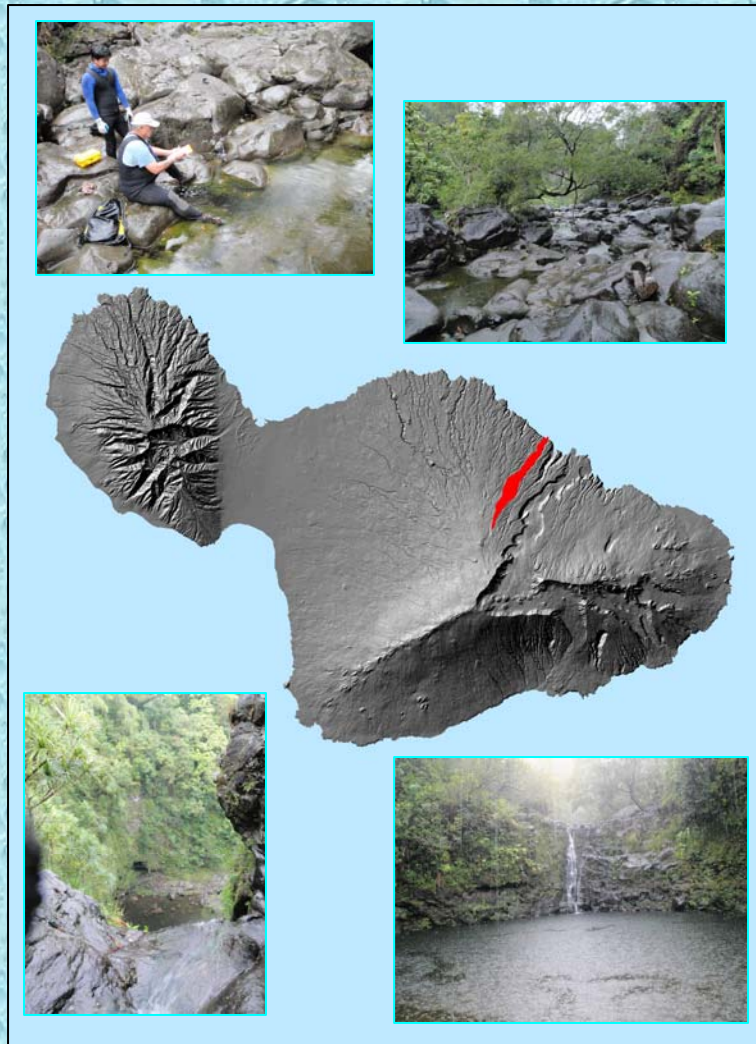


# Report on Puohokamo Stream Maui, Hawaii



**August 2009**

State of Hawai'i  
Department of Land and Natural Resources  
**Division of Aquatic Resources**

and

**Bishop Museum**





Funded in part by the Commission on  
Water Resource Management, DLNR  
and



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# Report on Puohokamoa Stream Maui, Hawai'i

August 2009

Prepared for  
Commission on Water Resource Management  
Department of Land and Natural Resources  
State of Hawai'i

Prepared by  
Division of Aquatic Resources<sup>1</sup>  
Department of Land and Natural Resources  
State of Hawai'i  
and  
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## Section 1: Introduction

### Overview

On May 24, 2001, the Native Hawaiian Legal Corporation (NHLC) filed a Petition to Amend the Interim Instream Flow Standard (IIFS) for 27 streams in east Maui on behalf of resident taro farmers. Since the acceptance of the petitions in July 2001, the Commission on Water Resource Management (CWRM) has been focused on gathering information for the 27 petitioned streams. Shortly thereafter, NHLC and CWRM staff reached an agreement that efforts would focus on 8 of the 27 petitioned streams: Honopou, Hanehoi, Huelo, Waiokamilo, Kualani, Pi'ina'au, Palauhulu, and Wailua Nui Streams. Currently, the CWRM is collaborating with the State's Division of Aquatic Resources and the U.S. Geological Survey (USGS) for assistance in collecting biological and hydrologic data to determine measurable interim IFS. CWRM has also requested biological data on the remaining 19 petitioned streams which is the main purpose of this report.

This report is an accounting of the aquatic resources that have been observed in Puohokamoa Stream, Maui from year 2000 to present. The report was generated to provide information to aid in the instream flow determination for the East Maui Streams at the request of the Commission on Water Resource Management. The focus of this report is the animals that live in the stream and the data collected during surveys of the stream. The report covers four main sections, including:

- Introduction
- Watershed Atlas Report
- DAR Point Quadrat Survey Report
- Photographs of stream taken during stream surveys

The introduction provides the overview for the purpose of this report, a summary of the findings on the stream and its animals, and a discussion of the importance of the findings and how stream conditions influence native species populations. The Watershed Atlas Report provides a description of the watershed and its aquatic resources from Division of Aquatic Resources (DAR) and other published and unpublished surveys as well as a rating of the condition of the stream compared to other streams on Maui as well as statewide. The DAR Point Quadrat Survey Report describes the distribution, habitats, and species observed during the standardized DAR stream surveys. Finally, the photographs provide context to the conditions that the stream surveyors encountered in the stream.

This overview reports on the highlights of these findings and provides a discussion of the importance of the information presented. We hope that this format provides the reader with a simplified, general discussion and understanding of the condition of Puohokamoa Stream while also providing substantial evidence to support the conclusions presented.

## Findings for Puohokamoa Stream, Maui

Puohokamoa is a small (3.2 sq miles) watershed. It is mostly zoned for conservation (94%) with some agriculture (6%). The land cover is mostly evergreen forest (86%), scrub (11%) and grassland (2%). Numerous stream surveys of different types have been completed in Puohokamoa Stream beginning in 1962 to the present. This watershed rates in the middle, based on the data contained in the DAR aquatic surveys database, in comparison to other watersheds in Maui and statewide. It has a total watershed rating of 8 out of 10, a total biological rating of 5 out of 10, and a combined overall rating of 5 out of 10.

Native species observed in the stream include the following categories and species:

Fish - *Awaous guamensis* and *Lentipes concolor*

Crustaceans - *Atyoida bisulcata*

Insect – *Anax junius* , *Anax* sp, *Megalagrion* sp. and *Telmatogen* sp.

Introduced species observed in this stream includes the following categories and species:

Crustaceans - *Macrobrachium lar*

Insects - Chironomid sp.

## Discussion

Puohokamoa watershed is characterized by a small and steep middle reach consisting of mainly bedrock and large boulders in the streambed. There are no tributaries or diversions in the middle reach.

Puohokamoa Stream mouth and lower reach were not surveyed due to inaccessibility by truck or helicopter. Nine point quadrat surveys were conducted in the middle reach, which was accessed from Hāna Highway. Surveys started below the highway at the top of a dry waterfall and continued above the highway to a large plunge pool. Flow was minimal in the middle reach during surveys, but started to increase towards the end of the survey due to rainy conditions. Stream habitat consisted mainly of shallow pools with cobble, boulder and bedrock substrate and one large deep plunge pool. One flow reading was conducted and no diversions or tributaries were encountered during surveys.

The majority of stream habitat appeared to be lost in Puohokamoa Stream due to minimal flow. Pools with little to no flow were the only habitat available. However, adult female **‘o‘opu alamo‘o** (*Lentipes concolor*) were observed in the plunge pool at the base of the waterfall at survey site 8. River prawns (*Macrobrachium lar*) and guppies (*Poecilia reticulata*) were observed in the middle reach at survey sites downstream of the plunge pool. USGS conducted previous surveys and observed **‘o‘opu nākea** (*Awaous guamensis*), *Lentipes concolor*, **‘ōpae kala‘ole** (*Atyoida bisulcata*) and *M. lar* in the lower reach and *A. bisulcata* and *M. lar* in the upper reach at 600 ft elevation.

Puohokamoa Stream has good potential stream habitat in the middle and upper reach for five native fish and invertebrate species, *A. bisulcata*, *A. guamensis*, *L. concolor*, **hihīwai** (*Neritina granosa*) and **‘o‘opu nōpili** (*Sicyopterus stimpsoni*). However, the majority of native species habitat was lost to water withdrawals. Restoration of flow would therefore improve animal



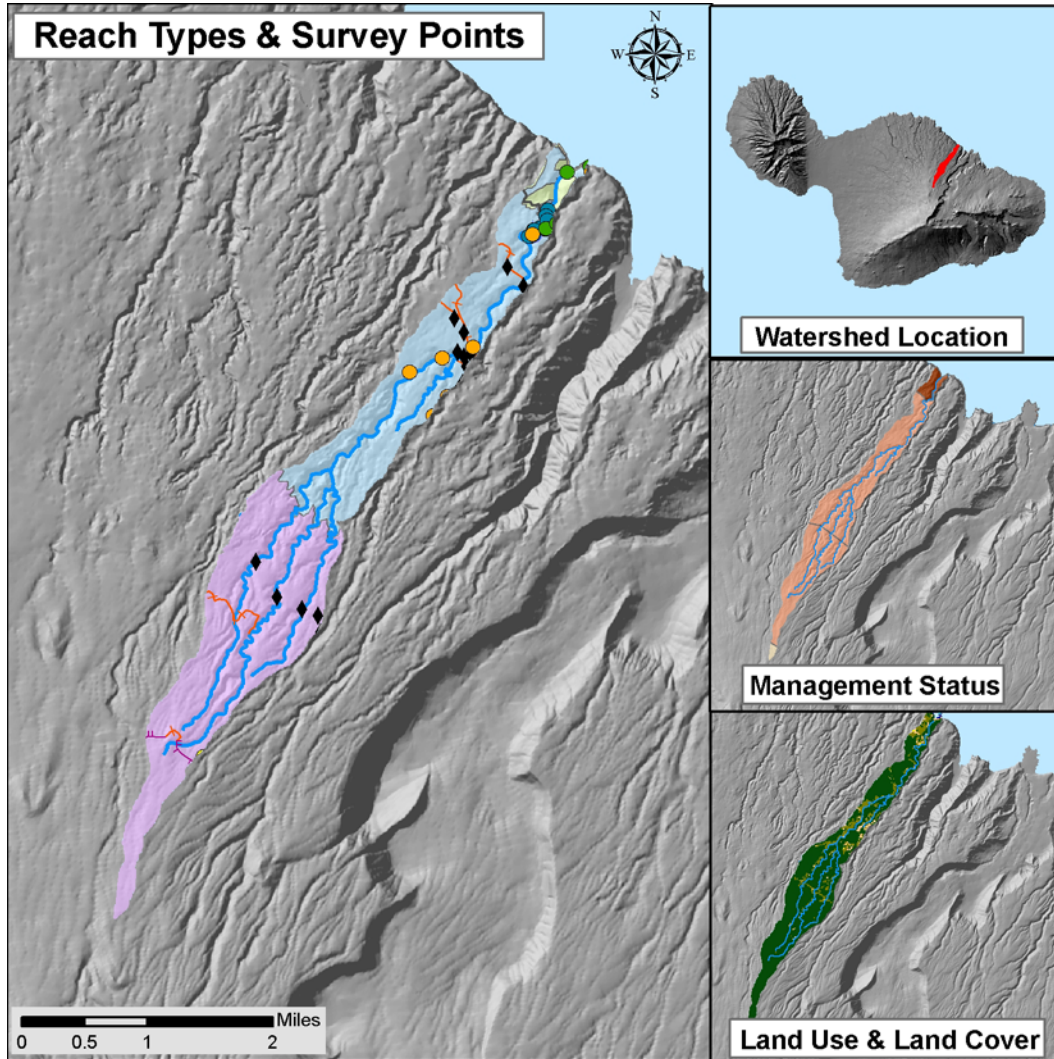
passage between diversions upstream and downstream and substantially increase the availability of habitat for native species. Restoration of flow and improvement of animal passage would further enhance the overall productivity of Puohokamoa Stream.

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## Section 2: Watershed Atlas

*DAR Watershed Code: 64006*

### Puohokamoa, Maui



### Watershed Features

Puohokamoa watershed occurs on the island of Maui. The Hawaiian meaning of the name is unknown. The area of the watershed is 3.2 square mi (8.3 square km), with maximum elevation of 5640 ft (1719 m). The watershed's DAR cluster code is not yet determined. The percent of the watershed in the different land use districts is as follows: 5.6% agricultural, 94.4% conservation, 0% rural, and 0% urban.

**Land Stewardship: Percentage of the land in the watershed managed or controlled by the corresponding agency or entity. Note that this is not necessarily ownership.**

<u>Military</u>	<u>Federal</u>	<u>State</u>	<u>OHA</u>	<u>County</u>	<u>Nature Conservancy</u>	<u>Other Private</u>
0.0	0.0	93.0	0.0	0.0	1.1	5.9

**Land Management Status: Percentage of the watershed in the categories of biodiversity protection and management created by the Hawaii GAP program.**

<u>Permanent Biodiversity Protection</u>	<u>Managed for Multiple Uses</u>	<u>Protected but Unmanaged</u>	<u>Unprotected</u>
1.1	93.0	0.0	5.9

**Land Use: Areas of the various categories of land use. These data are based on NOAA C-CAP remote sensing project.**

	<u>Percent</u>	<u>Square mi</u>	<u>Square km</u>
High Intensity Developed	0.0	0.00	0.00
Low Intensity Developed	0.0	0.00	0.00
Cultivated	0.0	0.00	0.00
Grassland	2.4	0.08	0.20
Scrub/Shrub	11.1	0.35	0.92
Evergreen Forest	86.0	2.75	7.13
Palustrine Forested	0.0	0.00	0.00
Palustrine Scrub/Shrub	0.0	0.00	0.00
Palustrine Emergent	0.0	0.00	0.00
Estuarine Forested	0.0	0.00	0.00
Bare Land	0.1	0.00	0.01
Unconsolidated Shoreline	0.1	0.00	0.01
Water	0.3	0.01	0.03
Unclassified	0.0	0.00	0.00

### Stream Features

Puohokamoa is a perennial stream. Total stream length is 13.6 mi (21.9 km). The terminal stream order is 2.

**Reach Type Percentages: The percentage of the stream's channel length in each of the reach type categories.**

<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
0.0	0.7	5.0	45.6	48.7

The following stream(s) occur in the watershed:  
Puohokamoa

## Biotic Sampling Effort

Biotic samples were gathered in the following year(s):

1962      1990      2003      2008

**Distribution of Biotic Sampling: The number of survey locations that were sampled in the various reach types.**

<u>Survey type</u>	<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
DAR General Surveys	0	0	2	0	0
DAR Point Quadrat	0	0	9	0	0
HDFG	0	0	1	3	0
Published Report	0	1	1	0	0

## Biota Information

### Species List

#### **Native Species**

**Crustaceans** *Atyoida bisulcata*  
**Fish** *Awaous guamensis*  
*Lentipes concolor*

#### **Native Species**

**Insects** *Anax junius*  
*Anax* sp.  
*Megalagrion* sp.  
*Telmatogeton* sp.

#### **Introduced Species**

**Crustaceans** *Macrobrachium lar*

#### **Introduced Species**

**Insects** Chironomid sp.

### **Species Size Data: Species size (inches) observed in DAR Point Quadrat Surveys.**

<u>Scientific Name</u>	<u>Status</u>	<u>Minimum Size</u>	<u>Maximum Size</u>	<u>Average Size</u>
<i>Macrobrachium lar</i>	Introduced	1	5	3.0
<i>Lentipes concolor</i>	Endemic	3	3	3.0

**Average Density: The densities (#/square yard) for species observed in DAR Point Quadrat Surveys averaged over all sample dates in each reach type.**

<u>Scientific Name</u>	<u>Status</u>	<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
<i>Lentipes concolor</i>	Endemic			0.43		
<i>Macrobrachium lar</i>	Introduced			4.32		

**Species Distributions: Presence (P) of species in different stream reaches.**

<u>Scientific Name</u>	<u>Status</u>	<u>Estuary</u>	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>	<u>Headwaters</u>
<i>Atyoida bisulcata</i>	Endemic		P	P	P	
<i>Lentipes concolor</i>	Endemic		P	P		
<i>Megalagrion</i> sp.	Endemic			P	P	
<i>Awaous guamensis</i>	Indigenous		P			
<i>Anax junius</i>	Indigenous				P	
<i>Anax</i> sp.	Indigenous			P	P	
<i>Telmatogeton</i> sp.	Indigenous				P	
<i>Macrobrachium lar</i>	Introduced		P	P		
Chironomid sp.	Introduced			P	P	

## Historic Rankings

**Historic Rankings: These are rankings of streams from historical studies. "Yes" means the stream was considered worthy of protection by that method. Some methods include non-biotic data in their determination. See Atlas Key for details.**

Multi-Attribute Prioritization of Streams - Potential Heritage Streams (1998): No

Hawaii Stream Assessment Rank (1990): Limited

U.S. Fish and Wildlife Service High Quality Stream (1988): No

The Nature Conservancy- Priority Aquatic Sites (1985): No

National Park Service - Nationwide Rivers Inventory (1982): No

**Current DAR Decision Rule Status: The following criteria are used by DAR to consider the biotic importance of streams. "Yes" means that watershed has that quality.**

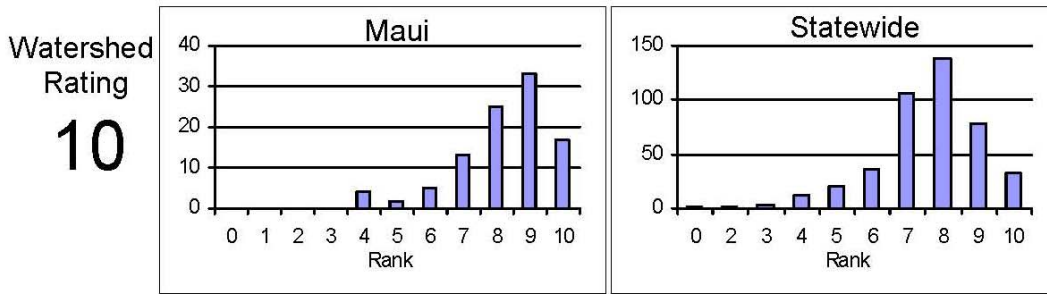
Native Insect Diversity <u>&gt; 19 spp.</u>	Native Macrofauna <u>Diversity &gt; 5 spp.</u>	Absence of Priority 1 <u>Introduced</u>
No	No	Yes
Abundance of Any <u>Native Species</u>	Presence of Candidate <u>Endangered Species</u>	Endangered Newcomb's <u>Snail Habitat</u>
No	No	No

### CURRENT WATERSHED AND STREAM RATINGS

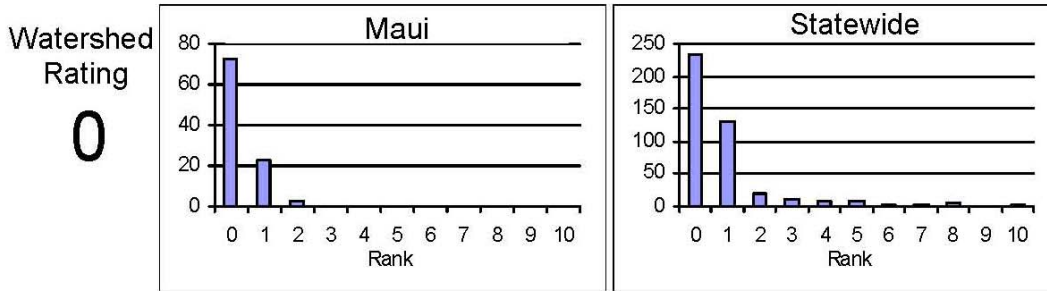
The current watershed and stream ratings are based on the data contained in the DAR Aquatic Surveys Database. The ratings provide the score for the individual watershed or stream, the distribution of ratings for that island, and the distribution of ratings statewide. This allows a better understanding of the meaning of a particular ranking and how it compares to other streams. The ratings are standardized to range from 0 to 10 (0 is lowest and 10 is highest rating) for each variable and the totals are also standardized so that the rating is not the average of each component rating. These ratings are subject to change as more data are entered into the DAR Aquatic Surveys Database and can be automatically recalculated as the data improve. In addition to the ratings, we have also provided an estimate of the confidence level of the ratings. This is called rating strength. The higher the rating strength the more likely the data and rankings represent the actual condition of the watershed, stream, and aquatic biota.

#### WATERSHED RATING: Puohokamoa, Maui

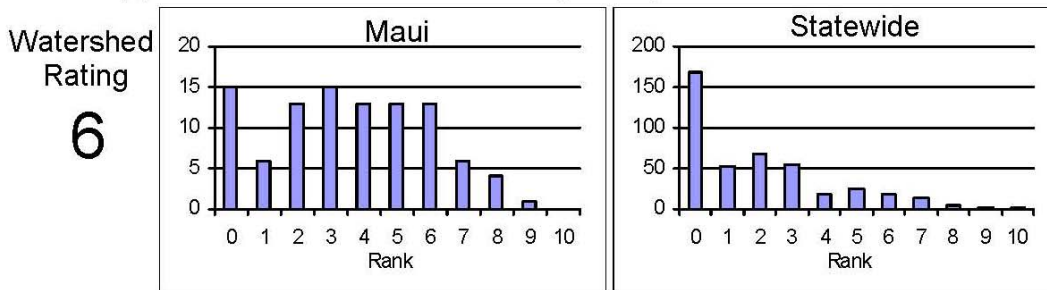
Land Cover Rating: Rating is based on a scoring system where in general forested lands score positively and developed lands score negatively.



Shallow Waters Rating: Rating is based on a combination of the extent of estuarine and shallow marine areas associated with the watershed and stream.

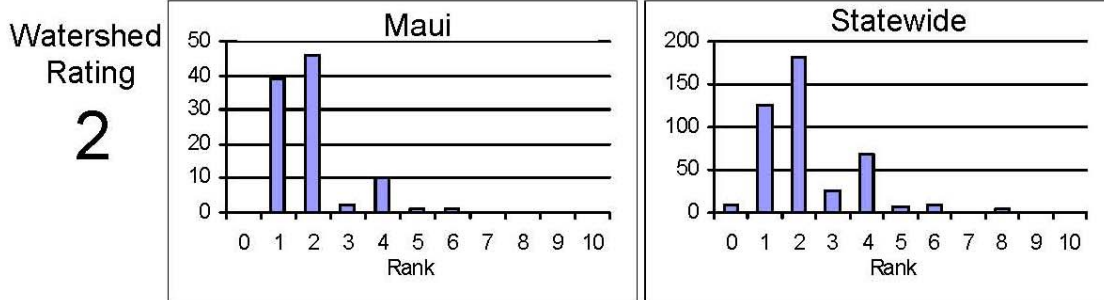


Stewardship Rating: Rating is based on a scoring system where higher levels of land and biodiversity protection within the watershed score positively.

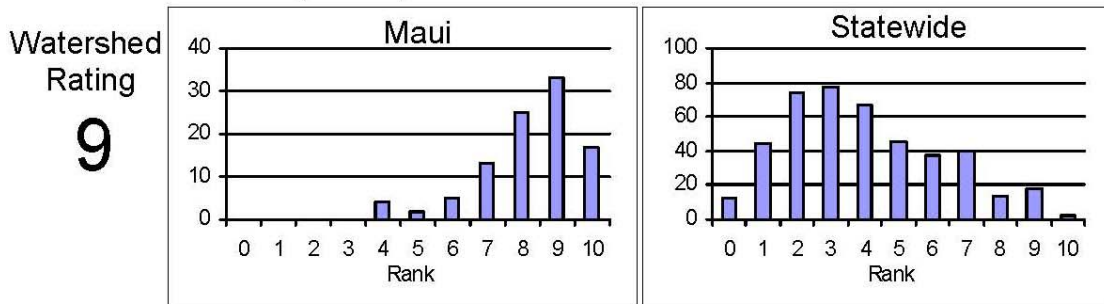


### WATERSHED RATING (Cont): Puohokamoa, Maui

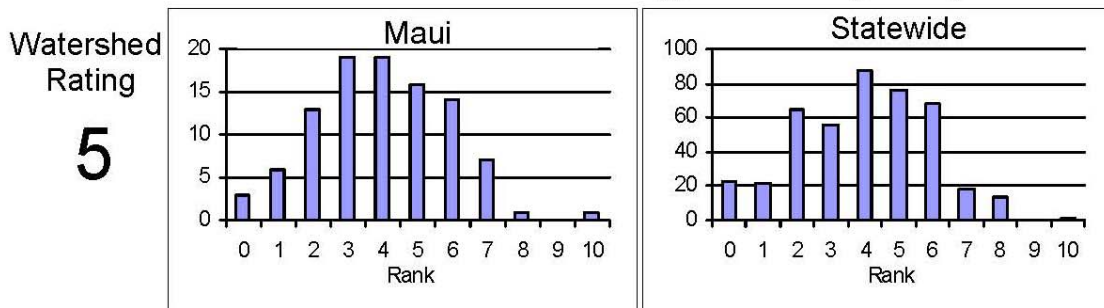
**Size Rating:** Rating is based on the watershed area and total stream length. Larger watersheds and streams score more positively.



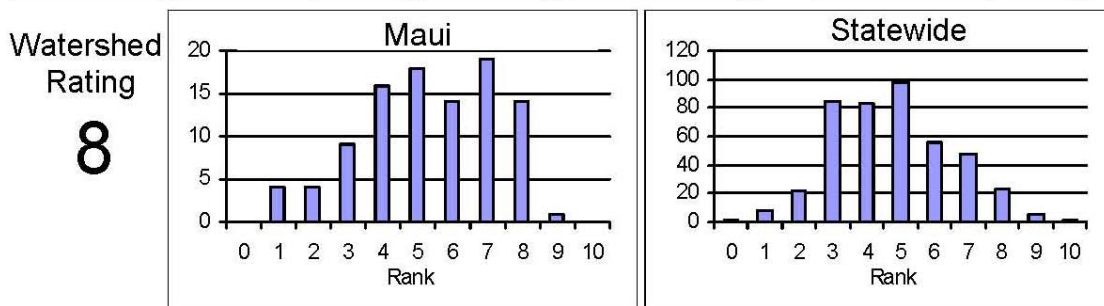
**Wetness Rating:** Rating is based on the average annual rainfall within the watershed. Higher rainfall totals score more positively.



**Reach Diversity Rating:** Rating is based on the types and amounts of different stream reaches available in the watershed. More area in different reach types score more positively.



**Total Watershed Rating:** Rating is based on combination of Land Cover Rating, Shallow Waters Rating, Stewardship Rating, Size Rating, Wetness Rating, and Reach Diversity Rating.

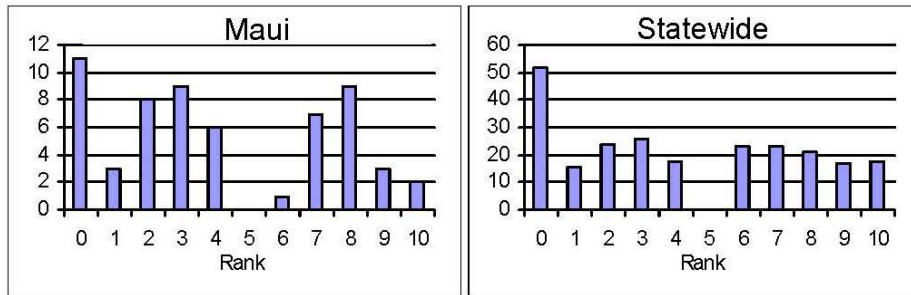




### BIOLOGICAL RATING: Puohokamoa, Maui

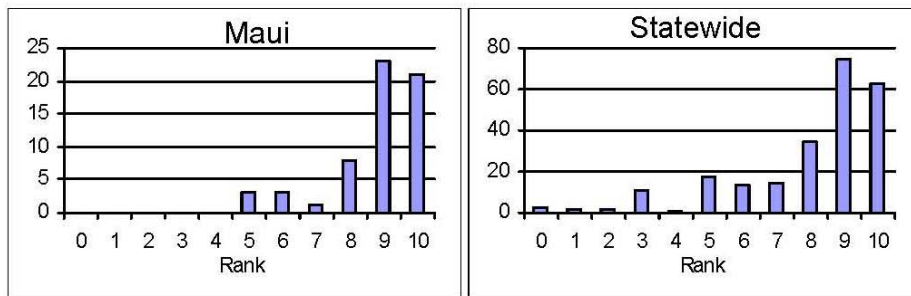
Native Species Rating: Rating is based on the number of native species observed in the watershed.

Stream Rating  
**3**



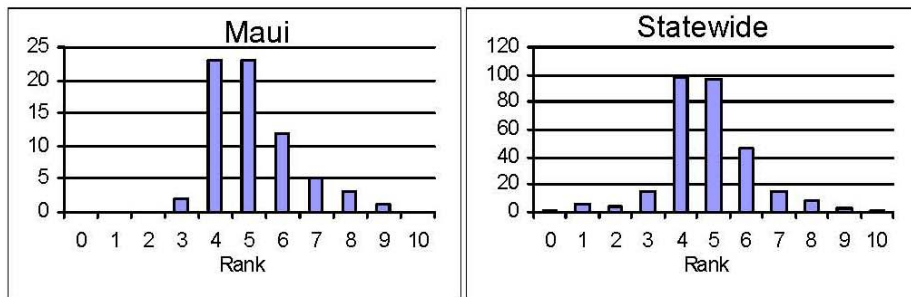
Introduced Genera Rating: Rating is based on the number of introduced genera observed in the watershed.

Stream Rating  
**10**



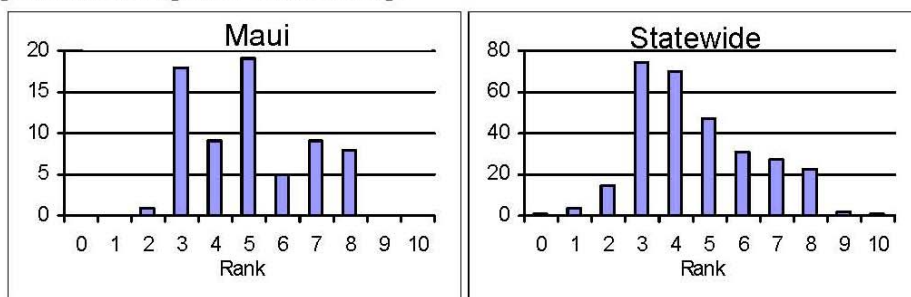
All Species' Score Rating: Rating is based on the Hawaii Stream Assessment scoring system where native species score positively and introduced species score negatively.

Stream Rating  
**5**



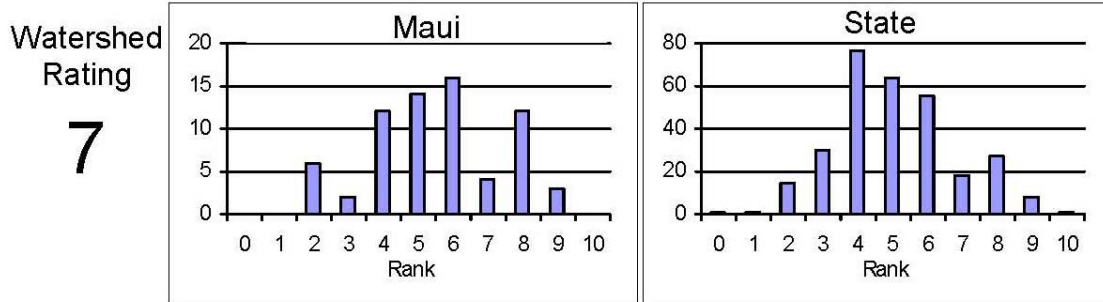
Total Biological Rating: Rating is the combination of the Native Species Rating, Introduced Genera Rating, and the All Species' Score Rating.

Stream Rating  
**5**



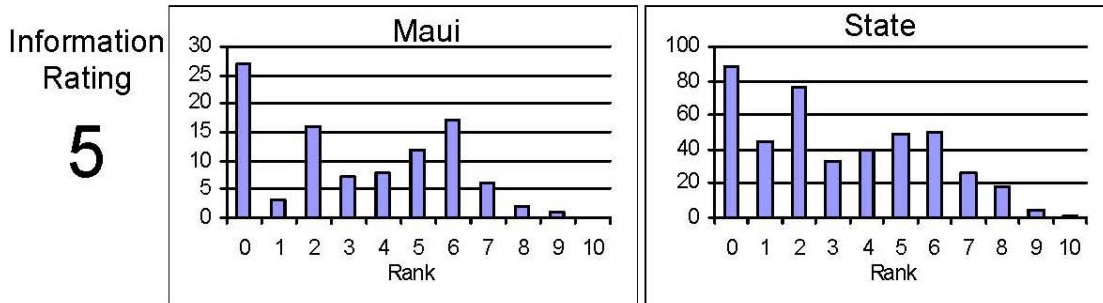
**OVERALL RATING: Puohokamoa, Maui**

Overall Rating: Rating is a combination of the Total Watershed Rating and the Total Biological Rating.



**RATING STRENGTH: Puohokamoa, Maui**

Rating Strength: Represents an estimate of the overall study effort in the stream and is a combination of the number of studies, number of different reaches surveyed, and the number of different survey types.



**REFERENCES**

1961. Shima, S.I. Limnological Survey for Introduction of Exotic Species of Fish.

1990. Hau, S. Skippy Hau Databook No. 311 Volume 3.

2005. Gingerich, S.B. and R.H. Wolff. Effects of Surface-Water Diversions on Habitat Availability for Native Macrofauna, Northeast Maui, Hawai‘i.

2008. Hawai‘i Division of Aquatic Resources. DAR Point Quadrat Survey Data from the DAR Aquatic Surveys Database.

## Section 3: DAR Point Quadrat Report for Puohokamoa, Maui

For Surveys from 12/11/2008 to 12/11/2008

### Introduction

This is a report of the Hawai'i Division of Aquatic Resources stream surveys using the Point Quadrat Methodology. Trained biologists and technicians survey a series of randomly located points in a stream to generate an assessment of the species and habitat in the stream. The Point Quadrat Methodology is one of several techniques that could be chosen for the surveys and is used to develop a statistically comparable stream survey. This methodology is a standardized visual survey technique involving snorkeling, and it is well suited for the physical and ecological characteristics of Hawai'i streams. The small, steep, dynamic nature of Hawaiian streams with their unique aquatic species is easily observed with this methodology. The in-stream distribution by elevation, behavior, and amphidromous life cycles are easily observed using this technique.

### Methods

The point quadrat methodology requires underwater observation. Sampling was conducted using a dive mask, snorkel and two-piece wet suit with hood and glove. Spiked felt-soled wading boots or Japanese spiked **tabis** are also necessary for easy climbing on the wet, algae-covered rocks. After the initial survey site is chosen all the survey sites upstream are selected randomly to prevent any bias in habitat type selection (e.g., pools and runs) and to obtain a representative sample of all habitat types in the stream. At each site, fish and invertebrate observations are recorded and data is collected on the species present, number, size, and sex. Habitat and substrate type, depth and site dimension data are also collected. Other site observations recorded at each station include GPS coordinates and the following water quality parameters using a Hydrolab Quanta: temperature (° C), salinity (PSS), dissolved oxygen (mg/L), pH, conductivity (mS/cm) and turbidity (NTU). Stream flow measurements are collected using a Marsh McBirney Flo-Mate 2000 at the beginning and ending of each survey as well as at tributaries and diversions.

The watersheds (and watershed ID), region, and island surveyed in this report are:

Puohokamoa (ID: 64006), Ke'anae, Maui

Surveys were conducted by these personnel:

Hau, Skippy  
Kuamo'o, Darrell  
Shimoda, Troy  
Shindo, Tim

## Results

Table 3-1. The distribution of sites by reach during this survey effort.

Reach	Total number of surveys
<b>Estuary</b>	0
<b>Lower</b>	0
<b>Middle</b>	9
<b>Upper</b>	0
<b>Headwaters</b>	0
<b>Unknown</b>	0

## Middle Reach

Table 3-2. Number of Habitat Types surveyed in the middle stream reach.

Reach	Total Habitat Surveyed	Plunge Pool	Cascade	Riffle	Run	Pool	Side Pool	No Water	Dirty Water	Unknown
<b>Middle</b>	9	2	0	0	0	4	2	1	0	0

Table 3-3. Observed Substrates (%) in point quadrat samples in the middle stream reach.

Reach	Detritus	Sediment	Sand	Gravel	Cobble	Boulder	Bedrock
<b>Middle</b>	5	0	0	5	16	40	33

Table 3-4. Observed Water Quality in point quadrat samples in the middle stream reach.

Reach	Temp (° C)	sCond (mS/cm)	DO (mg/L)	pH
<b>Middle</b>	19.611	0.1	7.59	7.658

Table 3-5. Summary of species observed in the middle reach of the watershed.

<u>Category</u>	<u>Status</u>	<u>Scientific Name</u>
Crustacean	Introduced	<i>Macrobrachium lar</i>
Fish	Endemic	<i>Lentipes concolor</i>

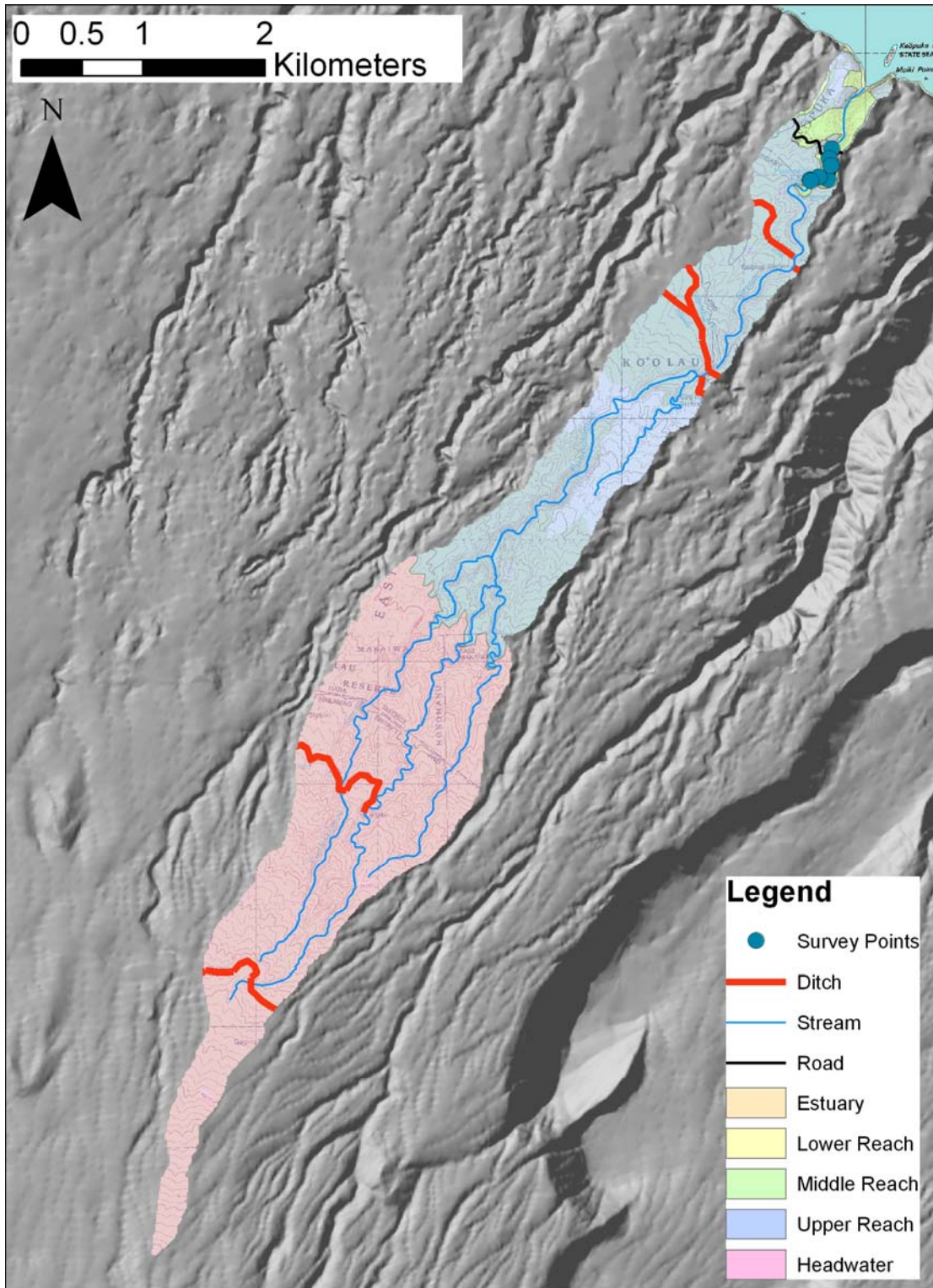


Figure 3-1. Locations of point quadrat surveys conducted in Puohokamoa Stream.



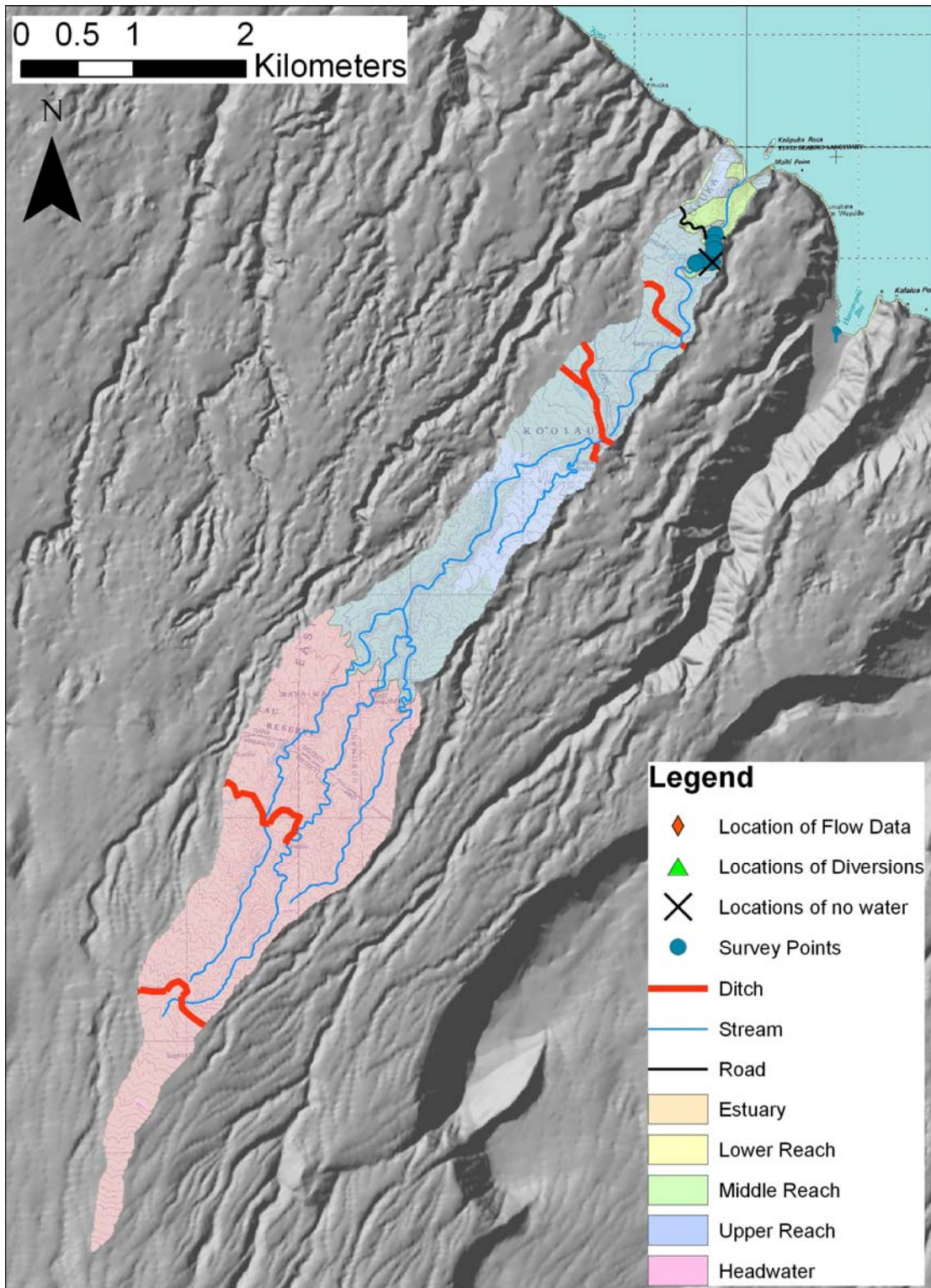


Figure 3-2. Locations of diversion, flow data and no flow conditions found in Puohokamoa Stream.

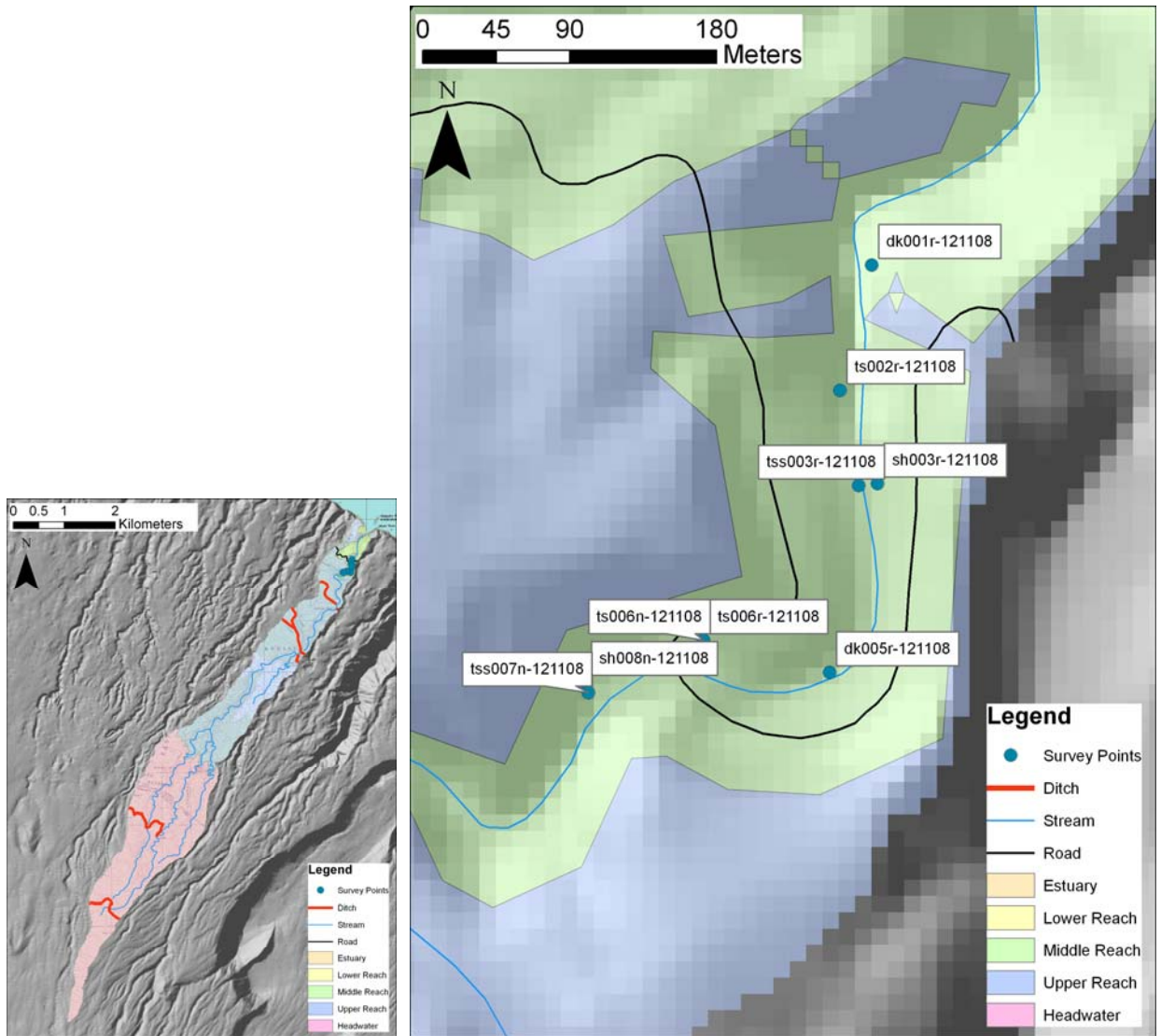


Figure 3-3. Point quadrat survey locations in the middle reach of Puohokamoa Stream.

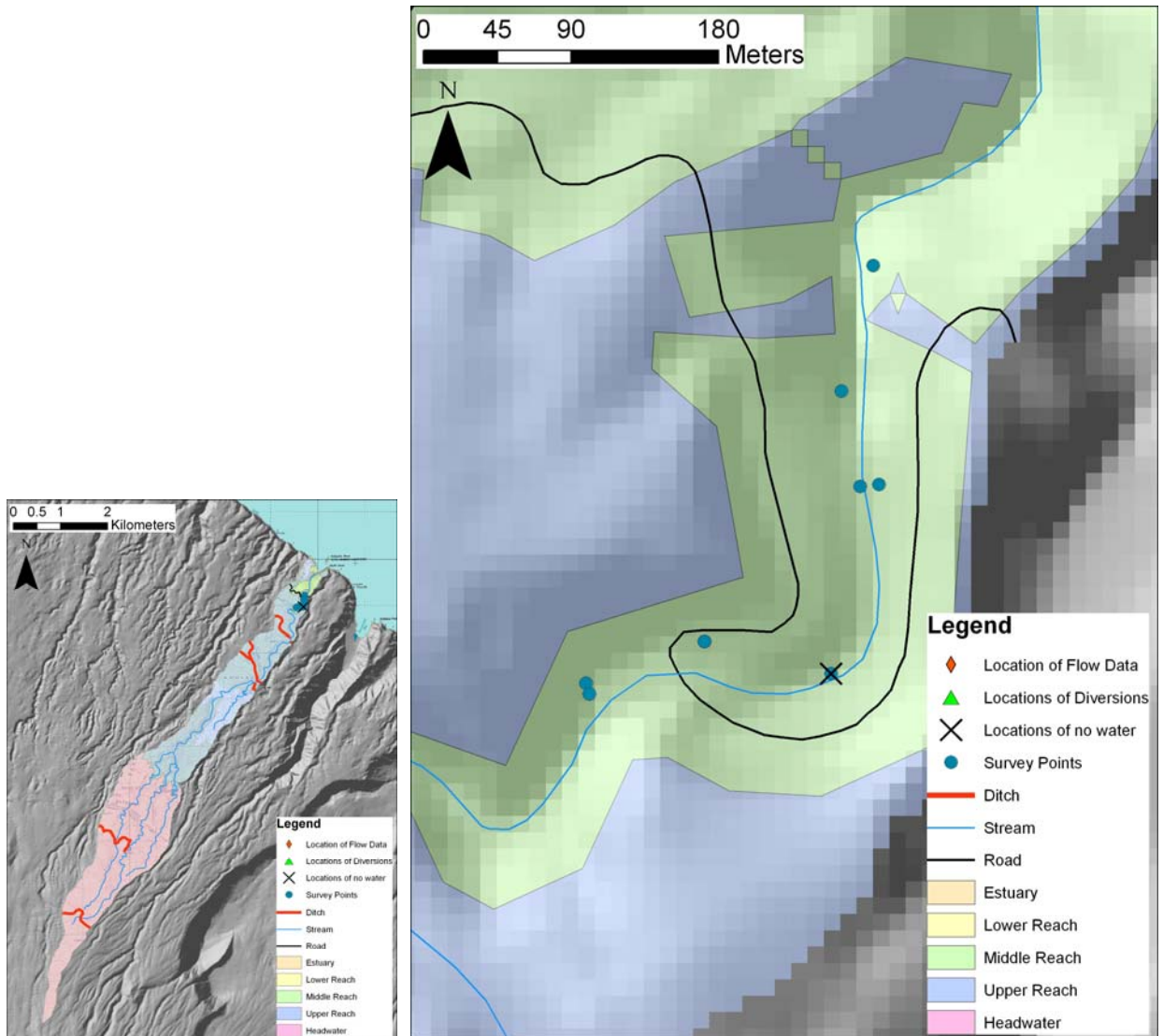


Figure 3-4. Locations of no water conditions in the middle reach of Puohokamoa Stream.



## Section 4: Photographs taken during stream surveys

### Middle Reach

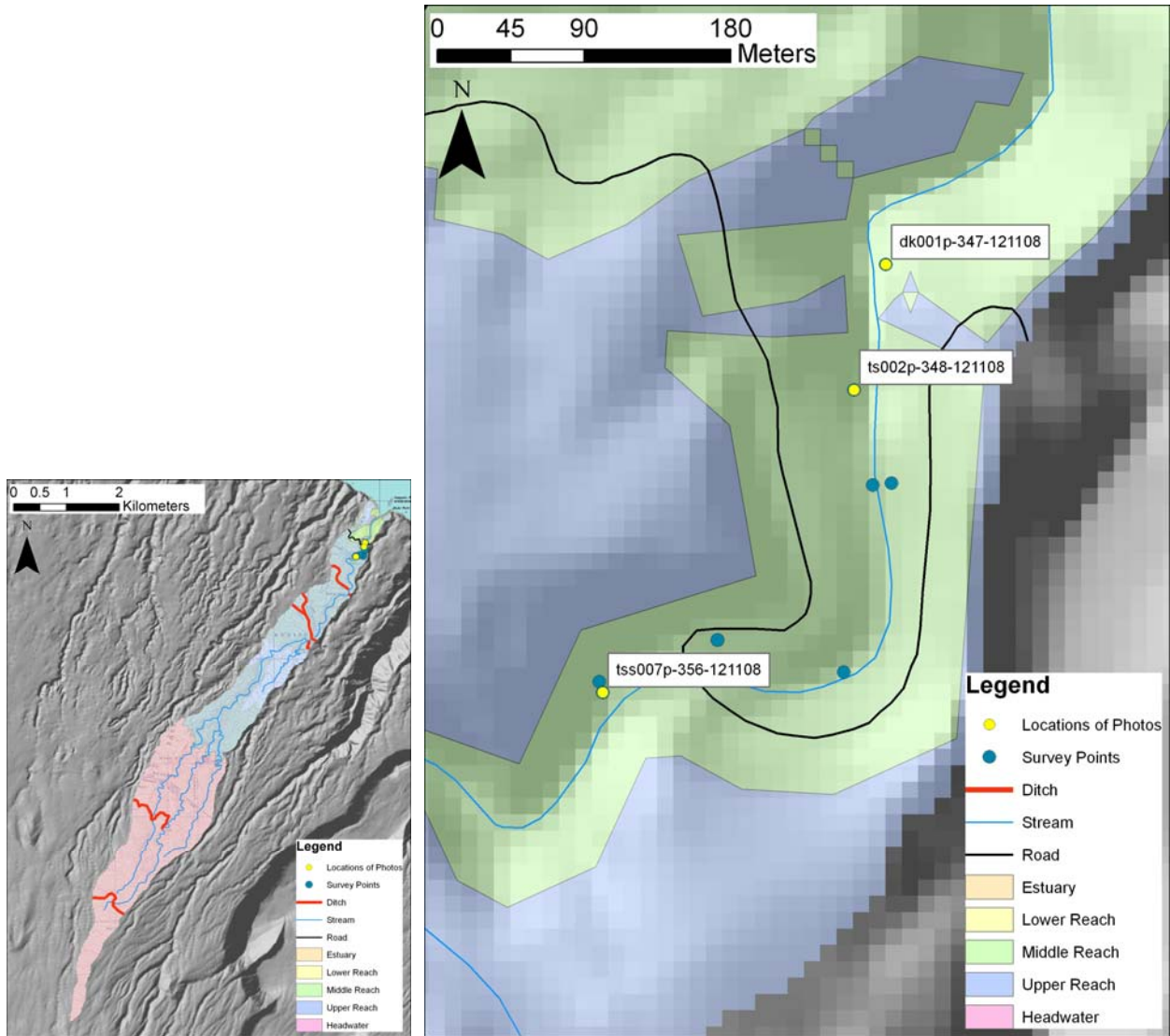


Figure 4-1. Photo locations in the middle reach of Puohokamoa Stream.



Figure 4-2. Photo of a semi-dry stream bed in Puohokamoa Stream with intermittent flows following heavy rains. Photo taken upstream from site 1. (12/11/2008; Tributary name: Puohokamoa (64006001); PBN: dk001p-347-121108; Surveyor: Kuamo'o, D.; Habitat type: Pool; SBN: dk001r-121108; Lat. (DD): 20.86891, Long. (DD): -156.17715).



Figure 4-3. Photo of survey site 2 with DAR staff conducting a stream survey. Photo taken upstream from site 1. (12/11/2008; Tributary name: Puohokamoa (64006001); PBN: ts002p-348-121108; Surveyor: Shimoda, T.; Habitat type: Side Pool; SBN: ts002r- -121108; Lat. (DD): 20.86822, Long. (DD): -156.17735).



Figure 4-4. Photo of a plunge pool in Puohokamoa Stream. Photo taken upstream and shows site 7. (12/11/2008; Tributary name: Puohokamoa (64006001); PBN: tss007p-356-121108; Surveyor: Shindo, T.; Habitat type: Plunge Pool; SBN: tss007n-121108; Lat. (DD): 20.86657, Long. (DD): -156.17886).

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**Appendix: Survey Sites Latitude and Longitude**

<u>Tributary</u>	<u>Stream</u>	<u>Survey Book #</u>	<u>Site</u>	<u>Surveyor</u>	<u>Date</u>	<u>Latitude</u>	<u>Longitude</u>
64006001	Puohokamoa	dk001r-121108	1	Kuamo'o, Darrell	12/11/2008	20.86891	-156.17715
64006001	Puohokamoa	tss003r-121108	3	Shindo, Tim	12/11/2008	20.86769	-156.17725
64006001	Puohokamoa	sh003r-121108	3	Hau, Skippy	12/11/2008	20.86770	-156.17714
64006001	Puohokamoa	dk005r-121108	5	Kuamo'o, Darrell	12/11/2008	20.86666	-156.17744
64006001	Puohokamoa	ts006r-121108	6	Shimoda, Troy	12/11/2008	20.86685	-156.17818
64006001	Puohokamoa	ts006n-121108	6	Shimoda, Troy	12/11/2008	20.86685	-156.17818
64006001	Puohokamoa	tss007n-121108	7	Shindo, Tim	12/11/2008	20.86657	-156.17886
64006001	Puohokamoa	sh008n-121108	8	Hau, Skippy	12/11/2008	20.86663	-156.17888
64006001	Puohokamoa	dk008r-121008	8	Kuamo'o, Darrell	12/11/2008	20.87200	-156.18738

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