92.8
12/10/10 16:21	23.5	0.0	8.1	1.3	3.2	25.2	92.4
12/10/10 16:21	23.4	0.1	8.1	1.0	3.3	26.2	92.1
12/10/10 16:21	23.5	0.4	8.1	1.1	3.4	27.0	91.8
12/10/10 16:21	23.5	0.6	8.1	1.6	3.3	29.9	91.5
12/10/10 16:21	23.7	1.0	8.1	1.9	3.6	30.5	91.1
12/10/10 16:21	23.8	1.4	8.1	3.1	3.7	33.6	90.4
12/10/10 16:21	24.0	1.7	8.1	3.2	3.9	34.2	89.9
12/10/10 16:21	24.1	2.0	8.1	3.3	3.9	34.5	89.2
12/10/10 16:21	24.3	2.3	8.1	3.7	3.8	34.5	88.5

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/10/10 16:21	24.4	2.8	8.1	4.1	3.7	34.5	87.8
12/10/10 16:21	24.4	3.2	8.1	4.7	3.7	34.5	87.3
12/10/10 16:21	24.4	3.7	8.1	5.3	3.7	34.5	86.9
12/10/10 16:21	24.5	3.9	8.1	5.8	3.6	34.5	86.5
12/10/10 16:21	24.5	4.2	8.1	6.3	3.5	34.6	86.1
12/10/10 16:21	24.5	4.5	8.1	7.1	3.6	34.6	85.8
12/10/10 16:21	24.5	4.7	8.1	8.3	3.5	34.6	85.4
12/10/10 16:21	24.5	5.1	8.1	9.1	3.4	34.6	85.1
2/16/11 13:15	26.0	0.2	8.0	3.1	1.8	15.8	98.3
2/16/11 13:15	26.0	0.2	7.9	1.4	1.7	15.1	96.3
2/16/11 13:15	26.0	0.3	7.9	1.8	1.2	14.0	95.8
2/16/11 13:15	25.9	0.4	7.9	1.2	1.1	17.0	96.0
2/16/11 13:15	26.0	0.6	7.8	0.6	1.2	21.2	95.4
2/16/11 13:15	26.0	0.9	7.8	0.3	1.3	26.2	93.7
2/16/11 13:15	26.0	1.2	7.8	0.1	1.4	28.7	91.5
2/16/11 13:15	25.9	1.4	7.8	0.0	1.3	28.9	90.1
2/16/11 13:15	25.7	1.6	7.8	0.0	1.3	29.2	89.5
2/16/11 13:15	25.5	1.9	7.8	0.1	1.4	29.7	89.0
2/16/11 13:15	25.2	2.2	7.8	0.3	1.4	30.1	88.8
2/16/11 13:15	25.1	2.5	7.8	0.4	1.4	30.4	88.8
2/16/11 13:15	25.0	2.8	7.9	0.5	1.4	30.7	88.9
2/16/11 13:15	24.9	3.2	7.9	0.7	1.6	30.9	88.9
2/16/11 13:15	24.9	3.5	7.9	1.0	1.9	31.0	89.0
2/16/11 13:15	24.8	3.9	7.9	1.3	2.1	31.2	88.9
2/16/11 13:15	24.8	4.1	7.9	1.6	2.5	31.3	89.0
2/16/11 13:15	24.8	4.4	7.9	1.9	2.6	31.4	88.7
2/16/11 13:15	24.8	4.6	7.9	2.5	2.8	31.4	87.8
2/16/11 13:15	24.8	5.0	7.9	10.1	3.3	31.5	87.1
2/16/11 13:15	24.8	5.2	7.9	10.3	3.6	31.5	86.7
2/16/11 13:15	24.8	5.4	7.9	10.4	3.7	31.6	86.8
2/16/11 13:15	24.8	5.5	7.9	10.3	3.8	31.6	85.8
2/16/11 13:15	24.8	5.7	7.9	10.4	4.0	31.6	84.8
2/16/11 13:15	24.8	5.8	7.9	10.8	5.8	31.6	84.0
2/16/11 13:15	24.8	5.9	7.9	12.7	6.2	31.6	83.4
2/16/11 13:16	24.8	6.0	7.9	17.5	6.0	31.6	83.0
2/16/11 13:16	24.8	6.1	7.9	22.1	7.1	31.7	82.7
2/16/11 13:16	24.8	6.1	7.9	35.8	7.9	31.7	82.9
2/16/11 13:16	24.8	6.2	7.9	38.7	8.5	31.7	83.2

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/16/11 13:16	24.8	6.2	7.9	38.3	9.6	31.7	83.5
2/16/11 13:16	24.8	6.2	7.9	39.1	10.1	31.7	83.3
2/16/11 13:16	24.8	6.2	7.9	39.6	10.0	31.7	83.4
3/4/11 11:23	24.1	0.1	7.9	3.4	1.3	8.1	100.3
3/4/11 11:23	24.1	0.1	7.9	3.6	1.2	8.5	100.2
3/4/11 11:23	24.1	0.1	7.8	3.6	1.3	9.8	100.3
3/4/11 11:24	24.1	0.1	7.8	3.5	1.3	19.9	100.4
3/4/11 11:24	24.2	0.2	7.7	3.0	1.5	20.8	100.1
3/4/11 11:24	24.2	0.3	7.7	2.6	1.6	24.8	99.3
3/4/11 11:24	24.3	0.3	7.7	2.3	1.7	26.4	98.4
3/4/11 11:24	24.3	0.4	7.7	1.9	2.0	27.6	97.7
3/4/11 11:24	24.4	0.6	7.7	1.7	2.0	27.8	96.5
3/4/11 11:24	24.4	0.7	7.7	1.6	2.1	27.8	95.7
3/4/11 11:24	24.4	0.8	7.8	1.1	2.4	29.4	94.8
3/4/11 11:24	24.4	1.0	7.8	1.1	2.5	29.8	94.0
3/4/11 11:24	24.4	1.2	7.8	0.8	2.4	30.0	93.1
3/4/11 11:24	24.4	1.4	7.8	0.7	2.4	30.3	92.4
3/4/11 11:24	24.4	1.7	7.9	0.6	2.4	31.2	92.0
3/4/11 11:24	24.4	1.9	7.9	0.4	2.5	31.3	91.4
3/4/11 11:24	24.4	2.1	7.9	0.2	2.5	31.4	91.5
3/4/11 11:24	24.4	2.4	7.9	0.2	2.6	31.5	91.4
3/4/11 11:24	24.4	2.7	7.9	0.0	2.8	31.6	90.9
3/4/11 11:24	24.4	3.0	7.9	0.3	2.7	31.7	91.0
3/4/11 11:24	24.4	3.6	7.9	0.4	2.9	31.9	91.1
3/4/11 11:24	24.4	4.0	7.9	0.6	3.0	31.9	90.8
3/4/11 11:24	24.4	4.5	7.9	0.9	2.9	32.0	90.1
3/4/11 11:24	24.4	4.9	7.9	0.9	2.7	32.1	89.9
3/4/11 11:24	24.4	5.2	7.9	0.9	2.6	32.1	89.9
3/4/11 11:24	24.4	5.5	7.9	4.2	2.6	32.1	89.5
3/10/11 9:58	21.9	0.3	8.8	0.5	0.8	0.1	94.1
3/10/11 9:58	21.8	0.3	8.9	0.0	0.6	0.1	95.6
3/10/11 9:58	21.8	0.3	8.5	0.2	0.6	0.1	95.9
3/10/11 9:58	21.9	0.3	8.4	0.1	0.7	0.5	96.0
3/10/11 9:58	21.9	0.3	8.4	0.1	0.7	0.6	95.5
3/10/11 9:58	21.9	0.5	8.4	0.1	0.6	0.5	95.1
3/10/11 9:58	21.9	0.6	8.4	0.1	0.7	0.5	94.9
3/10/11 9:58	21.9	0.9	8.3	0.1	0.7	0.4	94.9
3/10/11 9:58	21.9	1.2	8.3	0.0	0.8	0.4	94.7

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/10/11 9:58	21.9	1.5	8.3	0.1	0.8	0.5	94.2
3/10/11 9:58	21.9	1.8	8.3	0.3	1.0	0.6	94.1
3/10/11 9:58	22.0	2.0	7.6	0.6	1.2	3.4	94.2
3/10/11 9:58	22.1	2.3	7.3	0.9	1.3	6.4	93.7
3/10/11 9:58	22.4	2.6	7.3	0.7	1.6	8.8	92.4
3/10/11 9:58	22.6	2.9	7.3	0.7	1.8	11.5	90.2
3/10/11 9:59	22.8	3.1	7.3	0.6	1.8	11.9	87.5
3/10/11 9:59	23.0	3.4	7.3	0.6	2.0	14.4	84.8
3/10/11 9:59	23.1	3.7	7.3	1.3	2.2	15.1	82.8
4/5/11 11:41	25.5	0.3	8.3	0.3	1.5	0.0	98.5
4/5/11 11:41	25.5	0.3	8.3	0.3	1.5	0.1	98.5
4/5/11 11:41	25.5	0.4	8.2	0.3	1.5	7.5	98.4
4/5/11 11:41	25.7	0.7	8.1	0.3	1.5	22.1	98.2
4/5/11 11:41	26.9	1.1	8.0	0.1	1.5	27.1	96.5
4/5/11 11:41	27.5	1.6	7.9	0.1	1.5	32.2	95.6
4/5/11 11:41	27.6	2.2	7.8	0.1	1.5	33.0	95.5
4/5/11 11:41	27.6	2.8	7.8	0.1	1.5	33.1	95.4
4/5/11 11:41	27.6	3.4	7.8	0.0	1.5	33.2	95.4
4/5/11 11:41	27.7	4.0	7.8	0.0	1.5	33.3	95.3
4/5/11 11:41	27.8	4.7	7.8	0.0	1.5	33.6	95.2
4/5/11 11:41	27.8	5.2	7.8	0.0	1.5	33.7	95.1
4/5/11 11:41	27.8	5.7	7.8	0.0	1.5	33.9	95.1
4/5/11 11:41	27.8	6.0	7.7	0.0	1.5	34.1	95.1
4/5/11 11:41	27.9	6.2	7.7	0.0	1.5	34.1	95.0
5/22/11 10:20	24.0	0.2	8.4	0.3	1.0	0.0	100.7
5/22/11 10:20	24.2	0.2	8.3	0.3	0.9	4.6	99.9
5/22/11 10:20	24.2	0.2	8.3	0.3	0.9	4.6	99.2
5/22/11 10:20	24.2	0.4	8.2	0.2	0.9	4.6	99.1
5/22/11 10:20	24.3	0.6	8.1	0.1	0.9	7.4	99.3
5/22/11 10:20	26.1	1.0	7.6	0.0	1.3	27.5	99.8
5/22/11 10:20	28.1	1.6	7.5	0.0	2.0	35.9	99.4
5/22/11 10:20	28.7	2.4	7.5	1.7	3.2	36.2	99.7
5/22/11 10:20	28.7	3.1	7.5	10.4	4.7	36.3	99.5
5/22/11 10:20	28.7	3.7	7.5	20.7	6.0	35.2	97.9
5/22/11 10:20	28.7	4.2	7.5	21.4	7.2	35.1	95.9
5/22/11 10:20	28.6	4.4	7.5	41.4	8.5	35.2	93.9
5/22/11 10:20	28.6	4.6	7.5	64.3	9.7	35.2	92.0
5/22/11 10:20	28.6	4.6	7.5	75.2	10.5	35.3	90.5

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a μg/L	Sal ppt	ODO %
6/23/11 14:10	21.9	0.3	8.3	151.6	2.5	0.1	96.6
6/23/11 14:10	21.9	0.3	8.3	148.7	3.0	0.1	96.3
6/23/11 14:10	21.9	0.3	8.3	147.6	3.1	0.1	96.1
6/23/11 14:10	21.9	0.4	8.3	146.5	3.3	0.1	95.9
6/23/11 14:10	21.9	0.5	8.3	146.1	3.4	0.1	95.8
8/27/11 11:29	27.6	0.2	7.6	0.0	3.2	9.8	101.5
8/27/11 11:29	27.6	0.2	7.7	0.0	3.8	10.2	101.4
8/27/11 11:29	27.6	0.2	7.7	0.1	4.0	10.1	101.6
8/27/11 11:29	27.6	0.4	7.7	0.1	4.0	10.3	101.5
8/27/11 11:29	27.6	0.6	7.6	0.2	3.8	15.4	101.7
8/27/11 11:29	27.6	0.9	7.6	0.5	3.6	17.1	101.6
8/27/11 11:29	27.6	1.2	7.6	0.7	3.5	19.0	101.7
8/27/11 11:29	27.6	1.6	7.5	1.0	3.6	21.6	102.0
8/27/11 11:29	27.7	2.0	7.5	1.3	3.5	23.9	101.9
8/27/11 11:29	27.8	2.4	7.5	1.5	3.5	24.5	101.7
8/27/11 11:29	27.9	2.8	7.5	1.8	3.3	25.0	101.7
8/27/11 11:29	27.9	3.0	7.6	2.0	3.3	25.3	101.6
8/27/11 11:29	28.0	3.4	7.6	2.3	3.2	25.4	101.1
8/27/11 11:29	28.0	3.9	7.6	2.6	3.5	25.5	100.8
8/27/11 11:29	28.1	4.3	7.6	2.9	3.8	26.4	100.2
8/27/11 11:29	28.2	4.8	7.6	3.1	4.3	27.6	99.4
8/27/11 11:29	28.5	5.3	7.6	3.8	5.1	27.8	97.9
8/27/11 11:29	28.7	5.7	7.6	4.3	5.8	27.8	95.7
9/25/11 11:10	28.1	0.2	8.6	0.0	51.1	23.4	95.6
9/25/11 11:10	28.6	1.2	8.6	0.7	29.6	29.6	93.3
9/25/11 11:10	28.3	3.3	8.6	1.7	20.9	33.3	88.5
9/25/11 11:10	28.1	5.5	8.6	2.2	14.4	34.1	93.5
9/25/11 11:10	28.1	6.8	8.7	28.1	9.9	34.4	96.3
10/23/11 9:58	24.6	0.1	8.1	13.4	1.4	0.9	96.0
10/23/11 9:58	24.6	0.1	8.0	13.4	2.0	5.6	96.7
10/23/11 9:59	24.6	0.1	8.0	6.0	2.1	5.8	96.9
10/23/11 9:59	24.7	0.3	7.8	6.9	2.7	16.4	97.5
10/23/11 9:59	24.9	0.5	7.8	4.8	3.1	27.7	97.3
10/23/11 9:59	25.1	0.8	7.8	3.2	3.0	31.8	96.2
10/23/11 9:59	25.3	1.2	7.8	2.2	2.9	36.3	94.8
10/23/11 9:59	25.4	1.5	7.8	1.6	3.1	36.6	93.3
10/23/11 9:59	25.5	1.8	7.8	1.2	3.0	36.6	91.7
10/23/11 9:59	25.6	2.1	7.8	0.9	3.1	37.5	89.8

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a μg/L	Sal ppt	ODO %
10/23/11 9:59	25.8	2.4	7.8	0.8	3.1	37.7	87.6
10/23/11 9:59	25.8	2.8	7.8	0.8	2.9	38.0	85.5
10/23/11 9:59	25.9	3.1	7.9	0.6	2.9	38.1	83.8
10/23/11 9:59	25.9	3.4	7.9	0.5	2.9	38.1	82.5
10/23/11 9:59	25.9	3.7	7.9	0.4	2.8	38.2	81.5
10/23/11 9:59	25.9	4.0	7.9	0.2	2.7	38.2	80.9
10/23/11 9:59	25.9	4.3	7.9	0.3	2.7	38.3	80.7
10/23/11 9:59	26.0	4.6	7.9	0.2	2.7	38.4	80.6
10/23/11 9:59	26.0	4.9	7.9	0.2	2.6	38.5	80.2
10/23/11 9:59	26.0	5.0	7.9	0.1	2.7	38.5	79.7
10/23/11 9:59	26.0	5.3	7.9	0.0	2.7	38.6	79.4
10/23/11 9:59	26.0	5.6	7.9	0.0	2.7	38.6	79.1
10/23/11 9:59	26.0	5.9	7.9	0.3	2.9	38.7	78.7
10/23/11 9:59	26.1	6.0	7.9	0.5	2.9	38.7	77.4
10/23/11 9:59	26.1	6.4	7.9	1.2	3.0	38.8	75.9
10/23/11 9:59	26.2	6.7	7.9	2.2	3.2	38.8	74.0
11/1/11 10:44	24.1	0.3	7.8	14.7	0.0	0.1	96.3
11/1/11 10:44	24.1	0.3	7.7	14.6	1.7	0.1	96.2
11/1/11 10:44	24.1	0.3	7.7	15.4	1.8	4.9	96.3
11/1/11 10:44	24.1	0.4	7.7	15.7	2.1	5.0	96.6
11/1/11 10:44	24.1	0.6	7.6	14.2	2.2	7.2	96.5
11/1/11 10:44	24.3	0.9	7.5	11.0	2.6	28.2	96.8
11/1/11 10:44	25.6	1.2	7.5	8.5	2.9	27.1	94.5
11/1/11 10:44	25.8	1.5	7.6	6.5	3.0	32.0	92.5
11/1/11 10:44	25.9	2.0	7.7	4.9	2.9	33.0	90.2
11/1/11 10:44	25.9	2.4	7.7	3.6	2.8	32.8	87.9
11/1/11 10:44	25.9	2.9	7.8	2.7	2.9	33.2	86.0
11/1/11 10:44	25.9	3.3	7.8	2.2	2.7	33.3	84.8
11/1/11 10:44	25.9	3.7	7.8	1.8	2.7	33.4	83.6
11/1/11 10:44	25.8	4.2	7.8	1.1	2.6	33.5	82.6
11/1/11 10:44	25.8	4.7	7.8	0.5	2.6	33.6	81.9
11/1/11 10:44	25.8	5.1	7.9	0.0	2.5	33.7	81.4
11/1/11 10:44	25.8	5.6	7.9	2.0	2.8	33.8	80.9
11/1/11 10:44	25.8	6.0	7.9	4.0	3.8	33.8	80.4
11/1/11 10:44	25.8	6.4	7.9	4.2	4.4	31.3	79.9
11/1/11 10:44	25.8	6.6	7.9	19.1	4.9	31.4	79.5
12/14/11 10:57	23.3	0.3	7.7	136.9	24.0	0.1	93.9
12/14/11 10:57	23.4	0.3	7.7	121.8	48.3	0.1	94.0

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/14/11 10:57	23.4	0.3	7.7	0.0	46.6	8.7	94.7
12/14/11 10:57	23.3	0.3	7.7	0.1	40.4	8.8	94.9
12/14/11 10:57	23.2	0.4	7.6	0.0	35.7	11.8	95.0
12/14/11 10:57	23.2	0.7	7.6	0.1	32.0	19.4	95.0
12/14/11 10:57	23.3	0.9	7.5	0.1	29.1	22.1	94.3
12/14/11 10:57	23.4	1.1	7.5	0.1	26.6	24.9	93.0
12/14/11 10:57	23.6	1.4	7.5	0.1	24.5	27.6	90.4
12/14/11 10:57	23.7	1.6	7.5	0.4	22.8	29.0	87.4
12/14/11 10:57	23.7	1.9	7.6	0.6	21.2	30.1	84.4
12/14/11 10:57	23.8	2.2	7.6	0.8	19.5	31.1	81.9
12/14/11 10:58	23.4	0.3	7.9	2.2	6.1	0.2	81.9
12/14/11 10:58	23.3	0.3	7.9	2.0	5.3	0.8	84.0
12/14/11 10:58	23.2	0.3	7.8	1.8	4.9	8.4	85.0
12/14/11 10:58	23.2	0.5	7.7	1.6	4.5	12.9	86.1
12/14/11 10:58	23.2	0.8	7.6	1.5	4.2	23.2	86.9
12/14/11 10:58	23.4	1.2	7.6	1.5	4.0	24.8	86.7
12/14/11 10:58	23.5	1.6	7.6	1.6	3.8	28.1	85.5
12/14/11 10:58	23.6	2.0	7.6	1.8	3.6	28.8	83.6
12/14/11 10:58	23.7	2.4	7.7	2.0	3.7	31.9	81.7
12/14/11 10:58	23.8	2.9	7.7	2.3	3.7	32.5	80.4
12/14/11 10:58	23.8	3.4	7.8	2.5	3.3	32.5	79.6
1/28/12 9:32	23.0	0.3	7.9	0.3	0.0	0.0	96.7
1/28/12 9:32	22.9	0.3	7.9	0.3	0.0	0.0	96.8
1/28/12 9:32	22.9	0.3	7.9	0.3	0.0	14.2	96.8
1/28/12 9:33	23.0	0.3	7.9	0.3	0.0	14.3	96.8
1/28/12 9:33	23.0	0.4	7.9	0.3	0.0	15.8	96.7
1/28/12 9:33	24.1	0.5	7.8	0.2	0.0	17.3	95.1
1/28/12 9:33	25.4	0.7	7.8	0.1	0.0	24.8	93.3
1/28/12 9:33	25.7	0.9	7.8	0.1	0.0	25.1	92.8
1/28/12 9:33	25.9	1.1	7.8	0.1	0.0	29.8	92.5
1/28/12 9:33	26.1	1.3	7.8	0.1	0.0	30.9	92.3
1/28/12 9:33	26.4	1.5	7.8	0.0	0.0	31.6	92.0
1/28/12 9:33	26.6	1.7	7.8	0.0	0.0	32.6	91.7
1/28/12 9:33	26.7	1.9	7.8	0.0	0.0	33.3	91.5
1/28/12 9:33	26.8	2.1	7.9	0.0	0.0	33.9	91.4
1/28/12 9:33	26.7	2.4	7.9	0.0	0.0	34.0	91.5
1/28/12 9:33	26.5	2.8	7.9	0.0	5.1	34.1	91.8
1/28/12 9:33	26.3	3.0	7.9	3.9	5.9	34.1	88.5

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
1/28/12 9:33	26.2	3.2	7.9	3.9	5.1	34.2	88.2
1/28/12 9:33	26.0	3.4	7.9	3.9	5.8	34.2	88.0
1/28/12 9:33	25.9	3.7	7.9	3.9	5.9	34.3	87.5
1/28/12 9:33	25.9	4.0	7.9	3.9	6.3	34.4	86.6
1/28/12 9:33	25.8	4.2	7.9	7.1	6.8	34.5	85.5
1/28/12 9:33	25.8	4.5	7.9	7.1	6.8	34.5	84.3
1/28/12 9:33	25.7	4.6	7.9	7.9	7.2	34.6	83.0
1/28/12 9:33	25.7	4.8	7.9	9.1	7.8	34.6	81.7
1/28/12 9:33	25.7	4.9	7.9	9.7	13.6	34.7	80.4
1/28/12 9:33	25.7	5.0	7.9	11.4	12.5	34.7	79.2
1/28/12 9:33	25.7	5.1	7.9	28.9	12.4	34.6	78.2
1/28/12 9:33	25.7	5.2	7.9	37.4	11.6	31.3	77.5
1/28/12 9:33	25.7	5.3	7.9	41.3	10.8	31.5	76.8
1/28/12 9:33	25.7	5.4	7.9	40.7	10.0	31.4	76.2
1/28/12 9:33	25.7	5.5	7.9	39.2	9.3	31.4	75.7
2/25/12 10:20	24.1	0.3	8.0	0.0	4.1	28.5	94.7
2/25/12 10:20	24.1	0.3	8.0	0.0	4.1	28.4	94.7
2/25/12 10:20	24.1	0.3	8.0	0.0	4.1	28.8	94.7
2/25/12 10:20	24.2	0.4	8.0	0.0	4.1	30.0	94.7
2/25/12 10:20	24.3	0.7	8.0	0.0	4.1	31.3	94.5
2/25/12 10:20	24.4	0.9	8.0	0.0	4.1	32.2	94.4
2/25/12 10:20	24.4	1.1	8.0	0.0	4.1	32.8	94.3
2/25/12 10:20	24.5	1.3	8.0	0.0	4.1	32.6	94.1
2/25/12 10:20	24.6	1.6	8.0	0.0	4.1	33.8	94.0
2/25/12 10:20	24.7	1.8	8.0	0.0	4.1	34.2	93.9
2/25/12 10:20	24.8	2.1	8.0	0.0	4.1	34.0	93.8
2/25/12 10:20	24.8	2.4	8.1	0.0	4.1	34.8	93.8
2/25/12 10:20	24.7	2.6	8.1	0.0	4.1	34.9	93.9
2/25/12 10:20	24.7	2.9	8.1	0.0	4.1	35.0	94.0
2/25/12 10:20	24.6	3.0	8.1	0.0	17.5	35.1	94.0
2/25/12 10:20	24.5	3.3	8.1	8.3	10.9	35.2	95.2
2/25/12 10:20	24.5	3.5	8.1	8.3	10.1	35.3	95.0
2/25/12 10:20	24.5	3.7	8.1	8.3	10.2	35.4	94.6
2/25/12 10:20	24.4	3.9	8.1	8.3	10.5	35.4	94.2
2/25/12 10:20	24.4	4.1	8.1	4.1	10.5	35.4	93.8
3/3/12 11:03	23.2	0.2	8.3	1.8	0.0	5.8	94.8
3/3/12 11:03	23.2	0.2	8.1	1.8	0.9	7.7	95.0
3/3/12 11:03	23.2	0.3	8.0	1.7	0.9	9.3	95.1

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 11:03	23.2	0.5	8.0	1.1	0.8	10.2	95.2
3/3/12 11:03	23.2	0.6	7.9	0.5	1.2	19.7	95.3
3/3/12 11:03	23.2	0.8	7.8	0.0	1.4	24.2	95.2
3/3/12 11:03	23.2	1.1	7.8	0.1	1.5	30.5	94.7
3/3/12 11:03	23.2	1.4	7.8	0.2	1.5	30.2	94.6
3/3/12 11:03	23.3	1.6	7.9	0.3	1.5	30.9	94.2
3/3/12 11:03	23.3	1.9	7.9	0.2	1.5	30.8	93.9
3/3/12 11:03	23.3	2.2	7.9	0.3	1.6	31.1	93.6
3/3/12 11:03	23.3	2.4	7.9	0.6	1.6	31.5	93.3
3/3/12 11:03	23.4	2.7	7.9	0.7	1.6	31.6	92.9
3/3/12 11:03	23.4	3.1	7.9	0.7	1.7	31.8	92.6
3/3/12 11:03	23.5	3.4	7.9	0.9	1.9	31.9	92.2
3/3/12 11:04	23.5	3.7	7.9	1.5	2.0	32.0	91.5
3/3/12 11:04	23.5	4.0	7.9	3.1	2.1	32.2	90.5
3/3/12 11:04	23.6	4.4	7.9	5.4	2.2	32.4	89.0
3/3/12 11:04	23.7	4.7	7.9	9.1	2.4	32.6	87.2
3/7/12 11:51	21.9	0.3	8.2	2.3	2.4	0.6	99.2
3/7/12 11:51	22.0	0.3	8.1	2.9	1.1	0.8	98.7
3/7/12 11:51	22.0	0.4	8.1	3.1	1.3	3.3	98.6
3/7/12 11:51	22.0	0.7	8.1	3.2	1.4	3.3	98.5
3/7/12 11:51	22.1	1.1	8.0	2.8	1.4	3.3	98.4
3/7/12 11:51	22.1	1.5	7.9	2.6	1.5	4.8	98.3
3/7/12 11:51	22.1	1.9	7.3	1.6	1.6	20.2	98.7
3/7/12 11:51	22.3	2.4	7.3	0.5	1.6	26.4	98.2
3/7/12 11:51	22.6	2.9	7.4	0.0	1.4	29.3	97.1
3/7/12 11:51	22.9	3.3	7.4	0.2	1.4	31.3	95.5
3/7/12 11:51	23.0	3.9	7.5	0.1	1.5	31.4	93.9
3/7/12 11:51	23.1	4.4	7.6	1.3	1.6	31.5	92.4
4/21/12 13:09	24.8	0.1	8.3	5.9	35.9	0.2	105.6
4/21/12 13:09	24.9	0.1	8.2	0.1	13.2	4.1	107.5
4/21/12 13:09	25.0	0.1	8.2	0.3	11.2	5.6	107.7
4/21/12 13:09	25.1	0.3	8.2	0.0	10.1	6.0	108.0
4/21/12 13:09	25.2	0.5	8.1	0.0	9.1	6.8	108.1
4/21/12 13:09	25.2	0.8	8.0	0.3	8.4	9.4	108.4
4/21/12 13:09	25.2	1.1	7.9	1.4	8.3	10.4	109.7
4/21/12 13:09	25.4	1.4	7.9	2.1	8.0	17.1	110.8
4/21/12 13:09	25.6	1.8	7.8	2.8	7.6	19.3	111.2
4/21/12 13:09	25.7	2.1	7.8	3.3	7.3	22.0	111.5

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
4/21/12 13:09	25.8	2.4	7.8	3.8	7.1	22.5	111.2
4/21/12 13:09	25.8	2.9	7.8	4.2	7.1	23.7	110.6
4/21/12 13:09	25.9	3.4	7.8	4.8	7.1	26.4	110.4
4/21/12 13:09	26.1	4.0	7.8	5.4	7.4	27.2	109.6
4/21/12 13:09	26.4	4.4	7.8	5.4	7.8	28.3	108.4
4/21/12 13:09	26.5	4.9	7.8	5.3	8.1	28.8	106.7
4/21/12 13:09	26.5	5.3	7.7	5.3	8.6	29.3	104.2
4/21/12 13:09	26.5	5.7	7.7	5.5	9.0	29.6	101.1
4/21/12 13:10	26.5	6.0	7.7	5.7	9.4	29.6	97.8
4/21/12 13:10	26.4	6.3	7.7	6.4	9.8	29.6	94.6
5/19/12 12:14	27.5	0.3	8.1	0.3	4.6	5.8	105.1
5/19/12 12:14	27.5	0.3	8.1	0.3	4.0	8.5	105.5
5/19/12 12:14	27.5	0.3	8.1	0.0	4.5	14.4	105.7
5/19/12 12:14	27.5	0.5	8.0	0.0	4.6	16.3	105.9
5/19/12 12:14	27.6	0.9	7.9	0.3	4.1	23.6	106.6
5/19/12 12:14	27.8	1.1	7.8	0.3	3.9	25.4	106.6
5/19/12 12:14	27.9	1.2	7.8	0.3	3.8	28.0	106.1
5/19/12 12:14	28.0	1.6	7.8	0.7	3.9	31.0	105.6
5/19/12 12:14	28.1	2.1	7.8	1.0	3.6	31.3	104.5
5/19/12 12:15	27.9	2.6	7.8	1.6	3.5	32.3	103.9
5/19/12 12:15	27.7	3.2	7.8	2.0	3.5	32.4	103.4
5/19/12 12:15	27.5	3.7	7.9	2.2	3.4	32.5	103.1
5/19/12 12:15	27.4	4.3	7.9	2.5	3.7	32.7	103.1
5/19/12 12:15	27.4	4.8	7.9	2.7	4.1	33.7	102.9
5/19/12 12:15	27.7	5.4	7.9	3.2	4.6	34.3	102.3
5/19/12 12:15	27.9	5.9	7.9	3.5	5.2	34.2	101.2
5/19/12 12:15	28.1	6.3	7.9	4.7	5.7	34.1	99.5
5/19/12 12:15	28.2	6.5	7.9	5.4	6.2	34.1	97.6
6/30/12 11:20	26.0	0.2	7.8	0.0	5.4	4.8	99.7
6/30/12 11:20	26.0	0.2	7.8	0.0	5.4	5.5	99.7
6/30/12 11:21	26.0	0.3	7.8	0.0	5.4	6.3	99.7
6/30/12 11:21	26.0	0.5	7.7	0.0	5.4	9.3	99.8
6/30/12 11:21	25.9	0.7	7.6	0.0	5.4	14.3	99.8
6/30/12 11:21	25.9	0.9	7.6	0.0	5.4	15.1	99.9
6/30/12 11:21	25.8	1.1	7.5	0.0	5.4	19.2	100.0
6/30/12 11:21	25.7	1.4	7.5	0.0	5.4	21.4	100.2
6/30/12 11:21	25.6	1.6	7.6	0.0	5.4	22.3	100.3
6/30/12 11:21	25.5	1.9	7.6	0.0	5.4	23.0	100.5

Appendix 5: (Continued) Raw water column profile data for Station 2 of Ahuimanu Stream collected using a YSI 6600 Sonde.

DateTime M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
6/30/12 11:21	25.4	2.2	7.6	0.0	5.4	23.6	100.6
6/30/12 11:21	25.4	2.5	7.6	0.0	5.4	23.8	100.7
6/30/12 11:21	25.3	2.8	7.7	0.0	5.4	23.9	100.7
6/30/12 11:21	25.3	3.1	7.7	0.0	5.4	24.0	100.7
6/30/12 11:21	25.4	3.4	7.7	0.0	5.4	25.0	100.7
6/30/12 11:21	25.3	3.6	7.7	0.0	5.4	25.0	100.7
6/30/12 11:21	25.3	3.9	7.8	0.0	5.4	25.4	100.7
6/30/12 11:21	25.3	4.2	7.8	0.0	5.4	26.6	100.7
6/30/12 11:21	25.4	4.5	7.8	7.8	67.9	26.5	112.8
6/30/12 11:21	25.6	4.8	7.8	7.8	72.9	27.2	114.0
6/30/12 11:21	25.7	5.1	7.8	7.8	73.1	27.1	115.5
6/30/12 11:21	25.8	5.5	7.9	7.8	70.0	28.3	116.5
6/30/12 11:21	25.9	5.9	7.9	7.8	71.0	28.8	116.8
6/30/12 11:21	25.9	6.3	7.9	14.8	69.7	29.0	116.6
6/30/12 11:21	25.9	6.7	7.9	15.8	66.5	29.0	115.3

Appendix 6: Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 13:38	23.4	0.3	8.0	18.5	3.5	30.2	98.6
11/4/10 13:38	23.6	0.2	8.0	17.2	1.7	30.1	99.3
11/4/10 13:38	23.6	0.2	8.0	18.5	1.8	30.1	99.1
11/4/10 13:38	23.6	0.2	8.0	20.0	1.9	30.1	98.7
11/4/10 13:38	23.6	0.2	8.0	21.3	2.0	30.1	98.4
11/4/10 13:38	23.6	0.2	8.0	22.2	2.1	30.1	98.1
11/4/10 13:38	23.6	0.2	8.0	23.0	2.1	30.1	97.8
11/4/10 13:38	23.6	0.3	8.0	23.9	2.1	30.1	97.6
11/4/10 13:38	23.6	0.4	8.0	24.6	2.1	30.1	97.4
11/4/10 13:38	23.6	0.6	8.0	25.4	2.0	30.1	97.3
11/4/10 13:38	23.6	0.7	8.0	26.1	1.9	30.1	97.1
11/4/10 13:38	23.6	0.8	8.0	26.7	2.0	30.1	96.9
11/4/10 13:38	23.6	1.0	8.0	27.2	2.1	30.1	96.9
11/4/10 13:38	23.6	1.2	8.0	27.6	2.1	30.1	96.8
11/4/10 13:39	23.6	1.3	8.0	28.0	2.1	30.1	96.7
11/4/10 13:39	23.6	1.5	8.0	28.4	2.0	30.1	96.7
11/4/10 13:39	23.6	1.7	8.0	28.9	2.0	30.1	96.6
11/4/10 13:39	23.7	1.8	8.0	29.2	2.0	30.1	96.5
11/4/10 13:39	23.7	2.0	8.0	29.4	1.9	30.1	96.5
11/4/10 13:39	23.7	2.2	8.0	29.7	1.9	30.1	96.5
11/4/10 13:39	23.7	2.5	8.0	29.9	1.9	30.1	96.5
11/4/10 13:39	23.7	2.7	8.0	30.1	1.8	30.1	96.4
11/4/10 13:39	23.7	2.9	8.0	30.4	1.7	30.1	96.4
11/4/10 13:39	23.7	3.2	8.0	30.9	1.7	30.1	96.4
11/4/10 13:39	23.7	3.6	8.0	32.1	1.8	30.1	96.3
11/4/10 13:39	23.7	3.8	8.0	35.5	2.0	30.1	96.2
11/4/10 13:39	23.7	4.0	8.0	37.3	2.1	30.1	96.1
11/4/10 13:39	23.7	4.3	8.0	41.8	2.2	30.2	96.1
11/4/10 13:39	23.7	4.5	8.0	55.3	2.4	30.2	96.0
12/10/10 13:51	24.0	0.1	8.3	0.1	3.3	32.8	96.9
12/10/10 13:51	24.0	0.1	8.2	0.1	3.3	32.9	96.9
12/10/10 13:51	24.0	0.1	8.2	0.1	3.3	33.0	96.9
12/10/10 13:51	24.0	0.4	8.2	0.1	3.3	33.1	96.9
12/10/10 13:51	24.0	0.8	8.2	0.1	3.3	33.9	96.9
12/10/10 13:51	24.1	1.3	8.2	0.1	3.3	34.4	96.8
12/10/10 13:51	24.2	2.0	8.2	0.1	3.3	35.2	96.6
12/10/10 13:51	24.4	2.8	8.2	0.1	3.3	35.0	96.3
12/10/10 13:51	24.6	3.6	8.2	0.1	3.3	35.0	96.1

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/10/10 13:51	24.7	4.3	8.2	0.0	5.9	35.0	95.9
12/10/10 13:51	24.8	4.7	8.2	118.7	3.3	34.9	92.1
12/10/10 13:51	24.8	4.9	8.2	118.7	4.0	34.9	91.8
12/10/10 13:51	24.8	5.1	8.2	118.7	7.4	34.9	91.6
12/10/10 13:51	24.9	5.2	8.2	118.8	8.9	34.8	91.4
2/16/11 13:04	26.4	0.3	8.0	0.0	3.4	28.5	0.0
2/16/11 13:04	26.4	0.3	8.0	0.0	3.4	28.5	0.0
2/16/11 13:04	26.3	0.4	8.0	0.0	3.4	28.6	0.0
2/16/11 13:04	26.2	0.7	8.0	0.0	3.4	30.2	0.0
2/16/11 13:04	25.9	1.1	7.9	0.0	3.4	30.3	0.0
2/16/11 13:04	25.6	1.5	7.9	0.1	3.4	30.5	0.0
2/16/11 13:04	25.4	1.9	7.9	0.1	3.4	30.7	0.0
2/16/11 13:04	25.1	2.4	7.9	0.1	3.4	31.0	0.0
2/16/11 13:04	24.9	2.9	7.9	0.1	3.4	31.2	0.0
2/16/11 13:04	24.8	3.2	7.9	0.1	3.4	31.4	0.0
2/16/11 13:04	24.7	3.5	7.9	0.1	3.4	31.5	0.0
2/16/11 13:04	24.6	3.9	7.9	0.1	3.4	31.5	0.0
2/16/11 13:04	24.5	4.3	7.9	0.1	3.4	31.6	0.0
2/16/11 13:04	24.4	4.5	7.9	0.1	3.4	31.6	0.0
2/16/11 13:04	24.4	4.7	7.9	0.2	3.4	31.6	0.0
3/4/11 11:17	24.2	0.1	7.9	1.7	1.1	21.7	92.0
3/4/11 11:17	24.2	0.1	7.9	1.8	1.2	21.7	92.0
3/4/11 11:18	24.2	0.6	7.9	2.1	3.1	22.3	90.8
3/4/11 11:18	24.2	0.6	7.9	2.1	2.9	22.3	91.0
3/4/11 11:18	24.2	0.6	7.9	2.0	2.8	22.3	91.1
3/4/11 11:18	24.2	0.6	7.9	1.9	2.7	22.3	90.9
3/4/11 11:18	24.2	0.8	7.9	1.6	2.9	24.2	91.3
3/4/11 11:18	24.2	1.0	7.9	1.1	2.9	26.7	91.4
3/4/11 11:18	24.2	1.3	7.9	0.7	2.9	29.5	91.3
3/4/11 11:18	24.3	1.6	7.9	0.3	2.9	30.7	91.5
3/4/11 11:18	24.3	1.9	7.9	0.2	2.9	31.2	91.4
3/4/11 11:19	24.4	2.3	7.9	0.0	3.0	31.3	91.4
3/4/11 11:19	24.4	2.7	7.9	0.0	3.0	31.3	91.4
3/4/11 11:19	24.4	3.1	7.9	0.0	3.0	31.3	91.3
3/4/11 11:19	24.4	3.4	7.9	8.8	4.4	31.2	91.4
3/4/11 11:19	24.4	3.7	7.9	10.3	5.8	31.4	91.9
3/4/11 11:19	24.4	3.9	7.9	10.8	5.5	31.5	92.7
3/4/11 11:19	24.4	4.1	7.9	11.0	5.6	31.5	93.3

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/4/11 11:19	24.4	4.3	7.9	10.8	6.7	31.5	93.0
3/4/11 11:19	24.5	4.4	7.9	11.2	6.9	31.5	92.7
3/4/11 11:19	24.5	4.4	7.9	11.6	6.9	31.5	92.7
3/10/11 9:48	21.9	0.3	8.5	3.6	0.4	0.1	95.5
3/10/11 9:48	21.8	0.4	8.4	4.5	0.8	1.0	94.8
3/10/11 9:48	21.8	0.3	8.4	4.8	0.9	1.0	94.8
3/10/11 9:48	21.8	0.4	8.3	5.1	1.0	1.0	94.6
3/10/11 9:48	21.9	0.6	8.3	5.2	1.0	1.0	94.4
3/10/11 9:48	21.9	0.8	8.3	5.5	0.9	1.0	94.6
3/10/11 9:48	21.9	1.1	8.2	5.9	0.9	1.0	94.5
3/10/11 9:48	21.9	1.3	8.2	6.1	0.8	1.0	94.4
3/10/11 9:48	21.9	1.5	8.2	6.2	1.0	1.0	94.2
3/10/11 9:48	21.9	1.7	8.1	5.9	1.2	3.5	94.2
3/10/11 9:48	22.2	2.0	7.4	5.1	1.2	6.4	94.7
3/10/11 9:48	22.5	2.2	7.4	4.6	1.5	10.6	93.7
3/10/11 9:48	22.7	2.4	7.4	4.0	1.6	12.1	91.7
3/10/11 9:48	22.8	2.6	7.4	3.9	1.7	13.3	89.6
3/10/11 9:49	23.0	2.9	7.4	3.7	1.9	14.3	87.1
3/10/11 9:49	23.0	3.1	7.4	4.6	2.1	16.2	84.6
3/10/11 9:49	23.1	3.3	7.4	6.7	2.7	16.7	82.0
3/10/11 9:49	23.2	3.5	7.4	14.1	3.8	17.4	78.4
3/10/11 9:49	23.2	3.7	7.4	33.0	3.9	17.5	74.9
3/10/11 9:49	23.2	3.9	7.4	54.9	3.5	15.0	71.4
3/10/11 9:49	23.3	4.0	7.4	84.1	3.8	15.0	68.4
3/10/11 9:49	23.3	4.1	7.4	115.9	4.7	15.0	65.7
4/5/11 11:47	24.9	0.3	7.8	0.5	5.4	0.0	97.5
4/5/11 11:47	25.0	0.3	8.2	0.4	5.5	10.1	99.3
4/5/11 11:47	26.0	0.4	8.1	0.2	5.5	25.5	99.4
4/5/11 11:47	26.6	0.8	8.0	0.0	5.1	28.9	99.3
4/5/11 11:47	26.6	1.5	7.9	0.1	4.9	31.1	99.2
4/5/11 11:47	26.7	2.3	7.9	0.4	4.7	32.3	98.8
4/5/11 11:47	26.9	3.1	7.9	2.3	4.9	33.2	97.8
4/5/11 11:47	27.0	3.7	7.9	3.6	5.4	33.1	96.3
4/5/11 11:47	27.2	4.1	7.9	12.9	5.8	33.2	95.1
5/22/11 10:29	23.3	0.2	8.0	4.2	1.1	0.0	100.8
5/22/11 10:29	23.3	0.2	8.0	2.8	1.1	0.1	100.7
5/22/11 10:30	23.5	0.3	8.0	2.0	1.1	7.0	100.4
5/22/11 10:30	23.8	0.5	8.0	1.4	1.0	12.9	100.9

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/22/11 10:30	24.9	0.9	7.9	0.8	1.1	24.9	100.3
5/22/11 10:30	27.1	1.4	7.8	0.4	1.2	29.5	100.7
5/22/11 10:30	28.2	1.9	7.7	0.0	1.6	33.3	101.5
5/22/11 10:30	28.2	2.5	7.6	0.0	2.7	34.7	102.8
5/22/11 10:30	28.2	3.0	7.6	1.2	4.2	35.3	102.7
5/22/11 10:30	28.2	3.4	7.6	12.4	5.9	35.8	100.4
6/23/11 10:48	24.5	0.3	7.8	8.7	4.3	4.8	95.1
6/23/11 10:48	24.5	0.3	7.8	8.7	4.3	4.7	95.1
6/23/11 10:48	24.5	0.3	7.8	8.7	4.3	4.7	95.1
6/23/11 10:48	24.5	0.4	7.8	8.7	4.3	5.1	95.1
6/23/11 10:48	24.6	0.8	7.7	8.7	4.3	8.8	95.0
6/23/11 10:48	24.8	1.3	7.6	8.7	4.3	14.6	94.7
6/23/11 10:48	25.0	1.7	7.6	8.7	4.3	17.1	94.4
6/23/11 10:48	25.3	2.2	7.5	8.6	4.3	20.6	94.0
6/23/11 10:49	25.6	2.6	7.5	8.6	4.3	21.3	93.5
6/23/11 10:49	26.0	3.0	7.5	8.6	4.3	22.7	93.1
6/23/11 10:49	26.3	3.4	7.5	8.5	4.3	24.9	92.7
6/23/11 10:49	26.5	3.8	7.5	8.5	4.3	26.3	92.3
6/23/11 10:49	26.8	4.2	7.5	8.5	4.3	27.0	91.9
6/23/11 10:49	27.0	4.6	7.5	8.4	4.3	27.1	91.7
6/23/11 10:49	27.1	4.9	7.5	8.4	4.3	27.2	91.5
6/23/11 10:49	27.2	5.2	7.5	8.4	4.3	28.0	91.4
6/23/11 10:49	27.2	5.6	7.6	0.0	4.0	27.9	79.6
6/23/11 10:49	27.3	5.8	7.6	0.0	1.7	27.0	77.0
6/23/11 10:49	27.3	6.0	7.6	0.0	1.3	24.8	72.2
6/23/11 10:49	27.3	6.1	7.6	0.0	1.0	22.8	68.8
6/23/11 10:49	27.4	6.2	7.6	0.0	0.6	22.5	66.9
8/27/11 11:37	27.8	0.2	7.6	0.0	1.5	8.2	101.8
8/27/11 11:37	27.8	0.2	7.7	0.1	1.6	16.3	101.8
8/27/11 11:37	27.8	0.4	7.7	0.3	2.0	17.2	102.1
8/27/11 11:37	27.8	0.8	7.7	0.5	1.9	18.7	102.2
8/27/11 11:37	27.9	1.3	7.7	0.9	1.9	22.8	102.6
8/27/11 11:37	28.1	1.8	7.6	1.6	2.0	24.5	102.9
8/27/11 11:37	28.2	2.3	7.6	2.4	2.0	24.8	103.2
8/27/11 11:37	28.3	2.8	7.6	2.8	2.3	25.0	103.3
8/27/11 11:37	28.3	3.2	7.6	3.2	2.4	25.2	103.3
8/27/11 11:37	28.2	3.7	7.6	3.6	2.5	25.5	102.7
8/27/11 11:37	28.2	4.2	7.7	3.9	2.4	25.7	102.1

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
8/27/11 11:37	28.2	4.6	7.7	4.3	2.4	25.9	101.4
8/27/11 11:37	28.2	5.1	7.7	4.9	2.7	26.1	100.9
8/27/11 11:37	28.3	5.6	7.7	5.5	4.1	27.6	100.1
8/27/11 11:37	28.5	6.0	7.6	5.6	5.2	28.7	98.0
8/27/11 11:37	28.7	6.4	7.6	5.9	6.5	28.9	94.2
8/27/11 11:37	28.9	6.9	7.6	7.4	9.3	28.9	89.5
9/25/11 11:18	29.0	0.2	8.7	0.0	5.8	10.3	101.1
9/25/11 11:18	28.9	1.2	8.7	0.3	4.4	28.8	98.9
9/25/11 11:18	28.7	2.8	8.6	0.9	3.7	31.6	95.6
9/25/11 11:18	28.5	4.2	8.7	1.2	2.9	32.9	97.8
9/25/11 11:18	28.1	5.9	8.7	3.3	2.5	34.0	102.5
10/23/11 10:06	24.8	0.1	7.8	9.7	3.7	0.1	90.3
10/23/11 10:06	24.5	0.1	7.8	9.7	7.5	0.1	90.8
10/23/11 10:07	24.4	0.1	8.0	10.0	1.3	0.2	97.1
10/23/11 10:07	24.7	0.1	7.8	6.4	4.0	0.2	90.8
10/23/11 10:07	24.6	0.1	7.7	7.3	3.7	9.9	91.0
10/23/11 10:08	24.7	0.1	7.8	5.2	3.0	10.5	86.0
10/23/11 10:08	24.7	0.1	7.8	5.9	2.9	10.6	87.5
10/23/11 10:08	24.7	0.1	7.7	6.0	2.9	13.7	88.0
10/23/11 10:08	24.8	0.3	7.7	5.2	3.0	28.7	88.5
10/23/11 10:08	25.0	0.7	7.7	4.4	3.0	35.6	88.7
10/23/11 10:08	25.2	1.2	7.7	3.7	3.0	37.2	88.3
10/23/11 10:08	25.5	1.7	7.7	3.2	2.9	37.8	87.3
10/23/11 10:08	25.6	2.0	7.8	2.6	2.9	37.6	86.3
10/23/11 10:08	25.7	2.3	7.8	2.1	2.8	37.6	85.5
10/23/11 10:08	25.7	2.7	7.8	1.8	2.7	37.7	84.7
10/23/11 10:08	25.8	3.2	7.9	1.4	2.8	37.8	84.0
10/23/11 10:08	25.8	3.6	7.9	1.0	2.7	38.0	83.5
10/23/11 10:08	25.8	4.0	7.9	0.6	2.6	38.1	83.4
10/23/11 10:09	25.8	4.4	7.9	0.4	2.4	38.3	83.3
10/23/11 10:09	25.8	4.7	7.9	0.2	2.3	38.4	83.4
10/23/11 10:09	25.8	5.0	7.9	0.0	2.2	38.4	83.5
10/23/11 10:09	25.8	5.3	7.9	0.0	2.2	38.4	83.8
10/23/11 10:09	25.8	5.5	7.9	0.5	2.2	38.5	84.0
10/23/11 10:09	25.8	5.8	7.9	8.9	3.7	38.5	84.1
10/23/11 10:09	25.8	6.0	7.9	7.8	6.4	35.1	84.4
10/23/11 10:09	25.8	6.2	7.9	6.3	8.5	35.1	84.6
10/23/11 10:09	25.8	6.3	7.9	5.1	8.9	35.2	84.6

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
10/23/11 10:09	25.8	6.3	7.9	4.0	10.2	35.2	84.5
11/1/11 10:53	25.0	0.3	7.8	13.4	4.8	0.8	89.9
11/1/11 10:53	25.1	0.3	7.8	13.4	7.9	1.2	88.4
11/1/11 10:53	25.2	0.4	7.8	7.0	7.6	26.9	87.6
11/1/11 10:53	25.3	0.7	7.8	6.5	7.2	28.4	86.5
11/1/11 10:53	25.5	0.9	7.8	5.9	6.8	30.5	85.1
11/1/11 10:53	25.6	1.3	7.8	5.4	6.2	31.4	83.6
11/1/11 10:53	25.7	1.6	7.8	5.0	5.8	32.2	82.4
11/1/11 10:53	25.8	1.9	7.9	4.8	5.6	32.8	81.1
11/1/11 10:53	25.9	2.1	7.9	4.9	5.4	32.7	79.9
11/1/11 10:53	25.9	2.5	7.9	4.6	5.2	33.0	79.0
11/1/11 10:53	26.0	2.8	7.9	4.5	5.2	33.1	78.4
11/1/11 10:53	26.0	3.2	7.9	4.4	4.9	33.2	77.6
11/1/11 10:53	25.9	3.6	7.9	4.4	4.7	33.4	77.1
11/1/11 10:53	25.9	4.0	7.9	4.5	4.5	33.6	76.7
11/1/11 10:53	25.9	4.3	7.9	4.7	4.4	33.7	76.4
11/1/11 10:53	25.8	4.8	7.9	5.0	4.3	33.9	76.3
11/1/11 10:53	25.8	5.1	7.9	6.9	4.2	33.9	76.2
11/1/11 10:53	25.8	5.4	7.9	19.7	5.5	34.0	75.9
11/1/11 10:54	25.8	5.7	7.9	0.0	5.1	34.0	75.7
11/1/11 10:54	25.8	5.9	7.9	0.8	4.6	31.3	75.4
12/14/11 11:06	23.4	0.3	7.8	18.8	2.4	0.2	92.9
12/14/11 11:06	23.2	0.3	7.8	18.8	2.4	14.8	93.2
12/14/11 11:06	23.3	0.4	7.8	18.8	2.4	21.9	93.0
12/14/11 11:06	23.4	0.6	7.8	18.8	2.4	21.9	92.9
12/14/11 11:06	23.6	0.8	7.8	18.8	2.4	25.1	92.6
12/14/11 11:06	23.7	1.1	7.8	18.9	2.4	25.8	92.4
12/14/11 11:06	23.8	1.4	7.8	18.9	2.4	27.5	92.3
12/14/11 11:06	23.9	1.7	7.8	18.9	2.4	28.7	92.2
12/14/11 11:06	23.9	2.1	7.8	18.9	2.4	31.8	92.2
12/14/11 11:06	23.9	2.6	7.8	18.9	2.4	32.1	92.2
12/14/11 11:06	23.9	2.9	7.8	18.9	2.4	32.2	92.2
12/14/11 11:06	23.9	3.3	7.9	18.9	2.4	32.5	92.2
12/14/11 11:07	23.9	3.7	7.9	18.9	2.4	32.8	92.2
12/14/11 11:07	23.9	4.2	7.9	18.9	2.4	33.0	92.2
12/14/11 11:07	23.9	4.5	7.9	18.9	2.4	33.1	92.2
12/14/11 11:07	23.9	4.7	7.9	18.9	2.4	33.2	92.2
12/14/11 11:07	23.9	4.9	7.9	18.9	2.4	33.2	92.2

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/14/11 11:07	23.9	5.1	7.9	18.9	2.4	30.5	92.2
1/28/12 9:40	24.0	0.3	7.9	0.2	0.9	0.2	98.4
1/28/12 9:40	24.3	0.3	7.9	0.2	1.2	27.8	96.0
1/28/12 9:40	24.5	0.3	7.9	0.5	1.3	28.4	95.5
1/28/12 9:40	24.7	0.3	7.9	0.4	1.2	29.3	94.9
1/28/12 9:40	25.7	0.5	7.9	0.3	1.4	30.1	93.7
1/28/12 9:40	25.7	0.7	7.9	0.4	1.6	30.9	93.5
1/28/12 9:40	25.7	0.9	7.9	0.4	1.6	31.3	93.3
1/28/12 9:40	25.8	1.2	7.9	0.3	1.6	32.5	93.5
1/28/12 9:40	26.0	1.5	7.9	0.3	1.6	34.1	93.7
1/28/12 9:40	26.3	1.8	7.9	0.1	1.6	34.7	93.7
1/28/12 9:40	26.5	2.1	7.9	0.0	1.7	34.5	93.2
1/28/12 9:40	26.6	2.3	7.9	0.0	1.8	34.3	92.5
1/28/12 9:41	26.4	2.5	7.9	0.0	1.9	34.2	91.7
1/28/12 9:41	26.2	2.8	7.9	0.1	1.8	34.2	90.8
1/28/12 9:41	25.9	3.0	8.0	0.3	1.9	34.1	89.9
1/28/12 9:41	25.7	3.3	8.0	0.7	2.0	34.2	89.5
1/28/12 9:41	25.5	3.5	8.0	1.0	2.2	34.2	89.0
1/28/12 9:41	25.4	3.9	8.0	1.4	2.5	34.3	88.4
1/28/12 9:41	25.4	4.2	8.0	1.8	2.8	34.4	87.5
1/28/12 9:41	25.4	4.4	7.9	2.2	2.9	34.5	86.1
1/28/12 9:41	25.4	4.7	7.9	2.5	3.3	34.6	84.4
1/28/12 9:41	25.4	4.9	7.9	4.0	3.6	34.6	82.7
1/28/12 9:41	25.4	5.1	7.9	6.7	3.9	34.7	81.3
1/28/12 9:41	25.4	5.2	7.9	8.9	4.3	34.7	80.2
2/25/12 10:27	24.6	0.3	8.1	0.1	6.5	9.1	96.8
2/25/12 10:27	24.6	0.3	8.1	0.1	7.5	34.0	96.2
2/25/12 10:27	24.7	0.3	8.1	0.3	7.6	34.0	96.1
2/25/12 10:28	24.7	0.4	8.1	0.0	8.0	34.0	96.0
2/25/12 10:28	24.7	0.6	8.1	0.0	8.1	34.0	95.7
2/25/12 10:28	24.7	0.8	8.1	0.0	8.2	34.0	95.6
2/25/12 10:28	24.7	1.0	8.1	0.0	8.0	34.0	95.5
2/25/12 10:28	24.7	1.3	8.1	0.2	8.0	34.0	95.2
2/25/12 10:28	24.6	1.6	8.1	0.2	8.1	34.2	95.0
2/25/12 10:28	24.6	2.0	8.1	0.1	8.3	34.4	95.1
2/25/12 10:28	24.6	2.3	8.1	0.1	8.5	34.5	95.1
2/25/12 10:28	24.6	2.6	8.1	0.1	9.0	34.7	95.3
2/25/12 10:28	24.5	2.9	8.1	0.3	9.8	34.9	95.3

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/25/12 10:28	24.4	3.2	8.1	0.8	10.6	35.1	95.2
2/25/12 10:28	24.4	3.4	8.1	1.2	11.0	35.3	94.8
2/25/12 10:28	24.3	3.6	8.1	1.7	11.2	35.4	94.3
2/25/12 10:28	24.3	3.8	8.1	2.3	11.3	35.5	93.7
2/25/12 10:28	24.2	4.1	8.1	2.9	11.3	35.5	93.1
2/25/12 10:28	24.2	4.3	8.1	3.8	11.2	35.5	92.3
2/25/12 10:28	24.2	4.6	8.1	6.2	11.1	35.6	91.8
2/25/12 10:28	24.1	4.8	8.1	12.1	11.1	35.6	91.1
3/3/12 11:09	23.4	0.1	8.1	31.2	0.5	0.3	99.0
3/3/12 11:09	23.0	0.1	8.1	31.2	1.2	0.8	99.5
3/3/12 11:09	23.1	0.1	8.1	0.3	1.2	20.1	99.7
3/3/12 11:09	23.2	0.2	8.0	0.3	1.0	21.0	99.6
3/3/12 11:09	23.3	0.3	8.0	0.1	0.7	23.0	99.3
3/3/12 11:09	23.4	0.4	8.0	0.0	0.6	25.9	99.2
3/3/12 11:09	23.4	0.6	8.0	0.0	0.5	26.8	99.1
3/3/12 11:09	23.5	0.9	8.0	0.1	0.4	27.5	99.1
3/3/12 11:09	23.5	1.1	8.0	0.3	0.4	28.8	99.0
3/3/12 11:09	23.5	1.4	8.0	0.4	0.3	30.0	98.8
3/3/12 11:10	23.5	1.7	8.0	0.8	0.3	31.4	98.6
3/3/12 11:10	23.5	2.0	8.0	1.0	0.4	31.5	98.4
3/3/12 11:10	23.5	2.3	8.0	1.3	0.4	31.5	98.1
3/3/12 11:10	23.5	2.6	8.0	1.9	0.3	31.6	97.7
3/3/12 11:10	23.5	2.9	8.0	2.9	0.6	31.8	97.3
3/3/12 11:10	23.6	3.2	8.0	3.4	0.7	32.0	96.6
3/3/12 11:10	23.6	3.4	8.0	4.1	0.8	32.2	95.5
3/3/12 11:10	23.6	3.7	8.0	4.6	0.9	32.5	93.6
3/3/12 11:10	23.6	3.9	8.0	5.5	1.1	32.7	92.0
3/3/12 11:10	23.6	4.2	7.9	15.7	1.2	32.9	89.6
3/3/12 11:10	23.6	4.4	7.9	28.6	1.5	33.0	87.3
3/7/12 11:56	22.1	0.3	8.0	0.0	1.3	0.1	97.9
3/7/12 11:56	22.1	0.3	8.0	0.0	1.0	8.0	97.7
3/7/12 11:56	22.1	0.4	7.9	0.4	0.8	8.0	97.7
3/7/12 11:56	22.1	0.7	7.9	0.3	1.2	8.0	97.7
3/7/12 11:56	22.1	1.0	7.8	1.6	1.5	8.1	98.0
3/7/12 11:56	22.2	1.3	7.7	5.7	1.9	14.2	98.1
3/7/12 11:56	22.3	1.6	7.7	10.2	2.0	17.4	97.5
3/7/12 11:56	22.5	1.9	7.6	15.1	2.3	21.7	96.8
3/7/12 11:56	22.7	2.2	7.6	20.3	2.6	21.5	96.0

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/7/12 11:57	22.9	2.6	7.6	25.8	2.7	22.4	95.2
3/7/12 11:57	23.0	3.1	7.7	30.7	2.9	22.3	94.5
3/7/12 11:57	23.1	3.4	7.7	36.2	3.0	22.4	93.9
3/7/12 11:57	23.1	3.8	7.7	39.7	3.2	22.4	93.3
3/7/12 11:57	23.1	4.2	7.6	40.2	3.2	28.4	92.9
4/21/12 13:17	26.1	0.1	8.1	1.0	7.8	12.7	112.4
4/21/12 13:17	26.0	0.1	8.2	1.0	7.1	11.3	112.7
4/21/12 13:17	25.9	0.1	8.1	0.0	7.5	11.8	112.8
4/21/12 13:17	25.9	0.2	8.1	0.9	7.6	12.6	113.1
4/21/12 13:17	26.0	0.6	8.1	5.4	7.9	16.8	113.7
4/21/12 13:17	26.2	0.9	8.1	7.6	8.4	18.5	114.2
4/21/12 13:17	26.4	1.2	8.0	7.7	8.4	19.5	114.2
4/21/12 13:17	26.4	1.6	8.0	7.2	7.9	20.7	113.5
4/21/12 13:17	26.3	2.0	8.0	6.8	7.5	22.4	112.9
4/21/12 13:17	26.0	2.5	8.0	6.4	7.1	22.8	112.6
4/21/12 13:17	25.8	2.9	8.0	6.3	6.8	23.1	111.8
4/21/12 13:17	25.7	3.3	8.0	6.6	6.6	23.2	111.0
4/21/12 13:17	25.7	3.7	7.9	7.1	6.5	23.3	110.3
4/21/12 13:17	25.7	4.1	7.9	7.3	6.7	23.5	109.3
4/21/12 13:17	25.7	4.4	7.9	7.5	6.8	24.9	107.8
4/21/12 13:18	25.8	4.6	7.9	8.0	7.0	26.8	106.2
4/21/12 13:18	25.9	4.8	7.9	8.3	7.2	27.1	104.4
4/21/12 13:18	25.9	5.0	7.9	8.5	7.4	27.2	102.6
4/21/12 13:18	26.0	5.1	7.8	10.9	7.3	27.2	100.8
4/21/12 13:18	26.1	5.3	7.8	23.5	7.0	27.1	98.7
5/19/12 12:24	28.3	0.3	8.0	0.0	3.0	23.3	105.2
5/19/12 12:24	28.3	0.3	8.0	0.0	3.0	23.4	106.0
5/19/12 12:24	28.3	0.4	8.0	0.2	2.8	24.3	106.5
5/19/12 12:24	28.3	0.6	8.0	0.5	3.1	25.8	106.6
5/19/12 12:24	28.4	0.9	8.0	0.8	2.8	28.3	106.7
5/19/12 12:24	28.4	1.3	7.9	1.1	2.7	30.5	106.7
5/19/12 12:24	28.3	1.8	7.9	1.6	2.7	31.9	106.5
5/19/12 12:24	28.1	2.2	7.9	1.9	2.7	32.2	106.7
5/19/12 12:24	28.0	2.8	7.9	2.4	2.6	32.4	106.6
5/19/12 12:24	27.9	3.2	8.0	2.6	2.5	32.6	106.3
5/19/12 12:24	27.8	3.7	8.0	3.0	2.5	32.7	106.3
5/19/12 12:24	27.7	4.2	8.0	3.4	2.5	32.8	106.1
5/19/12 12:24	27.7	4.7	8.0	3.7	2.7	32.9	105.9

Appendix 6: (Continued) Raw water column profile data for Station 3 of Ahuimanu Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/19/12 12:24	27.6	5.1	8.0	3.9	2.9	32.9	105.7
5/19/12 12:24	27.5	5.6	8.0	4.2	3.5	33.1	105.7
5/19/12 12:24	27.6	6.1	8.0	5.5	4.7	34.0	105.2
6/30/12 11:27	25.6	0.2	8.3	0.0	3.1	8.8	104.1
6/30/12 11:27	25.6	0.2	8.2	0.0	3.0	17.4	105.0
6/30/12 11:27	25.6	0.3	8.2	1.2	3.0	17.1	105.4
6/30/12 11:27	25.6	0.5	8.1	0.8	3.1	18.3	105.7
6/30/12 11:27	25.6	0.8	8.1	1.0	3.0	20.8	105.9
6/30/12 11:28	25.6	1.0	8.1	0.9	2.9	22.1	105.8
6/30/12 11:28	25.5	1.3	8.0	1.0	2.9	23.7	105.6
6/30/12 11:28	25.5	1.5	8.0	1.0	2.8	24.3	105.3
6/30/12 11:28	25.5	1.7	8.0	1.0	2.7	24.6	105.1
6/30/12 11:28	25.5	2.0	8.0	1.0	2.6	24.8	104.9
6/30/12 11:28	25.5	2.3	8.0	1.0	2.4	25.0	104.9
6/30/12 11:28	25.5	2.5	8.0	1.0	2.4	25.3	104.6
6/30/12 11:28	25.5	2.7	8.1	1.2	2.2	25.5	104.2
6/30/12 11:28	25.5	2.9	8.1	1.5	2.1	25.8	104.3
6/30/12 11:28	25.5	3.1	8.1	1.5	2.2	26.0	104.2
6/30/12 11:28	25.5	3.4	8.1	1.5	2.2	26.2	104.2
6/30/12 11:28	25.5	3.6	8.1	1.6	2.3	26.5	104.2
6/30/12 11:28	25.5	3.8	8.1	1.7	2.3	26.6	104.0
6/30/12 11:28	25.5	3.9	8.1	1.9	2.3	26.9	103.7
6/30/12 11:28	25.6	4.2	8.1	2.2	2.3	27.1	103.9
6/30/12 11:28	25.6	4.4	8.1	2.5	2.4	27.2	103.9
6/30/12 11:28	25.6	4.5	8.1	2.7	2.4	27.3	104.0
6/30/12 11:28	25.6	4.7	8.1	3.2	2.5	27.3	104.0
6/30/12 11:28	25.6	5.0	8.1	4.6	3.0	27.5	104.6
6/30/12 11:28	25.6	5.2	8.1	5.1	3.3	27.6	105.0
6/30/12 11:28	25.6	5.5	8.1	5.9	4.2	27.7	104.9
6/30/12 11:28	25.6	5.7	8.1	7.0	5.1	27.8	104.7
6/30/12 11:28	25.7	6.0	8.1	8.5	4.8	27.9	104.5
6/30/12 11:28	25.7	6.2	8.1	9.7	4.4	27.9	104.0
6/30/12 11:28	25.7	6.3	8.1	11.3	4.1	27.0	103.7
6/30/12 11:28	25.7	6.4	8.1	12.6	3.6	27.0	103.5

Appendix 7: Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/10/10 10:45	19.5	0.0	8.2	0.0	0.3	0.1	97.2
12/10/10 10:45	19.5	0.0	8.2	0.4	0.3	0.1	97.2
12/10/10 10:45	19.5	0.0	8.2	0.8	0.3	0.1	97.2
12/10/10 10:45	19.5	0.0	8.2	1.1	0.4	0.1	97.1
12/10/10 10:45	19.5	0.0	8.1	1.4	0.5	0.1	97.0
12/10/10 10:46	19.6	0.0	8.1	1.7	0.6	0.1	96.9
12/10/10 10:46	19.6	0.1	8.1	1.9	0.6	0.1	96.8
12/10/10 10:46	19.6	0.1	8.1	1.9	0.6	0.1	96.7
12/10/10 10:46	19.6	0.1	8.1	2.2	0.6	0.1	96.5
12/10/10 10:46	19.6	0.2	8.1	2.4	0.6	0.1	96.4
12/10/10 10:46	19.6	0.2	8.1	2.7	0.7	0.1	96.3
12/10/10 10:46	19.6	0.3	8.1	3.5	0.8	0.1	96.1
12/10/10 10:46	19.6	0.3	8.1	3.7	0.8	0.1	96.0
12/10/10 10:46	19.6	0.4	8.1	4.2	0.8	0.1	95.7
12/10/10 10:46	19.6	0.5	8.1	4.7	0.9	0.1	95.5
2/16/11 16:17	21.1	0.2	9.4	0.0	4.6	0.1	0.0
2/16/11 16:17	21.1	0.2	9.0	0.0	4.6	0.1	0.0
2/16/11 16:17	21.2	0.2	9.0	0.0	4.6	0.1	0.0
2/16/11 16:17	21.1	0.2	8.9	0.0	4.6	0.1	0.0
2/16/11 16:17	21.2	0.5	8.9	0.0	4.6	0.1	0.0
2/16/11 16:17	21.2	0.6	8.9	0.0	4.6	0.1	0.0
2/16/11 16:18	21.2	0.8	8.8	0.0	4.6	0.1	0.0
2/16/11 16:18	21.2	0.9	8.8	0.0	4.6	0.1	0.0
2/16/11 16:18	21.2	1.0	8.8	0.0	4.6	0.1	0.0
2/16/11 16:18	21.2	1.3	8.7	0.0	4.6	0.1	0.0
2/16/11 16:18	21.2	1.6	8.7	0.0	4.6	0.1	0.0
2/16/11 16:18	21.2	2.0	8.7	0.0	0.0	0.1	0.0
2/16/11 16:18	21.2	2.2	8.7	0.3	0.8	0.1	97.0
2/16/11 16:18	21.3	2.3	8.7	0.3	0.2	0.1	97.0
3/10/11 12:09	21.1	0.3	9.1	0.0	1.0	0.0	0.0
3/10/11 12:09	21.1	0.3	8.9	0.0	1.0	0.1	0.0
3/10/11 12:09	21.1	0.3	8.9	0.0	1.0	0.1	0.0
3/10/11 12:09	21.1	0.3	8.8	0.0	1.0	0.1	0.0
3/10/11 12:09	21.1	0.3	8.7	0.0	1.0	0.1	0.0
3/10/11 12:09	21.1	0.4	8.7	0.0	1.0	0.1	0.0
3/10/11 12:09	21.1	0.5	8.7	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	0.6	8.6	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	0.8	8.6	0.0	1.0	0.1	0.0

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/10/11 12:10	21.1	0.9	8.5	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	0.9	8.5	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	1.2	8.5	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	1.4	8.4	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	1.9	8.4	0.0	1.0	0.1	0.0
3/10/11 12:10	21.1	2.3	8.4	0.0	1.0	0.1	0.0
4/5/11 13:50	22.1	0.2	8.6	0.0	0.0	0.0	103.5
4/5/11 13:50	22.1	0.2	8.5	0.0	0.0	0.0	103.4
4/5/11 13:50	22.1	0.2	8.5	0.0	0.0	0.1	103.4
4/5/11 13:50	22.1	0.2	8.4	0.0	0.0	0.1	103.4
4/5/11 13:50	22.1	0.3	8.4	0.0	0.0	0.1	103.5
4/5/11 13:50	22.1	0.6	8.4	0.0	0.0	0.1	103.4
4/5/11 13:50	22.1	1.0	8.4	0.0	0.0	0.1	103.4
4/5/11 13:50	22.2	1.6	8.4	0.0	0.0	0.1	103.4
4/5/11 13:50	22.2	2.2	8.4	0.0	0.0	0.1	103.3
4/5/11 13:50	22.3	2.6	8.4	0.0	0.0	0.1	103.2
5/22/11 13:19	21.4	0.3	8.7	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.2	8.6	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.2	8.6	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.3	8.5	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.3	8.5	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.4	8.5	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.5	8.5	52.1	0.4	0.1	102.6
5/22/11 13:19	21.4	0.7	8.4	52.1	0.4	0.1	102.5
5/22/11 13:19	21.4	0.9	8.4	52.1	0.4	0.1	102.5
5/22/11 13:19	21.4	1.3	8.4	52.1	0.4	0.1	102.5
5/22/11 13:19	21.4	1.6	8.4	52.1	0.4	0.1	102.5
6/23/11 14:24	29.0	0.2	7.9	5.1	1.5	0.1	116.3
6/23/11 14:24	29.0	0.2	7.9	2.9	1.0	0.1	118.0
6/23/11 14:24	29.0	0.4	7.8	3.5	1.1	0.1	118.1
8/27/11 14:21	23.2	0.2	5.5	0.0	0.0	0.1	103.0
8/27/11 14:21	23.2	0.2	5.4	0.0	0.0	0.1	103.1
9/25/11 12:30	21.9	0.2	8.0	0.0	0.0	0.0	104.6
9/25/11 12:30	22.0	0.8	7.9	0.0	0.0	0.1	104.5
9/25/11 12:30	22.0	2.4	8.0	0.6	1.1	0.1	105.1
9/25/11 12:30	21.9	3.9	8.0	1.2	1.1	0.1	105.1
10/23/11 12:14	21.4	0.1	8.1	69.1	3.8	0.1	95.9

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
10/23/11 12:14	21.3	0.1	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.1	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.1	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.2	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.4	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.7	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.7	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	0.8	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	1.0	8.1	69.0	3.8	0.1	95.9
10/23/11 12:14	21.3	1.3	8.1	69.0	3.8	0.1	96.0
10/23/11 12:14	21.3	1.5	8.1	69.0	3.8	0.1	96.0
10/23/11 12:14	21.3	1.7	8.1	69.0	3.8	0.1	96.0
10/23/11 12:14	21.3	2.1	8.1	69.0	3.8	0.1	96.0
10/23/11 12:14	21.3	2.7	8.1	73.5	6.1	0.1	95.3
10/23/11 12:14	21.3	3.2	8.2	73.5	5.0	0.1	95.1
10/23/11 12:14	21.2	3.7	8.2	73.5	4.7	0.1	95.0
10/23/11 12:14	21.2	3.6	8.2	73.5	4.4	0.1	95.0
10/23/11 12:14	21.2	3.4	8.3	73.5	4.7	0.1	95.1
11/1/11 13:08	21.8	0.3	8.1	30.4	0.0	0.0	95.0
11/1/11 13:08	21.9	0.3	8.0	30.4	0.0	0.1	94.9
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	94.9
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.3	8.0	30.4	0.0	0.1	94.9
11/1/11 13:08	21.8	0.3	8.1	30.4	0.0	0.1	94.9
11/1/11 13:08	21.8	0.3	8.1	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.4	8.2	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.6	8.3	30.4	0.0	0.1	95.0
11/1/11 13:08	21.8	0.8	8.4	35.5	4.1	0.1	95.0
11/1/11 13:08	21.8	1.1	9.0	33.0	4.6	0.1	95.3
11/1/11 13:08	21.8	1.5	9.2	33.0	4.1	0.1	95.2
12/14/11 13:41	21.1	0.3	8.6	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.3	8.4	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.3	8.4	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.3	8.3	0.0	0.0	0.1	97.5

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/14/11 13:41	21.1	0.3	8.3	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.3	8.3	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.4	8.2	0.0	0.0	0.1	97.4
12/14/11 13:41	21.1	0.5	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.6	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.7	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	0.9	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	1.0	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	1.1	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	1.6	8.2	0.0	0.0	0.1	97.5
12/14/11 13:41	21.1	2.2	8.3	0.0	1.2	0.1	97.5
12/14/11 13:41	21.1	2.6	8.3	0.0	2.6	0.1	96.1
12/14/11 13:41	21.1	3.0	8.4	0.0	1.7	0.1	96.2
12/14/11 13:41	21.1	3.7	8.4	0.0	1.2	0.1	96.2
1/28/12 12:09	21.3	0.3	8.9	0.0	0.0	0.0	101.2
1/28/12 12:09	21.3	0.3	8.8	0.0	0.0	0.0	101.3
1/28/12 12:09	21.3	0.3	8.8	0.0	0.0	0.1	101.3
1/28/12 12:09	21.3	0.3	8.8	0.0	0.0	0.1	101.3
1/28/12 12:09	21.3	0.4	8.8	0.0	0.0	0.1	101.3
1/28/12 12:09	21.3	0.5	8.8	0.0	0.0	0.1	101.3
1/28/12 12:09	21.3	0.7	8.7	0.0	0.0	0.1	101.3
1/28/12 12:09	21.3	0.9	8.7	0.0	0.0	0.1	101.3
1/28/12 12:09	21.3	1.0	8.7	0.0	0.0	0.1	101.3
1/28/12 12:10	21.3	1.2	8.7	0.0	0.0	0.1	101.3
1/28/12 12:10	21.3	1.4	8.7	0.0	0.0	0.1	101.3
1/28/12 12:10	21.3	1.6	8.7	0.0	0.0	0.1	101.3
1/28/12 12:10	21.3	1.9	8.7	0.0	0.0	0.1	101.3
1/28/12 12:10	21.3	2.2	8.7	0.0	0.0	0.1	101.3
1/28/12 12:10	21.2	2.5	8.6	0.8	1.4	0.1	101.4
1/28/12 12:10	21.2	2.6	8.6	0.4	0.4	0.1	101.1
1/28/12 12:10	21.2	2.8	8.6	0.4	1.0	0.1	101.2
1/28/12 12:10	21.1	3.0	8.7	0.4	0.7	0.1	101.2
1/28/12 12:10	21.1	3.3	8.7	0.4	0.9	0.1	101.1
1/28/12 12:10	21.1	3.6	8.7	0.4	1.0	0.1	101.0
1/28/12 12:10	21.1	3.8	8.7	0.7	0.7	0.1	100.8
2/25/12 12:12	21.0	0.2	8.9	0.4	2.2	0.1	100.5
2/25/12 12:12	21.0	0.2	8.8	0.4	2.2	0.1	100.5
2/25/12 12:12	21.0	0.3	8.8	0.4	2.2	0.1	100.5

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/25/12 12:12	20.9	0.5	8.7	0.4	2.2	0.1	100.5
2/25/12 12:12	20.9	0.6	8.7	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	0.8	8.7	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	0.9	8.6	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	1.1	8.6	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	1.3	8.6	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	1.4	8.6	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	1.6	8.6	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	1.8	8.5	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	2.0	8.5	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	2.2	8.5	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	2.3	8.5	0.4	2.2	0.1	100.6
2/25/12 12:12	20.9	2.5	8.5	0.4	2.2	0.1	100.7
2/25/12 12:12	20.9	2.7	8.5	0.1	1.2	0.1	105.9
2/25/12 12:12	20.9	2.9	8.5	0.1	1.4	0.1	105.9
2/25/12 12:13	20.9	3.1	8.5	0.1	1.6	0.1	106.0
2/25/12 12:13	20.9	3.3	8.4	0.1	2.0	0.1	106.1
2/25/12 12:13	20.9	3.4	8.4	0.1	2.2	0.1	106.2
2/25/12 12:13	20.9	3.8	8.4	0.2	2.5	0.1	106.4
2/25/12 12:13	20.9	4.1	8.4	0.1	2.2	0.1	106.4
2/25/12 12:13	20.9	4.3	8.4	0.0	2.1	0.1	106.5
3/3/12 9:11	20.3	0.2	8.3	0.0	1.2	0.1	97.6
3/3/12 9:11	20.3	0.2	8.1	0.0	1.2	0.1	97.6
3/3/12 9:11	20.3	0.2	8.1	0.0	1.2	0.1	97.6
3/3/12 9:11	20.3	0.2	8.0	0.0	1.2	0.1	97.6
3/3/12 9:11	20.2	0.3	8.0	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	0.3	8.0	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	0.4	8.0	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	0.5	7.9	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	0.7	7.9	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	1.0	7.9	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	1.2	7.8	0.0	1.2	0.1	97.7
3/3/12 9:11	20.2	1.5	7.8	5.7	3.8	0.1	97.7
3/3/12 9:11	20.2	1.8	7.8	3.1	1.0	0.1	97.1
3/3/12 9:11	20.2	2.1	7.8	3.1	1.2	0.1	97.0
3/3/12 9:11	20.2	2.3	7.9	3.1	0.9	0.1	97.0
3/3/12 9:11	20.2	2.6	7.9	3.1	0.9	0.1	97.0
3/3/12 9:11	20.2	2.8	7.9	2.6	0.6	0.1	96.9

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 9:11	20.2	3.2	7.9	3.7	0.5	0.1	96.9
3/3/12 9:11	20.2	3.5	7.9	5.1	1.0	0.1	96.8
3/3/12 9:12	20.2	3.8	7.9	5.8	0.7	0.1	96.9
3/3/12 9:12	20.2	4.0	7.9	6.4	0.6	0.1	96.8
3/7/12 8:48	20.2	0.3	8.5	0.0	2.0	0.1	98.6
3/7/12 8:48	20.2	0.3	8.5	0.0	2.0	0.1	98.6
3/7/12 8:48	20.2	0.3	8.4	0.0	2.0	0.1	98.6
3/7/12 8:48	20.2	0.3	8.4	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	0.5	8.4	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	0.6	8.4	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	0.8	8.3	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	1.0	8.3	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	1.3	8.3	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	1.4	8.3	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	1.7	8.2	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	1.9	8.2	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	2.2	8.2	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	2.4	8.2	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	2.7	8.1	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	2.9	8.1	0.0	2.0	0.1	98.6
3/7/12 8:49	20.2	3.2	8.1	0.0	0.3	0.1	98.6
4/21/12 9:24	20.7	0.1	9.1	0.0	1.6	0.1	107.4
4/21/12 9:25	20.6	0.1	8.8	0.0	1.6	0.0	107.4
4/21/12 9:25	20.6	0.2	8.8	0.0	1.6	0.1	107.4
4/21/12 9:25	20.6	0.2	8.7	0.0	1.6	0.1	107.4
4/21/12 9:25	20.6	0.3	8.6	0.0	1.6	0.1	107.4
4/21/12 9:25	20.6	0.4	8.6	0.0	1.6	0.1	107.5
4/21/12 9:25	20.6	0.6	8.5	1.6	0.0	0.1	100.8
4/21/12 9:25	20.6	0.8	8.5	1.6	1.6	0.1	100.6
4/21/12 9:25	20.6	1.0	8.5	1.6	1.1	0.1	100.7
4/21/12 9:25	20.6	1.3	8.4	1.6	1.3	0.1	100.5
4/21/12 9:25	20.6	1.5	8.4	1.6	1.6	0.1	100.5
4/21/12 9:25	20.6	1.8	8.3	1.5	1.9	0.1	100.3
4/21/12 9:25	20.5	2.2	8.3	1.6	1.7	0.1	100.2
4/21/12 9:25	20.5	2.4	8.3	1.5	1.9	0.1	100.1
4/21/12 9:25	20.5	2.7	8.2	1.6	1.9	0.1	100.0
4/21/12 9:25	20.5	2.9	8.2	1.7	1.8	0.1	99.9
4/21/12 9:25	20.5	3.1	8.2	1.6	1.8	0.1	99.8

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
4/21/12 9:25	20.6	3.4	8.2	1.6	1.6	0.1	99.7
4/21/12 9:25	20.6	3.6	8.2	1.6	1.7	0.1	99.7
4/21/12 9:25	20.5	3.8	8.1	1.6	1.7	0.1	99.6
5/19/12 9:11	21.2	0.3	8.9	0.0	1.5	0.1	101.9
5/19/12 9:11	21.2	0.3	8.8	0.0	1.5	0.1	101.9
5/19/12 9:11	21.2	0.3	8.8	0.0	1.5	0.1	101.9
5/19/12 9:11	21.2	0.5	8.7	0.0	1.5	0.1	101.9
5/19/12 9:11	21.2	0.8	8.7	0.0	1.5	0.1	101.9
5/19/12 9:11	21.1	1.1	8.6	0.0	1.5	0.1	102.0
5/19/12 9:11	21.1	1.4	8.6	0.0	1.5	0.1	102.0
5/19/12 9:11	21.1	1.5	8.5	0.0	1.5	0.1	102.0
5/19/12 9:11	21.1	1.7	8.5	0.0	1.5	0.1	102.0
5/19/12 9:11	21.1	1.9	8.4	0.0	1.5	0.1	102.0
5/19/12 9:11	21.1	2.1	8.4	0.0	1.5	0.1	102.0
5/19/12 9:12	21.1	2.4	8.3	0.0	1.5	0.1	102.0
5/19/12 9:12	21.1	2.7	8.3	0.0	1.5	0.1	102.0
5/19/12 9:12	21.1	2.9	8.2	0.0	1.5	0.1	102.0
5/19/12 9:12	21.1	3.2	8.1	0.0	1.5	0.1	102.0
5/19/12 9:12	21.1	3.4	8.1	0.0	1.5	0.1	102.1
6/30/12 9:28	21.4	0.2	9.1	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.2	9.0	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.2	8.9	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.3	8.9	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.4	8.8	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.5	8.8	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.6	8.8	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	0.7	8.7	0.0	2.3	0.1	101.8
6/30/12 9:28	21.5	0.8	8.7	0.0	2.3	0.1	101.7
6/30/12 9:28	21.5	0.9	8.6	0.0	2.3	0.1	101.6
6/30/12 9:28	21.5	1.0	8.6	0.0	2.3	0.1	101.7
6/30/12 9:28	21.5	1.1	8.6	0.0	2.3	0.1	101.7
6/30/12 9:28	21.4	1.3	8.6	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	1.6	8.5	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	1.9	8.5	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	2.2	8.5	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	2.5	8.4	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	2.8	8.4	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	3.0	8.4	0.0	2.3	0.1	101.8

Appendix 7: (Continued) Raw water column profile data for Station 1 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
6/30/12 9:28	21.4	3.3	8.4	0.0	2.3	0.1	101.8
6/30/12 9:28	21.4	3.5	8.4	1.0	1.3	0.1	103.7
6/30/12 9:28	21.5	3.8	8.3	1.0	2.1	0.1	104.1
6/30/12 9:28	21.5	3.9	8.3	1.0	1.8	0.1	103.9
6/30/12 9:28	21.5	4.1	8.3	1.0	1.8	0.1	103.8
6/30/12 9:28	21.4	4.2	8.3	0.8	1.7	0.1	104.1
6/30/12 9:28	21.4	4.3	8.3	0.8	1.8	0.1	103.7
6/30/12 9:28	21.4	4.5	8.3	0.9	1.8	0.1	103.4

Appendix 8: Raw water column profile data for Station 2 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 14:30	23.1	0.2	8.3	22.0	4.8	16.6	99.0
11/4/10 14:30	23.4	0.3	8.1	22.5	4.1	16.2	99.6
11/4/10 14:30	23.4	0.3	8.1	22.4	4.0	16.2	99.7
11/4/10 14:30	23.4	0.2	8.1	22.4	4.0	16.2	99.6
11/4/10 14:30	23.4	0.2	8.1	22.3	3.9	16.2	99.6
11/4/10 14:30	23.4	0.3	8.1	22.3	3.7	16.2	99.6
11/4/10 14:30	23.4	0.5	8.1	22.3	3.7	16.2	99.7
11/4/10 14:30	23.4	0.7	8.1	22.3	3.7	16.2	99.7
11/4/10 14:30	23.4	1.0	8.1	22.1	3.7	17.6	99.9
11/4/10 14:30	23.5	1.2	8.1	22.1	3.6	21.8	100.0
11/4/10 14:30	23.6	1.4	8.0	21.6	3.5	25.8	99.9
11/4/10 14:30	23.8	1.6	8.0	20.9	3.5	29.4	99.9
11/4/10 14:30	24.0	1.9	8.0	20.6	3.2	29.7	99.8
11/4/10 14:30	24.2	2.2	8.0	20.2	3.1	32.9	99.5
11/4/10 14:30	24.4	2.5	8.0	20.2	3.2	34.2	99.3
11/4/10 14:30	24.6	2.8	8.0	20.4	3.0	34.1	98.9
11/4/10 14:30	24.7	3.0	8.0	20.8	3.0	34.0	98.7
11/4/10 14:30	24.7	3.3	8.0	25.5	2.9	34.0	98.4
11/4/10 14:30	24.8	3.6	8.0	31.3	2.8	34.0	98.1
2/16/11 12:23	23.9	0.2	8.0	0.0	0.3	17.9	99.1
2/16/11 12:23	23.8	0.2	8.0	0.0	0.4	17.8	99.2
2/16/11 12:23	23.8	0.3	8.0	0.2	0.3	19.7	99.6
2/16/11 12:23	23.9	0.4	8.0	0.8	0.2	21.8	99.7
2/16/11 12:23	24.0	0.6	7.9	0.8	0.2	24.6	99.5
2/16/11 12:23	24.1	0.8	7.9	0.6	0.2	27.1	99.2
2/16/11 12:23	24.2	1.1	7.9	0.8	0.5	27.5	98.6
2/16/11 12:23	24.3	1.4	7.9	0.9	0.6	29.2	97.9
2/16/11 12:23	24.4	1.8	7.9	0.6	0.7	30.0	96.8
2/16/11 12:23	24.5	2.0	7.9	0.6	0.8	30.0	96.7
2/16/11 12:23	24.5	2.3	7.9	1.0	0.7	30.1	96.5
3/4/11 10:53	22.8	0.2	8.1	13.3	1.7	16.3	96.5
3/4/11 10:53	23.1	0.2	8.0	4.7	1.8	18.1	97.5
3/4/11 10:53	23.2	0.2	8.0	3.7	1.8	17.5	97.2
3/4/11 10:53	23.4	0.5	8.0	2.7	1.8	30.0	97.2
3/4/11 10:53	23.7	0.8	8.0	1.5	1.5	31.9	97.1
3/4/11 10:53	23.9	1.3	8.0	0.9	1.6	32.8	97.0
3/4/11 10:53	24.0	1.6	8.0	0.4	1.4	32.9	96.8
3/4/11 10:53	24.1	2.0	8.0	0.0	1.7	33.0	96.5

Appendix 8: (Continued) Raw water column profile data for Station 2 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/4/11 10:53	24.2	2.3	8.0	0.5	1.7	33.0	96.4
3/4/11 10:53	24.2	2.6	8.0	1.5	2.0	33.0	96.3
3/4/11 10:53	24.3	2.8	8.0	2.1	2.1	33.1	96.4
3/4/11 10:53	24.3	3.0	8.0	2.3	2.2	33.1	96.2
3/4/11 10:53	24.3	3.0	8.0	4.8	2.3	33.2	96.0
3/10/11 9:16	21.1	0.3	8.3	0.4	0.0	0.1	101.3
3/10/11 9:16	21.1	0.3	8.3	0.0	0.6	0.0	100.6
3/10/11 9:17	21.1	0.3	8.3	0.3	0.3	1.6	100.4
3/10/11 9:17	21.1	0.3	8.2	0.6	0.6	1.7	100.1
3/10/11 9:17	21.2	0.3	8.2	0.7	0.5	1.7	99.7
3/10/11 9:17	21.2	0.5	8.2	0.6	0.5	1.6	99.3
3/10/11 9:17	21.2	0.6	8.1	0.6	0.6	1.6	99.3
3/10/11 9:17	21.2	0.7	8.1	0.5	0.5	1.6	99.2
3/10/11 9:17	21.2	0.9	8.1	0.6	0.5	1.6	99.1
3/10/11 9:17	21.2	1.0	8.0	2.2	0.7	2.3	99.3
3/10/11 9:17	21.3	1.2	7.3	5.7	1.0	9.6	100.1
3/10/11 9:17	22.7	1.4	7.3	13.4	1.4	11.1	98.7
3/10/11 9:17	22.9	1.6	7.3	32.2	2.1	16.1	97.1
4/5/11 11:19	24.5	0.3	8.1	0.0	21.5	0.0	95.5
4/5/11 11:19	24.1	0.3	8.1	3.8	21.6	0.0	96.1
4/5/11 11:19	24.1	0.3	8.2	3.0	19.7	18.2	96.6
4/5/11 11:19	24.2	0.5	8.1	2.5	18.3	18.9	97.9
4/5/11 11:19	25.4	0.9	8.1	2.3	16.8	20.9	97.4
5/22/11 9:50	23.5	0.2	8.0	0.0	8.4	0.4	100.9
5/22/11 9:50	23.5	0.2	8.0	0.0	4.6	0.8	101.0
5/22/11 9:50	23.5	0.2	8.0	13.5	4.1	19.2	100.8
5/22/11 9:50	23.5	0.3	8.0	11.4	3.4	20.9	101.3
5/22/11 9:50	23.5	0.4	8.0	10.8	3.2	21.0	101.3
5/22/11 9:50	23.5	0.7	8.0	10.1	2.8	21.0	100.8
5/22/11 9:50	23.6	1.0	8.0	11.6	2.8	24.5	100.8
6/23/11 9:57	24.3	0.3	7.9	9.0	0.3	0.4	101.7
6/23/11 9:57	24.3	0.3	7.9	8.2	3.0	9.1	101.2
6/23/11 9:57	24.3	0.4	7.9	7.5	2.9	19.3	100.7
6/23/11 9:57	24.4	0.6	7.9	7.2	2.6	20.8	100.6
6/23/11 9:57	24.4	1.0	7.9	7.2	2.6	23.2	100.8
6/23/11 9:57	24.6	1.3	7.9	7.4	2.4	23.7	100.7
6/23/11 9:57	24.8	1.6	7.9	7.5	2.6	23.9	100.8

Appendix 8: (Continued) Raw water column profile data for Station 2 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
6/23/11 9:57	24.8	1.8	7.9	11.5	2.7	26.5	100.7
6/23/11 9:57	25.1	2.1	7.9	0.0	3.0	27.2	100.7
6/23/11 9:57	25.3	2.4	7.9	0.1	2.7	27.0	98.3
6/23/11 9:57	25.5	2.5	7.9	0.1	2.4	23.1	91.7
6/23/11 9:58	25.7	2.7	7.8	10.3	2.2	19.8	83.2
6/23/11 9:58	25.8	2.7	7.8	7.3	2.1	19.7	76.1
8/27/11 10:57	27.6	0.2	7.6	1.6	1.3	32.1	99.8
8/27/11 10:57	27.7	0.2	7.6	1.6	1.4	1.4	99.9
8/27/11 10:57	27.7	0.2	7.6	0.2	1.2	32.1	100.0
8/27/11 10:57	27.7	0.4	7.6	0.0	1.2	32.1	100.0
8/27/11 10:57	27.7	0.7	7.7	0.8	1.1	32.1	99.9
8/27/11 10:57	27.7	1.2	7.7	0.4	1.3	32.1	99.9
8/27/11 10:58	27.7	1.7	7.7	0.4	1.3	32.1	99.9
8/27/11 10:58	27.7	2.2	7.7	0.9	1.4	32.1	100.0
8/27/11 10:58	27.7	2.6	7.7	1.9	1.3	32.1	99.9
9/25/11 10:46	26.3	0.2	8.8	2.9	4.2	1.4	100.2
9/25/11 10:46	27.1	1.2	8.7	0.2	2.8	34.4	100.8
9/25/11 10:46	27.3	2.7	8.7	0.0	2.1	34.8	101.4
10/23/11 9:34	24.0	0.1	7.9	75.8	9.2	0.5	99.9
10/23/11 9:34	24.0	0.1	7.8	75.8	7.4	3.4	98.4
10/23/11 9:34	24.0	0.1	7.8	94.0	7.1	24.9	97.7
10/23/11 9:34	24.0	0.3	7.8	79.4	6.8	26.5	97.6
10/23/11 9:34	24.1	0.6	7.8	61.4	6.4	31.1	97.7
10/23/11 9:34	24.4	0.8	7.8	47.0	5.9	34.7	97.7
10/23/11 9:34	24.8	1.0	7.8	40.0	5.4	36.4	97.4
10/23/11 9:34	25.1	1.3	7.9	32.9	4.9	39.2	97.0
10/23/11 9:35	25.3	1.5	7.9	28.5	4.5	39.7	96.5
10/23/11 9:35	25.5	1.7	7.9	24.5	4.1	39.7	95.8
10/23/11 9:35	25.6	1.9	7.9	22.6	4.1	39.7	95.2
10/23/11 9:35	25.8	2.2	7.9	21.3	3.9	39.8	94.3
10/23/11 9:35	25.9	2.5	7.9	21.4	3.8	39.9	93.1
10/23/11 9:35	25.9	2.7	7.9	21.3	3.7	40.0	91.9
10/23/11 9:35	26.0	2.9	7.9	23.6	3.6	40.0	90.7
10/23/11 9:35	26.0	3.1	7.9	30.7	3.6	40.1	89.6
10/23/11 9:35	26.0	3.3	7.9	33.5	3.7	40.1	88.6
10/23/11 9:35	26.0	3.5	7.9	48.1	3.7	40.0	87.9
10/23/11 9:35	26.0	3.6	7.9	54.8	3.8	40.0	87.2
11/1/11 10:18	22.5	0.3	7.5	209.5	5.1	1.3	95.2

Appendix 8: (Continued) Raw water column profile data for Station 2 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/1/11 10:18	22.5	0.3	7.5	208.8	4.7	2.7	94.9
11/1/11 10:18	22.4	0.3	7.5	207.4	4.8	4.6	94.8
11/1/11 10:18	22.6	0.6	7.4	194.6	4.7	22.4	96.0
11/1/11 10:18	24.2	0.9	7.4	181.3	4.5	26.9	95.4
11/1/11 10:18	24.7	1.3	7.5	168.0	4.3	28.9	95.7
11/1/11 10:18	24.8	1.7	7.6	155.7	4.0	30.1	95.7
11/1/11 10:18	25.0	2.1	7.7	143.4	3.8	31.4	95.2
12/14/11 10:24	22.1	0.3	7.9	0.0	0.3	0.2	97.9
12/14/11 10:24	22.0	0.3	7.8	3.0	9.7	11.2	97.6
12/14/11 10:24	22.0	0.5	7.8	3.3	8.0	18.9	98.3
12/14/11 10:24	22.3	0.8	7.8	3.1	6.7	24.3	98.5
12/14/11 10:24	23.3	1.2	7.8	3.5	6.2	25.9	97.7
12/14/11 10:24	23.4	1.5	7.8	4.9	5.6	26.2	97.9
12/14/11 10:24	23.4	1.8	7.8	7.0	5.4	27.1	97.8
12/14/11 10:24	23.5	2.0	7.8	20.3	5.5	28.0	97.4
1/28/12 10:16	22.6	0.3	8.0	0.0	0.0	0.8	99.1
1/28/12 10:16	22.5	0.3	8.0	0.0	1.2	11.9	99.3
1/28/12 10:16	22.5	0.3	8.0	0.9	1.0	12.0	99.5
1/28/12 10:16	22.5	0.3	8.0	0.9	0.5	12.7	100.0
1/28/12 10:16	22.6	0.5	7.9	1.5	0.7	20.6	101.6
1/28/12 10:16	24.0	0.7	7.9	1.7	0.6	28.8	100.7
1/28/12 10:16	24.5	0.9	7.9	1.7	0.8	30.8	100.7
1/28/12 10:16	24.7	1.1	7.9	1.9	0.6	33.9	100.6
1/28/12 10:16	24.7	1.4	7.9	1.9	0.7	34.2	100.6
1/28/12 10:16	24.8	1.6	8.0	1.8	0.8	34.2	100.6
1/28/12 10:16	24.8	1.9	8.0	1.8	0.8	34.2	100.5
1/28/12 10:17	24.8	2.1	8.0	2.3	0.9	34.2	100.3
1/28/12 10:17	24.8	2.3	8.0	3.2	1.0	34.2	100.2
1/28/12 10:17	24.9	2.4	8.0	10.2	2.0	34.2	100.2
2/25/12 10:53	22.5	0.2	8.2	0.0	0.5	7.2	99.0
2/25/12 10:53	22.5	0.2	8.2	0.0	1.2	11.1	99.3
2/25/12 10:53	22.6	0.2	8.2	0.5	1.2	14.2	99.4
2/25/12 10:53	22.6	0.4	8.1	0.9	1.1	16.1	100.2
2/25/12 10:53	22.8	0.6	8.0	1.1	1.1	31.2	101.2
2/25/12 10:54	23.9	0.9	8.0	0.9	1.0	33.3	100.2
2/25/12 10:54	24.0	1.1	8.0	0.7	1.1	33.8	100.4
2/25/12 10:54	24.0	1.4	8.0	0.7	1.0	34.8	100.8
2/25/12 10:54	24.1	1.6	8.0	0.7	1.1	35.0	101.0

Appendix 8: (Continued) Raw water column profile data for Station 2 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/25/12 10:54	24.2	1.8	8.0	0.9	1.1	34.9	101.3
3/3/12 10:27	23.0	0.2	7.8	0.0	1.4	14.7	100.0
3/3/12 10:27	23.0	0.2	7.9	0.0	1.4	29.5	100.0
3/3/12 10:27	23.0	0.2	7.9	0.0	1.4	29.5	100.0
3/3/12 10:27	23.0	0.4	7.9	0.0	1.4	29.5	100.0
3/3/12 10:28	23.0	0.6	7.9	0.0	1.4	29.5	100.0
3/3/12 10:28	23.0	0.9	7.9	0.0	1.4	29.5	100.0
3/3/12 10:28	23.0	1.1	7.9	0.0	1.4	29.6	100.0
3/3/12 10:28	23.0	1.4	7.9	0.0	1.4	29.7	100.0
3/3/12 10:28	23.0	1.6	7.9	0.0	1.4	29.9	100.0
3/3/12 10:28	23.0	2.0	7.9	0.0	1.4	30.1	100.0
3/3/12 10:28	23.0	2.3	7.9	0.0	1.4	31.3	100.1
3/3/12 10:28	22.9	2.6	7.9	0.0	1.4	31.9	100.1
3/3/12 10:28	22.9	2.9	7.9	0.0	1.4	32.3	100.1
3/3/12 10:28	22.9	3.0	7.9	0.0	1.4	32.3	100.1
3/7/12 11:25	21.7	0.3	8.1	63.5	5.6	0.1	97.9
3/7/12 11:25	21.5	0.3	8.0	66.3	6.5	8.6	98.0
3/7/12 11:25	21.5	0.5	7.9	61.4	5.7	10.4	98.3
3/7/12 11:25	21.7	0.9	7.8	54.5	5.2	24.9	98.6
3/7/12 11:25	22.1	1.3	7.7	57.5	4.9	26.1	98.2
4/21/12 12:47	23.8	0.0	8.2	0.0	25.6	0.4	101.6
4/21/12 12:47	23.8	0.1	8.2	0.0	12.3	10.7	101.8
4/21/12 12:47	23.9	0.1	8.1	0.2	9.4	10.7	102.0
4/21/12 12:47	23.9	0.3	8.0	0.8	7.9	20.9	103.1
4/21/12 12:47	24.2	0.7	7.9	0.9	6.8	31.5	103.5
4/21/12 12:47	24.4	1.1	7.9	1.0	6.0	32.4	103.9
4/21/12 12:47	24.7	1.5	7.9	1.8	5.5	33.1	104.2
4/21/12 12:47	24.9	1.9	7.9	3.1	5.0	33.4	104.6
4/21/12 12:47	25.1	2.2	7.9	5.4	4.6	33.5	104.8
5/19/12 11:54	26.7	0.3	8.0	0.0	0.0	27.9	102.8
5/19/12 11:54	26.8	0.3	8.0	0.0	1.4	31.0	103.6
5/19/12 11:54	26.9	0.3	8.0	0.0	2.0	31.4	103.9
5/19/12 11:54	27.0	0.4	8.0	2.1	1.8	32.0	104.0
5/19/12 11:54	27.1	0.5	8.0	2.1	1.5	32.6	104.3
5/19/12 11:54	27.2	0.7	8.0	2.5	1.7	32.7	104.4
5/19/12 11:54	27.3	0.9	8.0	3.2	1.9	33.5	104.9
5/19/12 11:54	27.4	1.1	8.0	3.4	2.1	34.2	105.0
5/19/12 11:54	27.5	1.4	8.0	3.5	2.1	34.2	105.4

Appendix 8: (Continued) Raw water column profile data for Station 2 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/19/12 11:54	27.6	1.7	8.0	3.9	2.2	34.2	105.7
5/19/12 11:54	27.6	2.0	8.0	4.2	2.2	34.2	106.2
5/19/12 11:54	27.7	2.2	8.0	4.8	2.3	34.2	106.9
5/19/12 11:54	27.7	2.4	8.0	8.3	3.1	34.3	107.5
6/30/12 11:51	26.1	0.2	8.2	0.0	0.6	21.2	105.2
6/30/12 11:51	26.1	0.2	8.2	0.1	0.2	21.6	105.4
6/30/12 11:52	26.2	0.4	8.1	0.4	0.1	23.9	106.1
6/30/12 11:52	26.2	0.6	8.1	0.7	0.2	25.5	106.2
6/30/12 11:52	26.3	0.9	8.0	1.0	0.4	30.3	106.6
6/30/12 11:52	26.3	1.4	8.0	1.4	0.5	33.4	106.3
6/30/12 11:52	26.2	1.6	8.0	1.5	0.6	33.5	105.7
6/30/12 11:52	26.1	2.0	8.0	1.7	0.5	33.6	104.9
6/30/12 11:52	26.0	2.4	8.0	1.9	0.7	33.8	104.4
6/30/12 11:52	26.0	2.8	8.0	2.6	0.7	33.9	104.3
6/30/12 11:52	26.0	3.0	8.0	3.8	0.8	34.0	104.7
6/30/12 11:52	26.0	3.2	8.0	5.8	1.0	34.0	105.1
6/30/12 11:52	26.1	3.4	8.0	10.0	1.1	34.1	105.3
6/30/12 11:52	26.1	3.6	8.0	15.7	1.2	34.1	105.1
6/30/12 11:52	26.1	3.8	8.0	25.4	1.7	34.1	105.1

Appendix 9: Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
11/4/10 14:35	24.6	0.2	8.1	5.0	2.3	33.9	101.4
11/4/10 14:35	24.7	0.3	8.1	6.1	1.4	33.6	102.7
11/4/10 14:35	24.7	0.3	8.1	6.0	1.4	33.6	102.7
11/4/10 14:35	24.7	0.4	8.1	6.0	1.4	33.6	102.7
11/4/10 14:35	24.7	0.6	8.1	6.1	1.4	33.6	102.6
11/4/10 14:35	24.7	0.8	8.1	6.1	1.3	33.6	102.6
11/4/10 14:35	24.7	1.1	8.1	6.1	1.3	33.6	102.6
11/4/10 14:35	24.7	1.4	8.1	6.2	1.2	33.6	102.5
11/4/10 14:35	24.7	1.7	8.1	6.2	1.1	33.6	102.5
11/4/10 14:36	24.7	2.1	8.1	6.2	1.1	33.6	102.5
11/4/10 14:36	24.7	2.5	8.1	6.2	1.1	33.6	102.4
11/4/10 14:36	24.7	2.8	8.1	6.2	1.2	33.6	102.5
11/4/10 14:36	24.7	3.1	8.1	6.2	1.2	33.6	102.5
11/4/10 14:36	24.7	3.5	8.1	6.2	1.3	33.6	102.5
11/4/10 14:36	24.7	4.1	8.1	6.3	1.2	33.6	102.5
11/4/10 14:36	24.7	4.4	8.1	6.3	1.1	33.7	102.6
11/4/10 14:36	24.7	4.8	8.1	6.2	1.1	33.7	102.8
11/4/10 14:36	24.7	5.3	8.1	6.1	1.2	33.8	103.0
11/4/10 14:36	24.8	5.9	8.1	6.1	1.3	33.8	103.2
11/4/10 14:36	24.8	6.5	8.1	6.1	1.2	33.9	103.5
11/4/10 14:36	24.8	7.1	8.1	6.0	1.2	34.0	103.7
12/10/10 14:12	24.6	0.2	8.2	0.2	1.3	30.1	93.3
12/10/10 14:12	24.5	0.0	8.2	0.3	1.5	33.8	89.8
12/10/10 14:12	24.5	0.3	8.2	0.3	1.3	33.8	89.7
12/10/10 14:12	24.5	0.8	8.2	0.4	1.2	33.8	89.6
12/10/10 14:12	24.5	1.4	8.2	0.4	1.2	33.8	89.5
12/10/10 14:12	24.6	2.1	8.2	0.3	1.2	34.8	89.6
12/10/10 14:12	24.6	2.7	8.2	0.2	1.3	34.7	89.8
12/10/10 14:12	24.7	3.3	8.2	0.2	1.2	34.8	90.2
12/10/10 14:12	24.7	3.9	8.2	0.1	1.3	34.8	90.6
12/10/10 14:12	24.8	4.4	8.2	0.0	1.3	34.8	91.1
12/10/10 14:12	24.8	5.0	8.2	0.0	1.3	34.8	91.6
12/10/10 14:12	24.8	5.8	8.2	0.0	1.3	34.9	92.0
12/10/10 14:12	24.8	6.6	8.2	0.0	1.3	34.9	92.3
2/16/11 12:14	24.5	0.6	7.9	1.0	0.0	26.3	100.9
2/16/11 12:14	24.5	0.5	8.0	1.0	0.0	27.0	100.9
2/16/11 12:14	24.5	0.4	8.0	1.0	0.0	27.0	100.9
2/16/11 12:14	24.5	0.5	8.0	1.0	0.0	27.0	100.9

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
2/16/11 12:14	24.5	0.7	8.0	1.0	0.0	27.1	100.9
2/16/11 12:14	24.5	0.8	8.0	1.0	0.0	27.2	100.9
2/16/11 12:14	24.5	0.9	8.0	1.0	0.0	28.0	100.9
2/16/11 12:14	24.4	1.1	8.0	1.0	0.0	27.7	101.0
2/16/11 12:14	24.4	1.3	8.0	1.0	0.0	28.0	101.0
2/16/11 12:14	24.4	1.5	8.0	1.0	0.0	28.4	101.0
2/16/11 12:14	24.4	1.7	8.0	1.0	0.0	29.3	101.1
2/16/11 12:14	24.4	2.0	8.0	1.0	0.0	30.1	101.1
2/16/11 12:14	24.3	2.3	8.0	0.0	1.6	30.2	99.0
2/16/11 12:14	24.3	2.7	8.0	0.0	1.8	30.3	99.2
2/16/11 12:15	24.3	3.1	8.0	0.0	1.9	30.5	99.3
2/16/11 12:15	24.4	3.6	8.0	0.0	2.3	30.6	99.4
2/16/11 12:15	24.4	3.9	8.0	0.0	7.0	30.8	99.8
2/16/11 12:15	24.4	4.0	8.0	5.8	6.8	30.9	100.3
3/4/11 10:38	24.0	0.2	8.1	1.0	1.0	31.0	95.5
3/4/11 10:38	24.0	0.2	8.1	1.0	1.0	31.1	95.5
3/4/11 10:38	24.0	0.3	8.1	1.0	0.3	31.3	95.4
3/4/11 10:38	24.0	0.5	8.1	0.0	0.5	31.3	96.0
3/4/11 10:38	24.0	0.8	8.1	0.3	1.3	31.4	96.1
3/4/11 10:38	24.0	1.4	8.0	0.2	1.3	33.1	95.9
3/4/11 10:39	24.1	1.8	8.0	0.4	1.1	33.1	95.9
3/4/11 10:39	24.1	2.7	8.0	0.8	1.2	33.2	95.6
3/4/11 10:39	24.2	3.1	8.0	0.9	1.3	33.2	95.6
3/4/11 10:39	24.2	3.7	8.0	1.3	1.4	33.2	96.1
3/4/11 10:39	24.2	4.1	8.1	1.4	1.2	33.2	96.5
3/4/11 10:39	24.2	4.4	8.1	1.9	1.1	33.2	96.0
3/4/11 10:39	24.2	4.5	8.1	2.3	1.1	33.2	96.3
3/4/11 10:39	24.2	4.7	8.1	2.6	1.0	33.3	95.9
3/4/11 10:39	24.2	4.7	8.1	2.8	1.0	33.3	96.2
3/4/11 10:39	24.2	4.8	8.1	3.1	1.0	33.3	95.8
3/4/11 10:39	24.2	4.8	8.1	3.6	1.0	33.3	95.7
3/4/11 10:39	24.2	4.8	8.1	3.7	1.0	33.3	95.8
3/4/11 10:39	24.2	4.8	8.1	3.8	0.9	33.3	95.6
3/4/11 10:39	24.2	4.8	8.1	4.1	0.9	33.3	95.6
3/4/11 10:39	24.2	4.8	8.1	4.4	0.9	33.3	95.6
3/4/11 10:39	24.2	4.8	8.1	4.6	0.8	33.3	95.6
3/4/11 10:39	24.2	4.9	8.1	4.6	0.9	33.3	95.5
3/4/11 10:39	24.2	4.9	8.1	4.6	1.0	33.3	95.5

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/4/11 10:39	24.2	4.9	8.1	4.6	1.0	33.3	95.4
3/4/11 10:39	24.2	4.9	8.1	4.5	0.9	33.3	95.4
3/4/11 10:39	24.2	4.8	8.1	4.5	0.9	33.3	95.6
3/4/11 10:39	24.2	4.8	8.1	4.5	0.8	33.3	95.6
3/4/11 10:39	24.2	4.8	8.1	4.6	0.8	33.3	95.8
3/4/11 10:39	24.2	4.9	8.1	4.6	0.9	33.3	95.8
3/4/11 10:39	24.2	4.9	8.1	4.6	1.0	33.3	95.8
3/4/11 10:39	24.2	4.9	8.1	4.5	0.9	33.4	95.7
3/4/11 10:39	24.2	4.9	8.1	4.5	0.9	33.4	95.7
3/4/11 10:39	24.2	4.9	8.1	4.5	0.9	33.4	95.7
3/4/11 10:39	24.2	4.8	8.1	4.5	0.9	33.4	95.9
3/4/11 10:39	24.2	4.9	8.1	4.6	0.8	33.4	95.8
3/4/11 10:40	24.2	4.8	8.1	4.6	0.9	33.4	95.6
3/4/11 10:40	24.2	4.9	8.1	4.6	1.0	33.4	95.5
3/4/11 10:40	24.2	4.9	8.1	4.7	0.9	33.4	95.5
3/4/11 10:40	24.2	4.9	8.1	4.9	1.0	33.4	95.5
3/4/11 10:40	24.2	4.9	8.1	4.9	0.9	33.4	95.3
3/4/11 10:40	24.2	4.9	8.1	4.8	0.9	33.4	94.9
3/10/11 9:07	21.5	0.3	8.0	31.0	5.6	0.3	0.0
3/10/11 9:07	21.8	0.3	8.0	31.1	5.6	0.1	0.0
3/10/11 9:07	21.8	0.3	8.0	31.1	5.6	0.1	0.0
3/10/11 9:07	21.8	0.3	8.0	31.1	5.6	5.6	0.0
3/10/11 9:07	21.8	0.3	8.0	31.1	5.6	5.6	0.0
3/10/11 9:07	21.9	0.4	8.0	31.1	5.6	5.6	0.0
3/10/11 9:07	21.9	0.5	7.9	31.1	5.6	5.6	0.0
3/10/11 9:07	21.9	0.6	7.9	31.1	5.6	5.6	0.0
3/10/11 9:07	21.9	0.9	7.9	31.1	5.6	5.8	0.0
3/10/11 9:07	21.9	1.0	7.9	31.1	5.6	7.8	0.0
3/10/11 9:07	22.0	1.2	7.8	31.1	5.6	15.7	0.0
3/10/11 9:07	22.2	1.7	7.7	31.2	5.6	18.1	0.0
3/10/11 9:07	22.4	2.1	7.7	31.2	5.6	18.6	0.0
3/10/11 9:07	22.6	2.5	7.7	31.2	5.6	19.6	0.0
3/10/11 9:07	22.7	2.8	7.7	31.3	5.6	20.7	0.0
3/10/11 9:07	22.8	3.0	7.7	31.3	5.6	22.0	0.0
3/10/11 9:07	22.9	3.3	7.7	31.3	5.6	22.9	0.0
3/10/11 9:08	23.0	3.4	7.7	31.3	4.8	23.1	0.0
3/10/11 9:08	23.0	3.6	7.7	22.1	3.0	23.1	89.9
3/10/11 9:08	23.0	3.7	7.7	22.1	3.1	23.3	89.4

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/10/11 9:08	23.0	3.7	7.7	22.1	3.0	23.6	88.7
3/10/11 9:08	23.0	3.7	7.7	22.1	3.1	23.8	88.0
4/5/11 11:12	24.0	0.3	8.0	0.0	0.0	0.0	98.4
4/5/11 11:12	25.3	0.3	8.0	0.0	1.5	34.3	96.3
4/5/11 11:12	25.3	0.4	8.0	0.1	1.4	34.2	96.2
4/5/11 11:12	25.3	0.7	8.0	0.1	1.3	34.2	96.2
4/5/11 11:12	25.3	1.2	8.0	0.1	1.4	34.3	96.1
4/5/11 11:13	25.3	1.8	8.0	0.2	1.3	34.4	96.4
4/5/11 11:13	25.4	2.3	8.0	0.7	1.6	34.6	96.6
5/22/11 9:40	24.3	0.3	7.8	0.0	0.3	31.7	102.0
5/22/11 9:40	24.3	0.3	7.8	0.0	0.3	31.7	102.0
5/22/11 9:40	24.3	0.3	7.8	0.0	0.3	31.7	102.0
5/22/11 9:40	24.3	0.5	7.8	0.0	0.3	31.7	102.0
5/22/11 9:40	24.3	0.8	7.8	0.0	0.3	31.8	102.0
5/22/11 9:40	24.3	1.2	7.8	0.0	0.3	31.8	102.0
5/22/11 9:40	24.3	1.7	7.8	0.0	0.3	31.9	102.0
5/22/11 9:40	24.4	2.2	7.8	0.0	0.3	36.6	102.0
5/22/11 9:40	24.5	2.6	7.8	0.0	0.3	37.2	101.7
5/22/11 9:40	24.8	3.0	7.8	0.0	0.3	37.1	101.3
5/22/11 9:40	25.0	3.2	7.8	0.0	0.3	37.1	101.0
5/22/11 9:40	25.1	3.4	7.8	0.0	0.3	37.3	100.8
5/22/11 9:40	25.2	3.6	7.8	0.0	0.3	37.6	100.6
5/22/11 9:40	25.3	3.8	7.8	0.0	1.7	37.9	100.5
5/22/11 9:40	25.3	3.8	7.8	19.1	2.6	38.1	105.2
5/22/11 9:41	25.4	3.9	7.8	19.1	1.6	38.2	105.2
5/22/11 9:41	25.4	3.9	7.8	19.1	1.1	38.4	105.5
5/22/11 9:41	25.4	3.9	7.8	19.1	1.0	38.5	105.8
6/23/11 9:48	24.5	0.2	8.0	0.1	2.3	9.1	100.5
6/23/11 9:48	24.5	0.2	8.0	0.1	2.3	21.2	100.4
6/23/11 9:48	24.6	0.4	8.0	0.1	2.3	23.9	100.3
6/23/11 9:48	24.7	0.6	7.9	0.1	2.3	24.6	100.1
6/23/11 9:48	24.8	0.8	7.9	0.1	2.3	24.6	99.9
6/23/11 9:48	24.9	1.2	7.9	0.0	2.3	24.6	99.8
6/23/11 9:48	25.0	1.5	7.9	0.0	2.3	25.3	99.6
6/23/11 9:48	25.1	1.8	7.9	0.0	2.3	26.7	99.5
6/23/11 9:48	25.3	2.1	7.9	0.0	2.3	27.1	99.3
6/23/11 9:48	25.4	2.3	7.9	0.0	2.3	27.6	99.1
6/23/11 9:48	25.5	2.6	7.9	0.0	2.3	28.6	98.9

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
6/23/11 9:49	25.5	3.0	7.9	0.0	2.3	28.6	98.9
6/23/11 9:49	25.6	3.5	7.9	0.0	0.0	28.9	98.8
6/23/11 9:49	25.6	3.7	7.9	8.2	2.4	29.5	95.9
6/23/11 9:49	25.7	4.0	7.9	8.2	2.3	29.5	96.1
6/23/11 9:49	25.8	4.2	7.9	8.2	2.2	29.6	96.3
6/23/11 9:49	25.9	4.5	7.9	8.2	5.8	28.0	96.4
8/27/11 10:12	27.2	0.2	7.7	0.1	4.6	8.5	97.5
8/27/11 10:12	27.3	0.2	7.8	0.0	4.6	3.4	97.3
8/27/11 10:12	27.3	0.3	7.8	0.0	4.6	32.7	97.3
8/27/11 10:12	27.3	0.5	7.8	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	0.8	7.8	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	1.2	7.8	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	1.5	7.8	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	1.9	7.8	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	2.4	7.9	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	2.8	7.9	0.0	4.6	32.7	97.2
8/27/11 10:12	27.4	3.4	7.9	0.0	4.6	32.8	97.1
8/27/11 10:12	27.4	3.8	7.9	0.0	4.6	32.9	97.1
8/27/11 10:12	27.4	4.1	7.9	0.0	4.6	33.0	97.1
8/27/11 10:12	27.5	4.3	7.9	0.0	4.6	33.0	97.1
8/27/11 10:12	27.5	4.5	7.9	0.0	4.6	31.1	97.0
8/27/11 10:13	27.6	4.7	7.9	0.0	4.6	32.3	96.9
8/27/11 10:13	27.6	4.8	7.9	0.0	14.7	32.3	96.9
9/25/11 10:38	26.4	0.3	8.9	0.5	1.8	0.7	100.3
9/25/11 10:38	26.7	1.0	8.8	0.0	1.1	33.8	100.0
9/25/11 10:38	27.1	3.2	8.8	0.0	0.6	34.9	100.5
9/25/11 10:38	27.4	5.3	8.8	5.5	0.8	35.1	101.6
10/23/11 9:25	23.6	0.1	7.7	87.9	4.4	0.3	96.4
10/23/11 9:25	23.6	0.1	7.7	87.9	4.4	14.0	96.5
10/23/11 9:25	23.6	0.2	7.7	87.9	4.4	20.3	96.5
10/23/11 9:25	23.6	0.4	7.6	87.9	4.4	21.5	96.4
10/23/11 9:25	24.4	0.7	7.7	88.3	4.4	29.1	95.2
10/23/11 9:25	25.4	1.2	7.7	88.9	4.4	39.7	93.8
10/23/11 9:25	25.7	1.6	7.8	89.0	4.4	40.0	93.5
10/23/11 9:25	25.8	2.3	7.8	89.0	4.4	40.2	93.4
10/23/11 9:25	25.8	2.9	7.9	89.1	4.4	40.2	93.3
10/23/11 9:25	25.8	3.3	7.9	89.1	4.4	40.2	93.3
10/23/11 9:25	25.8	3.7	7.9	89.1	4.4	40.3	93.3

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
10/23/11 9:25	25.8	4.2	7.9	89.1	4.4	40.3	93.3
10/23/11 9:25	25.8	4.5	7.9	89.1	4.4	40.3	93.3
10/23/11 9:25	25.8	4.8	7.9	89.1	4.4	40.3	93.3
10/23/11 9:25	25.8	5.1	7.9	129.2	2.2	40.3	89.0
10/23/11 9:25	25.8	5.3	7.9	129.2	3.1	40.3	89.0
10/23/11 9:25	25.8	5.4	7.9	129.2	3.6	40.2	89.0
10/23/11 9:25	25.8	5.6	7.9	129.2	3.6	39.8	88.8
11/1/11 10:09	23.5	0.3	7.7	128.3	1.1	0.8	96.4
11/1/11 10:09	23.6	0.3	7.6	128.3	1.1	9.1	96.3
11/1/11 10:09	23.6	0.3	7.6	128.3	1.1	11.9	96.3
11/1/11 10:09	23.5	0.5	7.6	128.3	1.1	11.3	96.4
11/1/11 10:09	23.5	0.8	7.6	128.3	1.1	12.5	96.4
11/1/11 10:09	23.6	1.0	7.6	128.3	1.1	20.6	96.3
11/1/11 10:09	24.6	1.4	7.7	129.1	1.1	30.3	94.8
11/1/11 10:09	25.0	1.8	7.7	129.4	1.1	30.1	94.3
11/1/11 10:09	25.1	2.3	7.8	129.5	1.1	31.1	94.2
11/1/11 10:09	25.1	2.7	7.8	129.5	1.1	31.3	94.1
11/1/11 10:09	25.2	3.1	7.9	129.6	1.1	31.3	94.0
11/1/11 10:09	25.2	3.6	7.9	129.6	1.1	31.4	93.9
11/1/11 10:09	25.3	4.1	7.9	129.7	1.1	31.5	93.9
11/1/11 10:09	25.3	4.5	7.9	129.7	1.1	31.7	93.8
11/1/11 10:09	25.4	4.8	7.9	129.7	1.1	31.9	93.8
11/1/11 10:09	25.4	5.1	7.8	129.8	1.1	32.9	93.7
11/1/11 10:09	25.5	5.4	7.8	129.8	1.1	32.4	93.6
12/14/11 10:11	23.0	0.4	7.9	2.9	2.2	0.3	98.7
12/14/11 10:11	22.9	0.4	7.8	2.9	2.2	0.1	98.8
12/14/11 10:11	22.9	0.4	7.8	2.9	2.2	13.6	98.9
12/14/11 10:11	22.9	0.4	7.8	2.9	2.2	13.6	98.8
12/14/11 10:11	22.9	0.6	7.8	2.9	2.2	15.9	98.8
12/14/11 10:11	23.1	0.9	7.8	2.9	2.2	20.6	98.6
12/14/11 10:11	23.2	1.1	7.8	2.9	2.2	25.1	98.3
12/14/11 10:11	23.3	1.3	7.8	2.9	2.2	26.6	98.2
12/14/11 10:11	23.5	1.6	7.8	2.9	2.2	27.7	98.0
12/14/11 10:12	23.6	1.9	7.8	2.9	2.2	28.9	97.9
12/14/11 10:12	23.6	2.2	7.8	2.9	2.2	28.9	97.8
12/14/11 10:12	23.6	2.5	7.8	2.9	2.2	29.6	97.7
12/14/11 10:12	23.7	2.8	7.8	2.9	2.2	29.9	97.7
12/14/11 10:12	23.7	3.0	7.8	2.9	2.2	29.9	97.7

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
12/14/11 10:12	23.7	3.1	7.8	2.9	2.2	29.9	97.7
12/14/11 10:12	23.7	3.3	7.8	2.9	5.2	30.0	97.6
1/28/12 10:04	24.7	0.3	8.0	0.0	6.4	5.0	101.6
1/28/12 10:04	24.7	0.3	8.0	0.0	7.6	34.6	101.8
1/28/12 10:04	24.7	0.3	8.0	0.4	6.0	34.6	101.7
1/28/12 10:04	24.7	0.4	8.0	0.4	4.8	34.6	101.6
1/28/12 10:04	24.7	0.7	8.0	0.5	4.0	34.6	101.6
1/28/12 10:04	24.7	0.9	8.0	0.8	3.6	34.7	101.5
1/28/12 10:04	24.7	1.2	8.0	0.9	3.1	34.7	101.4
1/28/12 10:04	24.7	1.4	8.0	0.7	2.8	34.6	101.4
1/28/12 10:04	24.7	1.7	8.0	0.6	2.6	34.6	101.4
1/28/12 10:04	24.7	2.1	8.0	0.6	2.5	34.6	101.5
1/28/12 10:04	24.7	2.4	8.0	0.5	2.2	34.6	101.5
1/28/12 10:04	24.7	2.6	8.0	0.5	2.1	34.6	101.6
1/28/12 10:04	24.7	2.8	8.0	0.5	1.9	34.6	101.6
1/28/12 10:04	24.7	3.0	8.0	0.5	1.9	34.6	101.6
1/28/12 10:05	24.7	3.1	8.0	0.5	1.8	34.6	101.6
1/28/12 10:05	24.7	3.2	8.0	0.5	1.6	34.6	101.6
1/28/12 10:05	24.7	3.3	8.0	0.7	1.5	34.6	101.7
1/28/12 10:05	24.7	3.3	8.0	0.8	1.2	34.6	101.8
1/28/12 10:05	24.7	3.5	8.0	1.1	1.4	34.6	101.9
1/28/12 10:05	24.7	3.7	8.0	2.9	2.3	34.6	102.0
1/28/12 10:05	24.8	3.8	8.0	4.0	3.5	34.6	102.1
1/28/12 10:05	24.8	3.8	8.0	4.2	3.9	34.6	102.3
1/28/12 10:05	24.8	3.9	8.0	4.9	4.1	34.6	102.3
1/28/12 10:05	24.8	3.9	8.0	5.3	4.1	34.6	102.3
2/25/12 10:49	24.1	0.2	8.1	0.0	0.9	34.7	101.3
2/25/12 10:49	24.1	0.2	8.1	0.7	0.4	34.8	101.5
2/25/12 10:49	24.1	0.3	8.1	0.6	0.4	34.8	101.6
2/25/12 10:49	24.1	0.5	8.1	0.5	0.3	34.8	101.6
2/25/12 10:49	24.1	0.7	8.1	0.5	0.4	34.8	101.6
2/25/12 10:49	24.1	0.9	8.1	0.5	0.4	34.8	101.8
2/25/12 10:49	24.1	1.2	8.1	0.5	0.5	34.8	101.8
2/25/12 10:49	24.1	1.5	8.1	0.5	0.5	34.8	101.8
2/25/12 10:50	24.1	1.8	8.1	0.5	0.5	34.8	101.8
2/25/12 10:50	24.1	2.1	8.1	0.5	0.6	34.8	101.7
2/25/12 10:50	24.1	2.4	8.1	0.5	0.6	34.8	101.8
2/25/12 10:50	24.1	2.7	8.1	0.5	0.6	34.8	101.9

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
3/3/12 10:32	21.1	0.2	8.2	2.2	1.5	0.1	98.9
3/3/12 10:32	21.2	0.2	8.1	1.4	5.0	4.7	98.7
3/3/12 10:33	21.2	0.3	8.0	1.4	4.7	5.9	98.9
3/3/12 10:33	21.2	0.6	7.6	1.2	4.3	22.9	100.1
3/3/12 10:33	22.3	1.0	7.6	0.8	4.0	25.9	99.4
3/3/12 10:33	22.6	1.3	7.7	0.5	3.7	28.9	99.5
3/3/12 10:33	22.7	1.5	7.7	0.4	3.5	29.6	99.7
3/3/12 10:33	22.7	1.8	7.8	0.2	3.2	30.3	99.6
3/3/12 10:33	22.8	2.0	7.8	0.0	3.2	31.5	99.4
3/7/12 11:20	22.8	0.3	8.0	0.0	4.4	1.6	95.3
3/7/12 11:20	22.8	0.4	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	0.6	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	1.0	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	1.4	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	1.7	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	2.1	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	2.4	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	2.7	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	3.0	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	3.3	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	3.6	8.0	0.0	4.4	29.8	95.3
3/7/12 11:20	22.8	3.8	8.0	0.0	4.4	27.4	95.3
3/7/12 11:20	22.8	4.0	8.0	0.0	4.4	26.2	95.3
3/7/12 11:20	22.8	4.1	8.0	0.0	4.4	26.4	95.3
3/7/12 11:20	22.8	4.2	8.0	0.0	4.4	26.4	95.3
4/21/12 12:40	25.2	0.2	8.0	0.0	0.3	1.5	103.7
4/21/12 12:40	25.2	0.1	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	0.1	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	0.3	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	0.6	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	0.9	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	1.3	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	1.7	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	2.0	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	2.5	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	3.0	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	3.3	8.0	0.0	0.3	33.9	103.7
4/21/12 12:40	25.2	3.6	8.0	0.0	0.3	33.9	103.7

Appendix 9: (Continued) Raw water column profile data for Station 3 of Waiahole Stream collected using a YSI 6600 Sonde.

Date/Time M/D/Y	Temp C	Depth ft	pH	Turb NTU	Chl-a µg/L	Sal ppt	ODO %
5/19/12 11:46	27.2	0.3	8.0	0.0	15.5	17.1	101.9
5/19/12 11:46	27.2	0.3	8.0	0.0	15.5	8.5	101.9
5/19/12 11:46	27.3	0.3	8.0	0.0	15.5	15.7	101.8
5/19/12 11:46	27.3	0.4	8.0	0.0	15.5	34.8	101.8
5/19/12 11:46	27.3	0.5	8.0	0.0	15.5	34.8	101.8
5/19/12 11:46	27.3	0.8	8.0	0.0	15.5	34.8	101.8
5/19/12 11:46	27.3	1.3	8.0	0.0	15.5	34.8	101.8
5/19/12 11:46	27.3	1.7	8.0	0.0	15.5	34.7	101.8
5/19/12 11:46	27.3	2.4	8.0	0.0	15.5	34.7	101.8
5/19/12 11:46	27.3	3.0	8.0	0.0	15.5	34.7	101.8
5/19/12 11:46	27.3	3.3	8.0	0.0	15.5	34.7	101.8
5/19/12 11:46	27.3	3.6	8.0	0.0	15.5	34.7	101.7
5/19/12 11:46	27.3	3.9	8.0	0.0	15.5	34.7	101.7
5/19/12 11:46	27.3	4.1	8.0	0.0	15.5	33.6	101.7
5/19/12 11:46	27.3	4.2	8.0	0.0	15.5	33.5	101.7
6/30/12 11:45	26.2	0.2	8.1	0.1	0.0	0.8	102.0
6/30/12 11:45	26.1	0.2	8.1	0.0	1.3	32.1	101.8
6/30/12 11:45	26.1	0.2	8.1	0.1	1.1	32.2	101.7
6/30/12 11:45	26.1	0.3	8.1	0.3	1.1	32.3	101.9
6/30/12 11:45	26.1	0.4	8.1	0.4	1.0	32.5	102.0
6/30/12 11:45	26.1	0.5	8.1	0.5	1.0	32.7	102.2
6/30/12 11:45	26.0	0.8	8.1	0.6	1.0	32.9	102.2
6/30/12 11:45	26.0	1.1	8.1	0.7	0.9	33.1	102.2
6/30/12 11:45	26.0	1.3	8.1	0.9	0.9	33.2	102.2
6/30/12 11:45	26.0	1.5	8.1	1.0	0.8	33.3	102.3
6/30/12 11:45	25.9	1.8	8.1	1.1	0.7	33.5	101.9
6/30/12 11:45	25.9	2.2	8.1	1.1	0.6	33.5	101.4
6/30/12 11:45	25.9	2.6	8.1	1.1	0.5	33.7	101.1
6/30/12 11:45	25.8	3.0	8.1	1.4	0.5	33.9	100.9
6/30/12 11:45	25.9	3.4	8.1	1.6	0.5	34.0	100.8
6/30/12 11:45	25.9	3.7	8.0	1.9	0.5	34.1	100.6
6/30/12 11:45	25.9	4.1	8.0	16.1	1.3	34.1	100.8

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