

WILLIAM J. AILA, JR.

DENISE ANTOLINI KAMANA BEAMER MICHAEL G. BUCK MILTON D. PAVAO JONATHAN STARR

WILLIAM M. TAM

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT P.O. BOX 621 HONOLULU, HAWAII 96809

December 18, 2014

This report serves as written testimony pertaining to the work of the Commission on Water Resource Management (CWRM) in establishing, implementing, and monitoring of measurable interim instream flow standards (IIFS) for the 21 surface water hydrologic units comprising the 27 Petitions to Amend the Interim Instream Flow Standards in East Maui, filed by Native Hawaiian Legal Corporation (NHLC) on behalf of Na Moku 'Aupuni o Ko'olau Hui (Na Moku), Beatrice Kepani Kekahuna, and Marjorie Wallet.

The approach that the CWRM staff employed in developing each respective IIFS was to first compile best available information for each surface water hydrologic unit in the form of a prepared Instream Flow Standard Assessment Report (IFSAR) (See *PR-2008-01 IFSAR 6034 Honopou*; *PR-2008-02 IFSAR 6037 Hanehoi*; *PR-2008-03 IFSAR 6053 Piinaau*; *PR-2008-04 IFSAR 6055 Waiokamilo*; *PR-2008-05 IFSAR 6056 Wailuanui*; *PR-2009-01 IFSAR 6047 Waikamoi*; *PR-2009-02 IFSAR 6048 Puohokamoa*; *PR-2009-03 IFSAR 6059 Haipuaena*; *PR-2009-04 IFSAR 6050 Punalau*; *PR-2009-05 IFSAR 6051 Honomanu*; *PR-2009-06 IFSAR 6052 Nuaailua*; *PR-2009-07 IFSAR 6054 Ohia*; *PR-2009-08 IFSAR 6057 West Wailuaiki*; *PR-2009-09 IFSAR 6058 East Wailuaiki*; *PR-2009-10 IFSAR 6059 Kopiliula*; *PR-2009-11 IFSAR 6060 Waiohue*; *PR-2009-12 IFSAR 6061 Paakea*; *PR-2009-13 IFSAR 6062 Waiaaka*; *PR-2009-14 IFSAR 6063 Kapaula*; *PR-2009-15 IFSAR 6064 Hanawi*; *PR-2009-16 IFSAR 6055 Makapipi*).

Information in each IFSAR was organized into instream and noninstream uses as defined in the State Water Code, Chapter 174C-3, Hawaii Revised Statutes. The most important consideration included in each IFSAR was the hydrologic condition (surface water availability) for each hydrologic unit, which was largely based upon studies conducted by the U.S. Geological Survey.

After the preparation of each Draft IFSAR, a public comment period was conducted for review and comment to gather additional information along with Public Fact Gathering Meetings. Public comments were compiled and published in separate documents (See *PR-2008-07 Compilation of Public Review Comments*; *PR-2009-18, Compilation of Public Review Comments*; and *PR-2009-18 APPENDIX, Compilation of Public Review Comments Appendix*).

CWRM staff spent considerable time in assessing and weighing instream and noninstream uses against the hydrologic conditions for each hydrologic unit as prescribed by §174C-71, HRS. These assessments are captured in the submittals prepared for presentation to CWRM on September 24, 2008 (See *Staff Submittal C2 on Petition to Amend the Interim Instream Flow Standards for the Surface Water Hydrologic Units of Honopou (6034), Hanehoi (6037), Piinaau (6053), Waiokamilo (6055), and Wailuanui (6056), Maui)* and May 25, 2010 (See *Staff Submittal C1 on Petitions to Amend the Interim Instream Flow Standards For the Surface Water Hydrologic Units of Waikamoi (6047), Puohokamoa (6048), Haipuaena (6049), Punalau (6050), Honomanu (6051), Nuaailua (6052), Ohia (6054), West Wailuaiki (6057), East Wailuaiki (6058), Kopiliula (6059), Waiohue (6060), Paakea (6061), Waiaaka (6062), Kapaula (6063), Hanawi (6064), and Makapipi (6065), Maui).* The primary difference between the September 24, 2008 and May 25, 2010 Staff Submittals was the submission of additional information to CWRM. CWRM staff initially prepared a Staff Submittal for a December 16, 2009 meeting. Prior to the December meeting, information was submitted by multiple parties including the Department of Agriculture (HDOA), Maui Department of Water Supply (MDWS), Maui Office of Economic Development, Maui County Farm Bureau, Hawaiian Commercial & Sugar Company (HC&S) (See *PR-2009-17, Compilation of Data Submissions*), Bishop Museum and the Hawaii Division of Aquatic Resources (DAR) (See *Hawaiian Stream Habitat Evaluation Procedure for East Maui Streams Report*). Following two days of presentations and testimony at its December meeting, CWRM deferred action and directed certain parties to provide specific information to CWRM staff for further consideration. Additional information was submitted by DAR, HC&S, MDWS, Maui Land & Pineapple Company, Inc., and NHLC (See *PR-2010-01, Compilation of Data Submissions, Part II*).

The majority of this report provides a summary of the adaptive management strategies that were proposed by CWRM staff and approved by CWRM in the September 2008 and May 2010 decisions. CWRM staff did its best to follow through with implementation, monitoring, and evaluation strategies given the limited staffing experienced as a result of the economic challenges from 2010 to 2013. The actions summarized here are organized by hydrologic unit and provide references to specific files that include CWRM Gage Data, CWRM Submittals, CWRM Updates, Field Investigation Itineraries, Field Investigation Reports, and USGS Information. These files will be made available to the Hearings Officer and all parties via email and/or CWRM's website.

This report was prepared by Dean Uyeno, Hydrologic Program Manager for CWRM's Stream Protection and Management Branch. Should you have any questions, please contact Dean Uyeno by phone at (808) 587-0249 or by email at dean.d.uyeno@hawaii.gov.

NOTE: All of the references listed above are available for download from the CWRM website at http://dlnr.hawaii.gov/cwrm/surfacewater/ifs/eastmauiiifs1/

Contents

Table of Abbreviations	4
Summary of Maui Interim Instream Flow Standards	5
GENERAL EVENTS	6
HONOPOU (6034)	8
HANEHOI (6037)	11
WAIKAMOI (6047)	14
PUOHOKAMOA (6048)	17
HAIPUAENA (6049)	
PUNALAU/KOLEA (6050)	19
HONOMANU (6051)	20
NUAAILUA (6052)	21
PIINAAU (6053)	22
OHIA/WAIANU (6054)	25
WAIOKAMILO (6055)	26
WAILUANUI (6056)	
WEST WAILUAIKI (6057)	31
EAST WAILUAIKI (6058)	34
KOPILIULA (6059)	36
PUAKAA	
WAIOHUE (6060)	
PAAKEA (6061)	41
WAIAAKA (6062)	42
KAPAULA (6063)	43
HANAWI (6064)	44
MAKAPIPI (6065)	45

Table of Abbreviations

A&B	Alexander & Baldwin, Inc.
CFS	cubic feet per second
CWRM	Commission on Water Resource Management
DAR	Division of Aquatic Resources
DOCARE	Division of Conservation and Resources Enforcement
EMI	East Maui Irrigation Company
HC&S	Hawaiian Commercial and Sugar Company
HDOA	Hawaii Department of Agriculture
HRS	
IIFS	Interim Instream Flow Standard
IFSAR	Instream Flow Standard Assessment Report
MCFB	Maui County Farm Bureau
MDWS	County of Maui, Department of Water Supply
MGD	million gallons per day
ML&P	Maui Land and Pineapple Company
NHLC	Native Hawaiian Legal Corporation
OED	County of Maui, Office of Economic Development
USGS	United States Geological Survey
WTF	

Summary of Maui Interim Instream Flow Standards

	Interim IFS Amounts					Restoration Amounts				
	Wet S	Season	Dry S	eason	Wet S	Season	Dry Season		Altitude	Notes on Interim IFS Location
	cfs	mgd	cfs	mgd	cfs	mgd	cfs	mgd	feet	
EAST MAUI INTERIM IFS LC) DCATIONS (S	tream listed fr	om West to E	ast)	1		1	1		
Honopou – Site A	2.00	1.29	(An	nual)	1.49	0.96	(Ar	nnual)	383	Lower reach of Honopou Stream, downstream of Haiku Ditch.
Honopou – Site B	0.72	0.47	(An	nual)	Unk	nown	(Ar	nnual)	40	Lower reach of Honopou Stream near 40 feet elevation.
Huelo (Puolua)	0.89	0.57	(An	nual)	Unk	nown	(Annual)		420	Lower reach of Huelo (Puolua) Stream near 420 ft. elevation, downstream of Haiku Ditch
Hanehoi – Site B	0.63	0.41	(An	nual)	Unk	nown	(Annual)		420	Lower reach of Hanehoi Stream, downstream of Haiku Ditch.
Hanehoi – Site C	1.15	0.74	(An	nual)	Unk	nown	(An	nnual)	690	Lower reach of Hanehoi Stream, upstream of Lowrie Ditch and diversion of water for Huelo community.
Waikamoi	2.80	1.81	0	0	2.60	1.68	0	0	550	Just above Hana Highway.
Alo										One measurable interim IFS established for Waikamoi Stream below the confluence with Alo Stream.
Wahinepee	0.50	0.32	(An	nual)					575	Just above Hana Highway, as designated on October 8, 1988.
Puohokamoa	0.40	0.26	(An	nual)					565	Just above Hana Highway, as designated on October 8, 1988.
Haipuaena	0.10	0.06	(An	nual)					510	Just above Hana Highway, as designated on October 8, 1988.
Punalau/Kolea	0.20	0.13	(An	nual)					40	Just above Hana Highway, as designated on October 8, 1988.
Honomanu	0	0	(An	nual)					20	Just above Hana Highway, as designated on October 8, 1988.
Nuaailua	3.10	2.00	(An	nual)					110	Just above Hana Highway, as designated on October 8, 1988.
Piinaau	State	us quo								Just above Hana Highway.
Palauhulu	5.50	3.56	(An	nual)	0.70	0.45	(Ar	nnual)	80	Lower reach of Palauhulu Stream, upstream from the confluence of Piinaau and Palauhulu Streams.
Ohia (Waianu)	4.60	2.97	(An	nual)					195	Just above Hana Highway, as designated on October 8, 1988.
Waiokamilo	4.9	3.17	(An	nual)			(Ar	nnual)	420	Lower reach of Waiokamilo Stream, downstream of Koolau Ditch, but upstream of the confluence of Waiokamilo and Kualani Streams.
Kualani	State	us quo								Kualani (Hamau) Stream, tributary of Waiokamilo Stream.
Wailuanui	3.05	1.97	(An	nual)	2.05 1.33		(Annual)		620	Lower reach of Wailuanui Stream, downstream of Koolau Ditch, below the confluence of East and West Wailuanui Streams.
West Wailuaiki	3.80	2.46	0.40	0.26	3.80	2.46	0.40	0.26	1,235	Just above Hana Highway.
East Wailuaiki	3.70	2.39	0.20	0.13	3.70	2.39	0.20	0.13	1,235	Just above Hana Highway.
Kopiliula	0.50	0.32	(An	nual)					1,270	Just above Hana Highway, as designated on October 8, 1988.
Puakaa	0.60	0.39	(An	nual)					1,235	Just above Hana Highway, as designated on October 8, 1988.
Waiohue	3.20	2.07	0.10	0.06	3.2	2.07	0.10	0.06	1,195	Just above Hana Highway.
Paakea	1.50	0.97	(An	nual)					1,265	Just above Hana Highway, as designated on October 8, 1988.
Waiaaka	0	0	(An	nual)					1,235	At Hana Highway, as designated on October 8, 1988.
Kapaula	0.20	0.13	(An	nual)					1,194	Just above Hana Highway, as designated on October 8, 1988.
Hanawi	0.10	0.06	(An	nual)	0.10	0.06	(Ar	nnual)	1,315	Below EMI's main Hanawi diversion (Intake K-3).
Makapipi	0.93	0.60	(An	nual)	0.93	0.60	(Ar	nnual)	935	Just above Hana Highway.

GENERAL EVENTS

Date	Action / Description
09/25/2008	CWRM decision on the Petition to Amend the Interim Instream Flow Standards for the Surface Water Hydrologic Units of Honopou (6034), Hanehoi (6037), Piinaau (6053), Waiokamilo (6055), and Wailuanui (6056), Maui
10/2008	Geologist Elise Leroux leaves CWRM.
03/18/2009	CWRM staff presented a staff submittal to the CWRM to request to enter into cooperative agreements with USGS for hydrologic data collection for the East Maui IIFS. Ref: <i>sb200903D1</i> .
04/06/2009	CWRM staff, accompanied by DOA, MCFB, Maui OED, and HC&S, visited with farmers in the Kula Agricultural Park, Haleakala Ranch, and ML&P. Ref: <i>F12009040601</i> .
04/07/2009	CWRM staff, accompanied by DOA, met with MDWS to visit the Olinda WTF, Kahakapao and Waikamoi Reservoirs, Waikamoi Flume, Piiholo WTF, and Kamole WTF. Ref: <i>FI2009040701</i> .
04/08/2009	CWRM and DOA staff met with HC&S representatives to learn more about their mill operations, sugar processing, field operations, drip irrigation system, and hydroelectric facilities. The investigation included Maui Brand® sugar production, sugar milling and processing, Kaheka hydroelectric plant, and their overall field operations. Ref: <i>FI2009040801</i> .
06/2009	CWRM entered into a cooperative agreement with USGS to select suitable measurement sites, install staff plates and reference marks, establish gage datum, and develop low- water stage-discharge rating curves for 15 sites in two phases (five sites in Phase I and 10 sites in Phase II). The Phase I sites include Honopou IIFS sites A and B, Hanehoi site C, Palauhulu Site B, and the Wailuanui Site. The Phase II sites include Waikamoi, West Wailuaiki, East Wailuaiki, Waiohue, and Makapipi Streams (2 sites). Four of the remaining Phase II sites were relocated to Na Wai Eha, Maui
06/22/2009	CWRM staff, accompanied by DOA, met with ML&P to investigate the ML&P Kailiili Water System and Kailiili Reservoir, along with the Wailoa Ditch offtake to ML&P. Ref: <i>FI2009062201</i> .
	CWRM staff, accompanied by DOA, met with MCFB and MDWS to investigate the reservoirs that supply the farmers and ranchers in the Kula Agricultural Park with water. In the evening, CWRM staff presented information on the East Maui IIFS process at meeting hosted by the MCFB. Ref: <i>FI2009062202</i> .
12/2009	Hydrologic Program Manager Ed Sakoda retires from CWRM.
05/25/2010	CWRM decision on the Petitions to Amend the Interim Instream Flow Standards For the Surface Water Hydrologic Units of Waikamoi (6047), Puohokamoa (6048), Haipuaena (6049), Punalau (6050), Honomanu (6051), Nuaailua (6052), Ohia (6054), West Wailuaiki (6057), East Wailuaiki (6058), Kopiliula (6059), Waiohue (6060), Paakea (6061), Waiaaka (6062), Kapaula (6063), Hanawi (6064), and Makapipi (6065), Maui
08/25/2010	CWRM staff provided an update to CWRM on the implementation of IIFS for East Maui streams for actions from June 23, 2010 thru September 17, 2010.

Date	Action / Description
	Ref: 20100825 Maui IIFS Update.
11/17/2010	CWRM staff provided an update to CWRM on the implementation of IIFS for East Maui streams for actions taken from August 31, 2010 thru November 16, 2010. Ref: 20101117 Maui IIFS Update.
11/2010	Hydrologist Chui Ling Cheng leaves CWRM.
01/20/2011	CWRM staff presented a staff submittal to CWRM to request to enter into a joint funding agreement with USGS to conduct an East Maui Irrigation Diversion System Seepage Reconnaissance Study. The study was part of CWRM's adaptive management strategies from the May 25, 2010 action. Ref: <i>sb201101D1; USGS OFR 2012-1115.</i>
02/25/2011	CWRM enters into a Joint Funding Agreement to conduct an East Maui Irrigation Diversion System Seepage Reconnaissance Study, East Maui, Hawaii. Ref: 20110225 EMI Seepage Study JFA.
03/16/2011	CWRM staff provided an update to CWRM on the implementation of IIFS for East Maui streams for actions taken from December 7, 2010 thru March 14, 2011. Ref: 20110316 Maui IIFS Update.
05/17/2011	MDWS submitted a Status Report on the Waikamoi Flume Replacement Project providing a complete project timeline with completed and pending tasks starting from the award of the design contract and Notice to Proceed in August 2010 to the anticipated completion of the new flume in December 2014. Ref: 20110517 MDWS Status Report.
11/16/2011	CWRM staff provided an update to CWRM on the implementation of IIFS for East Maui streams for actions taken from March 22, 2011 thru November 2, 2011. Ref: 20111116 Maui IIFS Update.
08/2012	USGS completes the report Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i, Open-File Report 2012-1115. The report is available online at <u>http://pubs.usgs.gov/of/2012/1115/</u> . Ref: USGS OFR 2012-1115.
12/2012	Planner Robert Chong retires from CWRM.
07/2013 to 05/2014	CWRM hires new Stream Protection and Management Branch staff including a geologist, planner, and hydrologist.
05/29/2014	MDWS submitted Status Report No. 3 on the Waikamoi Flume Replacement Project. Most of the original redwood flume had been demolished (4,600 linear feet of 5,750 feet total) and replaced with an aluminum flume (3,700 linear feet of 5,750 feet total). Ref: 20140529 MDWS Status Report.

HONOPOU (6034)

Date	Action / Description
10/23/2008	CWRM staff met with USGS, DAR, and the Honopou community to identify potential IFS measurement sites (sites A & B) on Honopou Stream. Ref: <i>F12008102301; F12008102302.</i>
	In the evening, CWRM staff held a community meeting at the Haiku Community Center to explain the implementation steps for Honopou and Hanehoi Streams.
10/27/2008	CWRM staff met with EMI and the Honopou community to conduct a flow measurement at IIFS sites A and B on Honopou Stream. Ref: <i>F12008102701; F12008102702.</i>
	EMI staff, assisted by CWRM staff and Honopou residents, constructed a low berm atop the Haiku Ditch intake to try and force more water through the bypass pipes. CWRM staff took a measurement. Ref: <i>FI2008102703</i> .
	EMI staff opened the Lowrie Ditch sluice gate to release water downstream. Ref: <i>FI2008102704</i> .
10/28/2008	CWRM staff took a measurement at IIFS sites A and B on Honopou Stream (post-release). Ref: FI2008102801 Field Investigation Report; 2008102802 Field Investigation Report.
10/29/2008	CWRM staff took a flow measurement at the Haiku Ditch bypass pipes on Honopou Stream. Ref: <i>F12008102901</i> .
	CWRM staff took a second flow measurement at the Haiku Ditch bypass pipes on Honopou Stream. Ref: <i>F12008102903</i> .
11/18/2008	CWRM and DAR staff documented high flows at Haiku Ditch on Honopou Stream. Ref: <i>FI2008111807</i> .
11/19/2008	CWRM and DAR staff documented high flows at Haiku Ditch on Honopou Stream, noting that despite high flows, the berm constructed on 10/27/2008 was still present. Ref: <i>FI2008111807</i> .
02/11/2009	CWRM staff took a flow measurement at the IIFS site A on Honopou Stream. Ref: <i>FI2009021104</i> .
03/23/2009	CWRM staff documented the installation of the low-flow bypass channel across the Haiku Ditch diversion intake by EMI. Ref: <i>FI2009032301</i> .
06/23/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, and accompanied by Honopou residents, visited the Lowrie Ditch intake on Honopou Stream. USGS took a pre-release flow measurement. The group then went to the Wailoa Ditch and New Hamakua Ditch intakes, where EMI released water past both ditch intakes. Ref: <i>F12010062301</i> .
06/24/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, visited the Lowrie Ditch intake on Honopou Stream. USGS took a post-release flow measurement. Ref: <i>FI2010064302</i> .

Date	Action / Description
10/14/2010	CWRM staff installed a pressure transducer and field camera at the IIFS gage site on Honopou Stream. Ref: <i>FI2014101401</i> .
12/07/2010	CWRM staff documented the modification of the Haiku Ditch diversion intake structure by EMI to seal leaks and force more water through the low-flow bypass channel. Ref: <i>FI2010120701 (photos only)</i> .
02/16/2011	CWRM staff installed a barometric pressure transducer at the IIFS site on Honopou Stream. Ref: 20110215 Maui Field Investigation Itinerary.
03/21/2011	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20110321 Maui Field Investigation Itinerary.
04/26/2011	CWRM staff met with DAR and EMI staff and Honopou residents to discuss and agree upon specific diversion modifications to achieve biological connectivity at the Haiku Ditch, New Hamakua Ditch, and Wailoa Ditch intakes on Honopou Stream. Ref: 20110425 Maui Field Investigation Itinerary; FI2011042701.
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20110926 Maui Field Investigation Itinerary.
11/02/2011	CWRM staff documented the diversion modification for biological connectivity at the Haiku Ditch intake on Honopou Stream. Ref: 20111102 Maui Field Investigation Itinerary; FI2011110201 (photos only).
12/14/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20120329 Maui Field Investigation Itinerary.
06/13/2012	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Honopou Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/21/2013	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20130321 Maui Field Investigation Itinerary.
09/16/2013	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: 20130916 Maui Field Investigation Itinerary.
09/23/2014	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream. Ref: <i>None available.</i>
12/17/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Honopou Stream. Streamflow data is pending. Ref: 20141215 Maui Field Investigation Itinerary.

The graph below depicts the CWRM-measured streamflows for Honopou Stream (black line) compared with the IIFS (2.0 cfs; black dotted line) and streamflows for the USGS Honopou gage (No. 16587000). The USGS Honopou gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall.



Honopou Stream downstream of Haiku Ditch (IIFSSite A)

Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule.

HANEHOI (6037)

Date	Action / Description
10/23/2008	CWRM staff met with USGS, DAR, and the Honopou/Huelo community to identify potential IFS measurement sites (site A) on Puolua (Huelo) Stream. Ref: <i>F12008102303</i> .
	In the evening, CWRM staff held a community meeting at the Haiku Community Center to explain the implementation steps for Honopou and Hanehoi Streams.
10/24/2008	CWRM staff met with USGS, DAR, and the Honopou/Huelo community to identify potential IFS measurement sites (sites B & C) on Hanehoi and Puolua (Huelo) Stream. Ref: <i>FI2008102401; FI2008102402.</i>
10/27/2008	CWRM staff took a flow measurement at IIFS site A on Puolua (Huelo) Stream. Ref: <i>FI2008102705</i> .
10/28/2008	CWRM staff took a flow measurement at IIFS site A on Puolua (Huelo) Stream. EMI staff opened the Haiku Ditch sluice gate to release water downstream. Ref: <i>F12008102803</i> .
	EMI staff opened the Haiku Ditch sluice gate on Hanehoi Stream to release water downstream (the stream was dry). IIFS site B is located downstream of the Haiku Ditch intake. Ref: <i>F12008102804</i> .
	CWRM staff took a flow measurement at IIFS site A on Puolua (Huelo) Stream. Ref: <i>FI2008102805</i> .
11/19/2008	CWRM staff took a flow measurement at IIFS site A on Puolua (Huelo) Stream. Ref: <i>FI2008111904</i> .
	CWRM staff took a flow measurement upstream of IIFS site B at the Haiku Ditch sluice gate. Ref: <i>F12008111905</i> .
02/11/2009	EMI staff adjusted the sluice gate on the Haiku Ditch diversion sluice gate on Hanehoi Stream. Ref: <i>F12009021102</i> .
	CWRM staff took a flow measurement at IIFS site A on Puolua (Huelo) Stream. EMI staff adjusted the sluice gate on the Haiku Ditch diversion sluice gate on Puolua (Huelo) Stream. Ref: <i>F12009021103</i> .
12/08/2010	CWRM staff installed a pressure transducer at the IIFS site on Hanehoi Stream. Ref: <i>FI2010120801 (photos only).</i>
03/21/2011	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Hanehoi Stream. Ref: 20110321 Maui Field Investigation Itinerary.
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on Hanehoi Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on Hanehoi Stream. Ref: 20110926 Maui Field Investigation Itinerary.

Date	Action / Description
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on Hanehoi Stream.Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on Hanehoi Stream. Ref: 20120329 Maui Field Investigation Itinerary.
06/13/2012	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Hanehoi Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on Hanehoi Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/21/2013	CWRM staff downloaded transducer data at the IIFS site on Hanehoi Stream and documented that the Huelo community pipeline formerly located below the IIFS site was relocated approximately 50 ft. upstream of the IIFS site. Ref: 20130321 Maui Field Investigation Itinerary; FI2013032101 (photos only).
09/16/2013	CWRM staff downloaded transducer data at the IIFS site on Hanehoi Stream. Ref: 20130916 Maui Field Investigation Itinerary.
09/23/2014	CWRM staff downloaded transducer data at the IIFS site on Honopou Stream and documented the relocated Huelo community pipeline. Ref: <i>FI2014092401 (photos only)</i> .

The graph below depicts the CWRM-measured streamflows for Hanehoi Stream (black line) compared with the IIFS (1.15 cfs; black dotted line) and streamflows for the USGS Honopou gage (No. 16587000). The USGS Honopou gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall.



Hanehoi Stream above Lowrie Ditch (IIFS Site C)

Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule. Some errors may also result from the lack of a dedicated barometric pressure transducer operated in conjunction with the current stream transducer.

WAIKAMOI (6047)

Alo Stream is a tributary of Waikamoi Stream (confluence at approx. 825 feet elevation), thus the PAIFSs for both Alo and Waikamoi Stream were considered as part of the Waikamoi IFSAR. The PAIFS for Wahinepee Stream was also combined with the Waikamoi IFSAR because Wahinepee Stream falls within the surface water hydrologic unit delineation for Waikamoi.

Date	Action / Description
11/18/2008	CWRM and DAR staff documented high flows at Waikamoi Stream at Hana Hwy. Ref: <i>F12008111806</i> .
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Waikamoi Stream. Ref: <i>F12009111901</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Wahinepee Stream into the Manuel Luis Ditch. Ref: <i>F12010020301</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Waikamoi and Alo Streams into the Center Ditch, Wailoa Ditch, New Hamakua Ditch, and Spreckels Ditch. Ref: <i>F12010020401</i> .
06/23/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, conducted a field investigation of the Center Ditch intake on Waikamoi Stream to discuss modification options that would create wetted pathways for the upstream migration of native fauna. Ref: <i>F12010062302</i> .
12/08/2010	CWRM staff installed a pressure transducer at the IIFS site on Waikamoi Stream.
03/22/2011	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20110321 Maui Field Investigation Itinerary.
04/26/2011	CWRM staff met with DAR and EMI staff to discuss and agree upon specific diversion modifications to achieve biological connectivity at the Center Ditch intake on Waikamoi Stream. Ref: 20110425 Maui Field Investigation Itinerary: FI2011042601
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20110926 Maui Field Investigation Itinerary.
11/02/2011	CWRM staff documented the diversion modification for biological connectivity at the Koolau Ditch intake on Waiouhue Stream and documented the seasonal flow release by EMI staff. Ref: 20111101 Maui Field Investigation Itinerary; FI2011110201 (photos only).
11/03/2011	CWRM staff took a flow measurement at the IIFS site on Waikamoi Stream. Ref: 20111101 Maui Field Investigation Itinerary.
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20111212 Maui Field Investigation Itinerary.
12/14/2011	CWRM staff took a flow measurement at the IIFS site on Waikamoi Stream.

Date	Action / Description
	Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20120329 Maui Field Investigation Itinerary.
05/01/2012	CWRM staff accompanied EMI to document the summer season IFS at the Center Ditch diversion intake on Waikamoi Stream. Ref: 20120501 Maui Field Investigation Itinerary; FI2012020101 (photos only).
06/14/2012	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/22/2013	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20130321 Maui Field Investigation Itinerary.
09/17/2013	CWRM staff downloaded transducer data at the IIFS site on Waikamoi Stream. Ref: 20130916 Maui Field Investigation Itinerary.
12/16/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Waikamoi Stream. Streamflow data is pending. Ref: 20141215 Maui Field Investigation Itinerary.

The graph below depicts the CWRM-measured streamflows for Waikamoi Stream (black line) compared with the IIFS (2.8 cfs in the wet season / 0.0 cfs in the dry season; black dotted line) and streamflows for the USGS Waikamoi gage (No. 16552800). The USGS Waikamoi gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall.



Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule. Some errors may also result from the lack of a dedicated barometric pressure transducer operated in conjunction with the current stream transducer.

PUOHOKAMOA (6048)

Date	Action / Description
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Puohokama Stream. Ref: <i>FI2009111901</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Puohokamoa Stream into the Spreckels Ditch and Manuel Luis Ditch. Ref: <i>FI2010020301</i> .

HAIPUAENA (6049)

Date	Action / Description
11/19/2008	CWRM and DAR staff documented high flows at Haipuaena Stream at Hana Hwy. Ref: <i>FI2008111901</i> .
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Haipuaena Stream. Ref: <i>FI2009111901</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Haipuaena Stream into the Spreckels Ditch and Manuel Luis Ditch. Ref: <i>FI2010020301</i> .

PUNALAU/KOLEA (6050)

Date	Action / Description
11/18/2008	CWRM and DAR staff documented high flows at Punalau Stream at Hana Hwy. Ref: <i>FI2008111806</i> .
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Punalau Stream. Ref: <i>FI2009111901</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Punalau/Kolea Stream into the Spreckels Ditch and Manuel Luis Ditch. Ref: <i>FI2010020301</i> .

HONOMANU (6051)

Date	Action / Description
11/18/2008	CWRM and DAR staff documented high flows at Honomanu Stream at Hana Hwy. Ref: <i>FI2008111806</i> .
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Honomanu Stream. Ref: <i>FI2009111901</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Honomanu Stream into the Spreckels Ditch. Ref: <i>F12010020301</i> .

NUAAILUA (6052)

Date	Action / Description
11/18/2008	CWRM and DAR staff documented high flows at Nuaailua Stream at Hana Hwy. Ref: <i>FI2008111806</i> .
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Nuaailua Stream. Ref: <i>FI2009111901</i> .
02/03/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Nuaailua Stream into the Spreckels Ditch. Ref: <i>FI2010020301</i> .

PIINAAU (6053)

Date	Action / Description
10/24/2008	CWRM staff met with USGS, DAR, and the Honopou/Keanae community to identify potential IFS measurement sites (site B) on Palauhulu Stream. Ref: <i>F12008102403</i> .
10/27/2008	In the evening, CWRM staff held a community meeting at Keanae Elementary School to explain the implementation steps for Palauhulu, Waiokamilo, and Wailuanui Streams.
10/28/2008	CWRM staff took a flow measurement at the IIFS site on Palauhulu Stream. Ref: <i>FI2008102406</i> .
11/17/2008	CWRM staff took a flow measurement at the IIFS site on Palauhulu Stream. Ref: <i>FI2008111701</i> .
	CWRM staff, led by EMI, went up Piinaau Road to document the flow release from the Kano Stream intake by EMI staff. After EMI opened the sluice gate, the average streamflow was measured at 5.534 cfs (3.577 mgd). A flow measurement (2.802 cfs or 1.811 mgd) was also taken downstream of Kano falls Ref: <i>FI2008111702</i> .
11/18/2008	CWRM and DAR staff documented high flows on Palauhulu Stream. Ref: <i>FI2008111801</i> .
	CWRM and DAR staff documented high flows at the mouth of Piinaau Stream. Ref: <i>FI2008111805</i> .
11/19/2008	CWRM and DAR staff, and Keanae residents documented high flows at Piinaau Stream and the Keanae Flume Ref: <i>FI2008111902</i> .
12/09/2008	CWRM staff took a flow measurement at the IIFS site on Palauhulu Stream. Ref: <i>FI2008120901</i> .
12/10/2008	CWRM located Kaleiomaui Stream to verify that the stream was not diverted by Koolau Ditch. Ref: <i>F12008121004</i> .
	CWRM staff documented the Koolau Ditch major and minor diversion intakes located on Piinaau Stream and its tributaries because of a major landslide that occurred in 2003 and covered a relatively long stretch of the stream, Ref: <i>F12008121005</i> .
02/10/2009	CWRM staff visited the Keanae Arboretum to better understand and document the stream diversion on Piinaau Stream and the taro patches fed by it. Staff also observed a portion of Kuo Stream, a tributary of Piinaau. Ref: <i>F12008121006</i> .
02/11/2009	CWRM staff took a flow measurement at the IIFS site on Palauhulu Stream. Ref: <i>FI2009021105</i> .
09/15/2010	CWRM staff, accompanied by EMI staff and Keanae residents, conducted a field investigation of multiple stream sections on Palauhulu Stream to identify gaining and losing reaches.
10/14/2010	CWRM staff installed a pressure transducer and field camera at the IIFS gage site on Palauhulu Stream.

Date	Action / Description
	Ref: <i>F12014101401</i> .
02/16/2011	CWRM staff installed a barometric pressure transducer at the IIFS site on Palauhulu Stream. A field camera was also installed at an upper site (old USGS gaging station) on Palauhulu Stream. Ref: 20110215 Maui Field Investigation Itinerary; FI2011021602.
03/22/2011	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20110321 Maui Field Investigation Itinerary.
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20110926 Maui Field Investigation Itinerary.
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20120329 Maui Field Investigation Itinerary.
06/14/2012	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/22/2013	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream and documented the slight damage to the staff gage likely due to high flows. Ref: 20130321 Maui Field Investigation Itinerary; FI2013032201 (photos only).
09/17/2013	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream and documented further damage to the staff gage likely due to high flows. Ref: 20130916 Maui Field Investigation Itinerary; FI2013091701 (photos only).
09/24/2014	CWRM staff downloaded transducer data at the IIFS site on Palauhulu Stream. Ref: <i>None available.</i>
12/17/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Palauhulu Stream. Streamflow data is pending. The damaged staff gage was replaced. Ref: 20141215 Maui Field Investigation Itinerary.

The graph below depicts the CWRM-measured streamflows for Palauhulu Stream (black line) compared with the IIFS (5.5 cfs; black dotted line) and streamflows for the USGS West Wailuaiki gage (No. 16518000). The USGS West Wailuaiki gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns. CWRM were unable to retrieve data from the transducer from September 2013 to September 2014 and are working with the manufacturer to retrieve the data that may cause the stream to fall below the IIFS as a result of low rainfall.



Palauhulu Stream at Hana Hwy

Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule. Some errors may also result from the lack of a dedicated barometric pressure transducer operated in conjunction with the current stream transducer.

OHIA/WAIANU (6054)

No actions were taken for the surface water hydrologic unit of Ohia since the stream is spring-fed and occurs below the EMI irrigation system.

Date Action / Description

WAIOKAMILO (6055)

Kualani (Hamau) Stream is a tributary of Waiokamilo Stream (confluence at approx. 825 feet elevation), thus the PAIFSs for both Kualani and Waiokamilo Stream were considered as part of the Waiokamilo IFSAR.

Date	Action / Description
10/27/2008	In the evening, CWRM staff held a community meeting at Keanae Elementary School to explain the implementation steps for Palauhulu, Waiokamilo, and Wailuanui Streams.
11/18/2008	CWRM and DAR staff met with Wailua residents to document Lakini taro patch and Kulani Stream. The question was raised by community members where Kualani Stream meets with Waiokamilo Stream. The location of Kualani Stream was documented by photos and GPS. Ref: <i>F12008111803</i> .
12/09/2008	CWRM staff met with EMI staff to document the major and minor diversion structures on Waiokamilo Stream and its tributaries. Ref: <i>F12008120903</i> .
	CWRM staff, with EMI staff, located the headwaters of Kualani Stream to confirm that there were no EMI diversions of the stream located upstream of the Lakini taro patch diversion. Based on GPS locations, the headwaters of Kualani Stream begin below the elevation of Koolau Ditch. Ref: <i>F12008120903</i> .
02/09/2009	CWRM staff met with Wailua residents to better understand how water gets from the stream to the taro patches (auwai system) in Wailua Valley (focus on the center portion supplied by Waiokamilo Stream). Ref: <i>F12009020901</i> .
02/10/2009	CWRM staff met with Wailua residents to document the terminal waterfall at Waiokamilo Stream. Ref: <i>F12009021001</i> .
	CWRM staff met with Wailua residents to better understand how water gets from the stream to the taro patches (auwai system) in Wailua Valley (focus on the western portion supplied by Waiokamilo Stream). Ref: <i>F12009021002</i> .
	CWRM staff documented the diversion dam and confluence of Waiokamilo Stream and the Kualani Stream tributary. Ref: <i>F12009021003</i> .
	CWRM staff met with Keanae residents to document Dam 3 and upstream losing reaches on Waiokamilo Stream. Ref: <i>F12009021005</i> .
02/11/2009	CWRM staff documented the taro patches located at the Na Moku Project to better understand how water gets from the stream to the taro patches (auwai system). Ref: <i>F12009021106</i> .
12/08/2010	CWRM staff documented Waiokamilo Stream and the losing section above Dam #3. Though no measurements were taken, a greater percentage of streamflow appeared to be flowing into the losing section than previously observed. Ref: <i>F12010120802 (photos only)</i> .

In compliance with a 2005 Circuit Court ruling on the appeal of a Board of Land and Natural Resources contested case hearing decision, EMI disconnected or bypassed all of their major and minor diversions on Waiokamilo Stream in order to meet the required 6.0 mgd of streamflow at Dam #3. A USGS gage (No. 16521300) was also installed on Waiokamilo Stream below Koolau Ditch but just above Dam #3. The USGS discontinued the gage on 07/01/2011.

The graph below depicts the USGS-measured streamflows for Waiokamilo Stream (black line) compared with the IIFS (4.9 cfs, black dotted line) and streamflows for the USGS West Wailuaiki gage (No. 16518000). The USGS West Wailuaiki gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall.



Waiokamilo Stream at Dam 3 near Keanae (USGS Gage 16521300)

Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule. Some errors may also result from the lack of a dedicated barometric pressure transducer operated in conjunction with the current stream transducer.

WAILUANUI (6056)

The PAIFS for Waikani Stream was disregarded because it is actually Waikani Waterfall and was considered as part of the Wailuanui IFSAR.

Date	Action / Description
10/24/2008	CWRM staff met with USGS and DAR to identify potential IFS measurement sites on Wailuanui Stream. Ref: <i>F12008102404</i> .
10/27/2008	In the evening, CWRM staff held a community meeting at Keanae Elementary School to explain the implementation steps for Palauhulu, Waiokamilo, and Wailuanui Streams.
10/29/2008	CWRM staff hiked in Wailuanui Stream from Hana Hwy. to the top of Waikani Falls to try and find a suitable measuring site (none was found downstream). CWRM staff took a flow measurement at the IIFS site on Wailuanui Stream at Hana Hwy. Ref: <i>FI2008102902</i> .
11/18/2008	CWRM and DAR staff met with Wailua residents to document the high flows on Wailuanui Stream at the mouth (entering Wailua Bay). Ref: <i>FI2008111802</i> .
	CWRM and DAR staff documented high flows on Wailuanui Stream. Ref: <i>FI2008111804</i> .
11/19/2008	CWRM and DAR staff documented high flows on Wailuanui Stream at Hana Hwy. Ref: <i>FI2008111903</i> .
12/08/2008	CWRM and DOCARE staff met with EMI staff and took a flow measurement downstream of the East Wailuanui diversion sluice gate. Ref: <i>FI2008120801</i> .
	CWRM staff took a flow measurement just upstream of the West Wailuanui diversion sluice gate. Ref: <i>FI2008120802</i> .
	CWRM staff took a flow measurement at the IIFS site on Wailuanui Stream at Hana Hwy. Ref: <i>F12008120803</i> .
12/09/2008	CWRM staff took a flow measurement at the IIFS site on Wailuanui Stream. Ref: <i>FI2008120902</i> .
12/10/2008	CWRM staff, accompanied by EMI and DOCARE staff, met with Wailua residents and took a flow measurement at the IIFS site on Wailuanui Stream. Ref: <i>FI2008121001</i> .
	CWRM staff took a flow measurement just upstream of the East Wailuanui diversion sluice gate. Ref: <i>FI2008121002</i> .
	CWRM staff took a flow measurement just upstream of the West Wailuanui diversion sluice gate. Ref: <i>FI2008121003</i> .
02/09/2009	CWRM staff met with Wailua residents to better understand how water gets from the stream to the taro patches (auwai system) in Wailua Valley (focus on the eastern portion supplied by Wailuanui Stream).

Date	Action / Description
	Ref: <i>F12009020901</i> .
10/14/2010	CWRM staff installed a pressure transducer at the IIFS gage site on Wailuanui Stream. Ref: <i>FI2014101401</i> .
12/07/2010	CWRM staff installed a field camera at the IIFS site on Wailuanui Stream. Ref: <i>FI2010120702 (photos only)</i> .
03/22/2011	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20110321 Maui Field Investigation Itinerary.
12/14/2011	CWRM staff documented the sluice gate adjustments made by EMI staff at the Koolau Ditch on East and West Wailuanui Streams. Ref: <i>FI2011110201 (photos only).</i>
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20110926 Maui Field Investigation Itinerary.
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20111212 Maui Field Investigation Itinerary.
12/14/2011	EMI adjusted the gate heights on the Koolau diversion intakes at East and West Wailuanui Stream intakes. Ref: 20111212 Maui Field Investigation Itinerary; FI2011121401 (photos only).
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20120329 Maui Field Investigation Itinerary.
06/14/2012	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/22/2013	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream and documented the slight damage to the staff gage likely due to high flows. Ref: 20130321 Maui Field Investigation Itinerary; FI2013032201 (photos only).
09/17/2013	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. CWRM staff accompanied EMI staff to the Koolau Ditch diversion intake on East Wailuanui to readjust the sluice which had been tampered with prior. Ref: 20130916 Maui Field Investigation Itinerary; FI2013091701 (photos only).
09/24/2014	CWRM staff downloaded transducer data at the IIFS site on Wailuanui Stream. Ref: <i>None available.</i>
12/17/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Wailuanui Stream. Streamflow data is pending. Further damage to the staff was documented. Ref: 20141215 Maui Field Investigation Itinerary.

The graph below depicts the CWRM-measured streamflows for Wailuanui Stream (black line) compared with the IIFS (3.05 cfs; black dotted line) and streamflows for the USGS West Wailuaiki gage (No. 16518000). The USGS West Wailuaiki gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall.



Wailuanui Stream at Hana Highway

Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule. Some errors may also result from the lack of a dedicated barometric pressure transducer operated in conjunction with the current stream transducer.

WEST WAILUAIKI (6057)

Date	Action / Description
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on West Wailuaiki Stream. Ref: <i>FI2009111901</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on West Wailuaiki Stream into the Koolau Ditch. Ref: <i>F12010020201</i> .
06/23/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, conducted a field investigation of the Koolau Ditch intake on West Wailuaiki Stream to discuss modification options that would create wetted pathways for the upstream migration of native fauna. Ref: <i>F12010062302</i> .
12/07/2010	CWRM staff installed a pressure transducer at the IIFS site on West Wailuaiki Stream. Ref: <i>FI2010120702 (photos only).</i>
03/22/2011	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20110321 Maui Field Investigation Itinerary.
04/26/2011	CWRM staff met with DAR and EMI staff to discuss and agree upon specific diversion modifications to achieve biological connectivity at the Koolau Ditch intake on West Wailuaiki Stream. Ref: 20110425 Maui Field Investigation Itinerary; FI2011042601.
11/02/2011	CWRM staff documented the diversion modification for biological connectivity at the Koolau Ditch on West Wailuaiki Stream and documented the seasonal flow release by EMI staff. Ref: <i>FI2011110201 (photos only)</i> .
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20110926 Maui Field Investigation Itinerary.
11/02/2011	 CWRM staff documented the diversion modification for biological connectivity at the Koolau Ditch intake on West Wailuaiki Stream and documented the seasonal flow release by EMI staff. Ref: 20111101 Maui Field Investigation Itinerary; FI2011110201 (photos only).
11/03/2011	CWRM staff took a flow measurement at the IIFS site on West Wailuaiki Stream. Ref: 20111101 Maui Field Investigation Itinerary.
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20111212 Maui Field Investigation Itinerary.
12/14/2011	CWRM staff took a flow measurement at the IIFS site on West Wailuaiki Stream. Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20120329 Maui Field Investigation Itinerary.
05/01/2012	CWRM staff accompanied EMI to document the summer season IFS at the Koolau Ditch diversion intake on West Wailuaiki Stream.

Date	Action / Description
	Ref: 20120501 Maui Field Investigation Itinerary; FI2012020101 (photos only).
06/14/2012	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on West Wailuaiki Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/22/2013	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20130321 Maui Field Investigation Itinerary.
09/17/2013	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: 20130916 Maui Field Investigation Itinerary.
09/24/2014	CWRM staff downloaded transducer data at the IIFS site on West Wailuaiki Stream. Ref: <i>None available.</i>
12/17/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on West Wailuaiki Stream. Streamflow data is pending. Ref: 20141215 Maui Field Investigation Itinerary.

The graph below depicts the CWRM-measured streamflows for West Wailuaiki Stream (black line) compared with the IIFS (3.8 cfs in the wet season / 0.4 cfs in the dry season; black dotted line) and streamflows for the USGS West Wailuaiki gage (No. 16518000). The USGS West Wailuaiki gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall.



Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule. Some errors may also result from the lack of a dedicated barometric pressure transducer operated in conjunction with the current stream transducer.

EAST WAILUAIKI (6058)

Date	Action / Description
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on East Wailuaiki Stream. Ref: <i>FI2009111901</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on East Wailuaiki Stream into the Koolau Ditch. Ref: <i>F12010020201</i> .
06/23/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, conducted a field investigation of the Koolau Ditch intake on East Wailuaiki Stream to discuss modification options that would create wetted pathways for the upstream migration of native fauna. Ref: <i>F12010062302</i> .
02/16/2011	CWRM staff installed a pressure transducer at the IIFS site on East Wailuaiki Stream. Ref: 20110215 Maui Field Investigation Itinerary; FI2011021601.
03/22/2011	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20110321 Maui Field Investigation Itinerary.
04/26/2011	CWRM staff met with DAR and EMI staff to discuss and agree upon specific diversion modifications to achieve biological connectivity at the Koolau Ditch intake on East Wailuaiki Stream. Ref: 20110425 Maui Field Investigation Itinerary; FI2011042601.
11/02/2011	CWRM staff documented the diversion modification for biological connectivity at the Koolau Ditch on East Wailuaiki Stream and documented the seasonal flow release by EMI staff. Ref: <i>FI2011110201 (photos only)</i> .
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20110926 Maui Field Investigation Itinerary.
11/02/2011	CWRM staff documented the diversion modification for biological connectivity at the Koolau Ditch intake on East Wailuaiki Stream and documented the seasonal flow release by EMI staff.Ref: 20111101 Maui Field Investigation Itinerary; FI2011110201 (photos only).
11/03/2011	CWRM staff took a flow measurement at the IIFS site on East Wailuaiki Stream. Ref: 20111101 Maui Field Investigation Itinerary.
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20111212 Maui Field Investigation Itinerary.
12/14/2011	CWRM staff took a flow measurement at the IIFS site on East Wailuaiki Stream. Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2012	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20120329 Maui Field Investigation Itinerary.
05/01/2012	CWRM staff accompanied EMI to document the summer season IFS at the Koolau Ditch diversion intake on East Wailuaiki Stream.

Date	Action / Description
	Ref: 20120501 Maui Field Investigation Itinerary; FI2012020101 (photos only).
06/14/2012	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on East Wailuaiki Stream. Ref: 20120613 Maui Field Investigation Itinerary.
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20120918 Maui Field Investigation Itinerary.
03/22/2013	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20130321 Maui Field Investigation Itinerary.
09/17/2013	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: 20130916 Maui Field Investigation Itinerary.
09/24/2014	CWRM staff downloaded transducer data at the IIFS site on East Wailuaiki Stream. Ref: <i>None available.</i>
12/17/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on East Wailuaiki Stream. Streamflow data is pending. Ref: 20141215 Maui Field Investigation Itinerary.

A rating curve was not developed for the IIFS site on East Wailuaiki Stream due to a lack of field measurements. CWRM staff is working to fully restore its quarterly monitoring schedule.

KOPILIULA (6059)

Date	Action / Description
02/11/2009	CWRM staff documented Kopiliula Stream conditions at Hana Hwy. Ref: <i>FI2009021107</i> .
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Kopiliula Stream. Ref: <i>FI2009111901</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Kopiliula Stream into the Koolau Ditch. Ref: <i>F12010020201</i> .
PUAKAA

Date	Action / Description
02/11/2009	CWRM staff documented Puakaa Stream conditions at Hana Hwy. Ref: <i>FI2009021107</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Puakaa Stream into the Koolau Ditch. Ref: <i>FI2010020201</i> .

WAIOHUE (6060)

Date	Action / Description
02/11/2009	CWRM staff documented Waiohue Stream conditions at Hana Hwy. Ref: <i>F12009021107</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Waiohue Stream into the Koolau Ditch. Ref: <i>F12010020201</i> .
06/24/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, conducted a field investigation of the Koolau Ditch intake on Waiohue Stream to discuss modification options that would create wetted pathways for the upstream migration of native fauna. Ref: <i>F12010064302</i> .
12/07/2010	CWRM staff installed a pressure transducer at the IIFS site on Waiohue Stream. Ref: <i>FI2010120702 (photos only).</i>
02/16/2011	CWRM staff installed a barometric pressure transducer at the IIFS site on Waiohue Stream. Ref: 20110215 Maui Field Investigation Itinerary.
03/22/2011	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20110321 Maui Field Investigation Itinerary.
04/26/2011	CWRM staff met with DAR and EMI staff to discuss and agree upon specific diversion modifications to achieve biological connectivity at the Koolau Ditch intake on Waiohue Stream. Ref: 20110425 Maui Field Investigation Itinerary; FI2011042601.
06/14/2011	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20110613 Maui Field Investigation Itinerary.
09/27/2011	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20110926 Maui Field Investigation Itinerary.
11/02/2011	CWRM staff documented the diversion modification for biological connectivity at the Koolau Ditch intake on Waiouhue Stream and documented the seasonal flow release by EMI staff. Ref: 20111101 Maui Field Investigation Itinerary; FI2011110201 (photos only).
12/13/2011	CWRM staff took a flow measurement and downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20111212 Maui Field Investigation Itinerary.
12/14/2011	CWRM staff took a flow measurement at the IIFS site on Waiohue Stream. Ref: 20111212 Maui Field Investigation Itinerary.
03/27/2011	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20120329 Maui Field Investigation Itinerary.
05/01/2012	CWRM staff accompanied EMI to document the summer season IFS at the Koolau Ditch diversion intake on Waiohue Stream. Ref: 20120501 Maui Field Investigation Itinerary; FI2012020101 (photos only).
06/14/2012	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Waiohue Stream. Ref: 20120613 Maui Field Investigation Itinerary.

Date	Action / Description			
09/18/2012	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20120918 Maui Field Investigation Itinerary.			
03/22/2013	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20130321 Maui Field Investigation Itinerary.			
09/17/2013	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: 20130916 Maui Field Investigation Itinerary.			
09/24/2014	CWRM staff downloaded transducer data at the IIFS site on Waiohue Stream. Ref: <i>None available</i> .			
12/16/2014	CWRM staff downloaded transducer data and took a streamflow measurement at the IIFS site on Waiohue Stream. Streamflow data is pending. Ref: 20141215 Maui Field Investigation Itinerary.			

The graph below depicts the CWRM-measured streamflows for Waiohue Stream (black line) compared with the IIFS (3.2 cfs in the wet season / 0.1 cfs in the dry season; black dotted line) and streamflows for the USGS West Wailuaiki gage (No. 16518000). The USGS West Wailuaiki gage presents natural streamflow conditions above any diversions and is used to illustrate weather patterns that may cause the stream to fall below the IIFS as a result of low rainfall. Zero drift appears to be occurring in the transducer data from May 2014 to September 2014.



Waiohue Stream nr Hana Hwy

Note: There was a lack of regular transducer data collections and streamflow measurements from September 2013 to September 2014. As a result, the chances of transducer failure and the amount of zero drift can increase. Zero drift is defined as an undesired change in zero over a period of time. CWRM staff is working to fully restore its quarterly monitoring schedule.

PAAKEA (6061)

Date	Action / Description
02/11/2009	CWRM staff documented Paakea Stream conditions at Hana Hwy. Ref: <i>FI2009021107</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Paakea Stream into the Koolau Ditch. Ref: <i>FI2010020201</i> .

WAIAAKA (6062)

Date	Action / Description
02/11/2009	CWRM staff documented Waiaaka Stream conditions at Hana Hwy. Ref: <i>FI2009021107</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Waiaaka Stream into the Koolau Ditch. Ref: <i>FI2010020201</i> .

KAPAULA (6063)

Date	Action / Description
02/11/2009	CWRM staff documented Kapaula Stream conditions at Hana Hwy. Ref: <i>FI2009021107</i> .
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Kapaula Stream into the Koolau Ditch. Ref: <i>FI2010020201</i> .

HANAWI (6064)

Date	Action / Description			
02/11/2009	CWRM staff documented Hanawi Stream conditions at Hana Hwy. Ref: <i>F12009021107</i> .			
11/16/2009	CWRM staff met with EMI to investigate the system diversion on Hanawi Stream and the ML&P Hanawi Pump Station. Ref: <i>F12009111601</i> .			
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Hanawi Stream. Ref: <i>FI2009111901</i> .			
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Hanawi Stream into the Koolau Ditch. Ref: <i>F12010020201</i> .			
06/24/2010	CWRM staff, assisted by DAR, USGS, and EMI staff, conducted a field investigation of the Koolau Ditch intake on Hanawi Stream to discuss modification options that would create wetted pathways for the upstream migration of native fauna. Ref: <i>FI2010064302</i> .			
04/26/2011	CWRM staff met with DAR and EMI staff to discuss and agree upon specific diversion modifications to achieve biological connectivity at the Koolau Ditch intake on Hanawi Stream. Ref: 20110425 Maui Field Investigation Itinerary; FI2011042601.			
11/02/2011	CWRM staff documented the diversion modifications for biological connectivity at the Koolau Ditch intake on Hanawi Stream. Ref: 20111101 Maui Field Investigation Itinerary; FI2011110201 (photos only).			

MAKAPIPI (6065)

Date	Action / Description		
02/11/2009 CWRM staff documented Makapipi Stream conditions at Hana Hwy. Ref: <i>F12009021107</i> .			
11/09/2009	CWRM staff met with members of the Nahiku community and Representative Mele Carroll to investigate various portions of Makapipi Stream. Ref: <i>FI2009110901</i> .		
11/16/2009	CWRM staff met with EMI to investigate the system diversion on Makapipi Stream and ground water sources (development tunnel). Ref: <i>FI2009111601</i> .		
11/19/2009	CWRM staff accompanied USGS staff in selecting potential sites for monitoring IIFS on Makapipi Stream. Ref: <i>F12009111901</i> .		
02/02/2010	CWRM staff, assisted by DAR and EMI staff, documented the physical characteristics of diversions on Makapipi Stream into the Koolau Ditch. Ref: <i>FI2010020201</i> .		
06/24/2010	CWRM staff, assisted by DAR and EMI staff, assisted USGS staff in selecting potential monitoring sites for the IIFS on Makapipi Stream. Ref: <i>FI2010062401</i> .		
07/09/2010	USGS staff completed the installation of staff gages for both sites on Makapipi Stream - one 100 feet upstream from Hana Highway (interim IFS location), and the second at the bridge on Lower Nahiku Road.		
09/13-17/2010	USGS staff conducted a controlled-flow release study on Makapipi Stream to determine 1) the gaining and losing reaches of the stream downstream from the EMI diversion; and 2) if the released flow would reach the stream mouth - mauka to makai flow. During the study, a quantified amount of flow was released from the EMI diversion. Streamflow measurements were taken at various points on the stream, starting from below the diversion and working in the downstream direction towards the ocean. Ref: <i>USGS Makapipi Report 20100913</i> .		
09/28/2011	CWRM staff met with the Nahiku community and documented water flowing to the upper gage site installed by USGS on Makapipi Stream. Ref: 20110926 Maui Field Investigation Itinerary; FI2011092801 (photos only).		
05/01/2012	CWRM staff met with the Nahiku community and EMI to conduct a site visit to the Makapipi Stream diversion intake. Ref: 20120501 Maui Field Investigation Itinerary; FI2012020101 (photos only).		
12/16/2014	CWRM staff met with the Nahiku community. Ref: 20141215 Maui Field Investigation Itinerary.		

CWRM Submittals



LAURA H. THIELEN

MEREDITH J. CHING JAMES A. FRAZIER NEAL S. FUJIWARA CHIYOME L. FUKINO, M.D. DONNA FAY K. KIYOSAKI, P.E. LAWRENCE H. MIIKE, M.D., J.D.

KEN C. KAWAHARA, P.E. DEPUTY DIRECTOR

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT P.O. BOX 621 HONOLULU, HAWAII 96809

STAFF SUBMITTAL

for the meeting of the COMMISSION ON WATER RESOURCE MANAGEMENT

March 18, 2009 Honolulu, Oahu

Request to Enter into Cooperative Agreements with U.S. Geological Survey For Hydrologic Data Collection for <u>East Maui Interim Instream Flow Standards</u>

SUMMARY OF REQUEST:

Staff is requesting that the Commission on Water Resource Management (Commission) authorize the Chairperson to enter into cooperative agreements with the U.S. Geological Survey to conduct hydrologic data collection for established interim instream flow standard sites in east Maui.

BACKGROUND:

The State Water Code mandates that the Commission establish a statewide instream use protection program (State Water Code, Hawaii Revised Statutes, chapter 174C, section 71). The principle mechanism that the Commission has for protection of instream uses is to establish instream flow standards. "Each instream flow standard shall describe the flows necessary to protect the public interest in the particular stream. Flows shall be expressed in terms of variable flows of water necessary to protect adequately fishery, wildlife, recreational, aesthetic, scenic, or other beneficial instream uses in the stream in light of existing and potential water developments including the economic impact of restriction of such use" (State Water Code, section 174C-71(1)(C)). The State Water Code defines instream uses as beneficial uses of stream water for significant purposes which are located in the stream and which are achieved by leaving the water in the stream. Instream uses include, but are not limited to: (1) maintenance of fish and wildlife habitats; (2) outdoor recreational activities; (3) maintenance of ecosystems such as estuaries, wetlands, and stream vegetation; (4) aesthetic values such as waterfalls and scenic waterways; (5) navigation; (6) instream hydropower generation; (7) maintenance of water quality; (8) the conveyance of irrigation and domestic water supplies to downstream points of diversion; and (9) the protection of traditional and customary Hawaiian rights.

Staff Submittal

In September 2008, the Commission approved the establishment of measurable interim instream flow standards (interim IFS) for five surface water hydrologic units in east Maui as outlined below:

Honopou (6034)

- <u>Interim IFS A</u>: An interim IFS of 2.00 cubic feet per second (1.29 million gallons per day) at the lower reach of Honopou Stream near the inactive USGS stream gaging station 16595000 at 383 feet elevation, downstream of Haiku Ditch.
- <u>Interim IFS B</u>: An interim IFS of 0.72 cubic feet per second (0.47 million gallons per day) at the lower reach of Honopou Stream near 40 feet elevation. This location is upstream of the confluence of Puniawa Stream and Honopou Stream, and downstream of the lowest registered diversion on Honopou Stream.

Hanehoi (6037)

- <u>Interim IFS A</u>: An interim IFS of 0.89 cubic feet per second (0.57 million gallons per day) at the lower reach of Huelo (Puolua) Stream near 420 feet elevation, downstream of Haiku Ditch. This is the location of the ungaged site, station HuelL.
- <u>Interim IFS B</u>: An interim IFS of 0.63 cubic feet per second (0.41 million gallons per day) at the lower reach of Hanehoi Stream near 420 feet elevation, downstream of Haiku Ditch.
- <u>Interim IFS C</u>: An interim IFS of 1.15 cubic feet per second (0.74 million gallons per day) at the lower reach of Hanehoi Stream, upstream of Lowrie Ditch and the diversion of water for domestic use in the Huelo community.

Piinaau (6053)

 Interim IFS B: An interim IFS of 5.50 cubic feet per second (3.56 million gallons per day) at the lower reach of Palauhulu Stream near 80 feet elevation, upstream from the confluence of Piinaau and Palauhulu Streams. This is the location of the USGS ungaged site, station PhL.

Waiokamilo (6055)

Interim IFS A: An interim IFS of 4.9 cubic feet per second (3.17 million gallons per day) at the lower reach of Waiokamilo Stream at the location of the USGS gaging station 16521300 near Dam 3. This location is downstream of Koolau Ditch, but upstream of the confluence of Waiokamilo and Kualani (Hamau) Streams.

Wailuanui (6056)

Interim IFS: An interim IFS of 3.05 cubic feet per second (1.97 million gallons per day) at the lower reach of Wailuanui Stream near the inactive USGS gaging station 16521000 at 620 feet elevation. This location is downstream of Koolau Ditch, below the confluence of the tributaries, East and West Wailuanui Streams.

The Commission staff is seeking to establish a standardized methodology for the measurement and monitoring of streamflow in east Maui, in accordance with the adaptive management strategies associated with the approved interim IFS values above. The methods, developed in coordination with the USGS, will be incorporated as part of a long-term management framework for the implementation of measurable IFS statewide.

SCOPE OF SERVICES:

The proposed scope of work for the Federal FY 09 calls for gage installation and rating development at five priority stream sites in east Maui. The USGS will select suitable locations, install staff plates and reference marks, establish gage datum, and develop a low-water stage-discharge rating curve at each site. The period of performance is May 1, 2009 through September 30, 2009. The total cost of the work will be \$50,500, of which the Commission's share will be \$25,500 and the remaining \$25,000 to be provided by the USGS as Federal matching funds. The stream sites and associated costs for the program in Federal FY 09 are identified below:

CWRM Priority Stream Site	Reconnaissance and instailation	Rating curve development	Total
Honopou Site A (6034)	\$ 4,700	\$ 5,400	\$ 10,100
Honopou Site B (6034)	\$ 4,700	\$ 5,400	\$ 10,100
Hanehoi Site C (6037)	\$ 4,700	\$ 5,400	\$ 10,100
Palauhulu Site B (6053)	\$ 4,700	\$ 5,400	\$ 10,100
Wailuanui Site (6056)	\$ 4,700	\$ 5,400	\$ 10,100
TOTAL	\$ 23,500	\$ 27,000	\$ 50,500

For planning purposes, the Commission intends to enter into subsequent joint funding cooperative agreements in Federal FY 2010 and 2011. The estimated cost to continue operation and maintenance for the first five priority stream sites (identified above) in Federal FY 2010 is \$21,000 (\$4,200 per site).

While the Commission staff is currently working to address the remaining 19 petitions to amend interim IFS in east Maui, preliminary discussions with USGS have provided for the addition of up to 10 new stream sites in Federal FY 2010 at a cost of \$10,100 per site (referred to as Phase II). The USGS can contribute \$25,000 pending the availability of Federal matching funds.

The Commission staff intends to assume the operation and maintenance of the first five priority stream sites starting October 2010, while the operation and maintenance of the Phase II stream sites would be continued by USGS through Federal FY 2011. The tentative schedule and associated costs are outlined below:

Reconnaissance and instailation	Rating curve development	Operation and maintenance	Total
Federal FY 2009 (May 1, 2009 to September 30, 2009)			
\$ 23,500	\$ 27,000		\$ 50,500
2009 to September 30), 2010)		
-	. ,	\$ 21,000*	\$ 21,000*
\$ 47,000*	\$ 54,000*		\$ 101,000*
2010 to September 30), 2011)		
**CWRM Staff will assu	me operation and mai	ntenance of these gage s	ites
		\$ 42,000*	\$ 42,000*
\$ 70,500*	\$ 81,000*	\$ 63,000*	\$ 214,500*
	Reconnaissance and installation to September 30, 20 \$ 23,500 2009 to September 30 \$ 47,000* 2010 to September 30 **CWRM Staff will assu \$ 70,500*	Reconnaissance and installationRating curve developmentto September 30, 2009)\$ 23,500\$ 27,000\$ 23,500\$ 27,0002009 to September 30, 2010)\$ 47,000*\$ 54,000*\$ 47,000*\$ 54,000*\$ 54,000*2010 to September 30, 2011)**CWRM Staff will assume operation and mail\$ 70,500*\$ 81,000*	Reconnaissance and installation Rating curve development Operation and maintenance to September 30, 2009) \$ 23,500 \$ 27,000 2009 to September 30, 2010) \$ 21,000* \$ 47,000* \$ 54,000* 2010 to September 30, 2011) **CWRM Staff will assume operation and maintenance of these gage s \$ 42,000* \$ 63,000*

* Cost estimates for Federal FY 2010 and 2011 are subject to change pending USGS fee structure and availability of State and/or Federal matching funds.

Staff Submittal

FUNDING:

Funding through the Department's Special Land Maintenance Fund is currently available for project implementation.

RECOMMENDATION:

- 1. Staff recommends that the Commission authorize the Chairperson to enter into a cooperative agreement between the Commission and the U.S. Geological Survey to undertake specified gage installation, rating development and operation and maintenance activities at five priority stream sites in east Maui.
- 2. Staff also recommends that the Commission authorize the Chairperson to enter into subsequent agreements between the Commission and the U.S. Geological Survey to undertake specified gage installation, rating development and operation and maintenance activities at up to ten new stream sites (Phase II).

The terms of these agreements will be subject to the availability of funding and the approval of the Chairperson and the Department's Deputy Attorney General.

Respectfully submitted,

KEN C. KAWAHARA, P.E. Deputy Director

Exhibit(s) 1. USGS Letter presenting Scope of Work for Cooperative Hydrologic Data-Collection for East Maui Instream Flow Standards, Federal Fiscal Year 2009

APPROVED FOR SUBMITTAL:

AURA H. THIELEN Chairperson



United States Department of the Interior RECEIVED

U.S. GEOLOGICAL SURVEY Pacific Islands Water Science Center 677 Ala Moana Blvd., Suite 415 Honolulu, HI 96813 Phone: (808) 587-2400/Fax: (808) 587-2401

09 MAR 2 A 9:40

COMPRESSION OF WATES

February 27, 2009

Mr. Ken C. Kawahara, Deputy Director State of Hawaii Department of Land and Natural Resources Commission on Water Resource Management P.O. Box 621 Honolulu, HI 96809

Dear Mr. Kawahara:

Subject: Cooperative hydrologic data-collection for East Maui instream flow standards, Federal fiscal year 2009

This letter presents the scope of work and costs for gage installation and rating development at five sites in east Maui, following discussions with your staff. We will select suitable locations, install staff plates and reference marks, establish gage datum, and develop a low-water stage-discharge rating curve at each site. The period of performance is May 1, 2009 through September 30, 2009. The total cost of the work will be \$50,500, of which \$25,500 will be provided by the State Commission on Water Resource Management (CWRM) and \$25,000 will be provided by the U.S. Geological Survey (USGS). The stream sites and associated costs for the program in Federal fiscal year 2009 are provided below:

CWDM Drienity Stream Site	Reconnaissance	Rating curve	Tetal]
C w Kivi Fhonty Stream Sile	and installation	development	Total	
Honopou Site A (6034)	\$ 4,700	\$ 5,400	\$10,100	1
Honopou Site B (6034)	\$ 4,700	\$ 5,400	\$10,100	92 1
Hanehoi Site C (6037)	\$ 4,700	\$ 5,400	\$10,100	C • 1
Palauhulu Site B (6053)	\$ 4,700	\$ 5,400	\$10,100	1.8.3
Wailuanui Site (6056)	\$ 4,700	\$ 5,400	\$10,100	
TOTAL	\$23,500	\$27,000	\$50,500	1
		Ref Sole St. 1	AC INCOMP.	

EXHIBIT 1

Mr. Ken C. Kawahara, Deputy Director

For planning purposes, operation and maintenance cost for these five sites in Federal fiscal year 2010 is \$21,000 (\$4,200 per site). Costs to add up to 10 new sites in FY 2010 is \$10,100 per site. The USGS can contribute \$25,000 pending the availability of Federal matching funds.

The legal authority for the USGS to enter into this program is 43 USC 36C, 43 USC 50, and 43 USC 50b. Work performed with funds from this program will be conducted on a fixed-cost basis. This means that invoices will be based on agreed-upon amount, rather than actual expenses. Your agency will be billed using Form DI-1040. The results of all work under this program will be available for publication by the USGS. Staff plates will become the property of the Commission.

If you are in agreement with this program, please submit an updated Memorandum of Agreement by May 1, 2009, or at your earliest convenience. If you have any questions concerning this program, please feel free to contact me at 587-2405 or Ron Rickman of my staff at 587-2407.

Sincerely,

Stephen S. Anthony

Acting Center Director



WILLIAM J. AILA, JR. INTERIM CHAIRPERSON

WILLIAM D. BALFOUR, JR. SUMNER ERDMAN NEAL S. FUJIWARA DONNA FAY K. KIYOSAKI, P.E. LAWRENCE H. MIKE, M.D., J.D. NEAL A. PALAFOX, M.D.

WILLIAM M. TAM

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT P.O. BOX 621 HONOLULU, HAWAII 96809

STAFF SUBMITTAL

for the meeting of the COMMISSION ON WATER RESOURCE MANAGEMENT

January 20, 2011 Honolulu, Oahu

Request to Authorize the Chairperson to Enter into a Joint Funding Agreement with U.S. Geological Survey To Conduct an East Maui Irrigation Diversion System Seepage Reconnaissance Study, East Maui, Hawaii

SUMMARY OF REQUEST:

Staff is requesting that the Commission on Water Resource Management (Commission) authorize the Chairperson to enter into a Joint Funding Agreement with the U.S. Geological Survey (USGS) to conduct an East Maui Irrigation Diversion System Seepage Reconnaissance Study, East Maui, Hawaii.

BACKGROUND:

In September 2008, the Commission approved the establishment of measurable interim instream flow standards (interim IFS) for five surface water hydrologic units in east Maui.

On May 25, 2010, the Commission approved the establishment of measurable interim IFS for the remaining 16 surface water hydrologic units in east Maui, along with a number of adaptive management strategies addressing general, short-term, mid-term, and long-term implementation action, monitoring, evaluation, and reporting. One of the adaptive management strategies ordered by the Commission under Monitoring states that, "EMI, in coordination with the Commission and USGS, shall seek to cooperatively fund and undertake a system efficiency study to accurately determine EMI (East Maui Irrigation Company) systems losses and/or gains. Should such an effort not be possible, Commission staff shall report back to the Commission."

On August 4, 2010, the Commission staff met with USGS and HC&S to initiate discussions to develop a scope of work for such a study. After several meetings, USGS prepared the attached Joint Funding Agreement and Study Proposal (Exhibit 1).

SCOPE OF SERVICES:

The proposed scope of work calls for a 1.5-year study to assess, at the reconnaissance level, the amount of seepage into or from the four main ditches in the EMI system by documenting seepage rates for various construction-type sections of the ditches. The expected period of performance will be from March 1, 2011 to August 31, 2012. The total cost of the work will be \$130,000, of which the Commission's share will be \$86,000 and the remaining \$44,000 to be provided by USGS. Results from this study, including a map characterizing construction types for the ditch system, will be published in a USGS Open-File Report and made available through the Internet.

FUNDING:

HC&S has preliminarily agreed to fund a portion of the study equaling approximately one-third of the total study cost or \$43,000. Thus, the Joint Funding Agreement will be contingent upon the Commission's receipt of funds from HC&S prior to entering the Agreement.

The funds for the Commission's share, in the amount of \$43,000, are available from the Department's LNR 404, Water Resources Program FY 2011 Budget.

RECOMMENDATION:

1. Staff recommends that the Commission authorize the Chairperson to enter into a Joint Funding Agreement between the Commission and the U.S. Geological Survey to conduct an East Maui Irrigation Diversion System Seepage Reconnaissance Study, East Maui, Hawaii.

The terms of these agreements will be subject to the availability of funding and the approval of the Chairperson and the Department's Deputy Attorney General.

Respectfully submitted,

WILLIAM M. TAM Interim Deputy Director

Exhibit 1. USGS Joint Funding Agreement and Proposal for East Maui Irrigation System Seepage Reconnaissance Study, East Maui, Hawaii, December 2010

APPROVED FOR SUBMITTAL:

muph

WILLIAM J. AILA, JR. Interim Chairperson

Form 9-1366 (Oct. 2005)

U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement

Customer #:
Agreement #:
Project #:
TIN #:
Fixed Cost Agreement

Page 1 of 2 6000001189 11WSHI000000003 ZH00EEA 99-0266119 ✓ Yes ◯ No

FOR

WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the day of January, 2011, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the COMMISSION ON WATER RESOURCE MANAGEMENT, DEPARTMENT OF LAND AND NATURAL RESOURCES, STATE OF HAWAI'I, party of the second part.

- 1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation a study to assess the amount of seepage into or from the four main ditches in the East Maui Irrigation Company's diversion system, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
- 2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of \$0.00.

(a)	\$44,000.00	by the party of the first March 1, 2011	part durin to	g the period August 31, 2012
(b)	\$86,000.00	by the party of the second March 1, 2011	d part dur to	ing the period August 31, 2012

- (c) Additional or reduced amounts by each party during the above penod or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.
- (d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.
- 3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
- 4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
- 5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
- 6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
- 7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

EXHIBIT 1

Form 9-1366 continued	U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement	Customer #: Agreement #: Project #: TIN #:	6000001189 11WSHI000000003 ZH00EEA 99-0266119

- 8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
- 9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered quarterly. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

By

Name: Title:

U.S. Geological Survey United States Department of the Interior

USGS Point of Contact

Name: Chui Chena Address: **USGS-PIWSC** 677 Ala Moana Blvd., Ste 415 Honolulu, HI 96813 Telephone: 808-587-2418 Email: ccheng@usgs.gov

Signatures

By_	/s/	Stephen S. Anthony Date 12/10/10	
Nar	ne:	Stephen S. Anthony	
Title	e:	Center Director	

By		Date
Name:		
Title:	,	

Ву	Date
Name: Title:	

Ву	Date	E
Name:		N
Title:		, T

Ву	Date
Name:	
Title [.]	

Signatures

Date

Commission on Water Resource Management

Department of Land and Natural Resources

State of Hawai'i

Customer Point of Contact

Name: Dean Uyeno Address: CWRM P.O. Box 621 Honolulu, HI 96809 Telephone: 808-587-0249 Email: dean.d.uyeno@hawaii.gov

East Maui Irrigation Diversion System Seepage Reconnaissance Study, East Maui, Hawai'i

U.S. Geological Survey Pacific Islands Water Science Center Proposal, December 2010

SUMMARY

East Maui Irrigation Company's system, which consists of about 75 miles of ditch, diverts stream water and transports it to central Maui for sugarcane cultivation, general agriculture, and domestic use through the public water system(s). The State of Hawai'i Commission on Water Resource Management desires information on the seepage (losses/gains) rates of the ditch system to help in evaluating instream flow standards for the streams diverted by the ditch system. The objective of this 1.5-year study is to assess, at the reconnaissance level, the amount of seepage into or from the four main ditches in the East Maui Irrigation Company system by documenting seepage rates for various construction-type sections of the ditches.

Results from this study will be useful to the State of Hawai'i Commission on Water Resource Management for determining system efficiency and will aid in the management of surface-water resources in east Maui. Results will be published in the U.S. Geological Survey Open-File Report series and made available through the Internet. The study will take 1.5 years from the time work is commenced until the report is published and will cost \$130,000.

PROBLEM

For over a century, the East Maui Irrigation Company's (EMI) surface-water diversion systems have diverted water from streams in east Maui, Hawai'i for large-scale sugarcane cultivation by Hawaii Commercial and Sugar Company (HC&S) and for general agriculture and domestic use through the public water system(s). The EMI System consists of about 75 miles of ditches, which are used to collect and transport water from as far east as Nähiku to west of Māliko Gulch. About 50 miles of the ditches are tunnels and 25 miles are open. The system has four main ditches, Koʻolau/Wailoa, New Hāmākua, Lowrie, and Haʻikū Ditches (listed from highest to lowest elevation) with several additional ditches also connected to the main ditches (Kauhikoa, Center, Manuel Luis, and Spreckels Ditches). The New Hāmākua and Ha'ikū Ditches are considered overflow ditches that collect high flows that overflow the Ko'olau/Wailoa and Lowrie Ditches, respectively. Recently, the State of Hawai'i Commission on Water Resource Management (CWRM) established interim instream flow standards for many of the streams diverted by ditches in the EMI system. Part of the CWRM's decision ordered that "EMI, in coordination with the Commission and USGS, shall seek to cooperatively fund and undertake a system efficiency study to accurately determine EMI system losses and/or gains." (CWRM May 25, 2010 staff submittal). EMI reports that through a program of regular inspection and maintenance, water losses in the ditch system are minimized however they are unable to provide measurements or estimates documenting their system efficiency (Hawaiian Commercial and Sugar Company, 2010). Therefore, measurements of EMI's ditch system seepage rates are desirable to address the CWRM's order.

2

OBJECTIVES

The objectives of this 1.5-year study is to assess, at the reconnaissance level, the amount of losses or gains from the four main ditches in the EMI system in east Maui by documenting seepage rates for various construction-type sections of the ditches. Results from this study will be useful for determining system efficiency and will aid in the management of surface-water resources in east Maui. This study will not address the loss rates from reservoirs that receive water from or are part of the EMI system.

APPROACH

The four major ditch systems (Ko'olau/Wailoa, New Hāmākua, Lowrie, and Ha'ikū Ditches) will be characterized in their entirety from Makapipi Stream to Māliko Gulch using visual observations and handheld GPS equipment. Ditch sections will be characterized as lined, partially lined, or unlined based on definitions provided in figure 1. Three representative sections of each ditch-construction type will be selected and a series of flow measurements will be made in each selected section to determine the seepage rate for each type. Flow measurements will be made during stable conditions near median flow for each ditch and all surface-water inflows and outflows in each measurement section will be accounted for to ensure that changes in flow measured in the section are due only to seepage through the ditch walls and floor. Measurement sections will be selected to minimize surface water inflows and outflows, thereby minimizing the inherent error introduced with each additional measurement. Every effort will be made to choose representative sections that are as long as possible to increase the possibility of measuring average seepage conditions and minimize the effects of anomalous localized conditions on the overall average rates. To facilitate the fieldwork, the USGS will collaborate closely with EMI

3

staff to assist in the mapping survey, to discuss selection of representative sections for flow measurements, and maintain safety during all operations around the ditches.



Figure 1. Categories of ditch-construction types in the East Maui Irrigation System, east Maui, Hawai'i.

Three estimates of system seepage losses (or gains) will be provided using the lengths of each construction type combined with: (1) the average seepage rates for each construction type; (2) the lowest seepage rates for each construction type; and (3) the highest seepage rates for each construction type. Estimates of system seepage losses (or gains) will be applied to the unmeasured sections of the system. Actual seepage losses (or gains) will be applied to the sections measured.

REPORT

Results from this study, including a map characterizing construction types for the ditch system and seepage measurement results will be published in a USGS Open-File Report and made available through the Internet. The probable report title and milestone dates are listed in table 1. The first draft of the report shall be provided to EMI and CWRM for comment on factual information contained in the report.
 Table 1. Milestone dates for planned report

Probable title	Report outlet	First draft	Review	Approval	Publication
East Maui Irrigation Diversion System Seepage Measurements, East Maui, Hawaiʻi	USGS OFR	03/31/12	05/31/12	06/30/12	08/31/12

BUDGET

It is anticipated that a total of \$130,000 is needed for this 1.5-year study. The breakdown

is provided in table 2.

Table 2. P	roject	budget
------------	--------	--------

Category	Total
I at an	
Labor	99,350
Travel	18,500
Communications	100
Supplies	500
Report processing	2,000
Science Support	9,550
Total	130,000

WORK PLAN

The major tasks and associated periods of activity for this study are summarized in table 3.

Task	03/01/11	04/01/11	05/01/11	06/01/11	07/01/11	08/01/11	09/01/11	10/01/11	11/10/11	12/01/11	01/01/12	02/01/12	03/01/12	04/01/12	05/01/12	06/01/12	07/01/12	08/01/12
Ditch Characterization	X	Х	Х	X	X													
Flow Measurements				X	х	х	х	х	x									
Report writing									х	х	X	Х	х					
Peer review														х	х			
Report approval																х		
Publication																	x	x

REFERENCES CITED

- Department of Agriculture, 2003, Agricultural Water Use and Development Plan: Honolulu, Hawaii, 145 p.
- Department of Land and Natural Resources, 2010, News Release-State Water Commission decision balances competing demands: May 28, 2010, Honolulu, Hawaii.
- Hawaiian Commercial and Sugar Company, 2010, Appendix B-water lost from the EMI System: submission to Commission on Water Resource Management March 19, 2010: http://hawaii.gov/dlnr/cwrm/currentissues/iifsmaui1/data/20100319 HC&Sb.pdf.
- U.S. Geological Survey, 2007, Facing Tomorrow's Challenges-U.S. Geological Survey Science in the Decade 2007-2017: U.S. Geological Survey Circular 1309, 69 p., available at http://pubs.usgs.gov/circ/2007/1309/.



Figure 2. Schematic of the East Maui Irrigation System, island of Maui, Hawai'i. Modified from Department of Agriculture, 2003.

CWRM Updates

QUARTERLY UPDATE:

Implementation of Interim Instream Flow Standard (Interim IFS) for Maui Streams

East Maui Implementation

June 23-24, 2010: The purpose of this site visit was to document streamflow releases by East Maui Irrigation Co. (EMI) at the Wailoa and New Hamakua Ditches on Honopou Stream. Staff also coordinated with U.S. Geological (USGS) and Division of Aquatic Resources (DAR) staff to visit and discuss interim IFS sites, streamflow releases at specific streams, and options for promoting migration of native fauna past existing diversion structures.

- USGS staff measured streamflow on Honopou Stream just upstream of the Lowrie Ditch intake before and one day after water was released from the Wailoa Ditch intake. (Photo 1)
- Staff documented the release of water by EMI from the Wailoa Ditch intake on Honopou Stream via a sluice gate. In the week prior to the staff visit, EMI altered the diversion structure at the New Hamakua Ditch to bypass water released from Wailoa Ditch immediately upstream. Also in attendance were members of the Honopou Community Association. (Photos 2, 3, 4)



Photo 1. USGS staff measures the streamflow above the Lowrie Side Ditch intake on Honopou Stream prior to the release of water at Wailoa Ditch



Photo 2. Looking upstream, water is released from the sluice gate below the Wailoa Ditch diversion intake (at upper left) on Honopou Stream



The dividing wall has been altered to ensure that water flows downstream height of the dividing wall at the New Hamakua Ditch intake. before any water is diverted into the intake on the left bank (at center).



Photo 3. Water flows to the New Hamakua Ditch intake on Honopou Stream. Photo 4. A close-up view of the diversion structure altered by EMI, raising the



Makapipi Stream.

Photo 5. USGS staff looks at a potential site for installing a staff gage on Photo 6. A close-up view of the staff gage installed on the right bank of Palauhulu Stream.

- With DAR, USGS, and EMI, staff visited diversions and interim IFS sites on West Wailuaiki, East Wailuaiki, Waikamoi, Makapipi, Hanawi, and Waiohue Streams. (Photos 5, 6)
- Staff is still in discussions with EMI and DAR on an implementation schedule and identifying a solution for meeting seasonal flow requirements. In the wet season, EMI will likely open sluice gates to meet the interim IFS. In the dry season, EMI is tentatively planning to install pipes that will convey water from an upstream location and drop water onto the dam wall to create a wetted pathway allowing for the upstream migration of native fauna. DAR is currently field testing this method to confirm it works as expected.

June 2010: Under a joint funding agreement with the Commission, USGS completed rating curve development for five staff gages on Honopou, Hanehoi, Palauhulu, and Wailuanui Streams.

July 9, 2010: USGS completed installation of six staff gages on Waikamoi, West Wailuaiki, East Wailuaiki, Waiohue, and Makapipi Streams. Another four staff gages, originally slated for east Maui, were reallocated to four Na Wai Eha streams.

August 4, 2010: Staff met with USGS and Hawaiian Commercial and Sugar Co. (HC&S) to discuss the scope of a system efficiency study for EMI ditches and tunnels and HC&S reservoirs, and to review the entire EMI/HC&S irrigation system in detail. Due to the potentially high costs of a complete system study, USGS is considering to first conduct an overall system analysis. A scope of work, with cost estimates, is currently being prepared by USGS. Also discussed were: 1) Installation of continuous gaging stations for the purposes of monitoring the interim IFS and potential cooperators; 2) Installation of continuous recorders at four telemetry stations (Koolau Ditch at Nahiku, Koolau Ditch at Keanae, Spreckels Ditch at Haipuaena, Lowrie Ditch at Kailua); and 3) Water use reporting at the other four telemetry stations (Wailoa Ditch at Opana, Kauhikoa Ditch at Maliko, Lowrie Ditch at Maliko, Haiku Ditch at Maliko).

September 13-17, 2010: Staff will document the release of water by EMI past the Koolau Ditch intake on Makapipi Stream. USGS, in conjunction with the release, will conduct a week-long, controlled flow release study to identify: 1) The gaining and losing reaches of the stream downstream of the EMI diversion; and 2) If the released flow will reach the stream mouth.

September 2010 (Tentative): Staff will revisit some of the first interim IFS sites that were established by the Commission in September 2008.

- Staff will conduct a site visit of Palauhulu Stream upstream of the interim IFS location on Hana Highway. Staff will document known losing sections on this portion of the stream.
- Staff will evaluate diversion modifications and interim IFS values on Honopou, Hanehoi, Palauhulu, and Wailuanui Streams.

Future Meetings: Staff will schedule meetings with the respective parties to discuss the following:

- DAR Implementation of interim IFS on east Maui streams, biological response to streamflow restoration, and construction of wetted pathway measures for selected diversion structures.
- Maui Department of Water Supply (Maui DWS) Discuss adaptive management strategies including an update on the status of efforts to rehabilitate the Waikamoi Flume, and the regular reporting of monthly water or related monitoring data (e.g., ditch flow, reservoir levels, pumpage amounts, etc.).

Na Wai Eha Implementation

July 22, 2010: Staff held a teleconference with Wailuku Water Co. (WWC) and HC&S to discuss logistics of the August 9 flow releases on Waihee Stream, North Waiehu, and South Waiehu Streams.

August 4, 2010: Staff held a teleconference with WWC and HC&S to finalize logistics of the August 9 flow release schedules. Staff also met separately with HC&S to discuss

- Establishing a timetable to address 12.48 MGD of preventable system losses, especially leakage from Waiale Reservoir. HC&S is currently assessing various options to reduce water loss from the reservoir
- Monthly groundwater use report for Well No. 7 to include groundwater levels and salinity measurements. Staff will provide new forms to HC&S at which time they should begin reporting monthly water use for all pumped wells on the plantation.

August 9-10, 2010: WWC and HC&S, in coordination with Commission staff, released water past their respective diversions on Waihee River and North and South Waiehu Streams. On August 2, 2010, a news release was issued to inform the public about the release and potential safety concerns.

• Waihee River: The Commission amended the interim IFS to 10 mgd (15.47 cfs) just downstream of the Spreckels Ditch diversion and 6 mgd (9.28 cfs) at the mouth.

Staff measured 7.30 mgd (11.29 cfs) in the stream after the sluice gate was opened two notches (approx. 4-in.). WWC and HC&S officials indicated that opening the sluice gate another notch (approx. 2-in.) would result in the release of close to 14 mgd total. After conferring with the parties present, it was agreed that the present release would stand, but that WWC and HC&S would begin work on fabricating and testing shims to incrementally increase the sluice gate height, thereby gradually increasing flow released past the diversion to meet the interim IFS. (Photos 7, 8)



Waihee River. Water flows through a lined tunnel before entering the stream.

Photo 7. Water is released via a sluice gate on the Waihee Ditch diversion on Photo 8. Water is released back into Waihee River via a sluice gate below the Spreckels Ditch diversion intake.

South Waiehu Stream: The Commission amended the interim IFS to 0.9 mgd (1.39 cfs) just downstream of the Spreckels Ditch diversion and 0.6 mgd (0.93 cfs) between the confluence of North and South Waiehu Stream and the mouth.

Staff measured 1.02 mgd (1.58 cfs) flowing in the Spreckels intake ditch on Aug. 9; however, the release was postponed for the next day due to concerns regarding impacts to kuleana users receiving water directly from this diversion intake. On Aug. 10, based on the earlier measurement, HC&S opened the sluice gate two notches (approx. 4-in.) to release the entire streamflow past the diversion structure. (Photo 9)

North Waiehu Stream: The Commission amended the interim IFS to 1.6 mgd (2.47 cfs) just downstream of the North Waiehu Ditch diversion and 0.6 mgd (0.93 cfs) between the confluence of North and South Waiehu Stream and the mouth.

Staff measured 2.10 mgd (3.25 cfs) flowing in the stream upstream of the ditch intake. With a measurement of 0.53 mgd (0.82 cfs) flowing in the diversion ditch after the release, staff estimated that approximately 1.57 mgd (2.43 cfs) was being returned to the stream below the diversion intake. (Photo 10)





Photo 9. Water flows through the sluice gate at the South Waiehu diversion Photo 10. Water is released back into the stream via a wooden sluice gate on intake to Spreckels Ditch. The intake (left) also provides water to kuleana users. the North Waiehu Ditch after the diversion intake.

In the days leading up to and following the releases, Commission staff, WWC, and HC&S have been
receiving complaints from kuleana users indicating that water supply has been reduced or cut-off.
Kuleana users on the South Waiehu Auwai system were directly impacted by the streamflow
restoration. Staff and the parties have been in discussion regarding the impacted users and are
assessing ways to proceed in response to this situation.

September 2010 (Tentative): Staff will conduct post-release site visits.

- Staff is coordinating with WWC and HC&S as they fabricate and test the shims to incrementally
 increase streamflow releases to fully comply with the Decision & Order. Upon completion, staff
 will conduct a site visit with USGS personnel to document the implementation and verify the
 streamflows at selected sites below the diversions.
- In conjunction with measuring streamflow, Commission and USGS staff will scout potential sites for the installation of staff gages on Waihee River and Waiehu Stream.

Future Meetings: Staff will schedule meetings with the respective parties to discuss the following:

- WWC & HC&S Modification of existing diversion structures to allow recruitment of stream life past the diversion, and existing and potential new gaging stations to monitor amount of surface water diverted from each stream.
- DAR and others Addressing vertical impediments in order to develop methods of allowing upstream migration by native freshwater fauna.

Website

Staff continues to maintain the Commission webpage on the Implementation of Interim IFS for 27 East Maui Streams, and will begin creating a similar webpage for the Na Wai Eha streams.

For the latest updates on East Maui, please visit the Commission website at: http://hawaii.gov/dlnr/cwrm/currentissues_EastMauiIIFS.htm



QUARTERLY UPDATE:

Implementation of Interim Instream Flow Standard (Interim IFS) for Maui Streams

East Maui Implementation

August 31, 2010: Staff met with representatives of the Native Hawaiian Legal Corporation (NHLC), Office of Hawaiian Affairs (OHA), and U.S. Geological Survey (USGS) to discuss stream gaging and water temperature issues related to the setting of interim instream flow standards (interim IFS) in east Maui.

Of particular interest were monitoring stations located in Honopou. Over the past year, as part of the Land Division's contested case hearing on the East Maui water licenses, the Land Division has been funding monitoring of streamflow into the Wallett/Kekahuna auwai, Honopou Stream below the auwai intake, and three of four temperature probes (USGS was funding one probe) in the auwai/loi system. Upon Commission staff's recommendation, funding for all but one of the temperature probes were discontinued. The one remaining temperature probe and two streams gages will be funded by the Land Division at least through September 2011. Commission staff will continue working with the parties to identify and address issues related to the implementation actions for Honopou and other east Maui streams.

Note: The Commission did receive a Complaint/Dispute Resolution Filing Form (See Exhibit 1) on March 22, 2010, from Alan Murakami (NHLC) citing insufficient water for taro growing and other cultural practices, inability to monitor interim IFS, and insufficiency of the temporary bypass.

September 14, 2010: Staff documented the controlled flow release of water past East Maui Irrigation Company's (EMI) Makapipi Stream diversion (Photos 1 and 2). USGS initiated their study, as requested by the Commission, on September 13 prior to the release by conducting stream surveys along multiple reaches of the stream. The study objectives were to: 1) identify gaining and losing reaches downstream of the EMI diversion; and 2) determine if the released flow would reach the stream mouth. The study fieldwork concluded on September 17.





release water past the intake.

Photo 1. The sluice gate at the Makapipi Stream diversion intake is set to Photo 2. USGS staff measured streamflow about 40 feet downstream of the sluice gate at 1.35 cfs (605 gpm).



September 15, 2010: Staff conducted a survey of Palauhulu Stream above the interim IFS site at Hana Highway with the assistance of EMI and local residents. The objective was to document losing and gaining reaches and to identify potential monitoring sites that will aid in assessing the interim IFS (Photos 3 and 4). Though EMI has been releasing water from their main Palauhulu intake at Kano Falls since November 2008, the Commission staff has not observed consistent flows that meet the interim IFS.



USGS gage site. Streamflow loses below this site.

Photo 3. Potential monitoring site on upper Palauhulu Stream at an abandoned Photo 4. Looking down from atop a 100-ft. cliff at Store Spring (gaining reach) on Palauhulu Stream. The sream was dry above this point.

September 29, 2010: The Commission staff received from USGS a proposal for a Surface-Water Diversion System Leakage Reconnaissance Study, East Maui, Hawaii. This study proposal is intended to meet one of the east Maui monitoring management strategies which states, "EMI, in coordination with the Commission and USGS, shall seek to cooperatively fund and undertake a system efficiency study to accurately determine EMI system losses and/or gains." EMI and Commission staff reviewed the proposal and submitted revisions to USGS. A revised proposal, titled "East Maui Irrigation Diversion System Seepage Reconnaissance Study," was received November 10, 2010 and is currently being reviewed by Commission staff and EMI.

October 14, 2010: Staff installed pressure transducers at Honopou, Palauhulu, and Wailuanui Streams. The pressure transducers were mounted to the existing USGS staff gages and will provide for hourly recording of water levels and temperature. Commission staff intends to conduct quarterly site visits to retrieve data and perform streamflow measurements to check each staff gage rating curve.

November 5, 2010: Staff received a summary report of the discharge measurements made by the USGS in Makapipi Stream from September 13-17, 2010 (See Exhibit 2). While discharge below the EMI diversion on Makapipi Stream ranged from 1.18 to 1.35 cfs during this period, streamflow near the Hana Highway bridge remained at zero. USGS is continuing to take measurements at Makapipi when possible. Any future recommendations to the Commission shall be made after consultation with USGS and the Makapipi community.

November 16, 2010: Staff met with Division of Aquatic Resources (DAR) staff to discuss and coordinate on-going and future action items relative to the implementation of interim IFS in east and west Maui streams.



Future Events:

- Staff is coordinating with EMI to implement planned modifications for the Haiku Ditch diversion intake on Honopou Stream. In March 2009, a low-flow bypass channel was installed across the ditch intake grating. EMI plans to install more permanent modifications to reduce leakage of streamflow into the ditch and provide for biological connectivity, subject to review by DAR.
- Staff will be coordinating with EMI to locate and install monitoring sites on upper Palauhulu Stream to assess the interim IFS established in the lower reaches of the stream. EMI has released water into Palauhulu Stream; however, there are several gaining and losing reaches and streamflow at the interim IFS site has not noticeably increased.
- Staff is working with the Maui Department of Water Supply, EMI, and HC&S to provide monthly water use reports in a format suitable for the Commission's database system.

Na Wai Eha Implementation

September 1, 2010: A Stipulation and Order (S&O) was approved by the Commission suspending the implementation of the interim IFS for South Waiehu Stream for a period of sixty (60) days and requiring the parties to implement a release schedule setting forth specific actions for the South Waiehu diversion ditch intake. Wailuku Water Company (WWC) and HC&S provided regular updates on implementation actions (See Exhibits 3 and 4)

September 8, 2010: Staff accompanied USGS staff to identify and select potential sites for monitoring interim IFS at two locations in Waihee River and two locations on Waiehu Stream. Based on site selection, the USGS will install staff gages at each of the four sites.

For Waihee, the streambed configuration and presence of large boulders resulted in the first site being located approximately 1,500 feet downstream of the Spreckels Ditch intake. The second site on Waihee is located just upstream of the Kahekili Highway bridge and nearly 0.5 mile from the coast (see Photo 5).

For Waiehu, the first site was located at a bridge crossing on an unpaved road, about 300 ft. below the confluence of South and North Waiehu Streams. The second site near the ocean is located at a bridge crossing in a residential neighborhood approximately 600 ft. from the coast (see Photo 6).



Photo 5. Location selected by USGS and Commission staff to monitor the lower reach interim IFS on Waihee River.



Photo 6. Location selected by USGS and Commission staff to monitor the lower reach interim IFS on Waiehu Stream.


September 13, 2010: Staff conducted an investigation of a portion of the South Waihee Kuleana Auwai to document existing and undocumented diversions from the auwai and to respond to complaints of low water flows.

October 12, 2010: The S&O signed by the Commission on August 30, 2010, provided for a release schedule for South Waiehu Stream, which stated that between October 9- 25, 2010, "close the sluice gate and measure water flow in the diversion ditch. If the flow is equal to or less than 0.90 mgd then open the sluice gate to release all the water back into the stream. If the flow is more than 0.90 mgd then adjust the gate to allow the excess over 0.90 mgd to enter the diversion ditch."

In accordance with the schedule set forth in the S&O, HC&S closed the sluice gate and measured the diversion ditch at 0.87 mgd. Then, in consultation with Commission staff, HC&S opened the gate to allow water to continue flowing past the Spreckels Ditch intake on South Waiehu Stream.

October 13, 2010: Staff accompanied USGS staff during installation of a staff plate in Waihee River intended to monitor the interim IFS located below the Spreckels Ditch diversion (See Photo 7). This site is located approximately 1,500 ft. downstream from the diversion due to lack of suitable measuring sites below the Spreckels Ditch sluice gate where water is returned to the stream back into the main channel. Staff also installed a pressure transducer on the USGS staff plate. USGS also installed staff plates at the lower reach site on Waihee River and the upper Waiehu Stream site below the confluence of the north and south forks (See Photo 8).



Photo 7. USGS staff installing staff plate on the right bank of Waihee River as WWC staff looks on. Photo 8. USGS and Commission staff examine this site on Waiehu Stream located below the confluence of the north and south forks of the stream.

Staff accompanied HC&S staff to document actions taken in accordance with the S&O on South Waiehu Stream (Photos 9 and 10). One of several kuleana users affected by the restoration of streamflow met with staff and voiced frustration with the process. Staff will be working with the kuleana users, in coordination with the parties, to better inform them and address implementation-related issues.





Photo 9. Water is released via a sluice gate on the Spreckels Ditch diversion Photo 10. Water backs up behind the diversion sluice gate on South Waiehu intake on South Wajehu Stream. Stream, but water level is below the Spreckels Ditch intake.

Staff also conducted a site visit of South Waihee kuleana ditch in response to complaints that some users have been damming the auwai to increase flow into individual intakes, thus impacting the amount of water received by downstream auwai users. Reduced flows in the kuleana ditch may be due to the reduced flows in Spreckels Ditch resulting from the restoration of streamflow at the Spreckels Ditch intake.

October 26, 2010: Commission staff sent separate letters to WWC and HC&S requesting updates on specific items that are part of the Commission's Na Wai Eha Decision and Order (See Exhibit 5)

October 28, 2010: Commission staff hosted a meeting with representatives from Earthjustice, OHA and HC&S, to identify and discuss options for addressing the impacts to kuleana users resulting from the implementation of the interim IFS on South Waiehu Stream. The groups agreed to continue working on a Second Stipulation and Order to provide immediate relief to the affected kuleana users with commitments to working on a long-term solution.

November 4, 2010: The Second Stipulation and Order was approved by the Commission suspending the implementation of the interim IFS for South Waiehu Stream for a period of sixty (60) days.

November 5, 2010: Staff received responses to requests for updates on actions taken from WWC (See Exhibit 6) and HC&S (See Exhibit 7).

Future Events:

- November 30, 2010: Commission staff will accompany USGS staff on a streamflow measurement for Waihee River. In response to concerns raised by OHA and Earthjustice, USGS will assist CWRM in a reconnaissance of the reach on Waihee River immediately below Spreckels Ditch to determine suitability for a monitoring location.
- December 1-2, 2010: The Commission will be holding public hearings on applications for surface water use permits for existing uses at the Paia Community Center from 9:00 a.m. to 5:00 p.m. on both days. The public hearing notice is available from the Commission website.
- Staff will be working with Wailuku Water Company to prepare sketches for fish passageways at diversion locations, and will coordinate with DAR for review.



• In coordination with the parties, staff plans to meet with and document the kuleana users of the South Waiehu auwai system that are being impacted by the current implementation efforts.

Website

Commission staff is currently working on revising the Surface Water section of the Commission website to provide for easier dissemination and sharing of information where available, and recognizes that information pertaining to Na Wai Eha should be made available on-line.

Recent information on the implementation of interim IFS in East Maui is still available at: http://hawaii.gov/dlnr/cwrm/currentissues_EastMauiIIFS.htm

		State of Hawaii COMMISSION ON WATER RESOURCE MANAGEMENT Department of Land and Natural Resources COMPLAINT / DISPUTE RESOLUTION FILING FORM	For Official Use Only: Received Commission on Water Resource Management 2010 Mar 22 Am 9: 58
Instrue Water to this	ctions: Pleas Resource Ma application fo	e print in ink or type and send completed form with attachments to the Commission on nagement, P.O. Box 621, Honolulu, Hawaii 96809. For further information and updates orm, visit http://www.hawaii.gov/dlnr/cwrm.	Complaint File No: C
1.	Name: <u>A</u>	Alan T. Murakami Date: 03/23/10 : 1164 Bishop Street Suite 1205	
	Daytime	e Phone No.: <u>521-2302</u> Fax No. <u>537-4268</u>	
2.	Location	n of the violation or water problem: Honopou, East Maui	
	Tax Maj Landow	p Key: <u>2-9-001-014</u> ; 2-9-001-016 Beatrice Kekahuna, Marjorie Wallett, Lynn Scott and 2 ner's Name: <u>Kav Kepani</u>	8 others; Herman and Dana
	Landow	ner's Address: Honopou Road	
3.	Landow The part I Name: <u>I</u>	ner's Phone No.: <u>808-280-2359 (Lynn Scott)</u> y I have a complaint about or dispute with is: (if more than one party, ple Hawaiian Commercial & Sugar, East Maui Irrigation Company, State Resources, Governor of Hawai'i	ease attach additional sheets) e Board of Land and Natural
	Address	: c/o Alexander and Baldwin, 822 Bishop Street	
		Honolulu, Hawaii 96813	
	Phone N	Io.: <u>(808) 525-6611</u>	
	If the re	the is not the landowner listed in Section 2 shows places describe the	norty's volationship to the

If the party is not the landowner listed in Section 2 above, please describe the party's relationship to the TMK parcel described in Section 2.

HC&S operates a sugar plantation in Central Maui. East Maui Irrigation Company operates the diversion tunnels, ditches and diversions that supply irrigation water from over 100 East Maui streams to HC&S. Alexander and Baldwin is the parent company of both HC&S and EMI. All three entities receive authorization from the State Board of Land and Natural Resources to divert up to 450 million gallons (average of 166 mgd) per day from East Maui streams to Central Maui. The Governor appoints all members of the BLNR and supports the efforts of A&B to use water without any priority of use by downstream owners who farm taro, gather from streams, and fish along coastlines fed by those same streams in the tradition of ancient Hawaiians.

Describe the complaint or reason for the dispute:

4.

(Attach a sketch or photograph if that will help explain the problem.)

On September 25, 2008, the CWRM ordered the amendment of the IIFS of Honopou Stream to 2.0 cfs. To implement that decision, the CWRM staff oversaw the installation of a flat iron bypass over the Haiku Ditch at Honopou stream to address the need for more water to grow more kalo in the 'ohana's taro lo`i and promote traditional and customary gathering from the stream and fishing near its mouth.

Insufficient Water for Taro Growing and Other Cultural Practices. Unfortunately, despite our repeated complaints, these measures have NOT resulted in adequate flow to their lo'i, nor resulted in increased recruitment of o'opu, opae, and hihiwai in Honopou Stream to support our cultural practices. Additionally, there is no visible increase in stream flow from any attempt to release more diverted water into Honopou Stream that is enhancing the fish stocks near the mouth of the stream.

Inability to Monitor IIFS. Despite the efforts of the CWRM staff to implement the amended IIFS, its members have not been able to visit and monitor with the frequency and accuracy that would make the desired stream flow meaningful. While CWRM staff has taken flow measurements on several occasions since September 2008, they have been episodic with no regular, consistent set of data from which there can be any meaningful monitoring of the IIFS standard imposed. In fact, in spite of the attempt to install real-time monitoring at the IIFS points on Honopou Stream, the fact remains that the guaging points have not been accurately calibrated for almost a year since the March 2009 alteration of the Haiku Ditch diversion, which was intended to implement the IIFS, AND over a year and 4 months since the CWRM decided the issue. Accordingly, the CWRM staff has ONLY episodic flow measurements, from which it has no basis to determine whether EMI/HC&S has complied with the amended IIFS standard. The CWRM has to implement its decision fully and immediately, or its own integrity and reputation will suffer. What data is available shows that EMI is NOT meeting the IIFS establish in September 2008.

Temporary Bypass Insufficient. Moreover, the bypass at the Haiku ditch was never fully completed. The ramp that would allow the o'opu to continue their migration upstream has not been installed. This causes the water that falls over the lip of the flat iron bypass to splash back into the Haiku ditch, also falling into cracks and holes in the concrete apron. None of the o'opu, opae, or hihiwai which might otherwise migrate upstream can overcome this gap, denying these species a critical route for their important migration habits. The CWRM needs to demand that EMI finish the work on the bypass, allow connectivity with the stream bed so upstream migration can occur, and fill in cracks and holes in the concrete.

5. Describe how your water usage or water rights are specifically affected by the other party, if at all: See, attached description of complaint (in case the material below does not fit on your form).

Our experience this year has saddened all the residents along the Honopou Stream. The IIFS, which the CWRM set on September 25, 2008, is too low for both taro cultivation in Honopou and the support of traditional and customary practices. At one point during the 2009 summer, there was not enough water in Honopou stream to irrigate taro then growing at the Kekahuna/Wallet lo'i complex, which was left dry. In addition, there was no water for domestic use, i.e., no showers, no washing dishes, no irrigation for other plantings. See attached USGS flow records for its gauge at the intake of Beatrice Kekahuna, just downstream of IIFS-A on Honopou Stream, showing that stream flow for the past 14 months did not meet the IIFS over 99 percent of the time. When Laura Thielen explained the intended effect of the amendment of the IIFS in September 2008, she claimed downstream owners would get the first flow in the stream, with EMI able to take what is above that amount. The record of flow contradicts that representation.

Kalo growers are not the only ones affected by the low flow in Honopou stream. Honopou residents have found dead o'opu and prawn in their sun baked loi. Dead prawns have been found in the stream also. Low stream flow also causes any green debris in Honopou stream to grow and cause water to flow elsewhere. The Kekahuna/Wallett `ohana have plans to plant more kalo, gather from the stream, and fish from the ocean. However, withiout serious implementation, they will suffer from the inability to perform any of these activities, which would provide important food sources our ohana cannot afford to buy.

Inattention to Appurtenant Water Rights. After that decision, Aunty Beatrice Kekahuna planted kalo in a lo'i at her home kuleana near their common diversion intake. This lo'i receives the first water from the diversion which reduces the amount of water that continues through the auwai to the two-acre kalo lo'i. Aunty has three lo'i planted (# 3, 4, and 5). See, attached diagram. On several occasions in the summer of 2009, water flow was not sufficient enough to reach the third lo'i (# 5), leading to a poor yield this season. When flow is insufficient, the 'ohana is forced to return it to Honopou stream, bypassing the rest of the lo'i. Other 'ohana members have kalo in six other lo'i (# 6, 7, 12, 16/17, 21, and 22). With limited flow, they have been forced to rotate irrigation days and watering at night to reduce the stress on this kalo. Watering during the day with warm water from the stream caused great stress on our kalo. As a direct result of the low flow, the kalo grown does not have large corms and suffers from pocket rot and leaf blight due to low water flow. The low flow forces them to pull weeds

6. Date the problem was first noticed: <u>for years without resolution by this Commission (see, below)</u>

7. If this complaint or dispute is related to a water source, was the water source previously declared with the Commission on Water Resource Management?

🗌 Yes 🔲 No 🛛 Don't Know

If yes, what was the name and tax map key of the source?

While I am unsure whether declarations of use were filed, this use was on State ceded lands mauka in the Huelo license area (por. TMK 2-9-014-001; por 2-8-008) and various properties makai along Honopou Stream

- 8. Have you had any communication with the party/parties described in Section 3 above?
 - Yes No

If yes, list the communications and dates: (Attach copies if written communications were made) In May 2001, the Kekahuna/Wallett `ohana formally challenged the issuance of revocable permits that supposedly authorized the taking of water from the ahupua`a as part of the source for the East Maui Irrigation Company ditch system feeding the sugar plantation of Hawaii Commercial and Sugar Company. Informally, this `ohana has complained for years to EMI that it was not releasing enough water from the 4 diversions along Honopou Stream to supply the water to the auwai on which this `ohana is dependent to secure sufficient water for growing their taro. Simultaneously, the `ohana has pursued stream restoration by filing for the amendment of interim instream flow standards for Honopou Stream. All of these efforts have been documented with copies served on East Maui Irrigation attorneys for years. In addition, we've been involved in at least three formal attempts at mediation with A&B attorneys, the last one ending in 2007, for which Justice Robert Klein acted as a mediator.

9. Have you sought resolution of this matter with any other entity?

(e.g., government agency, judicial body, or private entity)

(a) Before the BLNR, complainant repeatedly sought immediate relief to obtain water for taro growing, after filing an administrative challenge to the proposed issuance of a 30-year water lease or reissuance of annual revocable permits.

(b) Before the Hawai`i Supreme Court, complainant attempted to obtain mandamus relief for this Commission's failure to address IIFS petitions (filed without action for 7 years) within the 180-day statutory deadline.

If so, with whom and what was the outcome?

(Please provide copies of any documentation of this process)

(a) Despite years of trying, the BLNR provided no remedy, except to appoint a monitor to attempt to informally resolve water disputes. That monitor visited the site twice, once with an expert from UH cooperative extension service, to assess the problem and supposedly devise a monitoring plan. Nothing happened thereafter. In fact, even after complainant formally complained and sought corrective action, the BLNR refused, simply deferring further action to the staff of the Commission on Water Resources Management in conjunction with its ongoing investigations to implement IIFS. Now, resource shortages appear to be preventing the CWRM staff from implementing the IIFS decisions made.
(b) The Hawai'i Supreme Court refused to grant the petition for mandamus, with no explanation.

10. Describe what you believe a successful and fair remedy might be:

Release of sufficient natural stream flow in Honopou Stream under simple adherence to the fundamental holding in HC&S v. Wailuku Sugar Company (1904). In that case, the current diverter, HC&S/EMI established that a holder of an appurtenant right downstream of a diverter can insist on the release of stream flow by the upstream diverter, when the upstream diverter cannot demonstrate that the downstream owner is suffering no harm from that diversion. In other words, "[t]he burden of demonstrating that any transfer of water [is] not injurious to the rights of others rest[s] wholly upon those seeking the transfer. Hawaiian Commercial & Sugar Co. v. Wailuku Sugar Co., 15 Haw. 675, 694 (1904)." Robinson v. Ariyoshi, 65 Haw. 641, 649 n. 8 (1982) ("Robinson") (emphasis added). More specifically, "in order to obtain any ultimate judicial sanction to a transfer of water away from the lands of ancient application, the holder of a water right would have to 1) have defined all the potentially affected." Id. (Emphasis added).

In short, HC&S/EMI should be required to abide by the same ruling it obtained from the Hawai'i Supreme Court when it acts as a water diverter negatively affecting a downstream water user like complainant. It should bear the burden of proving NO HARM to complainant. If it fails to do so for any reason, HC&S/EMI should not be allowed to divert water from Honopou Stream. Unless and until this burden is met, the continuing out of watershed diversions/transfers of East Maui stream water by A&B require that the State and its respective agencies, as the trustees of these public trust resources, take immediate action to enforce these limitations. Robinson, 65 Haw. at 650 (leaving "actual enforcement of these limitations to appropriate subsequent actions brought by the parties, including the State"). In order for the State, as trustee of these public trust resources, to fulfill its significant duties, it must require that, unless and until the burden placed on it and/or A&B is met, A&B must immediately release a sufficient amount of streamflow into each and every stream from which Na Moku, et al. and others superior rights derive.

Such an order must be backed up with fees assessed against HC&S/EMI to pay for any necessary costs of implementation. At a minimum, this fee schedule should pay for any costs of flow and temperature meaasurements in key locations along any affected lo`i system, as well as the monitoring necessary to monitor the return of stream and marine life, by which any permanent instream flow standard should be judged.

I request that the Commission on Water Resource Management assist in resolving the matter described herein.

1 and 1

Signature

3/23/10 Date

For Section 5 of the Complaint Form

Our experience this year has saddened all the residents along the Honopou Stream. The IIFS, which the CWRM set on September 25, 2008, is too low for taro cultivation in Honopou nor supported traditional and customary practices. At one point during the 2009 summer, there was not enough water in Honopou stream to irrigate taro then growing at the Kekahuna/Wallet lo'i complex, which was left dry. In addition, there was no water for domestic use, i.e., no showers, no washing dishes, no irrigation for other plantings. See, attached USGS flow records for its gauge at the intake of Beatrice Kekahuna, just downstream of IIFS-A on Honopou Stream, showing that stream flow for the past 14 months did not meet the IIFS over 99 percent of the time. When Laura Thielen explained the intended effect of the amendment of the IIFS in September 2008, she claimed downstream owners would get the first flow in the stream, with EMI able to take what is above that amount. The record of flow contradicts that representation.

Kalo growers are not the only ones affected by the low flow in Honopou stream. Honopou residents have found dead o'opu and prawn in our sun baked loi. Dead prawns have been found in the stream also. Low stream flow also causes any green debris in Honopou stream to grow and cause water to flow elsewhere. The Kekahuna/Wallett 'ohana have plans to plant more kalo, gather from the stream, and fish from the ocean. However, withiout serious implementation, they will suffer from the inability to perform any of these activities, which would provide important food sources our ohana cannot afford to buy.

Inattention to Appurtenant Water Rights. After that decision, Aunty Beatrice Kekahuna planted kalo in a lo'i at her home kuleana near our common diversion intake. This lo'i receives the first water from the diversion which reduces the amount of water that continues through the auwai to the two-acre kalo lo'i. Aunty has three lo'i planted (# 3, 4, and 5). See, attached diagram. On several occasions in the summer of 2009, water flow was not sufficient enough to reach the third lo'i (# 5), leading to a poor yield this season. When flow is insufficient, the `ohana is forced to return it to Honopou stream, bypassing the rest of the lo`i. Other `ohana members have kalo in six other lo'i (# 6, 7, 12, 16/17, 21, and 22). With limited flow, they have been forced to rotate irrigation days and watering at night to reduce the stress on this kalo. Watering during the day with warm water from the stream caused great stress on our kalo. As a direct result of the low flow, the kalo grown does not have large corms and suffer from pocket rot and leaf blight due to low water flow. The low flow forces us to pull weeds in the lo`i more often, taking away time we could spend opening more lo`i. This situation hurts us financially. Currently, what little we harvest is made into poi for our kupuna and keiki. There is not enough to sell any kalo. The `ohana cannot grow enough kalo to be self sufficient and pay rising property taxes.





United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Pacific Islands Water Science Center 677 Ala Moana Blvd., Suite 415 Honolulu, Hawai'i 96813 Phone: (808) 587-2400/Fax: (808) 587-2401



November 5, 2010

Ms. Lenore Ohye, Acting Deputy Director State of Hawai'i Department of Land and Natural Resources Commission on Water Resource Management P.O. Box 621 Honolulu, Hawai'i 96809

Dear Ms. Ohye:

Subject: Discharge measurements, Makapipi Stream, Maui, Hawai'i, September 13-17, 2010

The purpose of this letter is to provide you with a summary of discharge measurements made by the U.S. Geological Survey (USGS) in Makapipi Stream, Maui, Hawai'i from September 13-17, 2010. The measurements were made in cooperation with the Commission on Water Resource Management (CWRM) to document the release of water from the Ko'olau Ditch diversion by the East Maui Irrigation Company and to determine if the restored flow would result in continuous flow to the coast. Attached is a summary of the discharge measurements and discussion of the hydrologic context in which these measurements were made.

Discharge measurements on September 13, 2010 indicate that flow in Makapipi Stream increased 0.78 cfs in the 1,085-ft reach between station 204756156062101 and station 204805156061501, located about 140 feet upstream of the Ko'olau Ditch diversion. After the sluice gate opening was set on September 14, 2010, the discharge measurement values at station 204808156061401, located about 75 feet downstream of the diversion, ranged from 1.35 cfs on September 14, 2010 to 1.18 cfs on September 17, 2010. Daily site visits during September 13–17, 2010, indicated zero flow at the Hāna Highway bridge, located about two-thirds of a mile downstream of the diversion.

Staff of the USGS and CWRM, and local residents hiked about 1,000 feet upstream of the Hāna Highway bridge during the afternoons of September 14 and 16, 2010. This 1,000-foot reach was dry with the exception of a few isolated pools of water and there was no indication of recent streamflow. The precise location where Makapipi Stream went dry farther upstream was not determined because it could not be safely accessed on foot.

If you have any questions or concerns regarding these results, please feel free to contact Steve Gingerich of my staff at 587-2411 or by e-mail (sbginger@usgs.gov).

Sincerely,

Stephen S. Anthony Center Director

Attachment

Makapipi Stream, Maui, Hawai'i Discharge Measurements September 13–17, 2010

Prepared by: Adam G. Johnson and Stephen B. Gingerich U.S. Geological Survey Pacific Islands Water Science Center

Purpose

On May 25, 2010, the Commission on Water Resource Management (CWRM) ordered a conditional flow release of 0.93 cubic feet per second (cfs) into Makapipi Stream downstream of the Ko'olau Ditch diversion operated by East Maui Irrigation (EMI). From September 13–17, 2010, the U.S. Geological Survey (USGS) worked in cooperation with the CWRM to monitor the release of streamflow into Makapipi Stream and to determine if the restored flow would result in continuous streamflow from its headwaters to its mouth.

Acknowledgements

Access to monitor streamflow in Makapipi Stream was granted by EMI.

Study area

Makapipi Stream is located on the northeastern side of east Maui, Hawai'i (fig. 1). The Makapipi streambed runs beneath the Hāna Highway and through the village of Nāhiku. At an altitude of about 1,315 feet, a concrete barrier diverts water from Makapipi Stream into the Ko'olau Ditch system (fig. 2). The diversion structure is currently designed to capture all the stream water when the stream's stage is lower than the top of the concrete barrier. During periods of higher stream flow, some of the stream water may overtop the concrete barrier and flow downstream of the diversion. The diversion structure has a sluice gate that can be opened to allow water to flow through the concrete barrier (fig. 3), bypassing the Ko'olau Ditch intake. The sluice gate opening can be adjusted to different levels to allow variable amounts of water to flow through the opening.

Location of discharge measurement sites

During September 13–17, 2010, discharge measurements were made at five sites in Makapipi Stream (table 1; fig. 4). Two of the sites are upstream of the Ko'olau Ditch diversion intake and three of the sites are downstream of the Ko'olau Ditch diversion intake. The uppermost site, station 204756156062101, is at an altitude of about 1,500 feet above sea level, and is about 1,225 feet upstream of the diversion intake. Station 204805156061501 is at an altitude of about 1,350 feet, and is about 140 feet upstream of the diversion intake. Station 204808156061401 is at an altitude of about 75 feet downstream of the diversion intake. Station 204826156054701 is at an altitude of about 920 feet, is about 3,450 feet downstream of the diversion intake, and is about 115 feet upstream of the Hāna Highway bridge. Station 204930156053701 is at an altitude of about 80 feet, and is about 5 feet downstream of Nāhiku Road bridge crossing of Makapipi Stream.

Discharge measurements were also made at two water production tunnels, 6-4806-12 Pogues Tunnel (TU56) and 6-4806-11 E. Makapipi Tunnel 1 (TU55), located within the Makapipi Stream watershed upstream of the diversion intake (table 1; fig. 4). Water flows out of Pogues Tunnel outlet (station 204802156063901) at an altitude of about 1,600 feet and discharges into Makapipi Stream about 2,100 feet upstream of the diversion. Water flows out of E. Makapipi Tunnel 1 (station 204813156061901) at an altitude of about 1,360 feet where it is currently diverted into an intake pipe of the Ko'olau Ditch system.

Study team

Discharge measurements were made by Richard B. Castro, Clarence L. Edwards, Stephen B. Gingerich, and Adam G. Johnson from the U.S. Geological Survey (USGS) Pacific Islands Water Science Center.

Recent hydrologic conditions

Provisional rainfall data from West Wailuaiki rain gage 204916156083701 (State key number 348.5), about 2.6 miles west-northwest of the Makapipi Stream diversion, indicate that 1.32 inches of rain fell during the week prior to discharge measurements (September 6–12, 2010). During the 5-day period of discharge measurements (September 13–17, 2010) 1.19 inches of rain fell at the West Wailuaiki rain gage (table 2).

The nearest active continuous-record stream-gaging station to Makapipi Stream is station 16508000, Hanawī Stream near Nāhiku, Maui, Hawai'i (fig. 1). Station 16508000 is about 200 feet upstream of the Ko'olau Ditch diversion of Hanawī Stream. During the five days prior to the Makapipi discharge measurements (September 8–12, 2010), daily mean streamflow at 16508000 ranged from about 2.3 to 2.9 cfs (fig. 5). During the five days when the Makapipi discharge measurements were made (September 13–17, 2010), daily mean streamflow at 16508000 ranged from 2.2 to 2.6 cfs. During the 88 years of record (1922–2009) for station 16508000, daily mean flows less than 2.9 cfs occurred less than 10 percent of the time.

Summary of results

Initial discharge measurements were made on September 13, 2010 while the sluice gate was closed and most water from Makapipi Stream was being diverted into the Ko'olau Ditch system; only a small amount of water was leaking through the diversion barrier into the streambed downstream of the diversion. Beginning at about 0815 hours September 14, 2010, the sluice gate of the diversion was opened allowing water to flow downstream of the diversion. The gate was then closed and fully opened several times in order to flush out debris in the streambed. At about 0900 hours September 14, 2010, the gate was partially opened to allow the majority of the water in Makapipi Stream to flow downstream of the diversion; no known subsequent adjustments were made to the position of the sluice gate during the period when discharge measurements were made through September 17, 2010.

Results of the discharge measurements during September 13–17, 2010 are shown in table 1. On September 13, 2010, water discharging from Pogues Tunnel was measured to be 0.35 cfs, or 0.23 million gallons per day (mgd); about 1,225 feet upstream of the diversion at station 204756156062101, streamflow was measured to be 0.73 cfs (0.47 mgd); and about 140 feet upstream of the diversion at station 204805156061501, streamflow was measured to be about 1.51 cfs (0.98 mgd). Thus, on September 13, 2010, Makapipi streamflow increased 0.78 cfs in the 1,085-ft reach between station 204756156062101 and station 204805156061501.

After the sluice gate opening was set on September 14, 2010 at about 0900 hours, the discharge measured at station 204808156061401, downstream of the diversion, ranged from 1.35 cfs on September 14 to 1.18 cfs on September 17 (0.87–0.76 mgd). Some unquantified flow continued to be diverted into the Ko'olau Ditch system daily during the time that the sluice gate was open. Daily site visits during September 13–17, 2010 indicated zero flow at station 204826156054701, located about 115 feet upstream of the Hāna Highway bridge.

Previous measurements

Monthly mean discharge from E. Makapipi Tunnel 1 for the month of September ranged from 0.68 to 5.41 cfs (0.44 to 3.50 mgd) during 1932–1936 (Stearns and Macdonald, 1942). Monthly mean discharge for the month of September from Pogues Tunnel ranged from 1.86 to 3.98 cfs (1.20 to 2.57 mgd) during 1935–1936 (Stearns and Macdonald, 1942). These available historical monthly mean discharge values for September at both tunnels are higher than the values measured during September 2010, though comparisons should be done with caution since it is not known exactly where or how the measurements in the 1930s were made.

Streamflow in Makapipi Stream was previously measured by the USGS to be 0.66 cfs at 1239 hours on July 7, 2010 at station 204826156054701. Thus, water was flowing in Makapipi Stream near the Hāna Highway bridge on July 7, 2010.

A continuous-record stream-gaging station (16507000) was operated by the USGS in the vicinity of station 204826156054701 (about 100 feet upstream of the Hāna Highway bridge). Station 16507000 measured streamflow in Makapipi Stream from July 1932 to June 1945. USGS Surface Water Supply papers (U.S. Geological Survey 1937–48) all indicate that water from Makapipi Stream was being diverted into the Ko'olau Ditch upstream of the gaging station, though it is possible for water to have been periodically released past the diversion.

Figure 6 shows the mean monthly discharge for each month at station 16507000 on Makapipi Stream and station 16508000 on Hanawī Stream. Mean monthly discharge was highest during the months of March and April at both 16507000 and 16508000. At station 16508000 lowest mean monthly streamflow occurred from May to October, and the highest mean monthly streamflow occurred from November to April. Seasonal streamflow trends were similar at station 16507000. Mean monthly discharge at station 16507000 was lowest during the month of September, averaging 3.9 cfs (2.5 mgd).

Records from station 16507000 indicate the daily mean discharge was greater than zero 77 percent of the time (there was no flow 23 percent of the time) from July 1932 to June 1945. The numbers of days with zero streamflow at station 16507000 ranged from 0 to 198 days per calendar year.

Hydrologic context

The streamflow record of station 16507000 and the discharge measurements made in Makapipi Stream during September 2010 can be put into hydrologic context by examining streamflow records at station 16508000 Hanawī Stream. Station 16508000, initially established in 1914, has a complete daily streamflow record since November 1921, and thus is a useful index station of long-term streamflow trends near Makapipi Stream. For the discussion below, long-term averages for station 16508000 on Hanawī Stream are based on daily records from 1922 to 2009.

Recent records at 16508000 Hanawī Stream indicate persistently dry conditions, with annual mean streamflow being below average nine of the last ten years. Mean streamflow during 2000–2009 was the second lowest 10-consecutive-year mean on record. Annual mean streamflow from 2006 to 2009 was 71 percent of long-term average. Streamflow from July 2009 to June 2010 was 64 percent of long-term average.

Summary

Discharge measurements on September 13, 2010 indicate that flow in Makapipi Stream increased 0.78 cfs in the 1,085-ft reach between station 204756156062101 and station 204805156061501 upstream of the Ko'olau Ditch diversion. After the sluice gate opening was set on September 14, 2010 at about 0900 hours, the discharge measurement values at station 204808156061401, downstream of the diversion, ranged from 1.35 cfs on September 14, 2010 to 1.18 cfs on September 17, 2010. Daily site visits during September 13–17, 2010, indicated zero flow at station 204826156054701 near the Hāna Highway bridge, located about two-thirds of a mile downstream of the diversion (table 1).

USGS and CWRM staff, and local residents hiked about 1,000 feet upstream of the Hāna Highway bridge during the afternoons of September 14 and 16, 2010. This 1,000-ft reach was dry with the exception of a few isolated pools of water and there was no indication of recent streamflow (fig. 4). The precise location where Makapipi Stream went dry farther upstream was not determined because it could not be safely accessed on foot.

References

- Stearns, H.T., and Macdonald G.A., 1942, Geology and ground-water resources of the island of Maui, Hawaii: Hawaii Division of Hydrography Bulletin 7, 344 p.
- U.S. Geological Survey, 1937–48, Surface Water Supply of Hawaii, Water-Supply Papers 795, 815, 835, 865, 885, 905, 935, 965, 985, 1015, and 1045.

Online Data

Data for USGS stations is available online at: http://waterdata.usgs.gov/hi/nwis/nwis

Table 1. Makapipi Stream and tunnel discharge measurements September 13-17, 2010.

[HST, Hawaiian Standard Time: cfs, cubic feet per second; mgd, million gallons per day; ft, feet; TU, tunnel; Hwy, highway; Rd., road; E. east]

² (+) values indicate distance upstream of diversion. (-) values indicate distance downstream of diversion

^b estimated; stage measurement at reference point same as 9/16/2010

Date	Rainfall, in inches
9/6/2010	0.39
9/7/2010	0.31
9/8/2010	0.01
9/9/2010	0.32
9/10/2010	0.21
9/11/2010	0.01
9/12/2010	0.07
9/13/2010	0.35
9/14/2010	0.28
9/15/2010	0.48
9/16/2010	0.07
9/17/2010	0.01

Table 2. Provisional daily total rainfall measured at station 204916156083701 West Wailuaiki rain gage near Keanae, Maui, HI (State key 348.5).



Figure 1. Location of West Wailuaiki rain gage, Hanawī stream-gaging station, Makapipi stream-gaging station, Hāna Highway, Koʻolau Ditch and Makapipi Stream, Maui, Hawaiʻi.



Figure 2. Koʻolau Ditch diversion structure in Makapipi Stream, Maui, Hawaiʻi, at about 1,315 feet above mean sea level (September 14, 2010).



Figure 3. Downstream side of Ko'olau Ditch diversion structure in Makapipi Stream, Maui, Hawai'i. The sluice gate opening is approximately two feet wide; it is shown closed in the photograph. (September 14, 2010).



Figure 4. Location of September 13-17, 2010 discharge-measurement sites near and within Makapipi Stream, Maui, Hawai'i.



Figure 5. Provisional daily discharge at stream-gaging station 16508000 Hanawī Stream near Nāhiku, Maui, Hawai'i. Data for September 6-7, 2010 were not available.



Figure 6. Mean monthly streamflow at stream-gaging stations 16507000 (Makapipi Stream near Nāhiku, Maui, Hawai'i) and 16508000 (Hanawī Stream near Nāhiku, Maui, Hawai'i). Periods of record for 16507000 and 16508000 are July 1932 to June 1945, and November 1921 to July 2010, respectively.

COMPILATION OF REPORTS

WAIHEE (6022), ISLAND OF MAUI Interim Instream Flow Standard Implementation Information provided by Wailuku Water Company Last Update: October 25, 2010

Avery Chumbley / Clayton Suzuki

11/08/2010 08:54 AM Aloha Lenore... not much to report this week due to high stream flows, we did get our measuring device back so we are hoping to get better reading this week.

At what point will CWRM make a determination that WWC is compliant with the D&O on Waihee Stream?

The Waihee Strea	am had high flows	all week. We took one read	ing one Monday November 1. The stream
flow probe was re	turned. WWC did	not take stream flow reading	gs due to the high stream flows.
Date:	Staff Gauge	Flow	Stream Flow
	(feet)	MGD	Above intakes (MGD)
November 1	2.70	10.47 +	74.3

Avery Chumbley / Clayton Suzuki

Aloha Lenore... here is our compliance report for the past week.

The stream flow probe is waiting for parts expected this week. WWC monitored the stream gauge installed by USGS with 1.56 feet equating 10.47 MGD

The following readings were taken with the Waihee control gate set at two bolts and the Spreckles control gate set at 4 bolts + 1 ¼" to 4 bolts plus 3/4".

Date:	Gauge reading:	Flow MGD	Waihee Stream flow above intakes (MGD)
October 18	1.56	10.47	18.7
October 19	1.59	10.47 +	19.4
October 20	1.63	10.47 +	21.3
October 21	1.58	10.47 +	22.6

Wailuku Water Company

Waihee Stream IIFS

				Stream Flow	Stream Flow	USGS	Waihee Stream	Stream Flow
Date:	Waihee Ditch	Spreckles Ditch	Stream Flow	USGS site (MGD)	USGS reading	Staff Gauge	Staff Gauge	USGS reading
	Setting:	Setting:	WWC site (MGD)		(MGD)	(Feet)	(MGD)	(MGD)
8-9-10	second bolt	second bolt	4.78	Х				
9-3-10	second bolt	second bolt	4.73	Х				27.8
9-5-10	second bolt	second bolt	4.72	Х				20.7
9-7-10	second bolt	second bolt	4.87	Х				38.1
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52	5.96				34.2
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16	6.00				42.6
9-13-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	6.20	6.87				21.3
9-15-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	5.95	7.08				27.1
9-17-10	bolt 2 + 1/2 "	fourth bolt	8.66	9.66				20.0
9-21-10	bolt 2 + 1/2 "	fourth bolt	8.99	10.18				22.0
10-06-10	bolt 2 + 1/2 "	bolt 4 + 1/2"	-	10.11				20.7
10-08-10	bolt 2 + 1/2 "	bolt 4 + 1/2"	-	10.70				19.4
10-11-10	bolt 2 + 1/4 "	bolt 4 + 1"	-	10.46				27.1
10-12-10	bolt 2 + 1/4 "	bolt 4 + 1"	-	10.27				20.7
10-13-10	bolt 2 + 1/4 "	bolt 4 + 1"	-	10.36	10.47	1.56	10.47	20.0
10-15-10	bolt 2	bolt 4 + 1 1/2 "	-	-	-	1.57	10.47 +	20.0
10-18-10	bolt 2	bolt 4 + 1 1/4 "	-	-	-	1.56	10.47	18.7
10-19-10	bolt 2	bolt 4 + 1 "	-	-	-	1.59	10.47 +	19.4
10-20-10	bolt 2	bolt 4 + 3/4 "	-	-	-	1.63	10.47 +	21.3
10-21-10	bolt 2	bolt 4 + 3/4 "	-	-	-	1.58	10.47 +	22.6

Avery Chumbley / Clayton Suzuki

Aloha Lenore... below is the Waihee Stream compliance report for the previous week.

The CWRM and USGS staff did flow measurements on Waihee Stream and installed a staff gauge at the flow measurement site on Wednesday. WWC and USGS did stream flow measurements as follows: The flow probe broke down again on October 14, WWC is using the staff gauge established by USGS to check flows in Waihee Stream.

Date:	Time:	Waihee Stream flow	Waihee Stream flow	Waihee Stream flow	USGS Staff
		Above Waihee Ditch	at USGS site: WWC	USGS Measurement	Gauge

10/18/2010 01:28 PM



10/25/2010 10:21 AM

		(MGD)	(MGD)	(MGD)	(Feet)
October 11, 2010	8:34 AM	27.1	10.46	-	
October 12, 2010	8:35 AM	20.7	10.27	-	
October 13, 2010	8:55 AM	20.0	10.36	10.47	1.56
October 15, 2010	7:13 AM	20.0	+10.47	-	1.57

WWC used the following settings for the above readings:

Date:	Waihee Ditch	Spreckles Ditch
	Control Gate	Control Gate
October 11, 2010	Bolt 2 + ¼ "	Bolt 4 + 1 "
October 12, 2010	Bolt 2 + ¼ "	Bolt 4 + 1 "
October 13, 2010	Bolt 2 + ¼ "	Bolt 4 + 1 "
October 15, 2010	Bolt 2	Bolt 4 + 1 ½ "

Avery Chumbley / Clayton Suzuki

Hi Lenore... below is the reading we got on Friday for Waihee Stream.

The flow probe was received on October 5 Tuesday, a stream flow measurement was taken on October 6 Wednesday and October 8 Friday. The stream flow measured at the USGS site were:

Date:	Time:	Waihee Stream flow Above Waihee Ditch (MGD)	Waihee Stream flow flow at WWC site: (MGD)	Waihee Stream flow at USGS site: (MGD)
October 6	8:05 AM	20.7	-	10.11 .2010
October 8	8:02 AM	19.4		10.70

Waihee Stream had high flows on Sunday October 10, peaking at 211 MGD, again the USGS weir was washed out and replaced on Monday October 11.

The CWRM and USGS staff will be on Maui on October 13 Wednesday to do stream flow measurements.

Avery Chumbley / Clayton Suzuki

Aloha Lenore... attached is our weekly compliance report. In addition to the high flows which damaged the weirs there was an incident of vandalism again on our parshall flume which is used to measure the Kuleana flows in Waihee.

On October 2 Saturday, Waihee Stream peaked at 1260 cfs or 814 mgd, both WWC and the USGS weirs for stream flow measurement were wiped out. WWC personal worked to repair the USGS weir on October 4, Monday. The Global stream flow probe is due on October 5 and we will do a stream flow measurement on Wednesday. CWRM and USGS will be here on October 13, Wednesday to install staff gauges on the weir and work on weirs on the Waihee Stream mouth and for the Waiehu Stream.

On October 3 Sunday, someone tossed the parshall flume used to measure the South Waihee kuleana flow. WWC will not reinstall the flume.

Attached are the Waihee Stream flow chart and the South Waihee kuleana flume readings.

Wailuku Water Company

Waihee Stream IIFS

Date:	Waihee Ditch	Spreckles Ditch	Stream	Stream Flow
	Setting:	Setting:	Flow (MGD)	USGS site (MGD)
8-9-10	second bolt	second bolt	4.78	Х
9-3-10	second bolt	second bolt	4.73	Х
9-5-10	second bolt	second bolt	4.72	Х
9-7-10	second bolt	second bolt	4.87	Х
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52	5.96
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16	6.00
9-13-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	6.20	6.87
9-15-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	5.95	7.08
9-17-10	bolt 2 + 1/2 "	fourth bolt	8.66	9.66
9-21-10	bolt 2 + 1/2 "	fourth bolt	8.99	10.18

10/11/2010 02:31 PM

10/04/2010 01:47 PM

				South Waihe	e Kuleana Rea	ading:	
Date:	Flow MG:	Time Flow	Flow: Spreckles	s Flow: Waihee	Flow: Waihee	Flow: Waihee	Flow: Waihee
	South Waihee	Taken:	Ditch	Stream: 1 Hour	Stream: 1 Hour	Stream: 1.5 Hou	Stream: 1.5 Hour
	Kuleana		(MGD)	Prior to Reading	Prior to Reading	Prior to Reading	Prior to Reading
	MGD			CFS	MGD	CFS	MGD
23-Aug-10	1.7	9.45 AM	6.0	32	20.7	32	20.7
24-Aug-10	1.7	10:15 AM	5.9	34	22.0	33	21.3
25-Aug-10	1.7	9:00 AM	10.8	28	18.1	28	18.1
26-Aug-10	1.7	9:00 AM	7.0	32	20.7	32	20.7
27-Aug-10	1.7	9:00 AM	7.3	38	24.5	38	24.5
28-Aug-10	1.8	9:00 AM	7.0	33	21.3	34	22.0
29-Aug-10	1.8	9:00 AM	12.0	108	69.8	113	73.0
30-Aug-10	1.8	9:30 AM	7.0	33	21.3	33	21.3
31-Aug-10	1.8	9:30 AM	7.0	35	22.6	34	22.0
51-Aug-10	1.0	3.30 AW	7.0	55	22.0	54	22.0
01-Sep-10	1.8	8:30 AM	7.0	32	20.7	32	20.7
02-Sep-10	1.8	8:45 AM	6.9	32	20.7	31	20.0
03-Sep-10	1.8	9:00 AM	9.5	34	22.0	34	22.0
04-Sep-10	1.7	9:15 AM	8.2	34	22.0	34	22.0
05-Sep-10	1.8	9:25 AM	8.8	33	21.3	32	20.7
06-Sep-10	1.8	9:00 AM	8.9	35	22.6	35	22.6
07-Sep-10	1.8	9:15 AM	10.3	59	38.1	65	42.0
08-Sep-10	1.8	8:40 AM	8.8	35	22.6	36	23.3
09-Sep-10	1.8	8:45 AM	8.5	35	22.6	35	22.6
10-Sep-10	1.8	8:50 AM	8.8	38	24.5	37	23.9
11-Sep-10	1.8	8:50 AM	8.9	33	21.3	34	22.0
12-Sep-10	1.8	8:45 AM	8.7	32	20.7	32	20.7
13-Sep-10	1.8	9:25 AM	8.8	32	20.7	32	20.7
14-Sep-10	1.8	8:40 AM	8.8	33	21.3	32	20.7
15-Sep-10	1.0	8:40 AM	9.9	42	27.1	42	27.1
16-Sep-10	1.0	9:45 AM	6.2	34	22.1	22	21.1
17-Sep-10	1.0	0.45 AM	6.6	24	22.0	21	21.5
19 Sop 10	1.0	0.40 AM	5.0	20	20.0	21	20.0
10-Sep-10	1.7	0.40 AM	5.9	30	19.4	22	20.0
19-Sep-10	1.7	0:40 AIVI	5.9	32	20.7	32	20.7
20-Sep-10	1.0	9.15 AM	67	192	124.0	225	140.4
21-Sep-10	1.0	9.00 AN	0.7	30	23.3	30	22.0
22-Sep-10	1.0	7:30 AM	4.9	51	32.9	40	29.7
23-Sep-10	1.5	10:30 AM	4.3	34	22.0	34	22.0
24-Sep-10	1.4	8:45 AM	4.3	32	20.7	32	20.7
25-Sep-10	1.8	9:00 AM	5.4	35	22.6	36	23.3
26-Sep-10	1.8	9:00 AM	4.6	32	20.7	32	20.7
27-Sep-10	1.8	9:45 AM	4.9	32	20.7	32	20.7
28-Sep-10	1.7	8:45 AM	5.0	31	20.0	31	20.0
29-Sep-10	1.8	8:45 AM	5.0	30	19.4	31	20.0
30-Sep-10	1.7	8:45 AM	5.1	30	19.4	31	20.0
					0.0		0.0
01-Oct-10	1.7	8:00 AM	6.0	37	23.9	38	24.5
02-Oct-10	2.0	9:00 AM	10.5	243	157.0	516	333.3
03-Oct-10	1.8	10:00 AM	4.6	34	22.0	34	22.0

Avery Chumbley / Clayton Suzuki

Aloha Lenore,

Attached is a narrative and schedules of our compliance efforts for the week of September 20th. As indicated below our flow meter was returned to the manufacture for repairs so until it is returned back to us we will not be able to do any additional measurements. This down time will give us a good opportunity to see if saturation of the stream takes place from the last flow measurement to when we can do the next measurement.

If you have any questions please let me know.

During the week of September 20, 2010 WWC measured flows in Waihee Stream on September 21, 2010. The Waihee Stream flow peaked on September 19, 2010 Sunday at 253 MGD. WWC was scheduled to do stream flow measurements on September 20, 2010 but canceled due to high stream flow. WWC went to measure stream flow on September 21, 2010 with the expectation that the weirs were damaged. On inspecting both weirs they were okay with a some damage, all of the small gravel used to fill the weir rock side walls were gone so that had to be replaced and some of the rock wall for the weir were washed away. The weirs were rebuilt adding sand bags to prevent the small gravel from washing away and flow measurements were taken.

On September 22, 2010 WWC assisted HC&S in doing flow measurements in the South Waiehu Ditch, after two measurements the Global flow probe did not work. The instrument was sent back to the manufacturer on September 22, 2010. WWC cannot do any more stream measurements until the probe is returned.

Attached are charts showing the Waihee Stream flow measurements and the South Waihee kuleana flow measurements.

The following flows were measured on September 21, 2010.

Date:	Time:	Waihee Stream flow Above Waihee Ditch (MGD)	Waihee Stream flow flow at WWC site: (MGD)	Waihee Stream flow at USGS site: (MGD)
September 21, 2010	10:15 AM	22.0	8.99 ´	
September 21, 2010	8:15 AM	22.6		10.18

09/23/2010 12:24 PM

Wailuku Water Company

Waihee Stream IIFS

Date:	Waihee Ditch	Spreckles Ditch	Stream	Stream Flow
	Setting:	Setting:	Flow (MGD)	USGS site (MGD)
8-9-10	second bolt	second bolt	4.78	X
9-3-10	second bolt	second bolt	4.73	Х
9-5-10	second bolt	second bolt	4.72	Х
9-7-10	second bolt	second bolt	4.87	Х
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52	5.96
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16	6.00
9-13-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	6.20	6.87
9-15-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	5.95	7.08
9-17-10	bolt 2 + 1/2 "	fourth bolt	8.66	9.66
9-21-10	bolt 2 + 1/2 "	fourth bolt	8.99	10.18
9-23-10	bolt 2 + 1 "	fourth bolt + 1/2"		

South Waihee Kuleana Reading:

Date:	Flow MG:	Time Flow	Flow: Spreckles	Flow: Waihee	Flow: Waihee	Flow: Waihee	Flow: Waihee
	South Waihee	Taken:	Ditch	Stream: 1 Hour	Stream: 1 Hour	Stream: 1.5 Hout	Stream: 1.5 Hour
	Kuleana		(MGD)	Prior to Reading	Prior to Reading	Prior to Reading	Prior to Reading
	MGD			CFS	MGD	CFS	MGD
23-Aug-10	1.7	9.45 AM	6.0	32	20.7	32	20.7
24-Aug-10	1.7	10:15 AM	5.9	34	22.0	33	21.3
25-Aug-10	1.7	9:00 AM	10.8	28	18.1	28	18.1
26-Aug-10	1.7	9:00 AM	7.0	32	20.7	32	20.7
27-Aug-10	1.7	9:00 AM	7.3	38	24.5	38	24.5
28-Aug-10	1.8	9:00 AM	7.0	33	21.3	34	22.0
29-Aug-10	1.8	9:00 AM	12.0	108	69.8	113	73.0
30-Aug-10	1.8	9:30 AM	7.0	33	21.3	33	21.3
31-Aug-10	1.8	9:30 AM	7.0	35	22.6	34	22.0
01-Sep-10	1.8	8:30 AM	7.0	32	20.7	32	20.7
02-Sep-10	1.8	8:45 AM	6.9	32	20.7	31	20.0
03-Sep-10	1.8	9:00 AM	9.5	34	22.0	34	22.0
04-Sep-10	1.7	9:15 AM	8.2	34	22.0	34	22.0
05-Sep-10	1.8	9:25 AM	8.8	33	21.3	32	20.7
06-Sep-10	1.8	9:00 AM	8.9	35	22.6	35	22.6
07-Sep-10	1.8	9:15 AM	10.3	59	38.1	65	42.0
08-Sep-10	1.8	8:40 AM	8.8	35	22.6	36	23.3
09-Sep-10	1.8	8:45 AM	8.5	35	22.6	35	22.6
10-Sep-10	1.8	8:50 AM	8.8	38	24.5	37	23.9
11-Sep-10	1.8	8:50 AM	8.9	33	21.3	34	22.0
12-Sep-10	1.8	8:45 AM	8.7	32	20.7	32	20.7
13-Sep-10	1.8	9:25 AM	8.8	32	20.7	32	20.7
14-Sep-10	1.8	8:40 AM	8.8	33	21.3	32	20.7
15-Sep-10	1.8	8:40 AM	8.8	42	27.1	42	27.1
16-Sep-10	1.8	8:45 AM	6.3	34	22.0	33	21.3
17-Sep-10	1.8	8:40 AM	6.6	31	20.0	31	20.0
18-Sep-10	1.7	8:40 AM	5.9	30	19.4	31	20.0
19-Sep-10	1.7	8:40 AM	5.9	32	20.7	32	20.7
20-Sep-10	1.8	9:15 AM	12.7	192	124.0	225	145.4
21-Sep-10	1.8	9:00 AM	6.7	36	23.3	35	22.6
22-Sep-10	1.6	7:30 AM	4.9	51	32.9	46	29.7

Avery Chumbley / Clayton Suzuki

09/20/2010 09:13 AM

Aloha Lenore,

Attached is our Waihee compliance activity report for the week of September 13th., as you will see the adjustments are working and the flows are nearing the D&O of 10 MGD.

During the week of September 13, 2010 WWC measured flows in Waihee Stream on September 13, 15 & 17. After doing stream flow measurement on September 15, 2010, WWC adjusted the Spreckles Ditch sluice gate from 2 bolts + $\frac{3}{4}$ " to 4 bolts, no adjustment was done on Waihee Ditch sluice gate. On September 17, 2010 we noticed that the stream flow at both weirs were by passing the weir, work to correct the flow within the weirs was done but some water flows were by passing the weirs at both locations.

At the Spreckles Ditch gravel trap, WWC plugged 3 of the 19 pipes that transfer water from the gravel trap into Spreckles Ditch.

Attached are charts showing Waihee Stream flow measurements and South Waihee kuleana flow measurements.

The following flows were measured during the week of September 13, 2010.

Date:	Time:	Waihee Stream flow	Waihee Stream	Waihee Stream flow
		Above Waihee Ditch	flow at WWC site	at USGS site
		Intake (MGD)	(MGD)	(MGD)
September 13,	9:20 AM	21.3	6.20	
September 13,	10:10 AM	20.7		6.87
September 15,	7:50 AM	27.1	5.95	

September 15,	7:10 AM	27.1
September 17,	9:30 AM	20.0
September 17	7:55 AM	20.7

Wailuku Water Company

Waihee Stream IIFS

Date:	Waihee Ditch Setting:	Spreckles Ditch Setting:	Stream Flow (MGD)	Stream Flow USGS site (MGD)
8-9-10	second bolt	second bolt	4.78	Х (
9-3-10	second bolt	second bolt	4.73	Х
9-5-10	second bolt	second bolt	4.72	Х
9-7-10	second bolt	second bolt	4.87	Х
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52	5.96
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16	6.00
9-13-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	6.20	6.87
9-15-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	5.95	7.08
9-17-10	bolt 2 + 1/2 "	fourth bolt	8.66	9.66

				South Waihee	e Kuleana Re	ading:	
Date:	Flow MG:	Time Flow	Flow: Spreckles	Flow: Waihee	Flow: Waihee	Flow: Waihee	Flow: Waihee
	South Waihee	Taken:	Ditch	Stream: 1 Hour	Stream: 1 Hour	Stream: 1.5 Houf	Stream: 1.5 Hour
	Kuleana		(MGD)	Prior to Reading	Prior to Reading	Prior to Reading	Prior to Reading
	MGD			CFS	MGD	CFS	MGD
23-Aug-10	1.7	9.45 AM	6.0	32	20.7	32	20.7
24-Aug-10	1.7	10:15 AM	5.9	34	22.0	33	21.3
25-Aug-10	1.7	9:00 AM	10.8	28	18.1	28	18.1
26-Aug-10	1.7	9:00 AM	7.0	32	20.7	32	20.7
27-Aug-10	1.7	9:00 AM	7.3	38	24.5	38	24.5
28-Aug-10	1.8	9:00 AM	7.0	33	21.3	34	22.0
29-Aug-10	1.8	9:00 AM	12.0	108	69.8	113	73.0
30-Aug-10	1.8	9:30 AM	7.0	33	21.3	33	21.3
31-Aug-10	1.8	9:30 AM	7.0	35	22.6	34	22.0
01-Sep-10	1.8	8:30 AM	7.0	32	20.7	32	20.7
02-Sep-10	1.8	8:45 AM	6.9	32	20.7	31	20.0
03-Sep-10	1.8	9:00 AM	9.5	34	22.0	34	22.0
04-Sep-10	1.7	9:15 AM	8.2	34	22.0	34	22.0
05-Sep-10	1.8	9:25 AM	8.8	33	21.3	32	20.7
06-Sep-10	1.8	9:00 AM	8.9	35	22.6	35	22.6
07-Sep-10	1.8	9:15 AM	10.3	59	38.1	65	42.0
08-Sep-10	1.8	8:40 AM	8.8	35	22.6	36	23.3
09-Sep-10	1.8	8:45 AM	8.5	35	22.6	35	22.6
10-Sep-10	1.8	8:50 AM	8.8	38	24.5	37	23.9
11-Sep-10	1.8	8:50 AM	8.9	33	21.3	34	22.0
12-Sep-10	1.8	8:45 AM	8.7	32	20.7	32	20.7
13-Sep-10	1.8	9:25 AM	8.8	32	20.7	32	20.7
14-Sep-10	1.8	8:40 AM	8.8	33	21.3	32	20.7
15-Sep-10	1.8	8:40 AM	8.8	42	27.1	42	27.1
16-Sep-10	1.8	8:45 AM	6.3	34	22.0	33	21.3
17-Sep-10	1.8	8:40 AM	6.6	31	20.0	31	20.0
18-Sep-10	1.7	8:40 AM	5.9	30	19.4	31	20.0
19-Sep-10	1.7	8:40 AM	5.9	32	20.7	32	20.7

Avery Chumbley / Clayton Suzuki

09/13/2010 08:40 AM

Aloha Lenore.... Attached is our compliance summary for the past week, should you have any questions please let me know.

During the week of September 7, 2010, WWC measured stream flows on Waihee Stream on September 7, 8 and 10. On September 8 Wednesday staff from USGS and the CWRM were on Maui to establish sites for stream gauging on Waihee and Waiehu Streams. The USGS found a site approximately 1200 to 1500 feet below where water enters Waihee Stream from the Spreckles Ditch sluice gate ditch. A report on the stream flow measurement was sent last week.

At the WWC site for measuring stream flow WWC rebuilt the its site moving the site upstream four feet and built a weir to eliminate the zero and low flow sites by building a rock dam to channel the water. WWC measured the stream flow before building the rock dam and after and found the difference at 0.18 MGD, the flow measured before at 4.98 MGD and after at 5.16 MGD.

On September 10 after doing a stream flow measurement WWC installed a ½ " shim on the Waihee Ditch sluice gate and a ¾ " shim on the Spreckles Ditch sluice gate. Flow measurements will be done on the week of September 13.

Waihee South kuleana ditch flow readings are attached, also attached is a chart summary showing Waihee Steam flow measurements and gate settings on Waihee and Spreckles Ditch sluice gates.

The following fl	ows were me	easured during the week of September 7.	
Date:	Time:	Waihee Stream flow	Waihee Stream
		Above Waihee Ditch	flow at WWC site

		Intake (MGD)	
September 7	8:20 AM	38.1	4.87
September 8	12 Noon	34.2	5.52
September 10	10:25 AM	42.6	5.16

Wailuku Water Company

Waihee Stream IIFS

Date:	Waihee Ditch	Spreckles Ditch	Stream
	Setting:	Setting:	Flow (MGD)
8-9-10	second bolt	second bolt	4.78
9-3-10	second bolt	second bolt	4.73
9-5-10	second bolt	second bolt	4.72
9-7-10	second bolt	second bolt	4.87
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16

Flow: Waihee Stream: 1.5 Hour Prior to Reading MGD 20.7
Stream: 1.5 Hour Prior to Reading MGD 20.7
MGD 20.7
MGD 20.7
20.7
24.2
21.3
18.1
20.7
24.5
22.0
73.0
21.3
22.0
20.7
20.0
22.0
22.0
20.7
22.6
42.0
23.3
22.6
23.9
22.0
20.7
21.3 18.1 20.7 24.5 22.0 73.0 21.3 22.0 20.7 20.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 22.0 20.7 22.0 20.7 20.0 20.7 20.0 20.7 20.0 20.7 20.0 20.7 20.0 20.7 20.0 20.7 20.0 20.7 20.0

Avery Chumbley / Clayton Suzuki

Aloha All,

Here is a update on the WWC compliance activity.

Wailuku Water Company (WWC) received the Global Water flow probe on Wednesday September 1. Waihee Stream flow measurements were done on September 3, 5 and 7 with the following readings. The Waihee Stream gauge is approximately 320 feet downstream of where the Spreckles Ditch water returns to Waihee Stream. The Waihee Ditch sluice gate is set a one notch and the Spreckles Ditch sluice gate at two notches. Date: Time: Waihee Stream Flow (MGD) Waihee Stream Flow (MGD)

Date:	Time:	Wainee Stream Flow (MGD)	Wainee Stream Flow (MGD)
		Above Waihee Ditch intake	Below Spreckles Ditch return water
September 3,	10:30 AM	27.8	4.73
September 5,	8:10 AM	20.7	4.72
September 7,	8:20 AM	38.1	4.87

After making a stream reading on September 7, 2010, WWC flushed Waihee and Spreckels gravel traps and installed the ¼ inch shim on the Waihee Ditch sluice gate.

On September 8, 2010 the CWRM staff and USGS will be on Maui to find a suitable gauging station location for Waihee Stream below Spreckles Ditch intake. WWC plans to do stream flow measurements on Wednesday, Thursday and Friday and install the ½ inch shim on Friday if needed.

Attached is the South Waihee kuleana ditch reading up till September 7, 2010.

09/07/2010 10:58 AM

				e Kuleana Rea	ana Reading:			
Date:	Flow MG:	Time Flow	Flow: Spreckles	Flow: Waihee	Flow: Waihee	Flow: Waihee	Flow: Waihee	
	South Waihee	Taken:	Ditch	Stream: 1 Hour	Stream: 1 Hour	Stream: 1.5 Hou	Stream: 1.5 Hour	
	Kuleana		(MGD)	Prior to ReadingPrior to ReadingPrior to ReadingPrior to Reading				
	MGD			CFS	MGD	CFS	MGD	
24-Aug-10	1.7	10:15 AM	5.9	34	22.0	33	21.3	
25-Aug-10	1.7	9:00 AM	10.8	28	18.1	28	18.1	
26-Aug-10	1.7	9:00 AM	7.0	32	20.7	32	20.7	
27-Aug-10	1.7	9:00 AM	7.3	38	24.5	38	24.5	
28-Aug-10	1.8	9:00 AM	7.0	33	21.3	34	22.0	
29-Aug-10	1.8	9:00 AM	12.0	108	69.8	113	73.0	
30-Aug-10	1.8	9:30 AM	7.0	33	21.3	33	21.3	
31-Aug-10	1.8	9:30 AM	7.0	35	22.6	34	22.0	
01-Sep-10	1.8	8:30 AM	7.0	32	20.7	32	20.7	
02-Sep-10	1.8	8:45 AM	6.9	32	20.7	31	20.0	
03-Sep-10	1.8	9:00 AM	9.5	34	22.0	34	22.0	
04-Sep-10	1.7	9:15 AM	8.2	34	22.0	34	22.0	
05-Sep-10	1.8	9:25 AM	8.8	33	21.3	32	20.7	
06-Sep-10	1.8	9:00 AM	8.9	35	22.6	35	22.6	
07-Sep-10	1.8	9:15 AM	10.3	59	38.1	65	42.0	
v							08/31/2	010 09·30 AM
y							00/31/2	010 00.00 AN

Avery Chumbley

Aloha Lenore,

Pursuant to our approved implementation plan for Waihee we have tested the newly engineered shims and they appear to function as desired. WWC has ordered a Global Flow measuring device which according to the UPS notification below will be delivered to our office on Wednesday, upon receipt of the device we will take our first measurements of the stream just below the Spreckels ditch sluice gate to establish the current base flow in the stream.

The Parshall flume has been installed in the South Waihee Kuleana ditch at its head and we have been taking a daily readings of the flows in the ditch, I have attached the first weeks readings for your information. We will keep you posted on our progress, if you have any questions or comments please let me know.

South Walhee Kuleana Reading:								
Date:	Flow MG:	Time Flow	Flow: Waihee	Flow: Waihee	Flow: Waihee	Flow: Waihee		
	South Waihee	Taken:	Stream: 1 Hour	Stream: 1 Hour	Stream: 1.5 Hour	Stream: 1.5 Hou		
	Kuleana	Prior to ReadingPrior to Reading Prior to Reading Pri				Prior to Reading		
	MGD		CFS	MGD	CFS	MGD		
23-Aug-10	1.7	9.45 AM	32.0	20.7	32	20.7		
24-Aug-10	1.7	10:15 AM	34.0	22.0	33	21.3		
25-Aug-10	1.7	9:00 AM	28.0	18.1	28	18.1		
26-Aug-10	1.7	9:00 AM	32.0	20.7	32	20.7		
27-Aug-10	1.7	9:00 AM	38.0	24.5	38	24.5		
28-Aug-10	1.8	9:00 AM	33.0	21.3	34	22.0		
29-Aug-10	1.8	9:00 AM	108.0	69.8	113	73.0		
30-Aug-10	1.8	9:30 AM	33.0	21.3	33	21.3		

Avery Chumbley / Clayton Suzuki

08/26/2010 10:40 AM

Aloha Lenore,

I wanted to provide you a copy of the attached below email, the bottom line results of the explanation contained therein is that we feel there is more water being returned to Waihee Stream now that the gravel trap has been flushed out than on August 9th when we set the control gate release at the two notches for the initial release under the D&O.

I have ordered a stream flow measuring device which we should have soon, once we have the shims installed and flows adjusted will you be sending the staff over to confirm and verify the flows?

On Tuesday August 24, the Wailuku Water crew along with the HC&S crew went up to Waihee Valley to test the shims for the control gate on Spreckles and Waihee Ditch sluice gate. The test went well and the shims did the job of controlling the incremental lifting of the sluice gate by ¼ inch at a time. When testing the shims on both gates we opened the control gates to flush the gravel trap. After all the testing was done on both Spreckles and Waihee Ditches we reset the gates at two notches at both gates which was established by the CWRM staff. On Wednesday morning HC&S called me that the reading on Waihee Ditch at the Hopoi Chute gauging station was reading 3.5 MGD where it normally read 10 to 11 MGD after August 9 when we sent water back into Waihee Stream for the IIFS. I sent WWC crew back into Waihee Valley to investigate. They found that Waihee Ditch at Field 4 gauging station did read about 4 MGD and the Spreckles Ditch gauging station was reading 11 MGD where normally it read 6 to 7 MGD.

The crew checked the Spreckles Ditch sluice gate, closed it completely and opened it two notches, everything look normal. At Waihee Ditch sluice gate they closed the sluice gate and opened it two notches and found that the flow from the sluice gate to Waihee Stream was way above the setting that was measured by the CWRM staff. From the Waihee Ditch flow of 4 MGD from the normal 10 to 11 MGD. I estimated that the flow into Waihee Stream was between 12 to 14 MGD. I told them to reset the Waihee Ditch sluice gate to one notch. This morning the reading at Hopoi Chute gauging station read 8.8 MGD, still lower than the normal 10 to 11 MGD.

What happened is that when we did the IIFS on August 9, the gravel trap had built up with rocks and the flow back into the stream was hampered by the rocks. We did not flush the gravel trap again till August 24 when we tested the shims. With the gravel trap cleaned out the flow into Waihee Stream from the Waihee sluice gate increased.

Avery Chumbley / Clayton Suzuki

Aloha Lenore.... As we had discussed WWC is keeping a log of complaints and calls about water shortages that may have been the result of the stream IIFS being implemented.

As noted below it appears that Traditional users in the Waihee region have undertaken some self help actions in order to get higher volumes of water into the Kuleana ditches. As outlined by Clayton this could cause significant damages to our system and does result in down system users being shorted of water.

On Monday August 23, 2010 at 9: 45 AM, Wailuku Water Company (WWC) Ditch person Rene Chavez discovered a sand bag dam fronting the South Waihee Kuleana out take pipe on Spreckles Ditch. There were two rows of sand bags across the ditch. This caused the Spreckles Ditch to pond behind the sand bags. This could be a problem when the stream flow increases and the Spreckles Ditch flow increases, the water could breach the ditch banks causing a failure to the ditch bank. WWC workers removed the sand bag on August 24, 2010.

This also happened during the week of August 3, 2010, the sand bag dam was discovered on August 4, Wednesday and removed by WWC workers on August 5, 2010.

COMPILATION OF REPORTS

WAIEHU (6023), ISLAND OF MAUI Information provided by Hawaiian Commercial & Sugar Co.

Last Update: October 25, 2010

Garret Hew

This afternoon the sluice gate on South Waiehu stream was closed and all available water from the stream was measured in the diversion ditch at 0.87 mgd. As per the Stipulation and Order release schedule all of the water was released back into the stream because the flow was less than the IIFS of 0.90 mgd. There was no available water in the diversion ditch for Kuleana use. The sluice gate was set with a bolt in the 7th hole from the top of the sluice gate stem along with four shims under the bolt (see attached picture). We plan to do the same procedure before the end of the week and report the results to CWRM staff.



DSC00001.JPG

Garret Hew

10/12/2010 07:48 AM As discussed this morning we will not make any adjustments to the sluice gate to try to achieve the 0.90 mgd for the South Waiehu IIFS until you have a chance to discuss with OHA and Earthjustice. Due to drought conditions there is not sufficient water in the stream to meet both the IIFS and provide adequate water for Kuleana use based on our recent flow measurements. I will wait to hear back from you before making any adjustments to the South Waiehu sluice gate.

Garret Hew

10/08/2010 10:54 AM

I would like to provide you with an update of the South Waiehu stream Stipulation and Order. On October 7, 2010 Clayton Suzuki and I measured the flow in the South Waiehu stream diversion ditch at 1.02 mgd with the sluice gate close and all of the stream water diverted into the diversion ditch. The sluice gate was opened and adjusted with a bolt inserted into the 6th hole from the top of the stem (see picture #123.JPG) to try to achieve 0.50 mgd in the diversion ditch to supply adequate flow of 0.25 mgd for Kuleana use. Another measurement was taken after the adjustment of the sluice gate and the flow in the diversion ditch was 0.58 mgd. The balance of 0.44 mgd (1.02 - 0.58 = 0.44) was going into the stream via the sluice gate. Attached is picture # 124.JPG showing water going into the stream via the sluice gate and # 125.JPG showing water diverted into the diversion ditch.



Commission on Water Resource Management Stream Protection and Management Branch P.O. Box 621, Honolulu, HI 96809 Phone: 808.587.0234 Fax: 808.587.0219 Email: dlnr.cwrm@hawaii.gov Internet: http://hawaii.gov/dlnr/cwrm

10/12/2010 04:13 PM





DSC00125.JPG

Garret Hew

09/27/2010 03:41 PM

The leak under the sluice gate in the concrete floor made it impossible to regulate the flow of water in the diversion ditch and in the stream. Now that the repairs have been completed as of last Friday we will adjust the sluice gate to achieve the 0.50 mgd in the diversion ditch to supply adequate flow of 0.25 mgd for Kuleana use as soon as Wailuku Water Company's flow meter is available. Clayton told me this afternoon that the meter has been repaired and was shipped back to Maui today. As soon as we can measure the water in the diversion ditch and make the necessary adjustments with the shims, if necessary, the results will be reported to CWRM staff. Thank you for your understanding of the repair work that needed to be done and the repair of WWC's flow meter.

Garret Hew

09/24/2010 02:12 PM

I want to update you on the South Waiehu Stipulation and Order that was signed on September 1, 2010. As you know the sluice gate on South Waiehu stream was closed on the afternoon of September 1st to allow water back into the diversion ditch to supply adequate flow for Kuleana use. It was noted in my email to you that afternoon that approximately 0.40 to 0.50 mgd was flowing in the diversion ditch while 0.10 to 0.20 mgd was leaking back into the stream via a hole in the concrete floor under the sluice gate. On September 9, 2010 Clayton Suzuki and I measured the water in the diversion ditch at 0.30 mgd and noted that the leak under the sluice gate was more than the amount noted on September 1st. We attempted to measure the flow in the diversion ditch again on September 22nd but the flow meter malfunctioned and Wailuku Water Company sent it back to the manufacturer on the mainland for repairs. The repair to the hole in the concrete floor under the sluice gate upstream of the sluice gate was piped into the diversion ditch to supply flow for Kuleana use while the repairs were being made. Today the pipes were removed and the sluice gate closed to allow the concrete that was used for the repair yesterday to cure over the weekend. We plan to measure the flow in the diversion ditch as soon as WWC's flow meter is repaired in order to achieve 0.50 mgd in the diversion ditch to supply adequate flow of 0.25 mgd for Kuleana use.

Garret Hew

09/01/2010 03:19 PM

As per the Stipulation and Order the sluice gate on South Waiehu stream was closed at approximately 1:30 PM today to allow water into the diversion ditch to supply adequate flow of 0.25 mgd for Kuleana use. We plan to measure the flow in the diversion ditch as soon as the flow meter that Wailuku Water Company ordered arrives and is properly calibrated and report the results to Commission staff. The estimated flow in the diversion ditch was approximately 0.40 to 0.50 mgd while the flow in the stream below of the diversion was estimated at 0.10 to 0.20 mgd. Water was leaking through the bottom of the sluice gate via a hole in the concrete floor. Plans are being made to repair this hole. I will keep you informed of our plans.



LAURA H. THIELEN

WILLIAM D. BALFOUR, JR. SUMNER ERDMAN NEAL S. FUJIWARA CHIYOME L. FUKINO, M.D. DONNA FAY K. KIYOSAKI, P.E. LAWRENCE H. MIIKE, M.D., J.D.

LENORE N. OHYE

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT P.O. BOX 621 HONOLULU, HAWAII 96809

October 26, 2010

Mr. Avery Chumbley Wailuku Water Company P.O. Box 2790 Wailuku, Hawaii 96893

Dear Mr. Chumbley:

The purpose of this letter is to follow-up on actions taken by Wailuku Water Company (WWC) as part of the implementation of the Commission on Water Resource Management's (Commission) Decision and Order (D&O) in the Iao Ground Water Management Area High-Level Source Water-Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihee River, Waiehu, Iao, & Waikapu Streams Contested Case Hearing (CCH-MA06-01).

The Commission staff would like to request updates on the following items per the Commission's D&O:

- 1. Per discussions in the field, WWC was considering options to address leakage from areas within your system including, but not limited to, the North Waiehu Ditch and various reservoirs. This will assist us in preparing a timetable for addressing the approximately 12.48 mgd in preventable system losses.
- 2. Per discussions with the U.S. Geological Survey (USGS) and the Commission, the installation of stream gages for certain streams was being considered. This will help to address the installation and maintenance of stream gages immediately below the main diversions identified in the IIFS.
- 3. Per observations and discussions in the field, WWC was planning to construct low-flow bypass structures across the diversions in each stream. This will help to address the construction of bypasses of diversions that currently disrupt stream flows.
- 4. Report on the progress of and impediments to implementing the amended interim instream flow standards (IIFS) and their impacts on instream values and offstream uses.

For Item 4 above, staff is seeking specific clarification on the impediments faced in implementing the IIFS for North Waiehu Stream and Waihee River. Please provide comments on the configuration of the diversion structures in relation to the streams and ditches, the use of sluice gates for bypassing water, and the measurement sites identified by the USGS and Commission staff in monitoring IIFS.

Your response to the items outlined above, by Friday, November 5, 2010, would be greatly appreciated. Should you have any questions, please contact Dean Uyeno of the Stream Protection and Management Branch at 587-0249, or via email at dean.d.uyeno@hawaii.gov. On behalf of the Commission, I would like to thank you in advance for your cooperation in this matter.

Sincerely,

Lum h. Cha

LENORE N. OHYE Acting Deputy Director



LAURA H. THIELEN

WILLIAM D. BALFOUR, JR. SUMNER ERDMAN NEAL S. FUJIWARA CHIYOME L. FUKINO, M.D. DONNA FAY K. KIYOSAKI, P.E. LAWRENCE H. MIIKE, M.D., J.D.

LENORE N. OHYE

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT P.O. BOX 621 HONOLULU, HAWAII 96809

October 26, 2010

Mr. Garret Hew Hawaiian Commercial & Sugar Company P.O. Box 266 Puunene, Hawaii 96784

Dear Mr. Hew:

The purpose of this letter is to follow-up on actions taken by Hawaiian Commercial & Sugar Company (HC&S) as part of the implementation of the Commission on Water Resource Management's (Commission) Decision and Order (D&O) in the Iao Ground Water Management Area High-Level Source Water-Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihee River, Waiehu, Iao, & Waikapu Streams Contested Case Hearing (CCH-MA06-01).

The Commission staff would like to request updates on the following items per the Commission's D&O:

- 1. Per an August 4, 2010 meeting, HC&S was assessing options to address leakage from HC&S's unlined Waiale Reservoir. This will assist us in preparing a timetable for addressing the approximately 12.48 mgd in preventable system losses.
- 2. Per discussions with the U.S. Geological Survey (USGS) and the Commission, the installation of stream gages for certain streams was being considered. This will help to address the installation and maintenance of stream gages immediately below the main diversions identified in the IIFS.
- 3. Construction of bypasses of diversions that currently disrupt stream flows.
- 4. Report on the progress of and impediments to implementing the amended interim instream flow standards (IIFS) and their impacts on instream values and offstream uses.

For Item 4 above, staff is seeking specific clarification on the impediments faced in implementing the IIFS for South Waiehu Stream and Waihee River. Please provide comments on the configuration of the diversion structures in relation to the streams and ditches, the use of sluice gates for bypassing water, and the measurement sites identified by the USGS and Commission staff in monitoring IIFS.

Your response to the items outlined above, by Friday, November 5, 2010, would be greatly appreciated. Should you have any questions, please contact Dean Uyeno of the Stream Protection and Management Branch at 587-0249, or via email at dean.d.uyeno@hawaii.gov. On behalf of the Commission, I would like to thank you in advance for your cooperation in this matter.

Sincerely,

Um h. Olyes

LENORE N. OHYE Acting Deputy Director



November 5, 2010

State of Hawaii Department of Land & Natural Resources Commission on Water Resource Management c/o Lenore N. Ohye, Acting Deputy Director P.O. Box 621 Honolulu, Hawaii 96809

RE:

Letter dated October 22, 2010; Lenore N. Ohye to Avery B.Chumbley, Wailuku Water Company (WWC) Requesting Updates on Certain Items Per Commission on Water Resource Management, Decision and Order

Dear Mg. Ohye: Profe

This is in response to your letter dated October 22, 2010, as referenced above. We have attempted to categorize and address the issues you have presented to us, as provided below.

Options to Address Leakage From Areas Within the WWC System. Because Wailuku Water Company has implemented the amended instream flow standards such that 11.60 mgd no longer flows through its conveyance system, there is a consequential reduction in the losses from its system. There is now a sustained flow of 10 million gallons per day into the Waihee Stream and 1.6 million gallons a day flow into the North Waiehu Stream, a total of 11.60 million gallons a day that does not move through the conveyance system.

The seepage loss within the system has been calculated at 7.34% of the flow, as was acknowledged in the Commission's Decision and Order. Applying the 7.34% to the total instream flow of 11.60 mgd results in a mitigation of .85 mgd. The Findings of Fact and Conclusions of Law suggests that Wailuku reduce its system losses to 2 million gallons a day from a total of 4.06 mgd attributed to Wailuku (p. 169). The Decision and Order found that combined system losses were 12.48 mgd between Wailuku and HC&S. (p. 187). Consequently Wailuku's objective is to reduce system losses by an additional 3.21 million gallons a day (4.06 - .85). Wailuku has applied for a water use permit for system losses. The permit application is for 3.174 mgd.

Wailuku is considering addressing the loss reduction target by abandoning certain reservoirs. This would reduce the losses by .86 million gallons a day (See Exhibit "A" attached

Commission on Water Resource Management c/o Lenore N. Ohye, Acting Deputy Director November 5, 2010 Page 2

in PDF file). Wailuku is also considering abandoning the North Waiehu Ditch System. If this system is abandoned, the mitigation would result in approximately .04 million gallons a day. The third component to be addressed is system efficiency, infrastructure improvements and repairs. Currently there are certain areas where it is contemplated that the ditch system could be improved and the loss through the seepage in the system would be reduced. The reductions through a lower volume of water flowing through its conveyance system, infrastructure improvements and repairs and possible abandonment of some reservoirs would result in lowering system losses by approximately 1.75 million gallons per day.¹ We have been studying system losses by observing flows, where we might be able to observe and measure the losses, reservoir seepage and the loss of water through damaged surfaces. We wish to meet with you and your staff to discuss our objectives and strategies.

Installation of Stream Gauges. Stream gauges are contemplated for an area below the diversions on the Waihee and North Waiehu Streams. USGS has installed a stream staff gauge below the diversion at the Waihee Stream and is in the process of calibrating the same. (See Exhibit "B" pictures in a Word file). USGS has identified 3 additional locations for stream gauges, all of which are on private property not owned by Wailuku. Wailuku has been cooperating with USGS with regard to the access and implementation on Wailuku's property.

Construction of Low-Flow By Pass Structures Across the Diversions on Each Stream. Wailuku has constructed a low-flow by pass structure on the Waikapu Stream. (See Exhibit "C" pictures attached in a Word file). The by pass device is under review by the Water Commission and if approved, the same device will be implemented in the Iao System and two locations in the Waihee System, as well as the Waikapu System. The by pass provides for a continuous flow into the stream at low flows. The North Waiehu diversion is a rock dam system and this type of bypass alteration cannot be utilized there. Currently a continuous flow exists in the North Waiehu Stream.

Report on Progress and Impediments to Implementing the Amended Instream Flow Standards and the Impact of the Instream Values and Off Stream Uses. Wailuku has provided weekly reports on the Waihee Stream. The North Waiehu Stream IIFS was declared to be compliant by the staff on August 9, 2010. The current setting of gates has resulted in 10.47

4.06 mgd losses <.85> stream restoration <.86> reservoirs <<u><.04> North Waiehu</u> 2.21 mgd

1



Commission on Water Resource Management c/o Lenore N. Ohye, Acting Deputy Director November 5, 2010 Page 3

million gallons a day flow into the Waihee Stream which appears to be a sustaining flow, as well as 1.6 million gallons a day into the North Waiehu Stream. Wailuku continues to refine the settings to provide for a consistent and measured compliance with the instream standards. The compilation of the reports is shown on Exhibit "D" attached as a PDF file.

Impediments. There does not appear to be any serious impediments in implementing the amended interim instream flow standards. At this point it is unclear what impacts the same has made upon the instream values, but it is clear there has been impacts on off stream uses. Reports have been given to the Commission with regard to the self help measures taken by off stream users and the vandalism to Wailuku's systems.

<u>Configuration of Diversion Structures of Relation to the Streams and Ditches</u>. See Exhibit "E" which shows the sluice gate setting alterations designed and constructed by Wailuku at the Waihee and Spreckles Ditch with the setting at various bolts. Wailuku believes that the diversion structure, the use of the sluice gates, the low flow by-pass structure (H beam) are well suited to achieve the objectives of the amended instream flow standards. The measurement sites are a "work in progress" and as developed we will continue to monitor and report on the same. Each of these seem to be working adequately.

If any of the above needs elaboration or clarification, please don't hesitate to contact me. We look forward to meeting with you to discuss each of these issues.

Avery B. Chumbley Wailuku Water Company

Cc. Clayton Suzuki, WWC Paul R. Mancini, Esq


11/05/2010 Wailuku Water Company

		Reservoirs	
Proposed Re	servoir Elimin	ation:	
Reservoir:	Capacity:	Area:	Loss
	(MG)	Acres	2.5"/day
6	7.0	5.7	386,945
8	0.3	0.3	20,366
13	0.4	0.3	20,366
14	4.0	0.5	33,943
27	0.8	0.4	27,154
29	8.0	3.7	251,175
37	5.5	1.3	88,251
MTP	0.5	0.5	33,943
Total: Total MGD	26.5	12.7	862,140 0.86



Wailuku Water Company

Waihee Stream Gauging

By USGS



Wailuku Water Company

Waihee Ditch Intake on Waikapu Stream

H beam over grated intake to allow recruitment of stream life past the stream diversion



"Avery B. Chumbley" <abc@aloha.net> 08/24/2010 03:14 PM

To <Lenore.N.Ohye@hawaii.gov>, <Dean.D.Uyeno@hawaii.gov> cc "Paul Mancini" <PRM@mmkaw.com>, "Garret Hew" <ghew@hcsugar.com> bcc

Subject FW: South Waihee Kuleana

Aloha Lenore.... As we had discussed WWC is keeping a log of complaints and calls about water shortages that may have been the result of the stream IIFS being implemented.

As noted below it appears that Traditional users in the Waihee region have undertaken some self help actions in order to get higher volumes of water into the Kuleana ditches. As outlined by Clayton this could cause significant damages to our system and does result in down system users being shorted of water.

Mahalo.... Avery! Avery B. Chumbley Wailuku Water Company LLC P.O. Box 2790 Wailuku, Maui, Hawaii 96793-9355 Phone: 808.244.7079 cell: 276.3595 Fax: 808.242.7068 email: <u>abc@aloha.net</u> CONFIDENTIALITY NOTICE: THIS EMAIL AND ANY ATTACHMENT THERETO CONTAIN CONFIDENTIAL INFORMATION INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY. THIS TRANSMITTED INFORMATION IS PRIVATE AND PROTECTED BY LAW. IF YOU ARE NOT THE INTENDED RECIPIENT, YOU ARE HEREBY NOTIFIED THAT ANY DISCLOSURE, COPYING OR DISTRIBUTION, OR THE TAKING OF ANY ACTION BASED ON THE CONTENTS OF THIS INFORMATION IS STRICTLY PROHIBITED.

From: Clayton Suzuki [mailto:csuzuki@wailukuwater.com] Sent: Tuesday, Jayusu 24, 2010 3:07 PM To: SENATOR AVERY B. CHUMBLEY (Ret.) (abc@aloha.net) Subject: South Wailvee Kuleana

August 24, 2010

To: Avery Chumbley From: Clayton Suzuki Subject: South Waihee Kuleana out take pipe

On Monday August 23, 2010 at 9: 45 AM, Wailuku Water Company (WWC) Ditch person Rene Chavez

discovered a sand bag dam fronting the South Waihee kuleana out take pipe on Spreckles Ditch. There were two rows of sand bags across the ditch. This caused the Spreckles Ditch to pond behind the sand bags. This could be a problem when the stream flow increases and the Spreckles Ditch flow increases, the water could breach the ditch banks causing a failure to the ditch bank. WWC workers removed the sand bag on August 24, 2010.

This also happened during the week of August 3, 2010, the sand bag dam was discovered on August 4, Wednesday and removed by WWC workers on August 5, 2010.

*

"Avery B. Chumbley" <abc@aloha.net> 08/26/2010 10:40 AM

To <Lenore.N.Ohye@hawaii.gov>, <Dean.D.Uyeno@hawaii.gov> cc "Paul Mancini" <PRM@mmkaw.com>, "Garret Hew" <ghew@hcsugar.com> bcc

Subject Waihee Sluice Gate

Aloha Lenore,

I wanted to provide you a copy of the attached below email, the bottom line results of the explanation contained therein is that we feel there is more water being returned to Waihee Stream now that the gravel trap has been flushed out than on August 9th when we set the control gate release at the two notches for the initial release under the D&O.

I have ordered a stream flow measuring device which we should have soon, once we have the shims installed and flows adjusted will you be sending the staff over to confirm and verify the flows?

Mahalo.... Avery! Avery B. Chumbley Wailuku Water Company LLC P.O. Box 2790 Wailuku, Maui, Hawaii 96793-9355 phone: 808.244.7079 cell: 276.3595 fax: 808.242.7068 email: <u>abc@aloha.net</u> CONFIDENTIALITY NOTICE: THIS EMAIL AND ANY ATTACHMENT THERETO CONTAIN CONFIDENTIAL INFORMATION INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY. THIS TRANSMITTED INFORMATION IS PRIVATE AND PROTECTED BY LAW. IF YOU ARE NOT THE INTENDED RECIPIENT, YOU ARE HEREBY NOTIFIED THAT ANY DISCLOSURE, COPYING OR DISFIRIBUTION, OR THE TAKING OF ANY ACTION BASED ON THE CONTENTS OF THIS INFORMATION IS STRUCTLY PROHIBITED.

From: Clayton Suzuki [mailto:csuzuki@wailukuwater.com] Senti: Thursday, August 26, 2010 6:49 AM To: SENATOR AVERY B. CHUMBLEY (Ret.) (abc@aloha.net) Subject: Waihee Sluice Gate

August 26, 2010

Avery,

On Tuesday August 24, the Wailuku Water crew along with the HC&S crew went up to Waihee Valley to test the shims for the control gate on Spreckles and Waihee Ditch sluice gate. The test went well and the

shims did the job of controlling the incremental lifting of the sluice gate by ¼ inch at a time. When testing the shims on both gates we opened the control gates to flush the gravel trap. After all the testing was done on both Spreckles and Waihee Ditches we reset the gates at two notches at both gates which was established by the CWRM staff. On Wednesday morning HC&S called me that the reading on Wilf D after August 9 when we sent the Application was reading an Waihee Ditch at the Hopoi Chute gauging station was reading 3.5 MGD where it normally read 10 to 11 MGD after August 9 when we sent water back into Waihee Ditch at field 4 gauging station did read about 4 MGD and the Spreckles Ditch gauging station was reading 11 MGD where normally it read 6 to 7 MGD.

The crew checked the Spreckles Ditch sluice gate, closed it completely and opened it two notches, everything look normal. At Waihee Ditch sluice gate they closed the sluice gate and opened it two notches and found that the flow from the sluice gate to Waihee Stream was way above the setting that massured by the CWRM staff. From the Waihee Ditch flow of 4 MGD from the normal 10 to 11 MGD as stimated that the flow into Waihee Stream was between 12 to 14 MGD. I told them for reset the Waihee Ditch sluice gate to one notch. This morning the reading at Hopoi Chute gauging station read 8.8 MGD, still lower than the normal 10 to 11 MGD. What happened is that when we did the IIFS on August 9, the gravel trap had built up with rocks and the flow back into the stream was hampered by the rocks. We did not flush the gravel trap again till August 24 when we tested the shims. With the gravel trap cleaned out the flow into Waihee Stream from the Waihee sluice gate increased.

Clayton Suzuki

To "Chuit. Cheng" <chuit. cheng@hawaii.gov="">, "Clayton Suzuki" <csuzuki@wailukuwater.com>, "Dean.D.Uyeno" <pean.d.uyeno@hawaii.gov>, "Garret Hew "</pean.d.uyeno@hawaii.gov></csuzuki@wailukuwater.com></chuit.>	
bcc Subject Compliance actions report	At the request of avery, this notice alerts you of the status of the shipment listed below. Tracking Detail
	Your package is on time with a scheduled delivery date of 09/01/2010
mentation plan for Waihee we have tested d they annear to function as desired WWC	Tracking Number: <u>1Z8745920270896124</u> True: <u>Doub ore</u>
suring device which according to the UPS	Status: Contrast - On Time
stea to our onnee on weanesaay, upon receipt rest measurements of the stream just below	Scheduted Detivery: 09/01/2010 Shipped To: WAILUKU,HI,US, Shipped/Billed On: 08/30/2010
	Service: 2ND DAY AIR Weight: 6.20 Lbs
stalled in the South Waihee Kuleana ditch at ng a daily readings of the flows in the ditch, I	Package Progress
eadings for your information.	Location Date Local Time Description
r progress, if you have any questions or	WEST SACKAMENTO,08/31/2010 3:48 A.M. DEPARTURE SCAN CA, US
	08/31/2010 12:16 A.M. ARRIVAL SCAN SACRAMENTO, 08/30/2010 11:51 P.M. DEPARTURE SCAN CA 11S
	US 08/30/2010 10:45 P.M. ORIGIN SCAN 08/30/2010 5:55 P.M. BILLING
	INFORMATION RECEIVED
	Tracking results provided by UPS: 08/31/2010 2:51 P.M. ET
.3595 sc@aloha.net	
EMAIL AND ANY ATTACHMENT THERETO CONTAIN ENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY.	Discover more about UPS: Visit www.ups.com Sign Up For Additional E-Mail From UPS Read Compass Online
I IS PRIVATE AND PROTECTED BY LAW. IF YOU Tr, YOU ARE HEREBY NOTIFIED THAT ANY BUTION, OR THE TAKING OF ANY ACTION BASED MATION IS STRICTLY PROHIBITED.	Sign Up for UPS E-mail Register Now →
tify@ups.com]	© 2010 United Parcel Service of America, Inc. UPS, the UPS brandmark, and the color brown are trademarks of United Parcel Service of America. Inc. All in Johrs reserved.
ng Number 128745920270896124	For more information on UPS's privacy practices, refer to the UPS Privacy Policy. Piease do not repty directly to this e-mail. UPS will not receive any repty message. For questions or community wist Contant UPS.

Aloha Lenore,

08/31/2010 09:30 AM "Avery B. Chumbley" <abc@aloha.net>

notification below will be delivered to our office on W Pursuant to our approved implementation plan for W the newly engineered shims and they appear to funct has ordered a Global Flow measuring device which ac the Spreckels ditch sluice gate to establish the currer of the device we will take our first measurements of stream.

have attached the first weeks readings for your infor The Parshall flume has been installed in the South W its head and we have been taking a daily readings of

We will keep you posted on our progress, if you have comments please let me know.

Mahalo.... Avery!

email: abc@aloha.net phone: 808.244.7079 cell: 276.3595 Wailuku Water Company LLC Wailuku, Maui, Hawaii Avery B. Chumbley fax: 808.242.7068 P.O. Box 2790 96793-9355

ARE NOT THE INTENDED RECIPIENT, YOU ARE HEREBY NO DISCLOSURE, COPYING OR DISTRIBUTION, OR THE TAKING THIS TRANSMITTED INFORMATION IS PRIVATE AND PROTE ON THE CONTENTS OF THIS INFORMATION IS STRICTLY PF CONFIDENTIALITY NOTICE: THIS EMAIL AND ANY ATTACH CONFIDENTIAL INFORMATION INTENDED FOR A SPECIFIC

From: UPS Quantum View [mailto:auto-notify@ups.com] Sent: Tuesday, August 31, 2010 8:52 AM To: abc@aloha.net Subject: UPS Tracking Notification, Tracking Number 128745920270896

This communication contains proprietary information and may be confidential. If you are not the intended recipient, the reading,

copying, disclosure or other use of the contents of this e-mail is strictly prohibited and you are instructed to please delete this e-mail mendancy. Privacy Policy Commet UPS Commet UPS ScandO1, pdf

Flow Flow Stread Ken: Stread Ken: Stread S A M S 5 A M S 7 A M	Flow MG: Time Flow Flow Kuleana Taken: Streat Kuleana 9.45 AM Priort 1.7 9.45 AM 1.7 1.7 9.00 AM 1.7 1.7 9:00 AM 1.8 1.7 9:00 AM 1.8 1.8 9:00 AM 1.8
Ta 1000000	Flow MG: South Waihee MGD MGD M1.7 1.7 1.7 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8

	•	-	
1		-	
1	T.	11	Ì

09/07/2010 10:58 AM "Avery B. Chumbley" <abc@aloha.net>

To "Chui.L.Cheng" <Chui.L.Cheng@hawaii.gov>, "Clayton Suzuki" <csuzuki@wailukuwater.com>, "Dean.D.Uyeno" <Dean.D.Uyeno@hawaii.gov>, "Garret Hew "

Subject FW: Waihee Stream

ខ

pc

Aloha All,

Here is a update on the WWC compliance activity.

Mahalo....

Avery!

email: abc@aloha.net phone: 808.244.7079 cell: 276.3595 Wailuku Water Company LLC P.O. Box 2790 Wailuku, Maui, Hawaii Avery B. Chumbley fax: 808.242.7068 96793-9355

CONFIDENTIALITY NOTICE: THIS EMAIL AND ANY ATTACHMENT THERETO CONTAIN CONFIDENTIAL INFORMATION INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY. DISCLOSURE, COPYING OR DISTRIBUTION, OR THE TAKING OF ANY ACTION BASED THIS TRANSMITTED INFORMATION IS PRIVATE AND PROTECTED BY LAW. IF YOU ARE NOT THE INTENDED RECIPIENT, YOU ARE HEREBY NOTIFIED THAT ANY ON THE CONTENTS OF THIS INFORMATION IS STRICTLY PROHIBITED.

From: Clayton Suzuki [mailto:csuzuki@wailukuwater.com] Sent: Tuesday, September 07, 2010 10:18 AM To: SENATOR AVERY B. CHUMBLEY (Ret.) (abc@aloha.net) Subject: Waihee Stream

September 7, 2010

Avery,

Waihee Stream flow measurements were done on September 3, 5 and 7 with the following readings. The Waihee Stream gauge is approximately 320 feet downstream of where the Spreckles Ditch water returns to Waihee Stream. The Waihee Ditch sluice gate is set a one notch and the Spreckles Ditch sluice gate at Wailuku Water Company (WWC) received the Global Water flow probe on Wednesday September 1. two notches.

Date:	Time:	Waihee Stream Flow (MGD)	Waihee Stream Flow
(MGD)			
		Above Waihee Ditch intake	Below Spreckles Ditch
return water			
September 3,	10:30 AM	27.8	4.73
September 5,	8:10 AM	20.7	4.72

After making a stream reading on September 7, 2010, WWC flushed Waihee and Spreckels gravel traps 4.87 and installed the % inch shim on the Waihee Ditch sluice gate. 38.1 September 7, 8:20 AM

On September 8, 2010 the CWRM staff and USGS will be on Maui to find a suitable gauging station location for Waihee Stream below Spreckles Ditch intake. WWC plans to do stream flow measurements on Wednesday, Thursday and Friday and install the $\ensuremath{\mathcal{X}}$ inch shim on Friday if needed.

Attached is the South Waihee kuleana ditch reading up till September 7, 2010.

Clayton Suzuki

South Waihee Kuleana Use.pdf Por

To "Avery B. Chumbley" <abc@aloha.net>, "Chui.L.Cheng" <chui.l.cheng@nawaii.gov>, "Clayton Stuck?" <csuzuki@wailukuwater.com>, "Dean.D.Uyeno" cc</csuzuki@wailukuwater.com></chui.l.cheng@nawaii.gov></abc@aloha.net>	bcc	Subject FW: Waihee Stream IIFS			our compliance summary for the past week.	an aloco lot mo bacur	ins prease let me know.												276 R505	 : <u>abc@aloha.net</u>		IS EMAIL AND ANY ATTACHMENT THERETO CONTAIN	INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY.	ION IS PRIVATE AND PROTECTED BY LAW. IF YOU	TENT, YOU ARE HEREBY NOTIFIED THAT ANY	TRIBUTION. OR THE TAKING OF ANY ACTION BASED	FORMATION IS STRICTLY PROHIBITED	invalutionater com]	244 AM	ket.) (abc@aloha.net)) WWC measured stream flows on Waihee Stream on Sentember	by whether the stream nows on wantee stream on september law staff from USGs and the CMRM were on Mani to establish sites	idy stall 110111 0000 and the cynning were on maau to communication situation. Chromese The HCGS found a site annitoximately 1200 to 1500	e stream from the spreckles Ditch sluice gate ditch. A report on	nt last week.	I flow WWC rebuilt the its site moving the site upstream four feet	and low flow sites by building a rock dam to channel the water.	e building the rook dant and alter and round the unretence at 0.10 8 MGD and after at 5.16 MGD.	
"Avery B. Chumbley" ebc@eloha.net> 09/13/2010 08:40 AM					Aloha Lenore Attached is	chould you have any autochic	silould you liave any questic			Mahalo		AVERY:		Avery B. Chumbley	Wailuku Water Company LL	P.O. Box 2790	iieweH ineM nahilieW	96793-9355	nhone: 808 244 7079 cell:	fax: 808.242.7068 email			CONFIDEN LAL INFORMALION	THIS TRANSMITTED INFORMAT	ARE NOT THE INTENDED RECIF	DISCLOSURE. COPYING OR DIS	ON THE CONTENTS OF THIS IN	Erom. Clayton Suzuki [mailto:ceuzuki	Sent: Monday, September 13, 2010 6	To: SENATOR AVERY B. CHUMBLEY (I	Subject: Waihee Stream IIFS	September 13, 2010	Arrest	Avery,	During the week of Sentember 7 2010	7 8 and 10 On Sentember 8 Wedness	for stream galiging on Waihed and W	reet below where water enters walne	the stream flow measurement was se	At the WWC site for measuring stream	and built a weir to eliminate the zero	WWC Infeasured the stream now bero MGD, the flow measured before at 4.	
e Flow: Waihee ou&tream: 1.5 Hour ngPrior to Reading	MGD	21.3 18.1	20.7	24.5	22.0	73.0	21.3	22.0	20.7	20.0	22.0	22.0	20.7	22.6	44.0																												
ading: Flow: Waihee Jr Stream: 1.5 Ho	CFS	33 28	32	38	34	113	33	34	32	31	34	34	32	35 Sr	00																												
e Kuleana Re Flow: Waihee r Stream: 1 Hou gPrior to Readir	MGD	18.1	20.7	24.5	21.3	69.8	21.3	22.6	20.7	20.7	22.0	22.0	21.3	22.6	1.00																												
South Waihe Flow: Waihee Stream: 1 Hou Prior to Readin	CFS	34 28	32	38	33	108	33	35	32	32	34	34	33	35	80																												
Flow: Spreckles Ditch (MGD)		5.9 10.8	7.0	7.3	7.0	12.0	7.0	7.0	7.0	6.9	9.5	8.2	8.0	8.9	0.01																												
Time Flow Taken:	140 L 14.04	9:00 AM	9:00 AM	9:00 AM	9:00 AM	9:00 AM	9:30 AM	9:30 AM	8:30 AM	8:45 AM	9:00 AM	9:15 AM	9:25 AM	9:00 AM	AIN AIN																												
Flow MG: South Waihee Kuleana	MGD	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.8	8. 1	0.1																												
Date:	01 10	25-Aug-10	26-Aug-10	27-Aug-10	28-Aug-10	29-Aug-10	30-Aug-10	31-Aug-10	01-Sep-10	02-Sep-10	03-Sep-10	04-Sep-10	05-Sep-10	06-Sep-10	ni-dac-in																												

On September 10 after doing a stream flow measurement WWC installed a ${\it H}$ " shim on the Waihee

Ditch sluice gate and a % " shim on the Spreckles Ditch sluice gate. Flow measurements will be done on the week of September 13.

Waihee South kuleana ditch flow readings are attached, also attached is a chart summary showing Waihee Steam flow measurements and gate settings on Waihee and Spreckles Ditch sluice gates.

The following flows were measured during the week of September 7.

Waihee Stream flow at WWC site	4.87	5.52	5.16
Waihee Stream flow Above Waihee Ditch Intake (MGD)	38.1	34.2	42.6
Time:	8:20 AM	12 Noon	10:25 AM ana Use. pdf Wail
Date:	September 7	September 8	September 10 2011 Waihee Kule

Wailuku Water Company Waihee Stream IIFS

Stream	Flow (MGD)	4.78	4.73	4.72	4.87	5.52	5.16
Spreckles Ditch	Setting:	second bolt	second bolt	second bolt	second bolt	bolt 2	bolt 2
Waihee Ditch	Setting:	second bolt	second bolt	second bolt	second bolt	bolt 2 + 1/4 "	bolt 2 + 1/4 "
Date:		8-9-10	9-3-10	9-5-10	9-7-10	9-8-10	9-10-10

Exhibit D

To "Avery B. Chumbley" «abc@aloha net>, "Chui L.Cheng" <chui cheng@hawaii="" gov="" l.="">, "Clayton Suzuk" <csuzuki@wailukuwater.com>, "Dean.D.Uyeno"</csuzuki@wailukuwater.com></chui>	bcc	Subject FW: Waihee Stream IIFS					npliance activity report for the week of September	iustments are working and the flows are nearing									C.				776 JEDE	270:3333 I: abc@aloha.net		HIS EMAIL AND ANY ATTACHMENT THERETO CONTAIN	INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY.	TION IS PRIVATE AND PROTECTED BY LAW. IF YOU	PIENT, YOU ARE HEREBY NOTIFIED THAT ANY	STRIBUTION, OR THE TAKING OF ANY ACTION BASED	NFORMATION IS STRICTLY PROHIBITED.	i@wailukuwatar.com]	6:50 AM	(Ret.) (abc@aloha.net)				010 WWC measured flows in Waihee Stream on September 13, 15 & ment on September 15, 2010. WWC adjusted the Spreckles Ditch	ts, no adjustment was done on Waihee Ditch sluice gate. On	the stream flow at both weirs were by passing the weir, work to	done but some water flows were by passing the weirs at both	
"Avery B. Chumbley" eaccealona.net> 09/20/2010 09:13 AM					Aloha Lenore,		Attached is our Waihee com	$13^{ m th}$ as vou will see the adi	the D&O of 10 MGD.			Mahalo	Avervl		Arrow B Chumbler	Avery b. Cnumpley	Wailuku Water Company LL	P.O. Box 2790	Wailuku, Maui, Hawaii	96793-9355	100 0LUL 100 000 1000	fax: 808.242.7068 email		CONFIDENTIALITY NOTICE: TH	CONFIDENTIAL INFORMATION	THIS TRANSMITTED INFORMAT	ARE NOT THE INTENDED RECI	DISCLOSURE, COPYING OR DIS	ON THE CONTENTS OF THIS IN	Erom. Clavton Suruki [mailtorceuruki	Sent: Monday, September 20, 2010 6	To: SENATOR AVERY B. CHUMBLEY (Subject: Waihee Stream IIFS	September 20, 2010	Avery,	During the week of September 13, 20 17. After doing stream flow measurer	sluice gate from 2 bolts + $\frac{3}{2}$ " to 4 bolt	September 17, 2010 we noticed that	correct the flow within the weirs was	locations.
Flow: Waihee Etream: 1.5 Hour	Prior to Reading MGD	20.7	21.3 18.1	20.7	24.5	73.0	21.3	22.0	20.7	20.0	22.0	20.7	22.6	4Z.U 23.3	22.6	23.9	22.0	20.7																						
ing: ⁻ low: Waihee ream: 1.5 Hout	rior to Reading CFS	32	33 28	32	38	54 113	33	34	32	34	8	32	35 Gr	65 36	35	37	8	32																						
Kuleana Read Flow: Waihee F ttream: 1 Hour Sti	rior to ReadingPr MGD	20.7	22.0 18.1	20.7	24.5	21.3 69.8	21.3	22.6	20.7	20.7	22.0	21.3	22.6	38.1 22.6	22.6	24.5	21.3	20.7																						
South Waihee Flow: Waihee Stream: 1 Hour	Prior to ReadingP CFS	32	34 28	32	38	33 108	33	35	32	32	34	33	35	59 25	35	8000	33	32																						
low: Spreckles Ditch	(MGD)	6.0	9.c 10.8	7.0	7.3	0.7	7.0	7.0	7.0	0.9 0.5	8.2	8.8	8.9	10.3 8.8	8.5	0.00	6.8	8.7																						
Time Flow F Taken:		9.45 AM	9:00 AM	9:00 AM	9:00 AM	9-00 AM	9:30 AM	9:30 AM	8:30 AM	8:45 AM	9:15 AM	9:25 AM	9:00 AM	9:15 AM	8:45 AM	8:50 AM	8:50 AM	8:45 AM																						
Flow MG: South Waihee	Kuleana MGD	1.7	1.7	1.7	1.7	0.4	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8 8 1	0; 0	9 8 1 8	1.8	1.8																						
Date:		23-Aug-10	25-Aug-10 25-Aug-10	26-Aug-10	27-Aug-10	29-Aug-10 29-Aug-10	30-Aug-10	31-Aug-10	01-Sep-10	02-Sep-10 03-Sep-10	04-Sep-10	05-Sep-10	06-Sep-10	01-Sep-10 08-Sep-10	09-Sep-10	10-Sep-10	11-Sep-10	12-Sep-10																						

At the Spreckles Ditch gravel trap, WWC plugged 3 of the 19 pipes that transfer water from the gravel

trap into Spreckles Ditch.

Attached are charts showing Waihee Stream flow measurements and South Waihee kuleana flow measurements.

r 13, 2010.	flow Waihee Stream	itch flow at WWC site	(MGD)		6.20		5.95		8.66	
week of Septembe	Waihee Stream 1	Above Waihee D	Intake (MGD)		21.3	20.7	27.1	27.1	20.0	20.7
asured during the	Time:				9:20 AM	10:10 AM	7:50 AM	7:10 AM	9:30 AM	7:55 AM
lowing flows were mea	Date: Stream flow	4	o site		September 13,	September 13,	September 15,	September 15,	September 17,	September 17, 2010
The foll	Waihee		at USG	(MGD)		6.87		7.08		9.66

South Waihee Kuleana Use.pdf Waihee Stream IIFS flow chart.pdf

10E

POF

Stream Flow USGS site (MGD) 5.96 6.00 9.66 Stream Flow (MGD) 4.78 4.77 4.87 5.52 5.52 5.16 6.5.16 6.5.16 6.5.20 6.5.20 8.66 Spreckles Ditch Setting: second bolt second bolt second bolt bolt 2 + 3/4 " bolt 2 + 3/4 " fourth bolt Waihee Stream IIFS Waihee Ditch Setting: Second bolt second bolt second bolt second bolt 2 + 1/4 " bolt 2 + 1/2 " bolt 2 + 1/2 " 8-9-10 9-5-10 9-5-10 9-7-10 9-8-10 9-13-10 9-15-10 9-15-10

Date:

Wailuku Water Company

To ""Avery B. Chumblev" <abc@aloha.net>.""ChuiL Chend"</abc@aloha.net>	 <chuid. "clayton="" cheng@hawaii="" govo,="" li="" suzuki"<=""> <csuzuki@waliukuwater.com>, "Dean.D.Uyeno"</csuzuki@waliukuwater.com> cc </chuid.>	bcc	Subject FW: Waihee Stream IIFS						and schedules of our compliance efforts for the week	ndicated below our flow meter was returned to the	a countril it is whittened back to us will not be able	s so unui il is relurned dack lo us we will not de adie	easurements. This down time will give us a good	nturation of the stream takes place from the last flow	we can do the next measurement.			ons please let me know.								IN LLC					cell: 276.3595	email: <u>abc@aloha.net</u>		CE: THIS EMAIL AND ANY ATTACHMENT THERETO CONTAIN	TION INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY.	DRMATION IS PRIVATE AND PROTECTED BY LAW. IF YOU	RECIPIENT, YOU ARE HEREBY NOTIFIED THAT ANY	OR DISTRIBUTION, OR THE TAKING OF ANY ACTION BASED	HIS INFORMATION IS STRICTLY PROHIBITED.	csuzuki@wailukuwater.com]	22, 2010 1:30 PM	BLEY (Ret.) (abc@aloha.net)				
"Avery B. Chumblev"	eabc@aloha.net> 09/23/2010 12:24 PM)				Aloha Lenore.			Attached is a narrative	of Sentember 20 th . As i			to do any additional me	opportunity to see if sa	measurement to when			IT you nave any question			oledem		Avery:		Avery B. Chumbley	Wailuku Water Compar	D 0 Box 7700		Wailuku, Maui, Hawaii	96793-9355	phone: 808.244.7079	fax: 808.242.7068		CONFIDENTIALITY NOTIC	CONFIDENTIAL INFORMA	THIS TRANSMITTED INFO	ARE NOT THE INTENDED	DISCLOSURE, COPYING C	ON THE CONTENTS OF TH	From: Clayton Suzuki [mailto:o	Sent: Wednesday, September	To: SENATOR AVERY B. CHUM	subject: Wainee Stream ILFS	September 22, 2010	-	Avery,
	ee Flow: Waihee lou&tream: 1.5 Hour ingPrior to Reading	MGD 20.7	21.3	18.1	20.7	24.5	22.0	73.0	21.3	22.0	20.7	20.0	22.0	22.0	20.7	22.6	42.0	23.3	0.22	20.0 20.0	22.0	20.7	20.7	2.02	21.1	20.0	20.0	20.2	20.7																	
ading:	Flow: Waihe Ir Stream: 1.5 H IgPrior to Read	CFS 32	33	28	32	38	34	113	33	34	32	31	8	34	32	35	65	30	0.0	31	\$ 8	25 27	2 6	20	45	3.0	3.0	. 6	70																	
e Kuleana Re	Flow: Waihee Stream: 1 Hou Prior to Readin	MGD 20.7	22.0	18.1	20.7	24.5	21.3	69.8	21.3	22.6	20.7	20.7	22.0	22.0	21.3	22.6	38.1	9.77	2.22	C:47	5.12	7.02	21.02	6.12 1 7 C	22.0	20.02	19.4	20.7	7.07																	
South Waihe	Flow: Waihee Stream: 1 Hour Prior to Reading	CFS 32	34	28	32	38	33	108	33	35	32	32	34	34	33	35	59	35	0.00	200	33	32	20	00	4 6	t .	30	30	40																	
	⁻ low: Spreckles Ditch (MGD)	6.0	5.9	10.8	7.0	7.3	7.0	12.0	7.0	7.0	7.0	6.9	9.5	8.2	8.0	8.9	10.3	х, х и	0.0	0.0	0.0 1.0	0.0	0.0	0 a	0.0	6.6	5.9	0.4	0.0																	
	Time Flow F Taken:	9.45 AM	10:15 AM	9:00 AM	9:00 AM	9:00 AM	9:00 AM	9:00 AM	9:30 AM	9:30 AM	8:30 AM	8:45 AM	9:00 AM	9:15 AM	9:25 AM	9:00 AM	9:15 AM	8:40 AM	MIN CHO		MP NG:8	8:45 AM	9:40 AM	0.40 AM	0.40 AM	8:40 AM	8:40 AM	8-40 AM																		
	Flow MG: south Waihee Kuleana	MGD	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	0. 0	0.L	8.1	8.L	0.0	0 q	o. 1 8 1	0; 6	1.7	17																		
	Date:	23-Aud-10	24-Aug-10	25-Aug-10	26-Aug-10	27-Aug-10	28-Aug-10	29-Aug-10	30-Aug-10	31-Aug-10	01-Sep-10	02-Sep-10	03-Sep-10	04-Sep-10	05-Sep-10	06-Sep-10	07-Sep-10	08-Sep-10	01-dec-e0	10-Sep-10	11-Sep-10	12-Sep-10	13-Sep-10	15 Son 10	16-Sen-10	17-Sen-10	18-Sep-10	10-Sen-10	01-00-01																	

During the week of September 20, 2010 WWC measured flows in Waihee Stream on September 21, 2010. The Waihee Stream flow peaked on September 19, 2010 Sunday at 253 MGD. WWC was scheduled to do stream flow measurements on September 20, 2010 but canceled due to high stream

flow. WWC went to measure stream flow on September 21, 2010 with the expectation that the weirs were damaged. On inspecting both weirs they were okay with a some damage, all of the small gravel used to fill the weir rock side walls were gone so that had to be replaced and some of the rock wall for the weir were washed away. The weirs were rebuilt adding sand bags to prevent the small gravel from washing away and flow measurements were taken. On September 22, 2010 WWC assisted HC&S in doing flow measurements in the South Waiehu Ditch, after two measurements the Global flow probe did not work. The instrument was sent back to the manufacturer on September 22, 2010. WWC cannot do any more stream measurements until the probe is returned.

Attached are charts showing the Waihee Stream flow measurements and the South Waihee kuleana flow measurements.

The following flows were measured on September 21, 2010.

Date: Maihae Stream flow	Time:	Waihee Stream flow	Waihee Stream flow
		Above Waihee Ditch	flow at WWC site:
at used the		(MGD)	(MGD)
(MGD) Sentember 21 2010	10·15 AM	0.22	99 X
		2	5
September 21, 2010 10.18	8:15 AM	22.6	



Wailuku Water Company Waihee Stream IIFS

Date:	Waihee Ditch	Spreckles Ditch	Stream	Stream Flow
	Setting:	Setting:	Flow (MGD)	USGS site (MGD)
8-9-10	second bolt	second bolt	4.78	×
9-3-10	second bolt	second bolt	4.73	×
9-5-10	second bolt	second bolt	4.72	×
9-7-10	second bolt	second bolt	4.87	×
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52	5.96
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16	6.00
9-13-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	6.20	6.87
9-15-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	5.95	7.08
9-17-10	bolt 2 + 1/2 "	fourth bolt	8.66	9.66
9-21-10	bolt 2 + 1/2 "	fourth bolt	8.99	10.18
9-23-10	bolt 2 + 1 "	fourth bolt + 1/2"		

Avery B. Chumbley" To "Avery B. Chumbley" "Chuit. Cheng" abc@aloha.net> "Chuit. Cheng@hawaii.gov>, "Clayton Suzuk" abc@aloha.net> <	bcc	Subject FW: Waihee Stream IIFS			odi of noisily he at the new considence address in he deducted and	Ore autacheu is our weekiy compliance report. In audition to the	s which damaged the weirs there was an incident of vandalism	our parshall flume which is used to measure the Kuleana flows in								chumblev	Water Company 11 C			Maui, Hawaii	55	08.244.7079 cell: 276.3595	242.7068 email: abc@aloha.net				TIALITY NOTICE: THIS EMAIL AND ANY ATTACHMENT THERETO CONTAIN	TIAL INFORMATION INTENDED FOR A SPECIFIC INDIVIDUAL OR ENTITY.	SMITTED INFORMATION IS PRIVATE AND PROTECTED BY LAW. IF YOU	HE INTENDED RECIPIENT, YOU ARE HEREBY NOTIFIED THAT ANY	RE, COPYING OR DISTRIBUTION, OR THE TAKING OF ANY ACTION BASED	UNIENIS OF THIS INFORMATION IS STRICTLY PROHIBITED.	vn Suzuki [mailto:csuzuki@wailukuwater.com]	y, October 04, 2010 1:31 PM	A AVEKY B. CHUMBLEY (Кет.) (аbc@alona.net) ihee Stream IIFS	10			Saturday, Waihee Stream peaked at 1260 cfs or 814 mgd, both WWC and the USGS weirs	w measurement were wiped out. WWC personal worked to repair the USGS weir on	onday. The Global stream now prope is due on October 5 and we will do a stream now t on Wednesday (CWRM and USGS will be here on October 13, Wednesday to install staff	t on weatheady. Cwinin and 0000 will be there on October ±0, weathead to instant start e weir and work on weirs on the Waihee Stream mouth and for the Waiehu Stream.	
3							high flow	again on	Waihee.				Mahalo	Avery!		Avery B.			P.O. BUX	Wailuku,	96793-93	phone: 80	fax: 808.				CONFIDEN	CONFIDEN	THIS TRAN	ARE NOT 7	DISCLOSU	ON THE C	From: Clave	Sent: Mond	To: SENATO Subject: W:	October 4, 2	Avera	AVCI Y,	On October	for stream fl	UCTODEL 4, IV MPASILIAMA	gauges on th	D444D4
low: Waihee eam: 1.5 Hour	ior to Reading MGD	20.7	21.3	10.1	24.5	22.0	73.0	21.3	22.0	20.7	20.0	22.0	22.0	20.7	0.27	42.U 22.3	20.0	23.9	22.0	20.7	20.7	20.7	27.1	21.3	20.0	20.0	20.7	40.44 20.6	29.7														
Iding: Flow: Waihee F Stream: 1.5 Hou6tr	Prior to ReadingPr CFS	32	33	50 20	38	34	113	33	34	32	31	34	¥ 8	32	30	00 96	35	37	34	32	32	32	42	33	31	31	32	95 22	46	2													
e Kuleana Rea Flow: Waihee Stream: 1 Hours	JPrior to Reading	20.7	22.0	10.1	24.5	21.3	69.8	21.3	22.6	20.7	20.7	22.0	22.0	21.3	0.77	30.1 22.6	22.6 27.6	24.5	21.3	20.7	20.7	21.3	27.1	22.0	20.02	19.4	20.7	124.U 23.3	32.9	240													
South Waihe s Flow: Waihee Stream: 1 Hour	Prior to Reading CFS	32	34	50 7	38.5	33	108	33	35	32	32	34	34	33	0 0 1	0 9 9	35	38	33	32	32	33	42	34	100	30	32	192 36	51	5													
Flow: Spreckle Ditch	(MGD)	0.0	5.9	0.0	7.3	7.0	12.0	7.0	7.0	7.0	6.9	9.5	8.2	x0 0 x0 0	0.0 0.0	0.0 8 8	0.0 7	0.00	8.9	8.7	8.8	8.8	8.8	6.3	0.0	0.0 0	9.0.4 7 1	1.21	4.9	è.													
Time Flow Taken:		9.45 AM	10:15 AM		9:00 AM	9:00 AM	9:00 AM	9:30 AM	9:30 AM	8:30 AM	8:45 AM	9:00 AM	9:15 AM	9:25 AM	9:00 AM		8-45 AM	8:50 AM	8:50 AM	8:45 AM	9:25 AM	8:40 AM	8:40 AM	8:45 AM	8:40 AM	8:40 AM	8:40 AM		7:30 AM														
Flow MG: South Waihee	Kuleana MGD	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7	7.8 0	0.0	ο. τ	0. L	; e, f	1.8	1.8	1.8	1.8	1.8	1.8	0. L	1.1	/.1	ο. τ α	9.1	2													
Date:		23-Aug-10	24-Aug-10	26-Aug-10	27-Aug-10	28-Aug-10	29-Aug-10	30-Aug-10	31-Aug-10	01-Sep-10	02-Sep-10	03-Sep-10	04-Sep-10	01-Sep-10	01-dec-00	01-Sep-10	00-Sen-10	10-Sep-10	11-Sep-10	12-Sep-10	13-Sep-10	14-Sep-10	15-Sep-10	16-Sep-10	17-Sep-10	18-Sep-10	01-dec-61	21-Sep-10	22-Sep-10	0-400-44													

On October 3 Sunday, someone tossed the parshall flume used to measure the South Waihee kuleana flow. WWVC will not reinstall the flume.

Attached are the Waihee Stream flow chart and the South Waihee kuleana flume readings.

	Stream Flow USGS site (MGD)	×	×	×	×	5.96	6.00	6.87	7.08	9.66	10.18
	Stream Flow (MGD)	4.78	4.73	4.72	4.87	5.52	5.16	6.20	5.95	8.66	8.99
ater Company ream IIFS	Spreckles Ditch Setting:	second bolt	second bolt	second bolt	second bolt	bolt 2	bolt 2	bolt 2 + 3/4 "	bolt 2 + 3/4 "	fourth bolt	fourth bolt
Wailuku Wa Waihee St	Waihee Ditch Setting:	second bolt	second bolt	second bolt	second bolt	bolt 2 + 1/4 "	bolt 2 + 1/4 "	bolt 2 + 1/2 "			
	Date:	8-9-10	9-3-10	9-5-10	9-7-10	9-8-10	9-10-10	9-13-10	9-15-10	9-17-10	9-21-10



				South Waihee	Kuleana Rear	ding.		"Assessed	Chumbleu"	To "Avery B Chumbled	
Date:	Flow MG: South Waihee Kuleana	Time Flow Taken:	Flow: Sprecklet Ditch (MGD)	s Flow: Waihee Stream: 1 Hour ; Prior to ReadingF	Flow: Waihee Stream: 1 HourS Prior to ReadingF	Flow: Waihee Stream: 1.5 Hout Prior to Reading	Flow: Waihee Stream: 1.5 Hour Prior to Reading		aloha.net> 010 02:31 PM	 Chuil. Cheng@hav Chuil. Cheng@hav Csuzuki@wailukuw; 	 aboe and actives, with a sub- valigovs, "Clayton Suzuki" ater.coms, "Dean.D.Uyeno"
	MGD			CFS	MGD	CFS	MGD			bcc	
23-Aug-10	1.7	9.45 AM	6.0	32	20.7	32	20.7			Subject FW: Waihee Stream	IIFS
24-Aug-10	1.7	10:15 AM	5.9	34	22.0	33 33	21.3)
25-Aug-10	1.7	9:00 AM	10.8	28	18.1	28	18.1				
26-Aug-10	/	9:00 AM	0.7	32	20.7	32	20.7				
27-Aug-10	1.7	9:00 AM	7.3	38	24.5	38	24.5	Hi Lenore be	elow is the rea	ding we got on Friday fo	or Waihee Stream.
28-Aug-10	1.8	9:00 AM	7.0	33	21.3	34	22.0				
29-Aug-10	1.8	9:00 AM	12.0	108	69.8	113	73.0				
30-Aug-10	1.8	9:30 AM	7.0	33	21.3	33	21.3				
31-Aug-10	1.8	9:30 AM	7.0	35	22.6	34	22.0	Mahalo			
			c T	00	1	0	1	Averv!			
01-Sep-10	1.8	8:30 AM	0.7 2.0	32	20.7	32	20.7				
02-Sep-10	1.8	8:45 AM	6.9	32	20.7	31	20.0	ā			
03-Sep-10	1.8	9:00 AM	9.5	34	22.0	the second	22.0	Avery b. Cnurr	Diey		
04-Sep-10	1.7	9:15 AM	8.2	34	22.0	34	22.0	Wailuku Wate	r Company LLC	0	
05-Sep-10	1.8	9:25 AM	8.0	33	21.3	32	20.7	P.O. Rox 2790			
06-Sep-10	1.8	9:00 AM	8.9	35	22.6	35	22.6		ii		
07-Sep-10	1.8	9:15 AM	10.3	59	38.1	65	42.0	Walluku, Maul	, nawali		
08-Sep-10	1.8	8:40 AM	8.8	35	22.6	36	23.3	96793-9355			
09-Sep-10	1.8	8:45 AM	8.5	35	22.6	35	22.6	phone: 808.24	14.7079 cell:	276.3595	
10-Sep-10	1.8	8:50 AM	8.0	38	24.5	37	23.9	fax: 808 242 7	7068 email	· ahc@aloha net	
11-Sep-10	1.8	8:50 AM	8.9	33	21.3	34	22.0	144.000.472.0			
12-Sep-10	1.8	8:45 AM	8.7	32	20.7	32	20.7				
13-Sep-10	1.8	9:25 AM	8.8	32	20.7	32	20.7				
14-Sep-10	1.8	8:40 AM	8.8	33	21.3	32	20.7	CONFIDENTIALI	ITY NOTICE: TH	IS FMATI AND ANY ATTAC	HMENT THERETO CONTAIN
15-Sep-10	1.8	8:40 AM	8.8	42	27.1	42	27.1				
16-Sep-10	1.8	8:45 AM	6.3	34	22.0	33	21.3	CONFIDENTAL	INFURIMA I JUN	IN LENDED FOR A SPECIFIC	C INDIVIDUAL UK EN LITY.
17-Sep-10	1.8	8:40 AM	6.6	31	20.0	31	20.0	THIS TRANSMIT	TED INFORMAT	ION IS PRIVATE AND PRO	TECTED BY LAW. IF YOU
18-Sep-10	1.7	8:40 AM	5.9	30	19.4	31	20.0	ARE NOT THE II	NTENDED RECIP	IENT, YOU ARE HEREBY N	JOTIFIED THAT ANY
19-Sep-10	1.7	8:40 AM	5.9	32	20.7	32	20.7	DISCLOSUBE O	OPVING OR DIS	TRIRITTON OR THE TAKI	NG OF ANY ACTION BASED
20-Sep-10	1.8	9:15 AM	12.7	192	124.0	225	145.4				
21-Sep-10	1.8	9:00 AM	6.7	36	23.3	35	22.6			FURMALITON 13 STRICTED	PROMIBILIEU.
22-Sep-10	1.6	7:30 AM	4.9	51	32.9	46	29.7				
23-Sep-10	1.5	10:30 AM	4.3	34	22.0	34	22.0	From: Clayton Suz	uki [mailto:csuzuki@	@wailukuwater.com]	
24-Sep-10	4.1	8:45 AM	6.4 5.	32	20.7	32	20.7	Sent: Monday, Oct	ober 11, 2010 2:15	PM	
25-Sep-10	1.8	9:00 AM	5.4	35	22.6	36	23.3	To: SENATOR AVER	RY B. CHUMBLEY (F	<pre>tet.) (abc@aloha.net)</pre>	
26-Sep-10	1.8	9:00 AM	4.6	32	20.7	32	20.7	Subject: Waihee S	Stream IIFS		
27-Sep-10	1.8	9:45 AM	4.9	32	20.7	32	20.7	•			
28-Sep-10	1./	8:45 AM	0.0 1	31	20.0	31	20.0	October 11 2010			
29-Sep-10	0.1	MA 24:8	0.0	00	4.01	0.1 24	20.0				
	-	Mit of o	-	8	0.0	5	0.0	Avery,			
01-Oct-10	1.7	8:00 AM	6.0	37	23.9	38	24.5				
02-Oct-10	2.0 8	9:00 AM	10.5 1 6	243 34	157.0 22.0	516 34	333.3 22.0	The flow probe was	s received on Octob	oer 5 Tuesday, a stream flow me	sasurement was taken on October
	2		2	5	0	5	0.11	6 Wednesday and (October 8 Friday. Th	ne stream flow measured at the	USGS site were:
								Date.	Time:	Waihee Stream flow	Waihae Stream flow
								Waihee Stream flov			
										Above Waihee Ditch	flow at WWC site:
								at USGS site:			
										(MGD)	(MGD)
								(MGD) October 6 10.11.2010	8:05 AM	20.7	
								October 8	8:02 AM	19.4	

staff will be on Mari on October 13 Wednesday to do stream flow measurements.	Aloha Lenore b Aloha Lenore b previous week. Mahalo Avery B. Chumbl Vailuku Water C P.O. Box 2790 Vailuku Water C P.O. Box 244. Favery B. Chumbl Walluku Water C P.O. Box 244. This TRANSMITTE BARE NOT THE INTE Phone: 808.244. Fax: 808.244. THIS TRANSMITTE ARE NOT THE INTE DISCLOSURE, COP ON THE CONTENTY DISCLOSURE, COP ON THE CONTENTY Erom: Clayton Suzuki Sent: Monday. Octobe To: SENATOR AVERY I Senator AVERY I Senat	01:28 PM elow is the ompany LL awaii 079 cell: 8 emai 079 cell: 11NG OR DIS ONFORMATION ORMATION ON NDED RECT TING OR DIS (OF THIS IN ORMATION ORMATION ORMATION ORMATION ORMATION ORMATION ORMATION OF THIS IN ORMATION OF THIS IN ORMATION OF THIS IN ORMATION OF THIS IN ORMATION OF THIS IN	csuzuki@w bcs Subject FW: Waihee bcs Subject FW: Waihee Stream co Subject FW: Waihee Stream co 276.3595 276.3595 1: abc@aloha.net I: abc@aloha.net I: abc@aloha.net I: AM PIENT, YOU ARE HER FITON IS PRIVATE AND PIENT, YOU ARE HER FITON IS PRIVATE AND FITON OR THE FITON	ailukuwater.com>, "Dean.D.Uyeno" Stream IIFS mpliance report for the ATTACHMENT THERETO CONTAIN ECIFIC INDIVIDUAL OR ENTITY' PROTECTED BY LAW. IF YOU EBY NOTIFIED THAT ANY CTLY PROHIBITED.
	The CWRM and USGS s flow measurement site flow probe broke dowi flows in Waihee Strear	taff did flow m on Wednesda again on Octu	reasurements on Waihee IV. WWC and USGS did str ober 14, WWC is using the	Stream and installed a staff gauge at eam flow measurements as follows: ¹ • staff gauge established by USGS to c
	Date: Waihee Stream flow	lime: USGS Staff	Waihee Stream flow	Waihee Stream flow
	USGS Measurement	Gauge	Above Waihee Ditch	at USGS site: WWC
	(MGD)	(Feet)	(MGD)	(MGD)
	October 11, 2010	8:34 AM	27.1	10.46

October 12, 2010	8:35 AM	20.7	10.27		Avery B. Chumbley" :abc@aloha.net> 0/25/2010 10:21 AM	To "Aver <chui cc <csuz bcc</csuz </chui 	y B. Chumbley‴ <abc@aloha.net>. "Chui.L.Cheng" .L. Cheng@hawaii gov>, "Clayton Suzuki" uki@wailukuwater.com>, "Dean.D.Uyeno"</abc@aloha.net>
0ctober 13, 2010 .0.47	8:55 AM 1.56	20.0	10.36			Subject FW: W	Vaihee Stream IIFS
October 15, 2010	7:13 AM 1.57	20.0	+10.47	Aloha Len	iore here is our c	ompliance rep	ort for the past week.
VWC used the follow	ving settings for the abo	ve readings:					
)ate:	Waihee Ditch Control Gate	Spreckles Ditch Control Gate		Mahalo Avery!			
October 11, 2010 October 12, 2010 October 13, 2010 October 15, 2010 Jayton Suzuki	Bolt 2 + ¼ " Bolt 2 + ¼ " Bolt 2 + ¼ " Bolt 2	Bolt 4 + 1 " Bolt 4 + 1 " Bolt 4 + 1 " Bolt 4 + 1 ½ "		Avery B. C Wailuku V P.O. Box J Wailuku, I 96793-93 phone: 80 fax: 808.2	Chumbley Vater Company LL 2790 Maui, Hawaii 55 18.244.7079 cell: 242.7068 email	C 276.3595 : <u>abc@aloha.n</u>	et
				CONFIDEN CONFIDEN THIS TRAN ARE NOT T DISCLOSUF ON THE CC	TIALITY NOTICE: TH TIAL INFORMATION ISMITTED INFORMAT HE INTENDED RECI RE, COPYING OF DIS NUTENTS OF THIS IN	IIS EMAIL AND / INTENDED FOR TION IS PRIVATI TION IS PRIVATI TIENT, YOU ARE STRIBUTTON, OF	ANY ATTACHMENT THERETO CONTAIN A SPECIFIC INDIVIDUAL OR ENTITY. E AND PROTECTED BY LAW. IF YOU E HEREBY NOTIFIED THAT ANY & THE TAKING OF ANY ACTION BASED STRICTLY PROHIBITED.
				From: Clayto Sent: Monda To: SENATOF Subject: Wa	n Suzuki [mailto:csuzuki y, October 25, 2010 10: R AVERY B. CHUMBLEY (iihee Stream IIFS	@wailukuwater.con 16 AM Ret.) (abc@aloha.n	n] et)
				October 25, 2	2010		
				Avery,			
				The stream fl installed by U The following control gate 3 Date:	ow probe is waiting for _I JSGS with 1.56 feet equa 5 readings were taken wi set at 4 bolts + 1 ¼" to 4 Gauge reading:	parts expected this ting 10.47 MGD. the Waihee cont bolts plus ¾". Flow MGD	week. WWC monitored the stream gauge rol gate set at two bolts and the Spreckles Waihee Stream flow above intakes (MGD)
				October 18 October 19	1.56 1.59	10.47 10.47 +	18.7 19.4
				October 20 October 21	1.63 1.58	10.47 + 10.47 +	21.3 22.6
				Clayton Suzul	ki Waihee Stream IIFS flow cha	tt pdf	

Wailuku Water Company

Waihee Stream IIFS

				Stream Flow	Stream Flow	USGS	Waihee Stream	Stream Flow
Date:	Waihee Ditch	Spreckles Ditch	Stream Flow	USGS site (MGD)	USGS reading	Staff Gauge	Staff Gauge	USGS reading
	Setting:	Setting:	WWC site (MGD)		(MGD)	(Feet)	(MGD)	(MGD)
8-9-10	second bolt	second bolt	4.78	Х				
9-3-10	second bolt	second bolt	4.73	Х				27.8
9-5-10	second bolt	second bolt	4.72	Х				20.7
9-7-10	second bolt	second bolt	4.87	Х				38.1
9-8-10	bolt 2 + 1/4 "	bolt 2	5.52	5.96				34.2
9-10-10	bolt 2 + 1/4 "	bolt 2	5.16	6.00				42.6
9-13-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	6.20	6.87				21.3
9-15-10	bolt 2 + 1/2 "	bolt 2 + 3/4 "	5.95	7.08				27.1
9-17-10	bolt 2 + 1/2 "	fourth bolt	8.66	9.66				20.0
9-21-10	bolt 2 + 1/2 "	fourth bolt	8.99	10.18				22.0
10-06-10	bolt 2 + 1/2 "	bolt 4 + 1/2"	-	10.11				20.7
10-08-10	bolt 2 + 1/2 "	bolt 4 + 1/2"	-	10.70				19.4
10-11-10	bolt 2 + 1/4 "	bolt 4 + 1"	-	10.46				27.1
10-12-10	bolt 2 + 1/4 "	bolt 4 + 1"	-	10.27				20.7
10-13-10	bolt 2 + 1/4 "	bolt 4 + 1"	-	10.36	10.47	1.56	10.47	20.0
10-15-10	bolt 2	bolt 4 + 1 1/2 "	-	-	-	1.57	10.47 +	20.0
10-18-10	bolt 2	bolt 4 + 1 1/4 "	-	-	-	1.56	10.47	18.7
10-19-10	bolt 2	bolt 4 + 1 "	-	-	-	1.59	10.47 +	19.4
10-20-10	bolt 2	bolt 4 + 3/4 "	-	-	-	1.63	10.47 +	21.3
10-21-10	bolt 2	bolt 4 + 3/4 "	-	-	-	1.58	10.47 +	22.6



Wailuku Water Company

Waihee Ditch Sluice Gate

Setting at 2 bolts



Wailuku Water Company Spreckles Ditch sluice gate

Setting at 4 bolts + ¾ "



November 5, 2010

Ms. Lenore N. Ohye, Acting Deputy Director Department of Land and Natural Resources Commission on Water Resource Management P.O. Box 621 Honolulu, HI 96809

Dear Ms. Ohye:

As requested by your October 26, 2010 letter below are updates on actions taken by HC&S as part of the Commission's Decision and Order (D&O) in the Iao Ground Water Management Area High-Level Source Water-Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihee River, Waiehu, Iao, & Waikapu Streams Contested Case Hearing (CCH-MA06-01).

1. Per an August 4, 2010 meeting, HC&S was assessing options to address leakage from HC&S's unlined Waiale Reservoir. This will assist us in preparing a timetable for addressing the approximately 12.48 mgd in preventable system losses.

Prior to implementation of the ordered IIFS, HC&S had started exploring options to address preventable losses from the Waiale Reservoirs, including the complete lining of the reservoirs, partial lining, a bypass of the reservoirs via a direct feed of water to HC&S Waihee Ditch, or a combination of partial lining and direct feed. We conducted preliminary in-house engineering studies and obtained budgetary quotes for material and labor costs. As we were undertaking this analysis, however, it became clear to us that the implementation of the IIFS would have consequences (e.g., less water flowing into the reservoir thus lowering water levels in the reservoir, a change in how often the reservoir would actually be used for storage, as opposed to just a collection point, etc.), which would influence our analysis. Accordingly, since the implementation of the IIFS on August 9 and 10, we have begun to collect relevant flow data and to factor it into our analysis. As part of this analysis, we are also considering including some type of monitoring program to assess the impact of reservoir lining or bypass on chloride levels and yields in the underlying aquifer, which HC&S is more reliant upon as a consequence of implementation of the IIFS. We would like to meet with you and your ground water staff to discuss the scope and feasibility of such a program and will be calling you within the next week or two to set up a meeting to discuss this.

At the same meeting, we would like to discuss with you a timetable for addressing reservoir losses, which we believe should take into consideration the data collection effort we are currently engaged in as well as implementation of a ground water monitoring program.

2. Per discussions with the U.S. Geological Survey (USGS) and the Commission, the installation of stream gages for certain streams was being considered. This will help to address the installation and maintenance of stream gages immediately below the main diversions identified in the IIFS.

At the August 4, 2010 meeting with your staff, USGS, and WWC, there was discussion about establishing two gages on Waihee Stream to monitor the ordered IIFS: one below Waihee Ditch and one below Spreckels Ditch. This was suggested because releases were going to be made from both ditches to meet the ordered IIFS at the designated point below Spreckels Ditch. However, now that the releases have been implemented, it has become evident that a single gage below Spreckels Ditch will be sufficient because we have been able to fine-tune the opening of the sluice gate on the Waihee ditch to allow consistent flow that meets the IIFS down to the Spreckels ditch. In other words, the adjustments necessary to meet the IIFS are done on one sluice gate alone and, therefore, a gage is not necessary below of the Waihee ditch. In terms of siting this gage, however, , after doing a physical walk of Waihee Stream from the Spreckels ditch diversion to a point approximately 1/2 mile downstream, it became apparent that it would be very difficult to install a gage at the planned site below Spreckels Ditch. Various flow measurements were made at this location by USGS and WWC but during times of high stream flows, the section of stream that was channelized with rocks and silt to enable measurement of IIFS flow was washed out. It appears that a suitable site with a stable channel needs to be located before a continuous gaging station can be installed.

3. Construction of bypasses of diversions that currently disrupt stream flows.

A bypass structure needs consistent and sufficient flow across a diversion in order to work optimally. HC&S has studied and analyzed the construction of bypasses of diversions on Waihee and South Waiehu streams that disrupt stream flows, both of which pose very difficult challenges. The Waihee Ditch diversion on Waihee Stream consist of two separate diversion structures, the North diversion and the South diversion. The two structures divert differing amounts of water due to their differing upstream channel slope and topography. In addition, the diverted water does not enter the diversion structure equally across the length of the gratings. Thus, significant redesign and reconstruction of the diversions would have to be undertaken to construct a bypass structure that would allow fish passage and meet a specific IIFS, because of the variability of the stream flows, which dictate the amount of water that will go through the bypass structure. The Spreckels Ditch diversion on Waihee Stream also poses a challenge as the diversion dam is over 80 feet in length and is not perpendicular to the stream bed so that the flow of water is channeled towards the intake sluice basin. Any bypass would also require a complete modification of the existing structure so as to be able to regulate the flow over the diversion dam to meet the specified IIFS and allow for fish passage.

On South Waiehu Stream, it appears that the release of water that has occurred to meet the ordered IIFS has created continuous stream flow through the sluice gate adjacent to the diversion dam and is serving as a bypass structure. Further bypass of the diversion would not likely do any good as there is an approximately 10 foot vertical drop right below of the diversion structure which serves as an impediment for fish migration up/down the stream.

4. Report on the progress of and impediments to implementing the amended interim instream flow standards (IIFS) and their impacts on instream values and offstream uses.

Implementation of the IIFS:

Implementation of the ordered IIFS on both Waihee and South Waiehu Streams was achieved within the two month period specified in the D&O (see further explanation of South Waiehu below). While the existing sluice gates were designed to either be in an open or closed position, after some trial and error, they have been able to be utilized to implement the ordered IIFS on South Waiehu Stream and Waihee River with the modification of the lifting device to enable the proper gate opening. (It should be noted that because of the width of the sluice gate, a difference of 1/8th-inch in the opening of the gate could mean a difference of as much as 100,000 gpd.) While continuous measurements have

Ms. Lenore Ohye, Acting Deputy Director Page 4 November 5, 2010

been difficult to achieve, we believe the IIFS is being met based on a number of spot measurements taken on both streams.

As mentioned in the response to question 2 above, an appropriate measurement site on Waihee Stream just below Spreckels Ditch is difficult to identify due to the extensive width of the stream at that point and cobblestone stream bed. This is similar to the situation on Waiehu Stream where USGS and CWRM staff have had to adjust, as a result of conditions on the ground, moving the monitoring point to below the confluence of North and South Waiehu Streams due to issues relating to private property ownership, access to the stream, and a cobblestone streambed. Because separate IIFS were established for South Waiehu and North Waiehu Streams, separate monitoring points would be ideal, but difficult to implement. Both North Waiehu and South Waiehu Streams contribute to the flow at the monitoring site established, and we believe that the amended IIFS for both streams are being met.

Impacts of implementing the IIFS:

As you are well aware, the implementation of the IIFS has resulted in negative impacts on some of the Na Wai Eha kuleana users. As a result, OHA and Earthjustice have requested, and the parties have agreed to enter into, stipulations to defer full implementation of the IIFS for South Waiehu Stream to allow additional time to better understand and identify appropriate mitigation of the impacts to these kuleana users. Implementation of the IIFS during the summer period with low flows resulted in an immediate impact on some of the kuleana users as all available flows had to be left in the stream to meet the IIFS. As you know, HC&S has participated with your staff and other parties in efforts to mitigate the impacts to these kuleana users. With the advent of the wetter season, hopefully the negative impacts will not be severe and will provide additional time to address the problems the kuleana users will continue to face in times of low flows. HC&S will continue to participate with other parties and CWRM staff in addressing this issue.

With respect to impacts on HC&S, since implementation of the amended IIFS, there has been a 33% decrease in total deliveries to the Waiale Reservoirs. Consequently, Well 7 has been continuously pumped to make up for the reduced surface water inputs and lack of rainfall. Recent rains have brought some relief, but pumping of Well 7 is still required.

Ms. Lenore Ohye, Acting Deputy Director Page 5 November 5, 2010

Please contact me at 877-6950 or via email at <u>ghew@hcsugar.com</u> if you have any questions.

Sincerely, Janet Hew

Garret Hew Manager, Water Resources



QUARTERLY UPDATE:

Implementation of Interim Instream Flow Standard (Interim IFS) for Maui Streams

East Maui Implementation

December 7-8, 2010: Staff observed and documented the modification of the low-flow bypass channel at Haiku Ditch on Honopou Stream by Hawaiian Commercial & Sugar Co. (HC&S)/East Maui Irrigation Co. (EMI) staff. The purpose of the modification was to install a more permanent structure on the upstream side of the Haiku Ditch intake grates. The previously installed lumber was removed and angle iron was installed across the entire length of the intake, to raise the head level and allow more water to flow through the low-flow bypass channel (Photo 1). Concrete was also poured on the upstream side of the installed angle iron to prevent leakage into the grates (Photo 2).



Photo 1. HC&S/EMI staff begin installing angle iron on the upstream side of the Photo 2. Completed modifications at Haiku Ditch the following day. Note that Haiku Ditch intake grates. On December 6, the Lowrie Ditch sluice gate was concrete was poured on the upstream side of the angle iron to prevent leakage closed the to lower water levels so work could be performed on December 7.

into the ditch. The Lowrie Ditch sluice gate was reopened on December 8.

Staff is currently in discussions with Native Hawaiian Legal Corporation (NHLC), HC&S/EMI, and the Division of Aquatic Resources (DAR) to address biological connectivity and the water drop from the bypass channel to the concrete apron below.

Staff also installed pressure transducers at Waiohue Stream (Photo 3) and West Wailuaiki Stream (Photo 4), and installed a field camera at Wailuanui Stream.

On December 8, staff first installed a pressure transducer at Hanehoi Stream (Photo 5). Staff then observed and documented Waiokamilo Stream and the losing section above Dam #3 (Photo 6). Though no measurements were taken, a greater percentage of streamflow appears to be flowing into this losing section than previously observed. Staff also completed installing a pressure transducer at Waikamoi Stream.





Photo 3. Staff gage site at Waiohue Stream.



Photo 4. Staff gage site at West Wailuaiki Stream.



Photo 5. Staff gage at Hanehoi Stream.



Photo 6. Losing section on Waiokamilo Stream

February 16, 2011: Staff installed barometric pressure transducers at Waiohue, Palauhulu, and Honopou Streams. Upon preliminary review of data logged by pressure transducers at Honopou Stream, staff installed barometric pressure transducers to compensate for the atmospheric pressure effects upon the transducers deployed at various stream sites in East Maui. A field camera was also installed in an upper section of Palauhulu Stream above known losing sections and a pressure transducer was installed at the East Wailuaiki Stream site.

March 1, 2011: The Commission entered into a Joint Funding Agreement (JFA) with the U.S. Geological Survey (USGS) to conduct an East Maui Irrigation System Seepage Reconnaissance Study, East Maui, Hawaii. The Commission had authorized the Chairperson to enter into the JFA at its January 20, 2011 meeting.

March 4, 2011: Staff met with NHLC and their clients to discuss various issues related to the implementation of the interim IFS in East Maui. For Waiokamilo Stream, Commission staff has asked Na Moku Aupuni O Koolau Hui (Na Moku) to consider fixing the losing section on the stream. Na Moku is also seeking access to Akeke Springs to conduct a clean-up of the area in hopes to increase flow from the spring into the stream. Staff is continuing to work with the Deputy Attorney General and EMI to coordinate access.



For Honopou Stream, biological connectivity at the Haiku Ditch intake was discussed. NHLC clients are also seeking access to the upper watersheds to inspect recent EMI modifications for meeting the interim IFS and for cleaning the stream periodically. Discussions between residents and EMI will continue.

March 7, 2011: Staff met with DAR to discuss proposed diversion modifications for East Maui and Na Wai Eha diversions. A site visit is being planned for late April to meet in the field with EMI and Wailuku Water Company to discuss and agree upon diversion modifications to adequately provide for biological connectivity.

March 14, 2011: HC&S began submitting monthly water use reports for all of its gaging stations on the EMI system. This includes four stations that were not previously being reported and four stations which were recently upgraded with continuous recorders to enable reporting capability.

Future Actions:

- March 22, 2011: Commission staff will download pressure transducer data and any available field camera data for the upper reach of Palauhulu Stream and Hanehoi Stream.
- March 23, 2011: Commission staff will download pressure transducer data and any available field camera data for Waiohue, East Wailuaiki, West Wailuaiki, Wailuanui, Palauhulu, Waikamoi, and Honopou.
- April 25-26, 2011 (Tentative): Commission and DAR staff will meet with EMI staff in the field to discuss and agree upon proposed diversion modifications to adequately provide for biological connectivity.
- Staff will be assessing the interim IFS with regards to current streamflow conditions and actions taken thus far by EMI. Based on this assessment, staff may prepare recommendations for future actions to be brought before the Commission.
- Preliminary discussions with USGS indicate that funding may not be available to continue the operation and maintenance of six staff gages in East Maui for another fiscal year (July 1, 2011 to June 30, 2012). USGS is currently developing the rating curve for these six gages and will cease operation and maintenance on June 30, 2011. At that time, Commission staff will assume future operation and maintenance as deemed necessary.

Na Wai Eha Implementation

November 30, 2010: Staff accompanied USGS staff to Waihee River and completed the following actions: 1) Installed a field camera at the upper staff gage location; 2) Observed and documented the dry reach downstream of Spreckels Ditch (Photo 7); and 3) Documented the staff gage installation at the lower interim IFS site (Photo 8).

Regarding the dry reach downstream of Spreckels Ditch on Waihee River, USGS staff identified two possible staff gage locations approximately 140 ft. and 250 ft. below the Spreckels Ditch diversion dam. However, much of the streambed and the controls of each site are a mix of cobble and boulder. This composition may result in frequent changes to the control thereby requiring resurveying and adjustments to the rating curve. USGS staff indicated that staff gages could be installed at either site, but these are not ideal locations primarily due to the lack of more stable controls.







Photo 7. Possible staff gage location approximately 250 ft. below Spreckels Ditch on Waihee River.

Photo 8. Staff gage at lower site on Waihee River. View is looking upstream, with the gage is located at left center of photo.

At South Waiehu Stream, staff met with Mr. Garret Hew (HC&S) and Ms. Muriel Smith who formerly received water from Spreckels Ditch (Photo 9). Ms. Smith lives on the same property as others who receive water from HC&S' South Waiehu Stream intake; however, she cannot physically receive water from the same source. Mr. Hew indicated that HC&S could assist Ms. Smith in connecting her pipe to the same pipe that supplies the other users on the property. The status of this work is not known at this time and staff will continue working to resolve this matter.



Photo 9. Control valve from Spreckels Ditch

Photo 10. Staff gage and pressure transducer installed in Spreckels side ditch.

Lastly, staff installed a staff gage and pressure transducer within the Spreckels side ditch which conveys water from the South Waiehu Stream intake to the main Spreckels Ditch (Photo 10). Periodic flow measurements will be made over the next several months to develop the rating curve for the gage. Staff also installed a pressure transducer at the gaging site below the confluence of North and South Waiehu Streams.

January 3, 2011: A Third Stipulation and Order was approved by the Commission suspending full implementation of the interim IFS for South Waiehu Stream for a period of one (1) year to enable the collection of streamflow data by Commission staff.



February 17, 2011: Staff discovered that water in the Spreckels side ditch had backed up due to a sluice gate being lowered on the main Spreckels Ditch channel. This action was taken by HC&S a few days prior in response to a recent storm event to reduce the amount of water entering Spreckels Ditch and prevent it from overflowing. Staff decided to relocate the staff gage and pressure transducer roughly 100 ft. upstream. The gage was moved to the downstream end of the tunnel portion of the ditch before water drops down a slope at the end of the tunnel. Thus, the new gage location should not experience pooling resulting from ditch management practices in the future.

Staff also installed a barometric pressure transducer and made one flow measurement in the side ditch.



Photo 11. Downstream view of Spreckels side ditch, with staff gage and Photo 12. Staff preparing pressure transducer to be deployed, standing in the transducer housing mounted on the right (bank) wall.

side ditch just downstream of the tunnel exit.

Future Actions:

- March 21, 2011: Commission staff will conduct the following actions: 1) Download pressure transducer and field camera data at the Waihee River site below the Spreckels Ditch intake; 2) Download transducer data at Waiehu Stream and the Spreckels side ditch on South Waiehu; 3) Make a flow measurement in the Spreckels side ditch; 4) Conduct reconnaissance of North Waiehu Stream above the confluence; and 5) Meet with local residents receiving water from North Waiehu.
- April 25, 2011 (Tentative): Commission and DAR staff will meet with HC&S and Wailuku Water Co. staff in the field to discuss and agree upon proposed diversion modifications to adequately provide for biological connectivity.
- Commission staff will begin contacting area residents that receive water from the Spreckels side ditch on South Waiehu Stream to schedule a site visit. The purpose of the site visit is for the Commission staff and representatives from HC&S, Office of Hawaiian Affairs, and Earthjustice to learn more about the auwai system receiving water from the Spreckels side ditch and to meet with its users.
- Preliminary discussions with USGS indicate that funding may not be available to continue the operation and maintenance of four staff gages in Na Wai Eha for another fiscal year (July 1, 2011 to June 30, 2012). USGS is currently developing the rating curve for these four gages and will cease operation and maintenance on June 30, 2011. At that time, Commission staff will assume future operation and maintenance as deemed necessary.

DAVID TAYLOR, P.E. Director

PAUL J. MEYER Deputy Director

 $\overline{\infty}$

ထ္

DEPARTMENT OF WATER SUPPLY

COUNTY OF MAUI 200 SOUTH HIGH STREET WAILUKU, MAUI, HAWAII 96793-2155 www.mauiwater.org

May 17, 2011

ALAN M. ARAKAWA

Mayor

Mr. William M. Tam, Deputy Director Commission on Water Resource Management P.O. Box 621 Honolulu, Hawaii 96809

Dear Mr. Tam:

SUBJECT: WAIKAMOI FLUME REPLACEMENT – STATUS REPORT KOOLAU FOREST RESERVE, EAST MAUI, HAWAI'I

In response to the Commission on Water Resource Management's (CWRM) letter dated May 25, 2010 regarding interim instream flow standards, the County of Maui, Department of Water Supply (DWS) is presenting the following progress timeline on the above referenced project.

- August 2010 KAI Hawai'i was awarded the design contract and Notice to Proceed on August 27, 2010;
- October 2010 Early Consultation Package requesting preliminary comments relating to the Draft Environmental Assessment (EA) prepared by Munekiyo & Hiraga, Inc. was sent to participatory agencies;
- November 2010 Flora and Fauna Survey and Assessment, prepared by Robert W. Hobdy, Environmental Consultant, was completed;
- January 2011 Field Survey of the Waikamoi Flume (approximately 30-ft x 5800ft) was completed;
- February 2011 Working Topographic Drawings were developed for design and construction plans;
- March 2011 Correspondence letter and site assessment report was sent to the

"By Water All Things Find Life"

Mr. William M. Tam Subject: Waikamoi Flume Replacement May 17, 2011 Page 2

US Department of the Army (DA) requesting a "Jurisdictional Determination" on the stream, gully, and gulch crossings that the existing (and proposed) Flume trusses encounter; Preliminary design completed for several flume support systems. The design options are to be included in the Draft Environmental Assessment text. April 2011 -Received Jurisdictional Determination from the DA that Haipuaena Stream, Puohokamoa Stream, and Waikamoi Stream, have been determined to be waters of the US under the jurisdiction of the US Army Corps of Engineers (Corps). An aquatic resources survey and determination of the ordinary high water mark (OHWM) are required by the Corps in order to complete jurisdictional determination process for project corridor and to determine applicable Section 404 and related permitting requirements. Location of all bridge foundations was established. May 2011 -Completed site visit with contractor to review proposed design of flume. The purpose of the visit was to get feedback from the contractor regarding the constructability of the proposed design, and to get an opinion as to how much remediation work will be necessary for the access road in order for a contractor to safely traverse the road for the delivery of equipment and materials. An aquatic survey is presently being conducted by Robert W. Hobdy. Site visit by project biologist to determine Ordinary High Water marks at 13 stream locations. This information is critical for the Department of Army in their 404 determination. May 2011 Cultural Impact Assessment and Archaeological Inventory Survey reports are also in the process of being completed for integration into the Chapter 343, EA document.

Below, are the anticipated milestones for the progress of this complex reconstructionreplacement project:

- June 2011 to mid-2012 Completion of Chapter 343, HRS EA processing
- June 2011 to August 2011 Continued coordination with DA to determine Section 404

Mr. William M. Tam Subject: Waikamoi Flume Replacement May 17, 2011 Page 3

· ·- 3

		and related permitting requirements for project corridor.
•	August 2011 -	Fifty Percent (50%) construction plans are to be complete and submitted to DWS for review and comment.
•	August 2011 to late-2012 -	Processing of applicable DA Section 404 permit, Department of Health Section 401 Water Quality Certification, and Hawaii Coastal Zone Management (CZM) Consistency Determination applications.
	Mid 2012 to late 2012 -	Processing of Conservation District Use Application (CDUA) with the Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL).
•	January 2013 -	Anticipated Construction Bid Advertisement.
∎	March 2013 -	Anticipated start of Reconstruction/Replacement of the existing flume.
I	December 2014 -	Anticipated completion of new flume.

Currently, the critical path for this complex project appears to be dependent on securing confirmation from the DA on any Section 404 and other related State permits that may be triggered by the proposed flume replacement project. Once confirmation has been obtained from the U. S. Army Corps of Engineers, DWS will be proceeding, as necessary, with the preparation and processing of applications addressing any applicable Section 404 DA Permit, Section 401 Water Quality Certification and CZM Consistency Determination requirements for the project.

If you have any questions or require any additional information, please call Herb Chang or Thomas Ochwat of our Engineering Division at 270-7835.

Sincerely,

David Taylor, P.E. Director

 \mathbf{TO}_{i}


QUARTERLY UPDATE:

Implementation of Interim Instream Flow Standard (Interim IFS) for Maui Streams

East Maui Implementation

March 22-23, 2011: Commission staff downloaded stream and barometric transducer data from eight sites in east Maui on Waiohue, East Wailuaiki, West Wailuaiki, Wailuanui, Palauhulu (Photo 1), Waikamoi, Hanehoi and Honopou (Photo 2) Streams. These data retrievals are expected to be conducted on a quarterly basis. Two malfunctioning field cameras were also retrieved from Palauhulu and Wailuanui Streams likely due to water damage from very high streamflows or intense rainfall events.



Photo 1. A ladder is used to retrieve the transducer on Palauhulu Stream.

Photo 2. Staff retrieves the transducer from a swollen Honopou Stream.

April 26-27, 2011: Staff conducted field investigations with staff from the Division of Aquatic Resources (DAR) and East Maui Irrigation Company (EMI) to discuss and agree upon specific diversion modifications to achieve biological connectivity for the native stream macrofauna. The diversions modifications discussed included the following:

- Hanawi Stream at Koolau Ditch Intake: Two 6 in. PVC pipes on the right bank of the diversion structure convey water from other (i.e., spring/seep) sources. These sources are considered minor diversions not directly from Hanawi Stream. EMI plans to extend one of the existing pipes with elbows and short sections of pipe secured along the sluice gate structure to drop water onto the top of the diversion dam (Photo 3).
- Waiohue Stream at Koolau Ditch Intake: EMI plans to construct a pipe along one of the stream banks starting from atop the waterfall to drop water onto the top of the diversion dam (Photo 4). The pipe installation initially discussed in the field was the right bank.





Photo 3. View of Hanawi Stream diversion intake from the left bank



Photo 4. View of Wajohue Stream diversion intake from the left ban

- East Wailuaiki Stream at Koolau Ditch Intake: EMI plans to install a pipe along the right bank of the stream starting from a section of stream higher in elevation than the height of the diversion dam (Photo 5). Water from the pipe will be dropped onto the top of the diversion dam approximately 5 ft. from the right bank of the stream.
- West Wailuaiki Stream at Koolau Ditch Intake: EMI plans to install a pipe along the left bank of West Wailuaiki Stream from atop the waterfall and drop water onto the top of the diversion dam nearest the left bank (Photo 6).



right bank and the sluice gate/intake structure on the right bank.

Photo 5. Upstream view of East Wailuaiki Stream with diversion dam on the Photo 6. Upstream view of West Wailuaiki Stream with diversion dam on the left bank and and sluice gate/intake structure on the right bank.

- Honopou Stream at Haiku Ditch Diversion Intake: EMI plans to use cement to construct a small channel in the diversion intake structure where there is currently an opening nearest the right bank of the stream (Photo 7). The concrete berm on the upstream end of the channel will also be chipped away to allow water to flow downstream in the channel. The channel should be kept fairly rough. EMI will also construct a small concrete berm near at the base of the water drop from the low-flow bypass channel to prevent water from flowing back into the Haiku Ditch.
- Honopou Stream at Wailoa Ditch Diversion Intake: EMI plans to fill the first intake grate section (from the right bank) with cement, and leave the concrete slightly depressed to allow the section to fill with water and pool (Photo 8). Upon filling, the section would be expected to overflow down the intake apron to provide a wetted face for connectivity.





Photo 7. Downstream view of the Haiku Ditch diversion intake on Honopou Stream from the right bank. Photo 8. Upstream view towards the right bank of the Wailoa Ditch intake grate on Honopou Stream.

June 14, 2011: Staff conducted quarterly data retrieval of stream and barometric transducer data.

September 2011: The U.S. Geological Survey notified staff that the fieldwork phase of the East Maui Irrigation Diversion System Seepage Reconnaissance Study was complete. This study is a 1.5-year study to assess, at the reconnaissance level, the amount of seepage into or from the four main ditches in the EMI system by documenting seepage rates for various construction-type sections of the ditches. Published results of the study are expected September 2012.

September 27-28, 2011: Staff conducted quarterly data retrieval of stream and barometric transducer data. This trip also included streamflow measurements taken at Wailuanui, Palauhulu, Hanehoi, and Honopou.

September 28, 2011: Staff met with Makapipi residents to update them on the implementation of interim instream flow standards in east Maui and to review the summary of discharge measurements completed by USGS during September 13-17, 2010. Issues raised by the residents included questions about area wells and their impact on streamflow and coordination with EMI to access and view the Makapipi Stream diversions. Staff is currently researching these issues and will continue to communicate and work with the Makapipi residents.

November 2, 2011: Staff conducted a follow-up field investigation with staff from DAR and EMI to review the completed diversion modifications and propose any revisions if needed (Photos 9-20). Staff also documented the wet season releases for Waiohue, East Wailuaiki, West Wailuaiki, and Waikamoi Streams (See Table 1, with wet season interim IFS values shaded gray).

		Interim IFS Amounts				Restoration Amounts			
	Wet S	eason	Dry Season		Wet Season		Dry Season		Altitude
	cfs	mgd	cfs	mgd	cfs	mgd	cfs	mgd	feet
Waikamoi	2.80	1.81	0	0	2.60	1.68	0	0	550
West Wailuaiki	3.80	2.46	0.40	0.26	3.80	2.46	0.40	0.26	1,235
East Wailuaiki	3.70	2.39	0.20	0.13	3.70	2.39	0.20	0.13	1,235
Waiohue	3.20	2.07	0.10	0.06	3.2	2.07	0.10	0.06	1,195

Table 1. Downstream view of the Haiku Ditch diversion intake on Honopou Stream from the right bank.





Photo 9. Completed diversion modification on Hanawi Stream.



Photo 10. Close-up of water spilling onto the Hanawi diversion dam structure.



Photo 11. Completed diversion modification on Waiohue Stream conveys water via HDPE pipe from an upstream reach.





Photo 13. Completed diversion modification on East Wailuaiki Stream conveys water via HDPE pipe from an upstream reach.



Photo 14. HC&S implementing the wet season release for East Wailuaiki Stream.





Photo 15. Completed diversion modification on West Wailuaiki Stream conveys water via HDPE pipe from an upstream reach.



Photo 16. HC&S implementing the wet season release for West Wailuaiki Stream



Photo 17. Spacers were used to set the bolt for the sluice gate at a specific height to achieve the desired flow release on Waikamoi Stream. By the sluice gate on Waikamoi Stream. Gate heights were calculated ahead of time based on the sluice gate dimensions.





Photo 19. EMI constructed a concrete ramp and channel along the right bank of Honopou Stream to provide for connectivity. Photo 20. A concrete berm was constructed beneath the bypass channel to prevent water from spilling back into Haiku Ditch on Honopou Stream.





Na Wai Eha Implementation

March 21, 2011: Commission staff downloaded stream and barometric transducer data from three sites in Na Wai Eha on Waihee River, Waiehu Stream below the confluence, and at the Spreckels Side Ditch on South Waiehu Stream. These data retrievals are expected to be conducted on a quarterly basis. Staff made a stream flow measurement as part of the rating curve development at the Spreckels Ditch site.

Staff conducted a brief assessment of North Waiehu Stream by walking upstream from just above the confluence of the North and South forks. Much of the stream, starting from approximately 2,000 feet above the confluence, was dry for long stretches. Further investigations will need to be conducted to better determine the hydrologic conditions of North Waiehu Stream. This matter is complicated by changes in ownership of land encompassing North Waiehu Stream, the presence of squatters on the property, and reports of vandalism to the Wailuku Water Company (WWC) intakes. Staff will continur to monitor the situation and further investigate when appropriate.

April 25, 2011: Staff conducted field investigations with staff from the DAR, WWC, and Hawaiian Commercial & Sugar Compnay (HC&S) to discuss and agree upon specific diversion modifications to achieve biological connectivity for the native stream macrofauna. The diversions modifications discussed included the following:

- Waihee River at Waihee Ditch South Fork Intake: WWC will keep the existing iron 'H' beam channel installed across the intake grates in place. Plywood will be placed temporarily over the intake grating adjacent to the left bank wing wall to provide flow connectivity nearest the left bank. A permanent steel plate will be installed to replace the plywood once a suitable shape and size is determined (Photo 21). No actions will be taken for the Waihee Ditch North Fork Intake.
- Waihee River at Spreckels Ditch Intake: WWC plans to install an iron 'H' beam channel along the left bank wing wall of the diversion dam. The upstream end of the channel will be installed in a small pool approximately 10 ft. upstream of the dam (Photo 22). The downstream end of the channel will drop water atop the diversion dam nearest the left bank. An eroded portion of the concrete apron downstream of the bypass channel will be repaired.



Photo 21, View of Waihee River Waihee Ditch South Fork intake facing the left Photo 22, Upstream view of Waihee River towards the right bank with the bank and the existing iron 'H' beam bypass in the foreground.



diversion dam in the foreground.

• South Waiehu Stream at Spreckels Ditch Intake: HC&S is in the planning process to fix the eroded section of the concrete apron of the downstream face of the diversion structure. DAR and HC&S



have agreed to postpone actions to address biological connectivity for this diversion until the concrete apron is fixed and issues pertaining to the interim instream flow standards are addressed (Photos 23-24). HC&S has received permission from the landowner adjacent to the diversion and expects to complete repairs to the concrete apron by the end of the year.

• Waihee River at Spreckels Ditch Intake: WWC plans to install an iron 'H' beam channel along the left bank wing wall of the diversion dam. The upstream end of the channel will be installed in a small pool approximately 10 ft. upstream of the dam. The downstream end of the channel will drop water atop the diversion dam nearest the left bank. An eroded portion of the concrete apron downstream of the bypass channel will be repaired.



Photo 23. Diversion Intake structure to SprecekIs Ditch on the right bank of the South Waiehu Stream. Waiehu diversion

Photo 24. Downstream view of the eroded concrete apron on the South Waiehu diversion intake to Spreckels Ditch

- Iao Stream at Spreckels Ditch Intake: HC&S will clean a portion of the debris on the north side of the intake grates to create a pool where the biota can hold up (wait) and survive as they migrate upstream (Photo 25). HC&S will need to coordinate with the County of Maui and determine whether permits are needed for such actions.
- Iao Stream at Iao-Maniania Ditch Intake: WWC will install an iron 'H' beam channel at the point where the intake grate edge sections meet nearest the right bank of Iao Stream (Photo 26).



Photo 25. Cobble/boulder sediment collects around the diversion intake for Spreckels Ditch on the right bank of Iao Stream.



Photo 26. View of the Iao-Maniania Ditch intake grates looking towards the right bank of Iao Stream.

- Waikapu Stream at Waihee Ditch Intake: A portion of the concrete dam near the middle of the diversion structure will be chipped away to create a small channel towards the right bank side of the intake grates (Photo 27). The iron 'H' beam channel currently installed across the intake grates will remain in place; however, DAR has suggested that slower velocity and shallower flow across the concrete apron will promote biota migration.
- Waikapu Stream at Reservoir 6 Intake: The upstream berm of the diversion intake grates will be repaired with concrete to raise the water level (Photo 28). WWC will install an iron 'H' beam channel across the width of the intake grates. The eroded section in the concrete apron downstream of the intake will be left as is, but may be repaired if connectivity is not established after the bypass channel is installed.



Photo 27. Diversion Intake structure to Waihee Ditch facing towards the right bank on Waikapu Stream. Photo 28. Reservoir 6 diversion intake grate across the stream channel, facing towards the right bank on Waikapu Stream.

June 14, 2011: Staff conducted quarterly data retrieval of stream and barometric transducer data.

August 11, 2011: Staff made a stream flow measurement as part of the rating curve development at the Spreckels Ditch site.

September 26, 2011: Staff conducted quarterly data retrieval of stream and barometric transducer data.

October 19, 2011: Staff installed a stream transducer on the lower Waihee River interim IFS site at Kahekili Hwy.

November 1, 2011: Staff conducted a follow-up field investigation with staff from DAR, WWC, and HC&S to review the completed diversion modifications and propose any revisions if needed (Photos 29-33). DAR staff has asked for a few more minor modifications to be made by WWC at the Spreckles Ditch Intake on Waihee River, Iao-Maniania Ditch Intake on Iao Stream, and the Waihee Ditch Intake on Waikapu Stream. Commission staff will continue to coordinate with DAR, WWC, and HC&S on these matters.





Photo 29. Completed modification at Waihee Ditch intake on Waihee River.



Photo 30. Completed modification at Spreckels Ditch intake on Waihee River.



Photo 31. Completed modification at Iao-Maniania Ditch intake on Iao Stream.



Photo 32. Completed modification at Spreckels Ditch intake on Iao Stream.



Photo 33. Completed modification at Waihee Ditch intake on Waikapu Stream. Photo 34. Completed modification at Reservoir 6 intake on Waikapu Stream.





Preliminary information on South Waiehu Ditch: The graph below depicts daily mean flow values in the Spreckels Side Ditch on South Waiehu Stream over the past 190 days (03/21/2011 to 09/26/2011).



Future Actions:

- Staff will continue working with USGS on the completion of the rating curves and data transfer for east Maui and Na Wai Eha staff gages.
- Staff will continue working with Kisters on the implementation of WISKI (time-series data management software) and the management of field data, refinement of the rating curves, and computation of various streamflow statistics.

DAVID TAYLOR, P.E. Director

PAUL J. MEYER Deputy Director

1- NNF

E1 :01 HV

DEPARTMENT OF WATER SUPPLY

COUNTY OF MAUI 200 SOUTH HIGH STREET WAILUKU, MAUI, HAWAII 96793-2155 www.mauiwater.org

May 29, 2014

ALAN M, ARAKAWA

Mayor

Mr. William M. Tam, Deputy Director Commission on Water Resource Management P.O. Box 621 Honolulu, Hawaii 96809

Dear Mr. Tam:

SUBJECT: WAIKAMOI FLUME REPLACEMENT – STATUS REPORT NO. 3 KOOLAU FOREST RESERVE, EAST MAUI, HAWAI I

As a follow-up to the Commission on Water Resource Management's (CWRM) reporting stipulation noted in the letter dated May 25, 2010 regarding interim instream flow standards, the County of Maui, Department of Water Supply (DWS) is presenting the following annual progress report on the above referenced project. As of May 15, 2014:

- The existing redwood flume has been demolished and removed up to the construction stationing of approximately Station 46+00 (4,600 linear feet of a total of 5,750 feet)
- The new aluminum replacement flume is currently assembled up to the Construction Station 37+00 (3,700 linear feet of a total 5,750 linear feet).
- The newly constructed flume is in service and conveys raw water from several tributary laterals intakes and bypass flows from the Haipuaena Stream. When possible, flows from the intake at Haipuaena Stream by-pass the construction area, and are put back into the newly constructed flume.

Based on the Notice to Proceed, and revised Contract Time of two years-three months, the project is proceeding slightly ahead of schedule.

"By Water All Things Find Life"

Mr. William M. Tam Subject: Waikamoi Flume Replacement May 29, 2014 Page 2

If you have any questions or require any additional information, please call Jeffrey Pearson or Thomas Ochwat of our Engineering Division at 270-7835.

Sincerely,

1.24

DQ \sim

David Taylor, P.E. Director

Cc: J. Oana, Corp. Council COM

TO/to

Field Investigation Itineraries



State of Hawaii Department of Land & Natural Resources Commission on Water Resource Management

East Maui Site Visit: Trip 1

2 Days (October 23-24, 2008)

Day 1: Thursday, October 23

Time 7:30	Stream Honopou	IIFS Site B	CWRM Action Site selection, pre-restoration flow measurement
10:30	Honopou	A	Site selection, pre-restoration flow measurement
1:00	Honopou		Lunch. Drive to Hanehoi.
2:30	Huelo	A	Site selection, pre-restoration flow measurement
7:00			Community meeting at Haiku Community Center

<u>Day 2:</u>	Day 2: Friday, October 24				
Time 7:30	Stream Hanehoi	IIFS Site B	CWRM Action Site selection, pre-restoration flow measurement		
9:30	Hanehoi	С	Site selection, flow measurement		
12:00	Hanehoi		Lunch. Drive to Piinaau.		
1:30	Palauhulu	В	Site selection, pre-restoration flow measurement		
4:00	Wailuanui		Locate USGS gaging station. If time permits, site selection and pre-restoration flow measurement.		



State of Hawaii Department of Land & Natural Resources Commission on Water Resource Management

East Maui Site Visit: Trip 2

3 Days (October 27-29, 2008)

Day 1:	Monday, Octo	<u>ober 27</u>		
Time	Stream	IIFS Site	CWRM Action	EMI Action
8:00	Honopou	В	Pre-restoration measurement	
10:00	Honopou	А	Pre-restoration measurement.	
12:00	Honopou		Document release	Lowrie ditch, open sluice gate for 1.1 mgd bypass
1:00	Honopou		Document release	Haiku ditch, build up berm on diversion to build up head for
2:00	Honopou		Lunch. Drive to Huelo.	note new unough a four men pipes
3:00	Huelo	А	Pre-restoration measurement	
4:30	Hanehoi	В	Pre-restoration measurement	

Day 2:	Tuesday, Oct	<u>tober 28</u>		
Time	Stream	IIFS Site	CWRM Action	EMI Action
7:30	Honopou	В	Post-restoration measurement	
9:30	Honopou	А	Post-restoration measurement. Drive to Huelo.	
11:30	Huelo		Document release	Haiku ditch, open sluice gate for .57 mgd bypass
12:30	Huelo		Lunch	
1:30	Hanehoi		Document release	Haiku ditch, open sluice gate for 0.41 mgd bypass
7:00	Keanae		Community meeting Keanae Elementary	

Day 3:	Wednesday,	October 29	<u>)</u>	
Time	Stream	IIFS Site	CWRM Action	EMI Action
7:30	Huelo	А	Post-restoration measurement	
9:00	Hanehoi	В	Post-restoration measurement	
11:00	Hanehoi		Drive to Wailuanui	
12:30	Wailuanui		Lunch	
1:00	Wailuanui		If not accomplished on Trip 1, site selection and flow measurement.	



State of Hawaii Department of Land & Natural Resources Commission on Water Resource Management

East Maui Site Visit: Trip 3

3 Days (November 17-19, 2008)

Day 1:	Monday, Nove	ember 17			
Time	Stream	IIFS Site	CWRM Action	Alternative	
7:30			Leave Kahului. Drive to Palauhulu.		
9:00	Palauhulu	В	Pre-restoration measurement		
11:30	Kano		Select a site on Kano Stream. Take pre-restoration measurement.		
1:00			Lunch		
2:00	Kano		Document release: Koolau Ditch, open sluice gate at Kano		
4:00	Wailuanui		Flow measurement		

Note on Public Attendance: It is our understanding that a previous landslide covered part of the hiking trail leading to the Koolau Ditch intake on Kano Stream. While EMI staff have tried to clear the debris and loose soil off the trail, a portion of the trail is still dangerous to cross. Due to the hazardous conditions of the access roads and hiking trails to the ditch intakes (especially during rain), we will not accommodate public attendance for this day of the site visit. CWRM staff plans to fully document the flow release at the Koolau Ditch intake on Kano Stream with video and photos. These, along with field investigation reports, will be made available on the CWRM website following the field visit. We greatly appreciate the public's continued understanding on this matter.

Day 2: ⁻	Tuesday, Nov	ember 18		
Time 8:00	Stream	IIFS Site	CWRM Action Leave Kahului. Drive to Waiokamilo.	
9:30	Kualani		Map out Kualani. Visit dam 1 and Lakini taro loi. (Contingent on access from private owners)	Plans scheduled for Day 3

Day 3: Wednesday, November 19

Time 8:00	Stream	IIFS Site	CWRM Action Leave Kahului. Drive to Palauhulu.	
9:30	Palauhulu	В	Post-restoration measurement	
11:00			Drive to Hanehoi	Continue visit to Kualani Stream, dam 1, and Lakini taro loi
12:00	Huelo	А	Post-restoration measurement	Continue visit to Kualani Stream, dam 1, and Lakini taro loi
1:30	Honopou	В	Post-restoration measurement	Continue visit to Kualani Stream, dam 1, and Lakini taro loi
2:00	Honopou	А	Post-restoration measurement	
3:00	Honopou		Volumetric measurement of 3 pipes	

East Maui Site Visit - Trip #4



Scheduled Trip Date: December 8-10, 2008 Conditions as of: Friday, December 5, 2008

State of Hawaii, Commission on Water Resource ManagementPhone: (808) 587-0214Toll-Free (Maui): 984-2400, Ext. 70214Fax: (808) 587-0219E-mail: dlnr.cwrm@hawaii.govWebsite: http://hawaii.gov/dlnr/cwrm

Day 1: Monday, December 8

ltem	Stream	IIFS Site	CWRM Action
1	W. Wailuanui		Inspect the Koolau bypass sluice gates
2	W. Wailuanui		Flow measurement
3	E. Wailuanui		Inspect the Koolau bypass sluice gates
4	E. Wailuanui		Flow measurement
5	Kualani		Locate Kualani Stream from service road
6	Waiokamilo		Locate and document EMI diversion on east Waiokamilo tributary
			(formerly Kualani Stream intake)
7	Wailuanui	A	Flow measurement

Day 2: Tuesday, December 9

ltem	Stream	IIFS Site	CWRM Action
1	Wailuanui	А	Flow measurement
2	Palauhulu	В	Flow measurement
3	Waiokamilo		Document the Koolau Ditch diversion intakes
4	Hanehoi	В	If time permits, take flow measurement if stream is not dry
5	Honopou		If time permits, take flow measurement at Haiku Ditch

Day 3: Wednesday, December 10

ltem	Stream	IIFS Site	CWRM Action
1	Wailuanui	А	Flow measurement
2	W. Wailuanui		Document the adjustment of the Koolau Ditch bypass sluice gate
3	W. Wailuanui		Flow measurement
4	E. Wailuanui		Document the adjustment of the Koolau Ditch bypass sluice gate
5	E. Wailuanui		Flow measurement
6	Kaleiomaui		Hike up the stream, tributary of Piinaau Stream, from service road
7	Piinaau		Drive to Koolau Ditch diversion intake
8	Waiokamilo		If time permits, drive to Akeke (Banana) Springs
9	Hanehoi	В	If not accomplished on Day 2, take flow measurement
10	Honopou		If not accomplished on Day 2, take flow measurement at Haiku Ditch

Weather Forecast

National Weather Service Forecast Office, Honolulu, HI, 7-Day Zone Forecast: http://www.prh.noaa.gov/hnl/pages/ZFP.php

WINDWARD HALEAKALA- INCLUDING...HANA...MAKAWAO 346 AM HST FRI DEC 5 2008

Today...Mostly sunny with scattered showers. Highs around 80 at the shore to around 67 at 5000 feet. East winds 10 to 15 mph. Chance of rain 50 percent.

Tonight...Mostly cloudy with scattered showers. Lows around 62 at the shore to around 46 at 5000 feet. East winds 10 to 15 mph. Chance of rain 50 percent.

Saturday...Mostly sunny with scattered showers. Highs around 80 at the shore to around 67 at 5000 feet. East winds 10 to 15 mph. Chance of rain 50 percent.

Saturday Night...Partly cloudy. Scattered showers in the evening...then isolated showers after midnight. Haze through the night. Lows 45 to 68. Southeast winds 10 to 15 mph shifting to the southwest in the late evening and overnight. Chance of rain 40 percent.

Sunday...Mostly sunny with isolated showers. Haze. Highs 62 to 80. Northeast winds around 10 mph. Chance of rain 20 percent.

Sunday Night...Partly cloudy. Scattered showers in the evening... Then isolated showers after midnight. Haze through the night. Lows 44 to 68. East winds around 10 mph shifting to the southwest in the late evening and overnight. Chance of rain 40 percent.

Monday...Haze in the morning. Mostly sunny with isolated showers. Highs 63 to 81. Northeast winds around 10 mph. Chance of rain 20 percent.

Monday Night...Mostly clear. Lows 42 to 67. Light winds.

Tuesday...Mostly sunny with isolated showers. Highs 62 to 80. Light winds. Chance of rain 20 percent.

Tuesday Night...Mostly clear. Isolated showers in the evening. Haze after midnight. Lows 43 to 67. Light winds. Chance of rain 20 percent.

Wednesday...Mostly sunny with isolated showers. Haze. Highs 63 to 81. South winds around 10 mph. Chance of rain 20 percent.

Wednesday Night...Partly cloudy with isolated showers. Haze. Lows 43 to 67. Southeast winds around 10 mph. Chance of rain 20 percent.

Thursday...Mostly sunny with isolated showers. Haze. Highs 62 to 80. Southeast winds around 10 mph. Chance of rain 20 percent.

East Maui Site Visit - Trip #5



Scheduled Trip Date: February 9-11, 2009 Conditions as of: Wednesday, February 4, 2009

State of Hawaii, Commission on Water Resource ManagementPhone: (808) 587-0214Toll-Free (Maui): 984-2400, Ext. 70214Fax: (808) 587-0219E-mail: dlnr.cwrm@hawaii.govWebsite: http://hawaii.gov/dlnr/cwrm

Day 1: Monday, February 9

ltem	Time	Stream / Area	IIFS	CWRM Action
1	10:00	Wailuanui		Lakini: 1) Where water is taken from Kualani Stream; and 2) Auwai system and water flow through loi
2	11:30	Wailuanui		Na Moku Project: 1) Where water is taken from Waiokamilo Stream; and 2) Auwai system and water flow through loi
3	12:30	Wailuanui		Wailua Valley Taro Loi: 1) Sources of water; 2) Auwai system and water flow through loi; 3) Bottom of Waikani Falls; and 4) Where auwai join and flows back into the stream
4	4:00	Waiokamilo		Terminal waterfall

Day 2: Tuesday, February 10

ltem	Time	Stream / Area	IIFS	CWRM Action
1	08:00	Honopou	A	Observe flow at IIFS site. Flow measurement taken the following day.
2	09:00	Palauhulu	В	Observe flow at IIFS site. Flow measurement taken the following day.
3	10:00	Waiokamilo		Hike mauka on main Waiokamilo Stream from Hana Highway. Identify diversions, and where Kualani and Waiokamilo Streams split.
4	12:00	Wailuanui	А	Flow measurement.
5	02:00	Piinaau		Identify where Palauhulu and Piinaau Streams join.
6	02:30	Waiokamilo	А	Visit Dam 3 and the losing reaches above and below Dam 3.
7	04:00	Keanae		Keanae Arboretum

Day 3: Wednesday, February 11

ltem	Time	Stream / Area	IIFS	CWRM Action
1	08:00	Honopou	А	Flow measurement.
2	09:30	Huelo	А	Flow measurement.
3	11:30	Palauhulu	В	Flow measurement.
4	02:00	Wailuanui		Flow measurement.
5	03:30	East Maui		Visit all streams on the way to Makapipi.

Weather Forecast

National Weather Service Forecast Office, Honolulu, HI, 7-Day Zone Forecast: http://www.prh.noaa.gov/hnl/pages/ZFP.php

WINDWARD HALEAKALA- INCLUDING...HANA...MAKAWAO 337 AM HST WED FEB 4 2009

Today...Cloudy. Scattered showers in the morning...then numerous showers in the afternoon. Highs around 75 at the shore to around 66 at 5000 feet. East winds 10 to 20 mph. Chance of rain 70 percent.

Tonight...Cloudy with numerous showers. Lows around 63 at the shore to around 48 at 5000 feet. East winds 10 to 15 mph. Chance of rain 70 percent.

Thursday...Mostly cloudy with scattered showers. Highs around 76 at the shore to around 65 at 5000 feet. East winds 10 to 15 mph. Chance of rain 50 percent.

Thursday Night...Mostly cloudy with scattered showers. Lows 44 to 64. East winds around 10 mph. Chance of rain 50 percent.

Friday...Mostly cloudy with scattered showers. Highs 63 to 77. East winds 10 to 15 mph. Chance of rain 50 percent.

Friday Night...Mostly cloudy with scattered showers. Lows 41 to 65. East winds 10 to 20 mph. Chance of rain 50 percent.

Saturday...Mostly cloudy with scattered showers. Highs 62 to 77. East winds 10 to 15 mph. Chance of rain 50 percent.

Saturday Night...Mostly cloudy with scattered showers. Lows 42 to 66. East winds 10 to 15 mph. Chance of rain 50 percent.

Sunday...Partly sunny with scattered showers. Highs 62 to 79. East winds 10 to 15 mph. Chance of rain 50 percent.

Sunday Night...Mostly cloudy with scattered showers. Lows 43 to 66. East winds 15 to 20 mph. Chance of rain 50 percent.

Monday...Partly sunny with scattered showers. Highs 61 to 80. East winds 15 to 20 mph. Chance of rain 50 percent.

Monday Night...Partly cloudy with scattered showers. Lows 43 to 64. East winds 15 to 20 mph. Chance of rain 50 percent.

Tuesday...Partly sunny with scattered showers. Highs 61 to 80. East winds 15 to 20 mph. Chance of rain 50 percent.

East Maui Site Visit – Trip #7



Scheduled Trip Date: April 6-8, 2009 Conditions as of: Wednesday, April 1, 2009

State of Hawaii, Commission on Water Resource ManagementPhone: (808) 587-0214Toll-Free (Maui): 984-2400, Ext. 70214Fax: (808) 587-0219E-mail: dlnr.cwrm@hawaii.govWebsite: http://hawaii.gov/dlnr/cwrm

The objective of this Maui site visit will be to meet with those interests that rely upon the East Maui Irrigation system for delivery of water, including farmers at the County's Kula Agricultural Park, the Department of Water Supply, and Hawaiian Commercial & Sugar Company (HC&S).

Day 1: Monday, April 6

Staff will be meeting with representatives of the Maui County Farm Bureau and County Office of Economic Development to tour the Kula Agricultural Park and meet with farmers and ranchers in the Upcountry region.

Day 2: Tuesday, April 7

Staff will be meeting with the Maui Department of Water Supply to visit the Olinda, Piiholo, and Kamole Weir surface water treatment facilities.

Day 3: Wednesday, April 8

Staff will be meeting with HC&S representatives to learn more about their mill operations, sugar processing, hydroelectric facilities, field operations, and watering procedures.

Weather Forecast

National Weather Service Forecast Office, Honolulu, HI, 7-Day Zone Forecast: http://www.prh.noaa.gov/hnl/pages/ZFP.php

1 Miles ENE Pukalani HI 440 PM HST WED APR 1 2009

Today...Cloudy. Scattered showers in the morning...then numerous showers in the afternoon. Highs around 75 at the shore to around 66 at 5000 feet. East winds 10 to 20 mph. Chance of rain 70 percent.

Tonight...Cloudy with numerous showers. Lows around 63 at the shore to around 48 at 5000 feet. East winds 10 to 15 mph. Chance of rain 70 percent.

Thursday...Mostly cloudy with scattered showers. Highs around 76 at the shore to around 65 at 5000 feet. East winds 10 to 15 mph. Chance of rain 50 percent.

Thursday Night...Mostly cloudy with scattered showers. Lows 44 to 64. East winds around 10 mph. Chance of rain 50 percent.

Friday...Mostly cloudy with scattered showers. Highs 63 to 77. East winds 10 to 15 mph. Chance of rain 50 percent.

Friday Night...Mostly cloudy with scattered showers. Lows 41 to 65. East winds 10 to 20 mph. Chance of rain 50 percent.

Saturday...Mostly cloudy with scattered showers. Highs 62 to 77. East winds 10 to 15 mph. Chance of rain 50 percent.

Saturday Night...Mostly cloudy with scattered showers. Lows 42 to 66. East winds 10 to 15 mph. Chance of rain 50 percent.

Sunday...Partly sunny with scattered showers. Highs 62 to 79. East winds 10 to 15 mph. Chance of rain 50 percent.

Sunday Night...Mostly cloudy with scattered showers. Lows 43 to 66. East winds 15 to 20 mph. Chance of rain 50 percent.

Monday...Partly sunny with scattered showers. Highs 61 to 80. East winds 15 to 20 mph. Chance of rain 50 percent.

Monday Night...Partly cloudy with scattered showers. Lows 43 to 64. East winds 15 to 20 mph. Chance of rain 50 percent.

Tuesday...Partly sunny with scattered showers. Highs 61 to 80. East winds 15 to 20 mph. Chance of rain 50 percent.



Island of Maui

Day 1: Tuesday, February 15

- Time Action
- 07:30 Arrive on Maui
- 08:30 Conduct water level and CTD survey of Waiehu deep monitor well.
- 10:30 Conduct water level and CTD survey of Iao deep monitor well.
- 13:00 Conduct water level survey of Mahinahina deep monitor well.

Day 2: Wednesday, February 16

Time Action

- 07:30 Pick-up gate keys from EMI, Mark Vaught.
- 09:00 Install barometric pressure transducer at Waiohue.
- 10:00 Install pressure transducer at East Wailuaiki.
- 11:00 Install barometric pressure transducer at Palauhulu; Download field camera.
- 12:00 Install field camera and staff plate at Palauhulu upper site.
- 16:30 Install barometric pressure transducer at Honopou.** If can't get to Honopou, then complete on Thursday afternoon.

Day 3: Thursday, February 17

Time Action

08:30 Meet Garret Hew at South Waiehu Measure flow in Spreckels Side Ditch at South Waiehu. Install barometric pressure transducer at South Waiehu. Download pressure transducer at South Waiehu.



Island of Maui

Day 1: Monday, March 21

- Time Action
- 07:00 Arrive on Maui
- 08:00 Meet WWC at Waihee to download pressure transducer and field camera data.
- 09:30 Meet HC&S at South Waiehu. Take flow measurement in Spreckels side ditch. Download pressure transducers.
- 11:00 Waiehu Download stream transducer.
- 12:00 Conduct reconnaissance of North Waiehu Stream.
- 15:00 Meet with Les Nakama and David Singer.

Day 2: Tuesday, March 22

- Time Action
- 07:30 Pick-up keys from EMI
- 08:00 Hanehoi Download stream transducer and make streamflow measurement.
- 11:00 Palauhulu Download field camera and install staff gage.
- 15:00 Honopou Download stream and barometric pressure transducers.

Day 3: Wednesday, March 23

Time Action

- 08:00 Head out to East Maui
- 09:30 Waiohue Download stream and barometric pressure transducers.
- 10:30 East Wailuaiki Download stream transducer.
- 11:00 West Wailuaiki Download stream transducer.
- 11:30 Wailuanui Download field camera and stream transducer.
- 12:30 Palauhulu Download field camera, stream and barometric pressure transducers.
- 14:00 Waikamoi Download stream transducer.



Island of Maui

The purpose of this field investigation is for Hawaiian Commercial & Sugar Co. (HC&S), Wailuku Water Co. (WWC), Division of Aquatic Resources (DAR), and CWRM staff to meet in the field to discuss and agree upon specific diversion modifications to achieve biological connectivity for streams in Na Wai Eha and East Maui.

Day 1: Monday, April 25 (Na Wai Eha)

Time Action

- 0900 Meet at end of Waihee Valley Rd.
- Spreckels Ditch and Waihee Ditch intakes on Waihee River.
- 1100 Spreckels Ditch intake on South Waiehu Stream.
- 1200 Lunch at Kepaniwai Park.
- 1300 Iao-Maniania Ditch intake on Iao Stream.
- 1400 Spreckels Ditch intake on Iao Stream.
- 1500 Waihee Ditch and Reservoir 6 intakes on Waikapu Stream.

Day 2: Tuesday, April 26

Time Action

- 0830 Meet at Hanawi Stream on Hana Hwy. (near pump house).
- 0900 Koolau Ditch intake on Hanawi Stream.
- 1030 Koolau Ditch intake on Waiohue Stream.
- 1130 Lunch.
- 1230 Koolau Ditch intake on East Wailuaiki Stream.
- 1330 Koolau Ditch intake on West Wailuaiki Stream.
- 1500 Center Ditch intake on Waikamoi Stream.

Day 3: Wednesday, April 27

Time Action

- 0830 Meet at Haiku Ditch on Honopou Stream.
- 1000 Wailoa Ditch and New Hamakua Ditch on Honopou Stream.
- 1200 End of field investigation.



Quarterly Monitoring Trip

Day 1: Monday, June 13

Time Action

- 0900 Log Waiehu Deep Monitoring Well
- 1100 Log Iao Deep Monitoring Well
- 1400 Log Mahinahina Well

Day 2: Tuesday, June 14

Time Action

- 0730 Pick-up keys from EMI.
- 0800 Hanehoi Download stream transducer.
- 1000 Waiohue Download stream and barometric pressure transducers.
- 1030 East Wailuaiki Download stream transducer.
- 1100 West Wailuaiki Download stream transducer.
- 1130 Wailuanui Download stream transducer.
- 1300 Palauhulu (Upper) Download field camera.
- 1400 Palauhulu Download stream and barometric pressure transducers.
- 1500 Waikamoi Download stream transducer.
- 1600 Honopou Download stream and barometric pressure transducers.

Day 3: Wednesday, June 15

Time Action

- 0800 Meet WWC at gate to Waihee River.
- 0830 Waihee Download field camera and stream transducer.
- 1000 Waiehu Download stream transducer.
- 1030 Meet HC&S at bridge.
- 1100 Spreckels Ditch intake at South Waiehu Measure ditch flow and download stream and barometric pressure transducers.



Island of Maui

Quarterly monitoring trip.

Day 1: Monday, September 26

Time Action

- 0900 Meet WWC at gate to Waihee River
- 0930 Waihee Download field camera and stream transducer.
- 1030 Waiehu Download stream transducer and measure stream flow.
- 1200 Meet HC&S at gate at Spreckels Ditch.
- 1230 Spreckels Ditch intake at South Waiehu Measure ditch flow and download stream and barometric pressure transducers.

Day 2: Tuesday, September 27

- Time Action
- 0730 Pick-up keys from EMI.
- 0800 Hanehoi Download stream transducer.
- 1000 Waiohue Download stream and barometric pressure transducers
- 1030 East Wailuaiki Download stream transducer.
- 1100 West Wailuaiki Download stream transducer.
- 1130 Wailuanui Download field camera and stream transducer.
- 1300 Palauhulu (Upper) Download field camera.
- 1400 Palauhulu Download stream and barometric pressure transducers.
- 1500 Waikamoi Download stream transducer.
- 1600 Honopou Download stream and barometric pressure transducers.

Day 3: Wednesday, September 28

- Time Action
- 0800 Return keys to EMI.
- 1000 Meet with the Nahiku community.
- 1300 Measure streamflows at various sites and download transducers at any remaining locations.



Island of Maui

The purpose of this field investigation is for Hawaiian Commercial & Sugar Co. (HC&S), Wailuku Water Co. (WWC), Division of Aquatic Resources (DAR), and CWRM staff to meet in the field and assess diversion modifications for biological connectivity on streams in Na Wai Eha and East Maui. Day 2 will also include implementation of winter season water releases to meet interim IFS on Waiohue, East Wailuaiki, West Wailuaiki, and Waikamoi streams in East Maui.

Day 1: Tuesday, November 1

Time Action

- 0900 Meet at end of Waihee Valley Rd.
- Spreckels Ditch and Waihee Ditch intakes on Waihee River.
- 1100 Iao-Maniania Ditch intake on Iao Stream.
- 1200 Lunch at Kepaniwai Park.
- 1300 Spreckels Ditch intake on Iao Stream.
- 1400 Waihee Ditch and Reservoir 6 intakes on Waikapu Stream.

Day 2: Wednesday, November 2

Time Action

- 0730 Meet at access gate on Hana Hwy. before Hanawi Stream.
- 0800 Koolau Ditch intake on Hanawi Stream.
- 0930 Koolau Ditch intake on Waiohue Stream.
- 1100 Koolau Ditch intake on East Wailuaiki Stream.
- 1230 Lunch.
- 1300 Koolau Ditch intake on West Wailuaiki Stream.
- 1400 Center Ditch intake on Waikamoi Stream.
- 1600 Haiku Ditch intake on Honopou Stream.

Day 3: Thursday, November 3 (CWRM/DAR staff only)

Time Action

- 0900 Measure post-release streamflows at IFS sites: Waiohue Stream.
- 1000 East Wailuaiki Stream
- 1100 West Wailuaiki Stream
- 1200 Waikamoi Stream



Island of Maui

Quarterly monitoring trip. Day 3 will also include adjusting the East Maui Irrigation Co. (EMI) gates at East and West Wailuanui Stream diversions to ensure compliance with the interim instream flow standards while allowing EMI to divert water at high flows.

Day 1: Monday, December 12

Time Action

- 1000 Meet WWC at gate to Waihee River
- 1015 Waihee Download field camera and stream transducer.
 WWC will take the Deputy to Spreckels Intake on Waihee, while staff conducts fieldwork.
- 1045 WWC will take Deputy and staff to North Waiehu kuleana pipe on Waihee Ditch.
- 1130 Waihee at Kahekili Hwy. Download stream transducer.
- 1300 Meet HC&S at gate at Spreckels Ditch. WWC will continue on with the Deputy to Waihee Ditch and Spreckels Ditch Intakes on Iao, and Reservoir 6 and Waihee Ditch Intakes on Waikapu.
- 1330 Spreckels Ditch intake at South Waiehu Measure ditch flow and download stream and barometric pressure transducers.
- 1430 Waiehu Download stream transducer and measure stream flow. Staff will meet up with WWC when complete.

Day 2: Tuesday, December 13

Time Action

- 0730 Pick-up keys from EMI.
- 0800 Hanehoi Download stream transducer.
- 1000 Waiohue Download stream and barometric pressure transducers, measure streamflow.
- 1100 East Wailuaiki Download stream transducer and measure streamflow.
- 1200 West Wailuaiki Download stream transducer and measure streamflow.
- 1300 Wailuanui Download field camera and stream transducer.
- 1400 Palauhulu (Upper) Download field camera.
- 1600 Palauhulu Download stream and barometric pressure transducers.
- 1630 Waikamoi Download stream transducer.

Day 3: Wednesday, December 14

Time Action

- 0900 Meet EMI at Wailuaiki gate on Hana Hwy. Return EMI keys.
- 0930 Perform gate adjustments at East and West Wailuanui diversion gates.
- 1100 Measure post-release streamflows at IFS sites: Waiohue Stream, East Wailuaiki, West Wailuaiki and Waikamoi.
 - Perform any remaining tasks not completed on Day 2.
- 1500 Honopou Download stream and barometric pressure transducers.



Island of Maui

Quarterly monitoring trip.

Day 1: Thursday, March 29

Time Action

- 0800 Pick-up keys from EMI.
- 0830 Hanehoi Download stream transducer.
- 1000 Waiohue Download stream and barometric pressure transducers.
- 1100 East Wailuaiki Download stream transducer.
- 1200 West Wailuaiki Download stream transducer.
- 1300 Wailuanui Download stream transducer.
- 1400 Palauhulu Download stream and barometric pressure transducers.
- 1500 Waikamoi Download stream transducer.
- 1600 Honopou Download stream transducer.

Day 2: Friday, March 30

Time Action

- 0800 Meet WWC at Cane Haul Road intersection. View North Waiehu Stream Intake to Waihee Ditch.
- 0930 Go to Waihee Valley with WWC.
- 0945 Waihee below Spreckels Ditch Download field camera and stream transducer.
- 1030 Waihee at Kahekili Hwy. Download stream transducer.
- 1300 Meet HC&S at gate at Spreckels Ditch.
- 1330 Spreckels Ditch intake at South Waiehu Measure ditch flow and download stream and barometric pressure transducers. Reinstall barometric transducer.
- 1500 Waiehu Download stream transducer.



Island of Maui

The purpose of this field investigation is as follows: 1) Accompany Nahiku Community Association (NCA) representatives and East Maui Irrigation Co. (EMI) staff on a site visit of the Makapipi Stream diversion to the Koolau Ditch; 2) Accompany EMI in their implementation of summer season IFS and closing sluice gates on Waiohue, East Wailuaiki, West Wailuaiki, and Waikamoi streams in East Maui; and 3) Accompany U.S. Geological Survey staff on a site visit of Honokowai Stream in West Maui.

Day 1: Tuesday, May 1

Time Action

0700	Arrive on Maui, pick up car/equipment, head out to east Maui
0945	Meet NCA and EMI on Hana Hwy. at Makapipi Stream
1130	Meet EMI on Hana Hwy. at gate to Waiohue Stream.
	Action at Waiohue Stream.
1200	Head to Wailuaiki gate.
	Lunch.
	Action at East Wailuaiki and West Wailuaiki.
1300	Head to Waikamoi gate.

Action at Waikamoi Stream.

Day 2: Wednesday, May 2

Time Action

- 0700 Meet USGS staff at location to be determined
- 0730 Head to Honokowai Stream to accompany USGS to measurement sites.
- 1200 Lunch.
- 1400 Head to Wahikuli Stream and USGS measurement site, if time permits (need to be at Kahului Airport by 1600).
- 1700 Depart to Honolulu.



Island of Maui

Day 1: Wednesday, June 13

- Time Action
- 0700 Arrive on Maui
- 0830 Meet WWC at Waihee Valley Rd. gate.
- 0845 Waihee Download stream transducer and make streamflow measurement.
- South Waiehu Meet HC&S at gate at Spreckels Ditch.
 Spreckels Ditch intake at South Waiehu Download stream/baro transducers and make ditch flow measurement.
 Waiehu Download stream transducer.
- 1300 Pick-up keys from EMI.
- 1400 Hanehoi Download stream transducer and make streamflow measurement.
- 1530 Honopou Download stream/baro transducers and make streamflow measurement.

Day 2: Thursday, June 14

Time Action

- 0730 Drop-off keys at EMI
- 0900 Waiohue Download stream/baro transducers and make streamflow measurement.
- 1030 East Wailuaiki Download stream transducer and make streamflow measurement.
- 1200 West Wailuaiki Download stream transducer and make streamflow measurement.
- 1400 Wailuanui Download stream transducer.
- 1500 Palauhulu Download stream/baro transducers.
- 1600 Waikamoi Download stream transducer.


Island of Maui

Day 1: Tuesday, September 18

- Time Action
- 0700 Arrive on Maui
- 0830 Pick-up keys from EMI.
- 0930 Hanehoi Download stream transducer.
- 1100 Waiohue Download stream/baro transducers.
- 1130 East Wailuaiki Download stream transducer.
- 1200 West Wailuaiki Download stream transducer.
- 1300 Wailuanui Download stream transducer.
- 1400 Palauhulu Download stream/baro transducers.
- 1430 Waikamoi Download stream transducer.
- 1600 Honopou Download stream/baro transducers.

Day 2: Wednesday, September 19

- Time Action
- 0800 Drop-off keys at EMI
- 0900 Meet WWC at Waihee Valley Rd. gate.
- 0915 Waihee Download stream transducer.
- 1100 South Waiehu Meet HC&S at gate at Spreckels Ditch.
- 1115 Spreckels Ditch intake at South Waiehu Download stream/baro transducers and make ditch flow measurement.
- 1200 Waiehu Download stream transducer.
- 1300 Drop-off keys at WWC.



Island of Maui

Day 1: Thursday, March 21

- Time Action
- 0800 Arrive on Maui
- 0900 Meet WWC at Waihee Valley Rd. gate.
- 0915 Waihee Download stream transducer.
- 1000 Waiehu Download stream transducer.
- 1100 South Waiehu Meet HC&S at gate at Spreckels Ditch.
- 1115 Spreckels Ditch intake at South Waiehu Download stream/baro transducers. Ditch flow measurement will be optional
- 1200 Drop-off keys at WWC.
- 1400 Pick-up keys from EMI.
- 1500 Hanehoi Download stream transducer.
- 1600 Honopou Download stream/baro transducers.

Day 2: Friday, March22

Time Action

- 0800 Drop-off keys at EMI
- 1000 Waiohue Download stream/baro transducers.
- 1130 East Wailuaiki Download stream transducer.
- 1200 West Wailuaiki Download stream transducer.
- 1300 Wailuanui Download stream transducer.
- 1400 Palauhulu Download stream/baro transducers.
- 1430 Waikamoi Download stream transducer.



Island of Maui

Day 1: Monday, September 16

- Time Action
- 0700 Arrive on Maui
- 0830 CWRM Staff to conduct a class presentation
- 1030 Meet Wailuku Water Company staff at end of Waihee Valley Road
- 1100 Waihee Download stream transducer.
- 1130 South Waiehu Meet HC&S at gate at Spreckels Ditch.
- 1130 Waiehu Download stream transducer.
- 1215 Spreckels Ditch intake at South Waiehu Download stream/baro transducers.
- 1300 Drop-off keys at WWC.
- 1400 Pick-up keys from EMI.
- 1500 Hanehoi Download stream transducer.
- 1630 Honopou Download stream/baro transducers.

Day 2: Tuesday, September 17

- Time Action
- 0900 Meet EMI at East Wailuanui Gate. Conduct adjustment of East Wailuanui gate.
- 1100 Waiohue Download stream/baro transducers.
- 1200 East Wailuaiki Download stream transducer.
- 1300 West Wailuaiki Download stream transducer.
- 1400 Wailuanui Download stream transducer.
- 1500 Palauhulu Download stream/baro transducers.
- 1600 Waikamoi Download stream transducer.



Island of Maui

Monday, December 15 Time Action

DEAN & REBECCA

- 0700 Arrive on Maui (Pick-up rental car)
- 0900 Meet DOCARE at Honolua Bay lookout
- 0930 Conduct site investigation of Honokohau Valley, Ching's Dam
- 1200 Upon completion of site investigation, meet up with Ayron and Malie.

AYRON & MALIE

- 0700 Arrive on Maui (Pick-up DOFAW vehicle)
- 0800 Get equipment from DAR
- 0900 Meet WWC at Waihee Valley Rd. gate. *Waihee River below Spreckels Ditch* – Measure streamflow and download transducers.
- 1030 Meet HC&S at Cane Haul Rd. gate. Spreckels Ditch Intake at South Waiehu – Measure streamflow and download transducers.
- 1130 *Waiehu Stream below Confluence (at Cane Haul Rd. Bridge)* Measure streamflow and download transducers.
- 1230 Lunch
- 1330 Iao Stream at Kepaniwai Park Measure streamflow and download transducers.
- 1500 *Waikapu Stream at elev 600 feet* Measure streamflow and download transducers. Discuss IIFS staff plate installation site location.
- 1600 If not raining, try to get a streamflow measurement on *Iao Stream at Waiehu Beach Road Bridge*.

Tuesday, December 16

Time Action

- 0700 Pick-up keys at EMI
- 0800 Hanehoi Measure streamflow and download transducers.
- 1000 Makapipi Meet with residents
- 1100 Check out stream gages on Makapipi Stream
- 1200 Check out Hanawi Stream and others while driving back west.
- 1300 Lunch
- 1400 Palauhulu Measure streamflow and download transducers, reinstall staff plate.
- 1530 Honopou Meet with residents



1600 Honopou – Measure streamflow and download transducers.

Wednesday, December 17

Time Action

- 0800 Return keys to EMI
- 0930 Waiohue Measure streamflow and download transducers.
- 1030 East Wailuaiki Measure streamflow and download transducers.
- 1130 West Wailuaiki Measure streamflow and download transducers.
- 1230 Lunch
- 1330 Wailuanui Measure streamflow and download transducers.
- 1500 Waikamoi Measure streamflow and download transducers.
- 1700 Return equipment to DAR.
- 1830 Depart for Honolulu

Field Investigation Reports



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102301 (East Maui, Honopou IIFS Site A)

Date of Field Investig	Time (24-hour): 0500 - 0930
CWRM Staff:	Dean Uyeno, Ken Kawahara, Chui Ling Cheng
Individuals Present:	Agency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff); Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and Wanda Vierra
Hydrologic Unit:	Honopou (6034)
Stream Name:	Honopou Stream

Findings:

CWRM staff departed Oahu for Maui at 0500 hours. On Maui, staff picked up vehicle at the Division of Forestry and Wildlife (DOFAW) base yard. Then, met with Skippy Hau at the Division of Aquatic Resources (DAR) base yard. CWRM staff and Skippy drove (in one vehicle) to the USGS warehouse to meet with Matt Wong, who chose to take his own vehicle for the entire field visit. CWRM staff, Skippy Hau and Matt Wong will be referred as the staff crew in the remainder of this report.

At approximately 0800 hours, staff crew met with members of the Honopou community at the Haiku Ditch diversion on Honopou Stream. Everyone then drove to the bridge that crosses Honopou Stream further downstream. Staff crew evaluated the section of the stream from the pond upstream to the bridge. Matt Wong recommended two locations: 1) one for flow measurement; and 2) another with a gage pool to record gage height as well as for the possible installation of a staff gage. Together, these represent interim instream flow standard (IIFS) Site A as indicated in the staff submittal. The flow measurement location is approximately 60 feet upstream of the gage pool. The gage pool is approximately 10 feet upstream from the bridge, and is bounded by a concrete wall. Matt inspected the concrete wall and noted a minor leakage in the wall, towards the right stream bank.

Under Matt Wong's supervision, staff crew prepared the site for flow measurement. The site was flagged with yellow tape, labeled with the stream name, IIFS site, and the date. While CWRM staff and Skippy Hau were taking the flow measurement, Matt Wong set up a reference point at the gage pool downstream to record changes in gage height (if any) during the flow measurement. Matt used a hammer drill to install an anchor bolt to the old staff plate structure, concrete-reinforced masonry (CRM), on the right stream bank, then used red spray paint to mark the site. Staff crew completed the entire flow measurement in 40 minutes. Gage height readings were taken at the downstream gage pool at the start and finish of flow measurement. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.229 cubic feet per second (0.148 million gallons per day), with a gage height change of +0.01 feet.

Staff crew left Honopou IIFS Site A at approximately 0930 hours, and continued further downstream to select IIFS Site B on Honopou Stream. Refer to Field Investigation Report FI2008102302 (East Maui, Honopou IIFS Site B) for more information.

Image Listing: (Attach P	DF of image contact sheet)
File Name:	Brief Description:
20081023001	Bridge crossing Honopou Stream.
20081023002	Gage pool and concrete wall on Honopou Stream.
20081023003	Right bank of the gage pool where the reference point was set, Honopou Stream.
20081023004	Gage pool and concrete wall taken from the left bank of Honopou Stream.
20081023006	Staff crew setting up flow measuring station on Honopou Stream.
20081023008	Staff crew setting up flow measuring station on Honopou Stream.
20081023010	Staff crew conducting flow measurement on Honopou Stream.
20081023013	Wading rod and measuring tape indicating height of water level on Honopou Stream.
20081023014	Chui Ling Cheng recording flow measurement on Honopou Stream with the help of Matt Wong.
20081023016	Dean Uyeno adjusting the wading rod during flow measurement on Honopou Stream.
20081023017	Staff crew conducting flow measurement on Honopou Stream.
20081023019	Staff crew conducting flow measurement on Honopou Stream.
20081023020	Matt Wong installing anchor bolt into rock as the reference point on Honopou Stream.

20081023021	Matt Wong installing anchor bolt into rock as the reference point on Honopou Stream.
20081023023	Dean Uyeno and Matt Wong conducting flow measurement on Honopou Stream.
20081023026	Dean Uyeno conducting flow measurement on Honopou Stream.
20081023028	Staff crew conducting flow measurement on Honopou Stream. Also in the photo are members from the
	Kekahuna family.
20081023032	Chui Ling Cheng taking wind velocity measurement on Honopou Stream.
20081023033	Skippy Hau taking water temperature measurement on Honopou Stream.
20081023035	Matt Wong taking gage height measurement on Honopou Stream.
20081023036	Matt Wong taking gage height measurement on Honopou Stream.
20081023037	Matt Wong explaining to CWRM staff how to take gage height measurement on Honopou Stream.

GPS Listing:

Shapefiles: (List file name	s of all shapefiles created and a brief description of each)
File Name:	Brief Description:
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
6	20.916212	-156.245203	Bridge on Honopou Stream
7	20.916187	-156.245174	IIFS Site A Reference Point on Honopou Stream
8	20.916096	-156.245077	IIFS Site A Flow Measurement on Honopou Stream

Attachments:

 Brief Description:

 1. Image Contact Sheet

 2. Discharge Measurement and Gage Inspection Notes

Recommendations:



20081023001.JPG

20081023002.JPG

20081023003.JPG



20081023004.JPG



20081023006.JPG



20081023008.JPG







20081023010.JPG

20081023013.JPG

20081023014.JPG



20081023016.JPG



20081023017.JPG



20081023020.JPG

20081023021.JPG

20081023023.JPG



20081023026.JPG



20081023028.JPG



20081023032.JPG

20081023033.JPG



20081023035.JPG



20081023036.JPG



Form 9-275F (Apr. 2001)

downstr

upstr.

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008102301 - Page 5 of 6

Meas. No. _

Comp.by ______

Checked by DDW

Ŀ	Joto	10 10 / 23	20	070 P=	arty Ch	ui De	an, Ker	1, SKIDPY, Matt Word
\mathbf{v}	Jaie Midth	3.0	,20 Area	1.174	2Ve	el 0.1 ^c	G.	H. 0.85-0.86 Disch. 0.229 CFS
् ् क	Method	War	1100	N	o. secs.	40	G. H. cha	nge <u>+ 0.01</u> in <u>0.5</u> hrs.
Ň	viethod (coef.	Ho	riz. angle	e coef		Susp	Tags checked
P	Meter Tv	/pe		veter No)		Met	er ft. above bottom of wt.
F	Ratino u	sed		S	Spin test	before m	eas	; after
ļ	Vieas. pl	lots		% diff. fi	rom ratir	ng no		Indicated shift
Г					INGS		<u> </u>	Samples collected: water quality.
┟	Time	<u></u>				Inside	Outside	sediment, biological, other
┝				·				
ł						[Measurements documented on
ŀ		Start	8.20	AM		1 60 (R)	1)-0.15	separate sheets: water quality,
·			LEW	@ 3.1		= 0.1	35	aux./basegage.one
ŀ				<u>.v</u>				
ŀ		<u>† </u>	1					Rain gage serviceo/calibrateo
Ì						ļ		Westher Overcast light sorink
					·	<u> </u>	 	Air Tomo 19 °C at 09:13
:		Finish	09:09	AM	·	1.00(RP	1-0.14	Minternip Out
			KEIV G	6.1	<u> </u>	= 0.8	Ь	Water lemp. <u>cer.y</u> Cat
	Weighte	dMGH	·					
			•		-		1	
	GHcorr	ection		<u> </u>				
	GH corr Correct	ection MGH			wostr s	ide brida	- 60	Correct
	GH corr Correct Wading Measur conditio Cross s	ection MGH g, cable, i rement ra cons: Flow section:	ce, boat, u ated excel v: fair(L)	lpstr., do lent (2%) d_lam umfzr	ownstr.s), good (i unar f	side bridg 5%) fair (Tow ; obble ,	e, <u>60</u> 8%), pool 2ating bechtzk	Correct (> 8%); based on following . 5% good, fair (1) even velocit
	GH corr Correct Wading Measur conditio Cross s Gage o	ection MGH g, cable, i rement ra ons: Flow section:	ce, boat, u ated excel v: fauru;	ipstr., do ilent (2%) d_lam umfzr), good (1 1), good (1), goo	side bridg 5%) fair (Tow ; obble ,	e, <u>60</u> 8%), pool 2ating bechtzk Record Re	Correct (> 8%); based on following . 5% good , fair Ly even velocit emoved
	GH corr Correct Wading Measur conditio Cross s Gage o Battery	ection MGH g, cable, i rement ra ons: Flow section: operating y voltage	ce, boat, u ated excel v: fouric)	(pstr., do lent (2%) d_lam umfzr	ownstr_s), bood (f unar_f unf unC	ide bridg 5%) fair (10w ; 0bbl C , ifice clea	e, <u>60</u> 8%), poor Cating bechtzk Record Re ned/purge	Correct (> 8%); based on following . 5% good , fair lig even velocrt emoved
*	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble	ection MGH g, cable, i rement ra ons: Flow section: operating voltage: e-gage pr	ce, boat, u ated excel v: fzuru() : essure, p	ipstr., do lent (2%) <u>d lam</u> <u>um fam</u> Ir si: Tank	wnstr_s), tood (f unar_f rmC	side bridg 5%) fair (10% ; 10% ; 0 bbl C , 0 bbl C , ifice clea	e, <u>60</u> 8%), pool 2ating bechtzik Record Re ned/purge	Correct (> 8%); based on following . 5% good , fair Lij even veloart emoved god moved
*	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble Extrem	ection MGH g, cable, i rement ra ons: Flow section: operating voltage voltage pr ne-GH inv	ce, boat, u ated excel v:	(pstr., do lent (2%) d_lam umfzr lr si: Tank max	ownstr.s), good (f unar f vn.c	side bridg 5%) fair (10w ; 0bbl C , ifice clea , Lin , m	e, <u>60</u> 8%), pool lating becirt7k Record Re ned/purge	Correct (> 8%); based on following . 5% good , fair Lij even veloort emoved good
*	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble Extrem CSG c	ection MGH , cable, i rement ra ons: Flow section: operating voltage: -gage pr ne-GH ind	ce, boat, u ated excel v:	Ipstr., do Ient (2%) dlann lann lr si: Tank max HWM he	wnstr.s), bood (i unar f un c htake/Or	side bridg 5%) fair (10w ; 10w ; 10	e, <u>60</u> 8%), poor 2ating becirt7k Record Re ned/purge e in Ref	Correct (> 8%); based on following . <u>5% good , fair tri even velocit</u> emoved gibble-rate /min.
*	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble Extrem CSG c HWM i	ection MGH g, cable, i rement ra ons: Flow section: perating voltage r-gage pr he-GH in hecked:_ nside/ou	ce, boat, u ated excel v: fair(c) : essure, p dicators: r tside:	pstr., do lent (2%) d_lam in in si: Tank max HWM he	ownstr.s), good (f <u>unar f</u> un c ntake/Or eight on s	ide bridg 5%) fair (10w ; 0bbb c , ifice clea , Lin , m stick	e, <u>60</u> 8%), pool 2ating bechtzik Record Re ned/purge e in Ref	Correct (> 8%); based on following . 5% good , fair Ly even velocit emoved genoved f. elev HWM elev
	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble Extrem CSG c HVVM i Contro	ection MGH g, cable, i rement ra ons: Flow section: operating voltage voltage re-gage pr he-GH in hecked:_ nside/ou	ce, boat, u ated excel v:	(pstr., do lent (2%) d_lam umfzr umfzr is: Tank nax HWM he	bwnstr, s), good (f innar f inn c htake/Or eight on s	ide bridg 5%) fair (10w ; 0bbl C , ifice clea F ifice clea fin , m stick	e, <u>60</u> 8%), poor lating bechtt7k Record Re ned/purge	Correct Correct ft.)mi. upstr., downstr. of gage. ^{c01} r (>8%); based on following . <u>5% good , fair Inj even velocrt</u> emoved emoved ged: f. elev HWM elev
*	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble Extrem CSG c HWM i Contro	ection MGH g, cable, i rement ra ons: Flow section: operating voltage: -gage pr ne-GH ind hecked: nside/ou bl: voltage: -gage pr	ce, boat, u ated excel v:	Ipstr., do Ient (2%) dlan lan lr si: Tank max HWM he cm.	wnstr.s), good (i <u>annar 1</u> rn c ntake/Or eight on s	side bridg 5%) fair (10w ; 10w ; 0bbl C , ifice clea , Lin , m stick	e, <u>60</u> 8%), poor 2ating becirt7k Record Re ned/purge e in Ref	Correct (> 8%); based on following . 5% good , fair try even velocit emoved f. elev HWM elev
	GH corr Correct Wading Measur conditio Cross s Gage o Battery Bubble Extrem CSG c HVVM i Contro Remai	ection MGH g, cable, i rement ra- cons: Flow section: operating voltage re-gage pr hecked:_ nside/ou bl: rks:	ce, boat, u ated excel v:	(pstr., do lent (2%) d_lam umfzr Ir si: Tank max HWM he cmn, 	bwnstr, s), good (f inner f inner f i	side bridg 5%) fair (10w ; 0bbbl c , ifice clea , Lin , m stick	e, <u>60</u> 8%), pool 2ating beckrezk Record Re ned/purge	Correct (> 8%); based on following . 5% gocd , fair Ing even velocrt emoved get: ; Bubble-rate /min. f. elev HWM elev

₹	.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI2008102 . 75	2301 - Page 6 of 6
	UCEF-	DIST.			VA. PTH		TIME	VEL	OCITY	ADJUST- ED FOR			
	ANGLE C FICIEI	INITIAL POINT	WIDTH	DEPTH	OBSER TION DE	REVO- LUTIONS	SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	_
LEW	LEN	@ 04	0:30	(40	sec	arevelop)	GHT	= 1.0D	(RPI) -	0.15	= 0.85	- ,
left 08	.30	3.1	. 05	0									.85
edqo ; thro		3.2	. 1	.11		ESTN =	.5(.15)	0.075		. 011	. 001	_
1120		3.3	۰,۱	.31			40		0.15		.031	:005	
		3.4	۰ ۱	. 5			40		0.11		.050	.006	.90
- - - -		3.5	. I	.51			40		0.14		.051	,007	.92 '
		3.6	. 1	. 48			40		0.17		.048	.008	-94
· · · · · · · · · · · · · · · · · · ·		3.7	.1	.45			40		0.20		.045	,009	.54
1		3.8	.1	.45			40		0.21		.045	. 009	.96
		3.9	.1 .	- 50 -4	0		40		0.15	0.22	.048	.011	.97 [.]
5 	-	4.0	.1	-504	5		40		0.17	0.24	.045	. 011	.98 _
		4.1	.1	.49			40		0.23		.049	. 011	.99
1		4.2	, \	.45			40		0.22		.045	.010	
:		4.3	.(.૫૧			40		0.25		. 049	. 012	
• . •	O	4.4	. 1	.48			40		0.24		.048	.012	1.00
; ;	<u></u>	4.5	. 1	.52			40		0,24		.052	.012	_
and the second sec		4.6	. 1	. 50			40		0.23		.050	.012	
		4,7		. 50			40		0.25		.050	.013	.99
		4.8	.1	.50			40		0.26		.050	.013	98
		49	.1	. 50			40		0.Z3		.050	.012	97
:		5.0	.1	.52			40		0.25		.052	,013	.96
09:0Z		5.1	.1	.50			40		0.21		.050	.011	
		5.2	. 1	.47			40		0.22		.047	.010	.94
		5.3	.1	.48			40		0.21		.048	.010	.92
		5.4	1.1	.47	<u> </u>		40		0.14		.047	.007	.90
, , ,		5.5	.1	.32			40		0.00		.032	.003	
:		5.6	.15	. 30			40		0.02		.045	, 001	_
•		5.8	. 25	. 15			40	EST	= .5 (().0z)=0.01	.038	D	.85
		6.1	. 15	0									<u> </u>
-	:	REW	@ 04	1:09									
		3.0	3.0	1) (1) (1) (1) (1) (1) (1) (1) (1) (1) (AVE	0.19	12 - 12 - 14 - 14 - 15 - 15 - 15 - 15 - 15 - 15	1.176	0.229	.80
50° - 10° - 10°													-



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102302 (East Maui, Honopou IIFS Site B)

Date of Field Investig	Time (24-hour): 0930 - 1230
CWRM Staff:	Dean Uyeno, Ken Kawahara, Chui Ling Cheng
Individuals Present:	Agency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff);
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and
	Wanda Vierra
Hydrologic Unit:	Honopou (6034)
Stream Name:	Honopou Stream

Findings:

At 0930 hours, the staff crew (CWRM staff, Skippy Hau and Matt Wong) and members from the Honopou community drove to Beatrice Kekahuna's property. Starting from the Kekahuna's loi, everyone hiked along Honopou Stream to where it meets with tributary Puniawa Stream. Matt evaluated that length of the stream and recommended two locations: 1) one for flow measurement; and 2) another with a gage pool to record gage height as well as for the possible installation of a staff gage. Together, these represent interim instream flow standard (IIFS) Site B as indicated in the staff submittal. The flow measurement location is approximately 15 feet downstream of the gage pool. The gage pool is bounded by a concrete-reinforced masonry (CRM) wall. Matt inspected the CRM wall and found a 6.5 inch (O.D.) PVC pipe that extended from the pool to the other side of the concrete wall. When Matt removed some of the sediment that was blocking the upstream end of the pipe, water began flowing through the pipe. In order to stabilize the gage pool for more accurate gage height reading, staff crew plugged the pipe with rocks and sediment. CWRM staff planned to cap the pipe to permanently block water flow through the pipe.

Under Matt Wong's supervision, the staff crew prepared the site for flow measurement. The site was flagged with yellow tape, labeled with the stream name, IIFS site, and the date. While CWRM staff and Skippy Hau were taking the flow measurement, Matt Wong set up a reference point at the gage pool upstream to record changes in gage height (if any) during the flow measurement. Matt used a hammer drill to install an anchor bolt to a rock on the stream bank, then used red spray paint to mark the site. Staff crew completed the entire flow measurement in 20 minutes. Gage height readings were taken at the start and finish of flow measurement. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow at IIFS Site B was 0.189 cubic feet per second (0.122 million gallons per day), with no change in gage height.

During the flow measurement, Ken Kawahara noticed a property near the IIFS Site. He asked Lynn Scott if it was possible to meet the owner of the property. Ken and Lynn met with the owner, Melissa Souza, and asked if Ken could park the vehicle at her place. He also asked Ms. Souza if CWRM staff could access IIFS Site B through her property in the future. Ms. Souza agreed. After the flow measurement, the rest of the staff crew met with Ms. Souza and her husband Barron Souza.

Staff crew left the Honopou area at approximately 1230 hours, and visited Puolua (Huelo) Stream in the hydrologic unit of Hanehoi. Refer to Field Investigation Report FI2008102303 (East Maui, Huelo IIFS Site A) for more information.

Image Listing: (Attach P	PDF of image contact sheet)
File Name:	Brief Description:
20081023040	Confluence of Honopou Stream and tributary Puniawa Stream, facing makai.
20081023041	Above the confluence of Honopou Stream and tributary Puniawa Stream, facing mauka.
20081023045	PVC pipe on the gage pool side of Honopou stream.
20081023047	PVC pipe on the gage pool side of Honopou stream.
20081023048	Staff crew setting up the site for flow measurement on Honopou Stream.
20081023050	CWRM staff conducting flow measurement on Honopou Stream.
20081023051	CWRM staff, Dean Uyeno and Chui Ling Cheng, conducting flow measurement on Honopou Stream.
20081023053	Flow measurement site on Honopou Stream.
20081023054	Gage pool and concrete wall on Honopou Stream.
20081023055	Flow measurement site on Honopou Stream.
20081023056	Honopou Stream downstream from the gage pool.

_





20081023041.JPG



20081023045.JPG



20081023047.JPG



20081023048.JPG





20081023051.JPG



20081023053.JPG





20081023054.JPG



20081023055.JPG





20081023057.JPG



20081023059.JPG

20081023060.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008102302 - Page 5 of 6

Comp. by	<u>Chu</u>

Meas. No. _

Checked by DDU

	10/23	,20	<u>08</u> Pa	arty <u>De</u> i	<u>in, Ch</u>	un, Kei	1. Matt. Skippy
Width _	1.3	Area	0.466	2 Ve	1. <u>0.41</u>	G.	H. <u>0.84</u> Disch. <u>0.104</u> C
Method	Wadi	<u>ng</u>	N	o.secs.	40_	G. H. cha	$nge _ 10 $ in 0.5 hrs.
Method	coef	Ho	oriz, angl	e coef		Susp	lags checked
MeterT	уре	ľ	Meter No)		Met	er ft. above bottom of wt.
Ratingu	ised		\$	Spin test t	iefore me	eas	; after
Meas.p	lots		% diff. f	rom ratin	g no	·	Indicated shift
		GAG	E READ	INGS			Samples collected: water quality,
Time	T				Inside	Outside	sediment, biological, other
	1	QIEN					1
	13.0-1	CLEW					Measurements documented on
	Start	11:00	TEN	= 5 0			separate sheets: water quality,
		GUT =	100		0.84	-	aux./basegage.otner
		<u>qui</u>		<u>V. • IV</u>			
	<u>+</u>	+					Rain gage serviced/calibrated
	+						
<u> </u>						· · · · · · · · · · · · · · · · · · ·	Weather: <u></u>
	Finish	44-2-5-	- RE	1 G II	25		Air Temp. <u>20</u> °C at <u>11.21</u>
	<u></u>	GHT -	<u> </u>	n ih =	n. 84		Water Temp. <u>23</u> °C at <u>11. 28</u>
Weighte	d MGH	<u>- Gru -</u>	1. VV		0.0		Check bar/chain found
GH corr	ection	+		<u> </u>			Changed to at
Correct	MGH	1	<u> </u>				
<i>N</i> adirig Measur conditi), cable, id rement ra ons: Flow section:_	ce, boat, u ted excel <u>cobiots</u>	upstr., d¢ lent (2%) <u>mn , St</u> <u>fan</u>	wnstr., si), good (5 <u>cadul .</u> (ly fl	de bridge %), fair (i <u>Lamina</u> at . uni	9, 15 3%), poor 1r for m	(> 8%); based on following . Contr
Cross							-
Cross:	perating:				n	ecord Re	moved
Cross: Gage of Batter	perating: voltage:		In	take/Ori	Fice clear	ecord Re hed/purge	moved
Cross: Gage of Battery Bubble	perating: / voltage:	essure. ps	In si: Tank	itake/Ori	Fice clear	ecord Re hed/purge	moved ed; Bubble-rate /min
Gage c Battery Bubble	perating: / voltage: -gage pre	essure, pa	In si: Tank max	itake/Ori	fice clear , Line , mi	ecord Re hed/purge 	moved
Gage C Battery Bubble Extrem	perating: voltage: -gagepro ne-GH inc	essure, pa	in si: Tank nax HWM be	itake/Ori	Fice clear , Line , mi	ecord Re hed/purge m nRef	moved ed; Bubble-rate /min ; Bubble-rate /min
Cross: Gage c Battery Bubble Extrem CSG c	perating: voltage: -gage pre- ne-GH inc hecked:_ nside/out	essure, p: licators: r	In si: Tank max HWM he	itake/Ori	Fice clear , Line , mi	ecord Re hed/purge n Ref	moved
Cross Gage of Battery Bubble Extrem CSG of HWM i Contro	perating: voltage: -gage pre- ne-GH inc hecked_ nside/out vi;conc	essure, p: licators: r side:	In si: Tank max HWM he dear	itake/Ori	fice clear , Line , mi	ecord Re ned/purge n Ref	moved

FI2008102302	 Page 6 of 6
--------------	---------------------------------

.0	.10	.20	.30		.40	.50 River) at -	.60		.70	.75	302 -
COEF.	DIST.			PTH PTH		TIME	VEL		ADJUST ED FOR			
	INITIAL POINT	WIDTH	DEPTH	OBSEF TION DE	REVO-	SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80
	11:0 9	LEW	@ 5	9-	11:09		GHT	= 1.00	(RP2) -	0.16 =	0.84	_
	5.9	.05	0.21			40		0.48		.011	.005	.85
;	6.0	.1	0.21			40		0.48		.021	,010	-
	6.1	. \$	0.50			40		0.42		.050	.021	-
	6.2		0.50			40		0.39		.050	.020	. 9 0
	6.3	. 1	0.52			40		0.35		.052	.018	. 9 2
	6.4	, L -	0.52			40		0.34		,052	0.018	_
	6.5	.1	0.50			40		0.41		.050	0.021	-94
	6.6	.1	0.49			40		0.39		.049	0.019	.96
	6.7	.1 *	0.49			40		D.42		.049	0.021	.97
-	6.8	.1	0.30	۵		40		0.43		.030	0.013	.98
	6.9	.2	0.26			40		D.44		.052	0.023	.99
. ·	7.2	. 15	O			40						-
						H0						-
Ο	REW	@ 1	1:25				(ант =	1.00 -	0.16 =	0.84	1	.00
					_							-
	1.3	1.3					ANE =	0.41	9 / Maga Pangang (Dibang Talang) Ang	0.466	0.199	2.
												.99
												00
												.30
												.97 .96
												-
												.94
												.92
												.90
												•
												•
												.85
											·	.80



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102303 (East Maui, Huelo IIFS Site A)

Date of Field Investig	Time (24-hour): 1300 - 1600
CWRM Staff:	Dean Uyeno, Ken Kawahara, Chui Ling Cheng
Individuals Present:	Agency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff);
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and
	Wanda Vierra;
	Huelo community - Ernie Schupp and Moke Kahiamoe
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Puolua (Huelo) Stream

Findings:

At approximately 1300 hours, the staff crew (CWRM staff, Skippy Hau and Matt Wong) and members from the Honopou community met with Ernie Schupp and Moke Kahiamoe at the parking lot of the Door of Faith Church on Huelo Road. From the church, everyone walked to Ernie's property via a dirt road. After arriving at the Haiku Ditch diversion on Puolua (Huelo) Stream, staff crew walked along the stream to the auwai intake where Ernie diverts water from the Puolua (Huelo) Stream for his taro loi. Matt Wong evaluated that length of the stream and found no locations suitable for collecting gage height readings, or the installation of a staff gage. However, Matt recommended a location for flow measurement, which represents IIFS Site A as indicated in the staff submittal. The flow measurement site is approximately 16 feet upstream of the auwai intake.

Under Matt Wong's supervision, staff crew prepared the site for flow measurement. The site was flagged with yellow tape, labeled with the stream name, IIFS site, and the date. Staff crew completed the entire flow measurement in 15 minutes. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.052 cubic feet per second (0.034 million gallons per day). No gage height measurements were collected.

Staff crew concluded the field investigation at 1600 hours.

Image Listing: (Attach	PDF of image contact sheet)
File Name:	Brief Description:
20081023066	Haiku Ditch diversion structure on Puolua (Huelo) Stream.
20081023068	Haiku Ditch diversion structure on Puolua (Huelo) Stream.
20081023069	Haiku Ditch diversion structure on Puolua (Huelo) Stream.
20081023070	Haiku Ditch diversion structure (intake gate) on Puolua (Huelo) Stream.
20081023071	2 pipes on the concrete wall of the Haiku Ditch diversion structure on Puolua (Huelo) Stream.
20081023072	2 pipes on the concrete wall of the Haiku Ditch diversion structure on Puolua (Huelo) Stream.
20081023073	2 pipes on the concrete wall of the Haiku Ditch diversion structure on Puolua (Huelo) Stream.
20081023074	Puolua (Huelo) Stream downstream from Haiku Ditch.
20081023075	Auwai intake on Puolua (Huelo) Stream.
20081023080	Matt Wong setting up flow measurement site on Puolua (Huelo) Stream.
20081023081	Matt Wong setting up flow measurement site on Puolua (Huelo) Stream.
20081023083	Matt Wong setting up flow measurement site on Puolua (Huelo) Stream.
20081023086	Dean Uyeno conducting flow measurement on Puolua (Huelo) Stream.
20081023092	CWRM staff (Dean Uyeno and Chui Ling Cheng) conducting flow measurement on Puolua (Huelo) Stream.
20081023103	CWRM staff (Dean Uyeno and Chui Ling Cheng) conducting flow measurement on Puolua (Huelo) Stream.

GPS Listing:

Shapefiles:	(List file names of all shapefiles created and a brief description of each)
-------------	---

File Name: Brief Description:

i lie Maille.	Dher Description.
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude
18	20.903285
19	20.903252

Longitude -156.225661 -156.225375 Brief Description of each) Brief Description: Haiku Ditch on Huelo Stream IIFS Site A Measurement Site on Huelo Stream

Attachments:

Brief Description:

1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes

Recommendations:



20081023066.JPG

20081023068.JPG

20081023069.JPG



20081023070.JPG



20081023071.JPG



20081023072.JPG



20081023073.JPG



20081023074.JPG

20081023075.JPG



20081023080.JPG

20081023081.JPG



20081023086.JPG



20081023092.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008102303 - Page 5 of 6

Comp. by	Chui

Meas. No. _

Checked by DDU

Notify No. secs. G.H. change in hrs. Method	Midth /	12310	<u>8</u> ,20 Area	<u>_08</u> _Par _0.522	ty <u>_Ker</u> Ve	1. 0.1	0 G	H Disch0.052_CFS
Aethod coef. Horiz. angle coef. Susp. Tags checked Aeter Type Meter No. Meterft. above bottom of wt. Rating used Spin test before meas. ; after Aeas. plots % diff. from rating no. Indicated shift GAGE READINGS Samples collected: water quality, sediment, biological, other Time Inside Outside San UEw @ 14/04 Ne gage. Preight Assan UEw @ 14/04 Ne gage. Preight Ban UEw @ 14/20 Weather: oxercast. num befure. Rain gage serviced/calibrated Weather: oxercast. num befure. Finen Rew @ 14/20 Weather: oxercast. num befure. Veather: oxercast. num befure. Check bar/chain found Chorrection Changed to	Notin	- * *	_ ,	No	secs.		G. H. cha	nge in hrs.
Aleter Type Meter No. Meter	lethod coe	ef.	Ho	riz. angle	coef		Susp	Tags checked
Rating used	/leter Type	3		Aeter No.			Met	er ft. above bottom of wt.
Aeas. plots % diff. from rating no. Indicated shift GAGE READINGS Samples collected: water quality, sediment, biological, other Time Inside Outside Stan LEW @ 14:04 No gage. Meight Stan LEW @ 14:20 Rain gage serviced/calibrated Weighted MGH Check bar/chain found Check bar/chain found GH correction Check bar/chain found Check bar/chain found Greet MGH Check bar/chain found Changed to	Ratinouse	ed		Sp	in test	before m	eas	; after
GAGE READINGS Samples collected: water quality, sediment, biological, other	Aeas. plots	s		% diff. fro	mratin	ig no		Indicated shift
Time Inside Outside sediment, biological, other Stant LEW @ 14:04 No gage Meight Measurements documented on separate sheets: water quality, aux/base gage, other Stant LEW @ 14:04 No gage Meight aux/base gage, other Stant LEW @ 14:20 Rain gage serviced/calibrated Finish REW @ 14:20 Air Temp. 26_ *C at 12:55 Veather: overcast, roun befrie Cat 12:55 Weighted MGH Check bar/chain found Changed to			GAG		NGS			Samples collected: water quality,
Stant LEW @ 14:04 Ne gage, reight separate sheets: water quality, aux./base gage, other	Time	T				Inside	Outside	sediment, biological, other
Stant LEW @ 14/04 Ne gage Might Measurements documented on separate sheets: water quality, aux./base gage, other					×			
Start LEW @ 14:0.4 No gage might separate sheets: water duality, aux./base gage, other								Measurements documented on
Rain gage serviced/calibrated Finish REW © 14*20 Weighted MGH Weather: overcast, rain befare. GH correction Air Temp. 2b °C at 13:5b Weighted MGH Check bar/chain found GH correction Changed to	Sta	art	LEW @	14:04	NO	gace n	<u>eight</u>	aux /base gage, other
Rain gage serviced/calibrated Finish Rein (gage serviced/calibrated) Finish Rein (gage serviced/calibrated) Weighted MGH Air Temp. 2b °C at 13:56 Weighted MGH Check bar/chain found Check bar/chain found Changed to at Correct Weighted MGH Check bar/chain found Changed to at correct Coros section: 2 totk Cortect <t< td=""><td>_</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	_							
Finish REW © 14120 Weather: overcast, rain before. Air Temp. 2b °C at 13:55 Weighted MGH Check bar/chain found GH correction Check bar/chain found GH correction Check bar/chain found Correct MGH Correct Weighted MGH Check bar/chain found GH correction Check bar/chain found Correct MGH Correct Weighted MGH Correct Correct MGH Correct Correct MGH Correct Conditions: Flow: Slow (5%), fair (8%), poor (> 8%); based on following . Cons section: 2 vock/s were planted downstr of medsure pland						 		Rain gage serviced/calibrated
Finish Record Removed Finish Record Removed Finish Reference Finish Reference Finish Reference Finish Reference Finish Reference Finish Reference Weighted MGH Check bar/chain found GH correction Check bar/chain found Correct MGH Check bar/chain found Weighted MGH Correct Correct MGH Check bar/chain found Weighted MGH Correct Correct MGH Correct Weighted model Correct Correct MGH Correct Weighted model It Correct Correct Correct It Correct It Correct It Correct It Cor							·	
Finish REN © 14'20 Air Temp. 2b °C at 13:56 Weighted MGH Check bar/chain found Check bar/chain found GH correction Changed to at Correct MGH Correct MGH Correct MGH Weighted MGH Correct MGH Check bar/chain found Correct MGH Correct MGH Correct Correct Weighted MGH Correct MGH Correct MGH Weighted MGH Correct MGH Correct MGH Weighted MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Weighted MGH Correct MGH Correct MGH Weighted MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Weighted MGH Correct MGH Correct MGH Weighted MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct MGH Correct Construct Construl Construct Construl Construct Construct Construct Construct Cons								Weather: overcast, rain before
Image:		inich						Air Temp. <u>26</u> °C at <u>13:56</u>
Weighted MGH Check bar/chain found GH correction Changed to Correct MGH Changed to Wading, cable, ice, boat, upstr., downstr., side bridge, 15 (ft) mi. upstr., downstr. of gage. Wading, cable, ice, boat, upstr., downstr., side bridge, 15 (ft) mi. upstr., downstr. of gage. Wading, cable, ice, boat, upstr., downstr., side bridge, 16 (ft) mi. upstr., downstr. of gage. Wading, cable, ice, boat, upstr., downstr., side bridge, 16 (ft) mi. upstr., downstr. of gage. Wading, cable, ice, boat, upstr., downstr., side bridge, 16 (ft) mi. upstr., downstr. of gage. Wading, cable, ice, boat, upstr., downstr., side bridge, 16 (ft) mi. upstr., downstr. of gage. Wading, cable, ice, boat, upstr., downstr., side bridge, 16 (ft) mi. upstr., downstr. of gage. Conditions: Flow: Slow, uniform flow. laumineer flow. Cross section: 2 rock/s were planted downstr. of measure pt 10 build: up depth Uniform dcpth			REN (C)	14:20				Water Temp. 22.5 °C at 14.19
Weighted with the intervention in the intervention is intervention intervention. Weighted the intervention is intervention in the intervention is intervention. Intervention is intervention intervention intervention intervention intervention intervention intervention. Weighted the intervention is intervention intervention. Intervention intervention intervention intervention intervention. Weighted the intervention is intervention. Intervention intervention intervention. Weighted the intervention is intervention. Intervention intervention. Battery voltage: Intake/Orifice cleaned/purged: Bubble-gage pressure, psi: Tank , Line ; Bubble-rate /min. Extreme-GH indicators: max , min	Nhighted N	MGH						Check bar/chain found
Correct MGH Correct	vveignieun	tion						Changed to at
Wading, cable, ice, boat, upstr., downstr., side bridge,	GH correct							
Gage operating:	GH correct Correct MC	GH		└_┯───┴				
Battery voltage: Intake/Orifice cleaned/purged: Bubble-gage pressure, psi: Tank , Line Bubble-gage pressure, psi: Tank , min Extreme-GH indicators: max , min CSG checked: HWM height on stick Ref. elev. HWM inside/outside: HWM height on stick Ref. elev. Control: No control Remarks: Not too manue places to	GH correct Correct MC Wading, c Measuren conditions Cross sec	GH cable, ic ment rat s: Flow ction:	ted excel signal <u>slow</u> 2 rocks	ipstr., dow lent (2%), , uniferr were	/nstr., s good (! <u>n_fin</u> ₍ 210(.1	ide bridg 5%), fair (<u>v lan</u> cl down	16, 16 (8%), pool nincir fl nstr of	Correct (t) mi. upstr., downstr. of gage. an r(>8%); based on following . end measure pt to build up depth,
Bubble-gage pressure, psi: Tank, Line; Bubble-rate/min. Extreme-GH indicators: max, min CSG checked:HWM height on stick Ref. elevHWM elev HWM inside/outside: Control: No control Not too many places to measure flew, no gage pool so no	GH correct Correct MC Wading, c Measuren conditions Cross sed uniform Gage ope	GH ment rates: Flow ction: dcp1 erating	e, boat, (ted excel : <u>slow</u> 2 rocks	ipstr., dow lent (2%), , unifzer were	nstr., s good (! <u>n fin</u> platt	iide bridg 5%), fair 1 <u>v lan</u> cl down	(8%), pool nipar fl nstr_of Record Re	Correct (t, mi. upstr., downstr. of gage. and r(>8%); based on following . env (neasure pt to build up depth,
Extreme-GH indicators: max, min CSG checked: HWM height on stick Ref. elev HWM elev HWM inside/outside: Control: No control Control: No control No control Remarks: Not too many places to measure flew, no gage pool so no	GH correct Correct MC Weding, c Measuren conditions Cross sed <u>uniform</u> Gage ope Battery vo	GH cable, ic ment rat s: Flow ction: <u>dcp1</u> erating: oltage:	ie, boat, (ted excel :: <u>slow</u> 2 rocks	ipsti., dow lent (2%), , uniferr were Int	/nstr., s good (! <u>ρίαι</u> αke/Or	ide bridg 5%), fair (v <u>lan</u> cl down ifice clea	(8%), pool (8%), pool	Correct (t) mi. (pstr., downstr. of gage. au r (>8%); based on following . <u>env</u> measure pt to build up depth, emoved
CSG checked: HWM height on stick Ref. elev. HWM elev. HWM inside/outside:	GH correct Correct MC Wading, c Measuren conditions Cross sec <u>uniform</u> Gage ope Battery vo Bubble-gi	GH cable, ic ment rat s: Flow ction: dcpt erating: oltage: jage pre	e, boat, (ted excel :: <u>slow</u> 2 rocks in essure, p	ipstr., dow lent (2%), , unifzer Were Were i: Tank	ynstr., s good (! n <u>ftn</u> platt ake/Or	ide bridg 5%), fair (<u>v land</u> <u>cl down</u> <u>cl down</u> ifice clea , Lin	(8%), pool minar_fl mstr_of Record Re ned/purge	Correct (t, mi. upstr., downstr. of gage. au r (> 8%); based on following . <u>env</u> <u>measure pt to build up depth</u> , emoved ed; Bubble-rate /min.
HWM inside/outside:	GH correct Correct MC Wading, c Measuren conditions Cross sed uniform Gage ope Battery vo Bubble-g Extreme-	GH cable, ic ment rat s: Flow ction: dcpt erating: oltage: age pre- GH ind	e, boat, (ted excel 2 rocks 2 rocks b essure, p licators: r	ipstr., dow lent (2%), <u>unifzyr</u> weve weve isi: Tank nax	ynstr., s good (! <u>plaut</u> ake/Or	ide bridg 5%), fair (<u>v , lan</u> <u>cl dow</u> <u>cl dow</u> fice clea , Lin , m	(8%), poor nincir_fl nincir_fl nincir_fl Record Re ned/purge ned/purge	Correct (t) mi. upstr., downstr. of gage. au r(>8%); based on following . <u>env</u> measure pt to build up depth, emoved ed; Bubble-rate /min.
Control: <u>No control</u> Remarks: Not too many places to nearcure flew, no gage pool so no	GH correct Correct MC Weding, c Measuren conditions Cross sed uniform Gage ope Battery vo Bubble-g Extreme- CSG che	GH cable, ic ment rat s: Flow ction: dcpt acpt acpt acpt acpt acpt acpt acpt a	e, boat, (ted excel : <u>slow</u> 2 rocks in essure, pa	ipsti., dow lent (2%), , unifzer were were is: Tank nax HWM heig	ynstr., s good (! n fin platt ake/Or ake/Or	ide bridg 5%), fair (<u>v , lan</u> <u>cl down</u> ifice clea , Lin , m stick	le, 16 (8%), pool mincir fl nstr of Record Re ned/purge ie nin Ref	(t) mi. upstr., downstr. of gage. au r (> 8%); based on following .
Remarks: Not too many places to measure flew, no gage pool so no	GH correct Correct MC Wading, c Measuren conditions Cross sed uniform Gage ope Battery vo Bubble-g Extreme- CSG che HWM ins	GH cable, ic ment rat s: Flow ction: dcpt erating: oltage: age pre GH ind cked: ide/out	e, boat, (ted excel :: <u>slow</u> 2 rocks in essure, p licators: r	ipstr., dow lent (2%), <u>uniferr</u> <u>Were</u> is: Tank _ nax HWM heig	ynstr., s good (! <u>plaut</u> ake/Or ght on s	ide bridg 5%), fair <u>v lan</u> <u>cl alow</u> ifice clea , Lin , m stick	ie, 16 (8%), pool nipcir_fl nstr_of Record Re ned/purge inRef	Correct (ownstr.ofgage. au (> 8%); based on following .
ancher polt was placed.	GH correct Correct MC Weding, c Measuren conditions Cross sed <u>uniform</u> Gage ope Battery vo Bubble-gi Extreme- CSG che HWM ins Control:	GH cable, ic ment rat s: Flow ction: dcpt erating: oltage: age pre- dtage pre- decked cked cked cked	e, boat, (ted excel : <u>slow</u> 2 <u>rocks</u> in essure, pa licators: r side: side:	ipstr., dow lent (2%), <u>unifzvr</u> Weve is: Tank nax HWM heig	ynstr., s good (! <u>plant</u> ake/Or ght on s	ide bridg 5%), fair (<u>v , Ian</u> <u>ccl down</u> ifice clea , Lin , m stick	le, <u>16</u> (8%), pool <u>nincir fl</u> nstr_of Record Re ned/purge ne nin Ref	Correct (t) mi. (pstr., downstr. of gage. au r (> 8%); based on following .

upstr

∗ dunnstr

1	.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI2008102 . 75	2303 - Page 6 of 6
	ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	AT POINT	DCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	- .80
		LEW	@ 14	:04									- ·
		0.8	0.15	0							0	0	.85
		1.1	0.25	0.18			40		0.13		.045	.006	_
i i		1.3	0.15	0.20			40		0.10		.045	.005	_
		1.4	0.10	0.38			40		0.12		.038	.005	.90
4 4 2	_	1.5	01.0	0.39			40		0.12		.0391	. 005	.92
2 2 3 4 4		1.6	0.10	0.40			40		0.12		, 040	.005	-94
1		1.7	0.10	0.40			40		0.11		.0440	.004	-
-		1.8	0.10	0.40			40		0.09		0.040	.004	.96
· · ·		1.9	0.10	0.40			40		0.09		.040	.004	.97 [.]
	<u> </u>	2.0	0.10	0.40			40		0.10		.04	.004	.98 -
	 	2.1	0.10	0.40			40		0.08		.04	.003	.99
		2.2	0.10	0.35			40		0.08		.035	.003	
		2.3	0.10	0.33	ļ		40		0.06		.033	.002	
	0	2.4	0.15	0.31	<u> </u>		40		0.04		.047	.002 '	1.00
		2.6	0.10	0						The second se	0	0	_
:		t.8	1.8						0.01		0,522	0.052	 _
		REN	@ 14	:20	<u> </u>				0.10		6		.99
	· <u> ·</u>				ļ			 	anera	he vel o	t who	le scetio	n. 98
													97
:					ļ.,								.96 _
1												 	-04
1					ļ			· · · · · · · · · · · · · · · · · · ·					.94
: - -							ļ						.92 -
		} 			ļ						ļ		.90
-								ļ				ļ	_
, ,					<u> </u>		 	.	ļ	1		ļ	_
						. 	 			ļ			.85
		ļ		 		ļ				<u> </u>	 	<u> </u>	
: :		<u> </u>		ļ		ļ		_			ļ		- on
		_	<u> </u>	·		ļ	!	 	ļ	<u> </u>	<u> </u>	ļ	.0U
		1	ļ	1							1		



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102401 (East Maui, Hanehoi IIFS Site B)

Date of Field Investig	Time (24-hour): 0625 - 0900
CWRM Staff:	Dean Uyeno, Ken Kawahara, Chui Ling Cheng
Individuals Present:	Agency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff);
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, and Wanda Vierra;
	Huelo community - Moke Kahiamoe, Moke Kahiamoe Jr., and Ernie Schupp;
	EMI staff - Kai Andaya (Supervisor), Sherman Hauupu (Crew Chief)
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Hanehoi Stream

Findings:

At approximately 0730 hours, staff crew met with EMI staff, members from the Honopou community, and members from the Huelo community at the top of Huelo road by the mailboxes. Everyone rode in 3 vehicles, two EMI trucks and the CWRM 4WD, on the way to Haiku Ditch at Hanehoi Stream. Access to the site was through EMI roads.

Hanehoi Stream was dry. Staff crew evaluated the section of the stream approximately 400 feet downstream from Haiku Ditch. Since the stream was dry, staff crew had difficulty in selecting potential instream flow standard (IIFS) sites. Matt Wong recommended two sites: 1) one site for flow measurement; and 2) another site to record gage height as well as for the possible installation of a staff gage. Together, these represent IIFS Site B as indicated in the staff submittal. The flow measurement location is approximately 330 feet downstream of Haiku Ditch. The location chosen for gage height measurement was set approximately 200 feet from Haiku Ditch. These two locations are 130 feet apart. Then, the two locations were flagged with yellow tape, labeled with the stream name, IIFS site, and the date. Matt Wong set up a reference point at the location chosen for gage height measurement. Matt used a hammer drill to install an anchor bolt to a rock on the stream bank, then used red spray paint to mark the site.

Staff crew left Hanehoi IIFS Site B at approximately 0900 hours, and continued with the next field visit to select IIFS Site C on Hanehoi Stream. Refer to Field Investigation Report FI2008102402 (East Maui, Hanehoi IIFS Site C) for more information.

Image Li	isting: (Attach F	PDF of image contact sheet)							
File Name	<u>e:</u>	Brief Description:							
20081024	001	Haiku Ditch on Hanehoi Stream.							
20081024	002	Grate of Haiku Ditch on Hanehoi S	Stream.						
20081024	006	Mauka side of the gate of Haiku D	litch on Hanehoi Stream.						
20081024	010	Looking downstream from Haiku	Ditch on Hanehoi Stream.						
20081024	011	Staff evaluating stream section on	Hanehoi Stream downstream from Haiku Ditch.						
20081024	017	Staff evaluating stream section on	Hanehoi Stream downstream from Haiku Ditch.						
20081024	022	Reference point on 200 feet down	stream from Haiku Ditch on Hanehoi Stream.						
20081024	023	Reference point on 200 feet down	stream from Haiku Ditch on Hanehoi Stream.						
GPS Lis	ting:								
Shapefil	es: (List file nam	es of all shapefiles created and a brief o	description of each)						
File Name	e:	Brief Description:							
East_Mau	i_POI.shp	Points of interest (POI) recorded v	vith the GPS unit during the field visit. The file includes POI recorded						
_		from all the East Maui field investig	gations.						
Waypoir	nts: (List all wayp	oints in decimal degrees and provide a	brief description of each)						
WP No.	Latitude	Longitude	Brief Description:						
25	20.902082	-156.223372	IIFS Site B Measurement Site on Hanehoi Stream						
24	20.901837	-156.223664	IIFS Site B Reference Point on Hanehoi Stream						
23	20.901496	-156.224056	Haiku Ditch on Hanehoi Stream						

Attachments:

Brief Description: 1. Image Contact Sheet

Recommendations:



20081024001.JPG













20081024006.JPG



20081024017.JPG



20081024022.JPG





STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102402 (East Maui, Hanehoi IIFS Site C)

Date of Field Investig	Time (24-hour): 0930 - 1300					
CWRM Staff:	Dean Uyeno, Ken Kawahara, Chui Ling Cheng					
Individuals Present:	Agency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff);					
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, and Wanda Vierra;					
	Huelo community - Moke Kahiamoe, Moke Kahiamoe Jr., and Ernie Schupp;					
	EMI staff - Kai Andaya (Supervisor), Sherman Hauupu (Crew Chief)					
Hydrologic Unit:	Hanehoi (6037)					
Stream Name:	Puolua (Huelo) Stream					

Findings:

At approximately 0930 hours, staff crew (CWRM staff, Skippy Hau and Matt Wong), members from the Honopou and Huelo community, and EMI staff arrived at the Lowrie Ditch on Hanehoi Stream. Staff crew hiked up the ridge trail, that EMI staff had previously cleared, to access the section of Hanehoi Stream upstream of the waterfall and the Huelo community intake pipe. The trail begins on the left bank of Lowrie Ditch and ends above the waterfall. Once at the top of the waterfall, staff crew evaluated the section of the stream from the waterfall to approximately 150 feet upstream. Since there was a pond (with 4 feet deep of water) about 50 feet upstream from the waterfall, Matt Wong and Ken Kawahara hiked along the streambank to cross the pond and continue evaluating the stream section. Matt recommended two locations: 1) one for flow measurement; and 2) another to record gage height as well as for the possible installation of a staff gage. Together, these represent interim instream flow standard (IIFS) Site C as indicated in the staff submittal. The flow measurement location is approximately 1.5 feet upstream of the waterfall. The location chosen for gage height measurement was set approximately 3 feet from upstream of the waterfall.

Under Matt Wong's supervision, the staff crew prepared the site for flow measurement. To ensure laminar flow, staff crew spent 30-40 minutes moving a large boulder to the side of the stream using a shovel and two large branches for leverage. Then, the site was flagged with yellow tape, labeled with the stream name, IIFS site, and the date. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. Matt Wong set up a reference point at the location chosen for gage height measurement. Matt used a hammer drill to install an anchor bolt to a rock on the stream bank. Matt did not use red spray paint to mark the location because the streambank was saturated. As computed back in the Honolulu Office, the flow at IIFS Site C was 0.071 cubic feet per second (0.046 million gallons per day), with no change in gage height.

Staff crew left the IIFS Site C at approximately 1200 hours and hiked back down the ridge trail. One the way back, staff crew (excluding Matt Wong) hiked a short side trail to the bottom of the waterfall, where the Huelo community intake pipe is located. Photos were taken to document the height of the waterfall as well as the Huelo intake. Dean Uyeno measured the outside diameter of the pipe to be 2.5 inches wide.

Once at Lowrie Ditch, CWRM staff took a volumetric measurement of the water flowing through the two 3.5-inch (O.D.) PVC pipes that bypasses the ditch. With a stopwatch, staff recorded the number of seconds both pipes took to fill a 2 gallon bucket. This process was repeated 5 times, making a total of 5 measurements. As computed back in the Honolulu Office, the flow from the pipes was 0.037 cubic feet per second (0.024 million gallons per day).

Staff crew left Hanehoi IIFS Site C at approximately 1300 hours, and continued with the next field visit to select IIFS Site B on Palauhulu Stream. Refer to Field Investigation Report FI2008102403 (East Maui, Palauhulu IIFS Site B) for more information.

Image Listing: (Attach PDF of image contact sheet)					

20081024038	CWRM staff preparing the location for flow measurement on Hanehoi Stream.
20081024041	Top of the waterfall upstream of the Huelo intake on Hanehoi Stream.
20081024043	Matt Wong installing an anchor bolt to the streambank for gage height reading on Hanehoi Stream.
20081024051	Staff crew moving a boulder to the side of Hanehoi Stream.
20081024055	Staff crew moving a boulder to the side of Hanehoi Stream.
20081024057	CWRM staff (Dean Uyeno) cutting a large tree branch to use as a tool to move the boulder on Hanehoi Stream.
20081024058	Staff crew moving a boulder to the side of Hanehoi Stream.
20081024060	CWRM staff (Chui Ling Cheng) and Matt Wong conducting flow measurement on Hanehoi Stream.
20081024067	CWPM staff (Chui Ling Cheng) conducting flow measurement on Haneboi Stream
20081024007	CWPM staff (Dean Liveno) Skippy Hau and Matt Wong recording flow measurements on Haneboi
20001024074	Stream.
20081024079	Anchor bolt marking the reference point on Hanehoi Stream.
20081024082	Staff crew conducting flow measurement on Hanehoi Stream.
20081024086	Waterfall above the Huelo intake on Hanehoi Stream.
20081024089	Hanehoi Stream immediately downstream of the waterfall.
20081024099	Two bypass pipes at Lowrie Ditch on Hanehoi Stream.
20081024100	CWRM deputy (Ken Kawahara) taking volumetric measurement of the two bypass pipes at Lowrie Ditch on
	Hanehoi Stream.
GPS Listing:	
Shapefiles: (List file nam	nes of all shapefiles created and a brief description of each)
File Name:	Brief Description:
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:
Attachments: Brief Description: 1. Image Contact Sheet
2. Discharge Measurement and Gage Inspection Notes
Recommendations:



20081024026.JPG

20081024028.JPG

20081024029.JPG







20081024033.JPG

20081024034.JPG

20081024036.JPG







20081024038.JPG

20081024041.JPG

20081024043.JPG



20081024051.JPG

20081024055.JPG



20081024058.JPG

20081024060.JPG

20081024064.JPG



20081024067.JPG



20081024074.JPG



20081024079.JPG



20081024082.JPG



20081024086.JPG



20081024089.JPG



20081024099.JPG



Form 9-275F (Apr. 2001)

ų.,

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008102402 - Page 5 of 6

Meas. No. .

Comp.by Chur Checkedby Dean

a. No a. Name ate0 idth ethod ethod coe eter Type	HANE	HOL II	TT.				
a. Name ate <u>to</u> lidth <u>l</u> ethod ethod coe	HAN Inu		is alle	<u> </u>			
ate <u>10</u> ridth <u>1</u> ethod <u></u> ethod coe	174	IEHO)	_ <u>STREP</u>	IM,	<u> 11FS</u>	SHE U	Mark Charles
lidth <u>l</u> . ethod ethod coe eter Type	1 4-1	,20) <u>08</u> Pa	arty <u>M</u>	att, Dea	<u>an, sku</u>	py ken, mile
ethod ethod coe eter Type	.8	_ Area	0.595	<u> </u>	∋l. <u>0. (</u>	<u> </u>	H. <u>0,000 0</u>
ethod coe leter Type	Wadi	<u>ng</u>	N	o.secs.	40	G.H. cha	
eter Type	ef	Но	oriz. angl	e coef		Susp	
	e é		Meter No)		Mete	er ft. above bottom of wt.
ating use	d		\$	Spin test	before m	eas	; after
leas: plots	s		% diff. f	romrati	ng no		Indicated shift
		GAG		INGS	······································		Samples collected: water quality,
Time			[Inside	Outside	sediment, biological, other
			<u> </u>				
				. 1	1		Measurements documented on
Sta	art	LEW 1	B 10:	43			separate sheets: water quality,
		GHT =	1.00 -	0.11 =	.89		
							when whereast
					-		Air Temp 2 2 °C at
Fi	inish	REW	<u>e II: :</u>	24			Air lemp Cat
	;	GHT =	1.00 -	0.11 =	89		Water Temp. <u>22</u> Cat
Weighted N	MGH						Check bar/chain found
GH correct	tion					· · · ·	Changed to at
CorrectMC	GH						
Nading, c Measuren condition:	cable, id ment ra s: Flow ction:_	ted exce :: <u>lam</u> <u>Mbn-um</u>	illent (2% ivar fla ii form), good <u>)</u> , <u>, , , , , , , , , , , , , , , , , , </u>	(5%), fair active m	(8%), pool	(>8%); based on following .
Cross sec	aratina					Record Re	moved
Cross sec	oraung.			ntake/O	rifice clea	ned/nurde	ad'
Cross sec Gage ope	oltane.					nicarpaigi	
Cross sec Gage ope Battery vo Bubble-o	oltage: Jage pri	essure. r	osi: Tank		, Lir	ie	;Bubble-rate /mir
Cross sec Gage ope Battery vo Bubble-g	oltage: Jage pro -GH inc	essure, p	osi: Tank max		,Lir ,ń	nie	; Bubble-rate /mir
Cross sec Gage ope Battery vo Bubble-g Extreme-	oltage: Jage pro -GH inc	essure, r licators:	osi:Tank max HWM b	eight on	, Lir , n stick	nie	; Bubble-rate /mir
Cross sec Gage ope Battery vo Bubble-g Extreme- CSG che	oltage: age pro -GH inc ecked:_	essure, p licators:	osi: Tank max . HWM h	eighton	, Lir , n stick	nin Re	; Bubble-rate /mir
Cross sec Gage ope Battery vo Bubble-g Extreme- CSG che HWM ins Control	oltage: age pro -GH inc cked_ side/ou berly	essure, p dicators: tside:	osi: Tank max HWM h	eighton	, Lir , ה stick	nie nin Re	; Bubble-rate /mir f. elev HWM elev
Cross sec Gage ope Battery vo Bubble-g Extreme- CSG che HWM ins Control:	oltage: age pro -GH inc ecked:_ side/ou <u>berly</u>	essure, p licators: tside: oCl4	osi: Tank max . HWM h	eight on	, Lir , ח stick	nin Re	; Bubble-rate /mir f. elev HWM elev
Gage ope Battery vo Bubble-g Extreme- CSG che HWM ins Control:	oltage: age pro-GH inc ecked:_ side/ou berly	essure, p licators: tside: oCl4	osi: Tank max HWM h	eighton	, Lir , m stick	nin Re	; Bubble-rate /mir f. elev HWM elev
Gage ope Battery vo Bubble-g Extreme- CSG che HWM ins Control: Remarks	oltage: jage pro- GH inc ecked_ side/out bedv s:	essure, p licators: tside: pCl/_	osi: Tank max . HWM h	eight on	, Lir , m 	nin Re	, Bubble-rate /mir f. elev HWM elev

.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI2 76 810	02402 - Page 6 of 6
<u> </u>	DIST			÷₹		TIME	VELO	CITY	ADJUST-			
ANGLE COE	FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA TION DEPT	REVO- LUTIONS	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80 -
	LEND	2 10:	ł3				GHT=	1.00	(RP) - 0·11	= 0.89		_ ·
	6.0	0.10	0									85
· · ·	6.2	0.15	0.09		ESTV=	0.5 40		0.04	·	,014	.001	-
	6.3	0.10	6.17			40		0.08		,017	.001	- on
	6.4	0.10	0.32			цо		0.14		032	,004	_
*. *.	6.5	0.10	0.27			40		0.07		.027	.002	.92 _
	6.6	0.10	0.34			40		0.15		.034	,005	94
	6.7	0.10	8:37			40		0.16		.032	.005	<u>-</u>
	6.8	0.10	0.36	1		40		0.15		.036	.005	.96
	6.9	0.10-	0.37			40		0.14		.037	.005	.97
-	7.0	0.10	0.39			40		0.14		.039	. 005	.90
	7.1	0.10	0.50			40		0-11		.050	.006	.99
	7.2	0.10	0.55			40		8:04		.055	. 006	
	7.3	0.10	0.51			40		0.12		.051	.006	
	7.4	0.10	0.52			40		0.11		.052	.006	1.00
	7.5	0.10	0.52	-		40		0.11		.052	.006	
	7.6	0.10	0.40			40		0.13		.040	.005	
	7.7	0.10	0.27		ESTY	-0-		0.10		. 027	. 003	.99
	7.8	0.05	, 0							_		
	REW)@11:2	4				GHT	= 1.00 (R	1)-0.11=	0.89		
				-						and writing the second	Territor symmetric dates in the system and the	.96
	1.8	1.8		مخسخت مرير	8~~***********************************	(4) (40) (40) (40) (40) (40) (40) (40) (AVE	0.1+		. 595	5 0.065	
								0.12			0.0+1	.94
			- [_					.92
												.90
	1											
	-		-									
	-			-								.85
an a			-									
	-			- -								a
.: Sado por steriges			_	- -	-							.80
				-								
-		<u> </u>	<u></u>									- .

0

Ť



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102403 (East Maui, Palauhulu IIFS Site B)

Date of Field Investig	Time (24-hour): 1330 - 1630					
CWRM Staff:	Dean Uyeno, Ken Kawahara, Chui Ling Cheng					
Individuals Present:	resent: Agency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff);					
	Keanae community - Isaac Kanoa;					
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, and Wanda Vierra					
Hydrologic Unit:	Piinaau (6053)					
Stream Name:	Palauhulu Stream					

Findings:

At approximately 1330 hours, staff crew (CWRM staff, Skippy Hau and Matt Wong) and members from the Honopou community arrived at the residence of Isaac Kanoa. Everyone walked to the section of Palauhulu Stream directly below Keanae Flume. The stream section downstream of the flume was a dry reach, excepting a two feet deep pond of water resulting from the little water flowing from upstream of the Keanae Flume intake. Water was flowing upstream of the flume, but appeared to be going underground at the pond. While Sanford Kekahuna and Skippy Hau walked across the flume, CWRM staff and Matt Wong hiked up the wall of the stream (which was then a waterfall due to the dry conditions) to access the Palauhulu Stream upstream of Keanae Flume. The staff crew continued evaluating the stream section above the flume until reaching a large pond, which was approximately 200 feet upstream from the flume. Matt Wong did not find any locations suitable for flow measurement or gage height reading.

Staff crew hiked back to the dry streambed below the flume. Dean Uyeno walked to the one side of the flume to measure its dimensions, which are 1.25 feet high by 1.3 feet wide. The depth of water in the flume was approximately 0.7 feet. Staff crew then walked to the pond that is part of Piinaau Stream. Based on the high water level mark apparent on the streambank, water level in the pond had dropped significantly. Staff crew, Isaac Kanoa, and members of the Honopou community walked to the large pond further downstream on Palauhulu Stream.

Staff crew and members of the Honopou community left the Kanoa residence at 1500 hours.

While members of the Honopou community returned to their home, the staff crew continued up Hana Highway to the bridge that crosses Palauhulu Stream. The bridge is near the entrance to Piinaau Road. Staff crew hiked up Palauhulu Stream on the trail that begins on the left bank of the stream upstream of the bridge. Matt evaluated the stream section about 150 feet upstream from the bridge but did not find any locations suitable for flow measurement or gage height reading. The stream was either too deep or there was no safe way to access the location. Staff crew returned back to the bridge. From the bridge, Matt found a location that may be suitable for flow measurement. The location is directly below the bridge. Matt advised CWRM staff to revisit this location and take a flow measurement on the next field visit. This is a potential interim instream flow standard (IIFS) site.

Staff crew left Palauhulu Stream at approximately 1630 hours, and continued with the next field visit to select a flow measurement location on Wailuanui Stream. Refer to Field Investigation Report FI2008102404 (East Maui, Wailuanui IIFS Site) for more information.

Image Listing: (Attach PDF of image contact sheet)					
File Name:	Brief Description:				
20081024104	Keanae Flume above Palauhulu Stream.				
20081024105	Palauhulu Stream and pond below Keanae Flume.				
20081024107	Looking up at Keanae Flume from Palauhulu Stream.				
20081024108	Palauhulu Stream and pond below Keanae Flume.				
20081024110	Pond below Keanae Flume on Palauhulu Stream.				
20081024114	Palauhulu Stream upstream from the pond.				
20081024117	Keanae Flume intake structure upstream from the pond on Palauhulu Stream.				
20081024119	Keanae Flume intake structure upstream from the pond on Palauhulu Stream.				
20081024121	Keanae Flume intake structure upstream from the pond on Palauhulu Stream.				
20081024122	Hihiwai on a boulder within the Keanae Flume intake structure upstream from the pond on Palauhulu				
	Stream.				

20081024125	Palauhulu Stream further upstream from the Keanae Flume intake.
20081024127	Palauhulu Stream further upstream from the Keanae Flume intake.
20081024128	Palauhulu Stream further upstream from the Keanae Flume intake.
20081024132	Top of Keanae Flume above Palauhulu Stream
20081024135	Pond on Piinaau Stream.
20081024141	Large pond further downstream on Palauhulu Stream.
20081024143	Large pond further downstream on Palauhulu Stream.
20081024149	Palauhulu Stream directly below the bridge on Hana Highway.

GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)					
File Name:	Brief Description:				
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.				

WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:
26	20.856333	-156.146474	IIFS Site B on Palauhulu Stream at Hana Highway

Attachments:

Brief Description: 1. Image Contact Sheet

Recommendations:



20081024104.JPG



20081024105.JPG





20081024110.JPG



20081024107.JPG



20081024114.JPG



20081024108.JPG

20081024117.JPG



20081024119.JPG



20081024121.JPG



20081024122.JPG

20081024125.JPG


20081024128.JPG



20081024132.JPG



20081024135.JPG



20081024141.JPG



20081024143.JPG



20081024149.JPG



FIELD INVESTIGATION REPORT

FI2008102404 (East Maui, Wailuanui IIFS Site)

Date of Field Investigation: October 24, 2008 Time (24-hour): 1700 - 1830							
CWRM Staff: D	ean Uyeno, Ken Kawahara, Chui Ling Cheng						
Individuals Present: A	gency staff - Matt Wong (USGS-Maui field technician), Skippy Hau (DAR staff);						
Hydrologic Unit: V	/ailuanui (6056)						
Stream Name: V	/ailuanui Stream						
Findings:	Findings:						
At approximately 1700 hours, staff crew (CWRM staff, Skippy Hau and Matt Wong) arrived at the bridge on Hana Highway that crosses Wailuanui Stream. While Skippy Hau remained on the bridge taking photos of Wailuanui Stream, CWRM staff and Matt Wong hiked down from the bridge to the stream via a small trail that begins on the right bank of the stream, on the downstream side of the bridge. The trail condition was hazardous because of the loose rocks and large boulders on the hill. Staff hiked approximately 300 feet downstream from the bridge until reaching a pond. The hike was mostly boulder hopping. Since night was approaching and daylight was limited, staff decided to return to the bridge. On the way back, Matt Wong noticed a location that may be suitable for taking flow measurements. The location is directly below the bridge. Matt advised CWRM staff to revisit this location and take a flow measurement on the next field visit. This is a potential interim instream flow standard (IIFS) site.							
Staff crew concluded the	field investigation at 1830 hours.						
Image Listing: (Attach PD File Name: E 20081024154 C 20081024157 V 20081024158 V 20081024159 C 20081024160 V 20081024161 F 20081024162 L 20081024166 F	 (Attach PDF of image contact sheet) Brief Description: Cascading waterfall on Wailuanui Stream upstream from the bridge on Hana Highway. Wailuanui Stream upstream from the bridge on Hana Highway. Wailuanui Stream downstream from the bridge on Hana Highway. CWRM staff and Matt Wong hiking down to Wailuanui Stream from the bridge on Hana Highway. Wailuanui Stream downstream from the bridge on Hana Highway. Wailuanui Stream downstream from the bridge on Hana Highway. Pond 300 feet downstream from the bridge on Hana Highway on Wailuanui Stream. Looking at the from the bridge on Hana Highway from Wailuanui Stream. Potential flow measurement location on Wailuanui Stream. This location is directly below the bridge on Hana Highway. 						
GPS Listing:							
Shapefiles: (List file names of all shapefiles created and a brief description of each) File Name: Brief Description: East_Maui_POI.shp Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.							
Waypoints: (List all waypoints: (List all waypoints)	nts in decimal degrees and provide a brief description of each) Longitude Brief Description: IFS Site Flow Measurement on Weilyanui Stream						
4 20.833606	-156.13696 Parking area near IIFS Site on Wailuanui Stream						
Attachments: Brief Description: 1. Image Contact Sheet							
Recommendations: Wear hard hats and bring rope as safety precautions when hiking in Wailuanui Stream.							



20081024154.JPG



20081024159.JPG



20081024162.JPG



20081024157.JPG



20081024160.JPG





20081024158.JPG



20081024161.JPG



FIELD INVESTIGATION REPORT

FI2008102701 (East Maui, Honopou IIFS Site A)

Date of Field Investig	Time (24-hour): 0625 - 0915					
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng					
Individuals Present:	Garret Hew (EMI Water Resources Manager), Carl Freedman (Consultant at Haiku Design & Analysis) Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and Wanda Vierra					
Hydrologic Unit:	Honopou (6034)					
Stream Name:	Honopou Stream					

Findings:

CWRM staff departed Oahu for Maui at 0625 hours.

At approximately 0830 hours, CWRM staff met with Garret Hew, Carl Freedman, and members of the Honopou community at the Haiku Ditch diversion on Honopou Stream. At the community meeting on October 23, Carl Freedman had asked to join CWRM staff for this field visit. Everyone drove to the bridge that crosses Honopou Stream further downstream. CWRM staff prepared IIFS Site A on Honopou Stream for flow measurement. Staff checked the downstream gage pool for debris and there was none. The entire flow measurement was completed in 40 minutes. Gage height readings were taken at the downstream gage pool at the start and finish of flow measurement. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was sunny with cool air temperatures and no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.242 cubic feet per second (0.156 million gallons per day), with a no change in gage height.

Garret Hew mentioned that an incident was reported to Henry Robello on the morning of October 23, 2008. Someone had tampered with the bypass sluice gate of Lowrie Ditch on Honopou Stream and that the gate was open. Garret did not have information on who opened the gate or when it was opened. This incident may have an effect on previous flow measurements collected at IIFS Site A and B on Honopou Stream.

CWRM staff left Honopou IIFS Site A at approximately 0915 hours, and continued further downstream to conduct flow measurement at IIFS Site B on Honopou Stream. Refer to Field Investigation Report FI2008102702 (East Maui, Honopou IIFS Site B) for more information.

Image L <u>File Nam</u> 20081027 20081027	isting: (Attach F <u>e:</u> 7001 7002	ng: (Attach PDF of image contact sheet) <u>Brief Description:</u> Staff crew conducting flow measurement on Honopou Stream. Staff crew conducting flow measurement on Honopou Stream.								
20081027	7003	Chui Ling Cheng recording flow m	neasurement on Honopou Stream.							
GPS Lis	ting:									
Shapefil <u>File Nam</u> East_Mau	les: (List file nam <u>e:</u> ui_POI.shp	es of all shapefiles created and a brief Brief Description: Points of interest (POI) recorded from all the East Maui field invest	description of each) with the GPS unit during the field visit. The file includes POI recorded igations.							
Waypoii	n ts: (List all wayp	oints in decimal degrees and provide a	brief description of each)							
<u>WP No.</u>	<u>Latitude</u>	<u>Longitude</u>	Brief Description:							
6	20.916212	-156.245203	Bridge on Honopou Stream							
7	20.916187	-156.245174	IIFS Site A Reference Point on Honopou Stream							
8	20.916096	-156.245077	IIFS Site A Flow Measurement on Honopou Stream							

Attachments:

- Brief Description:

 1. Image Contact Sheet

 2. Discharge Measurement and Gage Inspection Notes

Recommendations:



20081027001.JPG



20081027002.JPG



20081027003.JPG

Form 9-: (Apr. 20)	275F 01)	U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION					
		Ĺ	DISCHARGE GAGE IN	E MEASUREMENT AND			
Sta. No.	Honopou	UFS	site A				
Sta. Nam	e		<u> </u>	(M)			

FI2008102701 - Page 4 of 6

Meas. No.	
-----------	--

Comp.by <u>Chui</u>

Checked by DDU

Sta. No		vinvi t	17.3 41	(2) · · · ·					
Sta. Na	me					M	· · · · · · · · · · · · · · · · · · ·		
Date	10127	,2	0 <u>08</u> P	'arty <u>C</u>	<u>ius, Va</u>	an, to	· · · · · · · · · · · · · · · · · · ·		<u></u>
vvidtn _	3.0	Area	$1 - \frac{1}{2} \frac{1}{2}$	<u>></u>	el. <u>U. 2</u>	<u>15</u> G.	H. <u>0.84</u>	_ Disch. <u>0, 2</u>	42
Method	<u> </u>	<u>iang</u>	P	No. secs.	_40	G. H. cha	ange0	in <u>0.83</u>	hrs.
Method	1 coet	H	oriz. ang	le coet		Susp	Tags	checked	····· ·· ·· ·· ··
Meter T	ype		Meter N	0		Met	er f	t. above bottor	nofwt.
Rating	used			Spin test	before m	eas	;af	ter	
Meas.p	plots	·	_ % diff. '	from ratir	ng no		_ Indicated shi	ft	
		GAC	E REAL	DINGS			Samples colle	cted: water qu	ality,
Time Inside Outside						sediment, bio	logical, other _	<u> </u>	
						1	Measurement	s documente	don
	Start	LEW (<u>ê 09:11</u>				separate she	ets: water qu	iality,
		GHT =	1.00 - 1	0.16 = 0	.84		aux./base gag		
		<u></u>	 					viand/anlihrata	 A
						····	r ain gage ser	viceu/calibrate	u
							Meather: SU	Innu. cool	
	Finish			· · · · ·				23 °Cat 0	9:21
 		RENI				<u> </u>		27 °C et D	
Meighte		ł							1.21
GHcorr	ection						Check bar/cha		
Correct	MGH	<u> </u>			· ·			at	
		!	\sim	l		l			
Wading	i, cable, ic	e, boat, (ipst), do	wnstr., si	de bridge	e, <u>60</u>	(ft), mi. up:	sir., downstr. of	gage.
conditio	ementral	eo excel	ient (2%) war fi		%), tair (8 Paixtus	3%), poor (fawya	(>8%); based c	n following .	λ.
Crosss	ection:	redvoek	, cobb	les r	elativelu	t anter	n onaled	Addec	<u>/·</u>
0.0000		<u>,</u>	1		Clerin i wra	<u>}</u>	<u>11 AIRANA</u>	1.5.1040 × ·	
Gage of	neratina:			·	P	ecord Ren			
Battery	voltane:		In	take/Orif	ice clean	ed/nurger	1		 _
Bubble	-oage pre	ssure ps	in si Tank	anci om	line	eurpuiget	Bubble-rat		/min
Extrem	e-GH indi	icators: n	nax		rmir	·			/// 14/1.
CSGct	ecked [.]	1001010.11	-11//// hoi	abtonst	,1100 ick				
HWM in	nside/outs	side [.]		gnton st	UN		CICV		
Control	: conci	(etc)	•••••						
				·					<u> </u>
Remark	cs cont	nol de	a not	have	debris		· ··		
, wroat					<u>and profiles</u>				
GHofz	ero flow =	GH	_	depth at	control		=	ft rated	· · · · · · · ·
				eebuildt,	- 100 L				
					Sh	eet NO. 🛸	Of	(sneets

	.0	.10	.20	.30		.40	.50 River) at-	.60		.70	FI20081027 . 75	01 - F	Page 5 of 6
	DEF-	DIST.]	Ϋ́́Η		TIME	VEL	OCITY	ADJUST-			-	
a after " trank "at	ANGLE C	FROM INITIAL POINT	WIDTH	DEPTH	OBSER TION DEF	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80	
		LEW	0	09:11				GHT	= 1.00 -	0.16 =	0.84		-	
5													.85	
·		3.0	.05	0							D	Ø		
		3.1	. (0.2			40		0.19		.02	.004	_	
		3.2	, 1	0.3			40		0.23		.03	.007	.90	
		3.3	. !	0.25			40		0.26		. 025	.007	.92	
:" 		3.4	.1	0.35			40		0.22		. 035	.00B	-04	
- - -		3.5	. 1	0.36			40		0.21		.036	.008	.94	
		3.6	. 1	0.40			40		0.19		. 04	800.	.96	
		3.7	. 1	0.42			40		0.20		.042	.00%	.97	
-		3.8	. 1	0.42	-		40		0.20		.042	. 003	.98	
		3.9	. I	0.43			40		0.22	. 313	,043	.009	.99	067
		4.0	, I	0.43			40		0.24		.043	010	_	
		4.1	٦,	0.43			40		0.23		.043	.010	-	
	0	4,2	. (0.48			40		0.25		.040	.012 1	.00	
		4.3	.	0.48			40		0.24		.048	.012		
		4.4	. (0.48			40		0.27		.048	.013	_	
		4.5	. 1	0,48			40		0.24		.040	.012	.99	
		4.6	.1	0,48			40		0.25		.048	.012	98	
-		4.7	. l	0.49			40		0.25		.049	.012	97	
-		4.8	. เ	d.48			40		0.24	.736_	.048	.012	.96	. 172
		4.9	. 1	0.48			40		0.27		.048	.013		
-		5.0	. (0.51			40		0.23		.051	.012	.94	-
-		5.1	1	0.49			40		0.25		.049	.012	.92	
-		5.2	.1	0.45			40		0.21		.045	. 009	.90	
-		5.3	\	0.46			40	-	0.21		. 046	· DIO		
_		5.4	.1	0.35			40		51.0		.035	. 006		
_		5.5	. \	0.30			40		0.12		.03	.004	85	
_		5.6	.1	0.29			40		0.05		.029	. 001		
-		5.7	. [0.25			40		6.07		.025	.002		
-		5.8	. 1	0.22			40		0.05		. 022	. 001	.80	,
-		5.9		0.09			40		0.03		.009	0		

0	.10	.20	.30		.40	.50 River	at -	.60		.70	.75	J 1 -
ANGLE COEF- FICIENT	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	- .80
	6.0	.05	Ø									-
	3.0	3.0						0.22		1.125	0.242	.85
	REW	@	09:50				GHT	= 1.00 -	D.16 =	0,84		-
												.90
												.92
												:94
	· · · · ·											96
								• • · · · · · • • •				.97
										r		.98
												.99
								• •••• •••••		·		
O											1	.00
								······			······································	.99
												98
		:										97 96
											· · · · · ·	94
	·											92
												90
												.85
												•
												.80



FIELD INVESTIGATION REPORT

FI2008102702 (East Maui, Honopou IIFS Site B)

Date of Field Investig	Time (24-hour): 0930 - 1130					
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng					
Individuals Present:	Garret Hew (EMI Water Resources Manager), Carl Freedman (Consultant at Haiku Design &					
	Analysis)					
	Honopou community – Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and					
	Wanda Vierra					
Hydrologic Unit:	Honopou (6034)					
Stream Name:	Honopou Stream					

Findings:

At approximately 0930 hours, CWRM staff, Garret Hew, Carl Freedman, and members of the Honopou community arrived at the property of Melissa Souza. At the community meeting on October 23, Carl Freedman had asked to join CWRM staff for this field visit. From Melissa Souza's property, everyone hiked to IIFS Site B on Honopou Stream. CWRM staff prepared the site for flow measurement. Staff checked the upstream gage pool for debris and there was none. The entire flow measurement was completed in 30 minutes. Gage height readings were taken at the downstream gage pool at the start and finish of flow measurement. In addition to flow measurement, CWRM staff also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was sunny with cool air temperatures and no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.140 cubic feet per second (0.090 million gallons per day), with no change in gage height.

Staff crew left Honopou Stream IIFS Site B at approximately 1130 hours, and drove to Haiku Ditch on Honopou Stream to document the building of the berm wall on the ditch. Refer to Field Investigation Report FI2008102703 (East Maui, Honopou Haiku Ditch) for more information.

Image Listing: (Attach PDF of image contact sheet)					
Brief Description:					
Ed Sakoda conducting flow measurement on Honopou Stream.					
Staff crew conducting flow measurement on Honopou Stream.					
Chui Ling Cheng recording flow measurement on Honopou Stream.					
Gage pool and concrete wall on Honopou Stream.					
Gage pool and concrete wall on Honopou Stream.					
IIFS Site B on Honopou Stream.					

GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)					
File Name:	Brief Description:				
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.				

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
12	20.931867	-156.244694	IIFS Site B Flow Measurement on Honopou Stream
11	20.931827	-156.244678	IIFS Site B Reference Point on Honopou Stream

Attachments:

Brief Description:

1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes

Recommendations:







20081027005.JPG



20081027007.JPG



20081027009.JPG



20081027010.JPG



20081027011.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

Meas No.

FI2008102702 - Page 4 of 5

Comp. by Chui

Checked by ______U

Sta. No	HON	OPOU II	FS SIT	<u>E</u> B			
Sta. Na	ime				·	- (6)	
Date_	1012	,2	0 <u>_08</u> _P	Party <u>C</u>	hui, t	<u>5284, Dec</u>	an [*]
Width _	1.3	Area	0.47	L V	el. <u>0.3</u>	<u>0</u> G	.H. <u>0.63</u> Disch. <u>0.14</u>
Method	<u>Mak</u>	aing	^	lo. secs.	40	G. H. cha	ange in hrs.
Method	l coef	H	oriz. ang	le coef		Susp	Tags checked
MeterT	Гуре		Meter N	0		Met	ter ft. above bottom of wt.
Rating	used		!	Spin test	before m	eas	; after
Meas.p	olots		_ % diff. !	from ratir	ng no	<u> </u>	_ Indicated shift
		GAG					Samples collected: water quality
Time			F.		Inside	Outside	sediment, biological, other
h <u></u>		1	<u> </u>				
			_	<u> </u>		· · · · · · · · · · · · · · · · · · ·	Measurements documented on
	Start	LEW	Q. 10	398			separate sheets: water quality,
		GHT	= 1.00	- 0.17 =	0.83		
· · · · · · · ·		_					Pain gage serviced/calibrated
			ļ			[
		+ • • • • • •	 				Weather: SUMMU COOL
<u> </u>	Finish						Air Temp. 25 °C at 10.57
		RENG	11:14	, ~r			Water Temp 23 °C at 10:57
Weighte	d MGH		- 1.00-	<u></u>	0.202		Check bar/chain found
GH corr	ection	1					Changed toat
Correct	MGH	<u> </u>					Correct
Madino	, cable ic		unctr da		de bridge	15	Ref. por
Measur	ement ra	ted excell	lent (2%)	. 300d (5	%), fair (8		(> 8%): based on following
conditio	ons: Flow	: fairli	y wit	ionn .	lamina	r	
Cross s	ection:_	farchy	unifor	<u>m. co</u>	bbles, i	PONEL	
		·					
Gage o	perating:			<u></u>	Re	ecord Rer	noved
Battery	voltage: .		Inf	take/Orif	ice clean	ed/purgeo	J:
Bubble	-gage pre	ssure, ps	i: Tank 🗉		Line		; Bubble-rate /min.
Extrem	e-GH ind	icators: m	1ax		, mir	1	·
CSGct	necked:	ŀ	-IWM hei	ght on sti	ck	Ref.	elev HWM elev
HWM ir	nside/outs	side:	•				
Control	: <u>Conc</u>	<u>vato</u>				<u>.</u>	
Remark	<s:< td=""><td></td><td></td><td></td><td>·</td><td></td><td></td></s:<>				·		
GHofz	ero flow =	GH		depth at o	control	···.	= ft_rated
				- , 	Ch.	not No	
					SUG	EELINO.	

.0	.10	.20	.30		.40	.50 River	at 🦂	.60		.70	FI20081027 . 75	02 - Page 5 of 5
ANGLE COEF.	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	- .80
	LEW	@ 10	:38				GHT	= 1.00 -	= 41.0	0.83		
	4.5	. 05	D			·						.85
· · · · · · · · · · · · · · · · · · ·	4.5	0.1	0.44			40		0.32		0.044	0.014	
	4.7	0.1	0.44			40		0.28		.044	.012	_
	4.8	0.1	0.44			40		0.32		.044	. 015	.90
	4.9	0.1	0.52			40		0.33		.052	.017	.92
- 	5.0	0.1	0.53			цo		0.33		.053	-017	
	5.1	0.1	0.54			40		0.29		.054	.016	.94
	5.z	0.1	0.54			40		0.26		.054	.014	.96
	5.3	0.1	0.58			40		0.29		.058	.017	.97 [.]
-	5.4	0.1	0.56	,		40		0.29		.059	.017	.98
	5.5	-05	- 0.14			40				- Sali Line (Sale (S	and the same succession and the same of	.99
	5.5	.2	0.19			40		0.15 4.145		.010	.001	``````````````````````````````````````
	5.8	,15	0					0			0.139	
0	1.3	1.3	ann a chuireach ann an tar an tar an					.30		1471	₽ . ₩₽ 1.	.00
	REW	(à)	11.14				GHT	= 1.00	- 0.17	= 0.83		
												•
												.99
·												09
					-							97
												.96
												94
<u></u>												92
												90
				·								
												85
												,
											•	80



FIELD INVESTIGATION REPORT

FI2008102703 (East Maui, Honopou Haiku Ditch, restore)

Date of Field Investig	Time (24-hour): 1200 - 1300				
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng				
Individuals Present:	Carl Freedman (Consultant at haiku Design & Analysis);				
	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry				
	Robello (Field Superintendent), Nelson Akiu (Keanae Supervisor), Walter Andrade (Field Crew),				
	and Jacob Tamsing (Field Crew);				
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and				
	Wanda Vierra				
Hydrologic Unit:	Honopou (6034)				
Stream Name:	Honopou Stream				

Findings:

At approximately 1200 hours, CWRM staff met with Carl Freedman, Garret Hew and EMI staff, and members of the Honopou community at the Haiku Ditch diversion on Honopou Stream. While the EMI Field Crew went to gather banana leaves and other tools for building of the berm wall, CWRM staff took a volumetric measurement of the water flowing through the three 4-inch (O.D.) PVC pipes that bypasses the ditch. With a stopwatch, staff recorded the number of seconds each of the pipes took to fill a 2 gallon bucket. This process was repeated 5 times, making a total of 5 measurements per pipe. As computed back in the Honolulu Office, the flow from the pipes was 0.130 cubic feet per second (0.084 million gallons per day).

The goal was to build a berm on the lip of the Haiku Ditch diversion grating structure on Honopou Stream. EMI staff began by placing banana stalks on the upstream edge of the ditch intake structure. With the help of Sanford Kekahuna, EMI staff piled large boulders on top of the leaves. The boulders were taken from Honopou Stream upstream and downstream of Haiku Ditch. The purpose of the banana stalks was to minimize seepage of stream water between the boulders when the water level in the stream rises over the ditch. This way, more water could potentially be pushed through the three 4-inch bypass pipes.

CWRM staff videotaped this event.

Staff crew left the Haiku Ditch diversion on Honopou Stream at approximately 1300 hours, and continued further upstream to document flow restoration at Lowrie Ditch on Honopou Stream. Refer to Field Investigation Report FI2008102704 (East Maui, Honopou Lowrie Ditch, restore) for more information.

Image Listing: (Attach F	DF of image contact sheet)
File Name:	Brief Description:
20081027013	EMI staff building a berm wall at Haiku Ditch on Honopou Stream by first placing banana leaves on the ditch grating structure.
20081027015	EMI staff building a berm wall at Haiku Ditch on Honopou Stream.
20081027017	EMI staff building a berm wall at Haiku Ditch on Honopou Stream.
20081027018	EMI staff building a berm wall at Haiku Ditch on Honopou Stream.
20081027020	Sanford Kekahuna helping EMI staff to gather boulders for building a berm wall at Haiku Ditch on Honopou Stream.
20081027021	EMI staff building a berm wall at Haiku Ditch on Honopou Stream.
20081027025	EMI staff building a berm wall at Haiku Ditch on Honopou Stream.
20081027031	Completed berm wall at Haiku Ditch on Honopou Stream.
20081027033	Completed berm wall at Haiku Ditch on Honopou Stream.
20081027035	Completed berm wall at Haiku Ditch on Honopou Stream, near the three 4-inch bypass pipes.
20081027038	Completed berm wall at Haiku Ditch on Honopou Stream.
20081027039	Completed berm wall at Haiku Ditch on Honopou Stream.
20081027040	Completed berm wall at Haiku Ditch on Honopou Stream.

GPS Listing:	
Shapefiles: (List file nam	es of all shapefiles created and a brief description of each)
File Name:	Brief Description:
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.
Waypoints: (List all wayp	oints in decimal degrees and provide a brief description of each)
WP No. Latitude	Longitude Brief Description:
Attachments:	
Brief Description:	
1. Image Contact Sheet	
Deserves detions	
Recommendations:	



20081027013.JPG

20081027015.JPG



20081027017.JPG



20081027018.JPG



20081027020.JPG





20081027025.JPG



20081027031.JPG

20081027021.JPG



20081027033.JPG



20081027035.JPG





20081027039.JPG

20081027038.JPG



20081027040.JPG



FIELD INVESTIGATION REPORT

FI2008102704 (East Maui, Honopou Lowrie Ditch, restore)

Date of Field Investig	Time (24-hour): 1310 - 1400			
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng			
Individuals Present:	Carl Freedman (Consultant at haiku Design & Analysis);			
	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), and Henry			
	Robello (Field Superintendent);			
	Honopou community - Lynn Scott, Beatrice Kekahuna, Sanford Kekahuna, Boni Kekahuna, and			
	Wanda Vierra			
Hydrologic Unit:	Honopou (6034)			
Stream Name:	Honopou Stream			

Findings:

At approximately 1310 hours, CWRM staff, Carl Freedman, Garret Hew and EMI staff, and members of the Honopou community arrived at the Lowrie Ditch diversion on Honopou Stream. The purpose of the field visit was to document the flow release just upstream of the Lowrie Side Ditch intake located on the left bank of the stream. Henry Robello and Garret Hew proceeded to lift up the Lowrie Side Ditch bypass sluice gate with a metal bar. Once the gate was opened, water from the upstream side of the sluice gate flowed through the gate. Then, Dean Uyeno measured the dimensions of the sluice gate opening to be 17 x 14 inches (W x H).

CWRM staff videotaped the flow release event.

CWRM staff walked upstream of the ditch to assess the condition of Honopou Stream. The stream had very little water but the stream was flowing into a pool downstream of the ditch.

Staff crew left the Lowrie Ditch diversion on Honopou Stream at approximately 1400 hours, and continued to Puolua (Huelo) Stream to take pre-restoration flow measurement. Refer to Field Investigation Report FI2008102705 (East Maui, Huelo IIFS Site A, pre-release) for more information.

Image Listing: (Attach P	DF of image contact sheet)
File Name:	Brief Description:
20081027049	CWRM staff, EMI staff, and members of the Honopou community arrived at the Lowrie Ditch diversion structure on Honopou Stream.
20081027050	Lowrie Ditch diversion intake (downstream side) on Honopou Stream.
20081027052	EMI staff Garret Hew and Henry Robello opening the Lowrie Ditch sluice gate on Honopou Stream.
20081027054	EMI staff Garret Hew and Henry Robello opening the Lowrie Ditch sluice gate on Honopou Stream.
20081027057	Looking from the top of the Lowrie Ditch sluice gate on Honopou Stream.
20081027058	Lowrie Ditch sluice gate on Honopou Stream.
20081027060	Lowrie Ditch sluice gate on Honopou Stream.
20081027061	Lowrie Ditch sluice gate on Honopou Stream.
20081027063	Honopou Stream upstream of Lowrie Ditch.
20081027065	Honopou Stream upstream of Lowrie Ditch.
20081027067	Dean Uyeno taking physical measurements of the Lowrie Ditch diversion intake on Honopou Stream.
20081027069	Dean Uyeno taking physical measurements of the Lowrie Ditch sluice gate on Honopou Stream.

GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)

File Name:	Brief Description:
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maui field investigations.

Waypoints: (List all waypoints in <u>WP No. Latitude</u>	n decimal degrees and prov Longitude	ide a brief description of each) Brief Description:	
Attachments: <u>Brief Description:</u> 1. Image Contact Sheet			
Recommendations:			









20081027050.JPG



20081027052.JPG



20081027054.JPG



20081027060.JPG



20081027065.JPG







20081027061.JPG



20081027067.JPG



20081027058.JPG



20081027063.JPG



20081027069.JPG



FIELD INVESTIGATION REPORT

FI2008102705 (East Maui, Huelo IIFS Site A)

Date of Field Investig	gation: October 27, 2008 Time (24-hour): 1430 - 1600
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Ernie Schupp (Huelo farmer)
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Puolua (Huelo) Stream
Findings:	

At approximately 1430 hours, CWRM staff arrived at Ernie Schupp's residence. CWRM staff prepared IIFS Site A on Puolua (Huelo) Stream for flow measurement. The entire flow measurement was completed in 23 minutes. Gage height readings were not recorded as a reference point was not established during the field investigation on October 23, 2008 (refer to Field Investigation Report FI2008102303 for more information). In addition to flow measurement, CWRM staff also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was sunny with no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.047 cubic feet per second (0.030 million gallons per day).

CWRM staff took a volumetric measurement of the water flowing through the two 5.4-inch (O.D.) PVC pipes that bypasses Haiku Ditch on Puolua (Huelo) Stream. With a stopwatch, staff recorded the number of seconds each of the pipes took to fill a 2 gallon bucket. This process was repeated 5 times, making a total of 5 measurements per pipe. As computed back in the Honolulu Office, the flow from the pipes was 0.063 cubic feet per second (0.041 million gallons per day).

Back on the dirt road by Ernie Schupp's taro loi, CWRM staff mentioned to Garret Hew that staff would drop by a hardware store in Wailuku to pick up a cap for the PVC pipe on the concrete-reinforced masonry (CRM) wall of the gage pool at Honopou Stream IIFS Site B. Garret Hew said that he would check the EMI Office for a cap so that CWRM staff would not need to purchase one from the warehouse.

CWRM staff concluded the field investigation at 1600 hours.

 Image Listing:
 (Attach PDF of image contact sheet)

 File Name:
 Brief Description:

GPS Listing:

	, ing.						
Shapefi	les: (List file nam	nes of all shapefiles created and a bri	ef description of each)				
File Name: East_Maui_POI.shp		Brief Description:					
		Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations					
Waypoi	nts: (List all way	points in decimal degrees and provide	e a brief description of each)				
WP No.	Latitude	Longitude	Brief Description:				
18	20.903285	-156.225661	Haiku Ditch on Huelo Stream				
19	20.903252	-156.225375	IIFS Site A Measurement Site on Huelo Stream				
Attachments: Brief Description: 1. Discharge Measurement and Gage Inspection Notes							
Recommendations:							

Form	9-275F
(Apr.	2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008102705 - Page 2 of 3

vieas.	NO.	
--------	-----	--

Comp. by ______

Checked by _____

Sta. No	ни	ELO IIF	S SITE	4	•	· ·	
Sta. Na	ime						
Date_	10/27		0 <u>08</u> F	Party	<u>Chui Li</u>	ing. Dea	m, Ed.
Width _	1.75	Area	0.40	<u>16</u> \	<i>J</i> el. <u>0, 0</u>	<u>9</u> G	H Disch0.047_CF
Method	<u> Waa</u>	ling		No. secs	s. <u>40</u>	G.H.cha	ange in hrs.
Method	d coef	H	oriz. ang	le coef.		Susp	Tags checked
Meter 7	Гуре		Meter N	0		Met	ter ft. above bottom of wt.
Rating	used			Spin tes	t before m	eas	; after
Meas.	plots		_ %diff.	fromrat	ing no. 🔄	<u> </u>	_ Indicated shift
		GAC	SE REAL	DINGS			Samples collected: water quality,
Time					Inside	Outside	sediment, biological, other
							Measurements documented on
L	Start	LEW	@ 14:	03		L	separate sheets: water quality, aux /base gage other
				ļ			
			 				Rain gage serviced/calibrated
						·	
							Weather: <u>Sunny</u>
	Finish	RENIQ	114.24				Air Temp. <u>25</u> °C at <u>14'.11</u>
·	1	1.010 0		1			Water Temp. 22_°C at 14:15_
Weighte	edMGH					<u> </u>	Check bar/chain found
GHcorr	rection				1		Changed to at
Correct	MGH		-				Correct
Wading Measur conditio Cross s), cable, id rement ra ons: Flow section:	ce, boat, (ted excel r: <u>lani</u> uniform	ipst)., do lent (2%) iviar , pebr	wnstr., s), good (<u>Luni fai</u> xes	side bridge 5%), fair (1 ven fluv	15 3%), poor v	(> 8%); based on following .
Gage o	perating				R	ecord Rer	moved
Battery	voltage:		In	take/Or	ifice clean	ed/puraea	d:
Bubble	-gage pre	essure, pa	si: Tank		, Line		;Bubble-rate /min.
Extrem	e-GH ind	icators: n	nax		, mir	۱	
CSGct	necked:	ł	-IWM hei	ght on s	tick	Ref.	elev HWM elev
HWMir	nside/out	side:	- -				·
Control	: <u>2 r</u> (ocks in	ere pl	aced	durunstr	earn o	f measuring point
Remari	ks:						
GHofz	ero flow =	GH		depth a	t control		= ft., rated
					Sh	eet No.	of sheets

.0	.10	.20	.30	 _	.40	.50 River) at -	.60		.70	FI2008102 .75	:705 - Pag
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARG	.80 E
	LEW	Q	@14:0	3								
	9-7		.69				<u> </u>					.85 —
	2.3		-+++			40-	}					_
												[—] .90
	1.05	.125	0									.92
	1.3	.175	.14			40					 	94
	1.4	<u>۱</u>	.22			40		. 14		.022	.003	
	1.5	- 1	. 33			40		. 09		.033	.003	.96
	1.6	. (.40			40		.11		.04	.004	.97 [.]
· <u></u>	1.7	.1	.40	-		цo		.12		, <u>04</u>	.005	.98
	1.9	.1	.40			40		. 10		. 04	.004	.99
	1.9	.1	.40			40		.11		. 04	.004	<u> </u>
	2.0	. ۱	.40			40		.10		.04	.004	_
0	2,1	.1	.40			40	-	۰ ۱ D		.04	.004	1.00
	2.2	. (.40			40		.10		,04	.004	_
	2.3	. ۱	.40	_		40		. 07		.04	.003	_
	2.4	. !	. 35			40		. 09		.035	.003	.99
<u> </u>	2.5	. (.31			чо		.06		.031	.002	98
	2.6	.1	.23			.40		.08		. 02B	.002	97
	2.7	. (.27		· · · · · · · · · · · · · · · · · · ·	40		. 09		. 027	.002	.96
<u> </u>	2.3	.05						11.11.11.11.11.11.11.11.11.11.11.11.11.	antonia, tugan mataka sa sa sa	aleba Sector Science and		
	1.75	1.75					AVE =	0.09		.496	.047	.94
								· 				.92
	REN	<u>@ 14</u>	<u>zb</u>	\rightarrow								.90
												_
												.85 -
												_
												.80
												_
	ı I									1		

3 of 3



FIELD INVESTIGATION REPORT

FI2008102801 (East Maui, Honopou IIFS Site A)

Date of Field Investig	Time (24-hour): 0740 - 0920
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (EMI Water Resources Manager) and Henry Robello (Field Superintendent)
	Honopou community - Beatrice Kekahuna, and Wanda Vierra
Hydrologic Unit:	Honopou (6034)
Stream Name:	Honopou Stream
ET ALL'AND A	

Findings:

On October 27, 2008, CWRM staff documented the flow release at Lowrie Side Ditch bypass sluice gate on Honopou Stream. Refer to Field Investigation Report FI2008102704 (East Maui, Honopou Lowrie Ditch, restore) for more information. Since flow was restored, the following flow measurements represent post-release flow conditions.

At approximately 0740 hours, CWRM staff arrived at the Haiku Ditch diversion on Honopou Stream. CWRM staff took a volumetric measurement of the water flowing through the three 4-inch (O.D.) PVC pipes that bypasses the ditch. With a stopwatch, staff recorded the number of seconds each of the pipes took to fill a 2 gallon bucket. This process was repeated 5 times, making a total of 5 measurements per pipe. As computed back in the Honolulu Office, the flow from the pipes was 0.121 cubic feet per second (0.078 million gallons per day).

CWRM staff then walked to a large pond downstream from Haiku Ditch on Honopou Stream.

Staff then drove to the bridge that crosses Honopou Stream further downstream to measure flow at IIFS Site A. Staff met with Garret Hew, Henry Robello, and members of the Honopou community at the bridge. CWRM staff prepared IIFS Site A on Honopou Stream for flow measurement. CWRM staff checked the downstream gage pool for debris and there was none. Staff noticed that the water level in the gage pool was considerable lower than the water level observed in previous field visits, during which the water overtopped the concrete-reinforced masonry (CRM) wall of the gage pool. Since the water level in the gage pool was low, and that water was not spilling over the CRM wall, Garret Hew noticed leakage at the center of the wall footing that was not apparent in previous field visits when the water overtopped the wall. When CWRM staff returned to the Honolulu Office, Matt Wong of the USGS-Maui Office contacted Chui Ling Cheng regarding the leakage. He mentioned that a gage pool with multiple leakages may not be stable enough for gage height readings. CWRM staff plans to return to this site in November to investigate this issue further.

The entire flow measurement was completed in 20 minutes. Gage height readings were taken at the downstream gage pool at the start and finish of flow measurement. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was overcast with vog and no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.060 cubic feet per second (0.039 million gallons per day), with no change in gage height.

Staff crew left Honopou IIFS Site A at approximately 0920 hours, and continued further downstream to conduct flow measurement at IIFS Site B on Honopou Stream. Refer to Field Investigation Report FI2008102802 (East Maui, Honopou IIFS Site B) for more information.

Image Listing: (Attach PDF of image contact sheet)								
File Name:	Brief Description:							
20081028001	Pond downstream of Haiku Ditch on Honopou Stream.							
20081028002	Pond downstream of Haiku Ditch on Honopou Stream.							
20081028005	Pond downstream of Haiku Ditch on Honopou Stream.							
20081028006	Gage pool and reference point on Honopou Stream IIFS Site A.							
20081028009	Gage pool and reference point on Honopou Stream IIFS Site A.							
20081028010	Gage pool and reference point on Honopou Stream IIFS Site A. Water level was below the CRM wall.							

GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)

File Name:

East_Maui_POI.shp

<u>Brief Description:</u> Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
6	20.916212	-156.245203	Bridge on Honopou Stream
7	20.916187	-156.245174	IIFS Site A Reference Point on Honopou Stream
8	20.916096	-156.245077	IIFS Site A Flow Measurement on Honopou Stream

Attachments:

Brief Description: 1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes

Recommendations:



20081028001.JPG



20081028002.JPG



20081028005.JPG



20081028006.JPG



20081028009.JPG



20081028010.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND

FI2008102801 - Page 4 of 6

Meas. No.	. <u> </u>		
		-	

Comp. by _____Chui

,		I	GAGE	NSPECT	ION NOT	ES Checked by
Sta. NoHon	logou h	FS SIT	EA			
Sta. Name						
Date10/24	,2	0 <u>0%</u> F	Party	Chui,	Dcan	Eal
Width <u>2.8</u>	Area	_0.90	<u>)</u> 2\	<i>l</i> el <u>0.0</u>)7 G.	H. <u>05</u> Disch. <u>0.06</u> CFS
Method <u>Wa</u>	ding	I	No. secs	40	_ G. H. cha	ange0 in hrs.
Method coef	H	oriz. ang	le coef.		Susp	Tags checked
Meter Type		Meter N	0		Met	er ft. above bottom of wt.
Rating used			Spin tes	t before m	eas	;after
Meas.plots		% diff.	from rati	ng no	·	_ Indicated shift
	GAC	SE REAL	DINGS	·		Samples collected: water quality.
Time				Inside	Outside	sediment, biological, other
						1
						Measurements documented on
Start	LEW	<u>@. 8:</u>	25			separate sheets: water quality,
	GHT =	1.00 -	.95 = .	05		
			. 			Rain name serviced/calibrated
···		ļ	<u> </u>			Weather: NOG overcost
Finish			13	, 		Air Temp 21 °C at 9:39
	KEW G	<u>es 4.0</u>				Water Temp 21.5 °C at 9:47
 Weighted MGH	<u>- 6H1 =</u>	1.00 -	.46 =	.05	 	Check bar/obain found
GH correction				<u> </u>		
CorrectMGH						
Nading, cable, i Neasurement ra conditions: Flow Cross section:_	ice, boat, u ated excel v: <u>lan</u> bedrock	pstr., do lent (2%) <u>atmar ,</u> , <u>cobiz</u>	wnstr., s), good (! <u>▼ fan</u> <u>I€ (, f</u>	ide bridge 5%), fair (1 (14 4n air (4 4	9, <u>60</u> 3%), poor (1. Form niform	(> 8%); based on following /
Gage operating	:	<u> </u>		R	ecord Ren	noved
Battery voltage:	<u>_</u>	<u>In</u>	take/Ori	fice clean	ed/purgec	d:
Bubble-gage pr	essure, ps	si: Tank		, Line		; Bubble-rate /min.
Extreme-GH inc	dicators: n	nax		, mii	·	······
SG checked	ŀ	HWMhei	ght on s	tick	Ref. (elev HWM elev
IWM inside/out	tside:	·				<u>.</u> ,,,,,,,,,,,,,
Control: <u>court</u>	<u>ral, r</u>	o den	ris			
Remarks:	iter did	vict	cio (N	er cor	ition du	ic to lun flow
GH of zero flow	= GH		depth at	control		= ft., rated
				Sh	eet No.	of sheets

.0	.10	.20	.30		.40	.50 River) 'at≩	.60		.70	FI2008102 . 75	801 - I	Page 5 of 6
CEF-	DIST.		1	Ϋ́́Η	÷	TIME	VEL	OCITY	ADJUST-	<u> </u>			
ANGLE C	FROM INITIAL POINT	WIDTH	DEPTH	OBSER	REVO- LUTIONS	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80 E	
	LEW	0	8:25				GHT	1.00 -	0.95 =	0.05			
											1	.85	
	2.6	.05	0				1					-	
	27		0.32			40		.84		· · · ·		-	
	2.4											.90	
	2.7	.	0.18				1/2 (.03	1=.02		.018	0	.92	
	2.8	. 1	0.42			40		.03		. D42	. 001	_ • •	
······	2.9	. 1	0.45		_	40		. 03		.045	.001	94	
	3.0	. 1	0.42			40		.06		.042	.003	.96	
	3.1	.1 *	0.37			40		.05		.037	.002	.97 [.]	
-	3.2	. ۱	0.37			40		. 05		.037	.002	.98	.009
-+	3.3	. 1	0.39			40		.07		.039	.003	.99	
	3.4	.1	0.36			40		, 09		.036	.003		
	3.5	. I	0.35			ЦD		.08		.035	,003		013
0	3.6	. I	0.35			40		.07		,035	.002 .	I.00	
<u> </u>	3.7		0.3b			40		-07		.036	.003	-	
····	3.9	· , l	0.35			40		.06		.035	.002	_	· .
	3.9	. 1	0.35			40		.07		.035	.002	.99	.027
	4.0		0.42			40		.07		.042	.003	98	
	4.1	.1	0.42			40		.09		.042	.004	9 7	
	<u>4.2</u>	. \	0.40			40		.08		.040	.003	.96	.037
<u></u>	4.3	-1-	0.40			40		. 09		.040	. 004		
	4.4	!	0.40			40	· · · ·	.10		.040	.004	.94 _	-
	4.5	. \	0.35			40		. 10		.035	.004	<i>.</i> 92 -	.049
	4.6	.	0.32			40		.10		.032	.003	.90	
	4.7	.	0.31			40		.00		.031	.002	-	
	4.8	.1	0.28			40		.07		.028	.002	-	
	4.9	.\	0.29			40		.06		.02%	.002	.85	•
	5.D	. \	0.Z1			40		.06		.021	.001	-	
	5.1	.1	0.21			40		.03		.0Z1	.001	- 20	.06
	5.2	,15	0.20			40		.01		.03	0	.80	
			1									_	•

.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI20081028	01 - Page 6 of 6
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	DCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	.80
	5.4		0						-			
	2.8	2.0					AN	E=.07		.902	0.06	.85
	REN	a	9:08				GHT :	1.00 -	.95=	.05		_
												_
									-			.90
												.92
												-94
											·	~
										·		.96
												.97
												.98 -
							L					.99
			-,									
<u></u>												-
0											1	.00
												-
												.99
												-98
<u> </u>												-97
								·				.96
												_
. <u> </u>												.94
									_			.92
												.90
												_
								: :				_
												.85
												_
			-									.80
												_



FIELD INVESTIGATION REPORT

FI2008102802 (East Maui, Honopou IIFS Site B)

Date of Field Investig	gation: October 28, 2008 Time (24-hour): 0930 - 1100						
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng						
Individuals Present:	EMI - Garret Hew (EMI Water Resources Manager) and Henry Robello (Field Superintendent)						
	Honopou community - Beatrice Kekahuna, and Wanda Vierra						
Hydrologic Unit:	Honopou (6034)						
Stream Name:	Honopou Stream						

Findings:

On October 27, 2008, CWRM staff documented the flow release at Lowrie Side Ditch bypass sluice gate on Honopou Stream. Refer to Field Investigation Report FI2008102704 (East Maui, Honopou Lowrie Ditch, restore) for more information. Since flow was restored, the following flow measurements represent post-release flow conditions.

At approximately 0930 hours, CWRM staff, Garret Hew, Henry Robello, and members of the Honopou community arrived at the property of Melissa and Barron Souza. From Melissa Souza's property, everyone hiked to IIFS Site B on Honopou Stream. CWRM staff prepared the site for flow measurement. CWRM staff checked the upstream gage pool for debris and there was none. The entire flow measurement was completed in 30 minutes. Gage height readings were taken at the downstream gage pool at the start and finish of flow measurement. In addition to flow measurement, CWRM staff also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was sunny with cool air temperatures and no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.151 cubic feet per second (0.098 million gallons per day), with a no change in gage height.

On the previous day, Garret Hew offered to bring the cap for the pipe (see Field Investigation Report FI2008102705 (East Maui, Huelo IIFS Site A). CWRM staff and Garret Hew capped the PVC pipe that is part of the concrete-reinforced masonry (CRM) wall of the gage pool on Honopou Stream. They used PVC cement to prevent any leakage from the pipe.

Staff crew left Honopou Stream IIFS Site B at approximately 1100 hours, and drove to Haiku Ditch on Puolua (Huelo) Stream to document the flow release. Refer to Field Investigation Report FI2008102803 (East Maui, Huelo Haiku Ditch, restore) for more information.

Image Listing: (Attach PDF of image contact sheet)										
File Nam	e:	Brief Description:								
20081028	3011	IIFS Site B on Honopou Stream								
20081028	3012	CRM wall of the gage pool on H	lonopou Stream at IIFS Site B.							
20081028	3013	Capped PVC pipe at the CRM v	vall of the gage pool on Honopou Stream at IIFS Site B.							
GPS Lis	ting:									
Shapefi	les: (List file nam	es of all shapefiles created and a brid	of description of each)							
File Nam	<u>e:</u>	Brief Description:								
East_Mau	East_Maui_POI.shp Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.									
Waypoir	n ts: (List all wayp	oints in decimal degrees and provide	a brief description of each)							
WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:							
12	20.931867	-156.244694	IIFS Site B Flow Measurement on Honopou Stream							
11	11 20.931827 -156.244678 IIFS Site B Reference Point on Honopou Stream									
Attachments: Brief Description:										

1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes

Recommendations:



20081028011.JPG





20081028013.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND

GAGE INSPECTION NOTES

FI2008102802 - Page 4 of 5

Meas.	No.	
-------	-----	--

Comp. by _ Chui

Checked by DDU

Sta. No	Hol	lopou	IIFS S	TE B					
Sta. Na	me								
Date	10/29	2,2	20_ <u>08</u> _P	arty(Yani .	Dean.	Ed		
Width _	1.3	Area	a <u>0.60</u>	<u>5</u> V	el. <u>0.2</u>	<u>5</u> G.	H. 0.03 Disch. 0.151		
Method	- Wad	ing	N	lo. secs.	40	G.H.cha	ange <u>0</u> in <u>5</u> hrs.		
Method	i coef	H	loriz. ang	le coef	` <u>`</u>	Susp	Tags checked		
MeterT	ype		Meter N	0		Met	er ft. above bottom of wt.		
Rating	used			Spin test	before m	eas	; after		
Meas.p	olots		_ %diff.	from ratir	ng no	÷	Indicated shift		
		GAC	GE REAL		Samples collected: water quality				
Time			<u></u>		Inside	Outside	sediment, biological, other		
							Measurements documented on		
	Start	LEW	@ 10:	00			separate sheets: water quality,		
	· .	GHT	= 1.00	- 0.17	= 0.93				
					ļ		rkain gage serviced/calibrated		
	· .		<u> </u>			·	Weather Mexanct		
	Finish	1 Jac 1 1 1 1					AirTemp 7h °Cat 10:07		
	Fillian	REW	1012	<u>ð</u>			Minemp: <u>20</u> Cat <u>10.02</u>		
Abiabta		GHT	1.00-	0.17:	: 0.83				
GH corr		<u> </u>							
Correct	MGH		-		· · · · · · · · · · · · · · · · · · ·	-	Changed to at		
			<u> </u>		í				
Wáding	, cable, ic	e, boat, i	upstr., do	wnstr., si	de bridge		(ft, mi. upstr., downstr. of gage		
Measur	ement rat		llent (2%)	, good (5 -failed	%), fa(r (8	5%), poor ((>8%); based on following .		
Crosss	ection	<u>nbbles</u>	Incky	fair Fair	<u>iava io</u> lut cuo	i form			
010333		CAPACITY .	<u>. 100-</u>		3 3	<u> : coffre .</u>			
Gage o	neratino	•••••			R	acord Ren	noved		
Batterv	voltane [.]		Int	ake/Orif	ice cleane				
Bubble	-dade pre	ssure os	III si Tank		lice cleane Line	earpuiged	Bubble-rate /min		
Extrem	e-GH indi	icators n	nax		min				
CSGch	ecked [.]	joarons. H	HIM/M hei	aht on sti	, (1000) ick	Pof			
HWM in	side/outs	side:		5	<u> </u>				
Control	COVICA	etc		•					
							· · · · · · · · · · · · · · · · · · ·		
Remark	(s: <u>notic</u>	ced wi	ater le	vel di	op. fro	m yes:	kerelay.		
GH of z	ero flow =	GH	~	depth at	control _		= ft., rated		
					She	et No	of sheets		
					OIR				

1	•			••								FI20081028	802 -	Page 5 of 5
	.0	.10		.30		.40	.50 River	<u>at</u>	.60		.70	.75	_	-
	COEF	DIST.			EPTH.	5510	TIME	VEL		ADJUST- ED FOR			- 80	
		INITIAL POINT	WIDTH	DEPTH	08SE	LUTIONS	SEC- ONDS	AT POINT	IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE		•
		LEW	@	10:01				GHT	= 1.00 -	0.17 =	0.83		_	
													.85	
		3.1	.05	0.19			est =	1/2 (.2	1)= .15		,010	.002	-	
		3.2	.1	0.51			40		0.29		.051	. 015	-	
		3.3	. 1	0.58			40		0.27		.050	.016	.90	
		3.4	.1	0.60			40		0.27		.060	.016	.92	
		3.5		0.58			40		0.25		.058	.015		÷
		3.6		0.58			40		0.24		.058	.014	.94	
		3.7	.1	0.58			40		0.23		.058	.013	.96	
		3.8	1	0.60			40		0.24		.060	.014	.97	
		3.9	.1	0.59	2		40		0.22		.059	. 013	.98	
		4.0	.1	0.55			40		0.25		055	.014	.99	
		4.1		0.55			40		0.24		.055	.013	.	.145
	· · ·	4.2	. 15	0.23			40		0.25		.023	.006	_	
	0	4.4	. [0				AV	E= .25		.605	. 151 1	.00	
		1.3	1.3	-									_	
•	· · ·												'	,
		reni	@	10 ! 2%				GHT	= 1.00	- 6,17=	0.83		.99	
											-		-98	
			· . ·										-97	
													.96	
								· · · · · ·					-	
													.94	-
													. 9 2 -	
												<u>.</u>	.90	
													<u> </u>	
													-	
													.85	,
													-	
		··.											00	5
													.ou	
		·												



FIELD INVESTIGATION REPORT

FI2008102803 (East Maui, Huelo Haiku Ditch, restore)

Date of Field Investig	Time (24-hour): 1130 - 1200
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Ernie Schupp (Huelo farmer);
	EMI - Garret Hew (EMI Water Resources Manager) and Henry Robello (Field Superintendent)
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Puolua (Huelo) Stream

Findings:

At approximately 1130 hours, CWRM staff, Garret Hew and Henry Robello, arrived at the Haiku Ditch diversion on Puolua (Huelo) Stream. CWRM staff took a volumetric measurement of the water flowing through the two 5.4-inch (O.D.) PVC pipes that bypasses Haiku Ditch on Puolua (Huelo) Stream. With a stopwatch, staff recorded the number of seconds each of the pipes took to fill a 2 gallon bucket. This process was repeated 5 times, making a total of 5 measurements per pipe. As computed back in the Honolulu Office, the flow from the pipes was 0.062 cubic feet per second (0.040 million gallons per day).

The purpose of the field visit was to document the flow release at the ditch. Henry Robello proceeded to lift up the Haiku Ditch sluice gate with a metal bar. Once the gate was opened, water from the upstream side of the sluice gate flowed through the gate opening. Water slowly stopped flowing from the two pipes that bypasses Haiku Ditch on Puolua (Huelo) Stream.

CWRM staff videotaped the flow release event.

Staff crew left the Haiku Ditch diversion on Puolua (Huelo) Stream at approximately 1200 hours, and continued to document opening of Haiku Ditch sluice gate on Hanehoi Stream. Refer to Field Investigation Report FI2008102804 (East Maui, Hanehoi Haiku Ditch, restore) for more information.

Image Listing: (Attach PDF of image contact sheet)

Image Listing. (Attach F	PDF of Image contact sheet)
File Name:	Brief Description:
20081028015	Garret Hew and Henry Robello inspecting the Haiku Ditch sluice gate on Puolua (Huelo) Stream.
20081028016	The two PVC pipes that bypasses Haiku Ditch on Puolua (Huelo) Stream.
20081028017	Haiku Ditch on Puolua (Huelo) Stream.
20081028019	CWRM staff conducting volumetric measurement of the water flowing through the two PVC pipes that
0000100000	bypasses Haiku Ditch on Puolua (Huelo) Stream.
20081028022	Henry Robello opening the Haiku Ditch sluice gate on Puolua (Huelo) Stream.
20081028023	Haiku Ditch on Puolua (Huelo) Stream. Haiku Ditch sluice gate opened.
20081028025	Henry Robello opening the Haiku Ditch sluice gate on Puolua (Huelo) Stream.
20081028026	Haiku Ditch sluice gate on Puolua (Huelo) Stream opened.
20081028027	The two PVC pipes that bypasses Haiku Ditch on Puolua (Huelo) Stream, after the sluice gate was opened.
20081028028	Haiku Ditch on Puolua (Huelo) Stream after the sluice gate was opened
GPS Listing:	
Shapefiles: (List file nam	es of all shapefiles created and a brief description of each)
File Name:	Brief Description:
East Maui POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maui field investigations.
Waypoints: (List all wayp	points in decimal degrees and provide a brief description of each)
WP No. Latitude	Longitude Brief Description:
Attachments:

- Brief Description: 1. Image Contact Sheet



20081028015.JPG



20081028016.JPG



20081028017.JPG



20081028019.JPG





20081028022.JPG



20081028026.JPG



20081028023.JPG



20081028027.JPG





FIELD INVESTIGATION REPORT

FI2008102804 (East Maui, Hanehoi Haiku Ditch, restore)

Date of Field Investig	jation: October 28, 2008 Time (24-hour): 1200 - 1300
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Huelo community - Ernie Schupp, Neola Caveny, and Ken Meade;
	EMI - Garret Hew (EMI Water Resources Manager) and Henry Robello (Field Superintendent)
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Hanehoi Stream

Findings:

At approximately 1200 hours, CWRM staff, Ernie Schupp, Garret Hew and Henry Robello, met with Neola Caveny and her friend Ken Meade outside of the Door of Faith Church on Huelo Road. Following EMI staff, everyone drove to the Haiku Ditch diversion on Hanehoi Stream. The purpose of the field visit was to document the opening of the Haiku Ditch sluice gate on Hanehoi Stream. The stream was dry. Henry Robello proceeded to lift up the Haiku Ditch sluice gate with a metal bar. Dean Uyeno measured the dimensions of the sluice gate opening to be 2 x 1.38 feet (W x H).

CWRM staff videotaped the event.

CWRM staff and Ernie Schupp hiked to IIFS Site B on Hanehoi Stream, both the flow measurement and reference point locations.

Staff crew left the Haiku Ditch diversion on Hanehoi Stream at approximately 1300 hours, and returned to Puolua (Huelo) Stream to take post-release flow measurements. Refer to Field Investigation Report FI2008102805 (East Maui, Huelo IIFS Site A) for more information.

Image Listing: (Attach PDF of image contact sheet)								
File Name:	Brief Description:							
20081028033	Haiku Ditch diversion intake structure on Hanehoi Stream.							
20081028035	Haiku Ditch diversion structure on Hanehoi Stream.							
20081028037	Henry Robello opening the Haiku Ditch sluice gate on Hanehoi Stream.							
20081028038	Henry Robello opening the Haiku Ditch sluice gate on Hanehoi Stream.							
20081028040	Haiku Ditch sluice gate on Hanehoi Stream.							

GPS Listing:

 Shapefiles: (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

 East_Maui_POI.shp
 Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:

Attachments:

Brief Description:

1. Image Contact Sheet







20081028035.JPG



20081028038.JPG



20081028040.JPG



20081028037.JPG



FIELD INVESTIGATION REPORT

FI2008102805 (East Maui, Huelo IIFS Site A)

Date of Field Investig	Time (24-hour): 1320 - 1340						
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng						
Individuals Present:	Ernie Schupp (Huelo farmer)						
Hydrologic Unit:	Hanehoi (6037)						
Stream Name:	Puolua (Huelo) Stream						
Stream Name: Puolua (Huelo) Stream Findings: At approximately 1320 hours, 1.5 hours following the flow release at the Haiku Ditch on Puolua (Huelo) Stream (refer to Field Investigation Report FI2008102803 for more information), CWRM staff returned to IIFS Site A on the stream. CWRM staff prepared the site for flow measurement. The entire flow measurement was completed in 20 minutes. Gage height readings were not recorded as a reference point was not established during the field investigation on October 23, 2008 (refer to Field Investigation Report FI2008102303 for more information). In addition to flow measurement, CWRM staff also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was overcast with no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.055 cubic feet per second (0.036 million gallons per day). Staff crew left the IIFS Site A on Puolua (Huelo) Stream at approximately 1340 hours, and continued to Palauhulu IIFS Site B) for more information.							
Image Listing: (Attach File Name:	PDF of image contact sheet) Brief Description:						
Image Listing: (Attach File Name: GPS Listing:	PDF of image contact sheet) Brief Description:						
Image Listing: (Attach File Name: GPS Listing: Shapefiles: (List file nar File Name: East_Maui_POI.shp Waypoints: (List all way WP No. Latitude	PDF of image contact sheet) Brief Description: hes of all shapefiles created and a brief description of each) Brief Description: Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations. points in decimal degrees and provide a brief description of each) Longitude Brief Description:						
Image Listing: (Attach File Name: GPS Listing: Shapefiles: (List file nar File Name: East_Maui_POI.shp Waypoints: (List all way WP No. Latitude	PDF of image contact sheet) Brief Description: These of all shapefiles created and a brief description of each) Brief Description: Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations. points in decimal degrees and provide a brief description of each) Longitude Brief Description:						

(Apr. 20	01)			U.S. G	eologic	al Surve	ey	Meas No.		
								Comp. by	Chui	
			0150	GAGE I	E WEAS		ES	<u> </u>	- DNI	
Sta No	Huo Hir	elo (Corre	ction mad	e 11/20/0	8)			Checked by	y_ <u>UBN</u>	
Sta Nam										
Date1	01295	.2	0_08 P	artv	Chui.	Dean.		· · · · · · · · · · · · · · · · · · ·		
Width	1.8	Area	0.52	<u> </u>	el. <u>0.0</u>	9 G.	Н	Disch.	0.055 C	FS
Method _	Wach	na	N	lo. secs.	40	G.H.cha	ange	in	hrs.	
Method c	oef	Н	oriz. angi	le coef		Susp		Tags checked	· · · · ·	
Meter Typ	be		Meter No	0		Met	er	ft. above	bottom of wt.	·
Rating us	ed		(Spin test	before m	eas		; after		
Meas. plo	ots		% diff. f	romratin	ng no	• • • • •	Indicat	ed shift		
		GAC	E READ	DINGS		÷	Samples	scollected: wa	ter quality,	
Time					Inside	Outside	sedime	nt, biological, o	ther	
							[<u></u>	
	terf.			. ·	· ·		Measure	ements docun	nented on	
	ndii	LEW	B 13.12				aux./bas	e gage, other	iei quanty,	
			· · ·			·		·	· · · · ·	
		· · · · ·					Raingag	je serviced/cal	ibrated	
		. <u></u> .								
		..			ļ		Weather	: <u>overcast</u>		
F	inish	REN (13:33				Air Temp	. <u>_26_</u> ℃	at 13:12	
							Water Te	emp. <u>22,5</u> °C	at <u>13/17</u>	
Weighted	MGH					 	Check b	ar/chain found		
GH correc	tion	<u> </u>					Change	toat	<u></u>	
	GH						Correct			
Aeasuren conditions Cross sec	nent rate s: Flow: ction:	e, boat, i ed excel <u>lami</u> fairly	ent (2%) nar 	whstr., si , good (5 <u>fzuirly</u> m, d	ide bridge %), fair (1 <u>unu for</u> ivt , <u>u</u>	3%), poor (m Hle pel	(>8%); ba	ni, upstr., dowr ased on followii	ng,	
Gage ope	rating:_				R	ecord Ren	noved	· · · · · · · · · · · · · · · · · · ·		
Battery vo	oltage:	<u> </u>	Int	ake/Orif	ice clean	ed/purged	<u>!</u>			
Bubble-ga	age pres	ssure, ps	i: Tank 🔔		, Line		;Bubb	le-rate	/min.	
Extreme-(GH indi	cators: n	nax		, mir	۱				
CSG chec	cked:	ł	IWM hei	ght on st	ick		elev	HWM ele	ev	
	de/outs	ide:						· · ·		
IWM insi	<u>2 ri</u>	<u>icks c</u>	ionns to	icam (2 +1)	nt mee	Isting	pmnt.		
HWM insi Control: _				·			· · · · · · · · · · · · · · · · · · ·		<u> </u>	
HWM insi Control: _ Remarks:	, . 									
HWM insi Control: Remarks:								<u>A</u> 1		

.0	.10	.20	.30		.40	.50 River) at -	.60		.70	FI20081028	305 - F	² age 3 of 3
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA. TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	.80	•
	LEW	Ø	13:12	•				:		÷* .		.	·
												.85	
	0.3											-	
	0.25	.075	0									-	
	0.4	.175	0.1			est =	1/2 (.D	1)=.05		.018	. 001	.90	
	0.6	.15	0.25			40		0.09		. 036	. 003	.92	/
	0.7	- 1	0.37			40		0.13		.037	005	-	
	0.8	. 1	0.40			Цо		0.11		.04	. 004	94 -	· .
	0.9	. (0.40			Цo	•	0.13		.04	.005	.96	-
	1.0	.	0.40			40	-	0.14		.04	.006	.97	
<u>.</u>	1.1	. (0.40	·		40		0.12		. 04	. 005	.98	-
	1.2	. 1	D.41			40	·	0.11		.041	. 005	.99	· .
	1.3		0.41			40		0.10		.041	.004	-	•
<u> </u>	1.4	.1	0.42			40		0.08		.042	.003	-	
0	1.5	. 1	0.42			40		6.07		.042	.003 1	.00	
	1.6	.١	0.40			40		0.09	н. 	,040	.004	-	
	1.7	.	0.36			40		0.08	artiget of the Article of the	.036	. 003		.051
. <u></u>	1.9	. (0.33			40		0.07		,033	.002	.99	
	1.9	ļ <u></u>	0.29			40		0.05	.557	.0z9	.001	.98	
	2.0	.075	0.30			40		0.04	analysister and the second second second	.023	.001	.97	•
· .	2.05	.025	0				AVE -	0.09	· · · · · · · · · · · · · · · · · · ·	,590	055	.96	
	1.90	1.9								0.574		•	
				· -								.94	-
	REW	@	13:33						· ·			.92	
											· · ·	.90	
					·								
]								.85	
						,						•.	
													, ,
									<u>\</u>			.80	
			· · · ·										•.



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT

Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102806 (East Maui, Palauhulu IIFS Site B, pre-release)

Date of Field Investig	ation: October 28, 2008 Time (24-hour): 1500 - 1700
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Palauhulu Stream
Findings:	

At approximately 1500 hours, CWRM staff, arrived at the Hana Highway bridge that crosses Palauhulu Stream. The bridge is near the entrance to Piinaau Road. Staff crew hiked up Palauhulu Stream on the trail that begins on the left bank of the stream upstream of the bridge. During a previous field visit, Matt Wong from the USGS-Maui Office found a location on the stream that may be suitable for flow measurement (refer to Field Investigation Report FI2008102403 for more information). The location was directly below the bridge. Matt did not find any locations suitable for gage height reading. The stream was either too deep or there was no safe way to access the location.

To access the measurement site, CWRM staff hiked upstream approximately 100 yards from the bridge on Hana Highway, and crossed the stream to the right bank. Then, staff hiked downstream to the measurement site directly below the bridge (IIFS Site B).

CWRM staff prepared the site for flow measurement. The site was flagged with yellow tape, labeled with the stream name, IIFS site, and the date. Staff completed the entire flow measurement in 35 minutes. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow at IIFS Site B was 1.951 cubic feet per second (1.261 million gallons per day), with no gage height readings.

CWRM staff concluded the field investigation at 1700 hours.

Image Listing: (Attach PDF of image contact sheet)									
File Name:	Brief Description:								
20081028049	Palauhulu Stream upstream from the Hana Highway bridge.								
20081028051	Flow measurement site (IIFS Site B) on Palauhulu Stream, directly below the Hana Highway bridge.								
20081028052	Palauhulu Stream downstream from the Hana Highway bridge.								
20081028056	Flow measurement site (IIFS Site B) on Palauhulu Stream, directly below the Hana Highway bridge.								

GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)										
File Name:	Brief Description:									
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.									
Waypoints: (List all wayp	oints in decimal degrees and provide a brief description of each)									

WP No.

Latitude	<u>Longitude</u>
20.856333	-156.146474

Brief Description: IIFS Site B on Palauhulu Stream at Hana Highway

Attachments:

26

Brief Description:

1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes



20081028049.JPG

20081028051.JPG



20081028052.JPG



Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND

GAGE INSPECTION NOTES

FI2008102806 - Page 3 of 4

Meas. No.	<u></u>
-----------	---------

Comp. by _____Chui

Checked by DOL

Sta. No. PALAUHULU IIFS SITE B	
Sta. Name	
Date 10128 , 20 00 Party Chui, Dean, Ed	
Width <u>5.0</u> Area <u>3.489</u> Vel. <u>0.56</u> G.H. Disch. <u>1.0</u>	<u>151 CFS</u>
Method Wading No. secs. <u>40</u> G.H. change in	hrs.
Method coef Horiz. angle coef Susp Tags checked	
Meter Type Meter No Meter ft. above botto	om of wt.
Rating used Spin test before meas; after	
Meas. plots % diff. from rating no Indicated shift	
GAGE READINGS Samples collected: water c	uality.
Time Inside Outside sediment, biological, other	
Measurements document	ed on
Start LEW (# 15:55 separate sheets: water of aux /base gage other	quality,
aux./basegage, other	· .
Rain gage serviced/cambra	
Air Temp 23 °C at	16:04
REW (2) 16:33	IL OLL
	10.04
Correct MGH	
Wading, cable, ice, boat, upstr., downstr., side bridge,ft., mi. upstr., downstr.	ofgage.
conditions: Flow: 10/2017/04 unifizition (5%), fair (6%), poor (> 6%); based on following ,	
Cross section: bedrock uneven	
Gage operating: Record Removed	
Battery voltage: Intake/Orifice cleaned/purged:	
Bubble-gage pressure, psi: Tank, Line; Bubble-rate	/min.
Extreme-GH indicators: max, min, min	
CSG checked HWM height on stick Ref. elev HWM elev	
HWM inside/outside:	
Control: none	
Remarks:	
GH of zero flow = GH depth at control = ft., rated	

.0	.10	.20	.30		.40	.50 River) 'at - (.60		.70	FI20081028 . 75	806 - Page 4 of 4
DEF.	DIST.			A. HH		TIME	VEL	OCITY	ADJUST-			-
ANGLE CO	FROM INITIAL POINT	WIDTH	DEPTH	OBSER	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80
· .	LEW	0	15:55									
												.85
 	3,25	.08	0									-
	3.4	.18	0.4	.6		40		.56		.072	.040	_
· .	3.6	:2	0.9	.6		40		.46		.16	.083	.90
	3.8	.2	0.93	.6		40		.52		. 196	. eno °	.92
	4.0	.2	0.95	.6		40		. 54		. 19	. 103	-94
· ·	4.2	.2	0.92	.6		40		.52		. 184	. 096	.54
<u> </u>	4.4	.2	0.88	.6		40		. 55		.176	.097	.96
	4.6	.2	0.87	.6		40		.41		176	.072	.97 -
	4.8	.2	0.95	.6		40		.38		.170	.065	.98
:	5.0	.2	0.82	.6		40		.48		.164	.079	.99
. .	5.2	.2	0.76	.6		40		.55		.15Z	.0904	•
	5.4	.2	0.78	.6		40		.64		.166	.100	
0	5.6	.2	0.90	.6		40		,54		.180	.097 1	.00
· .	5.8	.2	0.81	.6		40		.60		.162	.097	
	6.0	.2	0.78	.6		40		, 59		.156	.092	
	6.2	.2	0.74	.6		40	-	. 59		.158	.093	.99
	6.4	.2	0.72	.6		40		.60		.144	.086	.98
	6.6	.2	0,69	.6		40		.62		.138	.086	.97
· · ·	6.8	.2	0.73	.6		40		. 71		.146	.104	.96
<u> </u>	7.0	.2	0.70	.6		40	···	.68		.140	.095	
·	7.2	.2	0.62	.6		40		.68		.124	.084	.94
	7.4	. 2	0.53	.6		40		.68		.106	.072	.92
	7.6	.2	0.40	.6		40		.67		.080	.054	.90
	7.8	.2	0.3 3	.6		40		.63		. 066	.042	
	8.0	.225	0.37	.6		40		.38		.093	.032	
	8.25	.125	0	· · · · · · · · · · · · · · · · · · ·				Accession, in the second state of the second	Different and Artist Monte Statements	Sant da i sta altra como	Ma ¹⁵ 91 1999, 1991 4 10 1 10 10 10 10 10	85
	5.0	5.0					ANE =	.56		3.489	+.45+	
											1.950	00
	REN	@	16:33								·	80



FIELD INVESTIGATION REPORT

FI2008102901 (East Maui, Honopou IIFS Site A)

Date of Field Investig	gation:	October 29, 2008	Time (24-hour): 1045 – 1110	
CWRM Staff:	Ed Sak	oda, Dean Uyeno, and	Chui Ling Cheng	
Individuals Present:				
Hydrologic Unit:	Honopo	ou (6034)		
Stream Name:	Honopo	ou Stream		
Findings:				

On October 27, 2008, CWRM staff documented the flow release at Lowrie Ditch sluice gate on Honopou Stream. Refer to Field Investigation Report FI2008102704 (East Maui, Honopou Lowrie Ditch, restore) for more information. Since flow was restored, the following flow measurements represent post-release flow conditions.

At approximately 1045 hours, CWRM staff arrived at the Haiku Ditch diversion on Honopou Stream. The weather was sunny, but evidence of rain the previous night. Water temperature taken at the Honopou Stream downstream from Haiku Ditch was 23.5°C and air temperature was 25°C. CWRM staff took a volumetric measurement of the water flowing through the three 4-inch (O.D.) PVC pipes that bypasses the ditch. With a stopwatch, staff recorded the number of seconds each of the pipes took to fill a 2 gallon bucket. This process was repeated 5 times, making a total of 5 measurements per pipe. As computed back in the Honolulu Office, the flow from the pipes was 0.144 cubic feet per second (0.093 million gallons per day).

CWRM staff then drove to the bridge that crosses Honopou Stream further downstream to observe water level at the gage pool of IIFS Site A. Staff noticed that the water level in the gage pool was similar to the level observed on October 28, 2008 (refer to Field Investigation Report FI2008102801 for more information). The water level was considerably lower than the water level observed in previous field visits, during which the water overtopped the concrete-reinforced masonry (CRM) wall of the gage pool.

Staff left Honopou IIFS Site A at approximately 1110 hours, and continued to conduct flow measurement at IIFS Site on Wailuanui Stream. Refer to Field Investigation Report FI2008102902 (East Maui, Wailuanui IIFS Site) for more information.

Image Listing: (Attach P	DF of image contact sheet)
File Name:	Brief Description:
20081029001	Gage pool and reference point at IIFS Site A on Honopou Stream.
20081029003	Gage pool at IIFS Site A on Honopou Stream.
20081029006	Bridge by IIFS Site A on Honopou Stream.
GPS Listing:	
Shapefiles: (List file name	es of all shapefiles created and a brief description of each)
File Name:	Brief Description:
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maui field investigations.
File Name: East_Maui_POI.shp	<u>Brief Description:</u> Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	<u>Latitude</u>	Longitude	Brief Description:
6	20.916212	-156.245203	Bridge on Honopou Stream
7	20.916187	-156.245174	IIFS Site A Reference Point on Honopou Stream
8	20.916096	-156.245077	IIFS Site A Flow Measurement on Honopou Stream

Attachments:

- Brief Description: 1. Image Contact Sheet



20081029001.JPG

20081029003.JPG



20081029006.JPG



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES **COMMISSION ON WATER RESOURCE MANAGEMENT**

Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102902 (East Maui, Wailuanui IIFS Site)

Date of Field Investig	Time (24-hour): 1230 - 1600
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	
Hydrologic Unit:	Wailuanui (6056)
Stream Name:	Wailuanui Stream
Findings:	
At approximately 1230 staff hiked down from downstream side of th) hours, CWRM staff arrived at the Hana Highway bridge that crosses Wailuanui Stream. CWRM the bridge to the stream via a small trail that begins on the right bank of the stream, on the e bridge. The trail condition was hazardous because of the loose rocks and large boulders on the bilds devented and the trail of Wailyan.

hill. Staff continued to hike downstream until reaching the top of Waikani Falls, about 700 feet from the bridge. There was a concrete structure near the top of Waikani Fall which may be remnants of a previous gaging station or weir. On the right bank of the stream. Ed Sakoda found an old stilling well, as well as a concrete-reinforced masonry (CRM) wall that may have been for a staff gage previously installed. CWRM staff found a location suitable for measuring streamflow, about 10 feet from the top of Waikani Falls. Staff considered the possibility of establishing this location as the IIFS Site for Wailuanui Stream. However, staff realized that access to this location may be difficult during high flows, so no measurements were made. Staff hiked back to the bridge.

During a previous field visit, Matt Wong from the USGS-Maui Office found a location on Wailuanui stream that may be suitable for flow measurement (refer to Field Investigation Report FI2008102404 for more information). The location was directly below the bridge. Matt did not find any locations suitable for gage height reading.

CWRM staff prepared the site for flow measurement. The site was flagged with yellow tape, labeled with the stream name. IIFS site, and the date. Staff completed the entire flow measurement in 40 minutes. In addition to flow measurement, staff crew also recorded wind velocity, air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow at IIFS Site was 2.293 cubic feet per second (1.482 million gallons per day), with no gage height readings.

CWRM staff concluded the field investigation at 1600 hours.

Image Listing: (Attach F	PDF of image contact sheet)
File Name:	Brief Description:
20081029008	Wailuanui Stream near the top of Waikani Falls.
20081029010	Concrete structure near the top of Waikani Fall that may have been remnants of a previous gaging station
	or weir.
20081029011	Top of Waikani Falls on Wailuanui Stream.
20081029013	Wailuanui Stream upstream from Waikani Falls.
20081029014	Top of Waikani Falls on Wailuanui Stream.
20081029015	Wailuanui Stream upstream from Waikani Falls.
20081029016	Concrete structure near the top of Waikani Fall that may have been remnants of a previous gaging station
	or weir.
20081029017	Looking down the cliff from the top of Waikani Falls on Wailuanui Stream.
20081029018	Top of Waikani Falls on Wailuanui Stream.
20081029019	Wailuanui Stream upstream from Waikani Falls.
20081029021	Top of Waikani Falls on Wailuanui Stream.
20081029022	CRM wall on the right bank of Wailuanui Stream near the top of Waikani Falls.
20081029028	Top of Waikani Falls on Wailuanui Stream.
20081029041	Old stilling well on the right bank of Wailuanui Stream near the top of Waikani Falls.
20081029046	Old stilling well on the right bank of Wailuanui Stream near the top of Waikani Falls.
20081029048	CWRM staff at the top of Waikani Falls on Wailuanui Stream.
20081029053	CWRM staff conducting flow measurement at IIFS Site on Wailuanui Stream.

GPS Listing:

 Shapefiles: (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

 East_Maui_POI.shp
 Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
0	20.832394	-156.138458	IIFS Site Flow Measurement on Wailuanui Stream
4	20.833606	-156.13696	Parking area near IIFS Site on Wailuanui Stream

Attachments:

Brief Description:

1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes



20081029008.JPG



20081029013.JPG

20081029010.JPG





20081029014.JPG



20081029015.JPG







20081029016.JPG



20081029019.JPG

20081029017.JPG



20081029021.JPG



20081029022.JPG



20081029028.JPG

20081029041.JPG

20081029046.JPG



20081029048.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION

DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES FI2008102902 - Page 5 of 6

Meas. No.	_

Comp.by _____Chuu

Checked by Dow

Sta. No	VAILUAN	<u>ai iiFs</u>	SITE	: 1		
Sta. Name				· · · · ·		
Date 10 [29,	20 <u>0%</u> F	?arty <u>(</u>	hur,	Deciri .	Ea
Width <u>10</u> .	<u>6 Are</u>	a <u> </u>	<u>6</u> V	el. <u>0.2</u>	<u>57</u> G	.H Disch. <u>2.293 CF</u> S
Method	<u>Nacling</u>	1	No. secs.	40	G. H. cha	ange in hrs.
Method coef.	ł	loriz, ang	le coef		Susp	Tags checked
Meter Type		_ Meter N	0		Met	ter ft. above bottom of wt.
Rating used			Spin test	before m	eas	; after
Meas. plots		_ % diff.	from ratii	ng no. 🔔		_ Indicated shift
	GA	GE REAL	DINGS			Samples collected: water quality,
Time				Inside	Outside	sediment, biological, other
]
						Measurements documented on
Start	LEW	<u>@ 14:</u>	37			aux (base gage, other
			ļ		1 .	
			- · ·			Bain gage serviced/calibrated
					. ·	Weather: SUMMY
Finish	D Total	6 5	17			Air Temp. <u>21</u> °C at <u>14:37</u>
	KOW	100 15	10		• • • • • • • • • • • • • • • • • • •	Water Temp 21.5 °C at 14.49
Weighted MG						Check bar/chain found
GH correction	····					Changed to at
CorrectMGH						Correct
Wading, cabl Measuremen conditions: F Cross sectio	e, ice, boat, t rated exce low: <u>Not</u> n: <u>bedruc</u>	upstr., do ellent (2%) <u>unifor</u> k un	wnstr., s), good (5 <u>m, la</u> <u>even</u> ,	ide bridge 5%), fair (1 aminar boulde	2, <u>10</u> 3%), poor at sectic ers 10	(>8%); based on following . (>8%); based on following . <u>ons, edge, very slow</u> . wgc section
Gage operati	na:			R	ecord Rer	moved
Battery volta	1e:	In	take/Ori	fice clean	ed/purgeo	d:
Bubble-gage	pressure. c	si: Tank		Line		;Bubble-rate /min.
Extreme-GH	indicators:	max		, mir	۱	
CSG checke	d:	HWMhe	ight on st	ick	Ref.	elev HWM elev
HWM inside/	outside:		-			
Control:						
Remarks:	leasuning	point a	lirectuy	below	bridge	on Hana Highway
GH of zero flo	w=GH		depth at	control _		_ = ft., rated
				Sh	eetNo.	of sheets

.0	.10	.20	.30		.40	.50 River) ∙at-⊡∵	.60		.70	.75	
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	- .80
	LEW	e	14'.37									-
						· · · · · · · · · · · · · · · · · · ·				l	† <u> </u>	.85
	4.2	0.2	0			<u>.</u>						
	4.6	0.4	0.6	.6		40		0.13		.240	.031	-
	5.0	0.4	0.86	.6		40		0.12		.344	.041	.90
	5.4	0.4	1.16	.6		40		0.03		.464	,014	.92
	5.8	0.4	1.19	.6		40		0.01		.476	.005	-
	6.2	0.4	0.97	.6		40		0.03	:	. 368	.031	94
	6.6	0.4	0.97	.6		40		0.08		.388	.031	.96
-	7.0	0.4	1.00	.6		40		0.15		.,400	.060	.97
	7,4	0.4	1.03			40		0.30		.412	, 124	. 9 8
	7.8	0.4	1.08	.6		40		0.32		.432	. 138	.99
	8.2	0.4	1.13	.6		40		0.26		.452	, 118	-
	8.6	0.4	1.21	.6		40		0.26		.484	.126	-
0	9.0	0.4	0.92	.6		40		0.21		. 368	.077 1	.00
<u></u>	9.4	0.4	0.99	.6		40		0.28		.396	. []]	_
<u></u>	9.8	0.4	1.04	.6		40		0.40	5 66	.416	. 166	_
	10.2	0.4	1.03	6		40		0.27		.412	.111	.99
·	10.6	0.4	1.12	.6		40		0.29		.448	.120	-98
	11.0	0.4	0.96	.6		40		0.38	6.864	.344	.131	-97 -
	11.4	0,4	0.87	.6		40		0.43		.349	.150	.96
	11.8	0.4	0.55	.6		40	·	0.50	· · · · · · · · · · · · · · · · · · ·	.220		_
	12.2	0.4	0.55	.6		40	<u>_</u>	0.45		:22.0	.099	.94
	12.6	0.4	0.60	.b		40		0.37	·	,240	.089	.92
	13.D	0.4	0.56	·Ь		40		0.48		,224	.108	.90
	13.4	0.4	D.55	.6		40	·	0.35		,220	.077	-
	13.8	0.4	0.56	.6	· .	40		0.34	<u>-8.5t</u>	.224	.076	•
	14.2	0.4	0.67	<i>.</i> ь		40		0.40		.268	. 107	.85
	14.6	0.3	0.39	.6		40		0.41		.0.79	.032	-
	14.8	0.1	D								Hereit / marganite and an and a second s	
	10.6	10.6					ANE=	.257		8.906	2.293	.80
-	REN	(a)	15:13									

.445

.893

.001



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES **COMMISSION ON WATER RESOURCE MANAGEMENT**

Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FI2008102903 (East Maui, Honopou IIFS Site A)

Date of Field Investig	ation: October 29, 2008 Time (24-hour): 1730 – 1750
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	
Hydrologic Unit:	Honopou (6034)
Stream Name:	Honopou Stream
Findings: On October 27, 2008, of to Field Investigation R was restored, the follow At approximately 1730 volumetric measureme stopwatch, staff record repeated 5 times, making the pipes was 0.132 cu CWRM staff concluded	CWRM staff documented the flow release at Lowrie Ditch sluice gate on Honopou Stream. Refer eport FI2008102704 (East Maui, Honopou Lowrie Ditch, restore) for more information. Since flow ving flow measurements represent post-release flow conditions. hours, CWRM staff arrived at the Haiku Ditch diversion on Honopou Stream. CWRM staff took a nt of the water flowing through the three 4-inch (O.D.) PVC pipes that bypass the ditch. With a ed the number of seconds each of the pipes took to fill a 2 gallon bucket. This process was ng a total of 5 measurements per pipe. As computed back in the Honolulu Office, the flow from ibic feet per second (0.085 million gallons per day).
Image Listing: (Attach F File Name:	PDF of image contact sheet) Brief Description:
GPS Listing:	
Shapefiles: (List file nam File Name: East_Maui_POI.shp	es of all shapefiles created and a brief description of each) <u>Brief Description:</u> Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.
Waypoints: (List all wayp WP No. Latitude	points in decimal degrees and provide a brief description of each) Longitude Brief Description:
Attachments: Brief Description:	
Recommendations:	



FIELD INVESTIGATION REPORT

FI2008111701 (East Maui, Palauhulu IIFS Site B, pre-release)

Date of Field Investig	ation: November 17, 2008 Time (24-hour): 0900 - 1010
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Palauhulu Stream
Findings:	
CWRM staff departed (Dahu for Maui at 0520 hours.
At 0900 hours, CWRM entrance to Piinaau Ro the stream to the right I	staff arrived at the Hana Highway bridge that crosses Palauhulu Stream. The bridge is near the ad. Staff hiked upstream approximately 100 yards from the bridge on Hana Highway, crossed bank, and hiked back downstream to the measurement site directly below the bridge (IIFS Site B).
Staff prepared the site wind velocity, air temper computed back in the H per day), with no gage	for flow measurement. Flow measurement was completed in 30 minutes. Staff also recorded erature, water temperature and weather conditions. Weather was sunny with no rain. As Honolulu Office, the flow at the IIFS site was 2.133 cubic feet per second (1.379 million gallons height readings.
Staff left Palauhulu IIFS Koolau Ditch bypass sl Koolau Ditch, restore) f	S Site B at approximately 1010 hours, and proceeded on to document flow restoration at the uice gate on Kano Stream. Refer to Field Investigation Report FI2008111702 (East Maui, Kano for more information.
Image Listing: (Attach F File Name:	PDF of image contact sheet) Brief Description:
GPS Listing:	
Shapefiles: (List file nam File Name: East_Maui_POI.shp	es of all shapefiles created and a brief description of each) <u>Brief Description:</u> Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.
Waypoints:(List all wayp <u>WP No.</u> Latitude2620.856333	Longitude -156.146474Brief Description of each)Brief Description: IIFS Site B on Palauhulu Stream at Hana Highway
Attachments: Brief Description: 1. Discharge Measureme Recommendations:	ent and Gage Inspection Notes

			U.S. GO WATER F	eologic RESOUR(al Surv	ey Meas No ION
·		DIS	CHARG	EMEAS	UREMEN	IT AND Comp. by CHU!
· 7	7 ka a é		GAGE II	VSPEC7		ES Checked by
Sta No.	MLAUHUL	<u>u np</u>	<u>site</u> i	B		
Sta. Name _				-(FF)-		· · · · · · · · · · · · · · · · · · ·
Date <u>117</u>	14108 ,2	20_ <u>08_</u> P	Party[Dearn,	Ed, Ch	1AI
Width <u>5.0</u>	<u>70</u> Area	a <u>3.3</u>	<u>2</u> Ve	el. <u>0.6</u>	<u>북</u> G	H Disch. 2.133
Method <u>w</u>	<u>aannaj</u>	I	No. secs.	40	_ G. H. cha	ange in
vietnoa coet.	ŀ	loriz, ang	le coef	·····	Susp	Tags checked
Meter Type _		Meter N	0		Met	er ft. above bottom o
Rating used			Spin test	before m	eas	; after
vieas, plots		_ % diff.	from ratin	ig no		Indicated shift
	GAG	GE REA	DINGS			Samples collected: water qualit
Time				Inside	Outside	sediment, biological, other
]
		<u> </u>				Measurements documented of
	LEW C	09121				separate sheets: water qualit aux /base gage other
<u> </u>						
						Rain gage serviced/calibrated _
Finish			· · · · · ·			AirTomp 23 °C at 007
	<u>+6w (e</u>	0958				Mater Terre 19 80 -4 Mat
Neighted MGF						Chock her (she is found
GH correction						Check barrchain found
CorrectMGH						Contract at
Vading, cable leasurement onditions: Fl	; ice, boat, u rated excell ow: <u>Fairt</u> : <u>bedrock</u>	pstr., doi lent (2%) <u>4 ann</u>	wnstr., sic , good (59 <u>Wrm _ p</u>	le bridge Ø), fair (8 arts lo	, %), poor (minar	(ft), mi. upstr., downstr. of ga > 8%); based on following .
ross section						
cross section	ia			KE	cura rem	iovea
Cross section	ig:		ako/Orifiz		nd/nuree	• • •
attery voltag	ng: e:)ressure os	Int	ake/Orific	e cleane	ed/purged	· Pubble rote
Cross section Gage operatin lattery voltag lubble-gage p xtreme-GH i	ng: e: pressure, ps ndicators: m	i: Tank _	ake/Orific	ce cleane , Line 	ed/purged	;Bubble-rate /m
age operatir attery voltag ubble-gage p xtreme-GH i	ng: e: pressure, ps ndicators: m	i: Tank _ iax	ake/Orific	ce cleane , Line , min	ed/purged	;Bubble-rate /m
age operatir attery voltag ubble-gage p xtreme-GH i SG checked WM inside/o	ng: e: pressure, ps ndicators: m : H utside:	i: Tank _ iax iWM heig	ake/Orific	ce cleane , Line , min k	ed/purged	;Bubble-rate /m
Sage operation age operation attery voltag ubble-gage p xtreme-GH i SG checked WM inside/o	ng: pressure, ps ndicators: m H utside:	i: Tank _ hax WM heig	ake/Orific	ce cleane , Line , min .k	ed/purged	;Bubble-rate /m
Cross section Gage operatin lattery voltag lubble-gage p xtreme-GH i SG checked IVM inside/o ontrol:	ng: pressure, ps ndicators: m H utside:	i: Tank _ iax IWM heig	ake/Orific	ce cleane , Line , min k	ed/purged	; Bubble-rate /m lev HWM elev
Cross section Gage operatin Sattery voltag Subble-gage p Extreme-GH i SG checked WM inside/o Control: emarks:	ng: e: pressure, ps ndicators: m H utside:	i: Tank _ iax iWM heig	ake/Orific	ce cleane , Line , min .k	ed/purged	; Bubble-rate /m lev HWM elev
Cross section Gage operatin lattery voltag lubble-gage p Extreme-GH i SG checked IVM inside/o Control: emarks:	ng: pressure, ps ndicators: m H utside:	Int i: Tank _ iax iWM heig	ake/Orific	ce cleane , Line , min .k	ed/purged	; Bubble-rate /m lev HWM elev

LE CE	1					Rive	r at -					
ANGLE CI	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA. TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VE AT POINT	MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	80
<u> </u>	LEW	C	0921									_ ·
14.	2.05	.075	0									_ .85
<u> </u>	2.2	.175	0.19			40		0.50		.033	.017	-
	2.4	.20	0.77			40		0.59		. 154	.091	
	2.6	.20	0.90			40		0.60		.180	. 108	.90
	2.8	.20	0.92			40		0.61		. 184	. 112	.92
	3.0	.20	0.88			40		0.60		. 176	.106	-
	3.2	.20	0.85			40		0.60		.170	. 102	94
	3.4	.20	0.85			40		0.51	1.067	. 170	. 087	.96
	3.6	.20-	0.83			40		0.47		.166	.078	.97
	3.8	.20	0.80		· 	40	· · ·	0.56		.[60	.090	.98
	4.0	,20	0.72			40		0.64		144	.092	.99 ,003
	4.2	·20	0.75			40		0.66		.150	. 099	
	4.4	,20	0.88			40		0.64		.176	. 113	
0	4.6	.20	0.80			40		0.66		.160	.106 1	.00
	4.8	.20	0.77			40		0.66		.154	.102	•
	5.0	.20	0.77	-		чо		0.72		.154	.111	
	5.2	.20	0.71			40		0.71		.142	.101	.99
	5.4	.20	0.68			40		0.76		.136	.103	98
	5.6	.20	0.68			40	• •	0.76		.136	. (03	97
	5.8	.20	0.69			40	· .	0.76		.133	. 105	96 1.826
	6.0	,20	0.65			40		0.79	3,013	.130	. 103	• •
	6.2	.20	0.56			40	_	0.75		.112	.0824	94
	<u>6.4</u>	. 20	0.3%			40		0.74		.076	.056	92
	6.6	.20	0.33			40		0.62		.066	.041 .	90
	0.0	.225	0.20			40		0.51		.045	.023	
	1.05	125	0			40						
	5.00	5.00			81877-380 Marxiels (Part 1 (1-1))	, ha n	AVE =	0.64	997 gan 2 gan 2005 (2010) All (27 - 4493) And	3.312	2.133	85
	ZEW	(a, 1	nara									80
		<u> </u>	<u>·····································</u>					·				



FIELD INVESTIGATION REPORT

FI2008111702 (East Maui, Kano Koolau Ditch, restore)

Date of Field Investig	pation: November 17, 2008 Time (24-hour): 1010 - 1500								
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng								
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry								
	Robello (Field Superintendent), and Nelson Akiu (Keanae Supervisor)								
Hydrologic Unit:	Piinaau (6053)								
Stream Name:	Kano Stream (tributary of Palauhulu Stream)								
F 11									

Findings:

The purpose of the field visit was to document flow release at the Koolau Ditch bypass sluice gate on Kano Stream, a tributary of Palauhulu Stream. At 1010 hours, CWRM staff met with Garret Hew and EMI staff at the junction of Hana Highway and Piinaau Road. Staff drove up Piinaau Road, and then turned left onto Kano Road. The switch-back trail to the Koolau Ditch bypass sluice gate on Kano Stream begins near the end of Kano Road, along the side of the mountain. EMI staff had previously cleared the trail for the safety of CWRM staff. At the end of the trail is Kano Falls, a cascading waterfall directly upstream of Koolau Ditch. The sluice gate is located inside a tunnel, on the right bank at the foot of the waterfall (inside the pool). At approximately 1200 hours, Nelson Akiu and Garret Hew proceeded to lift up the bypass sluice gate. Once the gate was opened, water from the ditch flowed through the gate and out the side of the mountain, creating a waterfall. Very little water was flowing into the ditch. CWRM staff videotaped the flow release event.

CWRM staff measured the dimensions of the sluice gate to be 1.1 x 6.8 feet (W x H). The sluice gate was opened to a height of 0.45 feet.

According to the trip schedule, CWRM staff had planned to take flow measurements at Kano Stream near Koolau Ditch to estimate the amount of water that would be lost to the losing sections downstream from the ditch, before reaching IIFS Site B on Palauhulu Stream. However, the stream section near the ditch was mostly large boulders, without any well-defined sections suitable for flow measurements. Therefore, staff decided to take flow measurements near the Koolau Ditch bypass sluice gate to approximate the discharge that would flow into Kano Stream. Depth and velocity measurements were taken 3 feet downstream from the sluice gate at only three points along the cross section due to the turbulent flow conditions.

Number	Width of section (ft)	Depth of water (ft)	Velocity (ft/sec)	Discharge (CFS)
1	3.00	0.55	3.68	6.072
2	3.00	0.55	3.96	6.534
3	3.00	0.40	3.33	3.996

CFS = cubic feet per second

As computed back in the Honolulu Office, the average discharge was 5.534 CFS (3.577 million gallons per day). This flow measurement represents a very rough estimate of the discharge in Kano Stream. It does not have the same accuracy as the previous flow estimates where depth and velocity measurements were taken at equal intervals along the cross section.

On the drive back, CWRM staff stopped along Kano Road right before merging with Piinaau Road to access Palauhulu Stream downstream from Kano Falls and Koolau Ditch. Staff hiked from the road to the left bank of the stream, and continued to hike downstream. Staff located a suitable site for flow measurements and made necessary preparations. The site was not flagged because this location was not intended to be an IIFS site. Flow measurement was completed in 30 minutes. Staff recorded wind velocity, air temperature, water temperature and weather conditions. Weather was partly cloudy. As computed back in the Honolulu Office, the flow was 2.802 CFS (1.811 million gallons per day), with no gage height readings. Heavy rain began to fall as staff were hiking back to Kano Road.

CWRM staff were scheduled to return to IIFS Site B on Palauhulu Stream on the third day of the field visit (Wednesday, Nov. 19) and take flow measurements. However, heavy rain fell on East Maui the following day (Tuesday). Most of the streams in East Maui had flow velocities too high for taking measurements. Instead, staff documented the high flow events by taking photographs, descriptions, and GPS waypoints.

Staff concluded the field investigation at 1500 hours.

800

20.8563569

Image Listing: (Attach	PDF of image contact sheet)
File Name:	Brief Description:
20081117001	The 2001 landslide that covered part of Piinaau Stream.
20081117002	View of Keanae Valley from the hiking trail near Kano Road.
20081117004	Kano Falls upstream of Koolau Ditch on Kano Stream.
20081117005	The pond of Kano Falls upstream from Koolau Ditch.
20081117008	Cascading waterfall of Kano Falls upstream of Koolau Ditch on Kano Stream.
20081117011	The radio gate on the right bank of Kano Stream near the waterfall.
20081117013	Radio gate on the right bank of Kano Stream near the waterfall. This gate controls the water level in Koolau Ditch.
20081117015	Remnants of a concrete-reinforced masonry (CRM) wall on the left bank of Kano Stream near the waterfall.
20081117019	An open tunnel that is part of the Koolau Ditch on the left bank of Kano Stream near the waterfall.
20081117022	Cascading waterfall of Kano Falls upstream of Koolau Ditch on Kano Stream. Photo taken from the right
20081117024	The top part of the cascading waterfall of Kano Falls upstream of Koolau Ditch on Kano Stream. Photo taken from the right bank.
20081117026	Tunnel that leads to the Koolau Ditch bypass sluice gate on Kano Stream.
20081117027	Koolau Ditch bypass sluice gate on Kano Stream.
20081117028	Tunnel downstream the Koolau Ditch bypass sluice gate on Kano Stream, where water from Kano Stream
	exits on the side of the mountain.
20081117032	End of the tunnel downstream the Koolau Ditch bypass sluice gate on Kano Stream, where water from
	Kano Stream exits on the side of the mountain.
20081117033	Water from Kano Stream flowing into Koolau Ditch.
20081117034	EMI staff opening the Koolau Ditch bypass sluice gate on Kano Stream.
20081117035	Tunnel downstream the Koolau Ditch bypass sluice gate on Kano Stream, where water from Kano Stream exits on the side of the mountain. The sluice gate has already opened.
20081117037	Koolau Ditch bypass sluice gate opened on Kano Stream.
20081117046	CWRM staff taking flow measurements 3 feet downstream from the Koolau Ditch bypass sluice gate on Kano Stream
20081117047	Koolau Ditch bypass sluice gate opened on Kano Stream.
20081117048	Water from Kano Stream no longer flowing into Koolau Ditch after the Koolau Ditch bypass sluice gate was opened
20081117053	Water from Kano Stream flowed through the bypass sluice gate and out the side of the mountain.
20081117055	Upstream from the measurement site on Palauhulu Stream. This location is downstream from Koolau
20081117057	Downstream from the measurement site on Palauhulu Stream. This location is downstream from Koolau
20001117050	Dirich. Civid DM staff area arises the site on Dalaubulu Otacara for flow researchment.
20001117050	CVVRIVI stall preparing the site on Palauhulu Stream for flow measurement.
20081117039	CWRNIVI stall preparing the site on Palaunulu Stream for flow measurement.
20001117001	CVVrkivi stall taking now measurement at Palaunulu Stream, downstream from the Koolau Ditch.
20081117063	CVVRIVI STATT TAKING TIOW measurement at Palaunulu Stream, downstream from the Koolau Ditch.
GPS Listing:	

Shapef	iles: (List file nan	nes of all shapefiles created and a b	prief description of each)								
File Name: FI20081117wp.shp		Brief Description: Waypoints recorded during the field visit from Nov. 17-19, 2008.									
WP No.	Latitude	Longitude	Brief Description:								
001	20.81567106	-156.16222948	Pool below Kano Falls, near Koolau Ditch intake at Kano Stream								
002	20.81569428	-156.16190384	Access tunnel to Koolau Ditch bypass sluice gate								
003	20.81781037	-156.16314051	Start of trail to Koolau Ditch intake at Kano Stream								
005	20.81855167	-156.16347067	Flow measurement site on Palauhulu Stream, downstream from Koolau Ditch								
006	20.82588055	-156.16540278	Bridge across Hauolo Wahine Stream								

Attachments:

- Brief Description:

 1. Image Contact Sheet

 2. Discharge Measurement and Gage Inspection Notes



20081117001.JPG



20081117002.JPG



20081117004.JPG



20081117005.JPG



20081117008.JPG



20081117011.JPG







20081117013.JPG



20081117022.JPG

20081117015.JPG



20081117024.JPG



20081117026.JPG



20081117027.JPG



20081117033.JPG



20081117037.JPG



20081117048.JPG







20081117034.JPG



20081117046.JPG



20081117053.JPG



20081117032.JPG



20081117035.JPG



20081117047.JPG



20081117055.JPG



20081117057.JPG



20081117058.JPG



20081117059.JPG



20081117061.JPG

Form 9-275F (Apr. 2001)

U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION Meas. No. DISCHARGE MEASUREMENT AND

GAGE INSPECTION NOTES

FI2008111702 - Page 7 of 9

Comp by	СНи
Comp. by	Unit

Checked by DBU

Sta. Name			_07- KODUA	m pitch	
			<u> </u>		:
Date <u>11/1</u>	7,2	0 <u>0</u> 8_Party	Decin	Chui,	Ed
Vidth <u>5, 구</u> 덕	🗧 Area	3.706	Vel	<u>6</u> G.	H Disch2.302
Method	Nading	No. s	ecs. <u>Чо</u>	_ G. H. cha	inge in hrs.
Aethod coef	H	oriz. angle co	ef	Susp	Tags checked
Neter Type _	<u> </u>	Meter No		Met	er ft. above bottom of wt.
Rating used _		Spin	test before m	neas	; after
/leas: plots _		% diff. from	rating no		Indicated shift
	GAG		S		Samples collected: water quality.
Time			Inside	Outside	sediment, biological, other
				1	Measurements documented on
Start	LEW®	1453			separate sheets: water quality,
	· · ·			ļ	
				ļ	
					Weather: Drercost
Finish		2 15 22			Air Temp 26 °C at 1503
	REW C	p 1525			Water Temp 20 °C at 151b
Meighted MGH		· · ·	····		Check bar/chain found
Hcorrection	·			1	Changed toat
CorrectMGH				1	Correct
Vading, cable Measurement conditions: FI	, ice, boat, u rated excell ow: <u>part</u> : <u>bed rock</u>	ipstr., downs lent (2%), god <u>s laminar</u> <u>, pebbles</u>	tr., side bridge od (5%), fair (<u>non - unt</u> <u>Cobolts</u>	e, 1/4 8%), poor (Term ve	ft. (m) upstr., downstr. of gage. (>8%); based on following , louty
ross section					
cross section	a.		R	ecord Ren	noved
Cross section Gage operatin		Intake	R /Orifice clear	ecord Ren	noved
Cross section Gage operatin Battery voltag Bubble-gage r	e:	Intake	/Orifice clear	ecord Ren ed/purgec	noved
Cross section Gage operatin Battery voltag Bubble-gage p Extreme-GH i	g: e: vressure, ps ndicators: m	i: Tank	/Orifice clear , Line	ecord Ren ed/purgec	noved
Cross section Gage operatin Battery voltag Bubble-gage p Extreme-GH i CSG checked	g: e: >ressure, ps ndicators: m H	Intake si: Tank nax HWM height c	R /Orifice clear , Line , mii >n stick	ecord Ren ned/purgec nRef	noved
Cross section Gage operatin Battery voltag Bubble-gage p Extreme-GH i CSG checked	Ig: e: pressure, ps ndicators: m h utside:	i: Tank nax tWM height c	/Orifice clear , Line , mil on stick	ecord Ren bed/purgec b n Ref. (noved
Cross section Gage operatin Battery voltag Bubble-gage p Extreme-GH i CSG checked IVM inside/o Control:	Ig: e: pressure, ps ndicators: m h utside:	i: Tank nax HWM height c	/Orifice clear , Line , min on stick	ecord Ren ned/purgec nRef. (noved
Cross section Gage operatin Battery voltag Bubble-gage p Extreme-GH i CSG checked HVM inside/o Control: Remarks:	e: pressure, ps ndicators: m H utside:	Intake i: Tank nax HWM height c	/Orifice clear , Line , mi on stick	ecord Ren ned/purgec nRef. (noved
Cross section Gage operatin Battery voltag Bubble-gage p Extreme-GH i CSG checked IVM inside/o Control: Remarks: GH of zero flov	Pg: pressure, ps ndicators: m H utside: 	Intake	/Orifice clear , Line , mi on stick 	ecord Ren ned/purgec nRef. (noved/min. ; Bubble-rate/min.

	D	.10	.20	.30		.40	.50 River	at -	.60		.70	FI2008111 . 75	702 -	Page 8 of 9
-	DEF.	DIST.			₹Ħ		TIME	VEL	OCITY	ADJUST-	<u> </u>	Į	-	
_	ANGLE CO	FROM INITIAL POINT	WIDTH	DEPTH	OBSERV TION DEP	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80	
_		LEW	0	1453							# 		_	
		4.7	. 20	0									.85	·
		4.9		0.1			EST-				.040		_	
		5.1	- 30	0.16			EST =	.5(.26)	1-10,13		.048			
_		5.3	-20	0.25			Цo		0.26		, 050	. 013	.90	
_		5.5	.20	0.38			40		0.31		. 076	. 024	.92	
_		5.7	.2.0	0.54			ųD.		0.2%		.108	. 030	-04	
_		5.9	.20	0.43			40		0.44		.086	.038	.34	
_		6.1	,20	0.50			40		0.56		. (00	.056	.96 -	
	· • · · · <u>- · · ·</u>	6:3	.20	0.60			40		0.67		.120	,090	.97 -	
•		6.5	.2.0	0.56			40		0.72		.112	. 081	.98 -	
_		6.7	.20	0.46			Ч°		0.76		,092	.070	.99	. 39.8
_		6.9	.20	0.45			40		0.73	.892	.090	.066	.	
		7.1	.20	0.50			40	i	0.63		0.100	.063	_	•
_	0	7.3	.20	0.70			40		0.49		0.140	.069 1	.00	
		7.5-		0.80			40-						_	
_		7.5	.20	0.90			цо		0.46		0.100	.083	_	
		7,7	,20	0.92			40		0.72		0.184	.132	.99	
_		7.9	.20	0.90			40		0.84		0.160	. (51	- 98	
		8.1	.20	0.90			40		0.98		0.180	.176	97	•
		9.3	.20	0.92			40		1.02		0.184	.188	.96	1.326
		8.5	,20	0.90			40		0.98		0.190	, 176	-	
		8.7	,20	0.92			40		0.97		0.194	.178	.94 -	-
_		8.9	.20	1.03			40		0.95	2.6	0.206	. 196	.92 -	
_		9.1	.20	1.18			40		0.89		0.236	,210	.90_	2.086
		4.3		1.05			40-						-	
		9.3	.20	1.15			40		0.90		0.230	.207	_	
		9.5	.20	1.01			40		0.86		0.202	, 174	.85	,
		a.7	,20	1.01			40		0.85	<u>3.41</u>	0,202	. 172		.639
_		9.9	,20	0.60			40		0.76		0.120	.091	_	
		10.1	.20	0.45			40		0.70		0.090	.063	.80 -	5
_		10.3	.175	0.15			EST=	.5(0.7)	0.35		0.026	.009	-	-

......

.0	.10	.20	.30		.40	.50 River	<u>at -</u>	.60		.70	FI2008111	702 - Page 9 of
ANGLE COEF.	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	- .80
	10,45	0.075	0									-
				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	energenskerster optime over en			**************************************				.85
	5.75	5.75					AND:	0.76		3.706	2.802	<del></del>
	REW	@ 152	3									.90
												-
									· · · · · · · · · · · ·			.92
												-94
	<u> </u>											.96
	+											.97
											· ····································	.98
	-											99
												_
<u>.</u>											1	-
<u> </u>	ļ											-
												- 00
<b>`</b>		<u> </u>										98
<u></u>	<u> </u>	<b> </b>		   								97 .96
											· ·	.94
												92
												.90
. <u> </u>		ļ	 	 								_
	· · · · · ·	 						<b>.</b>				
		 		<b>_</b>			 		<b> </b>			.85
·		 			<u> </u>	 						-
		<u> </u>								<b> </b>	ļ	.80
												-
		1	1	1			<u> </u>	<u> </u>	<u> </u>	I		-



# FIELD INVESTIGATION REPORT

Fl2008111801 (East Maui, Palauhulu, high flow)

Date of Field Investig	pation: November 18, 2008 Time (24-hour): 0900 - 0910
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Skippy Hau (DAR)
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Palauhulu Stream
Eindin ein	

### Findings:

At 0900 hours, CWRM staff and Skippy arrived at the Hana Highway bridge that crosses Palauhulu Stream. Staff observed Palauhulu Stream from the bridge and determined the flow velocities in the stream to be too high for taking measurements.

Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM.



USGS 204916156083701 348.5 West Wailuaiki rain gage nr Keanae, Maui, HI

The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to normal conditions at 3.7 CFS.





20081118001.JPG





20081118003.JPG



20081118004.JPG





20081118006.JPG


# FIELD INVESTIGATION REPORT

FI2008111802 (East Maui, Wailuanui, high flow)

Date of Field Investig	pation: November 18, 2008 Time (24-hour): 0930 - 1030		
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng		
Individuals Present:	DAR - Skippy Hau;		
	Wailua Valley - Ed Wendt and Carl Wendt		
Hydrologic Unit:	Wailuanui (6056)		
Stream Name:	Wailuanui Stream		

#### Findings:

At 0930 hours, CWRM staff and Skippy arrived at Ed Wendt's residence on Wailua Road. Staff took a picture of Waikani Falls, which was full from the heavy rain*. After the heavy rain passed (about 10 minutes later), CWRM staff, Skippy, Ed and Carl Wendt drove down to Wailua Bay. During the Commission Site Visit in August 2008, the beach at Wailua Bay had a 30-40 feet long cobble beach that blocked the mouth of Wailuanui Stream. Streamflow would enter the ocean through the rocks or via a small channel near the right bank. During this field visit, the cobble beach was washed away by the high flows, allowing Wailuanui Stream to flow directly into the ocean.

Staff left Wailua Bay at 1030 hours, and continued to Lakini taro patch and Kualani Stream. Refer to Field Investigation Report FI2008111803 (East Maui, Lakini and Kualani) for more information.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach P	'DF of image contact sheet)		
File Name:	Brief Description:		
20081118008	Waikani Falls on Wailuanui Stream.		
20081118009	Beach at Wailua Bay, where Wailuanui Stream flows into the bay.		
20081118010	Beach at Wailua Bay, where Wailuanui Stream flows into the bay.		
20081118011	Beach at Wailua Bay, where Wailuanui Stream flows into the bay.		
20081118012	Wailua Bay.		
20081118013	Beach at Wailua Bay, where Wailuanui Stream flows into the bay.		
20081118014	Beach at Wailua Bay, where Wailuanui Stream flows into the bay.		
GPS Listing:			
Shapefiles: (List file name	es of all shapefiles created and a brief description of each)		
File Name:	Brief Description:		
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded		
	from all the East Maui field investigations.		
Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)			
WP No. Latitude	Longitude Brief Description:		

#### Attachments:

- Brief Description: 1. Image Contact Sheet



20081118008.JPG



20081118009.JPG



20081118010.JPG



20081118011.JPG

20081118012.JPG

20081118013.JPG





## FIELD INVESTIGATION REPORT

FI2008111803 (East Maui, Lakini and Kualani)

Date of Field Investigation: November 18, 2008 Time (24-hour): 1030 - 1500		
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng	
Individuals Present:	DAR - Skippy Hau;	
	Wailua Valley - Ed Wendt and Carl Wendt	
Hydrologic Unit:	Waiokamilo (6055)	
Stream Name:	Kualani Stream	

#### Findings:

The purpose of the field visit was to get a better understanding of the Lakini taro patch, its auwai, and Kualani Stream. At 1030 hours, CWRM staff, Skippy, Ed and Carl Wendt arrived at the Hana Highway bridge that crosses Waiokamilo Stream and Kualani Stream. Staff took photographs of both streams upstream and downstream from the bridge. The streams had high flows from the heavy rain*. Downstream from the bridge, Kualani Stream is diverted at Dam 4 for the Na Moku Project taro loi. Kualani Stream. Staff walked down Wailua Road from Hana Highway to see the auwai for the Na Moku Project. Water that exits the Na Moku Project taro lois, continues under Wailua Road to more taro fields in the valley.

The next destination was the Lakini taro patch. Kikokiko Falls on Waiokamilo Stream could be seen while walking up the taro patch from Hana Highway. At the end of Lakini is Dam 1 where Kualani Stream is diverted for the taro patch. Dean Uyeno and Ed Wendt continued to hike up Kualani Stream from the dam for another 200 feet. The streambank was heavily vegetated with California grass. Photos were taken at the point where water diverted from Waiokamilo Stream (at Dam 2) enters Kualani Stream. Dean continued further upstream past the inflow from Waiokamilo, however the area was heavily overgrown with California grass. Upon their return, the group walked to the concrete diversion box near Lakini. Water outflow from Lakini flows under Hana Highway to a concrete junction box which distributes the water into an Upper Ditch, Lower Ditch, and a third ditch for the Wailua taro patches. At the time of this visit, water to the Upper Ditch was blocked off by a wooden board. Carl Wendt indicated that normal water flow is insufficient to meet the water needs to taro loi serviced by the upper ditch.

At approximately 1330, everyone arrived at Wailua Valley State Wayside. Following Ed and Carl Wendt, CWRM staff and Skippy hiked mauka along the service road to Wailua Valley in search of Kualani Stream. The service road continues in an open pasture where Kualani Stream crosses. That part of the stream is very narrow and overgrown with vegetation. Then, everyone hiked into the forest and found Kualani Stream. Dean Uyeno, Chui Ling Cheng, and Skippy Hau continued to hike upstream along Kualani Stream to Kualani Falls. CWRM staff was not able to take GPS coordinates of the waterfall because the satellite signal was blocked by the mountain. From the waterfall, CWRM staff and Skippy hiked downstream and met up with the rest of the group. The group continued to hike downstream until the stream reaches the open pasture near the service road.

Staff left Wailua Valley State Wayside at 1500 hours, and continued to document high flows in Wailuanui Stream. Refer to Field Investigation Report FI2008111804 (East Maui, Wailuanui, high flow) for more information.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active stream gage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach PDF of image contact sheet)		
File Name:	Brief Description:	
20081118015	Waiokamilo Stream downstream from Hana Highway.	
20081118017	Waiokamilo Stream downstream from Hana Highway.	
20081118019	Waiokamilo Stream upstream from Hana Highway.	
20081118021	Waiokamilo Stream upstream from Hana Highway.	
20081118022	Kualani Stream downstream from Hana Highway.	
20081118024	Kualani Stream upstream from Hana Highway.	
20081118026	Kualani Stream upstream from Hana Highway.	
20081118028	Bridge on Hana Highway that crosses Waiokamilo Stream and Kualani Stream.	
20081118029	Dam 4 of the auwai for the Na Moku Project, downstream from Hana Highway.	
20081118030	Kualani Stream and the auwai for the Na Moku Project, downstream from Hana Highway but upstream	
	from Dam 4.	
20081118031	Auwai for the Na Moku Project, downstream from Hana Highway.	
20081118032	Kualani Stream and the auwai for the Na Moku Project, downstream from Hana Highway but upstream	
	from Dam 4.	
20081118033	Auwai for the Na Moku Project, downstream from Hana Highway.	
20081118034	Confluence of Kualani Stream and Waiokamilo Stream downstream from Hana Highway.	
20081118038	Auwai for the Na Moku Project, downstream from Hana Highway.	
20081118045	Lakini taro patch.	
20081118049	Dam 1 upstream of the Lakini taro patch. Kualani Stream flows into the auwai for Lakini.	
20081118051	Kualani Stream upstream of Dam 1.	
20081118052	Kualani Stream upstream of Dam 1.	
20081118055	Kualani Stream upstream of Dam 1.	
20081118057	Kualani Stream upstream of Dam 1.	
20081118058	Kualani Stream upstream of Dam 1.	
20081118059	Concrete diversion box downstream of Hana Highway.	
20081118061	Concrete diversion box downstream of Hana Highway.	
20081118065	Taro patches in Wailua Valley.	
20081118066	Kikokiko Falls on Waiokamilo Stream.	
20081118068	Kualani Stream upstream from Hana Highway.	
20081118070	Kualani Stream upstream from Hana Highway, on the way to Kualani Falls.	
20081118071	Kualani Stream upstream from Hana Highway, on the way to Kualani Falls.	
20081118072	Kualani Falls on Kualani Stream.	
20081118075	Kualani Falls on Kualani Stream.	

#### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each)

FI20081117wp.shp Waypoints recorded during the field visit from Nov. 17-19, 2008.

**Waypoints:** (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:
009	20.84859886	-156.13569514	Dam 4 on Kualani Stream to divert water to the Na Moku Project
010	20.84718358	-156.13481705	Water from the Na Moku Project auwai flows under Wailua Road
011	20.84544727	-156.1391966	Downstream auwai outflow from Lakini taro patch
012	20.84506379	-156.13927924	Upstream auwai outflow from Lakini taro patch
013	20.84485651	-156.13977679	Main auwai intake to Lakini taro patch that splits to upper and lower taro patches
014	20.8444613	-156.14018273	Dam 1 on Kualani Stream diverting water for Lakini taro patch
015	20.84361129	-156.14040786	Inflow to Kualani Stream from Waiokamilo Stream
016	20.84523194	-156.13900892	Concrete diversion box below Hana Highway
017	20.8388057	-156.14144512	Kualani Stream crossing the service road

#### Attachments:

Brief Description: 1. Image Contact Sheet

Flagging tape of a different color. Staff used yellow flagging tape to mark the trail to Kualani Stream. However, the tpae cannot be easily distinguished from the trees in the forest.



20081118015.JPG



20081118017.JPG



20081118019.JPG



20081118021.JPG



20081118022.JPG





20081118026.JPG



20081118028.JPG





20081118030.JPG



20081118031.JPG



20081118032.JPG









20081118037.JPG



20081118038.JPG



20081118045.JPG





20081118051.JPG



20081118057.JPG



20081118052.JPG



20081118058.JPG



20081118055.JPG



20081118059.JPG



20081118061.JPG



20081118068.JPG



20081118072.JPG

20081118065.JPG



20081118070.JPG



20081118075.JPG



20081118071.JPG



# FIELD INVESTIGATION REPORT

FI2008111804 (East Maui, Wailuanui, high flow)

Date of Field Investig	gation: November 18, 2008 Time (24-hour): 1520 - 1530
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Skippy Hau (DAR)
Hydrologic Unit:	Wailuanui (6056)
Stream Name:	Wailuanui Stream
Findings:	

At 1520 hours, CWRM staff and Skippy arrived at the Hana Highway bridge that crosses Wailuanui Stream. CWRM staff observed Wailuanui Stream from the bridge and determined the flow velocities in the stream to be too high* for taking measurements.

Staff left Wailuanui at 1530 hours, and continued to document high flows on Palauhulu Stream. Refer to Field Investigation Report FI2008111805 (East Maui, Palauhulu, high flow) for more information.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

**Image Listing:** (Attach PDF of image contact sheet)

File Name:	Brief Description:
20081118076	Cascading waterfall on Wailuanui Stream, upstream from from Hana Highway.
20081118078	Wailuanui Stream downstream from the cascading waterfall but upstream from Hana Highway.
20081118079	Cascading waterfall and Wailuanui Stream, upstream from Hana Highway.
20081118080	Wailuanui Stream downstream from Hana Highway.
20081118081	IIFS Site on Wailuanui Stream below the bridge on Hana Highway.
20081118083	Cascading waterfall and Wailuanui Stream, upstream from Hana Highway.

#### **GPS** Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)		
File Name:	Brief Description:	
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.	

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
0	20.832394	-156.138458	IIFS Site Flow Measurement on Wailuanui Stream
4	20.833606	-156.13696	Parking area near IIFS Site on Wailuanui Stream

#### Attachments:

**Brief Description:** 

1. Image Contact Sheet



20081118076.JPG



20081118078.JPG



20081118079.JPG



20081118080.JPG



20081118081.JPG



20081118083.JPG



# FIELD INVESTIGATION REPORT

FI2008111805 (East Maui, Palauhulu, high flow)

Date of Field Investig	gation: November 18, 2008 Time (24-hour): 1540-1600
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Skippy Hau (DAR)
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Palauhulu Stream
Findinge	

#### Findings:

At 1540 hours, CWRM staff and Skippy arrived at the Keanae Valley Lookout. From the lookout, staff could view Keanae Flume, Palauhulu Stream, and the large pond before flowing out to the ocean. During the field visit on Oct. 24, 2008 (refer to FI2008102403), Palauhulu Stream downstream from Keanae Flume was completely dry. No water was flowing into the large pond further downstream. At this field visit, the water level in Palauhulu Stream was at least 5 feet high based on the concrete base of the flume. Water was flowing into the large pond. Due to the heavy rain*, the high flows flushed debris and other contaminants out to the ocean, creating a large plume.

CWRM staff and Skippy then drove to the Hana Highway bridge that crosses Palauhulu Stream. Staff observed Palauhulu Stream from the bridge and determined the flow velocities in the stream to be too high for taking measurements.

Staff left Palauhulu Stream at 1600 hours. While driving to Honopou, staff took photographs of the highs flows in streams that cross Hana Highway. Refer to Field Investigation Report FI2008111806 (East Maui, High flows) for more information.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach PDF of image contact sheet)		
File Name:	Brief Description:	
20081118086	Palauhulu Stream and Keanae Flume from the Keanae Valley Lookout.	
20081118088	Mouth of Piinaau Stream.	
20081118091	Keanae Valley taro patches.	
20081118093	Palauhulu Stream upstream from Hana Highway.	
20081118094	IIFS Site B on Palauhulu Stream upstream from Hana Highway.	
20081118095	Palauhulu Stream downstream from Hana Highway.	
20081118096 Palauhulu Stream downstream from Hana Highway.		
GPS Listing:		
Shapefiles: (List file na	mes of all shapefiles created and a brief description of each)	
File Name:	Brief Description:	
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded	
	from all the East Maui field investigations.	
Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)		
WP No. Latitude	Longitude Brief Description:	
26 20.856333	-156.146474 IIFS Site B on Palauhulu Stream at Hana Highway	

#### Attachments:

- Brief Description: 1. Image Contact Sheet



20081118086.JPG



20081118088.JPG



20081118091.JPG



20081118093.JPG



20081118096.JPG



20081118094.JPG



20081118095.JPG



## FIELD INVESTIGATION REPORT

FI2008111806 (East Maui, High Flows)

Date of Field Investig	pation: November 18, 2008 Time (24-hour): 1600 - 1730		
CWRM Staff:	Staff: Ed Sakoda, Dean Uyeno, and Chui Ling Cheng		
Individuals Present:	Skippy Hau (DAR)		
Hydrologic Unit:	Multiple		
Stream Name:	Nuaailua Stream, Honomanu Stream, Punalau Stream, Waikamoi Stream, Kaaiea Stream, Nailiihaele Stream		

#### Findings:

At 1600 hours, CWRM staff and Skippy began driving to Honopou from Wailuanui. Along the way, staff took photographs of high flows* in the following streams:

- 1. Nuaailua Stream
- 2. Honomanu Stream
- 3. Punalau Stream
- 4. Waikamoi Stream
- 5. Kaaiea Stream
- 6. Nailiihaele Stream

Staff arrived at the Haiku Ditch diversion intake on Honopou Stream at 1730 hours. Refer to Field Investigation Report FI2008111807 (East Maui, Honopou IIFS Site A) for more information.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing	(Attach PDF of image contact sheet)
---------------	-------------------------------------

indge Listing. (Addit Di of indge condet sheet)		
File Name:	Brief Description:	
20081118098	Nuaailua Stream upstream from Hana Highway.	
20081118100	Nuaailua Stream downstream from Hana Highway.	
20081118101	Honomanu Stream downstream from Hana Highway.	
20081118102	Honomanu Stream downstream from Hana Highway.	
20081118103	Honomanu Stream upstream from Hana Highway.	
20081118104	Honomanu Stream downstream from Hana Highway.	
20081118106	Punalau Stream downstream from Hana Highway.	
20081118107	Punalau Stream upstream from Hana Highway.	
20081118110	Waikamoi Stream downstream from Hana Highway.	
20081118111	Waikamoi Stream upstream from Hana Highway.	
20081118114	Kaaiea Stream downstream from Hana Highway.	
20081118116	Center Ditch diversion intake on Kaaiea Stream upstream from Hana Highway.	
20081118117	Center Ditch diversion intake on Kaaiea Stream upstream from Hana Highway.	
20081118120	Center Ditch diversion intake on Nailiilihaele Stream upstream from Hana Highway.	
20081118122	Nailiilihaele Stream downstream from Hana Highway.	
20081118124	Nailiilihaele Stream downstream from Hana Highway.	

GPS Listing:				
Shapefi	iles: (List file nam	es of all shapefiles created and a brie	ef description of each)	
File Nam	<u>ne:</u>	Brief Description:		
FI20081	117wp.shp	Waypoints recorded during the	field visit from Nov. 17-19, 2008.	
Waypoi	nts: (List all wayp	oints in decimal degrees and provide	a brief description of each)	
WP No.	Latitude	Longitude	Brief Description:	
023	20.85498529	-156.16040474	Nuaailua Stream at the bridge on Hana Highway.	
024	20.85473383	-156.16952106	Honomanu Stream at the bridge on Hana Highway.	
025	20.86180279	-156.16985877	Punalau Stream at the bridge on Hana Highway.	
026	20.87230523	-156.18698317	Waikamoi Stream at the bridge on Hana Highway.	
027	20.87847708	-156.1953654	Kaaiea Stream at the bridge on Hana Highway.	
028	20.88661171	-156.21020204	Nailiilihaele Stream at the bridge on Hana Highway.	
Attachr	nents:			
Brief De	scription:			
1. Image Contact Sheet				
Recommendations:				



20081118098.JPG



20081118100.JPG





20081118102.JPG





20081118111.JPG



20081118103.JPG



20081118107.JPG



20081118114.JPG



20081118104.JPG



20081118110.JPG



20081118116.JPG



20081118117.JPG



20081118120.JPG



20081118122.JPG





## FIELD INVESTIGATION REPORT

FI2008111807 (East Maui, Honopou IIFS Site A)

Date of Field Investig	gation: November 18, 2008 Time (24-hour): 1730 - 1800		
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng		
Individuals Present:	: Skippy Hau (DAR)		
lydrologic Unit: Honopou (6034)			
Stream Name: Honopou Stream			

#### Findings:

At 1730 hours, CWRM staff and Skippy arrived at the Haiku Ditch diversion intake on Honopou Stream. Due to the high flows from the heavy rain*, debris had collected on the upstream side of the berm that EMI constructed on Oct. 27, 2008 (refer to FI2008102703 for more information). The berm did not wash downstream. Water was flowing over the berm and Haiku Ditch. The water level at the ditch was higher than the opening of the control gate at the right bank of the stream. Backflow of water from the control gate was apparent.

CWRM staff drove down Honopou Road to IIFS Site A on Honopou stream. Flow velocities in Honopou Stream were too high for taking flow measurements. Water flowed pass the CRM wall of the gage pool. The reference point was no longer visible.

Staff concluded the field visit at 1800 hours.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach PDF of image contact sheet)			
File Name:	Brief Description:		
20081118126	Haiku Ditch diversion intake on Honopou Stream.		
20081118127	Haiku Ditch diversion intake on Honopou Stream.		
20081118128	Honopou Stream downstream from Haiku Ditch.		
20081118130	Haiku Ditch east of the control gate and Honopou Road.		
20081118134	Control gate at the Haiku Ditch diversion intake on Honopou Stream.		
20081118136	Gage pool of IIFS Site A on Honopou Stream.		
20081118137	Honopou Stream downstream of the bridge that crosses Honopou Road.		
20081118139	Gage pool and reference point of IIFS Site A on Honopou Stream.		

#### GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)

<b>Chaperneer</b> (Elst me hames of an shapemes of cated and a bher description of each)			
File Name:	Brief Description:		
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.		

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
6	20.916212	-156.245203	Bridge on Honopou Stream
7	20.916187	-156.245174	IIFS Site A Reference Point on Honopou Stream
8	20.916096	-156.245077	IIFS Site A Flow Measurement on Honopou Stream

#### Attachments:

- Brief Description: 1. Image Contact Sheet



20081118126.JPG



20081118130.JPG





20081118134.JPG



20081118136.JPG



20081118137.JPG





## FIELD INVESTIGATION REPORT

FI2008111901 (East Maui, High Flows)

Date of Field Investig	pation: November 19, 2008 Time (24-hour): 0730 - 0900	
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng	
Individuals Present:	Skippy Hau (DAR)	
Hydrologic Unit:	Multiple	
Stream Name:	Vame: Oopuola Stream and Haipuaena Stream	
Findings		

#### Findings:

At 0730 hours, CWRM staff and Skippy left Kahului to Palauhulu. Along the way, staff took photographs of high flows* in Oopuola Stream and Haipuaena Stream.

Staff arrived at the Hana Highway bridge that crosses Palauhulu Stream at 0900 hours. Refer to Field Investigation Report FI2008111902 (East Maui, Palauhulu, high flow) for more information.

* Heavy rain fell on East Maui on the early morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach PDF of image contact sheet)

File Name:	Brief Description:
20081119002	Center Ditch diversion intake on Oopuola Stream.
20081119003	Center Ditch diversion intake on Oopuola Stream.
20081119004	Center Ditch diversion intake on Oopuola Stream.
20081119005	Oopuola Stream upstream from Center Ditch.
20081119006	Oopuola Stream downstream from Center Ditch, but upstream of Hana Highway.
20081119007	Diversion intake structure at Center Ditch on Oopuola Stream.
20081119008	Diversion intake structure at Center Ditch on Oopuola Stream.
20081119012	Haipuaena Stream upstream from Hana Highway.
20081119014	Haipuaena Stream upstream from Hana Highway.
20081119015	Haipuaena Stream downstream from Hana Highway.
20081119018	Waterfall at Haipuaena Stream upstream from Hana Highway.

#### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each)			
File Name:	Brief Description:		
FI20081117wp.shp	Waypoints recorded during the field visit from Nov. 17-19, 2008.		

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each) WP No. Latitude Longitude Brief Description:

-156.19590428

<u>WP No.</u>	<u>Latitude</u>
029	20.87989169

Brief Description: Oopuola Stream at bridge on Hana Highway

#### Attachments:

#### **Brief Description:**

1. Image Contact Sheet



20081119002.JPG



20081119005.JPG



20081119008.JPG



20081119015.JPG

20081119003.JPG



20081119006.JPG





20081119018.JPG



20081119007.JPG



20081119014.JPG



## FIELD INVESTIGATION REPORT

Fl2008111902 (East Maui, Palauhulu, high flow)

Date of Field Investig	pation: November 19, 2008 Time (24-hour): 0900 - 1200			
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng			
Individuals Present:	DAR - Skippy Hau;			
	Keanae - Gladys and Isaac Kanoa			
Hydrologic Unit:	Piinaau (6053)			
Stream Name:	Palauhulu Stream			

#### Findings:

At 0900, CWRM staff and Skippy arrived at the Hana Highway bridge that crosses Palauhulu Stream. CWRM staff observed the stream from the bridge and determined the flow velocities in the stream to be too high* for taking measurement. Staff then drove to the Keanae Valley Lookout. From the lookout, staff could view Keanae Flume, Palauhulu Stream, and the large fishpond before the stream flowed out to the ocean. During the field visit on Oct. 24, 2008 (refer to FI2008102403), Palauhulu Stream downstream from Keanae Flume was completely dry. No water was flowing into the large pond further downstream. At this field visit, the water level in Palauhulu Stream was approximately 5 feet high based on the concrete supports of the flume. Water was flowing into the large pond. Due to the heavy rain*, the high flows flushed debris and other contaminants out to the ocean, creating a large plume.

At 0930 hours, CWRM staff and Skippy arrived at the Kanoa residence. Gladys Kanoa took staff to see the outflow of Keanae Flume, Palauhulu Stream, and its confluence with Piinaau Stream. She also gave staff a tour of her taro loi and the auwai system.

Staff left the Kanoa residence at 1200 hours, and continued to document high flows in Wailuanui Stream. Refer to Field Investigation Report FI2008111903 (East Maui, Wailuanui, high flow) for more information.

*Heavy rain fell on East Maui on the early morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

#### **Image Listing:** (Attach PDF of image contact sheet)

5 5 (	<b>o</b> ,
File Name:	Brief Description:
20081119021	Palauhulu Stream upstream from Hana Highway.
20081119022	IIFS Site B on Palauhulu Stream below Hana Highway.
20081119024	Palauhulu Stream downstream from Hana Highway.
20081119030	Palauhulu Stream and Keanae Flume from Keanae Valley Lookout.
20081119031	Mouth of Piinaau Stream.
20081119032	Taro patches in Keanae Valley.
20081119034	Plume at the mouth of Palauhulu Stream.
20081119038	Outflow of Keanae Flume.
20081119039	Outflow of Keanae Flume.
20081119040	Outflow of Keanae Flume.
20081119041	Outflow of Keanae Flume.
20081119043	Piinaau Stream upstream from Keanae Flume.
20081119045	Piinaau Stream downstream from its confluence with Palauhulu Stream.
20081119047	Confluence of Piinaau and Palauhulu Stream downstream from Keanae Flume.
20081119051	Piinaau Stream and the large pond further downstream.

GPS Listing:		
Shapefiles: (List file nam	nes of all shapefiles created and a brief	description of each)
File Name:	Brief Description:	
East_Maui_POI.shp	Points of interest (POI) recorded	with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maul field invest	igations.
Waypoints: (List all way	points in decimal degrees and provide a	a brief description of each)
WP No. Latitude	Longitude	Brief Description:
26 20.856333	-156.146474	IIFS Site B on Palauhulu Stream at Hana Highway
Attachments:		
1 Image Contact Sheet		
Recommendations:		



20081119021.JPG



20081119022.JPG



20081119024.JPG



20081119030.JPG



20081119031.JPG



20081119032.JPG







20081119038.JPG



20081119039.JPG



20081119040.JPG

20081119041.JPG



20081119045.JPG



20081119047.JPG

20081119051.JPG



## FIELD INVESTIGATION REPORT

FI2008111903 (East Maui, Wailuanui, high flow)

Date of Field Investig	gation: November 19, 2008 Time (24-hour): 1210 - 1220
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Skippy Hau (DAR)
Hydrologic Unit:	Wailuanui (6056)
Stream Name:	Wailuanui Stream
Findings:	

At 1210 hours, CWRM staff and Skippy arrived at the Hana Highway bridge that crosses Wailuanui Stream. CWRM staff observed Wailuanui Stream from the bridge and determined the flow velocities to be too high* for taking measurements.

Staff left Wailuanui at 1220 hours, and drove to Hanehoi to measure discharge in Huelo Stream. Refer to Field Investigation Report FI2008111904 (East Maui, Huelo IIFS Site A) for more information.

*Heavy rain fell on East Maui on the early morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach PDF of image contact sheet)

File Name:	Brief Description:
20081119059	Cascading waterfall on Wailuanui Stream, upstream from Hana Highway.
20081119060	Wailuanui Stream downstream from the cascading waterfall but upstream from Hana Highway.
20081119061	Wailuanui Stream downstream from Hana Highway.

#### **GPS** Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each) **Brief Description:** File Name: East_Maui_POI.shp Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:
0	20.832394	-156.138458	IIFS Site Flow Measurement on Wailuanui Stream
4	20.833606	-156.13696	Parking area near IIFS Site on Wailuanui Stream

#### Attachments:

Brief Description:

1. Image Contact Sheet





20081119060.JPG



20081119061.JPG



## FIELD INVESTIGATION REPORT

FI2008111904 (East Maui, Huelo IIFS Site A)

Date of Field Investig	pation: November 19, 2008 Time (24-hour): 1315 - 1400
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Ernie Schupp (Huelo farmer)
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Puolua (Huelo) Stream
Eindinge:	

#### Findings:

On the way to IIFS Site A on the Puolua (Huelo) Stream, CWRM staff saw that Hanehoi Stream was flowing. During the previous field visit on Oct. 24, 2008, Hanehoi Stream was dry (refer to FI2008102401 for more information). Although not planned in the trip schedule, CWRM staff was prepared to conduct a field visit on Hanehoi Stream and possibly estimate discharge in the stream.

At approximately 1315 hours, CWRM staff arrived at IIFS Site A on the Puolua (Huelo) Stream. Despite the heavy rain*, the stream had relatively low flow. This is because the stream is still diverted at Lowrie Ditch upstream.

CWRM staff prepared the IIFS site for flow measurement. Flow measurement was completed in 30 minutes. Gage height readings were not recorded as a reference point was not established during the field investigation on October 23, 2008 (refer to Field Investigation Report FI2008102303 for more information). CWRM staff recorded wind velocity, air temperature, water temperature and weather conditions. The weather was overcast with no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.244 cubic feet per second (0.158 million gallons per day).

Staff left the IIFS Site A on Puolua (Huelo) Stream at approximately 1400 hours, and continued to Hanehoi Stream to take flow measurements. Refer to Field Investigation Report FI2008111905 (East Maui, Hanehoi IIFS Site B) for more information.

*Heavy rain fell on East Maui on the morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

 Image Listing: (Attach PDF of image contact sheet)

 File Name:
 Brief Description:

# GPS Listing: Shapefiles: (List file names of all shapefiles created and a brief description of each) File Name: East_Maui_POI.shp Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
18	20.903285	-156.225661	Haiku Ditch on Huelo Stream
19	20.903252	-156.225375	IIFS Site A Measurement Site on Huelo Stream

#### Attachments:

 Brief Description:

 1. Discharge Measurement and Gage Inspection Notes

Form 9-275F (Apr. 2001)

#### U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008111904 - Page 3 of 4

Meas. No. _____

Comp. by CHUI

Checked by DDU

Sta. No. HUELO	UFS	SITE A			1	а. 1
Sta. Name		1 - 14 - 14 				<b>\</b>
Date 11/19	, 20	0 <u>0</u> 8_Pa	rty(	Chui,	Dear?	Ed. Skippy, Ernie
Width <u>1.9</u>	Area	0.719	V	el. <u>0.3</u>	4 G.	.H Disch244
Method Wad	ing	No	. secs.	40	G. H. cha	ange in hrs
Method coef	Ho	oriz. angle	coef.		Susp	Tags checked
Meter Type		Meter No.	<u> </u>	<del></del> .	Met	ter ft. above bottom of w
Rating used		SI	oin test	before m	eas	; after
Meas: plots		% diff. fro	omratir	ng no		Indicated shift
· · · · ·	GAG	E READI	NGS	··· -		Samples collected: water quality,
Time				Inside	Outside	sediment, biological, other
						]
						Measurements documented on
Start	LEW	<u>e 1340</u>				separate sheets: water quality, aux /base cage other
			· · · · · · ·			Bain gage serviced/calibrated
						-
			· . ,		<u> </u>	Weather: _sunny (partly)
Finish	PEN (	ê man			<u> </u>	Air Temp°C at
	- EVV V	0 1407				Water Temp°C at355
Weighted MGH			<i>.</i>			Check bar/chain found
GH correction				<u> </u>		Changed to at
CorrectMGH						Correct
Wading cable ic	e boat û	ipstr.dow	nstr s	ide bridae	15	(ft) mi upstr downstr of <del>cage</del>
Measurement rat	ted excell	ent (2%),	goød (5	5%), fair (8	8%), poor	(>8%); based on following .
conditions: Flow	: <u>fai</u>	rly uni	farm	, lami	nar	· · · · · · · · · · · · · · · · · · ·
Cross section:	penbles	dirt				,,,,,,, _
Gage operating:				R	ecord Rer	moved
Battery voltage:	· · · · · · · · · · · · · · · · · · ·	Inta	ke/Orii	fice clean	ed/purged	d:
Bubble-gage pre	ssure, ps	si: Tank 🔔		, Line		,Bubble-rate /mir
Extreme-GH indi	icators: m	nax		, mi	n	·
CSG checked	ŀ	HWM heig	ht on st	i <b>c</b> k	Ref.	elev HWM elev
HWM inside/outs	side:	·			,	· · · · · · · · · · · · · · · · · · ·
Control:		<u> </u>	<del>.</del>			
Remarks:			-			
GH of zero flow =						
	• GH	d	epth at	control _		_ = ft., rated

.0	.10	.20	.30		.40	.50 River	at - ^{term}	.60	ц. 1999 ж. на 19	.70	FI2008111 . <b>75</b>	904 -	Page 4 of 4
OEF.	DIST.			ÄH		TIME	VEL	OCITY	ADJUST-			-	
	FROM INITIAL POINT	WIDTH	DEPTH	OBSER TION DEI	REVO- LUTIONS	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80	-
	LEW	@ 13	40									_	· .
												.85	
	0.65	.075	0	1								-	
	0.80	.125	0.13			EST =	%(.36)	= 0.18		.016	.003	-	
	0.90	. 10	0.20			40		0.36		. 020	. 007	.90	
	1.00	.10	0.24			40		0.39		.024	. 009	.92	
	1.10	,10	0.3D			40		0.41		.030	.012	-	
	1.20	.10	0.40			40		0.30		.040	.015	94	
	1.30	.10	0.47			40		0.41		.047	.019	.96	
	1:40	.10	0.47			40		0.40		.047	.019	.97	
	1.50	.10	0.48			40		0.398		. 648	.018	.98	
<u></u>	1.60	.10	0.49			40		0.34	.321	.049	. 017	.99	.119
	1.70	.10	0.50			yo		0.36		.050	, 019	_	
	1,90	,10	0.50			40		0.31		.050	.016	-	
0	1.90	.10	0.52			цo		0.32	.473	,052	.017 '	.00	.17
	2,00	.10	0.50			40		0.33		.050	.017	_	
	2.10	,10	0.47			40		0.32		.047	,015	-	
	2.20	.10	0.45			40		0.30	.615	,045	. 014	.99	,216
	2.30	.10	0.39			40		0.28		,034	.011	98	
	2.40	.10	0.38			40		0.25		.039	.010	97	
	2.50	.075	0.36			40		0,27		.027	.007	.96	
	2.55	.025	0										
5-0		Name and a state of the state o	CHINA CONTRACTOR OF CONTRACT	9666369736973	Carlogrammer and a many of the loss	97min.nks/m94245245247474247	2016:27-12-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-14-16-1 	- Caller and the sum comparison	in Andronicz koncernzyczy postawa pistu	748-3629-1879-3563-1226-75-123		.94 -	-
	1.9	1.9					ANE-	0.34		0.719	0.244	.92 -	
										· · · · · · · · · · · · · · · · · · ·		.90	
	REN	@ 14	07									_	
· · · · ·												-	
												.85 -	,
											 	_	
												- 00	L.
		 						-				-00	
	<u> </u>											_	



## FIELD INVESTIGATION REPORT

FI2008111905 (East Maui, Hanehoi IIFS Site B)

Date of Field Investig	pation: November 19, 2008 Time (24-hour): 1420 - 1610
CWRM Staff:	Ed Sakoda, Dean Uyeno, Chui Ling Cheng
Individuals Present:	Skippy Hau (DAR staff)
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Hanehoi Stream

#### Findings:

At approximately 1420 hours, CWRM staff and Skippy arrived at the Haiku Ditch diversion intake on Hanehoi Stream. Staff had previously informed Garret Hew (EMI Water Resource Manager) that staff would be hiking from the EMI gate on Hana Highway to the stream. During the previous field visit on Oct. 24, 2008, Hanehoi Stream was dry (refer to FI2008102401 for more information). At this field visit, Hanehoi Stream was flowing due to the heavy rain*.

CWRM staff and Skippy hiked downstream to the IIFS Site B established on Oct. 24, 2008 (refer to FI2008102401 for more information). Water level at the measurement location and the gage pool was over 3 feet deep. Water was dirty so the reference point in the gage pool was barely visible underwater. Staff was scheduled to meet with a resident in Honopou at 1600 hours. Due to time limitations, staff took a rough measurement immediately upstream of the Haiku Ditch bypass sluice gate. This location was selected for flow measurement because flow was confined to a 4 feet long concrete channel before flowing through the bypass sluice gate. However, the turbulent flow observed at the sluice gate may have resulted in errors in velocity measurements.

CWRM staff prepared the site for flow measurement. The entire flow measurement was completed in 30 minutes. Staff also recorded wind velocity, air temperature, water temperature and weather conditions. The weather was overcast with rain near the end of the measurement. As computed back in the Honolulu Office, the flow was 4.711 cubic feet per second (3.045 million gallons per day).

Staff left Hanehoi at 1600 hours, and continued to document high flows at the Haiku Ditch diversion intake on Honopou Stream. Refer to Field Investigation Report FI2008111906 (East Maui, Honopou Haiku Ditch) for more information.

*Heavy rain fell on East Maui on the early morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Attach PDF of image contact sheet)					
File Name:	Brief Description:				
20081119064	Haiku Ditch on Hanehoi Stream.				
20081119065	Hanehoi Stream upstream of Haiku Ditch.				
20081119066	Hanehoi Stream upstream of Haiku Ditch.				
20081119067	Haiku Ditch diversion intake on Hanehoi Stream.				
20081119068	Haiku Ditch on Hanehoi Stream.				

#### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each)

File Name:	Brief Descript

ion: Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations. East_Maui_POI.shp

#### Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
25	20.902082	-156.223372	IIFS Site B Measurement Site on Hanehoi Stream
24	20.901837	-156.223664	IIFS Site B Reference Point on Hanehoi Stream
23	20.901496	-156.224056	Haiku Ditch on Hanehoi Stream

#### Attachments:

Brief Description: 1. Image Contact Sheet

2. Discharge Measurement and Gage Inspection Notes



20081119064.JPG

20081119065.JPG



20081119066.JPG



20081119067.JPG
Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008111905 - Page 4 of 6

Meas.	No.	 

Comp. by ______

Checked by DDM

Sta. No.	$-\frac{HAN}{24}$	<u>EHOI</u> Frest LUI	<u>IIFS &amp;</u> istream	of di	ten ga	to)	
Old. INdi Dote	11/19	2	0 0 0 P	artv 1	rear	Ed. C	hui, skippy
Width	2.65	Area	2.05	+ Ve	el. 2.20	۲ G.	H Disch4.711_CFS
Method	Wa	ding	N	o. secs.	40	G. H. cha	nge in hrs.
Method	coef	Н	oriz. angl	e coef		Susp	Tags checked
Meter T	уре		Meter No	)		Met	er ft. above bottom of wt.
Ratingu	ısed		\$	Spin test	before m	eas	; after
Meas.p	lots		% diff. f	rom ratir	ng no	· · ·	Indicated shift
	· • ·	GAG	SE READ	INGS		<u> </u>	Samples collected: water quality,
Time	1	· · · · ·			Inside	Outside	sediment, biological, other
						· · · · · · · · · · · · · · · · · · ·	Measurements documented on
	Start	LEW	@ 1544	ł			aux./basegage, other
						<u>.</u>	
							Rain gage serviced/calibrated
			1				
					·		Weather: partly cloudy, raining
	Finish	RENI	6 1615				Air Temp°C at
							Water Temp. <u>20</u> °C at <u>1602</u>
Weighte	dMGH						Check bar/chain found
GH corr	ection						Changed to at
Correct	MGH		<u> </u>			<u> </u>	Correct qut
Wading	g, cable, i	ce, boat,	upsti, do	wnstr., s	side bridg	e, <u>2</u>	(ft), mi. upstr., downstr. of gage.
Measu	rement ra	ted exce	llent (2%)	), good (! E	5%), fa(r ( 1	8%), poor	(>8%); based on following .
Cross	ons: Flov	V: <u> </u>	er rat	bles.	fairlu e	nen C	0.80 feet
010553	section		<u> </u>	2	<u>10 -                                   </u>		
Ganer	nerating	•			F	Record Re	moved
Batter	voltade:		In	itake/Or	ifice clear	ned/purge	d
Bubble	-gage pr	essure, p	si: Tank		, Line	e	, Bubble-rate /min.
Extrem	ne-GH ind	dicators:	max		,ṁ	in	
CSGc	hecked_		HWM he	ight on s	stick	Ref	elev HWM elev
HWMi	nside/ou	tside:					
Contro	l:	ICASILIA	<u>a</u> ato s	huchu	<u>e (du</u>	wnstream	n of measurement parts
Rema	rks: <u>N</u>	ater le	iel fur	ther e	downstr	eam ra	ther high. No energy time
10 1	nake n	neasure	ment.				- 6 cotod
GH of:	zero flow	=GH		- depth a	at control		= n., rateu
					S	heet No.	of sheets

.0	.10	.20	.30		.40	.50 River	at -	.60	• •	.70	FI2008111	905 -	Page 5 of 6
	DIST.			₹₽		TIME	VEL	OCITY	ADJUST			-	
ANGLE CC	FROM INITIAL POINT	WIDTH	DEPTH	OBSERV TION DEF	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80	
	LEW	@ 11	544									_	
<del></del>												.85	•
<u> </u>	1.1	.05	0.70					0		.035	0	_	
	1.2	.10	0.70			40		0.13		.070	.009		
	1.3	.10	0.70			40		0.50		.070	.035	.90 	
	1.4	.10	0.75			40		1.02		.075	.077	.92	
	1.5	.10	0.75			цо		1.56		.075	.117	-94	
	1.6	.10	0.60			40		2.09		.080	.167	_	
	1.7	,10	0.80			40		2.06		.080	. 165	.96 _	
	1.9	.10	0.80			40		2.57		.080	. 206	.97	
-	1.9	.10	0.60	`.		40		3.16		(%)0	. 253	.98 -	
	2.0	.10	0.95			40		3.05	<u>.</u>	.095	. 259	.99	1.28%
	2.1	-10	0.80			40		2.92		. 080	234	_	
	2.2	.10	0.90			40		3.05		.080,	. 244	_	
0	2.3	.10	0.60	<u> </u>		40		3.44		.080	. 275	1.00	
	2.4	10	0.90			40		3.61		.080	. 289	_	
	2.5	.10	0.90			40		3.73		<u>_</u> 0&D	. 298	_	• •
	2.6	.10	0.90			40		3.66		.080	. 293	.99	
	2.7	.10	0.80			40		3.45	1,29	. 09 D	. 276	98	3.197
	2.8		0.95			Lto_		2:67	an <del>andar</del> an ina pinana ang managana kana ka	.005		97	·
	24-		0.905	48 (ALIMANA) (170)	₩ ₩1.₩973%2482/82%73338+2	40	inan tangan di Panés anta Bardia			-,085-		.96	3.623
, 	3.0-	<del></del>	0.85	-	the events of the second s	40-	7/2014/7/2017 heliocy/fe, exactly/	2:25		,#85	~		
	3.1		-0-55-	942277495712779 <b>497</b> 42	10 000,994,224,254,994,994,276,274,276		, 17. a <u>⊥</u> ausi/Po2 ar 1947/2764	-2.21-	ENER BLOOK BLOCK AND	.085	19. state = .	.94 —	-
	3.2				 		ļ					.92 	
	2.8	.10	0.95			40		3.09	<u> </u>	.085	. 263	.90	
	2.9	.10	0.85		ļ	40		2.52	ļ	.085	.214		
	3.0	.10	0.85			40		2.42	<b></b>	.095	.206		3.89
	3.1	.10	195			40		2.49	1,63	.085	. 211	.85 _	
	3.2	.10	0.95	<u> </u>	ļ	yo	ļ	2.24	<u> </u>	.095	.190	<u> </u>	
- 	3.3	, jð	0.95	<u> </u>		40		1.49		.095	. 127		x
							<b></b>					.80 —	
					1							سنند	
~						1	<u> </u>						

A.L	.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI20 <b>085</b> 11	905 - Page 6 of 6
a	NGLE COEF-	DIST. FROM INITIAL	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC-	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST ED FOR HOR. ANGLE OR	AREA	DISCHARGE	.80
	<u> </u>	POINT					UNDS		HUAL				<b>-</b> .
		3.4	,10	0.90			40		1.40		.020	.112	.85 U.53
		3.5	. 10	0.80			40		1.35		.080	.108	
		3.6	.125	0.75			40		0.78		.094	.073	
i i i		3.75	.075	-0-	<u>ا</u> ح	75 pm	40			DDr.	056	0 00	.90 M
				алан алан алан алан алан алан алан алан		، المحمد المحم			8. 1964 WWW 17. 17. 17. 19. 19. 19. 19. 19. 19. 19. 19. 19. 19			a energias energiadoren ezenderen er	92 _
	<u> </u>	2.65	2.65				 	AVE:	2-27		2,054	4.711	94
								 	2.23	÷l.	2.110	sin	 
		REN	@	1615	<b> </b>		 	·					.97
	<u> </u>				ļ		 				,		.98
					-								 
					<u> </u>			<u> </u>					
:	- <u></u>		<u> </u>			<u> </u>							_ · .
•													 1.00
		-			1		<b>}</b>			4			
			+		1	1							· ·
			1										.99
÷								<u> </u>					98
:								ļ			<u> </u>		<b></b>
х ,					ļ			<u> </u>	_		<u> </u>	· ·	.96
:					-			<u> </u>					.94
				-							<u> </u>		 92
											-		
	<u></u>												
	<u></u>								. <u>.</u>			<u> </u>	<del></del>
								-			+	+	
					+			<u>†</u>			1		<u> </u>
					-	+	+	1			1	-	_
Nu			-		-								.80
ų į	<u> </u>												<u> </u>
:	~	44			R				~~				

. . .

1

•



# FIELD INVESTIGATION REPORT

FI2008111906 (East Maui, Honopou Haiku Ditch)

Date of Field Investig	pation: November 19, 2008 Time (24-hour): 1620 - 1700
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Skippy Hau (DAR); Lynn Scott (Honopou resident)
Hydrologic Unit:	Honopou (6034)
Stream Name:	Honopou Stream

#### Findings:

At 1620 hours, CWRM staff and Skippy met with Lynn Scott at the Haiku Ditch diversion intake on Honopou Stream. Due to the high flows from the heavy rain*, debris had collected on the upstream side of the berm that EMI constructed on Oct. 27, 2008 (refer to FI2008102703 for more information). The berm did not wash downstream. Water was flowing over the berm and Haiku Ditch. The water level at the ditch was a couple inches lower than the opening of the control gate at the right bank of the stream. Compared to the water level observed the previous day (11/18/2008), the water level during this visit was slightly lower. Backflow of water from the control gate was apparent.

Staff concluded the field visit at 1700 hours.

*Heavy rain fell on East Maui on the early morning of Nov. 18. USGS rain gage (Station 204916156083701) in West Wailuaiki near Keanae recorded 1.8 inches of rain on Nov 18, and 0.82 inches on Nov. 19. Most of the rain fell on the early morning of Nov. 18, between 12AM and 3:30AM. The nearest USGS active streamgage with real-time data is located on West Wailuaiki Stream (Station 16518000). At approximately 12:00AM on Nov. 18, discharge in West Wailuaiki Stream began to increase from 2.7CFS to a peak flow of 2,010 CFS at 9:45AM. By Nov. 26, streamflow returned to 3.7 CFS. Refer to FI2008111801 (East Maui, Palauhulu, high flow) for real-time rainfall and discharge graphs.

Image Listing: (Atta	ch PDF of image contact sheet)
File Name:	Brief Description:
20081118169	Haiku Ditch diversion intake on Honopou Stream.
20081118170	Haiku Ditch diversion intake on Honopou Stream.
20081118171	Haiku Ditch diversion intake on Honopou Stream.
GPS Listing:	

Shapefiles: (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

 East_Maui_POI.shp
 Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
6	20.916212	-156.245203	Bridge on Honopou Stream
7	20.916187	-156.245174	IIFS Site A Reference Point on Honopou Stream
8	20.916096	-156.245077	IIFS Site A Flow Measurement on Honopou Stream

#### Attachments:

Brief Description:

1. Image Contact Sheet

#### **Recommendations:**



20081119069.JPG





20081119071.JPG



# FIELD INVESTIGATION REPORT

FI2008120801 (East Maui, East Wailuanui Koolau Ditch)

Date of Field Investig	pation: December 8, 2008 Time (24-hour): 0600 - 1120
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry
	Robello (Field Superintendent);
	DOCARE officers
Hydrologic Unit:	Wailuanui (6056)
Stream Name:	East Wailuanui Tributary
Cin din mar	

#### Findings:

CWRM staff departed Oahu for Maui at 0600 hours.

At 0900 hours, CWRM staff met with EMI staff and DOCARE officers at the EMI Keanae Baseyard. At 0940 hours, everyone arrived at the Koolau Ditch bypass sluice gate on East Wailuanui tributary. CWRM staff measured the dimensions of the sluice gate opening to be 3.0 x 2.0 feet (W x H). The depth of water at the sluice gate was 0.125 feet.

CWRM staff inspected the stream reaches upstream and downstream of the sluice gate and found a location suitable for measuring streamflow, about 15 feet downstream of the sluice gate. CWRM staff prepared the site for flow measurement. The site was not flagged because this location was not intended to be an IIFS site. Staff completed the entire flow measurement in 30 minutes. Staff also recorded air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow was 1.067 cubic feet per second (0.690 million gallons per day), with no gage height readings.

The recorded flow measurement is an estimate of the discharge in East Wailuanui tributary. Staff compared this flow with the discharge in West Wailuanui tributary (refer to FI2008120802) and that at the IIFS Site on Wailuanui Stream (refer to FI2008120803) to assess flow gains or losses in the stream reach between Koolau Ditch and the IIFS Site. This is discussed in Field Investigation Report FI2008120803 (East Maui, Wailuanui IIFS Site).

Staff left East Wailuanui tributary at approximately 1120 hours, and proceeded to West Wailuanui tributary. Refer to Field Investigation Report FI2008120802 (East Maui, West Wailuanui Koolau Ditch) for more information.

Image Listing: (Attach F	PDF of image contact sheet)
File Name:	Brief Description:
20081208001	East Wailuanui tributary upstream of Koolau Ditch bypass sluice gate.
20081208002	Koolau Ditch bypass sluice gate in East Wailuanui tributary.
20081208004	East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate. CWRM staff preparing the site for flow measurement.
20081208005	East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate. CWRM staff preparing the site for flow measurement.
20081208006	East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate. CWRM staff preparing the site for flow measurement.
20081208007	East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate. CWRM staff preparing the site for flow measurement.
20081208008	CWRM staff conducting flow measurement on East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate.
20081208009	CWRM staff conducting flow measurement on East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate.
20081208010	CWRM staff conducting flow measurement on East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate.
20081208011	CWRM staff conducting flow measurement on East Wailuanui tributary downstream of Koolau Ditch bypass sluice gate.

GPS Listing:		
Shapefiles: (List file nam	nes of all shapefiles created and a brief	description of each)
File Name:	Brief Description:	
East_Maui_POI.shp	Points of interest (POI) recorded	with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maui field invest	tigations.
Waypoints: (List all way	points in decimal degrees and provide a	a brief description of each)
WP No. Latitude	<u>Longitude</u>	Brief Description:
74 20.820689	-156.140675	Flow measurement site on East Wailuanui Stream below Koolau Ditch
		intake
Attachments:		
Brief Description:		
1. Image Contact Sheet		
2. Discharge Measurem	ent and Gage Inspection Notes	
<b>Recommendations:</b>		



20081208001.JPG



20081208002.JPG



20081208004.JPG



20081208005.JPG



20081208006.JPG



20081208007.JPG



20081208008.JPG



20081208009.JPG



20081208010.JPG



20081208011.JPG

Form 9-275F (Apr. 2001)

## U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

Meas.	No.	
-------	-----	--

Comp. by ______

	5. Writerin.	AL Stron	122/1			Checked by
Sta Name	E Mailur	an stea	ari Co cuma	15. 6.4	5 F . R	
Date 12	10. 100	10011 511	ecim ,	(4)	<u>CIOMY</u>	Istream of sluice gate
Width 5		20 <u>00</u> P	апу <u>ле</u> сыла	$\frac{n}{n}$	<u>tel. Chi</u>	al, Ken
Method	Nadina	d <u> </u>	<u> </u>	91. <u>0.5</u> 11.0	<u>24                                    </u>	i.H Disch. <u>1.067 CFS</u>
Method coe			10. Secs.		_ G. H. ch	ange in hrs.
Meter Type	· /	Matar Nu	ie coer		_ Susp	Tags checked
Rating used			D		Me	ter ft. above bottom of wt.
Meas plots		ک کا استغانہ /0	Spintest t	Sefore m	ieas	; after
meas. piots		_ 76 GIN. T	romratin	g no	<u> </u>	_ Indicated shift
   <u></u>	GA(	GE READ	NGS			Samples collected: water quality.
		<u> </u>		Inside	Outside	sediment, biological, other
Start			<u> </u>			Measurements documented on
	LEW	@ 102	0			separate sheets: water quality,
		┥				
		┨				
<u> </u>		┼				
		╀╼╾╌╾╀		· · · · · · · · · · · · · · · · · · ·		Weather: Sunny
Finish	PEast	G 1152				Air Temp 25 °C at 1035
		1.01			20 1000.0	
Weighted MG		<u> </u>			30 Frites	Check bar/obain formal
GH correction		<u>├──</u>				Changed to
CorrectMGH		<u> </u>				Correct
Mading cabl	ico host :	·		<u>-</u> <u>-</u> <u>-</u> <u>-</u> <u>-</u>	J	
Aeasuremen	rated evcel	ent (2%)	nstr., side	e bridge	,	(ft), mi. upstr., downstr. of gage.
conditions: F	ow: fairl	u unite	уооц (эм үм I	5), ( <b>ali (o</b> Chimpa	%), poor ( V Elowi	> 8%); based on following .
	: cobhles	frirl	u unif?	<u>ิ</u> ชทา	<u>-1.1070</u>	· · · · · · · · · · · · · · · · · · ·
Cross section						·
Cross section	· · · · · · · · · · · · · · · · · · ·					
Cross section Gage operation				R_		
Cross section Gage operation Battery voltac	ıg;	Inta	ke/Orific	Re	cord Rem	oved
Cross section Gage operation Battery voltag Bubble-gage	ig: e: )ressure. ps	Inta i: Tank	ike/Orific	e cleane	cord Rem d/purged	Bubble rate
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH	ig: e: pressure, ps ndicators: m	Inta i: Tank	ike/Orifici	e cleane , Line , min	ecord Rem ed/purged	aoved ; Bubble-rate /min.
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked	ng: e: pressure, ps ndicators: m	i: Tank iax	Ike/Orifice	e cleane , Line , min	ecord Rem ed/purged	/min.
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked	ng: e: pressure, ps ndicators: m H utside:	i: Tank iax iWM heigh	ike/Orifici	e cleane _ , Line _ , min <	ecord Rem ed/purged	lev HWM elev
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked WM inside/c	ng: e: pressure, ps ndicators: m H utside:	i: Tank iax iWM heigi	ike/Orifice	e cleane _ , Line _ , min <	ecord Rem ed/purged	lev HWM elev
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked WM inside/c	ng: e: pressure, ps ndicators: m H utside:	i: Tank iax iWM heigi	ht on stick	Re = cleane _ , Line _ , min <	ecord Rem ed/purged	lev HWM elev
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked IWM inside/c Control: Remarks	ng: e: pressure, ps ndicators: m H utside:	i: Tank iax iWM heigi	ike/Orifici	Re e cleane _ , Line _ , min <	ecord Rem ed/purged	lev HWM elev
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked WM inside/c Control: Remarks:	ng: e: pressure, ps ndicators: m H utside:	i: Tank iax iWM heigh	ht on stick	Re e cleane _ , Line _ , min <	ecord Rem ed/purged	lev HWM elev
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked IVVM inside/c Control: Lemarks: H of zero flow	Ig: e: pressure, ps ndicators: m H utside: 	i: Tank iax iWM heigi	ht on stick	Re e cleane _ , Line <, min <	ecord Rem ed/purged	lev HWM elev
Cross section Gage operati Battery voltag Bubble-gage Extreme-GH CSG checked WM inside/c Control: Remarks: H of zero flow	ng: e: pressure, ps ndicators: m H utside: v = GH	i: Tank iax iWM heigi	ht on stick	Re e cleane _ , Line < (  ntrol	ecord Rem ed/purged	eoved /min. ; Bubble-rate /min. lev HWM elev 

.0	.10	.20	.30		.40	.5( River	) at -	.60	. •	.70	FI200812080 . <b>75</b>	)1 - Page 5 of 6
LTEF.	DIST.			¥₽		TIME	VEL	OCITY	ADJUST-			-
ANGLE C	FROM INITIAL POINT	WIDTH	DEPTH	OBSERV TION DEF	REVO-	IN SEC- ONDS	AT POINT	MEÁN IN VER- TICAL	HOR. HOR. ANGLE OR	AREA	DISCHARGE	.80
	LEW	@	10:20								T	
												.85
) ? 4	5.6	 	-0.5				-	-0-			1	-
: : ·	2.0	.05	0.50				[	0		.025	0	-
	2.1		0.50			40		0.49		. 050	.025	.90
	2.2	. I	0.51			40		0:52		.051	.027	.92
	2.3	. 1	0.50			40		0.44		.050	. 022	-
	2.4	. 1	0.51			ЦО		0.49		.051	.024	94
	2.5	.1	0.51			40		0.50	.278	. 051	.026	- .96
	2:6	.1 -	0.51			40		0.53		.051	.027	.97
•	2.7	.	0.51			40		0.59		. 051	.030	.98
<u>.</u>	2.8	÷	0:52			-40-		2.00707-00000000000000000000000000000000	an the Contraction of the Contraction	.09Z		.99
	2.8		0.54			40		0.56		. 054	.030	•
	2.9	.1	0.54		·	40		0.62		.054	.033	-
0	3.0	.!	0.53			40		0.62		.053	. 033 1	.00
	3.1	.1	0.57			40		0.59	. 598	.057	.034	-
	3.2	.1	0.52			40		0.63		,052	.033	344
	3.3	. 1	0.53			40		0.57		.053	. 030	.99
	3.4	- 1	0.53			40		0.58		.053	. 031	98
	3.5	. (	0.59			40		0.57		.059	.034	
	3.6	.1	0.601			40		0.54	.976	.061	.033	96,472
	3.7		0.62			40		0.62		.062	.0395	
	3.8		0.62			40		0.55		.062	.034	94
	3.9	. 1	0.62			40		0.59		.062	.037	92
	4.0	.1	0.62			40		0.60		.062	.037	90 . 618
	4.1	. 1	0.67			40		0.53		.067	.036	
	4.2	. 1	0.57			40		0.56		.067	. 033	
	4.3	. 1	0.67			40		0.49		.067	.033	85
	4.4		0.68			40		0.53	1.393	.068	. 036	
	4.5	s. F	0.62			40		0.50		.062	. 031	
	4.6	. !	0.62			40		0.55		.052	.034	80
	4.7	. 1	0.62			40		0.47	1.579	.062	.029	. 855

.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI20 <b>75</b> 120	)801 - Page 6 óf 6
	DIST.			/A- 7TH		TIME	VELO	CITY	ADJUST- ED FOR			90
ANGLE CO FICIEN	FROM INITIAL POINT	WIDTH	DEPTH	OBSERV TION DEF	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.ou , <u>8555</u>
	4.8	.1	0.70			40		0.51	1.649.	.070	, 036	.871
<del></del>	4.9	1.1	0.67			40		0.48		.067	.032	.85
	5.0	. (	0.68			40		0.49		.068	.033	_
. <u> </u>	5,1	. (	0.59			40		0.52	1.943	.059	. 031	.987
	5.2	. (	0.55	[		40		0.56	1.898	.055	.031	.90 1.018
	5.3	۰, ۱	0.53			40		0.46		.053	.024	.92
	5.4	.1	0.37			40		0.30	1.988	,037	. 011	94
	5.5	. 15	0.34			40		0.28		.051	. 014	1.067
	5.7	. 1	0.07				·	0		.007	0	.96
	3.7	3.7		2	27 1934 1994 1996 1997 1997 1997 1997 1997 1997 1997	na (amia de assente nine) de la compa	AVE-	0.52		2.046	1.067	.97 
							ļ			,	ļ	.98
							ļ		<u> </u>			.99
	REW	0	1107			ļ		· · · ·				- ·
•							ļ			ļ		_
0								·		<b> </b>		1.00
												_ <del></del>
				 				<u> </u>		 	·	<b>_</b>
							·			<b> </b>		.99 
					_		<u> </u>	<u> </u>		<b> </b>		98
		<u> </u>					<u> </u>			<u> </u>		97
										<b>_</b>	· ·	.96
				<u> </u>			<u> </u>			<b>_</b>		 94
				1	_							
		· ]	ļ								_	.92 
			_					<u></u>				.90
				_			_		· ·	<u> </u>		<del></del>
	_						_			<b>_</b>		<u> </u>
				_			_					.85
				_				<u> </u>				
												.80
		-		_								
			1							<u> </u>		<del>,</del>
~	**	~										

۰

.

•



# FIELD INVESTIGATION REPORT

FI2008120802 (East Maui, West Wailuanui Koolau Ditch)

Date of Field Investig	<b>Jation:</b> December 8, 2008 <b>Time</b> (24-hour): 1140 - 1330
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry
	Robello (Field Superintendent);
	DOCARE officers
Hydrologic Unit:	Wailuanui (6056)
Stream Name:	West Wailuanui Tributary
<b>—</b>	

#### Findings:

At 1140 hours, everyone arrived at the Koolau Ditch bypass sluice gate on West Wailuanui tributary. CWRM staff measured the dimensions of the sluice gate opening to be  $2.8 \times 3.0$  feet (W x H). The depth of water at the sluice gate was 0.30 feet.

CWRM staff inspected the stream reach upstream of the sluice gate and did not find a location suitable for measuring streamflow. Approximately 400 feet upstream of the sluice gate is a waterfall. The stream reach downstream of the sluice gate is inaccessible. Staff decided to take flow measurements just 2 feet upstream of the sluice gate. The right bank of the channel is concrete lined. The left bank had minor seepage from ponded water downstream of the weir. EMI staff gathered banana stalks and large rocks, and placed them on the left bank to decrease the seepage.

CWRM staff prepared the site for flow measurement. The site was not flagged because this location was not intended to be an IIFS site. Staff completed the entire flow measurement in 40 minutes. Staff also recorded air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow was 1.235 cubic feet per second (0.798 million gallons per day), with no gage height readings.

The recorded flow measurement is an estimate of the discharge in West Wailuanui tributary. Staff compared this flow with the discharge in East Wailuanui tributary (refer to FI2008120801) and that at the IIFS Site on Wailuanui Stream (refer to FI2008120803) to assess flow gains or losses in the stream reach between Koolau Ditch and the IIFS Site. This is discussed in Field Investigation Report FI2008120803 (East Maui, Wailuanui IIFS Site).

Staff left West Wailuanui tributary at approximately 1330 hours, and proceeded to measure streamflow at the IIFS Site on Wailuanui Stream. Refer to Field Investigation Report FI2008120803 (East Maui, Wailuanui IIFS Site) for more information.

Image Listing: (Attach F	'DF of image contact sheet)
File Name:	Brief Description:
20081208014	Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208015	Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208016	CWRM staff conducting flow measurement 2 feet upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208017	CWRM staff conducting flow measurement 2 feet upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208019	Weir upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208020	Seepage upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208021	Ponded water downstream of the weir at the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208022	CWRM staff conducting flow measurement 2 feet upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208023	CWRM staff conducting flow measurement 2 feet upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208024	CWRM staff conducting flow measurement 2 feet upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.
20081208026	CWRM staff conducting flow measurement 2 feet upstream of the Koolau Ditch bypass sluice gate in West Wailuanui tributary.

GPS Listing:		
Shapefiles: (List file names	of all shapefiles created and a brie	f description of each)
File Name: B	rief Description:	
East_Maui_POI.shp P	oints of interest (POI) recorded	with the GPS unit during the field visit. The file includes POI recorded
Waypoints: (List all waypoir	its in decimal degrees and provide	a brief description of each)
WP No. Latitude	Longitude	Brief Description:
Attachments:		
Brief Description:		
1. Image Contact Sheet		
2. Discharge Measurement	and Gage Inspection Notes	
Recommendations:		



20081208014.JPG



20081208015.JPG



20081208016.JPG







20081208017.JPG

20081208019.JPG

20081208020.JPG



20081208021.JPG



20081208022.JPG



20081208023.JPG



20081208024.JPG

20081208026.JPG

Form (Apr.	9-275F 2001)		U.S. D	EPART U.S. G WATER	MENT ( eologic resour	OF THE cal Surv ces divis	FI2008120802 - Pag INTERIOR /ey Meas. No SION Comp by CHua	је 4 of 6
	x		Dis	GAGE	NSPEC		TES	
Sta. No	. <u>W.</u>	Wailu	anui				Checked by	•
Sta. Na	me <u>W</u> .	. Wail	uanai	STr.	2 ft	uostren	m from chice and	
Date_	1218		20_08_1	Party[	rear ()	Ed. Cr	un ken	
Width _	3.55	Are	a <u>1.23</u>	2 V	lel 1.00	b G	Disch 1,235 (FS	
Method	1 <u>w</u> i	ading		No. secs	<u>40</u>	_ G. H. ch	ange in brs	
Method	coef	H	loriz, ang	gle coef		_ Susp	Tags checked	
Meter 7	уре		MeterN	lo		Me	terft. above bottom of wt	
Rating	used			Spin test	before n	neas	;after	
Meas.p	olots		_ %diff.	from ratio	ng no		_ Indicated shift	
	· · · · · · · · · · · · · · · · · · ·	GAG	GE REA	DINGS				
Time			1	Τ	Inside	Outside	Sediment biological other	
			1		<u> </u>			
							Measurements documented on	
	Start	LEW	Ø	12.24			separate sheets: water quality,	
		ļ	 				aux./base gage, other	
	· · ·	ļ	ļ	ļ				
		<u> </u>		· · · · ·	· · · · · ·		Rain gage serviced/calibrated	s.
					· · ·		Weather SUMM	•
	Finish	DT. al	6 120	~			Air Temp $2^3$ °C at 1225	-
	· · · ·	REIU	130	<u>ч</u>	~	UU MIM	Water Temp 19 :0 at 1307	
Weighte	dMGH						Chook how on the second	
GH corre	ection		-			· · ·	Changed to	
Correct	ЛGH		-					
Wading, Measure condition Cross se	cable, ic ment rat ns: Flow:	e, boat, ( ed excell <u>parts</u>	ent (2%) <i>Lamine</i>	wnstr., sid , good (5 ⁴ (1 <u>1 , not</u>	de bridge %), fair (8	,2 %), poor ( <u>uni form</u>	(>8%); based on following, 	tc.
measu	vena si	the the	Chronese Chrones		tovale	<u>icivicji</u>	la second abuild the	
Gageop	eratina:_				<u> </u>	+ mostry	and surveyed, shareful charged	
Battery	oltage:		Int	ake/Orifi	ce cleans			
Bubble-g	age pres	ssure, ps	i: Tank		Line	salpuigeo	Bubble-rate /min	÷
Extreme	-GH india	cators: m	ax		, , min	<u> </u>		
CSG che	cked:		IWM heid	aht on stic	,, ck	Refe		
<b>HWM</b> ins	ide/outsi	ide:						
Control:								
<u> </u>								
Remarks	: <u>beine</u>	<u>ivia sta</u>	ilks E	bruck	<u>: 11 pla</u>	<u>cect</u> on	left bank to decreak	•
seepag	u <u>ì</u> n	nearcine	d fran	<u> 100 0</u>	f mail	to white	Y surface = 0.39 inches A.	
GHofzer	roflow = (	GH	d	lepth at c	ontrol		= ft. rated	
					She	etNo.	of sheets	

	.10	.20	.30		.40	.5 Rive	0 r at -	.60		.70	F12008120	boz - raye 5 of
ANGLE COEF- FICIENT	DIST. FROM INITIAL POINT	WIDTH	I DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	ADJUST- ED FOR HOR ANGLE OF	AREA	DISCHARC	.80 SE
	LEW	@	1224	L			<u> </u>					
			<u> </u>			 	L					.85
	1.05	.025	0.30					0		.008	. D.	
	1.1	. 075	0.32			40		0.18		.024	. 004	
	1.2	• 1	0.33			40		0.21		.033	.007	.90
	1.3	. (	0.40			40		0.22		.040	. 009	.92
	1.4	. (	0,39			40	L	0.34		.039	.013	
	1.5	. 1	0.39			40		0.30	. 183	.039	.012	<b>94</b> ,045
	1.6	. 1	0.38			40		0.44		.039	.017	.96
	1.7	. 1 :	0.35			40		0.44		, 035	, 015	.97
	1.8	. I	0.33	5		40		0.62		,033	.020	.98
	1.9	. 1	0.32			40		0.70	. 321	.032	. 022	.99
	2.0	.١	0.35	<u> </u>		40		0.93		.035	029	
_	2.1	.!	0.36			40		0.75		.036	.027	
	2.2	.1	0.37			40		0.80	.429	. 037	.030	- 1.00 - 15
	2.3	, l	0.39			40		0.74		.039	. 029	
	2.4	.	0.398			40		0.84		.038	.032	
	2.5	<u>, I</u>	0.36			40		0.90		.036	. 032	99
	2.6	, 1	0,33			40		1.15	.575	.033	.038	- مورعه مع
	2.7	.\	0.33			40		0.96		.033	.032	.30
_	2.8	.1	0.33			40		1.08		. 033	.036	.96
	2.9	.1	0.33			40		1.12		.033	,037	_
_	3.0	, (	0.34			Цo		1.23	,708	.034	.042	.94 . 1783
	3.1	.1	0.35			40		1.26		.035	.044	.92
	3.2	.1	0.35			yo		1.30		.035	,046	- .90
	3.3	.1	0.33			40		1.43		.033	.047	-
_   2	3,4	<u> </u>	0.33			40		1.26		.033	.042	-
3	3.5		0.33			40		1.23	. 873	033	. 041	- .85 703
2	o.6	. (	0.34			40		1.28		034	.044	, مــــــــــــــــــــــــــــــــــــ
3	.7		0.35			40	T	1.12		.035	.039	-
	3.8	1	0.26			40		1.21		036	.044	.80 43
3	.9	<u> </u>	0.38			40		1.21	+ 107	.039	.046	- 4 20 m

.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI20081208	802 - Page 6 of
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA. TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	<b>.80</b>
	4.0	. (	0.37			40		1.38	1.057	.037	.051	- , 927
·	U. 1	- }	0.35			Ц0		1.55		.035	. 054	.85
: 	4.2	. 1	0.34			40		1,73		.034	.059	-
	4.3	. 1	0.31			40		2.04	1.157	,031	,063	-
	4.4	. 1	0,30			40		2.19		.030	.066	.90
	4.5	. l	0.30			40		2,21	1,217	,030	.066	.92
	4.6	,05	0.30							.015		-
	3.55	3.55				والتلافينيين والمجلوبة والمرد المرتماني	AVE -	1.00	and the second	1,232	1.235	94
												.96
	REW	@	1309									.97
-			· ·							,		.98
												.99
0											1	.00
												-
												•
												.99
												-98 -
									·			-97 .96
												•
												.94
												.92
												- .90
												<u>.</u>
			-					`				-
												85
								····				
												-
												.80
										<u> </u>		-
	4.0						L		L		t	-



# FIELD INVESTIGATION REPORT

FI2008120803 (East Maui, Wailuanui IIFS Site)

Date of Field Investigation:December 8, 2008Time (24-hour): 1450 - 1600
CWRM Staff:         Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:
Hydrologic Unit: Wailuanui (6056)
Stream Name: Wailuanui Stream
Findings:
At approximately 1450 hours, CWRM staff arrived at the Hana Highway bridge that crosses Wailuanui Stream. CWRM
staff hiked down from the bridge to the stream via a small trail that begins on the right bank of the stream, on the
downstream side of the bridge. The trail condition was hazardous because of the loose rocks and large boulders on the
nill. The IIFS site is below the Hana Highway bridge.
CWRM staff prepared the site for flow measurement. Flow measurement was completed in 40 minutes. Staff also
recorded air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow
at IIFS Site was 2.803 cubic feet per second (1.812 million gallons per day), with no gage height readings.
According to the flow measurements taken at East Wailuanui tributary (1.067 cubic feet per second, refer to
FI2008120801) and at West Wailuanui (1.235 cubic feet per second, refer to FI208120802), the stream gained 0.501
cubic feet per second (0.324 million gallons per day) of flow between Koolau Ditch and the IIFS Site on this day.
Calculations are snown below:
Elow at IJES Site – ( Elow at E Wailuanui + Elow at W Wailuanui ) = Elow gains
2.803  CFS - (1.067  CFS + 1.235  CFS) = 0.501  CFS
CWRM staff concluded the field investigation at 1600 hours.
Image Listing: (Attach PDF of image contact sheet)
File Name: Brief Description:
GPS Listing:
Shapefiles: (List file names of all shapefiles created and a brief description of each)
File Name: Brief Description:
East_Maui_POI.shp Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded
from all the East Maui field investigations.
Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)
0 20.832394 -156.138458 IIFS Site Flow Measurement on Wailuanui Stream
4 20.833606 -156.13696 Parking area near IIFS Site on Wailuanui Stream
Attachments:
Brief Description:
1. Discharge Measurement and Gage Inspection Notes
Recommendations:

Form 9-275F

# U.S. DEPARTMENT OF THE INTERIOR

(Apr.	2001)			U.S. G	Beologi	cal Sur	/ey Meas. No
			DIS	SCHARG	SE MEAS		NTAND Comp. by <u>Chui</u>
				GAGE	NSPEC	TION NOT	TES OF THE DOLL
Sta. No	o. <u>Wa</u>	iluance	i IIFs	Site			Checked by
Sta. Na	ame						
Date_	12/9	5	20_08	Party [	Decin	Chui.	Ed
Width	11.3	Are	a <u>11.2</u>	78 V	/el. ,2U	19 0	H _ Disch 2903 C
Metho	d <u> </u>	iding		No. secs	40	GH ch	ange in bisch. <u>2.005</u> G
Method	d coef	ł	loriz. an	ale coef.	·	Susp	Tags checked
Meter 1	Гуре		Meter	No:			ter ficheve hetters fill
Rating	used			Spin test	t hefore n		it. above bottom of wt.
Meas.	plots _		% diff	from rati	nano	iicas	, aπer
Time	<u> </u>	GA	GE REA	DINGS			Samples collected: water quality,
	+			- <u> </u>	Inside	Outside	sediment, biological, other
	+	·		+	<u> </u>		
· · · · · · · · · · · · · · · · · · ·	Start		6	- <u> </u>	<u> </u>	<b> </b>	Measurements documented on
		LEW	<u>e</u>	1502			aux /base cage other
	-{						
-			+		· · · · · · · · · · · · · · · · · · ·	·	Rain gage serviced/calibrated
	+	+			 	· · · · · · · · · · · · · · · · · · ·	
	<del> </del>		<u> </u>			ļ	Westher: Overcast
·	Finish	DEal	6				Air Temp 20 cot 1533
	·	FUN	10	1542	· · · · · · · · · · · · · · · · · · ·		Water Temp 19 19
Weighte	dMGH	†	<u> </u>		~	40 Min	Checkbergeters (
GHcorre	ection						Check bar/chain found
Correct	MGH						
	·····	<u>.</u>	<u> </u>			!	Correct
Aeasure conditio Cross se	ement rai ns: Flow ection:	ted excel :por bedruck	lent (2%) ts lan k, not	), good (5 ninar unifar	%), fair (8 , Parts m	3%), poor ( ( sides)	(>8%); based on following , no flow.
Gage op	erating:				R/	acord Rem	ooved
Battery	voltage: _		Int	take/Orifi	ce clean	ed/purned	
Bubble-	gage pre	ssure, ps	i: Tank		Line		Bubble-rate
Extreme	-GH indi	cators: m	nax		min	- <del></del>	
CSG che	ecked	F	1WM hei	aht on stir	 ck	Rof o	
IWM ins	side/outs	ide:				rel. e	EIEV MVVIVI EIEV
Control:	<u></u>						
Remarks	s: <u>Pocl</u>	cs pus	hect th	o bank	<u>cha</u>	nnel mi	der
			·	I	<u> </u>		
or of Ze	ro tiow =	GH	(	depth at c	ontrol _	<u> </u>	= ft., rated
					She	etNo.	of sheets

.0	.10		20	.30	)	.40	.5 Rive	i0 r at -	.60	;	.70	FI200812	20803 - Page 3 of <b>75</b>
COEF		Г.   м			-AY		TIME	V.	ELOCITY	ADJUS	T.	-	
		AL WIC	TH	DEPTH	OBSEF TION DE	REVO-	IN SEC- ONDS	AT POIN	MEAN	HOR.	OR AREA	DISCHA	.80 RGE
	LEV	v@		1503								-	· <u>····</u>
	0.2	.15		0						<b>—</b> ——	0	$\frac{1}{0}$	.85
	0.4			0.5-					**-34.4 militizarimityistemisteri	terms and the second			
	0.5	.41	)	0.62	.6		40		0	-	240		
	1.0	.5(	>	0.70	.6		40	1	0		350		.90
	1.5	50	) (	0.93	.6		40	1	. 04		.465	Dia	.92
	2.0	.50		1.20	.6		40		.06	1	600	. 036	
· · · · · · · · · · · · · · · · · · ·	2.5	.স	<u>}   ı</u>	1.50	.8		40	.09	. 145		750	1.000	94
		<u> </u>			.2		40	.20		1	1		.96
	3.0	.50	- 1	1.80	છ		40	.07	.240		.900	216	.97
				·.	:2		40	.41					.98
	3.5	.50	1	.92	.8		ЦÓ	.08	. 145		.960	.139	.99
<u>-</u>					.2		40	.21					· ·
<u> </u>	4.0	.50	Į	.92	.8		40	.14	.265		.910	. 241	
0					.2		40	. 39					1.00
	4.5	.50	1	.90	.8		40	. 23	.375	t.133	.950	.356	 
·		ļ			. 2		40	. 52					
<u> </u>	5.0	.50	1.	.08	.6		40		.50	-	.540	.270	 .99
<u> </u>	5.5	.50	0	.68	.6		40		. 19		.340	.065	_
	6.0	.50	0.	.94	.6		40		.13	7.483	.470	.061	98
<u> </u>	6.5	. 50	0	.93	.6		40		. 54		.465	.251	.96
	7,0	.50	<u>  1,</u>	06	.6		40		. 34		,530	.180	
<u>`</u>	7.5	.50	0.	.80	.6		40		.46		.400	. 184	.94
<u></u>	8.0	.50	0.	.90 .	<u>.</u> b		40		.41		.45D	.185	.92
	8.5	.50	<u> 0.</u>	.69 .	6		40		, 33		.345	,114	.90
	9.0	.50	0.	,70 .	6	\	40		.21		.350	.074	2.5
	9.5	.50	0.	.60	6		40		.33	10.323	,300	, 0901	
	10.0	.50	0.9	57	6		40		,290	10.60%	,285	.080	.85 _{2.679}
<u> </u>	10.5	•50	0,0	67 .	6		+0		. 19		, 335	. 064	2.743
	11.0	.50	<u>0.</u> ŧ	67 .1	6		40		.18	11,278	, 335	. 060	2.903
	11.5	. 25	0			William Bagergenergy (Program)	Character and Character and				0		.80
<u> </u>	11.3	11.3	L					AVE-	244		11.278	2.803	

D	.10	.20	.30		.40	.50 River	<u>at -</u>	.60		.70	FI2008120	803 - Page 4 òf 4
ANGLE COEF- FICIENT	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	.80
	REW	0	1542									-
	ļ											.85 -
	<u> </u>									× .		.90
										· · · · · · · · · · · · · · · · · · ·		-
										:		.92 -
												94
				<u> </u>								.96
	<b>.</b>			<u> </u>								.97
										,	· · · · · ·	
												.99
	1							-				
												-
0				ļ							1	.00 -
	ļ						· · ···					-
	ļ			ļ								-
	<u> </u>											.99
						· · · ·		.   .		· · · ·		-98
	ļ			<u> </u>								97
		+										.96
	ļ											.94
				+								.92
	1			†			1	<u> </u>	1			 .90
	1		<u> </u>									 _
												.85
						<u> </u>	<b>_</b>					_
		ļ	 	<u> </u>		. 	ļ	1				
	<u> </u>		ļ		ļ	<u> </u>	<b> </b>			<b> </b>		.ov 
												_

ĩ

.

•

-



# FIELD INVESTIGATION REPORT

FI2008120901 (East Maui, Palauhulu IIFS Site B)

Date of Field Investiga	ation: December 9, 2008 Time (24-hour): 0820 - 0910						
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uveno, and Chui Ling Cheng						
Individuals Present:							
Hvdrologic Unit:	Piinaau (6053)						
Stream Name:	Palauhulu Stream						
Findings:							
At 0820 hours, CWRM entrance to Piinaau Ros the stream to the right b	staff arrived at the Hana Highway bridge that crosses Palauhulu Stream. The bridge is near the ad. Staff hiked upstream approximately 100 yards from the bridge on Hana Highway, crossed bank, and hiked back downstream to the measurement site directly below the bridge (IIFS Site B).						
While Ken, Ed, and Chu IIFS site to record chan anchor bolt on the right Flow measurement was conditions. Weather wa 2.033 cubic feet per see	While Ken, Ed, and Chui prepared the site for flow measurement, Dean set up a reference point 20 feet upstream of the IIFS site to record changes in gage height (if any) during the flow measurement. Dean used a hammer drill to install an anchor bolt on the right stream bank. Then, he used orange spray paint and orange flagging tape to mark the location. Flow measurement was completed in 35 minutes. Staff also recorded air temperature, water temperature and weather conditions. Weather was overcast with no rain. As computed back in the Honolulu Office, the flow at the IIFS site was 2.033 cubic feet per second (1.314 million gallons per day), with gage height at 3.83 feet.						
Staff left Palauhulu IIFS IIFS Site. Refer to Field	S Site B at approximately 0910 hours, and proceeded to take flow measurements at Wailuanui d Investigation Report FI2008120902 (East Maui, Wailuanui IIFS Site) for more information.						
Image Listing: (Attach P File Name: 20081209001 20081209004 20081209007 20081209008 20081209009 20081209012	DF of image contact sheet) <b>Brief Description:</b> CWRM staff setting up reference point on right bank of Palauhulu Stream. Reference point on right bank of Palauhulu Stream. CWRM staff taking gage height readings on right bank of Palauhulu Stream. CWRM staff taking gage height readings on right bank of Palauhulu Stream. CWRM staff taking gage height readings on right bank of Palauhulu Stream. Palauhulu Stream upstream of Hana Highway.						
GPS Listing:							
Shapefiles: (List file name File Name: East_Maui_POI.shp	es of all shapefiles created and a brief description of each) <u>Brief Description:</u> Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.						
Waypoints: (List all wayp <u>WP No.</u> 26 20.856333	oints in decimal degrees and provide a brief description of each) <u>Longitude</u> <u>Brief Description:</u> -156.146474 IIFS Site B on Palauhulu Stream at Hana Highway						
Attachments: <u>Brief Description:</u> 1. Image Contact Sheet 2. Discharge Measurement and Gage Inspection Notes							
Recommendations:							



20081209001.JPG

20081209004.JPG

20081209007.JPG



20081209008.JPG



20081209009.JPG

20081209012.JPG

Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008120901 - Page 3 of 4

IVI	eas.	INO.	 

Comp. by ______

Sta. No	PAI	ЛИНИЦ	U ILFS	В				
Sta. Na	me				· <u>-</u>		<u> </u>	·····
Date	1219		20 <u>06</u> F	Party	<u>Dean, C</u>	inu, E	d, Ken	
Width _	4.95	Are	a <u>3.3</u>	<u> </u>	/el. <u>61</u>	G	.H. <u>3.83</u>	Disch. <u>2.033_0</u> 49
Method	<u> </u>	ang	N	lo.secs	s. <u>40</u>	_ G. H. ch:	ange	in hrs.
Method	l coef	ŀ	loriz, ang	le coef.		Susp	Tag	s checked
Meter T	ype	<u>.</u>	Meter N	0		Me	ter	ft. above bottom of wt.
Rating	used			Spin tes	t before m	neas	;a	lfter
Meas.p	plots		% diff. '	fromrat	ing no		_ Indicated st	nift
		GA	GE REAL	DINGS			Samples coll	ected: water quality,
Time					Inside	Outside	sediment, bi	ological, other
							]	<u></u>
						-	Measuremer	nts documented on
	Start	LEW	@.08:	0			separate she	eets: water quality,
							aux./basega	ge, other
			· · · · · ·	ļ	· ·	ļ		n/icod/collibrated
						<u> </u>	Weather	Nerrast
· · · · ·	Finish						Air Temp	17 "Cat 0906
· · · · · · · · · ·		KEW	<u>@ 040</u>	06			Mator Tomp	19 °C at 0906
Mainhte	dMGH	· [	<u>+</u>		~	<u>35 min</u>	Valer temp.	
GH corr	ection	<u> </u>			+		Check bar/cr	
Correct	MGH		÷					at
Weding Measure conditio Cross s	, cable, id ement ra ens: Flow ection:	ce, boat, i ted exce r: <u>faur</u> bedrnc	ups)r., do Ilent (2%) Iy uni ( K ur	wnstr., s , good ( imn . ieven	ide bridge 5%), fair (l Lomina	a, <u>I</u> 8%), poor	(f), mi. u( (> 8%); based	bridges)r., downstr. of gage. on following
Gage or				<u> </u>	R	ecord Rer	moved	
Batterv	voltage:		Int	ake/Ori	fice clean	ed/nurger		
Bubble-	gage pre	essure, p	si: Tank		Line		: Bubble-ra	ate/min
Extreme	e-GH ind	icators: r	nax		mir			
CSGch	ecked:		HWM hei	ahtons	tick	Ref.	elev.	HWMelev
HWMin	side/out	side:					·	
Control:	·		<u> </u>					
				-	*			;
Remark	( <b>s</b> :lea s(fe	<u>rt sink</u> B.	anche	<u>N 1201</u>	<u>1 (7) ř</u>	ight b	kink, 20 fl	upstream of
GHofze	ero flow =	GH		depth at	control _		=	ft., rated
				-	Sh	eet No	of	sheets
					÷.,		VI .	0100(0

)	.10	.20	.30		.40	.5 Rive	0 rat	.60	· .	.70	.75	of - r age
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDT	I DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC ONDS	VE AT POINT	MEAN IN VER- TICAL	ADJUST ED FOR HOR ANGLE OR	AREA	DISCHARGE	80
	LEN	C	0830					1				
	ļ	<u> </u>									-	- .85
	2.7	. 1	0							0		-
	2.9	.2	0.74			40		0.36		.148	. 053.	-
	3.1	.2	0.98			40		0,55		. 196	.108	.90
	3,3	.2	1.01			40		0.69		.202	- 139	.92
<u> </u>	3.5	,2	0.95			40		0.69		. 190	.131	-
	3.7	.2	0.90			40		0.66		. 180	. 119	.94
	3.9	.2	0.86			40	<b> </b>	0.63	1.089	.17Z	.108	.96 . b59
	4.1	.2 .	0.85			40		0.41		. 170	. 070	.97
	4.3	.2	0.83			40		0.53		. 166	. 088	.98
	4.5	.2	0,79			40		0.61		.158	. 096	.99
	4.7	.2	0.92			40		0.66		.164	.108	
	4.9	.2	0:95			40		0.65	1,916	.170	. 111	1,131
2	5.1	. Z	0.93			40		0.65		.166	.108 1	.00
	5,3	.2	0.72			40		0.68		.144	, 098	
	5,5	.2	0,72			40	·	0.70		.144	.101	
	5.7	.2	0.65			40		0.72		.130	. 094	.99
	5.9	.2	0.62			40		0,70	2.624	.124	.087	981.619
	6.1	,2	0.62			40		0.63		,124	.078	.97
	6.3	.2	0.61			40		0.66		.122	.081	96
	6.5	.2	0.55	_		40		0.69		.110	.076	
	67	.2	0.48			40	·	0.68		.096	,065	94
	6.9	.2	0.47			40		0.65		.094	.061	92 _{1.98}
	7.1	,2	0.34			40		0.54		.068	.037	90
	7.3	.2	0.30			40		0.24		.060	.014	
	7.5	,125	0.10			est=	Ya(.24)=	0.12		.013	.002	
	7.55	.025	0	Kort-compact	Elizabethe and a second se	man of Simon and	4.000 44.000			0		85
	4.95	4.95					Est.	an in the second s	-> or Canada ( Ring Address graded ) 7	3.311	2.033	
				_			ANE =	.61				
	REW	0	0906		GH -	5-1.	17 = 3	.93				80

• •• •



# FIELD INVESTIGATION REPORT

FI2008120902 (East Maui, Wailuanui IIFS Site)

Date of Field Investig	ation: December 9, 2008	<b>Time</b> (24-hour): 1000 - 1110					
CWRM Staff:	Ken Kawahara, Ed Sakoda, De	ean Uyeno, and Chui Ling Cheng					
Individuals Present:							
Hydrologic Unit:	Wailuanui (6056)						
Stream Name:	Wailuanui Stream						
Findings:							
At 1000 hours, CWRM down from the bridge to of the bridge. The trail is below the Hana High	staff arrived at the Hana Highw the stream via a small trail tha condition was hazardous becau way bridge.	ray bridge that crosses Wailuanui Stream. CWRM staff hiked at begins on the right bank of the stream, on the downstream side use of the loose rocks and large boulders on the hill. The IIFS site					
While Ken, Ed, and Ch the IIFS site to record of an anchor bolt on the le Flow measurement was conditions. Weather w 2.392 cubic feet per se	While Ken, Ed, and Chui prepared the site for flow measurement, Dean set up a reference point 3 feet downstream of the IIFS site to record changes in gage height (if any) during the flow measurement. Dean used a hammer drill to install an anchor bolt on the left stream bank. Then, he used orange spray paint and orange flagging tape to mark the location. Flow measurement was completed in 30 minutes. Staff also recorded air temperature, water temperature and weather conditions. Weather was overcast with no rain. As computed back in the Honolulu Office, flow at the IIFS site was 2.392 cubic feet per second (1.546 million gallons per day), with gage height at 2.46 feet.						
Staff left Wailuanui IIFS on Waiokamilo Stream more information.	Site at approximately 1110 ho Refer to Field Investigation Re	urs, and proceeded to document Koolau Ditch diversion structures eport FI2008120903 (East Maui, Waiokamilo Koolau Ditch) for					
Image Listing: (Attach F <u>File Name:</u> 20081209018 20081209020 20081209021 20081209022 20081209023 20081209024 20081209025	ttach PDF of image contact sheet) Brief Description: CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. Reference point on the left bank of Wailuanui Stream, downstream of Hana Highway. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream. CWRM staff conducting flow measurement at IIFS site on Wailuanui Stream.						
GPS Listing: Shapefiles: (List file nam	es of all shapefiles created and a brief	description of each)					
<u>File Name:</u> East_Maui_POI.shp	Points of interest (POI) recorded v from all the East Maui field investi	with the GPS unit during the field visit. The file includes POI recorded igations.					
Waypoints:         (List all wayp)           WP No.         Latitude           0         20.832394           4         20.833606	oints in decimal degrees and provide a Longitude -156.138458 -156.13696	brief description of each) <u>Brief Description:</u> IIFS Site Flow Measurement on Wailuanui Stream Parking area near IIFS Site on Wailuanui Stream					
Attachments: <u>Brief Description:</u> 1. Image Contact Sheet 2. Discharge Measurement and Gage Inspection Notes							
Recommendations:							









20081209021.JPG



20081209022.JPG



20081209023.JPG



20081209024.JPG



20081209025.JPG

Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION

Meas. No. .

chur Comp.by _

		G	AGE IN	ISPECT	ION NOT	ES OLIVIER DOL
Sta. NoW	ailuan	i IIFs	Site			Checked by
Sta. Name						
Date 12/9	1	20 <u>08</u> Pa	irty0	ern M	Chui.	Ed. Ken
Width10.6	Are	a <u>9.469</u>	ve Ve	. ,25	G	H. 2.46 Disch 2.392 CFC
Method No	ading	No	o. secs.	40	G.H.cha	ange in hrs.
Method coef	I	Horiz, angle	coef	· · · · · · · · · · · · · · · · · · ·	Susp	Tags checked
Meter Type		_ Meter No.	·		Met	er ft. above bottom of wt.
Rating used		S	pin test l	before m	eas	; after
Meas. plots	·····	% diff. fr	om ratin	g no		Indicated shift
	GA	GE READI	NGS			Samples collected: water quality
Time				Inside	Outside	sediment, biological, other
				·		
	:					Measurements documented on
Start	LEN	@ 1037	-			separate sheets: water quality,
	· · · · · · · · · · · · · · · · · · ·	-				
· · · · ·	·				· · ·	
					· · · · · · · · · · · · · · · · · · ·	Weather: ON CASAST
Finish	RENI	12 110-			1	Air Temp. 21 °C at 1040
					50 min	Water Temp 19 °C at 1103
Weighted MGH						Check bar/chain found
GH correction			-			Changed to at
CorrectMGH						
Wading, cable, in Measurement ra conditions: Flow Cross section:	ce, boat, ted exce r: <u>par</u> bedirtra	upstr., down llent (2%), g ts larnin uk, uner	istr., sid lood (5% lov levi	e bridge 6), fair (8 flum	y), poor ( angles	(ft), mi. upstr., downstr. of gage: >8%); based on following . after section of measurement
Gage operating:				Re	cord Rem	noved
Battery voltage:		Intal	e/Orific	ecleane	d/purged	·
Bubble-gage pre	essure, pe	si: Tank 🔔		_ ; Line		;Bubble-rate /min
Extreme-GH ind	icators: n	nax		, min		· · · · · ·
CSG checked		HWM heigh	t on stic	k	Ref. e	lev HWM elev
HWM inside/outs	side:	•				
Control:			·····			
Remarks:			· · · · · · · · · · · · · · · · · · ·			······································
GH of zero flow =	GH	de	pth at co	ontrol		= ft rated

.0	.10	.20	) .30		.40	.5 River	0 * at -	.60		.70	FI2008120 . <b>75</b>	902 - Page 4
ANGLE COEF	DIST. FROM INITIA POINT	WIDT	н дертн	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VE AT POINT	LOCITY MEAN IN VER- TICAL	ADJUST ED FOR HOR ANGLE OF	AREA	DISCHARGI	.80 E
	LEN	0	1037	· .		GHT	- 5 -	2.54 =	2.46	17		
	·		. 				ļ					.85
<u> </u>	2.25	5.125	5 0				<b> </b>	· · · · · · · · · · · · · · · · · · ·		0		
	2.5	. 375	5 0.6			40	<b> </b>	.04		.225	.009	_
	3.0	. 50	0.97			40	ĺ	.01	· · · · ·	.485	.005	.90
	3.5	.50	1.10			40	<b> </b>	.07		.550	. 039	.92
	4.0	- 50	1,10			40		.14		,550	.077	- 94
	4.5	,50	1.00			40		,26		.500	.130	_
	5.0	.50	1.09			40	· · · · ·	.16	2.85.	.640	.086	.96
· · ·	5.5	.50	1.07			40	······	. 36		535	.193	.97
	6.0	.50	1.15	· .		40		, 30		.575	. 173	.98 -
	6.5	.50	1.22			40		.20		.610	.122	.99
	7.0	.50	0.99			40		.23		.490	.113	
	7.5	50	1.00			40		.44	5.56	.500	.220	1.167
0	9.0	.50	1.10			40		.35		.550	. 193 1	.00
	4.5	.50	1.14			40		,25		1570	. 143	_
	9.0	.50	0.999			40		.30		.445	.169	
	9.5	.50	0.90			40		.39		.400	, 156	.99
	10.0	.50	0.60			40		.33	7925	, 300	.099	98 1.927
	10.5	.50	0.68			40		.31		, 340	.105	.97
	11.0	.50	0.66			40		、32	8.495	.320	. 106	.96 <u>2.139</u>
	11.5	.50	0.60			40		. 28		.300	, 0204	
	12.0	.50	0.70			40		.29		.350	.102	94
	12.5	,425	0.76			40		.21	·	. 323	.068	92
	12,95	.175	0							0		90
			27 where the data ( and a star and a star		1994 - San Angele (1994) - San Angele (1994)	07554940445.min.en.en.es.		an a	anan amanan an an an an	marthia,Dethorfo03076366 v7	999 29 28 28 29 29 10 10 10 10 10 10 10 10 10 10 10 10 10	×
	10.6	10.6					AVE=	.25		7.469	2.392	
												85
	PEN	ဨ	1102									
·									. ·			
			<u> </u>								•	RO )
								·				



# FIELD INVESTIGATION REPORT

FI2008120903 (East Maui, Waiokamilo Koolau Ditch)

Date of Field Investig	pation: December 9, 2008 Time (24-hour): 1230 - 1550
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry
	Robello (Field Superintendent);
Hydrologic Unit:	Waiokamilo (6055)
Stream Name:	Waiokamilo Stream

#### Findings:

The purpose of this field visit was to document the Koolau Ditch major and minor diversion structures on Waiokamilo Stream and its tributaries. The following lists the diversions that were visited with a brief description of each.

- Time: 1230 hours. Minor diversion (K-22a) on a tributary of Waiokamilo Stream. Water from the stream used to
  pond upstream of a concrete wall about 1 foot high and 6 feet wide. When the water level in the pond reached
  high enough, water would flow through a 6-inch aluminum and PVC pipe on the right stream bank. The pipe
  transported water from this stream to a tributary of East Waiokamilo Stream further East. At this field visit, about
  one foot of the concrete wall on the left bank was broken to allow continuous flow of water in the stream through
  the diversion structure. A section of the PVC pipe on the right bank was broken to sever diversion of
  streamflow. Based on staff's observation, minor diversion K-22a is no longer functional and not diverting water
  from this tributary of Waiokamilo Stream. See photos 20081209031 20081209042.
- 2. Time: 1320 hours. Major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream, formerly referred to as Kualani Stream. In the next field visit (refer to Fl2008120904), CWRM staff confirmed that this stream is not Kualani Stream and that the headwaters of Kualani begins below Koolau Ditch. The diversion structure is concrete with a metal grate on the streambed at the left bank. Water would pond upstream from the sluice gate and flow through the metal grate into Koolau Ditch. A 6-inch PVC pipe is on the left bank. This pipe originates from the minor diversion (K-22a) on a tributary of Waiokamilo Stream as described in #1. At this field visit, the PVC pipe was broken and no water flowed in the pipe. The metal grate on the left bank was sealed with concrete. Based on staff's observation, major diversion (K-22, #10 intake), formerly referred to as Kualani Stream, is no longer functional and not diverting from this tributary of East Waiokamilo Stream. See photos 20081209043 20081209054.
- Time: 1358 hours. Minor diversion on a tributary of Waiokamilo Stream. A small PVC pipe crosscut intake that used to divert water from a tributary of Waiokamilo Stream. The diversion outfall was along the side of the service road. At this field visit, the PVC pipe was not capped and water was seen flowing out of the pipe. Based on staff's observation, the pipe is no longer diverting water from this tributary of Waiokamilo Stream. See photo 20081209055.
- 4. Time: 1400 hours. Koolau Ditch major diversion (K-23, #11 intake) on Waiokamilo Stream. Water from Waiokamilo Stream used to fall down a cliff and directly into Koolau Ditch. A wooden gate was built closer to the service road in the access tunnel. At this field visit, the wooden gate was moved closer to the ditch. As a result, water from the stream fell outside of the ditch and flowed downstream through the access tunnel. Based on staff's observation, this water is no longer diverted into the ditch. However, there was a small gap between the wooden gate and the ground, allowing water from the ditch to flow through the gate and downstream in the access tunnel. EMI staff used mud and vegetation to seal the leakage temporarily. See photos 20081209056 20081209065.
- 5. Time: 1422 hours. Water from Waiokamilo Stream flowed from above a cliff and then goes under the service road. Below the waterfall was a pond and a small PVC pipe was submerged in the pond. CWRM staff observed the other end of the pipe and it was not capped. According to EMI, this water was never diverted and that the pipe was mistakenly discarded there. Based on staff's observation, this water is not diverted into Koolau Ditch. See photos 20081209068 20081209076.
- 6. Time: 1425 hours. Koolau Ditch major diversion (K-24, #12 intake) on Waiokamilo Stream. The diversion structure is concrete with a sluice gate mounting (head wall) that was on the service road. Water from the stream would flow down the side of the mountain and into the ditch. With the sluice gate removed and the

intake sealed with cement, water continued to flow downstream. Based on staff's observation, major diversion #12 intake (K-24) is no longer functional and not diverting water from Waiokamilo Stream. See photos 20081209077 - 20081209084.

- 7. Time: 1435 hours. Minor diversion on Waiokamilo Stream. This is a crosscut #12 intake diversion structure with a small PVC pipe that captured seepage and transported water into Koolau Ditch. Very little water was observed. Based on staff's observation, this crosscut intake is no longer in operation. See photos 20081209085 and 20081209086.
- 8. Time: 1440 hours. Koolau Ditch major diversion (K-25, Kikokiko intake) on Waiokamilo Stream and the minor diversions. Water from Waiokamilo Stream would flow down a small waterfall and into the main intake structure on the left bank below the falls. A minor diversion (K-25a) is located on the left bank of the stream under the service road bridge. The diversion structure is a concrete catchment basin with a 2-inch pipe intake that would capture seepage and transported that water via a PVC pipe into another catchment basin below the service road. A second minor diversion (K-25c) begins mauka of the service road bridge on the left bank and then crossed over to the right bank. The diversion structure is a concrete catchment basin with a 6-inch pipe intake that would capture seepage and transported that water to Koolau Ditch. A third minor diversion (K-25d) is located further West along the service road. This diversion structure is a concrete catchment basin with a 4-inch PVC pipe that would capture seepage and transported that water to Koolau Ditch. A fourth minor diversion (K-25e) is located 20 feet West of minor diversion K-25d. This diversion structure is a concrete catchment basin with a 3-inch PVC pipe that would capture seepage and transported that water to Koolau Ditch. Based on staff's observation, the Kikokiko intake and the minor diversions are no longer functional because either the intakes were cemented and / or the pipes were severed. See photos 20081209088 and 20081209102.
- Time: 1543 hours. Koolau Ditch minor diversion (K-23a) on Waiokamilo Stream. The diversion structure is a 4inch PVC pipe intake located east of #11 intake (K-23). The outfall of the minor diversion was not capped and very little water was flowing out of the pipe. Based on staff's observation, this minor intake is no longer in operation. See photo 20081209104.
- 10. Time: 1548 hours. Koolau Ditch #10 crosscut minor intake (K-22d) on Waiokamilo Stream. The outfall of the minor diversion was not capped and no water was flowing out of the pipe. Based on staff's observation, this minor intake is no longer in operation. See photo 20081209105.

Staff completed documentation of the Waiokamilo diversion structures at 1550 hours. Staff continued to locate Kualani Stream from the service road. Refer to Field Investigation Report FI2008120904 (East Maui, Kualani) for more information.

Image Listing: (Attach F	PDF of image contact sheet)
File Name:	Brief Description:
20081209031	View of Keanae Valley from the service road.
20081209035	Minor diversion on a tributary of Waiokamilo Stream (K-22a). A 6-inch aluminum PVC pipe diverts water to a tributary of East Waiokamilo Stream, formerly known as Kualani Stream.
20081209037	Tributary of Waiokamilo Stream downstream of the minor diversion K-22a.
20081209038	Minor diversion on a tributary of Waiokamilo Stream (K-22a). A 6-inch aluminum PVC pipe diverts water to a tributary of East Waiokamilo Stream, formerly known as Kualani Stream.
20081209039	Concrete wall of the minor diversion on a tributary of Waiokamilo Stream (K-22a). This section of the concrete wall is broken sever diversion of water and allow continuous flow of water in the stream.
20081209040	Minor diversion on a tributary of Waiokamilo Stream (K-22a). This section of the 6-inch aluminum PVC pipe is broken sever diversion of water from the stream.
20081209041	Ninor diversion on a tributary of Waiokamilo Stream (K-22a). This section of the 6-inch aluminum PVC pipe is broken sever diversion of water from the stream.
20081209042	A for the second
20081209043	Tributary of East Waiokamilo Stream upstream of the Koolau Ditch major diversion #10 intake (K-22).
20081209045	Koolau Ditch major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream. Metal grate on the left streambank has been sealed with concrete.
20081209046	Koolau Ditch major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream.
20081209047	Koolau Ditch major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream.
20081209049	Koolau Ditch major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream.
20081209050	Koolau Ditch major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream.
20081209051	Tributary of East Waiokamilo Stream downstream of the Koolau Ditch major diversion (K-22, #10 intake).
20081209052	Koolau Ditch major diversion (K-22, #10 intake) on a tributary of East Waiokamilo Stream. A 6-inch PVC pipe outfall is located on the left bank. This pipe transported water from a tributary of Waiokamilo Stream at minor diversion K-22a to this stream.
20081209054	Tributary of East Waiokamilo Stream downstream of the Koolau Ditch major diversion (K-22, #10 intake). With the diversion structure sealed shut, water was seen flowing through the sluice gate and out the side of

	the mountain
20081209055	Minor diversion on a tributary of Wajokamilo Stream. A #10 crosscut intake pipe that used to divert water
	from Waiokamilo Stream.
20081209056	Koolau Ditch major diversion on Waiokamilo Stream (K-23, #11 intake).
20081209059	Koolau Ditch major diversion on Waiokamilo Stream (K-23, #11 intake).
20081209060	Waiokamilo Stream downstream from Koolau Ditch major diversion #11 intake (K-23).
20081209061	Board gates of the Koolau Ditch access tunnel at #11 intake (K-23) to prevent water from flowing into the
	ditch.
20081209062	Waiokamilo Stream above the Koolau Ditch major diversion #11 intake (K-23).
20081209063	Waiokamilo Stream above the Koolau Ditch major diversion #11 intake (K-23). Water from the stream was
00004000004	falling outside of the access tunnel and flowing downstream.
20081209064	Walokamilo Stream downstream from Koolau Ditch major diversion #11 intake (K-23) and the access
20091200065	tunnel. Kan Kawahara in frant of the board gotoe of the Kaeley Ditch access typnel at #11 inteks (K. 22)
20061209065	Tributary of Wajakamila Stream flowed from above a cliff and then under the service read
20081209008	Tributary of Walokamilo Stream flowed from above a cliff and then under the service road. Below the
20001209074	waterfall was a nond and a small PVC nine was submarged in the nond
20081209076	Tributary of Wajokamilo Stream flowed from above a cliff and then under the service road. Below the
20001200010	waterfall was a pond and a small PVC pipe was submerged in the pond.
20081209077	Seepage near the Koolau Ditch access tunnel and major diversion structure on Waiokamilo Stream (K-24,
	#12 intake).
20081209079	Upstream of the Koolau Ditch major diversion structure on Waiokamilo Stream (K-24, #12 intake).
20081209081	Sluice gate mounting (head wall) of the Koolau Ditch major diversion structure on Waiokamilo Stream (K-
	24, #12 intake).
20081209082	Water from Waiokamilo Stream flowed downstream of the Koolau Ditch major diversion structure (K-24,
0000000000	#12 intake).
20081209083	Downstream of the Koolau Ditch major diversion structure on Waiokamilo Stream (K-24, #12 intake).
20081209084	Akeke Springs viewed from the service road.
20081209085	Koolau Ditch #12 crosscut Intake on Walokamilo Stream.
20081209086	Downstream from the Koolau Ditch #12 crosscut intake on Walokamilo Stream.
20001209000	the service road that used to capture seepage from upstream
20081209089	the service road that used to capture seepage norm upstream.
20081209090	Bridge where Wajokamilo Stream crosses the service road
20081209091	Wajokamilo Stream upstream of the service road.
20081209092	Minor diversion K-25c on the right bank of Wajokamilo Stream at Kikokiko intake.
20081209093	Wajokamilo Stream downstream of the service road.
20081209094	Koolau Ditch Kikokiko minor intake structure on Waikamilo Stream. PVC pipe and catchment basin below
	the service road that used to capture seepage from upstream. The pipe from minor diversion K-25c can be
	seen in this photo.
20081209096	Koolau Ditch Kikokiko minor intake structure K-25a on Waikamilo Stream. PVC pipe and catchment basin
	below the service road bridge that used to capture seepage from upstream.
20081209098	Koolau Ditch Kikokiko minor intake structure K-25d on Waikamilo Stream. PVC pipe and catchment basin
00004000000	further West along the service road that used to capture seepage and transport to Koolau Ditch.
20081209099	Koolau Ditch Kikokiko minor intake structure K-25e on Walkamilo Stream. PVC pipe and catchment basin
	Zo reet west of minor diversion K-250 along the service road that used to capture seepage and transport to Koolog.
20081200101	Nouldu Dilcii. Main Kikokiko 6-inch intake nine that used to divert water from Wajokamilo Stream to Koolau Ditch
20081209101	Main Kikokiko 6-inch intake pipe that used to divert water from Walokamilo Stream to Koolau Ditch
20081209102	Koolau Ditch minor diversion on Wajokamilo Stream (K-23a). The diversion structure is a $4$ -inch PV/C nine
	intake located East of #11 intake.
20081209105	Koolau Ditch #10 crosscut minor intake on Waiokamilo Stream (K-22d).

### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each) **<u>Brief Description:</u>** Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations. File Name: East_Maui_POI.shp

### Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:
62	20.826608	-156.148956	EMI Diversion Intake K-22a
63	20.825728	-156.148713	EMI Diversion Intake K-22
64	20.825253	-156.152109	EMI Diversion Intake K-23a
65	20.825189	-156.152246	EMI Diversion Intake K-23
66	20.825028	-156.153359	Tributary to Waiokamilo Stream
67	20.824967	-156.153979	EMI Diversion Intake K-24
68	20.825016	-156.156391	EMI Diversion Intake K-25
69	20.82667	-156.149231	EMI Diversion Intake K-22d
70	20.826736	-156.149705	EMI Diversion Intake K-22e
71	20.826463	-156.1502	EMI Diversion Intake K-22f
72	20.826265	-156.150514	EMI Diversion Intake K-22g

#### Attachments:

Brief Description: 1. Image Contact Sheet

#### **Recommendations:**



20081209031.JPG

20081209035.JPG





20081209038.JPG



20081209039.JPG



20081209040.JPG





20081209047.JPG



20081209041.JPG





20081209045.JPG



20081209046.JPG



20081209049.JPG



20081209052.JPG



20081209056.JPG



20081209061.JPG



20081209050.JPG



20081209054.JPG



20081209059.JPG



20081209062.JPG



20081209051.JPG



20081209055.JPG



20081209060.JPG



20081209063.JPG



20081209064.JPG



20081209065.JPG



20081209068.JPG





20081209076.JPG



20081209074.JPG







20081209079.JPG



20081209081.JPG



20081209083.JPG



20081209084.JPG



20081209082.JPG



20081209085.JPG
# FI2008120903 - Page 8 of 9

# **IMAGE CONTACT SHEET**



20081209086.JPG



20081209088.JPG



20081209089.JPG



20081209090.JPG



20081209093.JPG





20081209094.JPG



20081209098.JPG



20081209099.JPG



20081209092.JPG



20081209096.JPG



20081209101.JPG



20081209102.JPG



20081209104.JPG



20081209105.JPG



# FIELD INVESTIGATION REPORT

FI2008120904 (East Maui, Kualani)

Date of Field Investig	pation: December 9, 2008 Time (24-hour): 1600 - 1720
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry
	Robello (Field Superintendent);
Hydrologic Unit:	Waiokamilo (6055)
Stream Name:	Kualani Stream

#### Findings:

The purpose of this field visit was to locate Kualani Stream, tributary of Waiokamilo Stream, near Koolau Ditch. CWRM staff had a GPS unit to pinpoint their location in relation to the ditch, service road, and the stream. Waypoints taken during this field visit were compared to those taken at Kualani Stream near Hana Highway and the Lakini taro patch in the downstream areas (refer to FI2008111803). The goal was to map out Kualani Stream from the headwaters to its confluence with Waiokamilo Stream, and to verify whether Kualani Stream was diverted at Koolau Ditch.

Kualani Stream crosses the service road approximately 1,100 feet west of West Wailuanui Stream. Upstream of the service road, Kualani Stream is a small waterfall and drops into a pond. The stream continues to flow downstream under the road. In order to access Kualani Stream above the waterfall, CWRM staff drove another 1,000 feet further west on the service road and began to hike into the forest in search of the stream. Staff hiked mauka for about 1,000 feet and then headed east for another 600 feet. The GPS unit indicated that staff were hiking above and parallel to the Koolau Ditch tunnel. Staff reached a deep gulch and found a stream below. Staff originally thought that the stream was Kualani Stream but later confirmed that it was West Wailuanui Stream. Staff headed West and then makai for 600 feet until reaching a slope. After hiking 100 feet down the steep slope, the terrain flattens out and water was seen seeping into a small streambed. Staff concluded that it was the headwaters of Kualani Stream. Staff continued to hike downstream for 300 feet, and then veered east into the forest and back on the service road. From there, staff hiked on the road to return to their vehicles.

Back in the Honolulu Office, CWRM staff plotted the waypoints taken with the GPS unit during the hike against the USGS quad map, Koolau Ditch, and the stream layer. Based on the map, the headwaters of Kualani Stream begins 650 feet makai of Koolau Ditch. Since Kualani Stream begins below Koolau Ditch, the stream is not diverted at the ditch. According to the photos taken earlier of the Koolau Ditch diversions on Waiokamilo Stream (refer to FI2008120903), the stream that is formerly believed to be Kualani Stream is actually a tributary of East Waiokamilo Stream. With the coordinates taken in this field visit, CWRM staff plans to re-evaluate the geographic location of the stream and possibly create a new GIS layer of this stream.

Staff concluded the field visit at 1720 hours.

Image Listing: (Attach PDF of image contact sheet)							
File Name:	Brief Description:						
20081209106	Small waterfall in Kualani Stream at the service road.						
20081209107	Small waterfall in Kualani Stream at the service road.						
20081209108	Small waterfall in Kualani Stream at the service road.						
20081209109	Small waterfall in Kualani Stream at the service road.						
20081209110	The brush that CWRM staff hiked through to locate Kualani Stream.						
20081209111	The brush that CWRM staff hiked through to locate Kualani Stream.						
20081209112	Headwaters of Kualani Stream, 650 feet makai of Koolau Ditch.						
20081209113	Headwaters of Kualani Stream, 650 feet makai of Koolau Ditch.						

### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each) **<u>Brief Description:</u>** Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations. File Name: East_Maui_POI.shp

### Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:
77	20.827438	-156.144607	Kualani Stream at EMI Service Road
78	20.826859	-156.144668	Kualani Stream
79	20.826648	-156.144803	Kualani Stream
80	20.826139	-156.144918	Kualani Stream, seepage begins to appear
81	20.824898	-156.14587	Kualani Stream, approx. over Koolau Ditch

#### Attachments:

Brief Description: 1. Image Contact Sheet



20081209106.JPG



20081209109.JPG



20081209107.JPG





20081209108.JPG



20081209111.JPG



20081209112.JPG



20081209113.JPG



# FIELD INVESTIGATION REPORT

FI2008121001 (East Maui, Wailuanui IIFS Site)

Date of Field Investig	gation: December 10, 2008 Time (24-hour): 0830 - 1000						
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng						
Individuals Present:	Amanda Martin (President of Na Moku) and Ed Wendt (Wailua farmer);						
	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry						
	Robello (Field Superintendent);						
	DOCARE officers						
Hydrologic Unit:	Wailuanui (6056)						
Stream Name:	Wailuanui Stream						

#### Findings:

At 0830, CWRM staff met with Amanda Martin and DOCARE officers at the Wailua Valley Lookout. Ken Kawahara briefly summarized the activities planned for that day. Ed Wendt stopped by and gave an overview of the auwai system in Wailua Valley.

At approximately 0910 hours, CWRM staff arrived at the Hana Highway bridge that crosses Wailuanui Stream. CWRM staff hiked down from the bridge to the stream via a small trail that begins on the right bank of the stream, on the downstream side of the bridge. The trail condition was hazardous because of the loose rocks and large boulders on the hill. The IIFS site is below the Hana Highway bridge.

CWRM staff prepared the site for flow measurement. Flow measurement was completed in 30 minutes. Staff also recorded air temperature, water temperature and weather conditions. Gage height readings were taken at the downstream reference point at the start and finish of flow measurement. As computed back in the Honolulu Office, the flow at IIFS Site was 2.076 cubic feet per second (1.342 million gallons per day), with 0.01 decrease in gage height. The gage height reading was 0.03 feet lower than the previous day (refer to FI2008120902).

According to the flow measurements taken at East Wailuanui tributary (0.921 cubic feet per second, refer to FI2008121002) and at West Wailuanui (1.242 cubic feet per second, refer to FI2008121003), the stream lost 0.087 cubic feet per second (0.056 million gallons per day) of flow between Koolau Ditch and the IIFS Site on this day. Calculations are shown below:

Flow at IIFS Site	_	(	Flow at E. Wailuanui	+	Flow at W. Wailuanui	)	=	Flow losses
2.076 CFS	_	(	0.921 CFS	+	1.242 CFS	)	=	0.087 CFS

Staff left Wailuanui IIFS Site at approximately 1000 hours, and proceeded to take flow measurements at East Wailuanui tributary. Refer to Field Investigation Report FI2008121002 (East Maui, East Wailuanui Koolau Ditch) for more information.

 Image Listing: (Attach PDF of image contact sheet)

 File Name:
 Brief Description:

#### GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)									
File Name:	Brief Description:								
East_Maui_POI.shp	Points of interest (POI) recorde from all the East Maui field inve	d with the GPS unit during the field visit. stigations.	The file includes POI recorded						
Waypoints: (List all way	points in decimal degrees and provide	e a brief description of each)							
WP No Latitude	Longitude	Brief Description:							

<u>WP NO.</u>	Latitude	Longitude	Brief Description:
0	20.832394	-156.138458	IIFS Site Flow Measurement on Wailuanui Stream
4	20.833606	-156.13696	Parking area near IIFS Site on Wailuanui Stream

### Attachments:

Brief Description: 1. Discharge Measurement and Gage Inspection Notes

Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008121001 - Page 3 of 4

Meas. No.	
-----------	--

Comp.by _Clui

Checked by DOLL

Sta. NoWa	uan		s site			
Sta. Name	Waim	anni	<u>stream</u>	below	v tland	a Hiahwan bridae
Date 12/10	, ·	20 <u>0ର</u> ା	Party _[	Rein	Ezt. Ch	
Width 10.65	Are	a <u>9.49</u>	<u>33</u> v	el. <u>, 2</u>	2 G	H. 2.43 Disch. 2.076 CFS
Method <u>wa</u>	ading		No. secs	<u>40</u>	_ G. H. ch	ange $01$ in $5$ hrs
Method coef	ł	loriz. ang	gle coef		_ Susp	Tags checked
Meter Type		_ Meter N	lo		Me	terft. above bottom of wt
Rating used		·	Spin test	before n	neas	;after
Meas plots	··	% diff.	from rati	ng no		Indicated shift
· · · · · · · · · · · · · · · · · · ·	GA	GE REA	DINGS			Samples collected: water quality
Time				Inside	Outside	sediment, biological, other
						Measurements documented on
Start	LEW	@ .092	b			separate sheets: water quality,
	<u>GHT=</u>	5-2.5	<u>д — 7.</u> ь	8-		
	·	5-2.	<u> 57 = 2,4</u>	3	ļ	Pain gage serviced/celibrated
	-					
· · · · · · · · · · · · · · · · · · ·			ļ			Weather: Summy
Finish	PEDA	6.001	a			Air Temp20 °C at 0930
	6411:	5-2	$\frac{1}{1}$	rt#L		Water Temp 18 °C at 0949
Weighted MGH			<u> </u>	~~~~	20 1011	Check bar/chain found
GH correction	1	1	1	· · · · · · · · · · · · · · · · · · ·	VO MAL	Changed to at
CorrectMGH				· · · ·		
Wading, cable, id Measurement ra conditions: Flow Cross section:_	ce, boat, i ted excel :: Drdvoc	upstr., dø llent (2%) <u>ts lar</u> k <u>une</u>	winstr., si , good (5 <u>nimar</u> <u>ven</u>	de bridge %), fair (8 fair 14	9 60 3%), poor ( 	(>8%); based on following . flux
Gage operating:				P		20vod
Battery voltage:		Ini	take/Orifi	ce clean	ed/nuraed	
Bubble-gage pre	ssure, ps	si: Tank	· · · · · · · · · · · · · · · · · · ·	; Line		:Bubble-rate /min
Extreme-GH ind	icators n	nax		, min		······································
CSG checked	ł	-IWM hei	ght on sti	ck	Ref. e	elev HWM elev
HWM inside/outs	sid <b>e</b> :					
Control:						
Remarks:	ator le	vel lov	NCr th	an pi	CEVIDUS	duy
<u>Ollafaa</u>						
GH of zero flow =	GH		depth at c	ontrol _		= ft., rated

.0	.10	.2	0.3	0	.40	.5 Rive	0 rat-	.60		.70	FI20081210 . <b>75</b>	001 - Page 4
COEF-	DIST			VA- PTH		TIME	V	ELOCITY	ADJUST	•		
		L WID1	TH DEPT	DBSEF	REVO-	S SEC- ONDS	AT POIN	MEAN IN VER T TICAL	- ANGLE O	R AREA	DISCHARGE	.80
	LEN		0920	)		GHT	= 5	- 2.57	= 2.43			
				_			· ·					.85
	3.55	.07	5 0							0		-
	3.7	. 225	5 0.3	· · · · ·		40		. 05		. 068	.003	_
<del></del>	4.0	.40	0.68	3	· · · · ·	40		. 03		.272	.008	.90
	4.5	.50	0.97			40		0		.485	0	.92
	5.0	.50	1.02			40		0		.510	0	-
<u> </u>	5.5	.50	1.01			40		.04		. 505	.020	94
	6.0	-50	1.01			40	· ·	. 12	2,345	.505	. 061	.96 .042
	6.5	.50	1.08	, .		40		.13		.540	.070	.97
	7.0	.50	1.10		· .	40		.14		.550	.077	.98
	7.5	.50	1.19			40		.25	4.03	.595	.149	.99
	8.0	.50	1.10		·	40		:16		.550	.088	.476
	8.5	.50	0.98			40		,21	<u>5.0</u>	.490	. 103	.579
<u> </u>	9.0	,50	1.12			μo		.32		.560	.179 1	.00
	9.5	.50	1.09			40		,34	6.175	.545	. 185	,943
	10.0	.50	1.20	$\left  \right $		40		,27		.600	.162	1.105
<u></u>	10.5	.50	.90			40		.43	7.225	.450	. 194	99 1.290
	11.0	.50	.79			цð	<u></u>	.46		.395	.182	98 1.401
	11.5	.50	.60			40	· · ·	.37	7,92	.300	. 11(	97
 	12.0	·50	.67			40		.36	8.355	,335	. 121	515 1 96
	12.5.	.50	.63			40		.34	<u> </u>	.315	.107	1.92
· · ·	13.0	.50	.60			40		,35		.300	.105	94 1.925
	13.5		,70			40		.26	9.22	,350	.091	92 2.016
	14.0	.35	,75			40		.23		,263	.060	90
	14.2	,10	0							0		
								**************************************	10-7-7-1-4922	27.7.8 <b>8.9</b> 2.4.51872.48.488.4.688.4.68	and the state of the	
	10.65	10.65		·			ANE=	.22		9.403	2.076	35
	REW	(a)	0949			<u>GH1 =</u>	5-2	56 =	2,44		· · · · · · · · · · · · · · · · · · ·	
								· · · · · ·				
												SU: `
]												



# FIELD INVESTIGATION REPORT

FI2008121002 (East Maui, East Wailuanui Koolau Ditch)

Date of Field Investig	gation: December 10, 2008 Time (24-hour): 1030 - 1120							
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng							
Individuals Present:	Amanda Martin (President of Na Moku);							
	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry							
	Robello (Field Superintendent);							
	DOCARE officers							
Hydrologic Unit:	Wailuanui (6056)							
Stream Name:	East Wailuanui Tributary							

#### Findings:

At 1030 hours, CWRM staff arrived at the Koolau Ditch bypass sluice gate on East Wailuanui tributary. The purpose of this field visit was to document the adjustment of the sluice gate. Following the adoption of IIFS, EMI had expressed interest in lowering the sluice gate so that the ditch could capture high flows during high rainfall events. CWRM staff was present to ensure that the height of the sluice gate opening after adjustment would allow enough flow to pass through, and satisfy the IIFS at the selected site further downstream on Wailuanui Stream. In other words, no water from the stream is diverted unless the IIFS is met.

CWRM staff measured the dimensions of the sluice gate opening to be 3.0 x 2.0 feet (W x H). The depth of water at the sluice gate was 0.11 feet, which was 0.015 feet lower than the water depth recorded on Monday, Dec. 8, 2008 (refer to FI2008120801). Staff also measured the gap between each notch on the sluice gate adjustment structure to be 0.18 feet.

Staff took flow measurements about 15 feet downstream of the sluice gate. This site was selected on Monday, Dec. 8, 2008 (refer to FI2008120801). The site was not flagged because this location was not intended to be an IIFS site. Flow measurement was completed in 20 minutes. Staff also recorded air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow was 0.921 cubic feet per second (0.595 million gallons per day), with no gage height readings. The flow was 0.146 cubic feet per second (0.944 million gallons per day) lower than the discharge recorded on Monday, Dec. 8, 2008.

The recorded flow measurement is an estimate of the discharge in East Wailuanui tributary. Staff compared this flow with the discharge in West Wailuanui tributary (refer to FI2008121003) and that at the IIFS Site on Wailuanui Stream (refer to FI2008121001) to assess flow gains or losses in the stream reach between Koolau Ditch and the IIFS Site. This is discussed in Field Investigation Report FI2008121001 (East Maui, Wailuanui IIFS Site).

Based on Field Investigation Report FI2008121001, the discharge at the IIFS Site on Wailuanui Stream was 2.076 cubic feet per second (1.342 million gallons per day). Since the adopted IIFS of 3.05 cubic feet per second (1.97 million gallons per day) was not attained, no water from the stream can be diverted. However, the sluice gate can be lowered to a height that during average flow conditions, so that enough flow passes the sluice gate to satisfy the IIFS at the selected site further downstream on Wailuanui Stream. The height of the opening was estimated by 1) calculating the flow velocity at the sluice using the discharge measured 15 feet downstream from the sluice gate;

Flow at E. Wailuanui	÷	(	Depth of water	х	Width of sluice gate	)	=	Flow velocity
0.921 CFS	÷	(	0.11 feet	х	3 feet	)	=	2.79 feet / sec

and 2) calculating the discharge in E. Wailuanui using increments of the notch gap on the sluice gate adjustment structure.

Flow velocity	х	(	Height of sluice gate	х	Width of sluice gate	) =	Flow at E. Wailuanui
2.79 feet / sec	Х	(	0.18 feet	х	3 feet	) =	1.51 CFS
2.79 feet / sec	х	(	0.36 feet	х	3 feet	) =	3.01 CFS

As previously measured, each notch is 0.18 feet. If the sluice gate was opened to a height of 0.18 feet, only 1.51 cubic

feet per second of flow would pass the sluice gate. Not accounting for the possibility of flow gains below Koolau Ditch and head build-up behind the sluice gate during higher flows that may increase flow velocity, opening the sluice gate to a height of 0.36 feet (2 notches) was a more conservative approach.

The final height of the sluice gate opening after adjustment was 0.35 feet. CWRM staff fluorescent yellow flagging tape to mark the height of the sluice gate opening.

Staff left East Wailuanui tributary at approximately 1120 hours, and proceeded to West Wailuanui tributary. Refer to Field Investigation Report FI2008121003 (East Maui, West Wailuanui Koolau Ditch) for more information.

Image Listing: (Attach F	PDF of image contact sheet)
File Name:	Brief Description:
20081210001	Downstream side of the Koolau Ditch bypass sluice gate on East Wailuanui Stream.
20081210002	Downstream side of the Koolau Ditch bypass sluice gate on East Wailuanui Stream.
20081210003	East Wailuanui Stream downstream of the Koolau Ditch bypass sluice gate.
20081210005	Upstream side of the Koolau Ditch bypass sluice gate on East Wailuanui Stream.
20081210006	Ken Kawahara, Amanda Martin, Dexter Tom, and Mark Vaught at the Koolau Ditch bypass sluice gate on East Wailuanui Stream.
20081210008	EMI staff adjusting the Koolau Ditch bypass sluice gate on East Wailuanui Stream.
20081210011	CWRM staff measuring the height of the Koolau Ditch bypass sluice gate opening on East Wailuanui Stream.
20081210012	Upstream side of the Koolau Ditch bypass sluice gate on East Wailuanui Stream after gate adjustment.
20081210013	East Wailuanui Stream downstream of the Koolau Ditch bypass sluice gate after adjustment.
20081210014	Upstream side of the Koolau Ditch bypass sluice gate on East Wailuanui Stream after gate adjustment.
20081210016	Notches of the Koolau Ditch bypass sluice gate on East Wailuanui Stream.
20081210020	Notches of the Koolau Ditch bypass sluice gate on East Wailuanui Stream.

#### GPS Listing:

 Shapefiles: (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

 East_Maui_POI.shp
 Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
74	20.820689	-156.140675	Flow measurement site on East Wailuanui Stream below Koolau Ditch intake

# Attachments:

Brief Description: 1. Image Contact Sheet

Discharge Measurement and Gage Inspection Notes



20081210001.JPG



20081210002.JPG







20081210011.JPG



20081210014.JPG



20081210006.JPG



20081210012.JPG



20081210016.JPG



20081210008.JPG



20081210013.JPG



20081210020.JPG

Form 9-275F (Apr. 2001)

### U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

FI2008121002 - Page 4 of 5

gate.

Meas. No.	
Comp. by	chui

Checked by DDU

Sta. No.	<u> </u>	<u>Nai lua</u>	m				
Sta. Nar	me				(NI)	<u> </u>	
Date	12/10	,2	0 <u>00</u> P	artyD	ean, E	d, Ch	111
Width _	3.63	Area	1.91	<u>2</u> V	el. <u> </u>	<u>в                                    </u>	H Disch. <u>. 921 045</u>
Method	Wad	ling	N	lo. secs.	40	G, H. cha	nge in hrs.
Method	coef	H	oriz. ang	le coef	<u> </u>	Susp	Tags checked
Meter T	уре		Meter No	0		Mete	er ft. above bottom of wt.
Rating	used	·	\$	Spin test	before m	eas	; after
Meas.p	olots	. <u>.</u>	_ % diff. 1	from rati	ng no		Indicated shift
		GAC		DINGS	··········		Samples collected: water quality,
Time	7			Outside	sediment, biological, other		
						<u> </u>	Measurements documented on
	Start	I Ens)	6 10	144			separate sheets: water quality,
				<u> </u>		-	aux./basegage, other
		<u> </u>					
		1					Rain gage serviced/calibrated
							<u> </u>
			· · ·			· · · · · · · · · · · · · · · · · · ·	Weather: <u>30</u> °C at 10144
	Finish	REW	@ 110	5	~	20 mil	Air lemp. <u>20</u> Cal <u>1044</u>
							Water Temp C at
Weighte	ed MGH	ļ	·	<u> </u>			Check bar/chain found
GH cori	rection	ļ	<u> </u>			ļ	Changed to at
Correct	MGH		<u> </u>	<u> </u>		<u> </u>	
Wadin	g, cable, i	ce, boat,	upstr., da	wnstr.,	<u>s</u> ide bridg	e, <u>20</u>	(ft), mi. upstr., downstr. of gage.
Measu	rementra	ted exce	llent (2%	), good (	5%), fair (	8%), poor	(>8%); based on following .
conditi	ons: Flow	r. <u>fai</u>	r huj u li	nfirm	<u>I. lam</u>	inar	
Cross	section:_	coldare	s. dirt	, bed	Inck, 1	<u>tairty u</u>	wirter m
	<del></del>						
Gage	operating				F	Record Re	moved
Battery	y voltage:		lŗ	ntake/Or	rifice clear	ned/purge	:d:
Bubble	e-gage pro	essure, p	si: Tank		, Line		; Bubble-rate /min.
Extren	ne-GH inc	licators	max			in	·
CSGc	hecked:		HWMhe	eight on s	stick	Ref.	. elev HWM elev
HWM	inside/ou	tside:	<u> </u>			<u> </u>	
Contro	ol:	<u> </u>	<u> </u>		<u>.</u>		
Rema	rks:			· · · · · · · · · · · · · · · · · · ·			
GHof	zero flow	= GH		- depth a	at control		ft., rated
			_	•	c	heet No	of sheets
					3	neetho.	

.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI2008121	002 - Page 5 of
TEF-	DIST.	·		Ϋ́́.		TIME	VELC	CITY	ADJUST ED FOR			-
ANGLE CO FICIEN	FROM INITIAL POINT	WIDTH	DEPTH	OBSERV TION DEP	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80
	LEW	0	1044									_
												.85
	4.07	.015	0.							0		_
	4.10	,115	.47			40		. 35		.054	.019	_
	4.3	.2	. 51			40		.34		. 102	.035	.90 
	4.5	.2	.51			40		,49		.102	.050	.92
	4.7	.2	.49			40		.48		.098	.047	94
	4.9	.2	.52			<u>цо</u>		.54	<u>,46</u>	.104	.056	207
	5.1	.2	.53		ļ	40		.54		.106	.057	.96 
	5.3	.2	.54			4D		.40	.674	.108	.052	.97
-	5.5	.2	.54			40	· · · ·	151		.108	. 055	.90
	5.7	.2	.61			40		.55	્લાગ્ય	.122	.067	.99 438
	5.9	.2	.60			40		.54		. 12.D	.065	. 503
	6.1	.2	.60	ļ		40		. 59	(,144	.120	.071	_ 574
0	6.3	.2	,64	ļ		40	 	. 50		.128	.064	<b>1.00</b> 63&
	6.5	.2	.62	ļ	ļ	40	ļ	<u>, 446</u>	1.396	.124	.057	<del></del>
	6.7	.2	.54			40		. 48	1.504	.10%	,052	.747
	6.9	.2	.53		ļ	40	ļ	.52		. 106	.055	.99 002
. <u> </u>	7.1	,2	.61			40	<b> </b>	.43	1.732	. 122	.052	<b>98</b> . 054
	7.3	.2	,52			40		.47	1.836	.104	.049	97 ^{.903}
•	7.5	.15	. 32			40		. 25	1.984	.040	.012	96 _{,915}
	7.6	. 1	.28			40	<u> </u>	,20	. (912	.028	.006	.921 94
	7.7	.05	0					< Provide and the state of the	arte presidente proventee (44)4		angan anganggatinggating an ing pag-ang a s	
									· · · ·	· · · · ·		.92
	3.63	3.63					Aves	.48		1.912	. 0.921	.90
	REN	@	1105	-				<u> </u>				
<u> </u>										· · · · · · · · · · · · · · · · · · ·		
	-	<u> </u>			<u> </u> .	+		<u> </u>		<b> </b>		.85
. <u></u>		<u> </u>		<u>_</u>		<u> </u>				<b> </b>		<u> </u>
						<u> </u>		<u> </u>				.80
		<u> </u>						ļ				
							<u> </u>			<u> </u>		_



# FIELD INVESTIGATION REPORT

FI2008121003 (East Maui, West Wailuanui Koolau Ditch)

Date of Field Investig	pation: December 10, 2008 Time (24-hour): 1220 - 1340					
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng					
Individuals Present:	Amanda Martin (President of Na Moku);					
	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry					
	Robello (Field Superintendent);					
	DOCARE officers					
Hydrologic Unit:	Wailuanui (6056)					
Stream Name:	West Wailuanui Tributary					

#### Findings:

At 1220 hours, CWRM staff arrived at the Koolau Ditch bypass sluice gate on West Wailuanui tributary. The purpose of this field visit was to document the adjustment of the sluice gate. Following the adoption of IIFS, EMI had expressed interests in lowering the sluice gate so that the ditch could capture high flows during high rainfall events. CWRM staff was present to ensure that the height of the sluice gate opening after adjustment would allow enough flow to pass through, and satisfy the IIFS at the selected site further downstream on Wailuanui Stream. In other words, no water from the stream is diverted until the IIFS is met.

CWRM staff measured the dimensions of the sluice gate opening to be 2.8 x 3.0 feet (W x H). The depth of water at the sluice gate on the left bank was 0.31 feet and at the right bank was 0.17 feet. The average water depth was 0.24 feet, which was 0.06 feet lower than the water depth recorded on Monday, Dec. 8, 2008 (refer to FI2008120802). Staff also measured the gap between each notch on the sluice gate adjustment structure to be 0.18 feet.

Staff took flow measurements about 2 feet upstream of the sluice gate. This site was selected on Monday, Dec. 8, 2008 (refer to FI2008120802). The site was not flagged because this location was not intended to be an IIFS site. Flow measurement was completed in 30 minutes. Staff also recorded air temperature, water temperature and weather conditions. As computed back in the Honolulu Office, the flow was 1.242 cubic feet per second (0.803 million gallons per day), with no gage height readings. The flow was 0.007 cubic feet per second (0.005 million gallons per day) lower than the discharge recorded on Monday, Dec. 8, 2008.

The recorded flow measurement is an estimate of the discharge in West Wailuanui tributary. Staff compared this flow with the discharge in East Wailuanui tributary (refer to FI2008121002) and flow at the IIFS Site on Wailuanui Stream (refer to FI2008121001) to assess flow gains or losses in the stream reach between Koolau Ditch and the IIFS Site. This is discussed in Field Investigation Report FI2008121001 (East Maui, Wailuanui IIFS Site).

Based on Field Investigation Report FI2008121001, the discharge at the IIFS Site on Wailuanui Stream was 2.076 cubic feet per second (1.342 million gallons per day). Since the adopted IIFS of 3.05 cubic feet per second (1.97 million gallons per day) was not attained, no water from the stream can be diverted. However, the sluice gate can be lowered to a height that during average flow conditions, so that enough flow passes the sluice gate to satisfy the IIFS at the selected site further downstream on Wailuanui Stream. The height of the opening was estimated by 1) calculating the flow velocity at the sluice using the discharge measured 2 feet upstream from the sluice gate;

Flow at W. Wailuanui	÷	(	Depth of water	х	Width of sluice gate	)	=	Flow velocity
1.242 CFS	÷	(	0.24 feet	х	2.8 feet	)	=	1.85 feet / sec

and 2) calculating the discharge in E. Wailuanui using increments of the notch gap on the sluice gate adjustment structure.

Flow velocity	х	(	Height of sluice gate	х	Width of sluice gate	)	=	Flow at W. Wailuanui
1.85 feet / sec	Х	(	0.18 feet	х	2.8 feet	)	=	0.93 CFS
1.85 feet / sec	х	(	0.36 feet	х	2.8 feet	)	=	1.86 CFS

As previously measured, each notch is 0.18 feet. If the sluice gate was opened to a height of 0.18 feet, only 0.93 cubic

feet per second of flow would pass the sluice gate. Not accounting for the possibility of flow gains below Koolau Ditch and head build-up behind the sluice gate during higher flows that may increase flow velocity, opening the sluice gate to a height of 0.36 feet (2 notches) was a more conservative approach.

The final height of the sluice gate opening after adjustment was 0.35 feet. CWRM staff used fluorescent yellow flagging tape to mark the height of the sluice gate opening.

Staff left East Wailuanui tributary at approximately 1340 hours, and proceeded to locate Kaleiomaui Stream from the service road. Refer to Field Investigation Report FI2008121004 (East Maui, Kaleiomaui) for more information.

Image Listing: (Attach	PDF of image contact sheet)
File Name:	Brief Description:
20081210022	CWRM staff conducting flow measurement at the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210024	CWRM staff conducting flow measurement at the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210025	CWRM staff conducting flow measurement at the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210026	Koolau Ditch bypass sluice gate on West Wailuanui Stream before gate adjustment.
20081210029	Koolau Ditch bypass sluice gate on West Wailuanui Stream before gate adjustment.
20081210030	EMI staff adjusting the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210033	CWRM staff measuring the height of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after the adjustment.
20081210034	CWRM staff measuring the height of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after the adjustment.
20081210039	Notches of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after adjustment.
20081210040	Notches of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after adjustment.
20081210041	Notches of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after adjustment.
20081210046	Dean Uyeno, Dexter Tom, Amanda Martin, Ken Kawahara, and Garret Hew at the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210048	Amanda Martin, Ken Kawahara, and Garret Hew at the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210051	CWRM staff flagging the height of the Koolau Ditch bypass sluice gate opening after adjustment.
20081210052	Notches of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after adjustment.
20081210053	Notches of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after adjustment.
20081210054	Amanda Martin, Ken Kawahara, and Garret Hew at the Koolau Ditch bypass sluice gate on West Wailuanui Stream.
20081210055	Notches of the Koolau Ditch bypass sluice gate on West Wailuanui Stream after adjustment.
20081210057	Koolau Ditch (#8) minor diversion intake on Wailuanui Stream.
20081210059	Koolau Ditch (#7) diversion intake on Wailuanui Stream.

#### GPS Listing:

**Shapefiles:** (List file names of all shapefiles created and a brief description of each)

File Name:	Brief Description:
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded
	from all the East Maui field investigations.

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:

#### Attachments:

Brief Description:

- 1. Image Contact Sheet
- 2. Discharge Measurement and Gage Inspection Notes







20081210022.JPG



20081210026.JPG



20081210033.JPG



20081210040.JPG

20081210024.JPG



20081210029.JPG



20081210034.JPG



20081210041.JPG

20081210025.JPG



20081210030.JPG



20081210039.JPG



20081210046.JPG



20081210048.JPG



20081210051.JPG



20081210052.JPG



20081210053.JPG



20081210054.JPG



20081210055.JPG



20081210057.JPG



20081210059.JPG

Form 9-275F (Apr. 2001)

### U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION

DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES FI2008121003 - Page 5 of 6

Meas.	No.	

Comp. by ______

Checked by DPN_

Sta. Name	of wt.
Date       121 10       , 20 00       Party       Deanty       Chun       Ed.         Width       3.55       Area       1.141       Vel.       1.09       G.H.       Disch.       1.242         Method       Wading       No. secs.       40       G.H. change       in	lity,
Width 3.55       Area 1.141       Vel. 1.04       G. H Disch. 1.242         Method Wadima       No. secs. 40       G. H. change in         Method coef Horiz. angle coef Susp Tags checked       Meter Type Meter No Meter ft. above bottom         Rating used Spin test before meas; after       Indicated shift         Meas. plots % diff. from rating no Indicated shift       Samples collected: water qua sediment, biological, other         Time Inside No. secs       Measurements documented separate sheets: water qua aux./base gage, other         Start       LEW @ 1250          Rain gage serviced/calibrated weather:       Submy	lity,
Method Wadwa	lity,
Method coef       Horiz. angle coef       Susp       Tags checked         Meter Type       Meter No       Meter       ft. above bottom         Rating used       Spin test before meas       ; after         Meas. plots       % diff. from rating no       Indicated shift         GAGE READINGS       Samples collected: water qua sediment, biological, other         Time       Inside Outside       Sediment, biological, other         Start       LEw @ 125D       Measurements documented separate sheets: water qua aux./base gage, other         Rain gage serviced/calibrated       Weather:	lity,
Meter Type Meter No Meter ft. above bottom         Rating used Spin test before meas; after         Meas. plots % diff. from rating no Indicated shift         GAGE READINGS       Samples collected: water qual sediment, biological, other         Time Inside       Measurements documented separate sheets: water qual sediment, biological, other         Start       LEW @ 1250       Measurements documented separate sheets: water qual aux./base gage, other         Rain gage serviced/calibrated       Weather:	lity, on ility,
Rating used	lity, on Ility,
Meas. plots       % diff. from rating no.       Indicated shift         GAGE READINGS       Samples collected: water qua sediment, biological, other         Time       Inside       Outside         Start       LEW @ 1250       Measurements documented separate sheets: water qua aux./base gage, other         Start       LEW @ 1250       Rain gage serviced/calibrated         Weather:       SUMMy	lity, on Ility,
GAGE READINGS       Samples collected: water qua sediment, biological, other         Time       Inside       Outside       sediment, biological, other         Start       LEW @ 1250       Measurements documented separate sheets: water qua aux./base gage, other         Rain gage serviced/calibrated       Weather:       Subring	lity, on Ility,
Time       Inside       Outside       sediment, biological, other         Start       LEW @ 1250       Measurements documented separate sheets: water qua aux./base gage, other         Rain gage serviced/calibrated       Weather:	on Ility,
Start       LEW @ 1250         Measurements documented separate sheets: water qua aux./base gage, other         Rain gage serviced/calibrated         Weather:       Stuhny	on ility, 
Start       LEW @ 1250       Measurements documented separate sheets: water qua aux./base gage, other	on ality, 
Start     LEW @ 1250     separate sheets: water qua aux./base gage, other	ality, 
Rain gage serviced/calibrated	
Rain gage serviced/calibrated	
Weather: <u>Suhny</u>	' <u> </u>
Weather:	
Finish ar Alugar Air Temp 23 °C at 130	02
$\frac{1}{1000} \frac{1}{1000} \frac{1}{1000} \frac{1}{1000} \frac{1}{1000} \frac{1}{10000} \frac{1}{10000000000000000000000000000000000$	15
Weighted MGH	<u></u>
GH correction	
Correct MGH	<u> </u>
Nading, cable, ice, boat, upst)., downstr., side bridge, <u>1.5</u> (ft), mi. upstr., downstr. of g Neasurement rated excellent (2%), good (5%), fair (8%), poor (> 8%); based on following, conditions: Flow: <u>laminar in center, angled flow on sides</u> . Cross section: <u>dirt, cobblet, pebbles, bedrate</u> .	<u>s</u> ιμι jage.
Gage operating: Record Removed	
Battery voltage: Intake/Orifice cleaned/purged:	
Bubble-gage pressure, psi: Tank, Line; Bubble-rate,	/min.
Extreme-GH indicators: max, min, min	
CSG checked: HWM height on stick Ref. elev HWM elev	·
HWM inside/outside:	
Control:	<u> </u>
Remarks:	
GH of zero flow = GH depth at control = ft., rated	
Sheet No of st	heets

.0	.10	.20	.30		.40	.5 River	0 'at-	.60	· · · ·	.70	FI20081210 . <b>75</b>	03 - Page 6
UEF.	DIST.			Ϋ́Ē		TIME	VE	OCITY	ADJUST-			-
ANGLE C	FROM INITIAL POINT	WIDTH	DEPTH	OBSER TION DEI	REVO-	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80
	LEW	0	1250									
												.85
	4.05	.075	0							.0.		_
	3.9	.125	.32			40		. 29		, 040	.012	-
	3.8	.10	. 36			LIO		.23		.03%	.009	.90
	3.7	. 10	.39			40		.35		.030	.013	.92
	3.6	.10	.37			40		. 47	.153	.037	.017	-
	3.5	.10	.39			40		.44		.038	.017	- <b>.94</b> . 069
	3.4	.10	.33			40		.64	,224	.033	. 021	.96 .0%1
	3:3	.10	.36			40		.70		.036	. 025	.97
	3.2	.10	.34			40		66	,294	.034	. 022	.98 136
	3.1	.15	.34			40		.73	·	.051	.037	.99
	2.9	.20	,32			40		.81		,064	,052	
	2.7	,20	.30			40				,060	,052	
0	2.5	.20	.32			40		1.07		.064	.068 1	.00
	2.3	.20	.31			40		1.08	,595	.062	.067	. 412
	2.1	,20	.32			40		1.14		.064	.073	
<b>.</b>	1.9	.20	.32			40		1.28		.064	. 092	.99
	1.7	.20	.34			40		1,23		.068	.084	.98
	1.5	.15	.35			40		1.40		.053	, 074	.97
	1.4	.10	, 33			40		1.47		.033	. 049	.96
	1.3	.10	.32			40		1.61	.909	,032	.052	
	1.2	.10	.32			Чð		1.55		.032	.050	<b>.94</b> . ,
· · · · · · · · · · · · · · · · · · ·	1.1	.10	.32			40		1.90		.032	.058	.92
	1.0	<u>۱</u> ۵,	.32			40		1.85	1.005	,032	.059	<b>90</b> , 993
	0.9	.10	.33			40	 	1.86	1.0.36	.033	.061	1.054
	0.8	.10	.30			40		2.10	1.068	.03D	.063	1.117
	0.7	.10	.30			40		2.14		.030	.064	.85
	0.6	.10	.28			40		2.18		.029	.061	
	0.5	.05	. 29	-nicionerni as	المراجع والمراجع المراجع				Carlo and service and	. 015	0	·
	3.55	3.55					AVE=	1.09		1.141	1.242	.¥Û ,
	REW	(a)	1323									



# FIELD INVESTIGATION REPORT

FI2008121004 (East Maui, Kaleiomaui)

Date of Field Investig	<b>Jation:</b> December 10, 2008 <b>Time</b> (24-hour): 1550 - 1615
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry
	Robello (Field Superintendent);
	DOCARE officers
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Kaleiomaui Stream

#### Findings:

The purpose of this field visit was to locate Kaleiomaui Stream near Koolau Ditch. During a previous field visit on Nov. 17, 2008, CWRM staff saw a tributary of Palauhulu Stream that crosses a bridge at the service road (Piinaau Road). At the time, the tributary was dry. Back in the Honolulu Office, CWRM staff found that the tributary could possibly be Kaleiomaui Stream. In this visit, staff wanted to examine this tributary stream, and verify that the stream is not diverted at Koolau Ditch.

At 1550, CWRM staff, EMI staff, and DOCARE officers arrived at the Koolau Ditch bypass gate, where the ditch daylights into open ditch. The water temperature at the gate was 20°C. While CWRM staff were inspecting the open ditch and the bypass gate, EMI staff Henry Robello hiked further east. When he returned, he reported the presence of a dry streambed and a large pond approximately 300 feet from the bypass gate. CWRM staff hiked to the location of the dry streambed. Based on the location of Koolau Ditch and the coordinates of Kaleiomaui Stream taken from the bridge on the service road (refer to FI2008111702), the dry streambed is Kaleiomaui Stream. The stream continues to be dry upstream from Koolau Ditch (tunnel). Immediately downstream from the ditch, water drops into a large pond and continues to seep downstream. The downstream streambed was relatively dry.

Staff left Kaleiomaui Stream at 1620 hours, and continued to document Koolau Ditch diversion intakes on Piinaau Stream. Refer to Field Investigation Report FI2008121005 (East Maui, Piinaau Koolau Ditch) for more information.

Image Listing: (Attach PDF of image contact sheet)				
File Name:	Brief Description:			
20081210062	Koolau Ditch daylights into open ditch near Kaleiomaui Stream.			
20081210063	Koolau Ditch daylights into open ditch near Kaleiomaui Stream.			
20081210064	Downstream from the Koolau Ditch bypass gate where the ditch daylights into open ditch near Kaleiomaui			
	Stream.			
20081210065	Koolau Ditch bypass gate where the ditch daylights into open ditch near Kaleiomaui Stream.			
20081210066	Koolau Ditch bypass gate where the ditch daylights into open ditch near Kaleiomaui Stream.			
20081210069	Koolau Ditch daylights into open ditch near Kaleiomaui Stream.			
20081210070	Koolau Ditch daylights into open ditch near Kaleiomaui Stream.			
20081210071	Large pond in Kaleiomaui Stream downstream from Koolau Ditch.			
20081210073	Large pond in Kaleiomaui Stream downstream from Koolau Ditch.			
20081210075	Large pond in Kaleiomaui Stream downstream from Koolau Ditch.			

#### GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)				
File Name:	<b>Brief Description:</b>			
East_Maui_POI.shp	Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations.			

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude
55	20.825877	-156.165388
60	20.8248	-156.168997
61	20.824275	-156.168629

**Brief Description:** Fork at Piinaau Road Koolau Ditch daylights, bypass gate on right bank of ditch Kaleiomaui Stream

### Attachments:

Brief Description: 1. Image Contact Sheet



20081210062.JPG



20081210063.JPG



20081210064.JPG



20081210065.JPG



20081210066.JPG



20081210069.JPG



20081210070.JPG



20081210075.JPG



20081210071.JPG



20081210073.JPG



# FIELD INVESTIGATION REPORT

FI2008121005 (East Maui, Piinaau Koolau Ditch)

Date of Field Investig	<b>Jation:</b> December 10, 2008 <b>Time</b> (24-hour): 1630 - 1700
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew (Water Resources Manager), Mark Vaught (Operations Manager), Henry
	Robello (Field Superintendent);
	DOCARE - 3 officers
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Piinaau Stream

#### Findings:

The purpose of this field visit was to document the Koolau Ditch major and minor diversion intakes on Piinaau Stream. At 1630, CWRM staff, EMI staff, and DOCARE officers arrived at bridge where Piinaau Stream crosses the service road. Approximately a 0.25 miles further west on the service road, the landslide that occurred in 2003 covered the road and a relatively long stretch of Piinaau Stream.

Downstream from Koolau Ditch, Piinaau Stream was dry. Upstream from the ditch, the stream was relatively dry with ponded water. Remnants of an old bridge still exist in the middle of the stream about 100 feet upstream of the ditch. Staff hiked up the left bank of the stream and passed the outfall of a minor diversion (K-31a) that transports water around a losing reach of the stream. The minor diversion is a 6-inch steel and PVC pipe that begins further upstream, diverts water around a losing reach, and drops the water back in the stream near Koolau Ditch. From the minor diversion intake, staff hiked 100 feet downstream in the losing reach where the stream drops into a pond. Garret Hew suspects that the pond could possibly be a sink hole.

The major diversion intake (K-31) is directly below the bridge where Piinaau Stream crosses the service road. The intake is concrete with a metal grate. When the stream is full, water is ponded in front of the grate. When the level of the water reaches a specific height, the water will spill into the ditch through the metal grate.

Staff left concluded the field visit at 1700 hours.

Image Listing: (Attach PDF of image contact sheet)				
File Name:	Brief Description:			
20081210079	The 2003 landslide that covered the service road (Piinaau Road) and a section of Piinaau Stream in the			
	valley.			
20081210080	Keanae valley below Koolau Ditch.			
20081210081	Section of Piinaau Stream covered by the 2003 landslide.			
20081210082	Piinaau Stream upstream from Koolau Ditch.			
20081210084	Outfall of minor diversion (K-31a) that transports water around the losing reach, from upstream reaches to			
	Piinaau Stream immediately upstream of the ditch.			
20081210085	Piinaau Stream upstream of minor diversion (K-31a).			
20081210086	Minor diversion (K-31a) on Piinaau Stream. Six inch steel and PVC pipe diversion to main Piinaau Stream			
	intake.			
20081210088	Piinaau Stream (losing reach) downstream of minor diversion (K-31a).			
20081210090	Piinaau Stream (losing reach) downstream of minor diversion (K-31a).			
20081210091	Possibly a sink hole on Piinaau Stream, downstream of minor diversion (K-31a).			
20081210092	Minor diversion (K-31a) on Piinaau Stream. Six inch steel and PVC pipe diversion to main Piinaau Stream			
	intake.			
20081210093	Koolau Ditch intake structure on the right bank of Piinaau Stream.			
20081210095	Section of Piinaau Stream covered by the 2003 landslide.			

#### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each) **<u>Brief Description:</u>** Points of interest (POI) recorded with the GPS unit during the field visit. The file includes POI recorded from all the East Maui field investigations. File Name: East_Maui_POI.shp

#### Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
75	20.828528	-156.174357	EMI Diversion Intake K-31 on Piinaau Stream
76	20.827211	-156.17516	EMI Diversion Intake K-31a on Piinaau Stream
82	20.828305	-156.174906	Outflow from Intake K-31a to Piinaau Stream

#### Attachments:

Brief Description: 1. Image Contact Sheet



20081210079.JPG

20081210080.JPG



20081210082.JPG



20081210084.JPG

20081210081.JPG



20081210085.JPG



20081210086.JPG



20081210088.JPG



20081210091.JPG



20081210092.JPG



20081210090.JPG



20081210093.JPG



20081210095.JPG



# FIELD INVESTIGATION REPORT

FI2009020901 (East Maui, Wailua Valley Taro)

Date of Field Investig	gation: February 9, 2009 Time (24-hour): 1000 - 1730
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Alan Murakami, Ed Wendt, Amanda Martin, Kimo Day, Steven Hookano
Hydrologic Unit:	Wailuanui (6056)
Stream Name:	
Findings:	

CWRM staff departed Oahu for Maui at 0600 hours.

The purpose of this field visit was to get a better understanding of the taro patches in Wailua Valley, with main focus on water flow from the sources and through the taro patches before water returns to the stream. CWRM staff had previously digitized the Wailua Valley taro patches from available aerial imagery. Maps were prepared to help staff collect additional data in the field, which included 1) water flow from the upper, lower, and middle ditches to the taro patches; 2) flow through the patches in the valley; 3) auwai system and location in relation to the patches; 4) locations of return flow from the auwai to the stream; and 5) operator of the general area where taro was cultivated at the time of the field visit.

At 1000, CWRM staff met with Alan Murakami, Ed Wendt, Amanda Martin, Steven Hookano and Kimo Day in Wailua Valley. Staff began data collection at the southwestern end of the valley, where most of the patches were fed by Wailuanui Stream (intake at Wakani Falls / Pond). A majority of the patches were operated by Kimo Day (upper patches) and Bush Martin (lower patches). From the auwai, Kimo Day led Alan Murakami and staff to the intake at Wakani Pond. On the way to the intake, water level in the auwai was less than one foot. At Wakani Pond, Alan Murakami inspected the intake and pulled out rocks, debris and a large log that were clogging the intake. Hiking back from Wakani Pond, water level in the auwai was about 2 feet. This event clearly illustrated the importance of auwai and intake maintenance in optimizing water flow to the taro patches.

The taro patches to the north were fed by water from Waiokamilo/Kualani Streams (flowing through Lakini). Staff hiked about 400 meters northwest along the lower ditch until reaching a location where the entire Wailua Valley could be viewed. Steven Hookano explained the overlay of the valley, who maintained each general area where taro was cultivated at the time. The middle ditch could be seen to run across the center of the valley. It mainly feeds taro patches belonging to the Nakanelua and Young (Steven Hookano's uncle) families. The upper patches in the center of the valley were overgrown with grass whereas most of the lower patches were cultivated at the time of the visit. Hiking back along the lower ditch, the farmers explained that pumpkin (instead of taro) was planted along the lower ditch due to the lack of water.

After lunch at approximately 1400, Steven Hookano led staff to the center of the valley. Staff collected information on water flow, primary patch operators, and whether the patches were in cultivation. The same survey was done to the lower patches in the center of the valley where a majority of the patches were maintained by Steven Hookano.

Staff concluded the field investigation at 1730 hours.

Image Listing: (Attach PDF of image contact sheet)				
File Name:	Brief Description:			
20090209001	Wailua Valley taro patches fed by Waikani Falls / Pond.			
20090209002	Wailua Valley taro patches fed by Lakini.			
20090209008	Auwai dividing the patches that are fed by Waikani Falls / Pond (left) and those fed by Lakini (right).			
20090209012	Lower patches fed by Lakini.			
20090209016	Pipe outflow from taro patch to auwai.			
20090209024	Taro patches belonging to Kimo Day. These patches were fed by Waikani Falls / Pond.			
20090209026	Taro patches belonging to Kimo Day. These patches were fed by Waikani Falls / Pond.			
20090209031	Taro patches belonging to Kimo Day, and a 6-inch pipe that took water from Waikani Falls / Pond to the			
	taro patches.			
20090209032	General area fed by Waikani Falls / Pond.			

20090209033	General area fed by Lakini.
20090209035	A 6-inch pipe with water from Waikani Falls / Pond to the taro patches.
20090209048	Intake pipe (6-inch) at the beginning of the auwai taking water from Waikani Falls / Pond.
20090209049	Where water from Waikani Falls / Pond splits into two pipes.
20090209051	Where water from Waikani Falls / Pond outflows into the auwai.
20090209057	Waikani Falls.
20090209058	Wailuanui Stream downstream of Waikani Falls.
20090209065	Alan Murakami clearing the intake at Waikani Pond.
20090209069	Where water from Waikani Falls / Pond outflows into the auwai after clearing of the intake at Waikani
	Pond.
20090209070	Location where water from Waikani Falls / Pond outflows into the auwai after clearing of the intake at
	Waikani Pond.
20090209077	Where water from Waikani Falls / Pond outflows into the auwai after clearing of the intake at Waikani
	Pond.
20090209080	Auwai full with water from Waikani Falls / Pond after clearing of the intake at Waikani Pond.
20090209100	Lower ditch in Wailua Valley.
20090209114	Pumpkin patch along the lower ditch in Wailua Valley.
20090209118	Overlooking the center of Wailua Valley at the lower ditch.
20090209120	Taro patches belonging to Nakanelua and Young families. These patches were fed by the middle ditch.
20090209134	Middle ditch in Wailua Valley.
20090209139	Young's family taro patches in the center of Wailua Valley.
20090209148	Steven Hookano's taro patches in Wailua Valley.
20090209149	Middle ditch in Wailua Valley.

## GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each)				
File Name:	Brief Description:			
FI20090209wp.shp	Waypoints recorded with the GPS unit during the field visit.			

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
027	20.835936	-156.13598	Waikani Pond: Outflow of 8-inch cast-iron pipe to unlined auwai
028	20.836238	-156.135933	Waikani Pond: Waste gate on auwai
029	20.837203	-156.135644	Auwai from Waikani Pond: Water flows into two10-inch PVC pipes
030	20.837478	-156.13579	Auwai from Waikani Pond: Water outflow from two 10-inch PVC pipes
031	20.838253	-156.135995	Auwai from Waikani Pond: Culvert, auwai flows across in concrete flume
032	20.83852	-156.136169	Auwai from Waikani Pond: Culvert, auwai flows across in concrete flume
033	20.838857	-156.136381	Auwai from Waikani Pond: Culvert, auwai flows across in 6-inch PVC
			pipe
035	20.839259	-156.136662	Wailua Valley taro patches: Y-Junction on 6-incch PVC pipe

#### Attachments:

Brief Description: 1. Image Contact Sheet



20090209001.jpg

20090209002.jpg



20090209008.jpg





20090209012.jpg

20090209016.jpg

20090209024.jpg







20090209026.jpg



20090209033.jpg

20090209031.jpg



20090209035.jpg

20090209032.jpg



20090209048.jpg



20090209049.jpg



20090209051.jpg



20090209057.jpg



20090209058.jpg



20090209070.jpg



20090209065.jpg



20090209077.jpg



20090209069.jpg



20090209080.jpg



20090209100.jpg





20090209114.jpg





20090209120.jpg



20090209134.jpg



20090209139.jpg



20090209148.jpg



20090209149.jpg



# FIELD INVESTIGATION REPORT

FI2009021001 (East Maui, Waiokamilo Terminal Waterfall)

Date of Field Investigation: February 10, 2009 Time (24-hour): 0930 - 1100				
CWRM Staff:	Ed Sakoda, Dean Uyeno, Ronnie Torres, and Chui Ling Cheng			
Individuals Present:	Elaine Wender, Ed Wendt, Amanda Martin, Steven Hookano			
Hydrologic Unit:	Waiokamilo (6055)			
Stream Name:	Waiokamilo Stream			
<b>Findings:</b> The purpose of this field visit was to view the terminal waterfall at Waiokamilo Stream. At 0930, Ed Wendt, Amanda Martin, Steven Hookano, and CWRM staff met with Elaine Wender. From her residence, staff hiked downstream along Waiokamilo Stream towards the top of the terminal waterfall. Elaine Wender showed staff three spring-fed ponds in the				
Stream above the waterrall. Staff then hiked across the stream to the northwest side of the cliff, and looked down at the terminal waterfall. The waterfall was relatively dry. Water was seen seeping out at four locations near the bottom of the cliff. While driving out from Elaine Wender's property, Elaine showed staff the trailhead to a losing section (pond) on Waiokamilo Stream. A future investigation may be conducted here, so a GPS waypoint was recorded. Staff left Waiokamilo Stream at 1100 hours, and continued to map out the taro patches in Wailua Valley. Refer to Field				
Image Listing: (Attach File Name: 2009021002 2009021003 2009021007 2009021008 2009021018 2009021020 2009021028	PDF of image contact sheet) <u>Brief Description:</u> Spring-fed pond approximately 80 feet upstream of the terminal waterfall at Waiokamilo Stream. Spring-fed pond approximately 50 feet upstream of the terminal waterfall at Waiokamilo Stream. Spring-fed pond approximately 5 feet upstream of the terminal waterfall at Waiokamilo Stream. Waiokamilo Stream upstream from the terminal waterfall. Terminal waterfall and seepage at Waiokamilo Stream. Terminal waterfall at Waiokamilo Stream. Seepage at four locations neart he bottom of the cliff at Waiokamilo Stream.			
GPS Listing:				
Shapefiles: (List file names of all shapefiles created and a brief description of each)         File Name:       Brief Description:         Fl20090209wp.shp       Waypoints recorded with the GPS unit during the field visit.				
Waypoints:         (List all way) <u>WP No.</u> Latitude           045         20.84881	points in decimal degrees and provide a brief description of each) <u>Longitude</u> -156.131054 Brief Description: Trailhead to losing pond on Waiokamilo Stream.			
Attachments: <u>Brief Description:</u> 1. Image Contact Sheet				
Recommendations:				



20090210002.jpg



20090210003.jpg



20090210007.jpg



20090210008.jpg



20090210018.jpg



20090210020.jpg



20090210028.jpg



# FIELD INVESTIGATION REPORT

FI2009021002 (East Maui, Wailua Valley Taro)

Date of Field Invest	igation: February 10, 2009	Time (24-hour): 1115 - 1200			
CWRM Staff: Ed Sakoda, Dean Uyeno, Ronnie Torres, and Chui Ling Cheng					
Individuals Present	ndividuals Present: Ed Wendt, Amanda Martin, and Steven Hookano				
Hydrologic Unit:	Wailuanui (6056)				
Stream Name:					
Findings:					
The purpose of this field visit was to get a better understanding of the taro patches in Wailua Valley, with main focus on water flow from the sources and through the taro patches before water returns to the stream. CWRM staff had previously digitized the Wailua Valley taro patches from available aerial imagery. Maps were prepared to help staff collect additional data in the field, which included 1) water flow from the upper, lower, and middle ditches to the taro patches; 2) flow through the patches in the valley; 3) auwai system and location in relation to the patches; 4) locations of return flow from the auwai to the stream; and 5) operator of the general area where taro was cultivated at the time of the field visit.					
On the previous day (Feb. 9, 2009), CWRM staff collected field data from taro patches in the sourthwestern end and the center of the valley. During this field visit, staff was to collect field data for the taro patches in the northern end of the valley. The patches there were operated by the Sinenci and Kaauamo families. Most of the patches were not in cultivation, and those in cultivation were fed by a second outflow of Lakini.					
Staff left Wailua Valley at 1200 hours, and continued to Waiokamilo Stream. Refer to Field Investigation Report FI2009021003 (East Maui, Waiokamilo Stream) for more information.					
Image Listing: (Attac	h PDF of image contact sheet)				
File Name:	Brief Description:				
20090210039	Outflow from Lakini to the taro pa	tches in the Northern end of Wallua Valley.			
20090210040	Outflow from Lakini to the taro pa	tches in the Northern end of Wailua Valley.			
20090210042	Outflow from Lakini to the taro pa	tches in the Northern end of Wallua Valley.			
20090210043	90210043 Taro patches in the Northern end of Wailua Valley.				
20090210044	Taro patches in the Northern end	of Wailua Valley.			
20090210045 Taro patches in the Northern end of Wailua Valley.					
20090210046	0090210046 Taro patches in the Northern end of Wailua Valley.				
20090210047	Taro patches in the Northern end	of Wailua Valley.			
GPS Listing:					
Shapefiles: (List file na	ames of all shapefiles created and a brief	description of each)			
File Name:	Brief Description:				
FI20090209wp.shp Waypoints recorded with the GPS unit during the field visit.					
	appoints in decimal degrees and provide a	Brief Description of each)			
046 20 845776	-156 135841	Auwai divergence			
047 20.845706	-156.135991	Inflow to upper auwai			
049 20.845111	-156.136846	Inflow from auwai; inflow of water from Lakini.			

### Attachments:

- Brief Description: 1. Image Contact Sheet


20090210039.jpg



20090210040.jpg



20090210041.jpg



20090210042.jpg



20090210043.jpg



20090210044.jpg



20090210045.jpg





20090210046.jpg



# FIELD INVESTIGATION REPORT

FI2009021003 (East Maui, Waiokamilo Stream)

Date of Field Investig	jation: February 10, 2009	Time (24-hour): 1230 - 1330			
CWRM Staff:	Ed Sakoda, Dean Uyeno, Ron	nie Torres, and Chui Ling Cheng			
Individuals Present:					
Hydrologic Unit:	Waiokamilo (6055)				
Stream Name:	Waiokamilo Stream				
Findings:					
Findings: The purpose of this field visit was to determine if and where Kualani Stream joins with Waiokamilo Stream upstream from Hana Highway. At approximately 1230, CWRM staff hiked upstream on Waiokamilo Stream from Hana Highway for about 360 feet to the diversion dam. The stream splits into two branches 60 feet upstream from the diversion dam. The dam is a low concrete structure approximately 7.0 feet long that directs the most of the water into the Kualani Stream reach. Due to the configuration of the stream channel, water flowing down Kualani stream (downstream of Lakini) would likely flow naturally back into the Waiokamilo reach if the diversion dam were not there. Staff continued to hike upstream (Waiokamilo reach) for another 350 feet and reached a pond at the foot of a dry waterfall approximately 60 feet high. Water was seen leaking near the base of falls, and staff believe this to be Waiokamilo Spring. On the way downstream, Dean Uyeno attempted to hike upstream on the Kualani reach but was eventually blocked by a field of hau. Two PVC pipes, which did not appear to be currently diverting water, were seen 120 feet upstream of the Waiokamilo/Kualani convergence.					
Highway. However, si diversion dam directs would be needed to ov Staff left Waiokamilo S FI2009021005 (East N	reamflow is somewhat controlle the majority of normal streamflo vertop the dam to push more wa Stream at 1330 hours, and conti Naui, Keanae) for more informat	ed just downstream of the convergence, where a concrete w towards the Kualani Stream reach. A sufficiently high flow ater into the Waiokamilo Stream reach. nued to Keanae. Refer to Field Investigation Report ion.			
Image Listing: (Attach	PDF of image contact sheet)				
File Name:	Brief Description:				
20090210048	Diversion dam on Waiokamilo Str	ream 360 feet upstream from Hana Highway.			
20090210050	Diversion dam on Walokamilo Sti Water overflowing the diversion of	eam 360 feet upstream from Hana Highway.			
20090210052	Waiokamilo Stream splits 10 ups	tream from the diversion dam above Hana Highway.			
20090210054	Waiokamilo Stream upstream of	diversion dam above Hana Highway.			
20090210056	Pond 710 feet upstream from Har	na Highway on Waiokamilo Stream.			
20090210059	Small waterfall at Kualani Stream	l.			
GPS Listing:					
Shapefiles: (List file nan	nes of all shapefiles created and a brief	description of each)			
File Name:	Brief Description:				
FI20090209wp.shp	Waypoints recorded with the GPS	S unit during the field visit.			
Waypoints:         (List all way           WP No.         Latitude           055         20.848181           056         20.848345	points in decimal degrees and provide a <u>Longitude</u> -156.137151 -156.138134	a brief description of each) <u>Brief Description:</u> Concrete dam on Waiokamilo Waiokamilo pond			

### Attachments:

- Brief Description: 1. Image Contact Sheet

#### **Recommendations:**



20090210048.jpg



20090210050.jpg



20090210051.jpg



20090210052.jpg



20090210054.jpg



20090210056.jpg





# FIELD INVESTIGATION REPORT

FI2009021005 (East Maui, Waiokamilo Stream)

Date of Field Investig	<b>Time</b> (24-hour): 1400 - 1600
CWRM Staff:	Ed Sakoda, Dean Uyeno, Ronnie Torres, and Chui Ling Cheng
Individuals Present:	Isaac Kanoa, Gladys Kanoa
Hydrologic Unit:	Piinaau (6053), Waiokamilo (6055)
Stream Name:	Piinaau Stream, Palauhulu Stream, Waiokamilo Stream
Cindingo	

#### Findings:

The purpose of this field visit was, in part, to familiarize Ronnie Torres, Geologist of CWRM's Survey Branch, with the conditions of Piinaau Stream, Palauhulu Stream, and Waiokamilo Stream near Dam 3. At 1400 hours, staff met with Isaac and Gladys Kanoa at their residence. Isaac Kanoa led staff to the junction of Palauhulu and Piinaau Streams. Both streams were flowing.

Thereafter, Gladys Kanoa and staff visited Dam 3 on Waiokamilo Stream. Compared to the conditions observed during last year's field visits, the stream channel at the downstream end of the USGS gage pool at Dam 3 was observed to be wider during this field visit. This could be the result of high flows from heavy rains that occurred throughout the months of November to January.

From Dam 3, Gladys Kanoa and staff hiked upstream to a losing section where water from Waiokamilo Stream flows into a pond and disappears underground. It is unknown where that water returns to the surface, if at all. Originally, staff planned to measure the amount of streamflow gained from blocking the flow into this losing section by creating a small temporary dam upstream. However, staff discovered another location where the stream leaked quite a large amount of flow into this losing section (see image 20090210074). This leak was not observed during the previous field visits. Due to the multiple leakages observed, staff was unable to measure the amount of flow gained from diverting water away from the losing section upstream from Dam 3.

Staff continued to hike upstream on Waiokamilo Stream for about 400 feet to a large pond. According to Gladys Kanoa, water from this pond used to split into two branches. Facing mauka, the water from the pond currently flows to the right branch. The left branch was completely blocked by gravel, trees, and other debris (see images 20090210090 and 20090210092).

Last stop was Dam 2 where Gladys Kanoa briefly explained the purpose of the dam.

Staff left Waiokamilo Stream at 1600 hours, and continued to Keanae Arboretum. Refer to Field Investigation Report FI2009021006 (East Maui, Keanae Arboretum) for more information.

Image Listing: (Attach PDF of image contact sheet)					
File Name:	Brief Description:				
20090210069	Dam 3 on Waiokamilo Stream.				
20090210071	Waiokamilo Stream upstream of Dam 3.				
20090210072	USGS gaging station gage pool at dam 3 on Waiokamilo Stream.				
20090210073	Losing section upstream from Dam 3 on Waiokamilo Stream.				
20090210074	Where the stream leaks into the losing section upstream from Dam 3 on Waiokamilo Stream.				
20090210083	Waiokamilo Stream upstream of the losing section upstream from Dam 3 on Waiokamilo Stream.				
20090210085	Large pond about 400 feet upstream of Dam 3 on Waiokamilo Stream.				
20090210090	Location where the large pond (see image 2009021085) flows into two branches of Waiokamilo Stream.				
20090210092	Location where the large pond (see image 2009021085) flows into two branches of Waiokamilo Stream.				

GPS Listing:
Shapefiles: (List file names of all shapefiles created and a brief description of each)         File Name:       Brief Description:
Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)         WP No.       Latitude       Longitude
Attachments: Brief Description: 1. Image Contact Sheet
Recommendations:



20090210069.jpg



20090210071.jpg



20090210072.jpg



20090210073.jpg



20090210074.jpg



20090210083.jpg



20090210085.jpg



20090210090.jpg



# FIELD INVESTIGATION REPORT

FI2009021006 (East Maui, Keanae Arboretum)

#### 20090210130 Part of Kuo Stream (tributary of Plinaau Stream) that flowed along strike of a steeply dipping basalt unit. 20090210138 Part of Kuo Stream (tributary of Plinaau Stream) that flowed along strike of a steeply dipping basalt unit.

### **GPS Listing:**

**Shapefiles:** (List file names of all shapefiles created and a brief description of each)

File Name: Brief D
--------------------

FI20090209wp.shp	Waypoints recorded with the G	3PS unit during the field visit.
------------------	-------------------------------	----------------------------------

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	Longitude	Brief Description:
057	20.849515	-156.15079	Keanae Arboretum auwai intake
058	20.850501	-156.15042	Keanae Arboretum inflow to upstream-most kalo loi

### Attachments:

- Brief Description: 1. Image Contact Sheet

#### **Recommendations:**



20090210100.jpg

20090210101.jpg

20090210102.jpg



20090210107.jpg

20090210116.jpg



20090210114.jpg



20090210115.jpg





20090210120.jpg



20090210125.jpg

20090210117.jpg



20090210130.jpg





# FIELD INVESTIGATION REPORT

FI2009021102 (East Maui, Hanehoi Haiku Ditch)

Date of Field Investig	<b>Time</b> (24-hour): 0900 - 0945
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Garret Hew
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Hanehoi Stream
Findings:	

At 0900 hours, Garret Hew and CWRM staff arrived at the Haiku Ditch bypass sluice gate on Hanehoi Stream. Following the adoption of IIFS, EMI had expressed interests in lowering the sluice gate so that the ditch could capture high flows during high rainfall events. Although not originally planned in this field visit schedule, CWRM staff decided to allow the adjustment of the Haiku Ditch bypass sluice gate on Hanehoi Stream during this field visit instead of scheduling an entirely separate trip. Similar to the previous field visits, CWRM staff documented the adjustment of the sluice gate. Staff had to ensure that the height of the sluice gate opening after adjustment would allow enough flow to pass through, and satisfy the IIFS at the selected site further downstream on Hanehoi Stream. In other words, no water from the stream can be diverted unless the IIFS is met.

CWRM staff measured the dimensions of the sluice gate opening to be 2.0 x 1.37 feet (W x H). Hanehoi Stream was relatively dry. Flow was not sufficient for taking a flow measurement.

Since the adopted IIFS of 0.63 cubic feet per second (0.41 million gallons per day) was not attained, no water from the stream could be diverted. However, the sluice gate could be lowered to a height that, during average flow conditions, allows enough flow to bypass the sluice gate to satisfy the IIFS at the selected site further downstream on Hanehoi Stream. The height of the opening was estimated by calculating the discharge in Hanehoi Stream at an arbitrary but conservative estimate of flow velocity at 1.5 cubic feet per second (0.646 million gallons per day).

Flow velocity	х	(	Height of sluice gate	х	Width of sluice gate	)	=	Flow at Hanehoi
1.50 feet / sec	х	(	0.27 feet	х	2.0 feet	)	=	0.81 CFS

If the bypass sluice gate was adjusted to a height of 0.27 feet, at a flow velocity of 1.5 feet per second, the flow was calculated to be 0.81 cubic feet per second (0.524 million gallons per day). This flow is above the IIFS adopted for Hanehoi Stream. The final height of the sluice gate opening after adjustment was 0.27 feet.

CWRM staff videotaped the event.

Staff left Hanehoi Stream at approximately 0945 hours, and continued to measure streamflow at the IIFS Site A on Puolua (Huelo) Stream. Refer to Field Investigation Report FI2009021103 (East Maui, Huelo IIFS Site A) for more information.

Image Listing: (Attach PDF of image contact sheet)						
File Name:	Brief Description:					
20090211012	Hanehoi Stream upstream of Haiku Ditch.					
20090211013	Hanehoi Stream downstream of Haiku Ditch.					
20090211014	Haiku Ditch at Hanehoi Stream.					
20090211015	Haiku Ditch bypass sluice gate at Hanehoi Stream.					
20090211016	Haiku Ditch bypass sluice gate at Hanehoi Stream.					
20090211017	CWRM staff Dean Uyeno taking physical measurement of the Haiku Ditch bypass sluice gate at Hanehoi Stream.					
20090211024	Haiku Ditch bypass sluice gate at Hanehoi Stream after adjustment.					
20090211026	Haiku Ditch bypass sluice gate at Hanehoi Stream after adjustment.					
20090211029	Haiku Ditch bypass sluice gate at Hanehoi Stream after adjustment.					
20090211030	Haiku Ditch bypass sluice gate at Hanehoi Stream after adjustment.					

GPS Listing:	
Shapefiles: (List file names of all shapefiles created and a brief description of each)	
File Name:         Brief Description:	
Wayneints: (List all wayneints in desired degrees and provide a brief description of each)	
We No. Latitude Longitude Brief Description of each)	
<u>Dier Description.</u>	
Attachments:	
Brief Description:	
1. Image Contact Sheet	
Recommendations:	





20090211013.jpg



20090211014.jpg



20090211015.jpg



20090211016.jpg



20090211017.jpg



20090211024.jpg



20090211030.jpg



20090211026.jpg



20090211029.jpg



# FIELD INVESTIGATION REPORT

FI2009021103 (East Maui, Huelo IIFS Site A)

Date of Field Investig	gation: February 11, 2009 Time (24-hour): 1000 - 1200
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Ernie Schupp, Garret Hew
Hydrologic Unit:	Hanehoi (6037)
Stream Name:	Puolua (Huelo) Stream
Cin din mar	

### Findings:

At 1000 hours, CWRM staff met with Ernie Schupp at IIFS Site A on Puolua (Huelo) Stream. Staff prepared the site for flow measurement. Flow measurement was completed in one hour. Gage height readings were not recorded as a reference point was not established during the field investigation on October 23, 2008 (refer to Field Investigation Report FI2008102303 for more information). CWRM staff recorded water temperature and weather conditions. The water temperature was 21 degrees Celsius and the weather was sunny. As computed back in the Honolulu Office, the flow at IIFS Site A was 0.380 cubic feet per second (0.246 million gallons per day). This is the highest flow staff has recorded during all field visits.

Following the adoption of IIFS, EMI had expressed interests in lowering the sluice gate so that the ditch could capture high flows during high rainfall events. Although not originally planned in the field visit schedule, CWRM staff decided to allow the adjustment of the Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream during this field visit instead of scheduling an entirely separate trip. Similar to the previous field visits, CWRM staff was present to document the adjustment of the sluice gate. Staff had to ensure that the height of the sluice gate opening after adjustment would allow enough flow to pass through, and satisfy the IIFS at the selected site further downstream on Puolua (Huelo) Stream. In other words, no water from the stream can be diverted unless the IIFS is met.

CWRM staff measured the dimensions of the sluice gate opening to be  $2.0 \times 1.13$  feet (W x H). The depth of water at the sluice gate on the left bank was 0.5 feet.

As previously measured, discharge at the IIFS Site A on Puolua (Huelo) Stream was 0.380 cubic feet per second (0.246 million gallons per day). Since the adopted IIFS of 0.89 cubic feet per second (0.57 million gallons per day) was not attained, no water from the stream could be be diverted. However, the sluice gate could be lowered to a height that, during average flow conditions, allows enough flow bypass the sluice gate to satisfy the IIFS at the selected site further downstream on Puolua (Huelo) Stream. For simplicity, the bypass sluice gate was lowered to the height of the water at approximately 0.50 feet.

The final height of the sluice gate opening after adjustment was 0.50 feet. CWRM staff used fluorescent yellow flagging tape to mark the height of the sluice gate opening.

CWRM staff videotaped the event.

Staff left the IIFS Site A on Puolua (Huelo) Stream at approximately 1200 hours, and continued to Honopou Stream to take flow measurements. Refer to Field Investigation Report FI2009021104 (East Maui, Honopou IIFS Site A) for more information.

#### Image Listing: (Attach PDF of image contact sheet)

File Name:	Brief Description:
20090211031	CWRM staff Ed Sakoda taking flow measurement at IIFS Site A on Puolua (Huelo) Stream.
20090211032	Puolua (Huelo) Stream upstream from IIFS Site A.
20090211033	Puolua (Huelo) Stream downstream from IIFS Site A.
20090211034	Haiku Ditch bypass sluice gate at Puolua (Huelo) Stream.
20090211035	Haiku Ditch at Puolua (Huelo) Stream.
20090211036	Puolua (Huelo) Stream downstream from Haiku Ditch bypass sluice gate.
20090211039	Ernie Schupp and Garret Hew at the Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream.
20090211040	Ernie Schupp and Garret Hew at the Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream.
20090211042	Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream.

20090211044Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream after adjustment.20090211045Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream after adjustment.20090211046Haiku Ditch bypass sluice gate on Puolua (Huelo) Stream after adjustment.	
GPS Listing:	
Shapefiles: (List file names of all shapefiles created and a brief description of each)         File Name:       Brief Description:	
Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:	
Attachments:	
Brief Description:	
2. Discharge Measurement and Gage Inspection Notes	
Recommendations:	



20090211031.jpg



20090211032.jpg



20090211033.jpg



20090211034.jpg



20090211035.jpg





20090211042.jpg



20090211046.jpg



20090211039.jpg



20090211044.jpg



20090211045.jpg

Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND **GAGE INSPECTION NOTES**

FI2009021103 - Page 4 of 6

Comp. by	<u>Chui</u>

Meas. No.

Sta M-	H11#11	0 1155	Site A				Checked by Don
Sta. NO	<u> </u>	ulo (r	Silv Fi	Chran	n 1	the call	- - А.
Sta. Na		<u>aav (r</u>		Shear		(M)	
	11		20 <u>0~</u> P	′aπy	DECEN,		
VVICIUN _	<u><u><u></u></u></u>		= <u>- 2.0-</u>	L \	/el. <u></u>	G.	H Disch 200 UFS
Method		<u>LICALFICI</u>	「   「	NO. SECS	. <u>40</u>	_ G. H. Cha	ange in hrs.
	1 coer	r	ionz. ang	le coet.		Susp.	
Nieter I	уре		MeterN	0		Met	er ft. above bottom of wt.
Rating t	usea		0/	Spin tes	t before m	eas	
			_ % am.	romrat	ing no	·	Indicated shift
		GAG	GE REAL	DINGS			Samples collected: water quality,
Time					Inside	Outside	sediment, biological, other
				<b></b>			
	Start	 			+		Measurements documented on
		LEW	<u>10</u> 10	15			aux./base gage, other
		1.	-				
	·	+					Rain gage serviced/calibrated
	·····	<u> </u>	+				· · · · · · · · · · · · · · · · · · ·
				·			Weather: <u></u>
	Finish	REW	@ 111	1			Air Temp°C at
				1			Water Temp <u>21</u> °C at <u>1116</u>
Weighte	dMGH						Check bar/chain found
GH corr	ection	ļ	<u> </u>				Changed to at
Correct	MGH		<u> </u>				Correct
Wading	, cable, ic	e, boat, i	pstr., do	wnstr., s	ide bridge	<u> </u>	(ft) mi. upstr. downstr. of gage-
Measur	ement rat	ted excel	llent (2%)	, good (	5%), fair (8	3%), poor (	(>8%); based on following .
conditio	ns: Flow	: Fairl	y unit	<u>term</u>	overall,	with a	a little angled flun @ edges
Crosss	ection:	Copples	pebb	<u>ka, sr</u>	nall roc	<u>ks, fau</u>	ly uniterm, tairly flat
ana	even.						
Gage of	perating:				R	ecord Rer	noved
Battery	voltage:	<u> </u>	ini	take/Ori	fice clean	ed/purged	<u></u>
Bubble-	-gage pre	ssure, p	si: lank _		, Line		; Bubble-rate /min.
Extreme	e-GH Indi	icators: n	nax		, mir	۱	
	iecked	İ	HVVMhei	ght on s	tick	Ref. (	elev HWM elev
Control	ISIGE/OUTS	siae:		ef an	aites the		al with realised boulding
back	$\frac{1}{100}$	there and the second	INCLUSIO -	MANH	130886 100	NA CIAU	and POCKS & DOUNTARYS
Demest	<u></u>	101761	VVIICAN	140111	EQUAS VUI	IN CAU	<u>~</u> pt.
rtemark	(S;	· · · · ·			//		
GH of 74	ero flow =	GH		denth of	control	<del>.</del> .	- <b>H</b> ratad
0110120		Un		achii gi			
					Sh	eet No. 🗋	of sheets

•	.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI2009021 . <b>75</b>	103 - Page 5 of 6
	ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEL AT POINT	OCITY MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE	.80
:	LEW	Ø	1015							- • ·	-		
													.85
vertical	$ \longrightarrow $	1.85	.125	. 15					0.		.019		-
wall build		2.1	. 175	. 33			40		. 53		.058	.031	
w/ rock		2.2	.10	. 39			40		. 56		. 039	. 022	.90
		2.3	.10	.43			40		.43		.043	.018	.92
- 1988) - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997		2.4	.10	.72			40		.41		.072	.030	-
		2.5	.10	.74			40		. 27		.074	.020	94
		2.6	.10	. 75			40		. 21	. 361	.075	.016	.96
		2.7	.10	. 79			40		.18		.079	.014	.97
	·	2.9	.10	.79	3		40		.21		. 079	.017	.98
	<u></u>	2,9	.10	.80			цо		. 27		.080	.022	.99
		3.0	.10	.80			40		,20	.674	.080	.016	. 206
1 1 1		3.1	.10	. 78			40		.20		.078	.016	
	0	3.2	.10	.78			40		.22		.078	. 017	1.00
		3.3	,10	, 75			цо		,25		.075	.019	_
Math Tau		3,4	.10	.77			40		.19	.967	.077	.015	_ 273
	· · · · · ·	3.5	,10	.77			40		.13		.077	,010	.99
		3.6	.10	.77			40	- <b>-</b>	.13	1.141	.077	.01D	-98 · 293
i i		3.7	.10	.75			40		.10		:075	.008	-97
•		3.9	.10	.74			40		.10	1,29	.074	.007	.96 308
-		3.9	.10	,71			40	· · · ·	.11	· .	.071	,008	_
		4.0	. ID	.70			40		.09		.HD	.006	<b>.94</b> 
		4.1	.10	,70			40		.10	1.501	.070	.007	.92 32.9
		4.2	.10	,70			40		.10		.070	.007	.90
	- <u></u>	4.3	.10	.65			40		.12	1.636	.065	,008	344
		4.4	.10	.62			40		.10		.062	.006	
•		4.5	.10	.60			ЦO		.11		.060	,007	.85
		4.6	.10	.59			40		.07		.059	.004	.361
- :		4.7	.10	55			40		.09	1.972	.055	.005	.366
- - -													.80
nda militi													-

99.9	.0	.10	.20	.30		.40	.50 River	at -	.60		.70	FI20090 <b>74</b> 10	3 - Page 6 of 6
	<u> </u>	DIST.			έĒ		TIME	VEL	OCITY	ADJUST-			-
	NGLE CO	FROM	WIDTH	DEPTH	OBSERV	REVO-	IN SEC-		MEAN IN VER-	ED FOR HOR. ANGLE OR	AREA	DISCHARGE	.80
-	<u> </u>		10	11.2	<b>P</b>	· · · · · ·	UNDS				1.972	, 366	
	· · · · · · · · · · · · · · · · · · ·	4.0	,10	.40			40		,10	<u>V.115</u>	.043	.004	.370
	· · · · · · · · · · · · · · · · · · ·	4.9	,10	.42			40		, 09	1.957	.,042	.004	.85, 374
		5.0	.10	.40			40		.07	1.997	.040	.003	.377
		5.1	,125	,39			40		.07	· · · · ·	.049	.003	-00
	) 	5.25	.075	. 32					0		.024		.90
		+	·······	ana (ala dan dan dan dan dan dan dan dan dan da	201 Con 194 Summer	Nakalan ing sa	anaa menéhainan n	agyana ni mana ana ang ang ang	Parent Male and Campoor Water Social Action of	in an ann an a	Ny amang aming ang ang ang ang ang ang ang ang ang a	56.0007407100960477,0707 <u>70</u>	.92
		3.4	3.4					AVE=	.19		2.09	. 390	.94
	REW	e	1114										.96
	-												.97
ı	- •				, , ,								.98
	: :												.99
												· - · · · · · · · · · · · · · · · · · ·	-
د ۲													
									· · · · · · · · · · · · · · · · · · ·			1	.00
	• •												-
											``		.99
											· · · · ·		.98
									_				-97
													.96
													_
													.94
													.92
													.90
:													
· >													.85
1 may													
, b` - [													
s 's strang angleggi													.80
										ĺ			-



# FIELD INVESTIGATION REPORT

FI2009021104 (East Maui, Honopou IIFS Site A)

Date of Field Investiga	tion: February 11, 2009	Time (24-hour): 1215 - 1330						
CWRM Staff: E	d Sakoda, Dean Uyeno, and	Chui Ling Cheng						
Individuals Present:								
Hydrologic Unit:	lonopou (6034)							
Stream Name:	lonopou Stream							
Findings:								
At approximately 1215 hours, CWRM staff arrived at IIFS Site A on Honopou Stream. Staff prepared the site for flow measurement. The downstream gage pool was free of debris. The entire flow measurement was completed in 40 minutes. Gage height readings were taken at the downstream gage pool at the start and finish of flow measurement. In addition to flow measurement, staff also recorded water temperature and weather conditions. The water temperature was 20.5 degree Celsius and weather was overcast with no rain. As computed back in the Honolulu Office, the flow at IIFS Site A was 1.223 cubic feet per second (0.791 million gallons per day), with no change in gage height.								
Staff crew left Honopou Investigation Report FI2	IIFS Site A at approximately 009021105 (East Maui, Palau	1330 hours, and continued to Palauhulu Stream. Refer to Field uhulu IIFS Site B) for more information.						
Image Listing: (Attach PE <u>File Name:</u> 20090211048 20090211049 20090211050	Brief Description:         20090211048       CWRM staff conducting flow measurement at IIFS Site A on Honopou Stream.         20090211049       CWRM staff conducting flow measurement at IIFS Site A on Honopou Stream.         20090211050       CWRM staff conducting flow measurement at IIFS Site A on Honopou Stream.							
GPS Listing:								
Shapefiles: (List file name <u>File Name:</u> East_Maui_POI.shp	s of all shapefiles created and a brie <u>Brief Description:</u> Points of interest (POI) recorded from all the East Maui field inves	f description of each) with the GPS unit during the field visit. The file includes POI recorded stigations.						
Waypoints: (List all waypo	ints in decimal degrees and provide	a brief description of each)						
WP No. Latitude	Longitude	Brief Description:						
6 20.916212 7 20.016197	-156.245203	Bridge on Honopou Stream						
8 20.916096	-156.245174 -156.245077	IIFS Site A Flow Measurement on Honopou Stream						
Attachments: <u>Brief Description:</u> 1. Image Contact Sheet 2. Discharge Measurement and Gage Inspection Notes								
Recommendations:								



20090211048.jpg



20090211049.jpg

Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND GAGE INSPECTION NOTES

Comp. by Chui

Meas. No. _

Checked by Dal

				·					
Sta. No	Hoy	10001	HFS S	ItC A					
Sta. Na	me								·· · · · · · · · · · · · · · · · · · ·
Date	2/10		20 <u>09</u> F	Party	Dean, 1	ECH. C	A1.51		<u> </u>
Width _	6.2	Area	a <u>3.150</u>	<u> </u>	/el. <u>39</u>	G	. H. <u>D</u>	Disch	223 CFS
Method	1 <u>Wak</u>	<u>ding</u>		No. secs	<u>    40   </u>	_ G. H. cha	ange	in	hrs.
Method	coef	ł	loriz. ang	le coef	·····	Susp	Tag	js checked_	
Meter T	уре		Meter N	0		Met	ter	ft. above bo	ttom of wt.
Rating	used			Spin test	beforem	neas	;;	after	
Meas.p	olots		% diff,	from rati	ng no. 🔔	· · · · ·	_ Indicated s	hift	
	· ·	GAG	GE REAL					lootod: watar	
Time	· · · · · · · · · · · · · · · · · · ·				Inside	Outside	sediment bi	iected: water	'quainy,
		·			1/10/00			iological, othe	
		··				<u> </u>	Measureme	nts documer	ated on
	Start	1 End	Q 172				separate sh	eets: water	quality,
	-	GH =	+0 0	*	1		aux./basega	ige, other	
		(mark	ax 1190	er war	ter 1		1	<u> </u>	
·	· · · · ·						Rain gage se	erviced/calibr	ated
			-					· · · · ·	
							Weather: _	overcast	
	Finish	REW	P 1312	·			Air Temp.	°C at	
		GH =	+.03				Water Temp.	<u>_20,5</u> °C at	1316
Weighte	dMGH						Check bar/cl	hain found	
GHcorr	ection						Changed to	at	
Correct	MGH						Correct		
Wading Measur conditio Cross s	, cable, id ement ra ons: Flow ection:	ce, boat, i ited exce v: <u>soni</u> cobbles	upstr, do llent (2%) er ori , pelolo	wnstr.s , good (5 leff l leg, k	ide bridge 3%), fair (1 2avik , 2eclyttick	e, <u>40</u> 8%), poor 1 <i>Gimina</i> fairl	(†), mi. u (>8%); based ur	ost)., downsti Ion following and unif	Contra c of gage.
Gage or	perating.				R	ecord Rer	noved		
Batterv	voltage:		In	take/Orif	ice clean	ed/nurraer	1. 1.		
Bubble-	gage pre	essure, p	si: Tank		Line		: Bubble-r	ate	/min
Extreme	e-GH ind	licators: n	nax		, mir				
CSG ch	ecked:		HWMhei	aht on st	ick	Ref	elev	HWMelev	
HWM in	side/out	side:							
Control:	CRM	wall	bu tr	IC ITTA	d. Cl	eared a	of debris		
							<u>, , , , , , , , , , , , , , , , , , , </u>		
Remark	s: The	, orig	inal 1	IFS SI	Hc. 60	Off LIDS	tream of a	ontrol 1	ζ
<u>no li</u>	maer	optimi	al as	flini	is he	wer			
GHofze	ero flow =	= GH		depth at	control	<u></u>	.=	ft rated	
						4 6 1			
					Sh		Of		_ sneets

.0	.10	.20	.30		.40	.5 River	0 * at -	.60		.70	FI2009021 . <b>75</b>	104 - Page 4 of 4
ANGLE COEF-	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VEI AT POINT	MEAN IN VER- TICAL	ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGI	.80 E
	LEN	0	1231							÷ .		
			·								† <u> </u>	.85
	3.9	. 05	.29					0		.015	-0-	
	4.0	.2	.27			40		.16		.054	.009	
	4.3	.3	.36			40		,20		.108	.022	.90
	4.6	.3	.45			40		.16	.312	.135	.022	.92 _{,055}
	4.9	13	.50			40		.26		.150	.039	.042
	5.2	.3	.53			40		,32	.621	,159	.051	.54
	5.5	.3	.51			40		,27		.153	.041	.96
. ·	5.8	.3	.53			40		,38		.159	.060	. <b>97</b> <u>, 244</u>
	6.1	.3	.63	ан сан ал		40		,35	1,122	.1991	.066	.98
	6.4	,3	,54			40		.37		.162	.060	.99
	6.7	.3	<i>.</i> 61		·	40		,34		. 183	.062	.432
	7.0	<b>.</b> З	,60			40		.24	1.647	.180	.043	_
0	7.3	.3	.53			Цo		.36		,159	.057 '	1.00 532
· · ·	7.6	.3	.62			40		.35	1,992	.186	.065	.547
	7.9	.3	.55			40		. 41		.165	.068	
	8.2	.3	.63		·····	40		.34		.189	.064	.99
<u> </u>	9.5	.3	.65			40		.48	2.471	,195	.094	<b>98</b> . 823
	8.8	.3	.63			40		.49		.189	.091	-97 914
	9.1	.3	.54			40	·	55	2.922	.162	.089	.96 1.003
/ 	9.4	.3	.51			40		.71	2975	,153	.109	
	9.7	.35	.51			40		.62		.179	<u>,</u> 4П	<b>.94</b> - "
	10.1	.20	0	·		40		0		0 -	*@sa	.92
	·					40						.90
		10 TO. 10 B. MT. TO MTR. M.C.			Record working three works	ananan karanan karang kara	Nadalan (kasalar Kaladar)	Land and The Control of Last American	élőterse sze zerzekénessek jévet i		979-0970-02595/0596/0502/0502/0502/0502/0502/0502/0502/050	and a second
	6.2	6.2			· .		AVE	· 388		3,154	1.223	_
<u> </u>	REN	0	1312					100		3.224		.85
							· · · ·	0.58				-
				-+								- 90
									· ·			.ov -
					<u> </u>		 					



# FIELD INVESTIGATION REPORT

FI2009021105 (East Maui, Palauhulu IIFS Site B)

Date of Field Investig	pation: February 11, 2009 Time (24-hour): 1430 - 1545
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	
Hydrologic Unit:	Piinaau (6053)
Stream Name:	Palauhulu Stream
Findings:	
At 1430 hours, CWRM entrance to Piinaau Ro	I staff arrived at the Hana Highway bridge that crosses Palauhulu Stream. The bridge is near the bad. Instead of hiking upstream and crossing over to the right bank to access the IIFS Site, staff
niked directly down the	e right streambank from Hana Highway to the IIFS Site under the bridge.
Flow measurement was water temperature was Office, the flow at the I feet (the water level was in all field visits.	as completed in 45 minutes. Staff also recorded water temperature and weather conditions. The s 19 degree Celsius and weather was overcast with no rain. As computed back in the Honolulu IFS site was 3.191 cubic feet per second (2.063 million gallons per day), with gage height at -1.32 as 1.32 feet below the reference point). This was the highest discharge measured by CWRM staff
Staff left Palauhulu IIF Project taro patches. I information.	S Site B at approximately 1545 hours, and continued to document water flow in the na Moku Refer to Field Investigation Report FI2009021106 (East Maui, Na Moku Project) for more
Image Listing: (Attach	PDF of image contact sheet)
File Name:	Brief Description:
20081209001	CWRM staff setting up reference point on right bank of Palauhulu Stream.
20081209004	CWRM staff taking gage beight readings on right bank of Palauhulu Stream
20081209008	CWRM staff taking gage height readings on right bank of Palauhulu Stream.
20081209009	CWRM staff taking gage height readings on right bank of Palauhulu Stream.
20081209012	Palauhulu Stream upstream of Hana Highway.
GPS Listing:	
Shapefiles: (List file nam	nes of all shapefiles created and a brief description of each)
File Name:	Brief Description:
Waypoints: (List all way <u>WP No. Latitude</u>	points in decimal degrees and provide a brief description of each) <u>Longitude</u> <u>Brief Description:</u>
Attachments:	
Brief Description: 1. Discharge Measurem	nent and Gage Inspection Notes
Recommendations:	

Form 9-275F (Apr. 2001)

# U.S. DEPARTMENT OF THE INTERIOR U.S. Geological Survey WATER RESOURCES DIVISION DISCHARGE MEASUREMENT AND

**GAGE INSPECTION NOTES** 

FI2009021105 - Page 2 of 3

Meas.	No.	 

Comp. by Chui

Checked by DDM

Sta. No.	Pale	auhulu	<u>IIFS</u>	<u>Situ</u>	ali ali ali			· · · · ·	
Sta. Na	me					<u> </u>	·		
Date	2/10	,2	0 <u>09</u> F	°arty[	Neary,	Cel U	Chui	·	
Width _	5.5	Area	4.049	<u>b                                     </u>	el7	7 G.	H. <u>~1.32</u>	_ Disch3, ^{(c}	<u>71 CFS</u>
Method	Wa	ding_	I	No. secs.	<u>    4D  </u>	_ G. H. cha	ange <u>O</u>	_ in <u>, 7</u>	hrs.
Method coef Horiz. angle coef Sus							Tags	checked	
Meter T	уре		Meter N	0		Met	er 1	ft. above botto	möfwt.
Rating	used			Spin test	before m	ieas	;af	ter	
Meas.p	olots	· · · · ·	_ %diff.	from ratir	ng no		_ Indicated shi	ift	<u> </u>
[		GAG		DINGS	<u></u>	<del></del>	Samples colle	cted: water qu	ality.
Time					Inside	Outside	sediment, bio	logical, other _	
							]	· ·	
							Measurement	ts documente	d on
	Start	LEW	<u>(</u> 2)	1447			separate she	ets: water qui le other	lality,
	L	-1.3	2 = 6	Н			dux	Jo, other	
	· · · · · · · · · · · · · · · · · · ·						Rain gage ser	viced/calibrate	
	· · · · · · · · · · · · · · · · · · ·	<u> </u>			· · · · · · · · · · · · · · · · · · · ·	· · · ·	i tangage coi	, could all all	, u
	+	+		<u> </u>	· · · · -		Weather: S	iunny	<u></u>
	Finish	PEN	6	1521			Air Temp.	°C at	
<u>}</u>	<u> </u>	Gild =	- 1.32	1991		<u>_</u>	Water Temp	<u>19_</u> °Cat <u>I</u>	531
Weighte	dMGH						Check bar/cha	ain found	
GH correction						ļ	Changed to _	at	
Correct	MGH						Correct		
Wading Measure conditio Cross s	, cable, ic ement rat ns: Flow ection:	e, boat, u led excell : <u>falir i</u> bedrock	lostr., do lent (2%) <u>y unc</u> <u>c, unc</u>	wnstr., si , good (5 ufarm, Nen	de bridge %), fair (l Lamm	8%), poor 1 ar,S	(>8%); based c ides have.	str., downstr. o on following , oungled flu	bridge igage: <u>n.</u>
Gage or	peratina:		<u> </u>		R	ecord Rer	noved		
Batterv	voltage:		In	take/Orif	ice clean	ed/puraer	<u></u>		
Bubble-	gage pre	ssure, ps	i: Tank		, Line	·	; Bubble-rat	te	. /min.
Extreme	e-GH indi	icators: m	nax		, mir	٦			
CSGch	ecked	ŀ	-IWM hei	ght on st	ick	Ref.	elev	HWM elev	
HWM in	side/outs	side:	·	_				·	
Control:		· • • • • • • • • • • • • • • • • • • •							<u></u>
Remark	:s:						<u> </u>		
GH of ze	ero flow =	GH		depth at	control _		=	ft., rated	
					Sh	eetNo.	of		sheets

.0	.10	.20	.30		.40	.5 Rive	0 rat.	.60		.70	FI20090211 <b>.75</b>	05 - Page 3 of 3
Line -	DIST.			₹Ĕ		TIME	VE		ADJUST-			-
ANGLE CI	FROM INITIAL POINT	WIDTH	DEPTH	OBSERV TION DEF	REVO- LUTIONS	IN SEC- ONDS	AT POINT	MEAN IN VER- TICAL	HOR. ANGLE OR	AREA	DISCHARGE	.80
LEW	e.	1447										<b>-</b>
										<u>`</u>	1	.85
	3.55	.125	D		н та ^л У у 2			_		0	and service of	_
	3.8	.225	.12	4			1/2(.71	= .36		.027	. 010	-
	4.0	.25	.92			40		.71		.23	.163	.90
. <u></u>	4.3	.30	1.08			40		.80		.324	. 259	.92 432.
	4.6	.30	1.01			40		. 79	. 884	.303	.239	
	4.9	,25	.95			40		.81		.238	. 193	94
	5.1	,20	.99			40		.71		. 198	.141	.96
	5.3	.20	.95			40		.71	1.51	.190	.135	
-	5,5	.20	.92			40		.80		.164	.131	.98 1.27)
	5.7	.20	. 84			40		.86	1942	.168	.144	.99 _{1.44} 5
· 	5.9	.20	.97			40		.85	:	.194	.165	-
	6.1	.20	1.04			40		.07	2,244	208	.181	- (.76)
0	6.3	.20	.93			40		.84		.196	.156 1	.00
	6.5	.25	.90			40		.89		,225	.200	-
	6.8	.30	.85			40		.89	2,91	.255	.227	2.344
	7,1	-30	.90			40		.84		.24	, 202	.99
·	7,4	.25	.81			40		. 78	3.353	,203	.158	00 7 704
· ·	7.6	.20	.79			40		. 77		. 158	.122	
	7.8	,20	.70			40		.83	3.651	.[4	.116	.96 2.942
	8:0	.20	.50			40		.87	3.661	. (D	.087	3.029
·	9,2	.20	.74			40		.61	3.909	.148	.090	.94
	8.4	.20	.55			40		.51	3919	,110	.056	.92
	8.6	.20	,42	_		40		.18	4.003	.084	.015	.90 3.19
	8.8	.225	,20			40		.02	4.049	.045	_001	
·	9.05	.125	0							0		
		an berefenden an berefenden en berefenden an berefenden en berefenden en berefenden en berefenden en berefende	gent / age of a monoral of the same age of a	resservations and	Acare 200 and 100 and 100 and 100		a wana kataoni katao	af e var - Solation ar seats b	arean and the second	anti-dente (ND Team anti-	Name of the State	.85
	5.5	5,5					AVE =	-79-		4.048	3.191	
PÈW	0	1531						0.77		4.138		
								<b>_</b>				.80



# **STATE OF HAWAII** DEPARTMENT OF LAND AND NATURAL RESOURCES **COMMISSION ON WATER RESOURCE MANAGEMENT**

Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009021006 (East Maui, Na Moku Project Taro)

Date of Field Investig	ation: February 11, 2009 Time (24-hour): 1600 - 1730
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	
Hydrologic Unit:	Waiokamilo (6055)
Stream Name:	Waiokamilo Stream
Findings:	
The purpose of this fie main focus on the wate staff collected the follo the patches; 4) location stream.	Id visit was to get a better understanding of the of the taro patches of the Na Moku Project, with er flow from its sources and through the taro patches before water returns to the stream. CWRM wing information: 1) water flow through the patches; 2) auwai system and location in relation to ns of return flow from the auwai to the stream; and 5) where flow enters the auwai from the
Taro patches in the Na	a Moku Project were fed by Waiokamilo Stream. Most of the patches were in cultivation.
Staff left the Na Moku included in the other 1 Stream Condition) for	Proectt at 1730 hours, and continued to document flow conditions in some of the streams 9 petitioned East Maui streams. Refer to Field Investigation Report FI2009021107 (East Maui, more information.
Image Listing: (Attach File Name: 20090210054 20090210056 20090210058	PDF of image contact sheet) <u>Brief Description:</u> Taro patches of the Na Moku Project. Taro patches of the Na Moku Project. Taro patches of the Na Moku Project.
GPS Listing:	
Shapefiles: (List file nan File Name:	nes of all shapefiles created and a brief description of each) Brief Description:
Waypoints: (List all way <u>WP No. Latitude</u>	points in decimal degrees and provide a brief description of each) <u>Longitude</u> <u>Brief Description:</u>
Attachments: Brief Description: 1. Image Contact Sheet	
Recommendations:	



20090211054.jpg

20090211056.jpg

20090211058.jpg



# **STATE OF HAWAII** DEPARTMENT OF LAND AND NATURAL RESOURCES **COMMISSION ON WATER RESOURCE MANAGEMENT**

Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009021107 (East Maui, Stream Condition)

CWRM Staff:       Ed Sakoda, Dean Uyeno, and Chui Ling Cheng         Individuals Present:       Hydrologic Unit:         Multiple       Multiple			
Individuals Present: Hydrologic Unit: Multiple Stream Name: Multiple			
Hydrologic Unit: Multiple			
Stream Name: Multiple			
Findings:			
At 1730 nours, CwRM stall began driving east from walluanul, loward Makapipi. The purpose was to help stall			
determine some of the field conditions of the remaining east Maul streams that need to be addressed. Along the way,			
stan took GPS waypoints and photographs of the now conditions in the following streams:			
1 Koniliula Stream			
2 Puakaa Stream			
2. Fuakaa Silealii 2. Wajahua Straam			
4 Deakee Culeb			
4. Faakea Guich			
5. Walaaka Suleani			
6. Kapaula Guich			
7. Hanawi Stream			
8. Makapipi Stream			
Cteff concluded the field visit at 1920 hours			
Image Listing: (Attach PDF of image contact sheet)			
File Name: Brief Description:			
20090211066 Makapipi Stream upstream from Hana Highway.			
20090211067 Makapipi Stream downstream from Hana Highway.			
20090211068 Makapipi Stream downstream from Hana Highway.			
200902110/0 Hanawi Stream upstream from Hana Highway.			
200902110/1 Hanawi Stream upstream from Hana Highway.			
20090211072 Hanawi Stream upstream from Hana Highway.			
20090211073 Hanawi Stream downstream from Hana Highway.			
20090211074 Water puttip at Hanawi Stream downstream from Hana Highway.			
20090211075 Hanawi Stream downstream from Hana Highway.			
20090211070 Hallawi Stiealii uowiistiealii iloin Halla Higliway. 20090211078 Water nump at Hanawi Stream downstream from Hana Highway.			
20090211070 Water pump at hanawi Stream downstream from Hana Highway.			
20090211082 Waiohue Stream upstream from Hana Highway			
20090211083 Walohue Stream downstream from Hana Highway			
20090211084 Wajohue Stream downstream from Hana Highway			
20090211087 Paakea Gulch upstream from Hana Highway.			
20090211088 Paakea Gulch downstream from Hana Highway.			
20090211091 Waiaaka Stream upstream from Hana Highway.			
20090211093 Waiaaka Stream downstream from Hana Highway.			
20090211095 Tributary to Kapaula Stream upstream from Hana Highway.			
20090211096 Tributary to Kapaula Stream downstream from Hana Highway.			
20090211098 Kapaula Gulch upstream from Hana Highway.			
20090211100 Kapaula Gulch downstream from Hana Highway.			
20090211102 Kapaula Gulch downstream from Hana Highway.			
20090211104 Puaaka Gulch downstream from Hana Highway.			

### GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each) File Name: **Brief Description:** FI20090209wp.shp Waypoints recorded with the GPS unit during the field visit. Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	<u>Latitude</u>	<u>Longitude</u>	Brief Description:
095	20.818364	-156.125233	Waiohue Stream at Hana Highway
097	20.8142	-156.119781	Tributary to Paakea Gulch at Hana Highway
096	20.813995	-156.119641	Paakea Gulch at Hana Highway
098	20.813117	-156.117854	Waiaaka Stream at Hana Highway
099	20.811957	-156.115956	Tributary to Kapaula Gulch at Hana Highway
100	20.811273	-156.114802	Kapaula Gulch at Hana Highway
101	20.817579	-156.127559	Puakaa Stream at Hana Highway

# Attachments:

Brief Description: 1. Image Contact Sheet

### **Recommendations:**



20090211066.jpg



20090211070.jpg



20090211073.jpg



20090211076.jpg



20090211067.jpg



20090211071.jpg



20090211074.jpg



20090211078.jpg



20090211068.jpg



20090211072.jpg



20090211075.jpg



20090211081.jpg



20090211082.jpg



20090211087.jpg



20090211093.jpg



20090211098.jpg



20090211083.jpg





20090211095.jpg



20090211100.jpg



20090211084.jpg



20090211091.jpg



20090211096.jpg



20090211102.jpg





# FIELD INVESTIGATION REPORT

FI2009032301 (East Maui, Low Flow Channel)

Date of Field Investig	gation:	March 23, 2009	<b>Time</b> (24-hour) <b>:</b> 0900 - 1530
CWRM Staff:	Ed Sak	koda, Dean Uyeno, and	I Chui Ling Cheng
Individuals Present:	Honop	ou community - Lynn S	Scott, Beatrice Kekahuna, Sanford Kekahuna, and Boni Kekahuna
	EMI St	aff - Garret Hew and st	taff from the HC&S Pump and Power section
Hydrologic Unit:	Honop	ou (6034)	
Stream Name:	Honop	ou Stream	

#### Findings:

CWRM staff departed Oahu for Maui at 0600 hours.

The purpose of this field visit was to document the installation of the low-flow bypass channel on Haiku Ditch in Honopou Stream. In November of 2008, CWRM staff met with EMI staff to discuss the design of the low-flow bypass channel. It was in agreement between the two parties and the Honopou community that the bypass channel would be installed on the Haiku Ditch intake structure in Honopou Stream as a pilot project. Since then, EMI staff has been working to construct the bypass channel in their shop. Because the openings of the Haiku Ditch intake grating structure are not of uniform width, the bypass channel had to be constructed in pieces and assembled on-site to achieve the perfect fit on the intake grating.

EMI staff began the installation work at approximately 0730 hours. EMI staff had to close the Lowrie Ditch bypass gate to decrease the amount of water reaching the work site. By the time CWRM staff arrived to Honopou, the low-flow bypass channel was placed on top of the Haiku Ditch intake structure and EMI staff was welding one of the anchor brackets to the main bypass channel (see image 20090323006). There were a total of six anchor brackets (3 on each side of the channel) to secure the bypass channel on the intake structure. A separate piece of metal was welded on the upstream side of the bypass channel and over the side of the intake structure to prevent high water from flowing underneath the bypass channel and lifting it up. During the installation, EMI staff had to pump out more water to draw down the level of water on the upstream side of the intake structure.

In order to determine the head (level of water) needed to meet the IIFS established at two sites further downstream, two 2-in x 4-in pieces of wood were installed along the upstream side of the intake structure as a temporary measure to channel stream water into the bypass channel. Mud and other debris were used to fill holes and gaps between the wood and the intake structure to prevent stream water from entering the ditch. When the installation was complete, the intakes of the 3 pipes on the left streambank were plugged to channel stream water into the bypass channel. When the level of water needed to satisfy the IIFS established at the two sites on Honopou Stream have been determined, EMI plans to replace the 2-in x 4-in pieces of wood with a more permanent structure.

CWRM staff videotaped parts of the installation work.

Upon returning to Honolulu, Garret Hew informed CWRM staff that EMI staff had reopened the Lowrie Ditch bypass gate on Honopou Stream that same day. As a result, more water flowed through the low-flow bypass channel on Haiku Ditch.

During the installation, CWRM staff visited Kekahuna's taro loi with the purpose of mapping water flow through the taro patches before water returns to the stream. Coincidentally, one of the Maui USGS staff was conducting field work in the same area. He offered to show CWRM staff the temperature probe that was installed in the auwai near the last taro loi, and the stream gaging station installed at the start of the auwai. He also showed CWRM staff the temperature data logger and how he downloaded the data from the logger to his computer. After the Maui USGS staff left, CWRM staff continued to map water flow in the taro loi.

Staff concluded the field visit at 1530 hours.

Image Listing: (Attach	PDF of image contact sheet)
File Name:	Brief Description:
20090323004	Low-flow bypass channel, upstream side
20090323005	Low-flow bypass channel, downstream side
20090323006	EMI staff welding an anchor bracket onto the main low-flow bypass channel
20090323008	Low-flow bypass channel (downstream side) with one of the anchor brackets in place
20090323009	EMI staff installing 2in x 4in wood onto the upstream side of the intake structure
20090323010	EMI staff welding an anchor bracket onto the main low-flow bypass channel
20090323015	EMI staff installing 2in x 4in wood onto the upstream side of the intake structure
20090323018	Left streambank where EMI staff transported the low-flow bypass channel onto the ditch intake structure
20090323020	EMI staff placing the pump line downstream of the ditch
20090323025	EMI staff operating the pump
20090323026	EMI staff operating the pump
20090323029	The pump used to pump water from the above the ditch downstream
20090323030	Pump water line upstream of the ditch
20090323031	Pump water line downstream of the ditch
20090323036	EMI staff installing the low-flow bypass channel
20090323038	EMI staff installing the low-flow bypass channel
20090323039	EMI staff welding an anchor bracket onto the main low-flow bypass channel
20090323040	A piece of metal welded on the upstream side of the bypass channel and over the side of the intake
20000222042	structure to prevent high water from flowing underneath the bypass channel and lifting it up
20090323042	Low-flow bypass channel, upstream side
20090323043	USGS temperature probe in Kekanuna's auwai
20090323046	USGS stream gage at the beginning of Kekahuna's auwai
20090323047	USGS stream gage at the beginning of Kekanuna's auwai
20090323058	Nekaliulia Sitalo loi EMI staff canding the low flow hypace channel
20090323061	EMI staff completing the installation of the low flow bypass channel
20090323065	EMI staff completing the installation of the low-flow bypass channel
20090323067	Metal that was welded on the unstream side of the hypass channel and over the side of the intake structure
20030323007	to prevent high water from flowing underneath the bypass channel and lifting it up
20090323070	One of the anchor brackets of the low-flow bypass channel
20090323074	Downstream view of the low-flow bypass channel. Rocks were placed beneath the intake structure to minimize the amount of water back-flowing into the ditch.
20090323080	Completed low-flow bypass channel
20090323087	First water entering the low-flow bypass channel
20090323090	First water entering the low-flow bypass channel
20090323092	First water entering the low-flow bypass channel
20090323094	First water entering the low-flow bypass channel and flowing downstream
20090323102	First water entering the low-flow bypass channel and flowing downstream
20090323106	EMI staff using mud and other debris to fill holes and gaps between the wood and the intake structure to
20000323100	Water flowing through the bypass channel while the 3 pipes were plugged
20090323109	Water nowing unough the bypass channel while the 5 pipes were plugged
GPS Listing:	
Shapefiles: (List file nam	nes of all shapefiles created and a brief description of each)
File Name:	Brief Description:
Waypoints: (List all way	points in decimal degrees and provide a brief description of each)
WP No. Latitude	Longitude Brief Description:
Attachments:	
Brief Description:	
1. Image Contact Sheet	
Deserves detternes	
Recommendations:	



20090323004.jpg

20090323005.jpg

20090323006.jpg



20090323008.jpg

20090323009.jpg

20090323010.jpg







20090323015.jpg

20090323018.jpg

20090323020.jpg



20090323025.jpg

20090323026.jpg


20090323030.jpg

20090323031.jpg

20090323036.jpg







20090323038.jpg

20090323039.jpg

20090323040.jpg







20090323042.jpg



20090323047.jpg

20090323043.jpg

20090323046.jpg





20090323053.jpg



20090323061.jpg



20090323065.jpg



20090323067.jpg





20090323070.jpg

20090323074.jpg

20090323080.jpg





20090323087.jpg

20090323090.jpg

20090323092.jpg



20090323094.jpg

20090323102.jpg





#### STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009040601 (Maui, Kula Agricultural Park)

Date of Field Investig	jation:	April 6, 2009	Time (24-hour): 0600 - 1700	
CWRM Staff:	Ed Sak	oda, Dean Uyeno,	and Chui Ling Cheng	
Individuals Present:	Sandra	Kunimoto, Clark H	lashimoto, Warren Watanabe, Ma	e Nakahata
Hydrologic Unit:				
Stream Name:				
Findings:				

CWRM staff departed Oahu for Maui at 0600 hours.

The purpose of this field visit was to meet with representatives of the Maui County Farm Bureau and County Office of Economic Development to tour the Kula Agricultural Park, and also to meet with farmers and ranchers in the Upcountry region. At the Kula Agricultural Park, CWRM staff met with James Tavares who grew a variety of turf grasses; Craig Rasmussen who was a flower farmer; Brian Otani who grew vegetables; and Jack Banks who was also a vegetable farmer. Staff also met with Jamie Shishido from Omaopio who grew a variety of vegetables. The farmers mainly discussed the type of crop they were growing, their farming and irrigation practices (e.g. crop rotation, drip irrigation), and their water needs. They also expressed their concerns for the possible effects of establishing interim instream flow standards in east Maui.

After lunch at about 1320 hours, staff continued to Haleakala Ranch and met with Vice President Scott Meidell and Assistant Manager Bobby Brooks to discuss farming operations in and water requirements of the ranch. They provided a map of the Haleakala Ranch pastures and explained the status of each region. At the time of the visit, Haleakala Ranch Company had approximately 30,000 acres of pastures with about 28,000 acres in grazing. The ranch had a newly developed grazing program, in which cattle were grass fed instead of grain fed, and that different species of animals (i.e. sheep and goat) were introduced to the pastures to graze with the cattle.

At approximately 1440 hours, staff met with General Manager Wesley Nohara and Water Manager Jeffrey Pearson at the Maui Land & Pineapple (ML&P) Company to discuss farming operations in and water requirements of the pineapple fields. At the time of the visit, ML&P had approximately 2,250 acres of land - 1,250 acres were owned by ML&P, 500 acres were leased from Alexander & Baldwin (A&B), and another 500 acres were subleased to another large scale farmer. Their main sources of water were brackish well water and water from East Maui Irrigation (EMI) Company's Wailoa Ditch.

At 1600 hours, staff arrived at the HC&S conference room to meet with interested farmers and ranchers who were unavailable to meet with CWRM staff during the site visit. Sandra Kunimoto, Clark Hashimoto, Warren Watanabe, and Mae Nakahata were at the meeting. The meeting ended in one hour because nobody came to the meeting.

Staff concluded the field visit at 1700 hours.

### History of the Kula Agricultural Park

(Provided by Clark Hashimoto, Agricultural Specialist at the County Office of Economic Development)

"The concept of the Kula Agricultural Park was conceived by the then Mayor Elmer Cravalho. In 1979, Mayor Cravalho proposed to Maui Land and Pineapple Company to acquire by way of land exchange, fee simple title to vacant unimproved land in Kula, containing approximately 326 acres, for the purpose of developing said land as a County agricultural park. The Kula Agricultural Park started construction by the County of Maui in 1982. In 1985, the first lots were leased to farmers. Today, there are 445 acres on 31 lots, farmed by 26 farmers. The lots range from 8 to 29 acres in size. The Office of Economic Development serves as the County's land management entity for the Kula Agricultural Park.

"The purpose of the Kula Agricultural Park is to promote the development of diversified agriculture by providing appropriately-sized agricultural lots at a reasonable rent and a long-term tenure. The



Image Listing: (Attach PDF of image contact sheet)				
File Name:	Brief Description:			
20090406002	James Tavares' farm in the Kula Agricultural Park			
20090406004	James Tavares at the Kula Agricultural Park			
20090406005	James Tavares and staff at the Kula Agricultural Park			
20090406006	Craig Rasmussen's farm in the Kula Agricultural Park			
20090406008	Brian Otani and staff at the Kula Agricultural Park			
20090406009	Brian Otani's farm in the Kula Agricultural Park			
20090406011	Brian Otani and staff at the Kula Agricultural Park			
20090406014	Crates of onions at Brian Otani's farm in the Kula Agricultural Park			
20090406016	Jack Banks and staff at the Kula Agricultural Park			
20090406018	Irrigation system timer at Jack Banks' farm in the Kula Agricultural Park			
20090406020	Jack Banks' farm in the Kula Agricultural Park			
20090406027	Jamie Shishido and staff at the Kula Agricultural Park			

### GPS Listing:

Shapefiles: (List file names of all shapefiles created and a brief description of each) File Name: **Brief Description:** 

**Waypoints:** (List all waypoints in decimal degrees and provide a brief description of each) WP No. Latitude Longitude Brief Description:

Attachments:

Brief Description: 1. Image Contact Sheet

### **Recommendations:**







20090406004.jpg



20090406005.jpg



20090406006.jpg



20090406008.jpg

20090406009.jpg



20090406011.jpg



20090406014.jpg



20090406016.jpg



20090406018.jpg





#### STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009040701 (Maui, Water Treatment Facilities)

Date of Field Investig	tion: April 7, 2009 Time (24-hour): 0830 - 1600		
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng		
Individuals Present:	Maui County Department of Water Supply - Paul Seitz		
	Department of Agriculture - Sandra Kunimoto, Brian Kau		
Hydrologic Unit:			
Stream Name			

#### Findings:

The purpose of this field visit was to meet with representatives of the Maui County Department of Water Supply (Maui DWS) to visit the surface water treatment facilities in Upcountry Maui. Staff first visited the Olinda Water Treatment Facility. Paul Seitz, Chief of the Water Treatment Facilities Division in the Maui DWS, provided an overview of the facility. This overview is detailed below as reference.

At the Olinda Water Treatment Facility, water first enters the flocculator where chemicals are added to help separate floc (mostly sediment) from the water. The flocculated water goes into a large reservoir (depth of 42 feet with capacity of 8.5 million gallons) where the sediment settles at the bottom. During reservoir maintenance, the floc is stored in a nearby area, where is it dried and can be used as gravel-like material to built roads and other structures. Water from the reservoir is transported into the treatment plant, where it goes through a filtering process to filter out organisms. Each filter is tube-shaped and the membrane size of the filter is 0.2 microns. The treated water is stored in a 3 million gallon capacity clearwell outside of the plant. In the winter months, the reservoir is shut down for maintenance. During that time, the backwash tank next to the reservoir is used as backup to store the flocculated water. Inside the treatment plant, membrane filters are cleaned with citric acid and chlorine. All processes are monitored in the laboratory. The capacity of the water treatment plant is 2.5 million gallons per day, which meets the demand of Upper Kula, which is on average 2 million gallons per day.

Staff then headed east 0.7 miles to the Kahakapao Reservoirs. Surrounding the reservoirs are Haleakala Ranch pastures. Kahakapao consists of two 50 million gallon reservoirs, making a total capacity of 100 million gallons. At the time of the visit, the water level in both reservoirs was about 28 feet. Water at the Kahakapao Reservoirs is treated at the Olinda Water Treatment Facility.

Staff continued to the Waikamoi Reservoirs (located about 2.2 miles east of the Kahakapao Reservoirs), near the beginning of the Upper Kula Pipeline. Between the Kahakapau and the Waikamoi Reservoirs, the Upper Kula System consists of two pipelines, a new 36-inch pipe and an old 12-inch pipe. The new 36-inch pipe is fed by Waikamoi Stream and the Waikamoi Flume. The old 12-inch pipe is fed by a group of five Maui DWS minor diversions, located about 1.8 miles east of the Kahakapao Reservoirs, that take water from various tributaries near Waikamoi Stream.

The Waikamoi Reservoirs consist of two 15 million gallon reservoirs, making a total capacity of 30 million gallons. The west reservoir is fed by 2 tributaries of Waikamoi Stream. The east reservoir is fed by the Waikamoi Flume. Water at the Waikamoi Reservoirs is treated at the Olinda Water Treatment Facility. An arch dam is located on Waikamoi Stream, about 700 feet east of the Waikamoi Reservoirs. Further downstream from the arch dam is a smaller dam that marks the end of Waikamoi Flume, where water from the flume is transported into the east Waikamoi reservoir and eventually into the new 36-inch pipe of the Upper Kula System. Staff walked the entire length of the flume. The flume captures water from Haipuaena Stream, Puohokamoa Stream and its tributaries. Staff documented all the minor diversions along the flume.

Next, staff toured the Piiholo Water Treatment Facility and the Kamole Weir Water Treatment Facility. Both facilities are similar to that of Olinda. The Piiholo Reservoir services Lower Kula. Its average daily production is 2.5 million gallons per day. The Kamole Weir Water Treatment Facility has a newly constructed 100 million gallon covered reservoir. It services Makawao, Pukalani, Haliimaile, and Haiku. In addition, the treatment plant has booster pumps to move water up to the 2,800 feet elevation, where it can be pumped to the 4,500 feet at Upper Kula. The Kamole

Water Treatment Facility was not in operation at the time of the visit. It normally operates in the summer months when water provided by the Upper Kula System is insufficient. Operating the treatment plant at Kamole is very expensive because of pumping costs incurred when providing water to Upcountry. Its average daily production is 3.6 million gallons per day.

Staff concluded the field visit at 1600 hours.

Image Listing: (Attach P	PDF of image contact sheet)		
File Name:	Brief Description:		
20090407002	Paul Seitz at the Olinda Water Treatment Facility.		
20090407004	Flocculator at the Olinda Water Treatment Facility. Chemicals are mixed into the water to help separate		
	the sediment from the water.		
20090407005	Flocculator at the Olinda Water Treatment Facility. Chemicals are mixed into the water to help separate		
	the sediment from the water.		
20090407006	Flocculator at the Olinda Water Treatment Facility. Chemicals are mixed into the water to help separate		
20000407007	Cates where the flequilated water flews into the reservoir at the Olinda Water Treatment Eacility		
20090407008	Gales where the nocculated water into the reservoir at the Olinida water Treatment facility.		
20090407000	bottom of the reservoir.		
20090407011	Sediment-free water flows out of the reservoir into the Olinda Water Treatment Plant.		
20090407013	Sediment-free water flows out of the reservoir into the Olinda Water Treatment Plant.		
20090407015	Olinda Water Treatment Facility. The sediment that settles at the bottom of the reservoir is transported into		
	this area, where it is dried and can be used as gravel for building roads.		
20090407018	Olinda Water Treatment Facility.		
20090407019	Backwash tank at the Olinda Water Treatment Facility that is used as the backup reservoir when the large		
	open reservoir (that holds the flocculated water) is in maintenance or repair.		
20090407020	Olinda Water Treatment Facility.		
20090407023	Pipes that transport flocculated water (without sediment) to the membrane filters in the Olinda Water		
	Treatment Facility.		
20090407024	Membrane filters in the Olinda Water Treatment Facility that filters bacteria and other organisms from the		
	water. The size of the membrane filters is 0.2 microns.		
20090407025	This device monitors the water being treated at the Olinda Water Treatment Facility.		
20090407028	This device monitors the turbidity of the treated at the Olinda Water Treatment Facility.		
20090407029	Olinda Water Treatment Facility. Backwash tank that cleans the membrane filters with citric acid and		
	chlorine.		
20090407030	Control house at the Olinda Water Treatment Facility.		
20090407032	Chlorinator at the Olinda Water Treatment Facility.		
20090407034	The actual membrane filter used at the Olinda Water Treatment Facility.		
20090407036	Laboratory at the Olinda Water Treatment Facility.		
20090407038	Kahakapao Reservoir consists of two 50 million gallon reservoirs.		
20090407041	Kahakapao Reservoir consists of two 50 million gallon reservoirs.		
20090407043	Control house at the Kahakapao Reservoir.		
20090407044	Maui DWS minor diversion from various tributaries near Waikamoi Stream into the Upper Kula Pipeline.		
20090407047	Maul DWS minor diversion from various tributaries near Walkamol Stream into the Upper Kula Pipeline.		
20090407049	Part of the Upper Kula Pipeline.		
20090407051	Waikamoi Reservoir consists of two 15 million gallon reservoirs.		
20090407054	Walkamoi Reservoir consists of two 15 million gallon reservoirs.		
20090407055	Walkamoi Reservoir consists of two 15 million gallon reservoirs.		
20090407060	Walkamoi Stream upstream from the arch dam about 0.2 miles east of the reservoirs.		
20090407061	Arch dam on Walkamol Stream about 0.2 miles east of the reservoirs.		
20090407064	Walkamol Stream downstream from the arch dam about 0.2 miles east of the reservoirs.		
20090407065	Bottom of the arch dam on Walkamoi Stream about 0.2 miles east of the reservoirs.		
20090407071	Control gate of the arch dam on Walkamol Stream about 0.2 miles east of the reservoirs.		
20090407072	Arch dam on Walkamol Stream about 0.2 miles east of the reservoirs.		
20090407073	Lower dam on Walkamol Stream.		
20090407079	Lower dam on vvalkamol Stream.		
20090407070	Lower dam on vvalkamol Stream.		
20090407079	Eu Sakoua anu Sahura Kuhimoto at the lower uam on waikamoi Stream. Lower dam en Weikemei Streem		
20030407002	Lower dam on vvalkamol Stream.		
20030407095	vvater from vvalkamol flume flows into the lower dam on vvalkamol Stream.		
20090407087	vvater from vvatkamol nume nows into the lower dam on vvalkamol Stream.		
20090407007	Walkamol flume aget of Walkamol Stream that taken water from Universe Stream and its tributaries, and		
20090407092	waikamor nume east or waikamor stream that takes water from maipuaena stream and its tributaries, and Puobokamoa Stream and its tributaries		
20090407095	Waikamoi flume capturing water from a tributary of Puohokamoi Stream		

20090407098	Waikamoi flume at Haipuaena Stream.
20090407100	Waikamoi flume at Haipuaena Stream.
20090407101	Grate structure where water from Haipuaena Stream flows into the Waikamoi Flume.
20090407102	Small dam on Haipuaena Stream that captures water from the stream into the Waikamoi Flume.
20090407104	Paul Seitz at Waikamoi Flume on Haipuaena Stream.
20090407106	Waikamoi flume at Haipuaena Stream, looking downstream.
20090407107	Water is captured from a tributary of Haipuaena Stream into the Waikamoi flume.
20090407183	Entering the Makawao Forest Reserve to visit the Piiholo Water Treatment Facility.
20090407184	Piiholo Reservoir.
20090407187	Piiholo Water Treatment Facility.
20090407189	Staff at the Piiholo Water Treatment Facility.
20090407194	End of Wailoa Ditch at Kamole Weir Water Treatment Facility.
20090407195	End of Wailoa Ditch at Kamole Weir Water Treatment Facility.
20090407196	Membrane filters at the Kamole Weir Water Treatment Facility.
20090407200	Power generator at Kamole Weir Water Treatment Facility.

### **GPS Listing:**

Shapefiles: (List file names of all shapefiles created and a brief description of each) File Name: **Brief Description:** 

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description: WP No. Latitude

#### Attachments:

Brief Description: 1. Image Contact Sheet

#### **Recommendations:**









20090407005.jpg





20090407004.jpg



20090407006.jpg

20090407007.jpg

20090407008.jpg







20090407011.jpg

20090407013.jpg

20090407015.jpg



20090407018.jpg

20090407019.jpg



20090407023.jpg

20090407024.jpg

20090407025.jpg





20090407028.jpg

20090407029.jpg

20090407030.jpg







20090407034.jpg

20090407036.jpg



20090407038.jpg

20090407041.jpg



20090407044.jpg



20090407047.jpg



20090407049.jpg





20090407051.jpg







20090407060.jpg



20090407065.jpg





20090407071.jpg



20090407064.jpg



20090407072.jpg



20090407073.jpg

20090407077.jpg



20090407078.jpg





20090407079.jpg

20090407080.jpg

20090407083.jpg







20090407085.jpg



20090407095.jpg

20090407087.jpg







20090407100.jpg



20090407101.jpg

20090407102.jpg

20090407104.jpg





20090407106.jpg

20090407107.jpg

20090407183.jpg







20090407184.jpg

20090407187.jpg

20090407189.jpg



20090407194.jpg



20090407195.jpg







STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009040801 (Maui, HC&S Sugar Mill)

Date of Field Investig	Jation:         April 8, 2009         Time (24-hour): 0800 - 1700
CWRM Staff:	Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Department of Agriculture - Brian Kau
	HC&S Staff - Donn Soares, Vice President of Sales and Marketing for Maui Brand Sugar;
	Rick Volner, Jr., Senior Vice President of Ag Operations;
	Robert Luuwai, Vice President of Factory Operations;
	Rodney Chin, Director of Farming Operations;
	Chris Benjamin, Plantation General Manager;
	Garret Hew, Manager of Water Resources.
Hydrologic Unit:	

Stream Name:

#### Findings:

The purpose of this field visit was to meet with representatives of the Hawaiian Commercial and Sugar Company (HC&S) to learn more about their mill operations, sugar processing, field operations, drip irrigation system, and hydroelectric facilities. Water Resources Manager Garret Hew organized the day's agenda.

#### Maui Brand[®] Sugar Production

At 0800 hours, staff met with Donn Soares who provided an overview of the sugar processing, sales and marketing strategies for Maui Brand[®] Sugar. Staff also toured its production and packaging facility. Maui Brand[®] Sugar is a type of specialty sugar produced by HC&S. It comes in two varieties, Natural Hawaiian Raw Sugar (white-colored) and Premium Hawaiian Turbinado (amber-colored). The raw sugar is available to retail or wholesale customers in single-serve packets; one and two-pound gift bottles; 5-, 10- and 50-pound bags; and one-ton supersacks.

#### Sugar Milling and Processing

At 0900 hours, staff met with Robert Luuwai to tour the Puunene Mill and learn about the various factory operations. Generally, harvested cane stalks are unloaded from a large trailer into the cane cleaner where they are washed. Soil, rocks, and debris are removed in a "sinkfloat". Eventually, the soil is returned to the fields. Washed cane stalks are chopped into smaller pieces by a set of revolving knives, and then a shredder crushes the stalks. A series of high-pressure rollers extracts about 95% of the liquid from the cane. The liquid is then transported to the boiling house and the leftover fiber (bagasse) is used for fuel in the factory's steam generating plant. One ton of bagasse produces the same amount of energy as a barrel of crude oil. Before the liquid is heated, lime juice is added to begin the clarifying process that prevents undesirable and premature conversion of sucrose into simple sugars, which cannot be crystallized. The clarifier separates insoluble materials from the liquid, which is then condensed to syrup through an evaporation using recycled heat. This process forces the syrup to crystallize. Molasses is separated from the raw sugar crystals by a centrifuge.

### Kaheka Hydroelectric Plant

At 1100 hours, staff toured the Kaheka Hydroelectric Plant. Water from EMI's Lowrie Ditch is used to produce renewable energy for HC&S' power needs. This plant is capable of producing 4.5 megawatts of power. Power generated from three of HC&S' hydroelectric plants (Kaheka, Paia, and Hamakua) and the burning of bagasse are used to satisfy sugar mill power requirements first, while the remaining power can be sold to Maui Electric Company (MECO). HC&S is currently providing about 12 megawatts of power to MECO.

#### Field Operations

After lunch at about 1300 hours, Rick Volner, Rodney Chin, and Garret Hew took staff to observe some of the field operations. First, staff observed field preparation, planting and irrigation installation. Generally, the soil is plowed before the planting of seed cane. Planting is done by machines that dig furrows, drop the seed cane pieces and inject irrigation tubing all at the same time. Workers were seen to assist with evening out the seed cane placement in the field. HC&S uses drip irrigation tubing that is replaced with every cane burning before harvesting. HC&S uses herbicides during the first six months of growth while the cane is still short.

Next, staff examined different fields of varying ages of cane crop. Usually, the age of the crop can be estimated by counting the number of nodes on the cane. A year of growth is indicated with three nodes. During times of drought, cane will grow slower and the length between each node is shorter. HC&S staff showed a cane stalk with stunted growth due to the lack of water.

When the cane is ready to harvest, the fields are burned to remove the leaves (the stalks do not burn). Cane burning is carefully planned to account for wind and weather conditions. It is usually done in the early morning hours to minimize impact to the plantation's neighbors. After the fields are burned, harvesting machines rip stalks from the root system and gathers them into large piles. The stalks are then loaded into trucks (weight capacity of 60 tons) to be transported to the factory. During the harvest season, the sugar mill is in operation at all times.

Staff also toured the seed cane fields.

Information contained in this report represents an overview of what was presented to CWRM staff during the field visit. CWRM staff is working with HC&S representatives to compile more detailed information on the plants' operations.

Staff concluded the site visit at 1700 hours.

Image Listing: (Attach P	PDF of image contact sheet)				
File Name:	Brief Description:				
20090408001	Sugar production facility at HC&S Sugar Mill.				
20090408004	Sugar production at HC&S Sugar Mill.				
20090408009	Sugar production at HC&S Sugar Mill. Difference between fine grain and larger grain of sugar.				
20090408010	Sugar production at HC&S Sugar Mill. The grain size of this sugar is not the right size so is it rejected.				
20090408015	Sugar packaging facility at HC&S Sugar Mill.				
20090408016	Sugar packaging facility at HC&S Sugar Mill.				
20090408017	Sugar packaging facility at HC&S Sugar Mill.				
20090408019	Sugar packaging facility at HC&S Sugar Mill.				
20090408022	Sugarcane harvest from the field and transported to the factory for processing.				
20090408023	Sugarcane collected from the field and transported to the factory for processing. The sugarcane goes into				
	the cane cleaner where soil and debris are removed from the cane.				
20090408024	Sugarcane collected from the field and transported to the factory for processing. The sugarcane goes into				
	the cane cleaner where soil and debris are removed from the cane.				
20090408025	Sugarcane collected from the field and transported to the factory for processing. The sugarcane goes into				
	the cane cleaner where soil and debris are removed from the cane.				
20090408026	Garret Hew, Robert Luuwai, and CWRM staff outside the HC&S Sugar Mill.				
20090408028	Sugarcane cleaning at HC&S Sugar Mill.				
20090408029	A series of high-pressure rollers extracting liquid from the sugarcane at the HC&S Sugar Mill.				
20090408031	Liquid extracted from the sugarcane at the HC&S Sugar Mill.				
20090408034	A series of high-pressure rollers extracting liquid from the sugarcane at the HC&S Sugar Mill.				
20090408041	Raw sugar travels by conveyor belt to storage.				
20090408042	This separates the mud from the water so that the water can be reused.				
20090408047	HC&S Sugar Mill.				
20090408053	Control house at the HC&S Sugar Mill.				
20090408054	Control house at the HC&S Sugar Mill.				
20090408055	Kaheka Hydroelectric Plant.				
20090408057	Inside the Kaheka Hydroelectric Plant.				
20090408058	Control machinery at the Kaheka Hydroelectric Plant.				
20090408060	Rick Volner, Rodney Chin, and CWRM staff at the Kaheka Hydroelectric Plant.				
20090408064	Lowrie Ditch outside the Kaheka Hydroelectric Plant.				
20090408070	Rows of seed corn planted at one of the HC&S fields.				
20090408071	Installing drip irrigation tubing at one of the HC&S fields.				
20090408075	Drip irrigation tubing at one of the HC&S fields.				
20090408077	Drip irrigation tubing at one of the HC&S fields.				
20090408079	Rick Volner explaining the effects of water shortage to the growth of sugarcane.				
20090408081	An example of sugarcane that has experienced water shortage during its growth.				
20090408083	Rick Volner and Garret Hew at one of the HC&S fields.				
20090408089	Rodney Chin explaining the effects of water shortage to the growth of sugarcane.				
20090408091	Damage of aphids on sugarcane leaves.				
20090408096	Rodney Chin showing the inside of a ripe sugarcane.				
20090408102	Harvesting of sugarcane. The sugarcane are loaded onto truck and transported to the plant for processing.				
20090408106	Harvesting of sugarcane. The sugarcane are loaded onto truck and transported to the plant for processing.				
20090408110	Seed corn harvesting.				
20090408112	Seed corn harvesting.				
	FI Form 04/13/2006				

20090408113 20090408119	Machine that is used to harvest seed corn. Dust control near one of the HC&S seed corn fields.
GPS Listing:	
Shapefiles: (List file <u>File Name:</u>	ames of all shapefiles created and a brief description of each) Brief Description:
Waypoints: (List all v <u>WP No. Latitude</u>	aypoints in decimal degrees and provide a brief description of each)          Longitude       Brief Description:
Attachments: Brief Description: 1. Image Contact Sh	pet
Recommendations	:



20090408001.jpg

20090408004.jpg

20090408009.jpg



20090408010.jpg



20090408015.jpg

20090408016.jpg





20090408017.jpg

20090408019.jpg

20090408022.jpg



20090408023.jpg

20090408024.jpg







20090408026.jpg

20090408028.jpg





20090408031.jpg



20090408034.jpg



20090408041.jpg







20090408042.jpg

20090408047.jpg

20090408053.jpg



20090408054.jpg

20090408055.jpg





20090408058.jpg

20090408060.jpg



20090408064.jpg



20090408070.jpg



20090408071.jpg



20090408075.jpg







20090408077.jpg



20090408083.jpg

20090408079.jpg



20090408089.jpg



20090408091.jpg







20090408096.jpg

20090408102.jpg

20090408106.jpg



20090408110.jpg



20090408112.jpg



20090408113.jpg





STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009062201 (Maui, Maui Land & Pineapple Company)

Date of Field Investig	<b>Time</b> (24-hour): 0800 - 1200
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Department of Agriculture – Duane Okamoto
	MLP Staff – Wesley Nohara (General Manager), Jeff Pearson (Water Manager), Stephen
	Nikaido, and Louis Lopes (Field Crew)
Hydrologic Unit:	
Stream Name:	
Findings:	

CWRM staff departed Oahu for Maui at 0600 hours.

The purpose of this field visit was to meet with representatives of the Maui Land & Pineapple (ML&P) Company to learn more about their water system and sources. At approximately 0800 hours, staff met with General Manager Wesley Nohara, Water Manager Jeffrey Pearson, and field crew Stephen Nikaido and Louis Lopes to discuss the schedule for the field visit. At time of the visit, ML&P had approximately 2,250 acres of land - 1,250 acres were owned by ML&P, 500 acres were leased from Alexander & Baldwin (A&B), and another 500 acres were subleased to another large scale farmer.

Staff visited the ML&P Kailiili Water System and the Kailiili Reservoir, which is a main storage system for surface water that is used in the company's pineapple fields. The reservoir receives water from Opana and Awalau Stream. Water from East and West Opana Stream are diverted by the East Maui Irrigation (EMI) Company intake structures. The diverted flow then passes through the Opana transmission tunnel into a concrete box that splits the water into three pipes. First, water is diverted into a 2.5 inch pipe for ML&P use. Then, the water is diverted into a 10 inch pipe for Maui County Department of Water Supply (MDWS) use. Lastly, water is diverted into a 12 inch pipe for ML&P use. A water meter is located about 25 feet makai of the transmission tunnel. Staff also saw a USGS staff gage inside the transmission tunnel to monitor the volume of water being diverted.

Next, staff visited part of the Awalau diversion intake structure that diverts water from a development tunnel on Awalau Stream into the Kailiili Reservoir. A dam is located on West Awalau Stream, where water flows over the dam and into a 4 inch pipe that transmits the diverted water into the Kailiili Reservoir. Due to weather condition, staff was not able to hike to the West Awalau dam, but was able to see part of the 4 inch pipe located next to the road.

Upon return, staff visited the intake structure at Hali`imaile that diverts water from EMI's Wailoa Ditch and gets pumped to the upper elevation fields. Next to the intake structure is the Hali`imaile well that is also an important source of water for the ML&P Company.

Staff left the ML&P Company at 1200 hours and continued to Kula Agricultural Park.

Image Listing: (Attach PDF of image contact sheet)			
File Name:	Brief Description:		
20090622001	Concrete box makai of the Opana transmission tunnel.		
20090622002	Makai of the Opana transmission tunnel.		
20090622003	Concrete box makai of the Opana transmission tunnel.		
20090622004	Makai of the Opana transmission tunnel.		
20090622005	Opana transmission tunnel. A USGS staff gage is located inside the tunnel.		
20090622006	Concrete box makai of the Opana transmission tunnel.		
20090622007	Makai of the Opana transmission tunnel.		
20090622008	Ken Kawahara standing on the concrete box makai of the Opana transmission tunnel.		
20090622009	Concrete box makai of the Opana transmission tunnel.		
20090622010	Concrete box makai of the Opana transmission tunnel.		
20090622011	Vegetation along the side of the mountain near the Opana transmission tunnel.		
20090622012	Opana transmission tunnel and concrete box that are part of the Kailiili Water System.		
20090622013	The 12-inch pipe that transmits water diverted at the Opana intake for ML&P use.		

20000622014	Another diversion off of the 2.5 inch nine at the Opana inteke				
20090022014	Another diversion off of the 2.5-inch pipe at the Opana intake.				
20090022013	Onana transmission tunnel and concrete how that are part of the Kailiili Water System				
20090022010	Opana transmission tunnel and concrete box that are part of the Kallilli Water System.				
20090022017	Opana transmission tunnel and concrete box that are part of the Kallilli water System.				
20090022010	Culvert at the Awalau diversion intake.				
20090022019	Culvert at the Awalau diversion intake.				
20090022020	The 4 inch nine that is part of the Awalay diversion inteke				
20090022021	Culture at the Awalay diversion interve				
20090022022	Culvert at the Awalau diversion intake.				
20090022023	The 4 inch him that is part of the Awalau diversion inteke				
20090022024	The 4 inch pipe that is part of the Awalau diversion intake.				
20090022025	Culvert at the Awalau diversion intake.				
20090022020	Cuiver at the Awalau diversion intake.				
20090022027	Kaliji Posorvojr				
20090022028	Kalilili Reservoir				
20090022029	Kalilii Reservoir				
20090022030	Area aurrounding the Kailijili Beconvoir				
20090022031	Alea surrounding the Rahmin Reservoir.				
20090022032	Stall at the Kallill Reservoir.				
20090022033	Inflow at the Keilijii Decenvoir				
20090022034	Holivimaile well and pump station				
20090622035	Hali imale well and pump station.				
20090622036	Hali imale well and pump station.				
20090622037	Hali imale pump station.				
20090622036	Hali imale pump station.				
20090622039	Hali imale pump station.				
20090622040	Hail imale pump station.				
20090622041	I ruck-wash at the Hall imalie well and pump station.				
20090622042	Intake structure at Hall imalie that diverts water from EMI's vvalioa Ditch and gets pumped to the upper elevation fields				
20090622043	Intake structure at Hali`imaile that diverts water from FMI's Wailoa Ditch and gets numbed to the upper				
20000022010	elevation fields.				
20090622044	Wailoa Ditch at Hali`imaile intake.				
20090622045	Kailiili Reservoir.				
GPS Listina:					
Shapefiles: (List file nar	nes of all shapefiles created and a brief description of each)				
File Name:	Brief Description:				
FI2009062201	Points of interest (ML&P)				

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

	( )	<b>U</b> 1	
WP No.	Latitude	Longitude	Brief Description:
001	20.84238485	-156.29210019	Turn off from Piiholo Road to Waiahiwi Road.
002	20.84296404	-156.28941732	Turn off to unpaved road.
003	20.84612444	-156.28674961	First locked gate.
004	20.85046601	-156.27734939	Kailiili Reservoir, with inflow from 12-in. pipe.
005	20.84808120	-156.26835728	Outlet of Opana Transmission Tunnel, drops into junction box which
			divides water to ML&P and MDWS.

#### Attachments:

Brief Description: 1. Image Contact Sheet

#### **Recommendations:**





20090622004.jpg



20090622007.jpg



20090622010.jpg



20090622002.jpg



20090622005.jpg



20090622008.jpg



20090622011.jpg



20090622003.jpg



20090622006.jpg



20090622009.jpg



20090622012.jpg



20090622013.jpg





20090622015.jpg



20090622016.jpg



20090622014.jpg

20090622017.jpg



20090622018.jpg



20090622019.jpg



20090622020.jpg



20090622021.jpg



20090622022.jpg

20090622023.jpg



20090622025.jpg

20090622026.jpg

20090622027.jpg



20090622028.jpg



20090622029.jpg

20090622030.jpg







20090622031.jpg

20090622032.jpg

20090622033.jpg







20090622035.jpg





20090622037.jpg



20090622038.jpg



20090622039.jpg



20090622040.jpg





20090622042.jpg



20090622043.jpg



20090622044.jpg

Contraction of the second seco



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009062202 (Maui, Kula Agricultural Park)

Date of Field Investig	<b>Time</b> (24-hour): 1300 - 1530
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Department of Agriculture – Duane Okamoto Maui County Farm Bureau – Warren Watanabe, Clark Hashimoto Maui Department of Water Supply – Mike Cabral
Hydrologic Unit:	
Stream Name:	

#### Findings:

The purpose of this field visit was to meet with representatives of the Maui County Farm Bureau (MCFB) and the Maui Department of Water Supply (DWS) to tour the reservoirs that provide storage for the Kula Agricultural Park. The farmers and ranchers in the Kula Agricultural Park use water from three reservoirs:

- Upper Kula Reservoir. This reservoir has a capacity of 3.5 million gallons. At full capacity, the reservoir can
  provide water to the Upcountry Kula region for 4 days.
- Lower Kula Reservoir. This reservoir has a capacity of 1.5 million gallons.
- Reservoir 40. Water from this reservoir is pumped 24 hours a day, 5 days a week to the Lower and Upper Kula Reservoirs. The existing agreement between Maui DWS and the Kula Agricultural Park allows for water pumpage of up to 1.5 million gallons per day. However, the average pump rate has been just a little over 1 million gallon per day.

As explained by Mike Cabral of the Maui DWS, one pipe connects all three reservoirs that serve as the inflow and outflow. When water is pumped from Reservoir 40 to the Lower and Upper Kula Reservoirs, water may be used for irrigation in the interim. Thus, the total amount of water pumped from Reservoir 40 may not reach the higher elevation reservoirs.

Next, staff met with Jimmy Jones, one of the nursery farmers in the Kula Agricultural Park. Mr. Jones mainly discussed the type of plants he was growing in the nursery, his farming and irrigation practices. He also expressed his concerns for the possible effects of establishing interim instream flow standards in east Maui.

At 1800 hours, CWRM staff attended a meeting conducted by the MCFB at the Mayor Hannibal Tavares Community Center. Approximately 60 people attended the meeting. Staff from Akaku, a Maui Community Television Station, was present to videotape and document the meeting. The purpose of the meeting was to educate the public the process for establishing interim instream flow standards (IFS). CWRM staff presented some background information on the events leading up to the petitions for setting interim IFS for 27 east Maui streams. Staff provided an overview of the process the Commission is using to establish interim IFS, a summary of the Commission's action on the 8 priority streams (i.e., Honopou, Hanehoi, Huelo, Palauhulu, Piinaau, Waiokamilo, Kualani, and Wailuanui Stream), and what the staff has been doing to follow up on the Commission's decision. Staff also discussed the process for the remaining 19 east Maui streams. Following staff's presentation was a question and answer session which will help to ensure the community that future decisions are based on best available information.

Staff concluded the field visit at 2030 hours.

Image Listing: (Attach PDF of image contact sheet)		
File Name:	Brief Description:	
20090622046	Water filtering station near Reservoir 40.	
20090622047	Water filtering station near Reservoir 40.	
20090622048	Water filtering station near Reservoir 40.	
20090622049	Water from Wailoa Ditch is filtered and then pumped to the higher elevations.	
20090622050	Staff at the water filtering and pumping station near Reservoir 40.	
20090622052	Wailoa Ditch near Reservoir 40.	
20090622053	Wailoa Ditch near Reservoir 40.	
20090622054	Water filtering and pumping station near Reservoir 40.	

20090622055 20090622056	Reservoir 40. Intake structure that diverts water from EMI's Wailoa Ditch into Reservoir 40 for use in the Kula Agricultural Park.
20090622058 20090622059 20090622060	Lower Kula Reservoir with a 1.5 million gallon capacity. Upper Kula Reservoir with a 3.5 million gallon capacity. Upper Kula Reservoir with a 3.5 million gallon capacity.
20090622061 20090622062 20090622065	Upper Kula Reservoir with a 3.5 million gallon capacity. Staff at the Upper Kula Reservoir. Staff at the Upper Kula Reservoir.
20090622066 20090622068 20090622074	Upper Kula Reservoir with a 3.5 million gallon capacity. Jimmy Jone's nursery. MCEB meeting at the Mayor Hannibal Tayares Community Center
20090622075	MCFB meeting at the Mayor Hannibal Tavares Community Center.
GPS Listing:	
Shapefiles: (List file nam	es of all shapefiles created and a brief description of each)
File Name:	Brief Description:
FI2009062201	Points of interest.
Waypoints: (List all wayp <u>WP No.</u> <u>Latitude</u> 006 20. 70425109	oints in decimal degrees and provide a brief description of each)           Longitude         Brief Description:           -156.36018338         South road to Department of Hawaiian Home Lands' Keokea-Waiohuli development.
Attachments: Brief Description: 1. Image Contact Sheet	
<b>Recommendations:</b>	



20090622046.jpg



20090622047.jpg



20090622048.jpg



20090622049.jpg



20090622050.jpg



20090622052.jpg



20090622053.jpg



20090622054.jpg



20090622055.jpg







20090622056.jpg

20090622058.jpg



20090622060.jpg

20090622061.jpg

20090622062.jpg





20090622065.jpg

20090622066.jpg

20090622068.jpg



20090622074.jpg





STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009110901 (East Maui, Makapipi)

Date of Field Investig	<b>Time</b> (24-hour): 0730 - 1745
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	Hawaii State House Representative – Mele Carroll
	Nahiku Community - Kumu Kamalu, Mapu Kekahuna, Corinna Kekahuna, Lihau Kekahuna,
	Jimmy Kaho`okele, Tommy Ko`omoa, Kekoa Ko`omoa, Kalei Johnson, Paul Bodnar, Allen
	Caster, and Michael Behrens.
Hydrologic Unit:	Makapipi
Stream Name:	Makapipi Stream
<b>F</b> 11	

Findings:

Staff arrived in Maui at 0730 hours.

The purpose of this field visit was to meet with residents of the Lower Nahiku community and to gather additional information on lower Makapipi Stream (downstream from Hana Highway). Community members showed Commission staff the following sites along Lower Makapipi Stream.

- 1. Une Pond. Residents claimed that Une Pond has been dry since the year 2000.
- 2. Spring upstream of Une Pond.
- 3. Haita Pond. This is the first large pond located below Hana Highway.
- 4. Unnamed Stream by the property of Michael Behrens.
- 5. Wahine Mo Pond. Residents claimed that this pond has traditionally been used for washing clothes.
- 6. Mouth of Makapipi Stream at Nahiku Landing.
- 7. Mouth of Hanawi Stream as seen from Nahiku Landing.
- 8. Pond upstream of Haita Pond.

Staff concluded the field visit at 1745 hours.

Image Listing: (Attach PDF of image contact sheet)		
File Name:	Brief Description:	
20091109001	Makapipi Stream upstream of Lower Nahiku Road.	
20091109002	Makapipi Stream downstream of Lower Nahiku Road.	
20091109003	Une Pond.	
20091109004	Une Pond.	
20091109005	Spring upstream from Une Pond.	
20091109006	Haita Pond.	
20091109007	Haita Pond.	
20091109009	Water from Haita Pond continues to flow downstream.	
20091109010	Existing taro loi wall.	
20091109011	Nahiku community taro loi.	
20091109012	Makapipi Stream splits.	
20091109013	Makapipi Stream splits.	
20091109014	Property of Michael Behrens.	
20091109015	Property of Michael Behrens.	
20091109016	Unnamed stream at the property of Michael Behrens.	
20091109017	Unnamed stream at the property of Michael Behrens.	
20091109020	Unnamed pond downstream from Une Pond.	
20091109021	Wahine Mo Pond.	
20091109022	Wahine Mo Pond.	
20091109023	Wahine Mo Pond.	
20091109024	Wahine Mo Pond.	
20091109026	Mouth of Makapipi Stream.	
20091109027	Mouth of Makapipi Stream.	
20091109029	Makapipi coast.	
20091109030	Makapipi coast.	

20091109031	Outlet of the unnamed pond (photo 20091109020) downstream from Une Pond.
20091109033	View of Hanawi Stream mouth from Makapipi.
20091109034	Lunch meeting.
20091109035	Lunch meeting.
20091109039	Pond upstream from Haita Pond.
20091109041	Pond upstream from Haita Pond.

### **GPS Listing:**

 Shapefiles:
 (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:

#### Attachments:

Brief Description:

1. Image Contact Sheet

### **Recommendations:**



20091109001.jpg



20091109002.jpg



20091109003.jpg





20091109004.jpg

20091109005.jpg

20091109006.jpg







20091109007.jpg



20091109011.jpg





20091109012.jpg



20091109013.jpg


20091109014.jpg



20091109015.jpg



20091109016.jpg



20091109017.jpg



20091109020.jpg



20091109021.jpg



20091109022.jpg



20091109023.jpg



20091109024.jpg



20091109026.jpg

20091109027.jpg



20091109030.jpg

20091109031.jpg

20091109033.jpg





20091109034.jpg

20091109035.jpg

20091109039.jpg





STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009111601 (East Maui, Makapipi)

Date of Field Investig	pation: November 16, 2009 Time (24-hour): 0730 - 1600
CWRM Staff:	Ken Kawahara, Ed Sakoda, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	EMI Staff - Garret Hew, Henry Robello
Hydrologic Unit:	Makapipi, Hanawi
Stream Name:	Makapipi Stream, Hanawi Stream
Findinge	

Findings:

Staff arrived in Maui at 0730 hours.

The purpose of this field visit was to gather additional information on upper Makapipi Stream (upstream from Hana Highway), as well as visit the EMI diversions on Makapipi and Hanawi Streams. Staff met with EMI staff at the top of Lower Nahiku Road and first drove to the EMI major diversion on the main branch of Makapipi Stream, which is also known as west Makapipi Stream.

Staff then visited the start of EMI's Koolau Ditch on the left bank of east Makapipi Stream. A development tunnel (Makapipi tunnel 2) is located on the right bank of the stream. Water from this development tunnel is conveyed to the Koolau Ditch via a pipe crossing under a waterfall on east Makapipi Stream (see photo 20091116011). The Koolau Ditch also receives water from Kuhiwa Well (via a pipe) located further east in the hydrologic unit (see photo 20091116032). Addition water input is seepage captured in a concrete collection box and conveyed to the ditch via a pipe. As the Koolau Ditch daylights, the County of Maui Department of Water Supply diverts water from the ditch to serve the Lower Nahiku Community. This water is chlorine treated.

Heading back to Hana Highway, staff took photos of Makapipi Stream at high flow conditions. Staff also visited Wahine Mo Pond and drove to Nahiku Landing to view the mouth of Makapipi Stream at high flow.

Next, staff visited the Hanawi Pump Station on Hanawi Stream (see photo 20091116061). Maui Land & Pineapple Company used to divert water for irrigating their pineapple fields. Further upstream, staff visited EMI's major diversion on Hanawi Stream. The diversion intake grate is located on the right bank of the stream. Staff took a short hike from the right bank of the stream to a small tributary stream where there was a minor diversion (see photo 20091116083).

Staff concluded the field visit at 1600 hours.

Image Listing: (Attach PDF of image contact sheet)	
File Name:	Brief Description:
20091116001	(West or main) Makapipi Stream upstream of the EMI major diversion.
20091116002	(West or main) Makapipi Stream downstream of the EMI major diversion.
20091116003	(West or main) Makapipi Stream downstream of the EMI major diversion.
20091116004	EMI major diversion at (West or main) Makapipi Stream.
20091116007	Small bridge at the EMI major diversion on (West) Makapipi Stream.
20091116008	Seepage captured at a collection box near the East Makapipi Stream.
20091116009	Collection box that captures seepage and conveys the water to the EMI Koolau Ditch (tunnel).
20091116011	Waterfall on East Makapipi Stream.
20091116012	Waterfall on East Makapipi Stream.
20091116013	Pipe located below the waterfall (see photo 20091116012) conveying water from a development tunnel to the Kaplay Ditch (tunnel)
20091116015	Pine conveying water from Kuhiwa Well to the start of the Koolau Ditch (tunnel)
20091116016	Pipe located below the waterfall (see photo 20091116012) conveying water from a development tunnel to the Koolau Ditch (tunnel).
20091116018	Pipe conveying water from Kuhiwa Well to the start of the Koolau Ditch (tunnel).
20091116021	Start of the Koolau Ditch (tunnel) near East Makapipi Stream.
20091116023	Development tunnel – Makapipi tunnel 2.
20091116027	East Makapipi Stream.
20091116032	Right bank of East Makapipi Stream. Kuhiwa Well is located further east.
20091116033	East Makapipi Stream.

00001110007	Fact Malanini Otanana Tha air a share tha stranger construction from 16 birs Mall to the Kashar Ditch
20091116037	East Makapipi Stream. The pipes above the stream convey water from Kuniwa Well to the Koolau Ditch.
20091116039	County pipeline diverting water from the Koolau Ditch to the Nahiku Community.
20091116041	County pipeline diverting water from the Koolau Ditch to the Nahiku Community.
20091116044	County control water tank.
20091116046	Makapipi Stream (at high flow) upstream from Hana Highway.
20091116047	Makapipi Stream (at high flow) downstream from Hana Highway.
20091116049	Wahine Mo Pond on Makapipi Stream at high flow.
20091116050	Wahine Mo Pond on Makapipi Stream at high flow.
20091116051	Wahine Mo Pond on Makapipi Stream at high flow.
20091116052	Wahine Mo Pond on Makapipi Stream at high flow.
20091116053	Outlet of the unnamed pond downstream from Une Pond.
20091116055	Makapipi coast.
20091116056	Mouth of Makapipi Stream at high flow.
20091116057	Mouth of Makapipi Stream at high flow.
20091116058	Mouth of Makapipi Stream at high flow.
20091116059	Makapipi coast.
20091116061	Hanawi Pump.
20091116063	Hanawi Stream (at high flow) upstream from Hana Highway.
20091116064	Hanawi Stream (at high flow) at Hana Highway.
20091116066	EMI major diversion on Hanawi Stream.
20091116067	EMI major diversion on Hanawi Stream.
20091116072	EMI major diversion intake grate on Hanawi Stream.
20091116075	EMI major diversion on Hanawi Stream.
20091116082	EMI minor diversion on a tributary of Hanawi Stream.
20091116083	Tributary of Hanawi Stream.
20091116088	This flume was used to measure the amount of water diverted by the Nahiku Pump.
GPS Listing:	
Shapefiles: (List file name	es of all shapefiles created and a brief description of each)
File Name:	Brief Description:
	i
Waypoints: (List all wayp	oints in decimal degrees and provide a brief description of each)
WP No. Latitude	Longitude Brief Description:
Attachments:	
Brief Description:	
1. Image Contact Sheet	
<b>Recommendations:</b>	



20091116001.jpg



20091116002.jpg





20091116004.jpg



20091116007.jpg



20091116009.jpg



20091116013.jpg



20091116011.jpg



20091116015.jpg



20091116008.jpg



20091116012.jpg



20091116016.jpg



20091116018.jpg



20091116021.jpg



20091116023.jpg



20091116032.jpg



20091116033.jpg



20091116037.jpg







20091116044.jpg

20091116039.jpg



20091116046.jpg



20091116047.jpg



20091116049.jpg



20091116050.jpg



20091116051.jpg



20091116052.jpg



20091116053.jpg



20091116055.jpg



20091116056.jpg









20091116063.jpg



20091116059.jpg

20091116061.jpg



20091116064.jpg



20091116066.jpg



20091116067.jpg



20091116072.jpg



20091116075.jpg





20091116083.jpg



20091116088.jpg



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2009111901 (East Maui, USGS)

Date of Field Investig	pation: November 19, 2009 Time (24-hour): 0730 - 1630
CWRM Staff:	Ken Kawahara, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	USGS Staff – Clarence Edward, Steve Gingerich,
Hydrologic Unit:	East Maui
Stream Name:	Multiple Streams

#### Findings:

Staff arrived in Maui at 0730 hours.

The purpose of this field visit was to accompany USGS staff in selecting potential sites for monitoring interim instream flow standards. The following is a list of streams that staff visited and the location of a potential monitoring site.

- 1. Makapipi Stream about 15 feet upstream of Hana Highway on the left stream bank.
- 2. Hanawi Stream directly below Hana Highway on the right stream bank.
- 3. Kopiliula Stream no potential monitoring site selected due to the location of the EMI major diversion.
- 4. East Wailuaiki Stream directly below Hana Highway on the right stream bank.
- 5. West Wailuaiki Stream directly below Hana Highway on the left stream bank.
- 6. Nuaailua Stream below Hana Highway on the right stream bank.
- 7. Honomanu Stream about 200 feet upstream from Hana Highway on the left stream bank.
- 8. Punalau Stream about 100 feet upstream from Hana Highway on the right stream bank.
- 9. Haipuaena Stream about 100 feet upstream from Hana Highway on the right stream bank.
- 10. Puohokamoa Stream below Hana Highway on the right stream bank.
- 11. Waikamoi Stream about 150 feet upstream from Hana Highway on Waikamoi Stream on the left stream bank.

Staff also visited Wailuanui Stream and Palauhulu Stream, and took photos of the installed USGS staff gages. Both gages were submerged due to high flow conditions.

Staff concluded the field visit at 1630 hours.

Image Listing: (Attach PDF of image contact sheet)	
File Name:	Brief Description:
20091119001	Wahine Mo Pond on Makapipi Stream.
20091119002	Wahine Mo Pond on Makapipi Stream.
20091119003	Makapipi Stream 300 feet upstream from Hana Highway.
20091119004	Makapipi Stream 300 feet upstream from Hana Highway.
20091119005	Makapipi Stream at Hana Highway.
20091119006	USGS staff selecting a potential monitoring location on Makapipi Stream – 15 feet upstream of Hana Highway on the left stream bank.
20091119007	USGS staff selecting a potential monitoring location on Makapipi Stream – 15 feet upstream of Hana Highway on the left stream bank
20091119008	USGS staff selecting a potential monitoring location on Makapipi Stream – 15 feet upstream of Hana Highway on the left stream bank
20091119009	USGS staff selecting a potential monitoring location on Makapipi Stream – 15 feet upstream of Hana Highway on the left stream bank.
20091119010	Makapipi Stream at Hana Highway.
20091119011	USGS staff selecting a potential monitoring location on Makapipi Stream – 15 feet upstream of Hana Highway on the left stream bank.
20091119014	Makapipi Stream upstream from Hana Highway.
20091119015	Makapipi Stream downstream from Hana Highway.
20091119018	Hanawi Stream upstream from Hana Highway.
20091119019	Hanawi Stream downstream from Hana Highway.
20091119021	A deep spot on Hanawi Stream downstream from Hana Highway.
20091119022	Hanawi Pump.

20091119024	USGS staff selecting a potential monitoring location on Hanawi Stream – directly below Hana Highway on
00001110000	the right stream bank.
20091119028	Kopiliula Stream and EMI major diversion at Hana Highway.
20091119029	Kopiliula Stream upstream of Hana Highway.
20091119032	Kopiliula Stream downstream of Hana Highway.
20091119033	Kopiliula Stream downstream of Hana Highway.
20091119035	Kopiliula Stream upstream of Hana Highway.
20091119036	EMI major diversion on Kopiliula Stream.
20091119038	East Walluaiki Stream upstream of Hana Highway.
20091119040	East Wailuaiki Stream downstream of Hana Highway.
20091119041	USGS staff selecting a potential monitoring location on East Wailuaiki Stream – directly below Hana
	Highway on the right stream bank.
20091119042	East Walluarki Stream at Hana Highway.
20091119044	East Walluaiki Stream at Hana Highway.
20091119045	Left bank of East Walluaiki Stream at Hana Highway.
20091119046	Right bank of East Walluaiki Stream at Hana Highway.
20091119050	West Wailuaiki Stream upstream Hana Highway.
20091119051	West Wailuaiki Stream downstream Hana Highway.
20091119052	West Wailuaiki Stream downstream Hana Highway.
20091119053	West Wailuaiki Stream at Hana Highway.
20091119056	USGS staff selecting a potential monitoring location on West Wailuaiki Stream – directly below Hana
	Highway on the left stream bank.
20091119061	Wailuanui Stream upstream from Hana Highway.
20091119062	USGS staff gage on the right bank of Wailuanui Stream at Hana Highway.
20091119063	Wailuanui Stream downstream from Hana Highway.
20091119066	Wailua Valley.
20091119068	USGS staff gage on the right bank of Palauhulu Stream upstream of Hana Highway.
20091119070	Palauhulu Stream upstream of Hana Highway.
20091119071	Palauhulu Stream downstream of Hana Highway.
20091119074	Nuaailua Stream upstream of Hana Highway.
20091119075	Nuaailua Stream downstream of Hana Highway.
20091119076	Nuaailua Stream at Hana Highway.
20091119077	Potential monitoring location on Nuaailua Stream –below Hana Highway on the right stream bank.
20091119079	Hana Highway bridge at Nuaailua Stream.
20091119081	Potential monitoring location on Nuaailua Stream – below Hana Highway on the right stream bank.
20091119082	Potential monitoring location on Nuaailua Stream – below Hana Highway on the right stream bank.
20091119086	Honomanu Stream upstream from Hana Highway.
20091119087	Honomanu Stream downstream from Hana Highway.
20091119088	Old stilling well on Honomanu Stream 200 feet upstream from Hana Highway.
20091119089	Honomanu Stream 200 feet upstream from Hana Highway.
20091119090	Honomanu Stream 200 feet upstream from Hana Highway, looking at the highway.
20091119091	Potential monitoring location on Honomanu Stream – 200 feet upstream from Hana Highway on the left
	stream bank.
20091119093	Hana Highway bridge at Honomanu Stream.
20091119099	Punalau Stream 100 feet upstream from Hana Highway.
20091119100	Punalau Stream 100 feet upstream from Hana Highway, looking at the highway.
20091119103	USGS staff selecting a potential monitoring location on Punalau Stream – 100 feet upstream from Hana
	Highway on the right stream bank.
20091119114	Haipuaena Stream upstream from Hana Highway.
20091119115	Haipuaena Stream downstream from Hana Highway.
20091119116	USGS staff selecting a potential monitoring location on Haipuaena Stream – 100 feet upstream from Hana
	Highway on the right stream bank.
20091119118	Haipuaena Stream 100 feet upstream from Hana Highway, looking at the highway.
20091119120	USGS staff selecting a potential monitoring location on Haipuaena Stream – 100 feet upstream from Hana
	Highway on the right stream bank.
20091119139	Puohokamoa Stream upstream from Hana Highway.
20091119141	Puohokamoa Stream downstream from Hana Highway.
20091119142	Culvert on Hana Highway at Puohokamoa Stream.
20091119143	USGS staff selecting a potential monitoring location on Puohokamoa Stream - below Hana Highway on the
000044/04/0	right stream bank.
20091119144	USGS statt selecting a potential monitoring location on Puohokamoa Stream – below Hana Highway on the
00004440440	right stream bank.
20091119148	Large pond on Walkamol Stream about 150 feet upstream from Hana Highway.
20091119149	Outlet of the large pond on Walkamol Stream about 150 feet upstream from Hana Highway.
20091119150	vvaikamoi Stream 150 teet upstream trom Hana Highway, looking at the highway.
20091119151	Large pond on Walkamol Stream about 150 feet upstream from Hana Highway.

20091119154	USGS staff selecting a potential monitoring location on Waikamoi Stream –150 feet upstream from Hana
20091119155	USGS staff selecting a potential monitoring location on Waikamoi Stream –150 feet upstream from Hana
	Highway on Waikamoi Stream on the left stream bank.
20091119156	USGS staff selecting a potential monitoring location on Waikamoi Stream –150 feet upstream from Hana
20001110157	Highway on Walkamol Stream on the left Stream on Walkamol Stream –150 feet upstream from Hana
20031113137	Highway on Waikamoi Stream on the left stream bank.
CDS Listing	
GF3 Listing.	
Shapefiles: (List file nam	nes of all shapefiles created and a brief description of each)
File Name:	Brief Description:
Waypoints: (List all way	points in decimal degrees and provide a brief description of each)
WP No. Latitude	Longitude Brief Description:
Attachments:	
Brief Description:	
1 Image Contact Sheet	
1. Intage Contact Check	
Decommondational	
Recommendations:	



20091119001.jpg

20091119002.jpg



20091119003.jpg



20091119004.jpg



20091119005.jpg



20091119006.jpg







20091119007.jpg

20091119008.jpg

20091119009.jpg



20091119010.jpg

20091119011.jpg



20091119015.jpg



20091119018.jpg



20091119019.jpg



20091119021.jpg



20091119022.jpg



20091119024.jpg







20091119028.jpg



20091119033.jpg

20091119029.jpg

20091119032.jpg





20091119035.jpg



20091119038.jpg



20091119040.jpg

1.24





20091119042.jpg



20091119044.jpg



20091119045.jpg



20091119046.jpg



20091119052.jpg



20091119050.jpg



20091119053.jpg



20091119051.jpg



20091119056.jpg



20091119061.jpg



20091119062.jpg





20091119066.jpg



20091119071.jpg



20091119076.jpg



20091119068.jpg



20091119074.jpg



20091119077.jpg





20091119075.jpg



20091119079.jpg



20091119081.jpg





20091119090.jpg



20091119099.jpg





20091119088.jpg



20091119091.jpg



20091119100.jpg



20091119086.jpg



20091119089.jpg



20091119093.jpg



20091119103.jpg



20091119114.jpg



20091119115.jpg



20091119116.jpg



20091119118.jpg



20091119120.jpg



20091119139.jpg



20091119141.jpg



20091119142.jpg

20091119143.jpg



20091119144.jpg

20091119148.jpg



20091119150.jpg



20091119155.jpg



20091119151.jpg

20091119156.jpg



20091119157.jpg



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2010020201 (East Maui, Diversions)

<b>Time</b> (24-hour): 0630 - 1630
Dean Uyeno, Diane England, and Chui Ling Cheng
DAR Staff – Lance Nishiura
EMI Staff – Garret Hew, Mark Vaught, Henry Robello
East Maui
Multiple Streams

#### Findings:

Staff arrived in Maui at 0630 hours.

The purpose of this field visit was to document the physical dimensions of and how water flows past the EMI diversion structures in 17 petitioned streams in east Maui. The streams include Alo, Waikamoi, Wahinepee, Puohokamoa, Haipuaena, Pnalau/Kolea, Honomanu, Nuaailua, West Wailuaiki, East Wailuaiki, Kopiliula, Waiohue, Paakea, Waiaaka, Kapaula, Hanawi, and Makapipi. Documentation was completed in three days. The following is a list of streams and the respective diversions that staff visited on the first day of the field visit.

1. Makapipi Stream, K-1 intake into Koolau Ditch.

Diversion structure consists of a 15 feet (L) x 5 feet (H) dam. Intake and sluice gate (3 x 1.83 feet, W x H) situate on the left bank. Water flows down a small waterfall before reaching the diversion. Makapipi Stream had ponded water downstream of the diversion.

2. Hanawi Stream, K-4 intake into Koolau Ditch.

Diversion structure consists of a 38 feet (L) dam. Intake and sluice gate (2.97 x 4 feet, W x H) situate on the right bank, with the intake grate about 30 feet upstream of the sluice gate. Minor diversion on the right bank consists of 2 white pipes that transmit seepage flow into the gravel basin. Water flows down a waterfall before reaching the diversion. Hanawi stream was flowing downstream of the diversion, mostly likely a result of the open sluice gate at the time of the visit.

3. Kapaula Stream, K-7 intake into Koolau Ditch.

Diversion structure consists of a 19.5 feet (L) x 2.7 feet (H) dam. Intake grate (3 x 19 feet, W x L) situates on the right bank with no sluice gate. Water flows down a small cascading waterfall before reaching the diversion. Downstream of the diversion appears to have an existing diversion dam. According to Garret Hew, the stream is losing upstream of the old dam. Therefore, the diversion dam was moved further upstream from the losing section.

4. Waiaaka Stream, K-9 intake into Koolau Ditch.

Waiaaka Stream is used to convey water from a development tunnel into the Koolau Ditch. The stream was dry downstream from the diversion. No physical measurements were recorded.

5. Paakea Stream, K-10 intake into Koolau Ditch.

Diversion structure consists of a 24 feet (L) x 3.6 feet (H) dam. Intake  $(2.7 \times 1.05 \text{ feet}, W \times H)$  and sluice gate  $(3.1 \times 2.5 \text{ feet}, W \times H)$  situate on the left bank. The dividing wall between the gravel basin and the ditch has an opening with diameter of 0.7 feet. Paakea Stream had ponded water downstream of the diversion.

6. Waiohue Stream, K-13 intake into Koolau Ditch.

The intake (2.4 x 2.1 feet, W x H) is further upstream from the sluice gate (1.4 x 5.9 feet, W x H). Water flows from a waterfall into the plunge pool, where it is diverted into the intake grate and then through a short tunnel into the gravel basin downstream from the intake. The dividing wall of the diversion structure has two openings with diameters 1.3 feet and 0.8 feet diameter.

- 7. Puakaa Stream, K-14 intake into Koolau Ditch. Diversion structure consists of a 46 feet (L) x 2.3 feet (H) dam. Intake (5.7 x 5.2 feet, W x H) and sluice gate (2 x 4 feet, W x H) situate on the left bank, with the sluice gate further downstream from the intake. The dividing wall between the gravel basin and the ditch has an opening with diameter of 1.6 feet. Puakaa Stream was dry downstream from the diversion.
- Kopiliula Stream, K-15 intake into Koolau Ditch. Diversion structure is located by Hana Highway and consists of a 25.5 feet (L) x 2 feet (H) dam. Intake

and sluice gate situate on the left bank. Water from Kopiliula flows downstream and co-mingles with the ditch water (diverted from Makapipi, Hanawi, Kapaula, Waiaaka, Paakea, Waiohue, and Puakaa Streams) in the gravel basin and then flows back into the Koolau Ditch (tunnel) on the left bank. Kopiliula Stream had ponded water downstream from the diversion.

9. East Wailuaiki Stream, K-16 intake into Koolau Ditch.

Diversion dam consists of two walls, one man-made dam (34 feet - L, 4.4 feet - H), and a natural dam (61 feet - L, 5.5 feet - H). Intake ( $5 \times 4 \text{ feet}$ ,  $W \times H$ ) and sluice gate ( $3 \times 2 \text{ feet}$ ,  $W \times H$ ) situate on the left bank. The dividing wall between the gravel basin and the ditch is 42 feet (L) x 5 feet (H) and has two openings. East Wailuaiki Stream had ponded water downstream from the diversion.

10. West Wailuaiki Stream, K-17 intake into Koolau Ditch.

Diversion structure consists of a 30 feet (L) x 2 feet (H) dam. Intake ( $4.5 \times 3$  feet, W x H) and sluice gate ( $5.5 \times 3$  feet, W x H) situate on the right bank. The dividing wall between the gravel basin and the ditch is 33.5 feet in length. Water flows down a waterfall into a tunnel that runs further downstream into the intake and sluice structures. Past the diversion, water flows down a waterfall. West Wailuaiki Stream had ponded water downstream from the diversion.

Staff concluded the field visit at 1630 hours.

Image Listing: (Attach PDF of image contact sheet)	
File Name:	Brief Description:
20100202001	Small waterfall on Makapipi Stream upstream of K-1 intake into Koolau Ditch.
20100202002	Diversion structure (K-1 intake) on Makapipi Stream. Intake and sluice gate on the left bank.
20100202003	Downstream view of Makapipi Stream from the diversion structure.
20100202004	Makapipi Stream downstream of diversion.
20100202006	K-1 intake into Koolau Ditch on the left bank of Makapipi Stream.
20100202007	Diversion dam on Hanawi Stream.
20100202008	Minor diversion and sluice gate on the right bank of Hanawi Stream.
20100202009	Hanawi Stream upstream of diversion.
20100202010	Diversion structure (K-4 intake) on Hanawi Stream.
20100202011	Minor diversion on Hanawi Stream.
20100202013	Hanawi Stream downstream of diversion.
20100202014	K-4 intake into Koolau Ditch on the right bank of Hanawi Stream.
20100202016	Hanawi Stream downstream of diversion with water flowing past the sluice gate.
20100202018	Kapaula Stream about 150 feet downstream of diversion.
20100202019	Diversion dam on Kapaula Stream.
20100202020	Kapaula Stream immediately downstream of diversion dam.
20100202021	Kapaula Stream upstream of diversion.
20100202022	K-7 intake into Koolau Ditch on the right bank of Kapaula Stream.
20100202025	K-7 intake into Koolau Ditch on the right bank of Kapaula Stream.
20100202031	K-9 intake into Koolau Ditch on Waiaaka Stream. Water drops directly into the open ditch.
20100202032	K-9 intake into Koolau Ditch on Waiaaka Stream. Water drops directly into the open ditch.
20100202033	Waiaaka Stream upstream of the diversion.
20100202034	Waiaaka Stream downstream of the diversion.
20100202036	Diversion dam on Paakea Stream. K-10 intake and sluice gate on the left bank of the stream.
20100202037	Gravel basin and sluice of the diversion structure (K-10 intake) on Paakea Stream.
20100202038	Paakea Stream upstream of diversion.
20100202039	Paakea Stream downstream of diversion.
20100202040	CWRM staff measuring the dimensions of the control gate at the K-10 intake on Paakea Stream.
20100202042	CWRM staff measuring the dimensions of the sluice gate at the diversion structure (K-10 intake) on
	Paakea Stream.
20100202043	CWRM staff measuring the diameter of the opening on the dividing wall of the diversion structure (K-10
	intake) on Paakea Stream.
20100202048	K-13 intake into Koolau Ditch on Waiohue Stream.
20100202053	Waterfall and pond at the Koolau Ditch K-13 intake on Waiohue Stream.
20100202054	Close up of K-13 intake into Koolau Ditch on Waiohue Stream.
20100202059	Gravel basin and K-13 intake on Waiohue Stream.
20100202062	Dividing wall at the diversion structure (K-13 intake) on Waiohue Stream.
20100202063	K-14 intake into Koolau Ditch on the left bank of Puakaa Stream.
20100202064	Puakaa Stream upstream of diversion.
20100202065	Puakaa Stream downstream of diversion.
20100202068	Gravel basin, control gate, and sluice gate downstream of the main K-14 intake on Puakaa Stream.
20100202069	Gravel basin, control gate, and sluice gate downstream of the main K-14 intake on Puakaa Stream.
20100202070	Channel where water from the sluice gate flows down into Puakaa Stream.
20100202074	Diversion structure (K-15 intake) on Kopiliula Stream.

20100202075	Diversion structure (K-15 intake) on Kopiliula Stream.
20100202077	Kopiliula Stream upstream of diversion.
20100202079	Kopiliula Stream downstream of diversion.
20100202080	K-15 intake into Koolau Ditch on the left bank of Kopiliula Stream.
20100202082	Sluice gate on the left bank of the diversion structure (K-15 intake) on Kopiliula Stream.
20100202083	Diversion structure (K-16 intake) on East Wailuaiki Stream.
20100202084	Gravel basin of the diversion (K-16 intake) on the left bank of East Wailuaiki Stream.
20100202085	K-16 intake into Koolau Ditch on the left bank of East Wailuaiki Stream.
20100202087	East Wailuaiki Stream downstream of diversion.
20100202089	Dividing wall and gravel basin of the diversion (K-16 intake) on the left bank of East Wailuaiki Stream.
20100202091	Sluice gate at the diversion structure (K-16) on the left bank of East Wailuaiki Stream.
20100202092	Sluice gate at the diversion structure (K-16) on the left bank of East Wailuaiki Stream.
20100202095	East Wailuaiki Stream downstream of diversion.
20100202097	Koolau Ditch diversion structure (K-17 intake) on West Waikuaiki Stream.
20100202098	Koolau Ditch diversion structure (K-17 intake) on West Waikuaiki Stream.
20100202099	K-17 intake (right bank) into a short tunnel on West Wailuaiki Stream.
20100202100	Diversion dam on West Wailuaiki Stream.
20100202101	Gravel basin and sluice gate of the diversion structure (K-17 intake) on the right bank of West Wailuaiki
	Stream.
20100202104	West Wailuaiki Stream by the EMI access road.
20100202105	Gravel basin and sluice gate of the diversion structure (K-17 intake) on the right bank of West Wailuaiki Stream.
20100202106	West Wailuaiki Stream downstream of diversion intake.
20100202107	Diversion structure (K-17 intake) on West Wailuaiki Stream.
20100202111	Waterfall on West Wailuaiki Stream upstream of diversion by the bridge.
GPS Listing:	
Shapefiles: (List file nam	es of all shapefiles created and a brief description of each)
File Name:	Brief Description:
<u>ne nume.</u>	Bher Besenption
Waynoints: (List all wayr	wints in decimal degrees and provide a brief description of each)
WP No Latitude	Longitude Brief Description of cachy
Attachments:	
Brief Description:	
1. Image Contact Sheet	

2. Diversion Sketches

#### **Recommendations:**



20100202001.jpg



20100202002.jpg



20100202003.jpg



20100202004.jpg



20100202006.jpg





20100202008.jpg



20100202009.jpg





20100202011.jpg



20100202013.jpg



20100202014.jpg



20100202016.jpg

20100202018.jpg



20100202019.jpg







20100202020.jpg



20100202025.jpg

20100202021.jpg

20100202022.jpg









20100202033.jpg



20100202034.jpg



20100202036.jpg



20100202037.jpg



20100202038.jpg



20100202039.jpg



20100202040.jpg



20100202042.jpg



20100202043.jpg







20100202048.jpg

20100202053.jpg

20100202054.jpg



20100202059.jpg

20100202062.jpg



20100202064.jpg

20100202065.jpg





20100202069.jpg



20100202070.jpg



20100202074.jpg



20100202075.jpg



20100202077.jpg



20100202080.jpg



20100202082.jpg



20100202083.jpg



20100202084.jpg



20100202085.jpg



20100202087.jpg



20100202089.jpg



20100202091.jpg



20100202092.jpg



20100202095.jpg



20100202097.jpg

20100202098.jpg



20100202099.jpg

20100202100.jpg





20100202105.jpg



20100202106.jpg



20100202107.jpg



20100202111.jpg



x sink hole by highway

× mostly opue



- x gate was open by mistake.
- x with water, critters can climb up diversion
- × waterfall upstream.
- × how long is dry reach below diversion?



- × losing section downstream so moved dam further upstream.
- × no since gate.








## **DIVERSION SKETCH**













STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2010020301 (East Maui, Diversions)

Date of Field Investig	<b>Time</b> (24-hour): 0730 - 1630
CWRM Staff:	Dean Uyeno, Diane England, and Chui Ling Cheng
Individuals Present:	DAR Staff – Lance Nishiura
	EMI Staff – Garret Hew, Mark Vaught, Henry Robello
Hydrologic Unit:	East Maui
Stream Name:	Multiple Streams

#### Findings:

The purpose of this field visit was to document the physical dimensions of and how water flows past the EMI diversion structures in 17 petitioned streams in east Maui. The streams include Alo, Waikamoi, Wahinepee, Puohokamoa, Haipuaena, Pnalau/Kolea, Honomanu, Nuaailua, West Wailuaiki, East Wailuaiki, Kopiliula, Waiohue, Paakea, Waiaaka, Kapaula, Hanawi, and Makapipi. Documentation was completed in three days. The following is a list of streams and the respective diversions that staff visited on the second day of the field visit.

- Nuaailua Stream, S-1 intake into Spreckels Ditch. Diversion structure consists of a 25 feet (L) x 3.3 feet (H) dam. Intake (1.7 x 2.32 feet, W x H) situate on the left bank without a sluice gate. Two minor diversion pipes sit adjacent to the diversion dam, with diameters 0.62 feet and 0.5 feet. Nuaailua Stream marks the start of the Spreckels Ditch.
- Honomanu Stream, Banana Intake (S-2 intake) into Spreckels Ditch. Diversion structure consists of a 16 feet (L) x 2.7 feet (H) dam. Intake (2.3 x 3.3 feet, W x H) and sluice gate (2.5 x 2.7 feet, W x H) situate on the left bank. The dividing wall has a height of 3.2 feet. Honomanu Stream continues as a waterfall downstream from the diversion.
- Honomanu Stream, Center Intake (S-3 intake) into Spreckels Ditch. Diversion structure is below a waterfall and consists of a 24 feet (L) x 2.7 feet (H) dam, 5 feet (W) x 4.5 feet (H) intake, and 2.6 feet (W) x 2.7 feet (H) sluice gate. A black pipe on the right bank collects seepage and discharges into this diversion. Honomanu Stream continues as a waterfall downstream from the diversion, and the stream was dry.
- 4. Honomanu Stream, S-4 main intake into Spreckels Ditch. Diversion structure consists of a curved dam about 66 feet in length. Intake (4 x 3 feet, W x H) and sluice gate (4 x 3 feet, W x H) situate on the left bank. The dividing wall is 37 feet in length. Downstream from the diversion, the stream was dry but continues as a waterfall if the stream flowed.
- 5. Honomanu Stream, High Falls Intake (S-5 intake) into Spreckels Ditch. Diversion structure consists of a dam about 23 feet in length. Intake (4.2 x 2.4 feet, W x H) and sluice gate (2.6 x 2.7 feet, W x H) situate on the left bank. The dividing wall (16 x 2.6 feet, W x H) has two short pipes of diameter 0.37 feet. On the right is another pipe (ID of 3 inches) that captured seepage and discharges into the gravel basin of this diversion. Downstream from the diversion, the stream was relatively dry but continues as a waterfall if the stream flowed.
- 6. Uluini Stream (tributary of Honomanu Stream), S-6 intake into Spreckels Ditch. Diversion structure consists of an intake grate (11 x 4 feet) that spans the entire stream channel. Gravel basin and the sluice gate (2 x 4 feet, W x H) situate on the left stream bank. The dividing wall is about 5.5 feet in height. The stream was relatively dry downstream from the diversion.
- 7. Punalau/Kolea Stream, S-7 intake into Spreckels Ditch. Diversion structure consists of a 35 x 6 feet (W x H) dam with a valve (0.4 feet ID) that returns water to the stream. The intake (8 feet wide) is on the left stream bank. At the time of the field visit, the valve was open; thus, Kolea Stream downstream from the diversion was flowing.
- Haipuaena Stream, S-8 intake into Spreckels Ditch. Haipuaena Stream drops directly into Spreckels Ditch. The diversion structure does not have a sluice gate or gravel basin. The diversion dam is 63 feet in length, and the control gate at the intake 5 feet wide.
- 9. Puohokamoa Stream, K-33 intake into Koolau Ditch. Diversion structure consists of a 41 feet (L) x 3.2 feet (H) dam. Intake (10 x 5 feet, W x H) is on the left stream bank, with no sluice gate. The control (radio) gate is connected to a float in the Koolau Ditch. When the ditch is full, the float rises and the control gate shuts to allow water flow downstream to the next

ditch level, i.e., Spreckels Ditch. The Koolau and Spreckels Ditch are situated at different elevations. The intakes on Puohokamoa Stream into these two ditches are about 200 feet apart, with the Koolau Ditch intake upstream from the Spreckels Ditch intake.

10. Puohokamoa Stream, S-9 intake into Spreckels Ditch.

Diversion structure consists of 37 feet (L) x 3.5 feet (H) dam. The intake (4 x 2 feet, W x H) is on the left stream bank. Water from Puohokamoa Stream flows past the gravel basin, into the Spreckels Ditch, and eventually ends up in Alo Stream (tributary of Waikamoi Stream). The Koolau Ditch by Puohokamo Stream has a lower capacity. Therefore, the excess water captured by the Spreckels Ditch will continue to Alo Stream, where the Koolau Ditch has a higher capacity.

11. Punalau/Kolea Stream, ML-1 intake into Manuel Luis Ditch.

Diversion structure consists of a 39 feet (L) x 4.6 feet (H) dam, with the intake (4 x 1.8 feet, W x H) and sluice gate  $(3.8 \times 4 \text{ feet}, W \times H)$  on the left stream bank. The dividing wall is 27 feet in length and 3.3 feet high with one opening for water to flow from the gravel basin to the intake. If water is allowed to flow past the sluice gate, the water flows in a waterfall before continuing downstream. Punalau Stream was dry downstream from the diversion.

12. Haipuaena Stream, ML-2 intake into Manuel Luis Ditch.

Haipuaena Stream drops directly into Manuel Luis Ditch. The diversion structure does not have a sluice gate or gravel basin. The diversion dam is located on the opposite side of the EMI access road, and it is 36 feet in length and 6 feet high. Haipuaena Stream was dry downstream from the diversion.

- 13. Puohokamoa Stream, ML-3 intake into Manuel Luis Ditch. Puohokamoa Stream drops directly into Manuel Luis Ditch. The diversion structure does not have a sluice gate or gravel basin. The diversion dam is 30 feet in length and 6 feet high. Puohokamoa Stream was dry downstream from the diversion.
- 14. Waihinepee Stream, ML-5 intake Manuel Luis Ditch.

Wahinepee Stream drops directly into Manuel Luis Ditch. The diversion structure does not have a sluice gate or gravel basin. The diversion dam, which is also the ditch wall, is 17.5 feet in length and 8 feet high. Wahinepee Stream was dry downstream from the diversion.

Staff concluded the field visit at 1630 hours.

Image Listing: (Attach PDF of image contact sheet)		
File Name:	Brief Description:	
20100203006	Diversion structure (S-1 intake) at Nuaailua Stream.	
20100203007	Nuaailua Stream upstream of diversion (S-1 intake).	
20100203008	S-1 intake into Spreckels Ditch on the left bank of Nuaailua Stream.	
20100203009	Nuaailua Stream downstream of diversion (S-1 intake).	
20100203010	Honomanu Stream downstream from the diversion structure (S-2 intake).	
20100203011	S-2 intake into Spreckels Ditch on the left bank of Honomanu Stream. Active dam on the far right followed by three other abandoned dams.	
20100203012	S-2 intake into Spreckels Ditch on the left bank of Honomanu Stream.	
20100203013	Honomanu Stream upstream from the diversion (S-2 intake).	
20100203015	Gravel basin and dividing wall of the diversion structure (S-2 intake) on Honomanu Stream.	
20100203016	S-3 intake into Spreckels Ditch on Honomanu Stream.	
20100203017	Sluice gate of the diversion structure (S-3 intake) on the right bank of Honomanu Stream.	
20100203018	Honomanu Stream downstream from the diversion. The stream was dry.	
20100203019	S-3 intake into Spreckels Ditch on Honomanu Stream.	
20100203020	Minor diversion of seepage flow on the right bank of Honomanu Stream.	
20100203021	Diversion dam (S-4 intake) on Honomanu Stream.	
20100203022	Honomanu Stream downstream from the diversion.	
20100203023	Diversion dam (S-4 intake) on Honomanu Stream.	
20100203024	Gravel basin of the diversion structure (S-4 intake) on the right bank of Honomanu Stream.	
20100203025	Dividing wall between the gravel basin and the intake on Honomanu Stream.	
20100203026	Sluice gate of the diversion structure (S-4 intake) on the right bank of Honomanu Stream.	
20100203027	Honomanu Stream downstream from the diversion.	
20100203038	S-5 intake into Spreckels Ditch on the left bank of Honomanu Stream.	
20100203041	Honomanu Stream downstream from the diversion.	
20100203043	Diversion structure (S-5 intake) on Honomanu Stream.	
20100203045	High Falls above diversion structure (S-5 intake) on Honomanu Stream.	
20100203064	S-6 intake into Spreckels Ditch on Uluini Stream.	
20100203065	Uluini Stream upstream from the diversion.	
20100203066	Uluini Stream downstream from the diversion.	
20100203067	Gravel basin and sluice gate of the diversion structure (S-6 intake) on Uluini Stream.	
20100203072	Spreckels Ditch near S-6 intake on Uluini Stream.	

20100203074	Spreckels Ditch and S-6 intake on Uluini Stream.
20100203076	Diversion dam (S-7 intake) on Kolea Stream
20100203077	Kolog Stream unstream from the diversion
20100203077	
20100203078	S-7 Intake into Koolau Ditch on Kolea Stream.
20100203079	Kolea Stream downstream from the diversion.
20100203080	Diversion structure (S-7 intake) on Kolea Stream
20100200000	Kales Street doubter the first the FML access read
20100203061	Kolea Stream downstream norm the Enh access road.
20100203083	Kolea Stream diverted into the Spreckels Ditch.
20100203084	Control gate of the S-8 intake into Spreckels Ditch on the left bank of Haipuaena Stream.
20100203085	Haipuaena Stream upstream from diversion
20100202086	Control acts of the S single intersection around the lotter on the left hank of Heinycone Stream
20100203080	Control gate of the S-o intake into Spieckels Dich of the left bank of Halpuaena Stream.
20100203087	Haipuaena Stream downstream from diversion.
20100203088	Diversion structure (S-8 intake) on the left bank of Haipuaena Stream.
20100203094	K-33 intake into Koolau Ditch on the left hank of Puohokamoa Stream
20100202005	K 22 intake into Koolay Dish on the left bank of Dyshakamaa Straam
20100203095	K-33 Intake into Koolau Ditch on the left bank of Puonokamoa Stream.
20100203096	Puohokamoa Stream downstream from the K-33 intake into Koolau Ditch, but upstream from the S-9 intake
	into Spreckels Ditch.
20100203097	Diversion dam for the K-33 intake on Puohokamoa Stream
20100202000	Bushakaman Stram unatraam from the K 22 intake into Kaalau Ditah
20100203098	Puonokamoa Stream upstream from the K-33 intake into Koolau Ditch.
20100203100	Diversion dam, gravel basin, and dividing wall of the Spreckels Ditch diversion on the left bank of
	Puohokamoa Stream.
20100203101	Puohokamoa Stream downstream from the S-9 intake into Spreckels Ditch
20100202107	Diversion dom for the K-23 inteke on Pueblomee Stream
20100203107	
20100203108	Dividing wall for the K-33 intake on Puohokamoa Stream.
20100203109	Puohokamoa Stream upstream from the K-33 intake into Koolau Ditch.
20100203112	Diversion dam for the M -1 intake on Punalau Stream
20100202112	Busiliau Straam dourinteram from the diversion (ML 1 intelse)
20100203113	
20100203114	Diversion dam, gravel basin, and dividing wall of the ML-1 intake into Manuel Luis Ditch on the left bank of
	Punalau Stream.
20100203115	Punalau Stream upstream from the diversion (MI -1 intake).
20100203116	Diversion structure (ML 1 intake) on Punglau Stream Intake and sluice gets on the left stream bank
20100203110	Diversion structure (ME-1 intake) on Fundau Stream. Intake and since gate on the left stream bank.
20100203117	Diversion dam, gravel basin, and dividing wall of the ML-1 intake into Manuel Luis Ditch on the left bank of
	Punalau Stream.
20100203119	Diversion dam of the ML-2 intake into Manuel Luis Ditch on Haipuaena Stream.
20100203120	Hainyaona Stram unstram from the diversion
20100203120	
20100203121	ML-2 intake into the Manuel Luis Ditch on Haipuaena Stream.
20100203122	Haipuaena Stream downstream from the diversion (ML-2 intake).
20100203123	Puohokamoa Stream upstream from the diversion (MI -3 intake)
20100203125	Diversion day and ML 2 into the Manual Luis Ditch on Puebekamea Stream
20100203123	
20100203129	Puohokamoa Stream downstream from the diversion (ML-3 intake).
20100203140	ML-5 intake into the Manuel Luis Ditch on Wahinepee Stream. Waterfall drops directly into the ditch.
Video Listing:	
File Name:	Brief Description:
2010020301	Nuaailua Stream, S-1 Intake, Spreckels Ditch, Feb. 3, 2010.
	Compiled from the original m2ts files: 20100203101912
2010020202	University Valley Trib To University Stream C 2 (Danage) Intele Streakele Ditch Tob 2 2010
2010020302	Honorianu Valley, Thb. To Honorianu Stream, S-2 (Bahana) Intake, Spreckels Ditch, Feb. 3, 2010.
	Compiled from the original m2ts files: $20100203103701$ , $20100203103830$ , $20100203104002$ ,
	20100203104306, 20100203104530, 20100203104636.
2010020303	Trib. To Honomanu Stream. S-3 (Center) Intake, Spreckels Ditch. Feb. 3, 2010.
	Compiled from the original m2ts files: 20100203110644, 20100203110750
2010020201	
2010020304	Honomanu Stream, S-4 (Main) Intake, Spreckels Ditch, Feb. 3, 2010.
	Compiled from the original m2ts files: 20100203111804, 20100203111943, 20100203112112,
	20100203112235.
2010020305	Trib. To Honomanu Stream, S-5 (High Falls) Intake, Spreckels Ditch, Feb. 3, 2010.
	Compiled from the original m2ts files: 20100203113320
2010020206	Trib To Homenou Stroom C. 6 (Illuini) Intele Special Ditab Eab 2, 2010
2010020300	The remonstrate Stream, S-b (Olumi) Intake, Spieckers Ditch, Feb. 3, 2010.
	Compiled from the original m2te files: 20100202120641_20100202120716_20100202121616
2010020307	
_0.00_000.	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010.
	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931.
2010020308	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Hainuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010.
2010020308	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Haipuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010.
2010020308	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Haipuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203124953, 20100203125140.
2010020308 2010020309	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Haipuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203124953, 20100203125140. Puohokamoa Stream, K-33 Intake, Koolau Ditch, Feb. 3, 2010.
2010020308 2010020309	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Haipuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203124953, 20100203125140. Puohokamoa Stream, K-33 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203130138, 20100203134856, 20100203135408.
2010020308 2010020309 2010020310	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Haipuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203124953, 20100203125140. Puohokamoa Stream, K-33 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203130138, 20100203134856, 20100203135408. Puohokamoa Stream, S-9 Intake, Spreckels Ditch, Feb. 3, 2010.
2010020308 2010020309 2010020310	Punalau/Kolea Stream, K-32 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203122931. Haipuaena Stream, S-8 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203124953, 20100203125140. Puohokamoa Stream, K-33 Intake, Koolau Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203130138, 20100203134856, 20100203135408. Puohokamoa Stream, S-9 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203130138, 20100203134856, 20100203135408. Puohokamoa Stream, S-9 Intake, Spreckels Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203140514

2010020312 2010020313 2010020314	Compiled from the original m2ts files: 20100203144409, 20100203144524, 20100203145606. Haipuaena Stream, ML-2 Intake, Manuel Luis Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203151023. Puohokamoa Stream, ML-3 Intake, Manuel Luis Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203152734, 20100203153033. Wahinepee Stream, ML-5 Intake, Manuel Luis Ditch, Feb. 3, 2010. Compiled from the original m2ts files: 20100203160306.
GPS Listing:	
Shapefiles: (List file	names of all shapefiles created and a brief description of each)
File Name:	Brief Description:
FI2010020201	GPS shapefile provided by DAR for field investigations FI2010020201, FI2010020301, FI2010020401. See DAR report for specific waypoint information.
Waypoints: (List all v <u>WP No. Latitude</u>	waypoints in decimal degrees and provide a brief description of each)    Longitude Brief Description:
Waypoints: (List all <u>WP No.</u> <u>Latitude</u> Attachments:	waypoints in decimal degrees and provide a brief description of each)    Longitude Brief Description:
Waypoints: (List all <u>WP No.</u> <u>Latitude</u> Attachments: Brief Description:	waypoints in decimal degrees and provide a brief description of each)     Longitude   Brief Description:
Waypoints: (List all <u>WP No.</u> <u>Latitude</u> Attachments: <u>Brief Description:</u> 1. Image Contact Sh	waypoints in decimal degrees and provide a brief description of each)    Longitude Brief Description:   neet Image: State Stat
Waypoints: (List all N <u>WP No.</u> Latitude Attachments: <u>Brief Description:</u> 1. Image Contact Sh 2. Diversion Sketche	waypoints in decimal degrees and provide a brief description of each)    Longitude Brief Description:   neet %



20100203007.jpg

20100203008.jpg



20100203009.jpg



20100203010.jpg



20100203012.jpg



20100203013.jpg



20100203016.jpg







20100203015.jpg



20100203018.jpg







20100203020.jpg

20100203021.jpg







20100203025.jpg



20100203023.jpg



20100203026.jpg

20100203024.jpg



20100203027.jpg



20100203038.jpg

20100203041.jpg







20100203064.jpg

20100203065.jpg







20100203066.jpg

20100203067.jpg

20100203072.jpg







20100203074.jpg

20100203076.jpg

20100203077.jpg



20100203078.jpg

20100203079.jpg



20100203083.jpg

20100203084.jpg





20100203085.jpg

20100203086.jpg

20100203087.jpg







20100203088.jpg

20100203094.jpg

20100203095.jpg



20100203096.jpg

20100203097.jpg









20100203107.jpg



20100203108.jpg

20100203109.jpg



20100203112.jpg



20100203113.jpg



20100203114.jpg



20100203115.jpg



20100203116.jpg

20100203117.jpg



20100203121.jpg

20100203122.jpg



20100203123.jpg



20100203125.jpg



20100203140.jpg

















.....









×.





SQ

FI2010020301 - Page 24 of 24 Ditch watchfull SN clitch wall (Manuel Luis Ditch.) - 17.5' 18 - 4 Sa MLS × no sluice gate. x dry bs Matia WAHINEPEE



STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2010020401 (East Maui, Diversions)

Date of Field Investig	<b>Time</b> (24-hour): 0730 - 1430
CWRM Staff:	Dean Uyeno, Diane England, and Chui Ling Cheng
Individuals Present:	DAR Staff – Lance Nishiura
	EMI Staff – Garret Hew, Mark Vaught, Henry Robello
Hydrologic Unit:	East Maui
Stream Name:	Multiple Streams

#### Findings:

The purpose of this field visit was to document the physical dimensions of and how water flows past the EMI diversion structures in 17 petitioned streams in east Maui. The streams include Alo, Waikamoi, Wahinepee, Puohokamoa, Haipuaena, Punalau/Kolea, Honomanu, Nuaailua, West Wailuaiki, East Wailuaiki, Kopiliula, Waiohue, Paakea, Waiaaka, Kapaula, Hanawi, and Makapipi. Documentation was completed in three days. The following is a list of streams and the respective diversions that staff visited on the third day of the field visit.

- 1. Waikamoi Stream, C-1 intake into Center Ditch.
  - Diversion structure consists of a 80 feet (L) x 6 feet (H) dam. Intake and sluice gate (3.8 x 4.7 feet, W x H) situate on the left stream bank. The dividing wall is 50 feet (L) x 3 feet (H), and has three openings with diameter of 0.6 feet. This section of the Waikamoi Stream is used for conveying water from the Manuel Luis Ditch to the Center Ditch. Downstream from the diversion, Waikamoi Stream was dry but would continue as a waterfall when there is flow.
- 2. Alo Stream (tributary to Waikamoi), W-1 intake into Wailoa Ditch. Diversion structure consists of a 36 feet (L) x 8 feet (H) dam. The intake grate (8 x 10 feet) spans across the stream channel and is about 6.5 feet above the stream. The control gate, gravel basin, and two sluice gates (3 x 3 feet, W x H) are situated on the left stream bank. This section of Alo Stream is used to convey water from Spreckels Ditch to the Wailoa Ditch.
- 3. Alo Stream (tributary to Waikamoi), NH-1 intake into New Hamakua Ditch.

Diversion structure consists of a 10 feet tall curved dam, of about 26 feet from the intake to the sluice gate. The dividing wall (43 feet in length) and the intake (5 x 2.2 feet, W x H) are situated on the left stream bank. The sluice gate (3 x 4.4 feet, W x H) is on the right stream bank. During normal flows, much of the water from Alo Stream has already been diverted at the Wailoa Ditch level. Therefore, this stretch of the stream is most often dry. However during high flows, when the Wailoa Ditch is full, the excess water from the Wailoa Ditch and the stream itself is diverted into the New Hamakua Ditch via this intake. Alo Stream was dry downstream from this diversion and would continue as a waterfall if flow was present.

4. Waikamoi Stream, W-2 intake into Wailoa Ditch.

Diversion structure consists of a 50 feet (L) x 4 feet (H) dam. The dividing wall, about 41 feet in length and 2.1 feet in height, is on the left stream bank. Water flows into two inlets and is transported to the Wailoa Ditch further downstream (by the swinging bridge). A minor diversion is located on the right stream bank. At the Wailoa Ditch by the swinging bridge, the radio gate (with float chamber) controls the water entering the New Hamakua Ditch (via a cross-tunnel) when Wailoa Ditch is full. The two sluice gates are 4 x 4 feet (W x H). Waikamoi Stream was dry downstream from the diversion.

- Waikamoi Stream, Skimming Dam Intake (S-10 intake) into Spreckels Ditch. Diversion structure consists of a 31 feet (L) x 4.7 feet (H) dam. The dividing wall is 41 feet (L) x 1.8 feet (H) and has one opening that is 3 inches wide. The intake (6.8 x 4 feet, W x H) is located on the left stream bank, with no sluice gate. This diversion diverts excess water from Waikamoi to Kolea Stream. The stream was dry downstream from the diversion.
- 6. Kolea Stream, Kolea Power House Intake (K-32 intake) into Koolau Ditch. Diversion structure consists of a 50 feet (L) x 13 feet (H) dam with the intake grate (17 x 28 feet), control gate (9.5 x 1.3 feet, W x H), dividing wall, and gravel basin on the left stream bank. There are two sluice gates on the left stream bank, each 3.6 feet wide x 5 feet high. Kolea Stream was dry downstream from the diversion. The power house was no longer in operation.

Staff concluded the field visit at 1430 hours.

Image Listing: (Attach F	PDF of image contact sheet)	
File Name:	Brief Description:	
20100204003	Diversion structure (C-1 intake into Center Ditch) on the left bank of Waikamoi Stream.	
20100204004	Waikamoi Stream downstream from the diversion (C-1 intake).	
20100204005	Waikamoi Stream upstream from the diversion (C-1 intake).	
20100204006	Dividing wall and C-1 intake into Center Ditch on the left bank of Waikamoi Stream.	
20100204007	Sluice gate of the C-1 intake into Center Ditch on the left bank of Waikamoi Stream.	
20100204008	Sluice gate of the C-1 intake into Center Ditch on the left bank of Waikamoi Stream.	
20100204009	Diversion structure (C-1 intake into Center Ditch) on the left bank of Waikamoi Stream.	
20100204010	Waikamoi Stream downstream from the diversion (C-1 intake).	
20100204016	W-1 intake into Wailoa Ditch on Alo Stream.	
20100204017	Control gate and gravel basin of the diversion (W-1 intake) on the left bank of Alo Stream.	
20100204018	Alo Stream upstream from the diversion (W-1 intake).	
20100204019	W-1 intake into Wailoa Ditch on Alo Stream. The intake spans across the stream channel.	
20100204020	W-1 intake into Wailoa Ditch on Alo Stream. The intake spans across the stream channel.	
20100204021	Diversion dam of the W-1 intake into Wailoa Ditch on Alo Stream.	
20100204022	Sluice gates of the diversion structure (W-1 intake) on the left bank of Alo Stream.	
20100204023	Diversion structure (W-1 intake) on Alo Stream.	
20100204024	Diversion structure (W-1 intake) on Alo Stream.	
20100204025	Alo Stream upstream from diversion (W-1 intake).	
20100204026	Diversion structure (NH-1 intake into New Hamakua Ditch) on Alo Stream.	
20100204027	Diversion dam of the NH-1 intake into New Hamakua Ditch on Alo Stream.	
20100204028	Dividing wall, gravel basin, and intake of the diversion (NH-1 intake) on the left bank of Alo Stream.	
20100204029	Alo Stream downstream from the NH-1 intake into New Hamakua Ditch.	
20100204031	Diversion structure (NH-1 intake into New Hamakua Ditch) on Alo Stream.	
20100204032	Dividing wall and intake of the diversion (NH-1 intake) on the left bank of Alo Stream.	
20100204033	Alo Stream downstream from the NH-1 Intake into New Hamakua Ditch.	
20100204034	Swinging bridge on the way to the W-2 Intake into Walloa Ditch on Walkamol Stream.	
20100204036	Walkamol Stream upstream from the W-2 Intake into Walloa Ditch.	
20100204037	Graver basin, dividing wall, and w-2 intake into walloa Ditch on the left bank of walkamor Stream.	
20100204038	W 2 inteke into Weilee Ditch on the left bank of Weikemei Streem	
20100204040	W 2 inteke into Walloa Ditch on the left bank of Walkamoi Stream.	
20100204042	Weikamei Stream dewestream from the sluice gates of the W 2 inteke diversion structure	
20100204043	National Subarray and the $W_2$ intake diversion structure on Weikemoi Stream	
20100204044	Waikamoi skimming dam of the S-10 intake into Spreckels Ditch on Waikamoi Stream	
20100204045	S-10 intake into Spreckels Ditch on the left bank of Waikamoi Stream	
20100204047	Waikamoi Stream unstream from the S-10 intake into Spreckels Ditch	
20100204047	Waikamoi Stream downstream from the S-10 intake into Spreckels Ditch	
20100204049	Waterfall on Waikamoi Stream unstream from the S-10 intake into Spreckels Ditch	
20100204050	Waternal on Waternahol et can dividing wall, and gravel basin of the S-10 intake into Spreckels Ditch on	
20100201000	Waikamoi Stream.	
20100204054	Diversion structure (K-32 intake into Koolau Ditch) on the left bank of Kolea Stream.	
20100204055	Diversion dam of the K-32 intake into Koolau Ditch of Kolea Stream.	
20100204056	K-32 intake into Koolau Ditch of Kolea Stream.	
20100204057	K-32 intake into Koolau Ditch of Kolea Stream.	
20100204059	Sluice gate of the K-32 diversion intake into Koolau Ditch of Kolea Stream.	
GPS Listing		
Shapefiles: (List file names of all shapefiles created and a brief description of each)		
File Name:	Brief Description:	
Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)		

**Brief Description:** 

Attachments:

WP No. Latitude

Longitude

Brief Description: 1. Image Contact Sheet 2. Diversion Sketches

#### **Recommendations:**







20100204004.jpg



20100204005.jpg



20100204006.jpg





20100204008.jpg



20100204009.jpg



20100204010.jpg



20100204016.jpg



20100204017.jpg

20100204018.jpg





20100204020.jpg

20100204021.jpg



20100204022.jpg



20100204023.jpg



20100204024.jpg



20100204025.jpg



20100204026.jpg



20100204029.jpg



20100204027.jpg







20100204032.jpg



20100204033.jpg





20100204034.jpg

20100204036.jpg









20100204038.jpg



20100204043.jpg

20100204040.jpg



20100204044.jpg



20100204045.jpg

20100204046.jpg



20100204048.jpg



20100204049.jpg



20100204050.jpg



20100204054.jpg



20100204055.jpg

20100204056.jpg





20100204059.JPG
















# FIELD INVESTIGATION REPORT

FI2010062301 (East Maui)

Date of Field Investig	<b>Time</b> (24-hour): 0600 - 1100
CWRM Staff:	Ken Kawahara, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	DAR Staff – Robert Nishimoto, Glenn Higashi
	USGS Staff - Clarence (Buzz) Edwards, Richard Castro
	EMI Staff – Garret Hew, Mark Vaught, Henry Robello
Hydrologic Unit:	Honopou
Stream Name:	Honopou Stream

#### Findings:

Staff arrived in Maui at 0600 hours.

The purpose of this field investigation was to visit the diversion modification at New Hamakua Ditch on Honopou Stream, and to document flow release at the Wailoa Ditch on Honopou Stream. At 0730 hours, staff met with EMI staff and the Honopou residents at the Haiku Ditch on Honopou Stream. From there, everyone drove to the Lowrie Ditch for a pre-release flow measurement. USGS staff selected a measurement cross section upstream from the Lowrie Ditch intake on Honopou Stream. Flow measurement was completed in 20 minutes. The estimated discharge was 0.45 cubic feet per second (0.29 million gallons per day).

At 0930 hours, staff arrived at the New Hamakua Ditch on Honopou Stream. The EMI staff had modified this diversion the previous week in an effort to allow water to flow downstream first before going into the ditch. Refer to the Image Contact Sheet for pictures of the diversion modification. At 0955 hours, streamflow was released from the sluice gate at the Wailoa Ditch diversion on Honopou Stream. By 1053 hours, streamflow reached the diversion dam of the New Hamakua Ditch on Honopou Stream. Staff departed Honopou Stream at 1130 hours.

* Note: Post-release flow measurement was conducted the following day.

Image Listing: (Attach F	PDF of image contact sheet)
File Name:	Brief Description:
20100623002	USGS staff conducting pre-release flow measurement upstream from the Lowrie Ditch intake on Honopou
	Stream.
20100623004	USGS staff conducting pre-release flow measurement upstream from the Lowrie Ditch intake on Honopou
	Stream.
20100623008	Measurement cross section for the pre-release flow measurement upstream from the Lowrie Ditch intake
	on Honopou Stream.
20100623014	Modification of the New Hamakua Ditch intake on Honopou Stream.
20100623015	Pond downstream from the New Hamakua Ditch intake on Honopou Stream.
20100623016	Modification of the New Hamakua Ditch intake on Honopou Stream.
20100623018	Modification of the New Hamakua Ditch intake on Honopou Stream.
20100623022	Honopou Stream downstream from the Wailoa Ditch intake.
20100623024	Wailoa Ditch intake on Honopou Stream.
20100623025	Honopou Stream upstream from the New Hamakua Ditch intake.
20100623026	EMI staff opening the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623029	EMI staff opening the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623030	Flow release from the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623031	Flow release from the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623032	Flow release from the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623035	The community witnessed the flow release from the sluice gate at the Wailoa Ditch diversion on Honopou
	Stream.
20100623037	Flow release from the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623038	Flow release from the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623040	CWRM staff taking measurements of the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623041	CWRM staff taking measurements of the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623042	CWRM staff taking measurements of the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623044	CWRM staff taking measurements of the sluice gate at the Wailoa Ditch diversion on Honopou Stream.

20100623046	Behind the sluice gate at the Wailoa Ditch diversion on Honopou Stream.
20100623051	Flow reaching the diversion dam of the New Hamakua Ditch intake on Honopou Stream.
GPS Listing:	
Shapefiles: (List file r <u>File Name:</u>	names of all shapefiles created and a brief description of each) Brief Description:
Waypoints: (List all w <u>WP No. Latitude</u>	aypoints in decimal degrees and provide a brief description of each) <u>Longitude</u> <u>Brief Description:</u>
Attachments:	
Brief Description:	
1. Image Contact She	eet
2. Discharge Summa	ry
Recommendations	:



20100623002.jpg

20100623004.jpg

20100623008.jpg



20100623014.jpg



20100623018.jpg



20100623015.jpg



20100623022.jpg

20100623016.jpg



20100623024.jpg



20100623025.jpg



20100623026.jpg



20100623029.jpg



20100623030.jpg

20100623031.jpg

20100623032.jpg





20100623035.jpg

20100623037.jpg

20100623038.jpg







20100623040.jpg



20100623044.jpg

20100623041.jpg

20100623042.jpg





20100623046.jpg

20100623051.jpg

ro UISO	charge	Sumn	nary						•	Original Aq	uaCalc Val	nes	O Re-Cal	culated Val	ues
	2	<b>WRIE</b>				USI U	er ID:		<b>-</b>			seg Time:	-	06/23/10	08:27
		Me	asurement	t Informati	on						-	Aeter Info	rmation		
15		ш	d Time:	0	6/23/10 0	8:47	Measur	e time:		40	-	Aeter name		BUZZMA	ڻ ن
0.49	_	Me	as Time:		0.33		Measur	e standaro	÷	SAE	-	Aeter id:		P05410	
2.85		Sei S	ction Diff:		0.45		Measur	e equipme	ant: TopS	set Rod	-	Aeter type:	-	PYGMY	
0.92	~ .	Be	g Gage hei	ght:	0.00		Soundi	ng Weight		ΝA	-	Aeter Stan	dard:	SAE	
0.45		Ĕ	d Gage hei	ght:	0.00		Measur	e ice:		Ŷ	-	Aeter Revs	i/Pulses:	1/1	
0.45		Be	g Staff heig	ht:	0.00		Flood N	leasureme	ent:	Ŷ	-	Aeter Cons	st.S1:	0.9604	
%00		Ĕ	d Staff heig	ht:	0.00		Flood 0	coef:		0.00	-	Aeter Cons	st.01:	0.0312	
č	~	Est	imated Q:		0.00		Max Ve	rtical Q:		5%	-	Aeter Cons	st.C1:	0.0000	
3.15		Adj	usted Q:		0.00		Percen	t Slope:		0.00	-	Aeter Cons	st.S2:	0.0000	
0.2	6	Aq	uaCalc				Measur	e Start at:		LEW	-	Aeter Cons	st.02:	0.0000	
8.0	0	2/S		0	00000F25	952F					-	Aeter Cons	st.C1:	0.0000	
8.0	0	Ë	mware Vers	sion: A	QP-1V1.2						-	Aeter Cons	st.S3:	0.0000	
		File	Version:	~	/1.5						-	Aeter Cons	st.03:	0.0000	
			C	heaniati						Maseuro			- dus	-dus	Sub.
Ę	al	lce	fective	No	œ	Revolu H	oriz	Meth	od Clock	p	Obs	Vertical	section	Section 5	ection %
Dept	£	Draft	Depth	Location	Time	tions Ar	ngle HC	:VF Co	ef Tme	Velocity	Velocity	Velocity	Area	ð	of Total Q
0.0		0.00	0.00	ш	0.00	0	0	00 0.0	0 08:27			00.00	0.00	0.00	0.00%
0.20	~	0.00	0.20	0.6	41.49	5	0	00 1.0	0 08:29	0.15	0.15	0.15	0.04	0.01	2.20%
0.2	5	0.00	0.25	0.6	41.54	13	0	00 1.0	0 08:30	0.33	0.33	0.33	0.05	0.02	4.40%
0.2	0	0.00	0.25	0.6	41.61	18	0	00 1.0	0 08:32	0.45	0.45	0.45	0.05	0.02	4.40%
0.3	0	0.00	0.30	0.6	41.21	13	0	00 1.0	0 08:33	0.33	0.33	0.33	0.06	0.02	4.40%
0.4	N N	0.00	0.42	0.6	41.08	17	0	00 1.0	0 08:34	0.43	0.43	0.43	0.08	0.04	8.90%
0.4	ŝ	0.00	0.45	0.6	40.92	34	0	00 1.0	0 08:35	0.83	0.83	0.83	0.09	0.07	15.60%
0.4	ب ب	0.00	0.43	0.6	40.01	46	0	00 1.0	0 08:36	1.14	1.14	1.14	0.09	0.10	22.20%
0.4	9	0.00	0.40	0.6	41.43	32	0	00 1.0	0 08:37	0.77	0.77	0.77	0.08	0.06	13.30%
0.3		0.00	0.38	0.6	45.89	11	0	00 1.0	0 08:41	0.26	0.26	0.26	0.08	0.02	4.40%
4.0	0	0.00	0.40	0.6	41.00	16	0	00 1.0	0 08:43	0.41	0.41	0.41	0.08	0.03	6.70%
0.4	o o	0.00	0.40	0.6	45.41	7	0	00 1.0	0 08:44	0.18	0.18	0.18	0.08	0.01	2.20%
0.4	0	0.00	0.40	0.6	42.25	13	0	00 1.0	0 08:45	0.33	0.33	0.33	0.08	0.03	6.70%
0.3	0	0.00	0.30	0.6	41.19	6	0	00 1.0	0 08:47	0.24	0.24	0.24	0.07	0.02	4.40%
0.0	0	0.00	0.00		0.00	0	0	00 0.0	0 08:47			0.00	0.00	0.00	0.00%



# FIELD INVESTIGATION REPORT

FI2010062302 (East Maui)

Date of Field Investig	<b>Time</b> (24-hour): 1130 - 1630
CWRM Staff:	Ken Kawahara, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	DAR Staff – Robert Nishimoto, Glenn Higashi
	USGS Staff - Clarence (Buzz) Edwards, Richard Castro
	EMI Staff – Garret Hew, Mark Vaught, Henry Robello
Hydrologic Unit:	Multiple
Stream Name:	West Wailuaiki, East Wailuaiki, and Waikamoi Streams

Findings:

The purpose of this field investigation was to show DAR staff the diversions that need to be modified according to the May Commission decision on implementing interim IFS for 6 east Maui streams: Waikamoi, West Waikuaiki, East Waikuaiki, Waiohue, Hanawi, and Makapipi streams. For this field investigation, staff visited the following sites:

- 1. Koolau Ditch intake on West Wailuaiki Stream
- 2. Koolau Ditch intake on East Wailuaiki Stream
- 3. Center Ditch intake on Waikamoi Stream

After seeing some of the diversions, DAR proposed a few solutions for meeting seasonal flow requirements. In the wet season, EMI will likely open sluice gates to meet the interim IFS. In the dry season, EMI could install pipes that would convey water from an upstream location and drop water onto the dam wall to create a wetted pathway allowing for the upstream migration of native fauna. DAR would field test this method to confirm its feasibility.

Staff concluded the field investigation at 1630 hours.

Image Listing: (Attach PDF of image contact sheet) File Name: Brief Description:

**GPS Listing:** 

 Shapefiles:
 (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:

Attachments: Brief Description:

**Recommendations:** 



# FIELD INVESTIGATION REPORT

FI2010062401 (East Maui, Makapipi)

Date of Field Investig	<b>Time</b> (24-hour): 0830 - 1000
CWRM Staff:	Ken Kawahara, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	DAR Staff – Robert Nishimoto, Glenn Higashi
	USGS Staff - Clarence (Buzz) Edwards, Richard Castro
11 1	EMI Staff – Garret Hew, Mark Vaught, Henry Robello
Hydrologic Unit:	Makapipi
Stream Name:	Makapipi Stream
Findings:	
The purpose of this fie Makapipi Stream. In a the interim IFS location staff gage for the purp gage would be located	Id visit was to accompany USGS staff in selecting potential sites for monitoring interim IFS on a previous site visit, USGS staff selected a site about 100 feet upstream from Hana Highway as n. During this field visit, USGS staff selected a second location for the installation of a second ose of providing the Nahiku residents a way to monitor the flow in the stream. The second staff I by the bridge on Lower Nahiku Road.
Image Listing: (Attach	PDF of image contact sheet)
File Name:	Brief Description:
20100624001	Makapipi Stream upstream from the bridge on Lower Nahiku Road.
20100624002	Makapipi Stream at the bridge on Lower Naniku Road. Potential site for the second staff dage on Makapini Stream immediately downstream from the bridge on
20100024000	Lower Nahiku Road.
20100624011	Very flow in Makapipi Stream downstream from the bridge on Lower Nahiku Road.
20100624013	Potential site for the second staff gage on Makapipi Stream viewed from the bridge on Lower Nahiku Road.
GPS Listing:	
Shapefiles: (List file nam File Name:	nes of all shapefiles created and a brief description of each) Brief Description:
Waypoints: (List all waypoints: (List all waypoints) WP No. Latitude	points in decimal degrees and provide a brief description of each)          Longitude       Brief Description:
Attachments:	
Brief Description:	
1. Image Contact Sheet	
Recommendations:	
Neconinentiations.	



20100624001.jpg



20100624011.jpg

20100624013.jpg

20100624008.jpg



# FIELD INVESTIGATION REPORT

FI2010062402 (East Maui)

Date of Field Investig	<b>Time</b> (24-hour): 1000 - 1300
CWRM Staff:	Ken Kawahara, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	DAR Staff – Robert Nishimoto, Glenn Higashi
	USGS Staff - Clarence (Buzz) Edwards, Richard Castro
	EMI Staff – Garret Hew, Mark Vaught, Henry Robello
Hydrologic Unit:	Hanawi, Waiohue
Stream Name:	Hanawi and Waiohue Streams

#### Findings:

The purpose of this field investigation was 1) to show DAR staff the diversions that need to be modified according to the May Commission decision on implementing interim IFS for 6 east Maui streams - Waikamoi, West Waikuaiki, East Waikuaiki, Waiohue, Hanawi, and Makapipi streams; and 2) to accompany USGS staff in selecting potential sites for monitoring interim IFS.

At 1000 hours, staff arrived at the Koolau Ditch diversion intake on Hanawi Stream. DAR staff inspected the diversion and proposed that EMI could use the existing pipes for the minor diversion and drop water onto the dam wall to create a wetted pathway allowing for the upstream migration of native fauna. DAR would field test this method to determine its feasibility.

At 1200 hours, staff arrived at Pua Kaa State Park and walked to Waiohue Stream for the purpose of selecting a site for monitoring interim IFS established at the May Commission meeting. USGS staff selected a site beneath Hana Highway on the right stream bank for installation of a staff gage.

At 1230 hours, staff left Pua Kaa State Park and headed for the Koolau Ditch diversion intake on Waiohue Stream. DAR staff inspected the diversion and proposed that in the wet season, EMI could open sluice gates to meet the interim IFS. In the dry season, EMI could install pipes that would convey water from an upstream location and drop water onto the dam wall to create a wetted pathway allowing for the upstream migration of native fauna. DAR would field test this method to determine its feasibility.

Image Listing: (Attach P	DF of image contact sheet)
File Name:	Brief Description:
20100624016	Minor diversion intake at the tributary of Hanawi Stream.
20100624019	Minor diversion intake from a tributary of Hanawi Stream dropped into the Koolau Ditch by the major diversion.
20100624020	Minor diversion intake from a tributary of Hanawi Stream dropped into the Koolau Ditch by the major diversion.
20100624022	Hanawi Stream upstream from the Koolau Ditch intake.
20100624028	Potential site for installation of a staff gage on Waiohue Stream, beneath Hana Highway.
20100624033	Waiohue Stream upstream from Hana Highway.
20100624034	Waterfall on Waiohue Stream upstream from the Koolau Ditch intake.
20100624036	Koolau Ditch intake diversion dam on Waiohue Stream.
20100624037	Koolau Ditch intake on Waiohue Stream.
20100624040	Waiohue Stream downstream from the Koolau Ditch intake.
GPS Listing:	

# Shapefiles: (List file names of all shapefiles created and a brief description of each) File Name: Brief Description:

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)WP No.LatitudeLongitudeBrief Description:

### Attachments:

Brief Description: 1. Image Contact Sheet

#### **Recommendations:**



20100624016.jpg

20100624019.jpg



20100624020.jpg



20100624022.jpg



20100624028.jpg



20100624033.jpg



20100624034.jpg



20100624040.jpg



20100624036.jpg



20100624037.jpg



# FIELD INVESTIGATION REPORT

FI2010062303 (East Maui, Honopou)

Date of Field Investig	<b>Time</b> (24-hour): 1500 - 1600
CWRM Staff:	Ken Kawahara, Dean Uyeno, and Chui Ling Cheng
Individuals Present:	DAR Staff – Glenn Higashi
	USGS Staff - Clarence (Buzz) Edwards, Richard Castro
	EMI Staff – Garret Hew, Henry Robello
Hydrologic Unit:	Honopou
Stream Name:	Honopou Stream
Findings: The purpose of this fie Stream. Prior to the re feet per second (0.29	Id investigation was to conduct a flow measurement following yesterday's release on Honopou elease, discharge on Honopou Stream upstream from the Lowrie Ditch intake was 0.45 cubic million gallons per day).
At 1600 hours, staff ar discharge measureme measurement. The po- five times the pre-relea Ditch and rainfall that	rived at Honopou Stream upstream from the Lowrie Ditch intake to conduct a post-release int. USGS staff measured the flow at the same cross section that was used for the pre-release ost-release measurement was 2.03 cubic feet per second (1.31 million gallons per day), almost ase flow measurement. This increase in flow can be attributed to the flow release at Wailoa occurred the previous night.
Staff concluded the fie	ld investigation at 1600 hours.
Image Listing: (Attach File Name: 20100624056	PDF of image contact sheet) <u>Brief Description:</u> USGS staff conducting flow measurement on Honopou Stream upstream from Lowrie Ditch intake.
GPS Listing:	
Shapefiles: (List file nar File Name:	nes of all shapefiles created and a brief description of each) Brief Description:
Waypoints: (List all way <u>WP No.</u> <u>Latitude</u>	points in decimal degrees and provide a brief description of each) <u>Longitude</u> <u>Brief Description:</u>
Attachments: Brief Description: 1. Image Contact Shee 2. Discharge Summary	
Recommendations:	



20100624056.jpg

AquaCalc	Pro Di	scharge	e Sum	mary							Original	AquaCalc V	/alues	O _{Re}	Calculatu	ed Value	s
Gage	ö	_	OWRIE	w			Usi	er ID:	2	ъ			Beg Tin	:ec	06/2	4/10 1	5:06
Discharge Sum	mary		2	Aeasurement Ir	nformatic	u							Meter Ir	nformatio	r.		
Vertical Count:		15	ш	End Time:	Ō	6/24/10 1	5:21	Measu	ure time:		4(		Meter n.	ame:	BUZ	ZMAG	
Section Velocity.		1.33	2	Aeas Time:		0.25		Measu	ure stand	ard:	SAE		Meter id		P054	t10	
Section Width:		2.90	U)	Section Diff:		2.03		Measu	urre equip	ment: T	^{opSet Roc}	~	Meter ty	:ed/	ΡYG	YM≎	
Section Area:		1.53	8	3eg Gage heigh.	÷	0.00		Sound	ding Weig	pht:	Ż	7	Meter S	tandard:	S	ЧE	
Section Q:		2.03	ш	End Gage heigh:	÷	0.00		Measu	urre ice:		ž	0	Meter R	tevs/Pulse	Se	1/1	
Section Diff:		2.03		seg Staff height:		0.00		Flood	Measure	ment:	ž	0	Meter C	const.S1:	0.96	304	
Section Pct Err.		0.00%	ш	End Staff height:		0.00		Flood	Coef:		0.0	~	Meter C	const.01:	0.03	312	
Section Quality:		na	ш	Estimated Q:		0.00		Max V	/ertical Q		5%		Meter C	const.C1:	0.00	000	
Section WetPeri	ä	3.59	<	Adjusted Q:		0.00		Perce.	int Slope:		0.0	~	Meter C	const.S2:	0.00	000	
Section Hyd Rac	÷	0.43	4	AquaCalc				Measu	ure Start.	at:	LEV	-	Meter C	onst.02:	0.00	000	
Section Manning	<u>14</u>	0.000	<i>w</i>	:N/S	Ō	00000F2	952F						Meter C	const.C1:	0.00	000	
Section Chezy:		0.000	ш	irmware Versio	۹. N	QP-1V1.	2.1						Meter C	onst.S3:	0.00	000	
			Ľ	File Version:	>	1.5							Meter C	const.03:	0.00	8	
				, HC	servati						Measur	4		ng.	4	-que	Sub-
Vertical		Total	lce	Effective	5	-	Revolu Hu	loriz	Me	thod C	lock	d Obs	Vertic	al secti	on Sec	tion Sec	ction %
Number D	istance	Depth	Draft	Depth Lo	cation	Time	tions Ar	ngle H(	C:VF	Coef	Tme Velocit	y Velocity	<ul> <li>Veloci:</li> </ul>	ty Ar	ea.	Q of 1	Fotal Q
-	0.40	0.00	0.00	0.00	ш	0.00	0	0	00.0	0.00 15:	06		0.0	0.0	0.00	00.	%00.0
2	0.60	0.40	0.00	0.40	0.6	40.25	69	0	1.00	1.00 15:	07 1.68	3 1.68	1.6	8 0.C	0.	.13 e	3.40%
ო	0.80	0.40	0.00	0.40	0.6	40.02	68	0	00.1	1.00 15:	08 1.66	3 1.66	1.6	6 0.C	0.	.13	3.40%
4	1.00	0.45	0.00	0.45	0.6	40.04	76	0	1.00	1.00 15:	09 1.85	5 1.85	1.8	5 0.C	.0 0.	.17 8	3.40%
5	1.20	0.50	0.00	0.50	0.6	40.59	73	0	00.1	1.00 15:	10 1.76	3 1.76	1.7	6 0.1	10 0.	.18	3.90%
9	1.40	0.63	0.00	0.63	0.6	40.42	41	0	1.00	1.00 15:	11 1.0	1 1.01	1.0	1 0.1	13 0.	.13	3.40%
7	1.60	0.65	0.00	0.65	0.6	40.01	45	0	1.00	1.00 15:	12 1.1	1 1.11	1.1	1 0.1	13 0.	.14 6	°.90%
80	1.80	0.70	0.00	0.70	0.6	40.20	59	0	00.1	1.00 15:	14 1.4	1.44	4.	4 0.1	14 0.	20 6	%06.0
6	2.00	0.70	0.00	0.70	0.6	40.74	65	0	1.00	1.00 15:	15 1.56	3 1.56	1.5	6 0.1	14 0.	.22 10	.80%
10	2.20	0.65	0.00	0.65	0.6	40.30	06	0	00.1	1.00 15:	16 2.18	3 2.18	2.1	8 0.1	13 0.	.28 13	3.80%
11	2.40	0.62	0.00	0.62	0.6	40.45	75	0	1.00	1.00 15:	17 1.8	1 1.81	1.8	1 0.1	12 0.	.22 1C	.80%
12	2.60	0.60	0.00	0.60	0.6	40.47	38	0	1.00	1.00 15:	18 0.90	3 0.93	0.0	3 0.1	12 0.	.11 5	6.40%
13	2.80	0.60	0.00	0.60	0.6	40.84	23	0	1.00	1.00 15:	19 0.5.	7 0.57	. 0.5	7 0.1	12 0.	:07	3.40%
14	3.00	0.60	0.00	0.60	0.6	42.59	13	0	00.1	1.00 15:	21 0.3;	2 0.32	0.3	2 0.1	15 0.	.05	
15	3.30	0.00	0.00	0.00		0.00	0	0	00.0	0.00 15:	21		0.0	0.0	0	00.	%00.0

7/26/2010



# FIELD INVESTIGATION REPORT

FI2010091501 (East Maui, Palahulu)

Date of Field Investig	<b>jation:</b> September 15, 2010 <b>Time</b> (24-hour): 0830 - 1230
CWRM Staff:	Dean Uyeno and Chui Ling Cheng
Individuals Present:	EMI - Garret Hew and Nelson Akiu
	Keanae - Gladys Kanoa, Issac Kanoa, and Val Diehl
Hydrologic Unit:	Palauhulu
Stream Name:	Palauhulu Stream

#### Findings:

The purpose of this field visit was to survey Palauhulu Stream and identify the losing reaches of the stream. Staff met with the Kanoa's, Val, and EMI staff at the entrance to Piinaau Road. After driving a short distance on the EMI access Road, everyone began hiking from the road across the field to "Big Pond" which was dry (see photo 20100915001). Everyone continued to cross the field in the downstream direction until reaching the top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles upstream from Hana Highway (see photo 20100915006). The stream was dry above the waterfall but the spring down below had flow (see photo 20100915002).

Afterwards, Issac Kanoa lead the group to "Opae Pond" where the Kanoa's collect opae. In the past, Issac has seen water flow into the pond but not out of the pond. However on the day of the field visit, water was flowing out of the pond (see photo 20100915011). Staff began hiking downstream from the "Opae Pond" for about 600 feet where the flow in the stream decreased significantly (see photo 20100915015). Issac Kanoa was able to find a trail that lead the group back to the EMI road where the cars were parked.

Everyone continued in the upstream direction by car and reached a possible old USGS gaging station location with a weir (see photo 20100915017). This is located about 0.6 miles upstream from the "Opae Pond".

Prior to departing Keanae, CWRM staff recorded the gage height of the staff gage on Palauhulu Stream by Hana Highway. The gage height reading on Palauhulu Stream was 2.06 feet at 1228 hours.

Image Listing: (Attach F	PDF of image contact sheet)
File Name:	Brief Description:
20100915001	"Big Pond" on Palauhulu Stream, about 0.8 miles upstream from Hana Highway
20100915002	Top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles upstream from Hana Highway
20100915003	Top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles upstream from Hana Highway
20100915004	Top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles upstream from Hana Highway
20100915005	Top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles upstream from Hana Highway
20100915006	Upstream of the waterfall at Store Spring on Palauhulu Stream, about 0.5 upstream miles from Hana Highway
20100915007	Top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles upstream from Hana Highway
20100915008	Upstream of the waterfall at Store Spring on Palauhulu Stream, about 0.5 upstream miles from Hana Highway
20100915009	Upstream of the waterfall at Store Spring on Palauhulu Stream, about 0.5 upstream miles from Hana Highway
20100915010	Everyone that was present at the site visit
20100915011	"Opae Pond" on Palauhulu Stream where the Kanoas collect opae, about 1.6 miles from Hana Highway
20100915012	"Opae Pond" on Palauhulu Stream where the Kanoas collect opae, about 1.6 miles from Hana Highway
20100915013	"Opae Pond" on Palauhulu Stream where the Kanoas collect opae, about 1.6 miles from Hana Highway
20100915014	"Opae Pond" on Palauhulu Stream where the Kanoas collect opae, about 1.6 miles from Hana Highway
20100915015	Palauhulu Stream downstream from "Opae Pond" where the stream is losing, about 600 feet downstream from "Opae Pond"
20100915016	Palauhulu Stream downstream from "Opae Pond" where the stream is losing, about 600 feet downstream from "Opae Pond"
20100915017	Upper Palauhulu Stream where there was a possible USGS gaging station, about 0.6 miles upstream from "Opae Pond"
20100915018	Upper Palauhulu Stream where there was a possible USGS gaging station, about 0.6 miles upstream from "Opae Pond"

20100915019	Palauhulu Stream downstream from the USGS gaging station weir, about 0.6 miles upstream from "Opae Pond"
20100915020	Palauhulu Stream downstream from the USGS gaging station weir, about 0.6 miles upstream from "Opae Pond"
20100915022	Staff gage on Palauhulu Stream by Hana Highway
20100915023	Palauhulu Stream (Ching's pond) downstream from the staff gage
20100915024	Staff gage on Palauhulu Stream by Hana Highway
20100915025	Palauhulu Stream below Hana Highway
20100915026	Staff gage on Palauhulu Stream by Hana Highway
20100915027	Staff gage on Palauhulu Stream by Hana Highway
20100915028	Staff gage on Palauhulu Stream by Hana Highway

### **GPS Listing:**

 Shapefiles:
 (List file names of all shapefiles created and a brief description of each)

 File Name:
 Brief Description:

 Fl2010091501.shp
 Brief Description:

Waypoints: (List all waypoints in decimal degrees and provide a brief description of each)

WP No.	Latitude	<u>Longitude</u>	Brief Description:
047	20.8460164	-156.14659103	"Big Pond" on Palauhulu Stream, about 0.8 miles from Hana Highway
048	20.85009671	-156.14511221	Top of the waterfall at Store Spring on Palauhulu Stream, about 0.5 miles from Hana Highway
049	20.83565284	-156.15022349	"Opae Pond" on Palauhulu Stream where the Kanoas collect opae, about 1.6 miles from Hana Highway
050	20.83688197	-156.14865507	Palauhulu Stream downstream from "Opae Pond" where the stream is losing, about 600 downstream from "Opae Pond"
051	20.83011392	-156.15551054	Upper Palauhulu Stream where there was a possible USGS gaging station, about 0.6 miles upstream from "Opae Pond"

### Attachments:

Brief Description: 1. Image Contact Sheet

**Recommendations:** 







20100915003.JPG



20100915001.JPG

20100915004.JPG



20100915005.JPG

20100915006.JPG



20100915007.JPG



20100915008.JPG



20100915009.JPG



20100915010.JPG

20100915011.JPG



20100915014.JPG

20100915015.JPG





20100915016.JPG

20100915017.JPG

20100915018.JPG







20100915022.JPG



20100915025.JPG

20100915019.JPG

20100915020.JPG



20100915023.JPG



20100915026.JPG



20100915027.JPG



20100915028.JPG



# FIELD INVESTIGATION REPORT

FI2010101401 (East Maui, transducers)

Date of Field Investigation: October 14, 2010 Time (24-hour): 0800 - 1500 hours				
CWRM Staff:	Dean Uyeno and Chui Ling Cheng			
Individuals Present:				
Hydrologic Unit:	Multiple - Honopou, Piinaau, and Wailuanui			
Stream Name:	Multiple - Honopou, Palauhulu, and Wailuanui Streams			
Findings:				
The purpose of this field visit was to install pressure transducers and field cameras at the staff gage locations on Honopou, Palauhulu, and Wailuanui Streams. A pressure transducer measures the gage height or the level of water in the stream. All the pressure transducers deployed in this field visit were set to start taking measurements on October 15 at 1 AM in hourly frequency. The field cameras were installed to monitor the gage height readings on the staff plate so that the readings could be correlated to the gage height measurements recorded by the pressure transducer. The field cameras were set to take one photo at noon each day. Staff did not deploy a field camera at Wailuanui Stream.				
On Honopou Stream, staff installed the transducer on the outer bank side of the staff plate. The camera was installed on the mango tree located at the left streambank.				
On Palauhulu Stream, staff installed the transducer on the right streambank next to the staff plate. The camera was installed on a rock wall at the left streambank.				
On Wailuanui Stream, staff installed the transducer on the right streambank next to the staff plate. Staff did not deploy a field camera at Wailuanui Stream.				
Staff plans to retrieve the data on a quarterly basis.				
Image Listing: (Attach PDF of image contact sheet)				
File Name:	Brief Description:			
20101014001	Interim IFS site on Honopou Stream downstream from Haiku Ditch			
20101014002	Field camera installed on a mango tree at the interim IES site on Honopou Stream downstream from Haiku			
20101014000	Ditch			
20101014004	Field camera at the interim IFS site on Palauhulu Stream			
20101014005	CWRM staff installing a field camera at the interim IFS site on Palauhulu Stream			
20101014006	Staff gage and transducer at the interim IFS site on Palauhulu Stream			
20101014007	Field camera at the interim IFS site on Palauhulu Stream			
20101014008	CWRM staff installing a field camera at the interim IFS site on Palauhulu Stream			
20101014009	CWRM staff installing a field camera at the interim IFS site on Palauhulu Stream			
20101014011	CWRM staff installing a field camera at the interim IFS site on Palauhulu Stream			
GPS Listing:				
Shanefiles: (List file names of all shapefiles created and a brief description of each)				
File Name:	Brief Description:			
Waypoints:       (List all waypoints in decimal degrees and provide a brief description of each)         WP No.       Latitude       Longitude         Brief Description:				

### Attachments:

Brief Description: 1. Image Contact Sheet

### **Recommendations:**





20101014001.JPG

20101014002.JPG



20101014003.JPG



20101014004.JPG



20101014005.JPG



20101014006.JPG



20101014007.JPG





20101014009.JPG









20101207001.JPG



20101207002.JPG



20101207003.JPG

20101207004.JPG



20101207005.JPG

20101207006.JPG







20101207008.JPG



20101207009.JPG

20101207010.JPG



20101207011.JPG

20101208001.JPG



20101208002.JPG



20101208003.JPG



20101208004.JPG

20101208005.JPG



20101208006.JPG



20101207012.JPG

20101207013.JPG



20101207014.JPG

20101207015.JPG



20101207016.JPG



20101207018.JPG

20101207019.JPG



20101207020.JPG

20101207021.JPG



20101207022.JPG



20101208007.JPG

20101208008.JPG



20101208009.JPG





20101208012.JPG

20101208013.JPG



20101208014.JPG



20101208015.JPG



20101208016.JPG

20101208017.JPG


20101208018.JPG



20101208019.JPG



20101208020.JPG



20101208021.JPG



20101208022.JPG

20101208023.JPG



20101208024.JPG





20110216001.jpg

20110216002.jpg



20110216003.jpg

20110216004.jpg



20110216005.jpg



20110216006.jpg



20110216007.jpg



20110216008.jpg





20110216010.jpg



20110216011.jpg



20110216012.jpg



20110216013.jpg



20110216014.jpg





#### STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

FIELD INVESTIGATION REPORT

FOR STAFF USE ONLY

File ID: _____ Doc ID: _____

Date of Field Investig	ation:	04/26/2011	<b>Time</b> (24-hour): 0825
CWRM Staff:	Dean L	lyeno	
Individuals Present:	Divisior East M	n of Aquatic Reso aui Irrigation Co.	ources: Robert Nishimoto, Glenn Higashi, Skippy Hau (EMI): Garret Hew, Mark Vaught, Kai Andaya
Reference:			
TMIC Develo (2. 11. 10)			

TMK Parcels (9-digit):

# Findings:

The purpose of this field investigation was to meet with DAR and EMI staff in the field to discuss and agree upon specific diversion modifications to achieve biological connectivity for streams in East Maui. The proposed modifications are listed below by location and may be subject to change based on the actual conditions encountered during site-specific reconnaissance, fabrication, and installation/construction.

# Hanawi Stream at Koolau Ditch Intake:

FI2011042601

 There are currently two 6 in. PVC pipes on the right bank of the diversion structure which convey water from other (i.e., spring/seep) sources. These sources are considered minor diversions not directly from Hanawi Stream. EMI plans to extend one of the existing pipes with elbows and short sections of pipe and secured along the sluice gate structure to drop water onto the top of the diversion dam.



Diversion dam with minor diversion pipes in the foreground.



View from the opposite (left) bank of Hanawi Stream.

# Waiohue Stream at Koolau Ditch Intake:

- At the time of this site visit, the level of the water was approximately 3 ft. below the concrete dam structure.
- EMI also intends to construct a pipe along one of the stream banks starting from atop the waterfall to drop water onto the top of the diversion dam. The pipe installation initially discussed in the field was the right bank; however, EMI will scout trails to the top of the waterfall to determine the best route to convey the pipe.





Waterfall and pool upstream of the Waiohue Stream diversion intake.

Diversion intake and dam structure on Waiohue Stream.



Panoramic view of right bank of Waiohue Stream with waterfall and diversion intake (left), and possible location for bypass pipe installation.

<u>East Wailuaiki Stream at Koolau Ditch Intake:</u>
EMI plans to install a pipe along the right bank of East Wailuaiki Stream starting from a section of stream higher in elevation than the height of the diversion dam. Water from the pipe will be dropped onto the top of the diversion dam approximately 5 ft. from the right bank of the stream.



Diversion dam on the right bank of East Wailuaiki Stream.



Upstream view of dam (left) and sluice gate/intake structure (right).

# West Wailuaiki Stream at Koolau Ditch Intake:

• EMI plans to install a pipe along the left bank of West Wailuaiki Stream from atop the waterfall and drop water onto the top of the diversion dam nearest the left bank. EMI will scout trails to the top of the waterfall to determine the best route to convey the pipe. This site may require "trial-and-error" due to high flow events and the stability of the installation.



Diversion dam facing the left bank of West Wailuaiki Stream.



Upstream view of sluice gate/intake structure (left) and dam (center).



Panoramic view of left bank of West Wailuaiki Stream with waterfall and diversion dam (right), and possible location for bypass pipe installation.

Waikamoi Stream at Center Ditch Intake:

No action is proposed for this stream, since the dry season interim instream flow standard is 0 cfs.



Manual Luis Ditch drops water into Waikamoi Stream on the right bank.



Upstream view of Waikamoi Stream and diversion dam from left bank.

 Image Listing:
 (Attach PDF of image contact sheet)

 File Name:
 Brief Description:

 20110426001
 Koolau Ditch diversion in

20110426001 20110426002 Koolau Ditch diversion intake on Hanawi Stream towards the right bank, with diversion dam at center. The Koolau Ditch diversion dam on Hanawi Stream towards the left bank, with two 6 in. PVC pipes conveying water from minor diversion sources in the foreground. Sluice gate is located at the bottom right. FI Form 04/13/2006

20110426003 20110426004	DAR and HC&S staff discuss potential modifications. Close-up of the minor diversion conveyance pipes (6 in. PVC). Diversion dam at middle left and sluice gate at bottom right.
20110426005	Hanawi Stream below the Koolau Ditch diversion dam.
20110426006	Top view of minor diversion conveyance pipes, with sluice gate at top.
20110426007	Hanawi Stream above the Koolau Ditch diversion dam, with intake at bottom left.
20110426008	Pool on Hanawi Stream at Koolau Ditch diversion intake, with conveyance pipes in the upper left, diversion intake at middle right, and dam at bottom left.
20110426009	Waiaohue Stream above Koolau Ditch diversion intake.
20110426010	Koolau Ditch diversion intake on Waiohue Stream.
20110426011	Koolau Ditch diversion intake is located on the right bank of the pool on Waiohue Stream, with intake at upper center and dam at bottom center.
20110426012	Koolau Ditch diversion dam on Waiohue Stream
20110426013	Left bank of the pool on Waiohue Stream at the Koolau Ditch diversion intake.
20110426014	Waiohue Stream channel just below the Koolau Ditch diversion dam.
20110426015	Right bank of the pool on Waiohue Stream.
20110426016	Right bank of the pool on Waiohue Stream, with intake at middle left.
20110426017	Walohue Stream channel approximately 40 ft. downstream of the diversion dam.
20110426018	Walohue Stream channel approximately 40 ft. downstream, looking upstream towards the diversion dam.
20110426019	Koolau Ditch diversion intake on East Walluaiki Stream towards the right bank, with sluice gate at left.
20110426020	Upstream of the diversion intake on East Wallualki Stream, with an upstream diversion dam at upper left.
20110426021	Upstream of the diversion intake on East Wallualki Stream, with an upstream diversion dam at center.
20110426022	Downstream of the diversion intake on East Walluarki Stream, from the left bank, with bloge crossing at top.
20110420023	Opstream view of the diversion intake on East Wallauki Stream, with suice gate at right.
20110420024	Koolau Ditch diversion dam on West Wailuaiki Stream, towards the left bank
20110426026	Downstream of the diversion dam on West Wailuaiki Stream
20110426027	Koolau Ditch diversion dam on West Wailuaiki Stream, towards the left bank
20110426028	Close-up of the left bank wing wall at the diversion dam on West Walluaiki Stream
20110426029	Koolau Ditch diversion intake on West Wailuaiki Stream, with diversion dam at top and debris basin at left.
20110426030	Downstream of the diversion intake on West Wailuaiki Stream.
20110426031	Koolau Ditch diversion intake on West Wailuaiki Stream, from the bridge crossing, with diversion dam at
20110426032	Manuel Luis Ditch conveys water and terminates at the right bank of Waikamoi Stream, approximately 150 ft.
20110426033	Waikamoi Stream upstream of the Manuel Luis Ditch inflow.
20110426034	Waikamoi Stream downstream of the Manuel Luis Ditch inflow.
20110426035	Center Ditch diversion intake and dam on Waikamoi stream facing the left bank.
20110426036	Close-up of diversion dam nearest the right bank on Waikamoi Stream.
20110426037	Center Ditch diversion intake and sluice gate (at right) on Waikamoi Stream.
20110426038	Upstream view of the Center Ditch diversion dam on Waikamoi Stream.
20110426048	Panoramic of the right bank of Waiohue Stream above the Koolau Ditch diversion intake.
20110426049	Panoramic of the left bank of West Wailuaiki Stream above the Koolau Ditch diversion intake.
GPS Listing:	
Snapefiles: (List file na File Name:	mes of all shapefiles created and a brief description of each) Brief Description:
Waypoints: (List all way WP No. <u>Latitude</u> 	<pre>/points in decimal degrees and provide a brief description of each) Longitude Brief Description:</pre>
Attachments:	
Brief Description: 1. Image Contact Shee	ut de la constance de la const
Recommendations:	



20110426002.jpg



20110426004.jpg



20110426005.jpg



20110426006.jpg



20110426007.jpg







20110426009.jpg



20110426010.jpg

20110426011.jpg

20110426012.jpg



20110426014.jpg

20110426015.jpg



20110426016.jpg

20110426017.jpg

20110426018.jpg



20110426019.jpg







20110426022.jpg

20110426023.jpg



20110426025.jpg

20110426027.jpg



20110426028.jpg

20110426029.jpg

20110426030.jpg



20110426031.jpg





20110426033.jpg



20110426034.jpg

20110426035.jpg





20110426037.jpg



20110426049.jpg



#### STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT Stream Protection and Management Branch

# FIELD INVESTIGATION REPORT

FI2011042701

FOR STAFF USE ONLY

File ID: _____ Doc ID: _____

Date of Field Investigation:		04/27/2011	<b>Time</b> (24-hour): 0830	
CWRM Staff:	Dean l	Jyeno		
Individuals Present:	Division of Aquatic Resources: Robert Nishimoto, Glenn Higashi, Skippy Hau East Maui Irrigation Co. (EMI): Garret Hew, Mark Vaught Others: Lyn Scott, Lucienne DeNaie			
Reference:				
TMIZ Develo (0. 11. 10)				

TMK Parcels (9-digit):

# Findings:

The purpose of this field investigation was to meet with DAR and EMI staff in the field to discuss and agree upon specific diversion modifications to achieve biological connectivity for streams in East Maui. The proposed modifications are listed below by location and may be subject to change based on the actual conditions encountered during site-specific reconnaissance, fabrication, and installation/construction.

# Honopou Stream at Haiku Ditch Diversion Intake:

- EMI intends to use cement to construct a small channel in the diversion intake structure where there is currently an opening nearest the right bank of the stream. The concrete berm on the upstream end of the channel will also be chipped away to allow water to flow downstream in the channel. The channel should be kept fairly rough (i.e., not smooth).
- EMI will also construct a small concrete berm near at the base of the water drop from the low-flow bypass channel to
  prevent water from flowing back into the Haiku Ditch.



Right bank of the Haiku Ditch diversion intake on Honopou Stream.



Concrete berm proposed for modification.

Honopou Stream at New Hamakua Ditch Diversion Intake:

• No actions are proposed for this site since bypass provides flow downstream.



Overflow bypass from the New Hamakua Ditch diversion intake.



Downstream view from above the New Hamakua Ditch intake bypass.

Honopou Stream at Wailoa Ditch Diversion Intake:

- One option discussed was to place an iron 'H' beam on the right bank edge of the diversion intake grates, and bolted into the wing wall.
- The preferred option is to fill the first intake grate section (from the right bank) with cement, and leave the concrete slightly depressed to allow the section to fill with water and pool. Upon filling, the section would be expected to overflow down the intake apron to provide a wetted face for connectivity.



Downstream view of the Wailoa Ditch diversion intake.



Close-up of the right bank of the Wailoa Ditch intake grate.

Note: At the time of the site visit, the sluice gate bypassing water from the Wailoa Ditch intake was wide open. EMI indicated that they had not opened the gate more than the height which had been agreed to at a previous visit.

Image Listing: (Attach PDF of image contact sheet)				
File Name:	Brief Description:			
20110427001	DAR and EMI staff inspect the right bank portion of the Haiku Ditch diversion on Honopou Stream (upstream view).			
20110427002	Close-up of right bank portion of the Haiku Ditch diversion.			
20110427003	Close-up of right bank portion, upstream edge of the Haiku Ditch diversion.			
20110427004	View of the right bank portion of the Haiku Ditch diversion (downstream view).			
20110427005	View of the Haiku Ditch diversion on Honopou Stream from the right bank, with three bypass pipes at bottom and lowflow-bypass channel at center.			
20110427006	Close-up of the right bank portion, downstream edge of the Haiku Ditch diversion.			
20110427007	Bypass flow adjacent to the New Hamakua Ditch diversion on Honopou Stream from the left bank (upstream view).			

20110427008	Honopou Stream above New Hamakua Ditch diversion, with Wailoa Ditch diversion at top center (upstream							
00440407000	View). Mailes Ditch diversion on Hananau Otroom (devrecturers view)							
20110427009	Vvalioa Ditch diversion on Honopou Stream (downstream view).							
20110427010	Close-up of the right bank portion, upstream edge of the valida Ditch diversion.							
20110427011	view of the right bank portion of the vialioa Ditch diversion (downstream view).							
20110427012	<ul> <li>Close-up of the right bank portion, downstream edge of the Wailoa Ditch diversion.</li> <li>View of the right bank portion of the Wailoa Ditch diversion (upstream view).</li> </ul>							
20110427013								
20110427014	Open sluice gate below the Walloa Ditch diversion intake (upstream view).							
20110427015	Honopou Stream below Wailoa Ditch diversion, with New Hamakua Ditch diversion at top center (downstream view).							
20110427016	16 New Hamakua Ditch diversion located on left bank of Honopou Stream. Wetted areas due to leakage from modifications and spring seeps on the left bank							
20110427017	017 Bypass flow adjacent to the New Hamakua Ditch diversion on Honopou Stream from the right bank (upstream view)							
20110427018	Bypass flow approximately 100 ft. downstream of New Hamakua Ditch flowing across roadway.							
 Waypoints: (List al <u>WP No. Latitude</u> 	I waypoints in decimal degrees and provide a brief description of each)          Longitude       Brief Description:							
Attachments:								
Brief Description:								
1. Image Contact S	Sheet							
Recommendation	ns:							



20110427002.jpg

20110427003.jpg



20110427004.jpg

20110427005.jpg

20110427006.jpg



20110427007.jpg







20110427010.jpg

20110427011.jpg



20110427013.jpg

20110427014.jpg

20110427015.jpg



20110427016.jpg

20110427017.jpg

20110427018.jpg



















20111102001.JPG



20111102002.JPG



20111102003.JPG

20111102004.JPG



20111102005.jpg

20111102006.JPG



20111102007.JPG

20111102008.JPG



20111102009.JPG

20111102010.JPG



20111102011.JPG

20111102012.JPG



20111102013.JPG

20111102014.JPG



20111102015.JPG

20111102016.JPG



20111102017.JPG



20111102019.JPG

20111102020.JPG



20111102021.JPG

20111102022.JPG



20111102023.JPG



20111102025.JPG

20111102026.JPG



20111102027.JPG

20111102028.JPG



20111102029.JPG



20111102030.JPG



20111102031.JPG



20111102032.JPG



20111102033.JPG



20111102034.JPG



20111102035.JPG



20111102036.JPG



20111102037.JPG



20111102038.JPG



20111102039.JPG



20111102040.JPG



20111102041.JPG

20111102042.JPG



20111102043.JPG

20111102044.JPG





20111102047.JPG



20111102046.JPG



20111102048.JPG





20111102050.JPG



20111102051.JPG

20111102052.JPG



20111102053.JPG



20111102055.JPG



20111102057.JPG



20111102059.JPG



20111102056.JPG



20111102058.JPG



20111102060.JPG





20111102063.JPG



20111102065.JPG



20111102062.JPG





20111102066.JPG







20111102068.JPG



20111102069.JPG



20111102070.JPG



20111102071.JPG

20111102072.JPG



20111102073.JPG

20111102074.JPG



20111102075.JPG

20111102076.JPG



20111102077.JPG



20111214001.jpg



20111214002.jpg



20111214003.jpg



20111214004.jpg



20111214005.jpg



20111214007.jpg

20111214008.jpg



20111214009.jpg

20111214010.jpg



20111214011.jpg


20111214013.jpg



20111214014.jpg



20111214015.jpg



20111214016.jpg



20111214017.jpg

20111214018.jpg



20111214019.jpg



20111214020.jpg



20111214021.jpg



20111214022.jpg



20111214023.jpg

20111214024.jpg



20111214025.jpg



20111214026.jpg



20111214027.jpg





20111214029.jpg

20111214030.jpg



20111214031.jpg

20111214032.jpg



20111214033.jpg

20111214034.jpg





















































































20130917001.JPG



20130917003.JPG



20130917005.JPG



20130917002.JPG



20130917004.JPG



20130917006.JPG





20130917008.JPG

20130917007.JPG



20130917009.JPG



20130917010.JPG









# **USGS** Information

#### U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement

Customer #: Agreement #: Project #: TIN #: Flxed Cost Agreement Page 1 of 2 6000001189 11WSHI000000003 ZH00EEA 99-0266119 ✓ Yes ◯ No

#### FOR WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the ^{1st} day of March, 2011, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the COMMISSION ON WATER RESOURCE MANAGEMENT, DEPARTMENT OF LAND AND NATURAL RESOURCES, STATE OF HAWAI'I, party of the second part.

- 1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation a study to assess the amount of seepage into or from the four main ditches in the East Maui Irrigation Company's diversion system, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
- 2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of \$0.00.

(a)	\$44,000.00	by the party of the first part during the period March 1, 2011 <b>to</b> August 31, 2012	
(b)	\$86,000.00	by the party of the second part during the period March 1, 2011 <b>to</b> August 31, 2012	

- (c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.
- (d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.
- 3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
- 4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
- 5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
- 6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
- 7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

#### Form 9-1366 continued

#### U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement

6000001189
11WSHI00000003
ZH00EEA
99-0266119

- 8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
- 9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered <u>quarterly</u>. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey United States Department of the Interior

#### **USGS Point of Contact**

Name: Chui Cheng Address: USGS-PIWSC 677 Ala Moana Blvd., Ste 415 Honolulu, HI 96813 Telephone: 808-587-2418 Email: ccheng@usgs.gov

#### **Signatures**

Date 12/10/10 By Name: Stephen S. Anthony Center Director Title:

By		Date
Name:		
Title:	•	

Ву		Date
Name:	,	
Title:		

# Department of Land and Natural Resources State of Hawai'i

**Commission on Water Resource Management** 

#### **Customer Point of Contact**

Name:Dean UyenoAddress:CWRMP.O. Box 621Honolulu, HI 96809Telephone:808-587-0249Email:dean.d.uyeno@hawaii.gov

#### **Signatures**

_ Date_2/25/4 Name: William J. Aila,

Title: Chairperson

Ву	Date
Name:	
Title:	
	B alash
By VI AC	Date/23/11

Name: Linda L.W. Chow Title: Deputy Attorney General

# East Maui Irrigation Diversion System Seepage Reconnaissance Study, East Maui, Hawai'i

12.

## U.S. Geological Survey Pacific Islands Water Science Center Proposal, December 2010

#### SUMMARY

East Maui Irrigation Company's system, which consists of about 75 miles of ditch, diverts stream water and transports it to central Maui for sugarcane cultivation, general agriculture, and domestic use through the public water system(s). The State of Hawai'i Commission on Water Resource Management desires information on the seepage (losses/gains) rates of the ditch system to help in evaluating instream flow standards for the streams diverted by the ditch system. The objective of this 1.5-year study is to assess, at the reconnaissance level, the amount of seepage into or from the four main ditches in the East Maui Irrigation Company system by documenting seepage rates for various construction-type sections of the ditches.

Results from this study will be useful to the State of Hawai'i Commission on Water Resource Management for determining system efficiency and will aid in the management of surface-water resources in east Maui. Results will be published in the U.S. Geological Survey Open-File Report series and made available through the Internet. The study will take 1.5 years from the time work is commenced until the report is published and will cost \$130,000.

#### **PROBLEM**

For over a century, the East Maui Irrigation Company's (EMI) surface-water diversion systems have diverted water from streams in east Maui, Hawai'i for large-scale sugarcane cultivation by Hawaii Commercial and Sugar Company (HC&S) and for general agriculture and domestic use through the public water system(s). The EMI System consists of about 75 miles of ditches, which are used to collect and transport water from as far east as Nahiku to west of Māliko Gulch. About 50 miles of the ditches are tunnels and 25 miles are open. The system has four main ditches, Ko'olau/Wailoa, New Hāmākua, Lowrie, and Ha'ikū Ditches (listed from highest to lowest elevation) with several additional ditches also connected to the main ditches (Kauhikoa, Center, Manuel Luis, and Spreckels Ditches). The New Hāmākua and Ha'ikū Ditches are considered overflow ditches that collect high flows that overflow the Ko'olau/Wailoa and Lowrie Ditches, respectively. Recently, the State of Hawai'i Commission on Water Resource Management (CWRM) established interim instream flow standards for many of the streams diverted by ditches in the EMI system. Part of the CWRM's decision ordered that "EMI, in coordination with the Commission and USGS, shall seek to cooperatively fund and undertake a system efficiency study to accurately determine EMI system losses and/or gains." (CWRM May 25, 2010 staff submittal). EMI reports that through a program of regular inspection and maintenance, water losses in the ditch system are minimized however they are unable to provide measurements or estimates documenting their system efficiency (Hawaiian Commercial and Sugar Company, 2010). Therefore, measurements of EMI's ditch system seepage rates are desirable to address the CWRM's order.

2

#### **OBJECTIVES**

The objectives of this 1.5-year study is to assess, at the reconnaissance level, the amount of losses or gains from the four main ditches in the EMI system in east Maui by documenting seepage rates for various construction-type sections of the ditches. Results from this study will be useful for determining system efficiency and will aid in the management of surface-water resources in east Maui. This study will not address the loss rates from reservoirs that receive water from or are part of the EMI system.

#### **APPROACH**

The four major ditch systems (Koʻolau/Wailoa, New Hāmākua, Lowrie, and Haʻikū Ditches) will be characterized in their entirety from Makapipi Stream to Māliko Gulch using visual observations and handheld GPS equipment. Ditch sections will be characterized as lined, partially lined, or unlined based on definitions provided in figure 1. Three representative sections of each ditch-construction type will be selected and a series of flow measurements will be made in each selected section to determine the seepage rate for each type. Flow measurements will be made during stable conditions near median flow for each ditch and all surface-water inflows and outflows in each measurement section will be accounted for to ensure that changes in flow measured in the section are due only to seepage through the ditch walls and floor. Measurement sections will be selected to minimize surface water inflows and outflows, thereby minimizing the inherent error introduced with each additional measurement. Every effort will be made to choose representative sections that are as long as possible to increase the possibility of measuring average seepage conditions and minimize the effects of anomalous localized conditions on the overall average rates. To facilitate the fieldwork, the USGS will collaborate closely with EMI

3

staff to assist in the mapping survey, to discuss selection of representative sections for flow measurements, and maintain safety during all operations around the ditches.



Figure 1. Categories of ditch-construction types in the East Maui Irrigation System, east Maui, Hawai'i.

Three estimates of system seepage losses (or gains) will be provided using the lengths of each construction type combined with: (1) the average seepage rates for each construction type; (2) the lowest seepage rates for each construction type; and (3) the highest seepage rates for each construction type. Estimates of system seepage losses (or gains) will be applied to the unmeasured sections of the system. Actual seepage losses (or gains) will be applied to the sections measured.

#### REPORT

Results from this study, including a map characterizing construction types for the ditch system and seepage measurement results will be published in a USGS Open-File Report and made available through the Internet. The probable report title and milestone dates are listed in table 1. The first draft of the report shall be provided to EMI and CWRM for comment on factual information contained in the report.

4

 Table 1. Milestone dates for planned report

Probable title	Report outlet	First draft	Review	Approval	Publication
East Maui Irrigation Diversion System Seepage Measurements, East Maui, Hawaiʻi	USGS OFR	03/31/12	05/31/12	06/30/12	08/31/12

# BUDGET

It is anticipated that a total of \$130,000 is needed for this 1.5-year study. The breakdown

is provided in table 2.

Table 2.	Project budget

Category	Total
Labor	99,350
Travel	18,500
Communications	100
Supplies	500
Report processing	2,000
Science Support	9,550
Total	130,000

#### WORK PLAN

The major tasks and associated periods of activity for this study are summarized in table 3.

Table 3. Major tasks and timelines

Task	03/01/11	04/01/11	05/01/11	06/01/11	07/01/11	08/01/11	11/10/60	10/01/11	11/01/11	12/01/11	01/01/12	02/01/12	03/01/12	04/01/12	05/01/12	06/01/12	07/01/12	08/01/12
Ditch Characterization	x	Χ	Χ	Χ	Χ				÷									
Flow Measurements				Х	X	Х	X	Х	Х									
Report writing									Х	Х	Х	Х	Х					
Peer review														X	Х			
Report approval																X		
Publication																	X	х

#### **REFERENCES CITED**

- Department of Agriculture, 2003, Agricultural Water Use and Development Plan: Honolulu, Hawaii, 145 p.
- Department of Land and Natural Resources, 2010, News Release–State Water Commission decision balances competing demands: May 28, 2010, Honolulu, Hawaii.
- Hawaiian Commercial and Sugar Company, 2010, Appendix B-water lost from the EMI System: submission to Commission on Water Resource Management March 19, 2010: http://hawaii.gov/dlnr/cwrm/currentissues/iifsmaui1/data/20100319 HC&Sb.pdf.
- U.S. Geological Survey, 2007, Facing Tomorrow's Challenges–U.S. Geological Survey Science in the Decade 2007–2017: U.S. Geological Survey Circular 1309, 69 p., available at http://pubs.usgs.gov/circ/2007/1309/.



Figure 2. Schematic of the East Maui Irrigation System, island of Maui, Hawai'i. Modified from Department of Agriculture, 2003.

Pacific Islands Water Science Center 677 Ala Moana Blvd., Suite 415 Honolulu, Hawai'i 96813 Phone: (808) 587-2400/Fax: (808) 587-2401

November 5, 2010

Ms. Lenore Ohye, Acting Deputy Director State of Hawai'i Department of Land and Natural Resources Commission on Water Resource Management P.O. Box 621 Honolulu, Hawai'i 96809

Dear Ms. Ohye:

Subject: Discharge measurements, Makapipi Stream, Maui, Hawai'i, September 13-17, 2010

The purpose of this letter is to provide you with a summary of discharge measurements made by the U.S. Geological Survey (USGS) in Makapipi Stream, Maui, Hawai'i from September 13-17, 2010. The measurements were made in cooperation with the Commission on Water Resource Management (CWRM) to document the release of water from the Ko'olau Ditch diversion by the East Maui Irrigation Company and to determine if the restored flow would result in continuous flow to the coast. Attached is a summary of the discharge measurements and discussion of the hydrologic context in which these measurements were made.

Discharge measurements on September 13, 2010 indicate that flow in Makapipi Stream increased 0.78 cfs in the 1,085-ft reach between station 204756156062101 and station 204805156061501, located about 140 feet upstream of the Ko'olau Ditch diversion. After the sluice gate opening was set on September 14, 2010, the discharge measurement values at station 204808156061401, located about 75 feet downstream of the diversion, ranged from 1.35 cfs on September 14, 2010 to 1.18 cfs on September 17, 2010. Daily site visits during September 13–17, 2010, indicated zero flow at the Hāna Highway bridge, located about two-thirds of a mile downstream of the diversion.

USGS and CWRM staff, and local residents hiked about 1,000 feet upstream of the Hāna Highway bridge during the afternoons of September 14 and 16, 2010. This 1,000-foot reach was dry with the exception of a few isolated pools of water and there was no indication of recent streamflow. The precise location where Makapipi Stream went dry farther upstream was not determined because it could not be safely accessed on foot.

If you have any questions or concerns regarding these results, please feel free to contact Steve Gingerich of my staff at 587-2411 or by e-mail (sbginger@usgs.gov).

Sincerely,

Stephen S. Anthony Center Director

Attachment

# Makapipi Stream, Maui, Hawai'i Discharge Measurements September 13–17, 2010

# Prepared by: Adam G. Johnson and Stephen B. Gingerich U.S. Geological Survey Pacific Islands Water Science Center

# Purpose

On May 25, 2010, the Commission on Water Resource Management (CWRM) ordered a conditional flow release of 0.93 cubic feet per second (cfs) into Makapipi Stream downstream of the Ko'olau Ditch diversion operated by East Maui Irrigation (EMI). From September 13–17, 2010, the U.S. Geological Survey (USGS) worked in cooperation with the CWRM to monitor the release of streamflow into Makapipi Stream and to determine if the restored flow would result in continuous streamflow from its headwaters to its mouth.

## Acknowledgements

Access to monitor streamflow in Makapipi Stream was granted by EMI.

# Study area

Makapipi Stream is located on the northeastern side of east Maui, Hawai'i (fig. 1). The Makapipi streambed runs beneath the Hāna Highway and through the village of Nāhiku. At an altitude of about 1,315 feet, a concrete barrier diverts water from Makapipi Stream into the Ko'olau Ditch system (fig. 2). The diversion structure is currently designed to capture all the stream water when the stream's stage is lower than the top of the concrete barrier. During periods of higher stream flow, some of the stream water may overtop the concrete barrier and flow downstream of the diversion. The diversion structure has a sluice gate that can be opened to allow water to flow through the concrete barrier (fig. 3), bypassing the Ko'olau Ditch intake. The sluice gate opening can be adjusted to different levels to allow variable amounts of water to flow through the opening.

# Location of discharge measurement sites

During September 13–17, 2010, discharge measurements were made at five sites in Makapipi Stream (table 1; fig. 4). Two of the sites are upstream of the Ko'olau Ditch diversion intake and three of the sites are downstream of the Ko'olau Ditch diversion intake. The uppermost site, station 204756156062101, is at an altitude of about 1,500 feet above sea level, and is about 1,225 feet upstream of the diversion intake. Station 204805156061501 is at an altitude of about 1,350 feet, and is about 140 feet upstream of the diversion intake. Station 204808156061401 is at an altitude of about 1,275 feet, and is about 75 feet downstream of the diversion intake. Station 204826156054701 is at an altitude of about 920 feet, is about 3,450 feet downstream of the diversion intake, and is about 115 feet upstream of the Hāna Highway bridge. Station 204930156053701 is at an altitude of about 80 feet, and is about 5 feet downstream of Nāhiku Road bridge crossing of Makapipi Stream.

Discharge measurements were also made at two water production tunnels, 6-4806-12 Pogues Tunnel (TU56) and 6-4806-11 E. Makapipi Tunnel 1 (TU55), located within the Makapipi Stream watershed upstream of the diversion intake (table 1; fig. 4). Water flows out of Pogues Tunnel outlet (station 204802156063901) at an altitude of about 1,600 feet and discharges into Makapipi Stream about 2,100 feet upstream of the diversion. Water flows out of E. Makapipi Tunnel 1 (station 204813156061901) at an altitude of about 1,360 feet where it is currently diverted into an intake pipe of the Ko'olau Ditch system.

# Study team

Discharge measurements were made by Richard B. Castro, Clarence L. Edwards, Stephen B. Gingerich, and Adam G. Johnson from the U.S. Geological Survey (USGS) Pacific Islands Water Science Center.

# **Recent hydrologic conditions**

Provisional rainfall data from West Wailuaiki rain gage 204916156083701 (State key number 348.5), about 2.6 miles west-northwest of the Makapipi Stream diversion, indicate that 1.32 inches of rain fell during the week prior to discharge measurements (September 6–12, 2010). During the 5-day period of discharge measurements (September 13–17, 2010) 1.19 inches of rain fell at the West Wailuaiki rain gage (table 2).

The nearest active continuous-record stream-gaging station to Makapipi Stream is station 16508000, Hanawī Stream near Nāhiku, Maui, Hawai'i (fig. 1). Station 16508000 is about 200 feet upstream of the Ko'olau Ditch diversion of Hanawī Stream. During the five days prior to the Makapipi discharge measurements (September 8–12, 2010), daily mean streamflow at 16508000 ranged from about 2.3 to 2.9 cfs (fig. 5). During the five days when the Makapipi discharge measurements were made (September 13–17, 2010), daily mean streamflow at 16508000 ranged from 2.2 to 2.6 cfs. During the 88 years of record (1922–2009) for station 16508000, daily mean flows less than 2.9 cfs occurred less than 10 percent of the time.

# **Summary of results**

Initial discharge measurements were made on September 13, 2010 while the sluice gate was closed and most water from Makapipi Stream was being diverted into the Ko'olau Ditch system; only a small amount of water was leaking through the diversion barrier into the streambed downstream of the diversion. Beginning at about 0815 hours September 14, 2010, the sluice gate of the diversion was opened allowing water to flow downstream of the diversion. The gate was then closed and fully opened several times in order to flush out debris in the streambed. At about 0900 hours September 14, 2010, the gate was partially opened to allow the majority of the water in Makapipi Stream to flow downstream of the diversion; no known subsequent adjustments were made to the position of the sluice gate during the period when discharge measurements were made through September 17, 2010.

Results of the discharge measurements during September 13–17, 2010 are shown in table 1. On September 13, 2010, water discharging from Pogues Tunnel was measured to be 0.35 cfs, or 0.23 million gallons per day (mgd); about 1,225 feet upstream of the diversion at station 204756156062101, streamflow was measured to be 0.73 cfs (0.47 mgd); and about 140 feet upstream of the diversion at station 204805156061501, streamflow was measured to be about 1.51 cfs (0.98 mgd). Thus, on September 13, 2010, Makapipi streamflow increased 0.78 cfs in the 1,085-ft reach between station 204756156062101 and station 204805156061501.

After the sluice gate opening was set on September 14, 2010 at about 0900 hours, the discharge measured at station 204808156061401, downstream of the diversion, ranged from 1.35 cfs on September 14 to 1.18 cfs on September 17 (0.87–0.76 mgd). Some unquantified flow continued to be diverted into the Ko'olau Ditch system daily during the time that the sluice gate was open. Daily site visits during September 13–17, 2010 indicated zero flow at station 204826156054701, located about 115 feet upstream of the Hāna Highway bridge.

#### **Previous measurements**

Monthly mean discharge from E. Makapipi Tunnel 1 for the month of September ranged from 0.68 to 5.41 cfs (0.44 to 3.50 mgd) during 1932–1936 (Stearns and Macdonald, 1942). Monthly mean discharge for the month of September from Pogues Tunnel ranged from 1.86 to 3.98 cfs (1.20 to 2.57 mgd) during 1935–1936 (Stearns and Macdonald, 1942). These available historical monthly mean discharge values for September at both tunnels are higher than the values measured during September 2010, though comparisons should be done with caution since it is not known exactly where or how the measurements in the 1930s were made.

Streamflow in Makapipi Stream was previously measured by the USGS to be 0.66 cfs at 1239 hours on July 7, 2010 at station 204826156054701. Thus, water was flowing in Makapipi Stream near the Hāna Highway bridge on July 7, 2010.

A continuous-record stream-gaging station (16507000) was operated by the USGS in the vicinity of station 204826156054701 (about 100 feet upstream of the Hāna Highway bridge). Station 16507000 measured streamflow in Makapipi Stream from July 1932 to June 1945. USGS Surface Water Supply papers (U.S. Geological Survey 1937–48) all indicate that water from Makapipi Stream was being diverted into the Ko'olau Ditch upstream of the gaging station, though it is possible for water to have been periodically released past the diversion.

Figure 6 shows the mean monthly discharge for each month at station 16507000 on Makapipi Stream and station 16508000 on Hanawī Stream. Mean monthly discharge was highest during the months of March and April at both 16507000 and 16508000. At station 16508000 lowest mean monthly streamflow occurred from May to October, and the highest mean monthly streamflow occurred from November to April. Seasonal streamflow trends were similar at station 16507000. Mean monthly discharge at station 16507000 was lowest during the month of September, averaging 3.9 cfs (2.5 mgd).

Records from station 16507000 indicate the daily mean discharge was greater than zero 77 percent of the time (there was no flow 23 percent of the time) from July 1932 to June 1945. The numbers of days with zero streamflow at station 16507000 ranged from 0 to 198 days per calendar year.

## Hydrologic context

The streamflow record of station 16507000 and the discharge measurements made in Makapipi Stream during September 2010 can be put into hydrologic context by examining streamflow records at station 16508000 Hanawī Stream. Station 16508000, initially established in 1914, has a complete daily streamflow record since November 1921, and thus is a useful index station of long-term streamflow trends near Makapipi Stream. For the discussion below, long-term averages for station 16508000 on Hanawī Stream are based on daily records from 1922 to 2009.

Recent records at 16508000 Hanawī Stream indicate persistently dry conditions, with annual mean streamflow being below average nine of the last ten years. Mean streamflow during 2000–2009 was the second lowest 10-consecutive-year mean on record. Annual mean streamflow from 2006 to 2009 was 71 percent of long-term average. Streamflow from July 2009 to June 2010 was 64 percent of long-term average.

# Summary

Discharge measurements on September 13, 2010 indicate that flow in Makapipi Stream increased 0.78 cfs in the 1,085-ft reach between station 204756156062101 and station 204805156061501 upstream of the Ko'olau Ditch diversion. After the sluice gate opening was set on September 14, 2010 at about 0900 hours, the discharge measurement values at station 204808156061401, downstream of the diversion, ranged from 1.35 cfs on September 14, 2010 to 1.18 cfs on September 17, 2010. Daily site visits during September 13–17, 2010, indicated zero flow at station 204826156054701 near the Hāna Highway bridge, located about two-thirds of a mile downstream of the diversion (table 1).

USGS and CWRM staff, and local residents hiked about 1,000 feet upstream of the Hāna Highway bridge during the afternoons of September 14 and 16, 2010. This 1,000-ft reach was dry with the exception of a few isolated pools of water and there was no indication of recent streamflow (fig. 4). The precise location where Makapipi Stream went dry farther upstream was not determined because it could not be safely accessed on foot.

# References

- Stearns, H.T., and Macdonald G.A., 1942, Geology and ground-water resources of the island of Maui, Hawaii: Hawai'i Division of Hydrography Bulletin 7, 344 p.
- U.S. Geological Survey, 1937–48, Surface Water Supply of Hawaii, Water-Supply Papers 795, 815, 835, 865, 885, 905, 935, 965, 985, 1015, and 1045.

# **Online Data**

Data for USGS stations is available online at: http://waterdata.usgs.gov/hi/nwis/nwis

#### Table 1. Makapipi Stream and tunnel discharge measurements September 13–17, 2010.

						Stream distance	
			Time	Discharge	Discharge	from Koʻolau	
Station number	Station name	Date	(HST)	(cfs)	(mgd)	diversion (ft) ^a	Notes
204802156063901	6-4806-12 Pogues Tunnel (TU56) [at 1,600 ft]	9/13/2010	1528	0.35	0.23	+2,100	Water flows into Makapipi
							Stream above diversion
204756156062101	Makapipi Stream at 1,500 ft	9/13/2010	1630	0.73	0.47	+1,225	
204805156061501	Makapipi Stream at 1,350 ft	9/13/2010	1713	1.51	0.98	+140	
204808156061401	Makapipi Stream at 1,275 ft	9/14/2010	0933	1.35	0.87	-75	
		9/14/2010	1404	1.27	0.82		
		9/15/2010	1100	1.32	0.85		
		9/16/2010	1106	1.18	0.76		
		9/17/2010	0915	^b 1.18	^b 0.76		
204826156054701	Makapipi Stream near Hāna Hwy [at 920 ft]	9/13/2010	1330	0	0	-3,450	Site is about 115 ft upstream of
		9/14/2010	1530	0	0		Hāna Hwy bridge
		9/15/2010	1400	0	0		
		9/16/2010	1540	0	0		
		9/17/2010	1020	0	0		
204930156053701	Makapipi Stream at Nāhiku Rd. Bridge [at 80 ft]	9/15/2010	1200	0	0	-10,500	Site is about 5 ft downstream of
							Nāhiku Road bridge
204813156061901	6-4806-11 E. Makapipi Tunnel 1 (TU55)	9/14/2010	1449	1.09	0.70	0	Site is about 700 ft southeast
	[at 1,360 ft]						of main diversion; water flows
							into ditch system pipeline
							at tunnel entrance

[HST, Hawaiian Standard Time; cfs, cubic feet per second; mgd, million gallons per day; ft, feet; TU, tunnel; Hwy, highway; Rd., road; E. east]

^a (+) values indicate distance upstream of diversion, (-) values indicate distance downstream of diversion

^b estimated; stage measurement at reference point same as 9/16/2010

Table 2. Provisional daily total rainfall measured at station <u>204916156083701</u> West Wailuaiki rain gage near Keanae, Maui, HI (State key 348.5).

Date	Rainfall, in inches
9/6/2010	0.39
9/7/2010	0.31
9/8/2010	0.01
9/9/2010	0.32
9/10/2010	0.21
9/11/2010	0.01
9/12/2010	0.07
9/13/2010	0.35
9/14/2010	0.28
9/15/2010	0.48
9/16/2010	0.07
9/17/2010	0.01



Figure 1. Location of West Wailuaiki rain gage, Hanawī stream-gaging station, Makapipi stream-gaging station, Hāna Highway, Koʻolau Ditch and Makapipi Stream, Maui, Hawaiʻi.



Figure 2. Koʻolau Ditch diversion structure in Makapipi Stream, Maui, Hawaiʻi, at about 1,315 feet above mean sea level (September 14, 2010).



Figure 3. Downstream side of Koʻolau Ditch diversion structure in Makapipi Stream, Maui, Hawaiʻi. The sluice gate opening is approximately two feet wide; it is shown closed in the photograph. (September 14, 2010).


Figure 4. Location of September 13–17, 2010 discharge-measurement sites near and within Makapipi Stream, Maui, Hawai'i.



Figure 5. Provisional daily discharge at stream-gaging station 16508000 Hanawī Stream near Nāhiku, Maui, Hawai'i. Data for September 6–7, 2010 were not available.



Figure 6. Mean monthly streamflow at stream-gaging stations 16507000 (Makapipi Stream near Nāhiku, Maui, Hawai'i) and 16508000 (Hanawī Stream near Nāhiku, Maui, Hawai'i). Periods of record for 16507000 and 16508000 are July 1932 to June 1945, and November 1921 to July 2010, respectively.



## Prepared in cooperation with the State of Hawai'i Commission on Water Resource Management

# Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i



Open-File Report 2012–1115

U.S. Department of the Interior U.S. Geological Survey

# Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i

By Chui Ling Cheng

Prepared in cooperation with the State of Hawai'i Commission on Water Resource Management

Open-File Report 2012–1115

U.S. Department of the Interior U.S. Geological Survey

## **U.S. Department of the Interior**

KEN SALAZAR, Secretary

### **U.S. Geological Survey**

Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2012

For product and ordering information: World Wide Web: http://www.usgs.gov/pubprod Telephone: 1-888-ASK-USGS

This report and any updates to it are available online at: http://pubs.usgs.gov/of/2012/1115/.

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment: World Wide Web: http://www.usgs.gov Telephone: 1-888-ASK-USGS

Suggested citation:

Cheng, C.L., 2012, Measurements of seepage losses and gains, East Maui Irrigation diversion system, Maui, Hawai'i: U.S. Geological Survey Open-File Report 2012–1115, 23 p.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted material contained within this report.

## Contents

Abstract	1
Introduction	1
Purpose and Scope	2
Acknowledgments	2
Description of the Study Area	2
EMI Diversion System	4
Climate and Rainfall	4
Seepage Loss and Gain Investigation	4
Ditch Characterization	6
Seepage Runs	12
Seepage Losses and Gains	13
Summary and Conclusions	19
References Cited	20
Appendix—Ditch characteristics and seepage rates of the East Maui	
Irrigation diversion system, east Maui, Hawai'i	21

## Figures

1.	East Maui Irrigation diversion system, water-license areas, and photographed locations, east Maui, Hawai'i	3
2.	Mean annual rainfall, east Maui, Hawaiʻi	5
3.	Ditch characterization of the East Maui Irrigation diversion system, east Maui, Hawai'i	6
4.	Photographs of two flumes that are part of the East Maui Irrigation diversion system, east Maui, Hawai'i	8
5.	Photographs of two sections of the Koʻolau Ditch, East Maui Irrigation diversion system, east Maui, Hawaiʻi	9
6.	Photographs of two sections of the Spreckels Ditch, East Maui Irrigation diversion system, east Maui, Hawai'i	9
7.	Photographs of three sections of the New Hāmākua and Kauhikoa Ditches, East Maui Irrigation diversion system, east Maui, Hawai'i	10
8.	Photographs of two sections of the Spreckels Ditch at Pāpa'a'ea, East Maui Irrigation diversion system, east Maui, Hawai'i	10
9.	Photographs of Manuel Luis, Center, and Lowrie Ditches, East Maui Irrigation diversion system, east Maui, Hawai'i	11
10.	Photographs of two sections of the Ha'ikū Ditch, East Maui Irrigation diversion system, east Maui, Hawai'i	12

## **Tables**

1.	Summary of ditch characteristics for the East Maui Irrigation diversion system, east Maui, Hawai'i	8
2.	Summary of ditch characteristics for seepage-run measurement reaches of the East Maui Irrigation diversion system, east Maui, Hawai'i	14
3.	Seepage-run discharge-measurement stations on the East Maui Irrigation diversion system, east Maui, Hawai'i	14
4.	Seepage-run measurement reaches with associated discharge measurements, estimated seepage losses and gains, length of measurement reach, and estimated seepage rates of the East Maui Irrigation diversion system, east Maui, Hawai'i	17

## **Conversion Factors**

Multiply	Ву	To obtain							
	Length								
inch (in.)	25.4	millimeter (mm)							
foot (ft)	0.3048	meter (m)							
mile (mi)	1.609	kilometer (km)							
	Area								
acre	0.004047	square kilometer (km ² )							
square foot (ft ² )	0.09290	square meter (m ² )							
square mile (mi ² )	2.590	square kilometer (km ² )							
	Volume								
gallon (gal)	0.003785	cubic meter (m ³ )							
million gallons (Mgal)	3,785	cubic meter (m ³ )							
cubic foot (ft ³ )	0.02832	cubic meter (m ³ )							
	Flow rate								
cubic foot per second (ft ³ /s)	0.64636	million gallons per day (Mgal/d)							
gallon per day (gal/d)	0.003785	cubic meter per day (m ³ /d)							
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m ³ /s)							
inch per year (in/yr)	25.4	millimeter per year (mm/yr)							

Seepage rate in cubic feet per second per mile of ditch (ft³/s/mi) may be converted to cubic meter per second per kilometer of ditch (m³/s/km) as follows: m³/s/km = 0.0176 x (ft³/s/mi)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:  $^{\circ}F=(1.8\times^{\circ}C)+32$ 

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:  $^{\circ}C=(^{\circ}F-32)/1.8$ 

Vertical coordinate information is referenced relative to local mean sea level.

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

# Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i

#### By Chui Ling Cheng

### Abstract

The U.S. Geological Survey conducted a field study from March to October 2011 to identify ditch characteristics and quantify seepage losses and gains in the East Maui Irrigation (EMI) diversion system, east Maui, Hawai'i. The EMI diversion system begins at Makapipi Stream in the east and ends at Māliko Gulch in the west. It consists of four primary ditches known as the Wailoa, New Hāmākua, Lowrie, and Ha'ikū Ditches. Additional ditches that connect to the four primary ditches include the Ko'olau, Spreckels, Kauhikoa, Spreckels at Pāpa'a'ea, Manuel Luis, and Center Ditches.

Ditch characteristics for about 63 miles of the EMI diversion system, excluding abandoned ditches and stream conveyances, were identified. About 46 miles (73 percent) of the surveyed diversion system are tunnels and 17 miles are open ditches-in which 11 miles are unlined, 3.5 miles are lined, and 2.5 miles are partially lined. The Wailoa, Kauhikoa, and Ha'ikū Ditches have greater than 96 percent of their total lengths as tunnels, whereas more than half of the Lowrie Ditch and Spreckels Ditch at Papa'a'ea are open ditches. About 70 percent of the total length of lined open ditches in the EMI diversion system is located along the Ko'olau Ditch, whereas about 67 percent of the total length of unlined open ditches in the diversion system is located along the Lowrie Ditch. Less than 4 percent of the EMI diversion system is partially lined open ditches, and about half of the total partially lined open-ditch length is in the Spreckels Ditch. EMI regularly maintains and repairs the diversion system; therefore, ditch characteristics documented in this report are representative of conditions existing during the period of this study.

Discharge measurements were made along 26 seepagerun measurement reaches that are a total of about 15 miles in length. The seepage-run measurement reaches represent 23 percent of the total length of ditches in the EMI diversion system. Discharge measurements were made along the measurement reaches during periods of stable ditch flow in the months of June, August, and September 2011. The discharge measurements indicate that Ko'olau Ditch and Spreckels Ditch at Pāpa'a'ea generally had seepage losses, whereas Wailoa, Kauhikoa, and New Hāmākua Ditches had seepage gains within the measured reaches. The Manuel Luis, Center, Lowrie, and Ha'ikū Ditches had variable seepage losses and gains within the seepage-run measurement reaches. Openditch measurement reaches generally had seepage losses that ranged from 0.1 cubic feet per second per mile of ditch at the Lowrie Ditch to 3.0 cubic feet per second per mile at the Ko'olau Ditch. Tunnel measurement reaches generally had seepage gains that ranged from 0.1 cubic feet per second per mile at the Manuel Luis Ditch to 5.2 cubic feet per second per mile at the Wailoa Ditch.

## Introduction

Since the late 1800s, the East Maui Irrigation Company (EMI) has been diverting surface water from streams in northeast Maui, Hawai'i mainly for the irrigation of sugarcane cultivated in the central isthmus of the island. Hawaiian Commercial and Sugar Company (HC&S) manages the sugarcane plantation, which has been the major sugar producer in the State of Hawai'i for more than a century. The EMI diversion system collects and transports water emanating from lands between Makapipi Stream to the east and Maliko Gulch to the west, and provides irrigation water for about 30,000 acres of the HC&S sugarcane plantation. The source of water for the EMI diversion system is primarily surface water from a total watershed area of 87.5 square miles (mi²), about two-thirds of which is owned by the State of Hawai'i (Wilcox, 1996, p. 118) and managed by the State of Hawai'i Department of Land and Natural Resources (DLNR). In 1938, Alexander and Baldwin, Inc. (A&B), the parent company of EMI and HC&S, obtained rights to the water on State of Hawai'i lands pursuant to water leases from four waterlicense areas identified as Nāhiku, Ke'anae, Honomanū, and Huelo, listed from east to west (fig. 1) (Kumu Pono Associates, LLC, 2001). When the water leases expired in 1986, A&B/EMI received year-to-year revocable permits from the DLNR for diverting water from the streams on State of Hawai'i lands.

The State Water Code mandates that the State of Hawai'i Commission on Water Resource Management (CWRM) establish a statewide instream use protection program (State Water Code, Hawai'i Revised Statutes, chapter 174C, section 71). The principal mechanism that CWRM implements for the purpose of protecting instream uses is establishing instream flow standards that describe flows necessary to protect the public interest in the stream with consideration of existing and potential water developments, including the economic impact of restricting such use (State Water Code, Hawai'i Revised Statutes, chapter 174C, section 71[1][C]). In September 2008 and May 2010, CWRM established interim instream flow standards for a majority of the streams in northeast Maui that are diverted by the EMI diversion system. CWRM's decision included a comprehensive list of adaptive management strategies, one of which required that "EMI, in coordination with the Commission and USGS [U.S. Geological Survey], shall seek to cooperatively fund and undertake a system efficiency study to accurately determine EMI system losses and/or gains." (State of Hawai'i Department of Land and Natural Resources, 2010). EMI reported that through a program of regular inspection and maintenance, seepage losses in the diversion system were minimized; however, they were unable to provide measurements or estimates documenting the efficiency of the diversion system (Hawaiian Commercial and Sugar Company, 2010).

The U.S. Geological Survey (USGS), in cooperation with CWRM and in collaboration with EMI, undertook an investigation that aims to provide measurements of seepage losses and gains in the EMI diversion system that are necessary to address CWRM's order to evaluate system efficiency. Moreover, results from this study will provide area water-resource managers with additional hydrologic information to aid in the management of surface-water resources in east Maui.

### **Purpose and Scope**

The objective of this study is to quantify seepage losses and gains for selected reaches of the EMI diversion system in east Maui, Hawai'i. This study provides baseline data that will help determine if there is a need for additional data or a more comprehensive study focused on a particular ditch-construction type(s) or ditch reaches. This study does not address seepage rates of reservoirs that receive water from or are part of the EMI diversion system.

This report documents (1) the locations of tunnel and open-ditch sections of the EMI diversion system, and (2) seepage losses and gains for selected reaches of the diversion system, including tunnel and open-ditch reaches. Seepage losses and gains for each selected reach were computed from same-day discharge measurements of water inflows to and outflows from the reach.

### Acknowledgments

The author gratefully acknowledges the State of Hawai'i Commission on Water Resource Management and the East Maui Irrigation Company for providing USGS with an opportunity to explore and understand one of the largest and most complex irrigation diversion systems in the State of Hawai'i. The author is especially thankful to EMI for providing access to the entire diversion system and for making certain that maintenance and repair work did not affect parts of the ditch reaches where discharge measurements were being made. EMI personnel Garret Hew, Mark Vaught, Henry Robello, and Kai Andaya were most generous with their time as they accompanied USGS personnel to ensure their safety while working along the access roads and in the ditches.

Thank you to an experienced group of USGS personnel for their dedication and assistance throughout the study. Chiu W. Yeung, Clarence L. Edwards, Richard B. Castro, and Casey J. Rita conducted discharge measurements and helped with all field-related activities. They also shared their diverse knowledge in selecting measurement cross sections, conducting discharge measurements, and using different types of discharge measuring equipment in a variety of conditions. Bobbie L. Arruda and Heather A. Jeppesen assisted with data management. Matt A. Wong and James W. Nelson (USGS Maui Field Office) shared their field equipment. Finally, I appreciate Delwyn S. Oki, Stephen B. Gingerich, Scot K. Izuka, Richard A. Fontaine, and Ronald L. Rickman for their helpful comments and suggestions regarding project design and interpretation of the results.

## **Description of the Study Area**

The study area (figs. 1 and 2) is located on the northern flank of Haleakalā Volcano, also known as the "East Maui Volcano," which forms the eastern part of the Island of Maui and rises to an altitude of 10,023 feet (ft) at Pu'u 'Ula'ula (Red Hill). Covering an area of about 151 mi², the study area is bounded to the north-northeast by 33 miles of coastline and encompasses 39 drainage basins that the EMI diversion system traverses-from Makapipi in the east to Māliko Gulch in the west. The topography of the northern flanks of the volcano is characterized by the steep walls of many deeply incised valleys, as well as by gently sloping terrain at the intermediate altitudes where dense rain forests exist. The land surface at higher altitudes of the volcano commonly supports grasses and shrubs.



Figure 1. East Maui Irrigation (EMI) diversion system, water-license areas, and photographed locations, east Maui, Hawai'i.

#### **EMI Diversion System**

The EMI diversion system is a complex water collection and transport system that consists of roughly 388 separate stream-water intakes, 12 inverted siphons, and numerous secondary feeders, dams, intakes, pipes, and flumes (Wilcox, 1996, p. 117-18). The diversion system has four primary levels of ditches: Wailoa, New Hāmākua, Lowrie, and Ha'ikū Ditches, listed from highest to lowest altitude (fig. 1). Additional ditches that connect to the primary ditches include the Koʻolau, Kauhikoa, Manuel Luis, Center, Spreckels, and Spreckels at Papa'a'ea Ditches. These ditches are interconnected by short sections that transport water from one ditch to another and natural stream channels that convey diverted water between the ditches. The New Hāmākua and Ha'ikū Ditches function as overflow ditches that capture excess flows from the Wailoa and Lowrie Ditches, respectively.

Ko'olau Ditch marks the beginning of the EMI diversion system, and it transports water diverted from streams in the eastern half of the study area to Alo Stream (appendix), where the Ko'olau Ditch is thereafter referred as Wailoa Ditch. Combined, the Ko'olau and Wailoa Ditches make one continuous ditch that is located at the highest altitude of the four primary ditches. The Wailoa/Ko'olau Ditch traverses the northern flank of the East Maui Volcano along a relatively uniform altitude of about 1,200-1,300 ft. New Hāmākua Ditch is situated immediately below Wailoa Ditch at altitudes of 1,000-1,260 ft. The western end of New Hāmākua Ditch is abandoned; alternatively, flow in the ditch is transferred to Kauhikoa Ditch at the tributaries of Kakipi Gulch (appendix). The lower ditches-Lowrie and Ha'ikū Ditch-are farther apart in terms of altitude than the upper ditches are. Lowrie Ditch and its connected ditches, Manuel Luis and Center Ditch (appendix), span a larger range of altitudes than the rest of the ditches, ranging from 940 ft near Punalau Stream to 400 ft near Kuiaha Gulch. Ha'ikū Ditch is located at the lowest altitude of all the ditches in the EMI diversion system and it is situated between the altitudes of 300 and 500 ft. All four primary ditches drop in altitude at Māliko Gulch to allow for the transport of ditch water across the gulch to the HC&S plantation by means of gravity-feed siphons.

The main purpose of the EMI diversion system is to transport surface water, originating from a majority of the drainage basins within the study area, to central Maui for sugarcane cultivation, diversified agriculture, and domestic use through public-water systems. Demand for water from the EMI diversion system is generally the greatest from May to September. During these periods, the diversion system captures most of the water available in the study area streams at the points of diversion. According to Gingerich (1999, p. 15), during the 73-year period 1925–97, the total combined flow for the four primary ditches of the EMI diversion system measured at Honopou Stream averaged about 163 million gallons per day (Mgal/d). During 1924–87, average flows measured at Honopou Stream were 110 Mgal/d for Wailoa Ditch, 23 Mgal/d for New Hāmākua and Lowrie Ditches, and 15 Mgal/d for Ha'ikū Ditch.

Parts of the EMI diversion system not assessed in this study include (1) abandoned ditches such as the westernmost section of the New Hāmākua Ditch; (2) ditches that transport water from diversion intakes to the main ditches; and (3) minor diversions that capture runoff water. Although ditch characteristics of Spreckels Ditch were identified, seepage-run discharge measurements were not made there because EMI was repairing the ditch during the study period.

#### Climate and Rainfall

Climate in northeast Maui is primarily controlled by trade winds from the east-northeast that create a series of distinct microclimates occurring at different altitudes on the East Maui Volcano. Trade winds are more frequent in the summer months when they are present more than 90 percent of the time (Schroeder, 1993). The study area lies mainly on the windward side of the volcano where the distribution of rainfall is controlled by orographic effects (fig. 2). Orographic rainfall occurs when northeasterly trade winds lift moist air up the windward slopes of the volcano into higher altitudes where the air is cooled, clouds are formed, and rainfall is generated. The study area receives near-daily orographic rainfall resulting in mean annual rainfall of about 140 inches per year (in/yr) near the northeastern coast, rainfall of more than 280 in/yr on the eastern intermediate slopes, and rainfall of less than 40 in/yr at the summit of the volcano and in Maliko Gulch (Giambelluca and others, 2011). Mean annual rainfall at the altitude of the Ko'olau Ditch is the highest of all ditches in the EMI diversion system, averaging about 240 in/yr near Makapipi Stream and decreasing to about 210 in/yr in Ke'anae Valley. Mean annual rainfall at the altitudes of the Wailoa and New Hāmākua Ditches ranges from an average of 200 in/yr east of Kakipi to about 65 in/yr near Māliko Gulch. Mean annual rainfall at the altitudes of the lower ditches is about 170 in/yr at the start of the Manuel Luis Ditch, decreasing to about 50 in/yr at the western end of the Ha'ikū Ditch.

## Seepage Loss and Gain Investigation

Field reconnaissance of the EMI diversion system was done to characterize the ditches, locate diversion structures, and select seepage-run measurement reaches and discharge measurement sites. Accessible parts of the ditches were inspected in the field, and ditch characteristics were documented using visual observations, photographs, and a handheld global positioning system (GPS) unit. To aid the selection of suitable seepage-run measurement reaches, locations of surface-water inflows and outflows were noted along the EMI diversion system. Inflows were typically



Figure 2. Mean annual rainfall, east Maui, Hawai'i (modified from Giambelluca and others, 2011). EMI, East Maui Irrigation.

from stream diversions, and outflows from the ditch were typically flow releases to streams and reservoirs. Discharge measurements were made using Price pygmy and Price type AA vertical-axis current meters. All discharge measurements made as part of this study were entered into the USGS National Water Information System (NWIS) database and are available for online retrieval at http:// waterdata.usgs.gov/hi/nwis/nwis using USGS station numbers (see table 3).

#### **Ditch Characterization**

The lengths of EMI's four primary ditches and their connecting ditches are characterized as being either tunnel or open ditch on the basis of definitions summarized in figure 3. Lengths of ditch that are covered or underground, including culverts, siphons, and pipes, are categorized as tunnel. The construction types of tunnels are not identified in this study due to safety concerns associated with conducting surveys in confined spaces. Although the construction types at the tunnel entrances and exits are documented, those construction types may not be representative of the entire length of the tunnel. Openditch sections are further characterized by construction type, which is defined by the materials that make up the ditch walls and bottom. The three categories of open-ditch construction types are lined, partially lined, and unlined. Lined open-ditch sections have ditch walls and bottoms that are either concrete, stainless steel, solid bedrock, or cut stone with mortared joints-also known as armored

cut-stone wall. A majority of the flumes are lined openditch sections because they are constructed entirely of concrete (fig. 4A) or stainless steel (fig. 4B) at the time of the study. Unlined open-ditch sections have walls and bottoms that consist of stacked rocks without mortared joints or any earthen material. Partially lined open-ditch sections have various combinations of lined and unlined ditch walls and bottoms, such as concrete-lined walls with an earthen bottom or an earthen bottom and wall with armored cut-stone on the other wall. Typically, partially lined open-ditch sections were at one time short unlined ditch sections that have been repaired.

Ditch characteristics of the EMI diversion system are mapped in the appendix and summarized in table 1. Photographs were taken to illustrate the various types of ditch characteristics identified in the EMI diversion system. Figure 1 shows the locations where the photographs included in figures 4 to 10 were taken. About 63 miles of the EMI diversion system were inspected in the field-73 percent of the system is tunnels and the remainder of the system is open ditches. Of the 17 miles of open ditches surveyed, about 65 percent is unlined, 21 percent is lined, and 14 percent is partially lined. EMI regularly maintains and repairs its diversion system, which may result in changes to the characteristics of each ditch over time. Therefore, the ditch characteristics documented in this report are representative of the EMI diversion system during the period of the study. The following is a summary of the ditch characteristics of each primary ditch system.



Koʻolau and Wailoa Ditches.—Koʻolau Ditch conveys water between Makapipi Stream and Alo Stream, a tributary of Waikamoi Stream, where the ditch is thereafter referred as Wailoa Ditch. Ko'olau Ditch has a total length of 10.2 miles, 75 percent of which is tunnels and most of the remainder of which (about 2.5 miles) is lined open ditches that have concrete or armored cut-stone walls such as those shown in figure 5. From the start of the ditch at Makapipi Stream to Kopili'ula Stream, Ko'olau Ditch consists of a combination of tunnel and lined open-ditch sections. The remainder of the ditch between Kopili'ula and Waikamoi Streams is entirely tunnel, except a short lined open-ditch section near Pi'ina'au Stream. Heading west from Alo Stream, the Wailoa Ditch conveys water for about 9.6 miles mostly in tunnels and terminates at Māliko Gulch, where the water is delivered to the HC&S plantation. The open-ditch sections of Wailoa Ditch are limited to concrete-lined flumes, one of which is illustrated in figure 4A.

Spreckels Ditch.-Not to be confused with Spreckels Ditch at Pāpa'a'ea or the Spreckels Ditch of west Maui, Spreckels Ditch of the EMI diversion system is located between altitudes of 1,210 and 1,760 ft. The ditch conveys water from Nua'ailua Stream to Alo Stream, where it discharges water to the Wailoa Ditch. Spreckels Ditch can also discharge water to Ko'olau Ditch by means of Kolea Stream. Parts of Kolea, Puohokamoa, and Haipua'ena Streams convey water between sections of the Spreckels Ditch (fig. 6A). Excluding the streams that convey ditch water, Spreckels Ditch is about 3.6 miles in length, 2.0 miles of which are tunnels and 1.6 miles of which are a combination of short partially lined and unlined openditches (fig. 6B). At the time of the study, EMI was in the process of repairing the Spreckels Ditch and a portion of the water in the ditch was being discharged to Ko'olau Ditch. Therefore, the ditch characteristics identified for Spreckels Ditch as part of this study may change once the repairs are complete.

New Hāmākua and Kauhikoa Ditches.-New Hāmākua and Kauhikoa Ditches are located immediately below the Wailoa Ditch between altitudes of 600 and 1,260 ft. The active parts of New Hāmākua Ditch extend from Alo Stream to Maka'a, Halehaku, and 'Opana Streams-tributaries of Kakipi Gulch. The section of New Hāmākua Ditch between 'Ōpana Stream and 'Ōpaepilau Gulch is abandoned and is therefore not characterized as part of this study. Excluding the stream conveyances, New Hāmākua Ditch is about 8.0 miles in length with 2.4 miles of open ditches and 5.6 miles of tunnels. About 60 percent of the open-ditch sections is unlined (fig. 7A), 36 percent is partially lined (fig. 7*B*), and the remainder is lined. New H $\bar{a}m\bar{a}kua$  Ditch discharges water into the tributaries of Kakipi Gulch and subsequently into Kauhikoa Ditch. The Kauhikoa Ditch conveys water westward for about 5 miles almost entirely in tunnels to Māliko Gulch. One of the longest open-ditch sections of Kauhikoa Ditch is located near ' $\bar{O}$ pana Stream, where both ditch walls and the bottom are constructed of concrete (fig. 7*C*).

Spreckels Ditch at Pāpa'a'ea.—The shortest ditch in the EMI diversion system, Spreckels Ditch at Pāpa'a'ea, is located between altitudes of 680 and 930 ft. The ditch conveys water for about 1.0 mile from Ka'aiea Stream to Nailiilihaele Stream (the Hawaiian form of this stream name has not yet been verified), where the water is transferred to Lowrie Ditch. Near the end of Spreckels Ditch is Pāpa'a'ea Reservoir, which stores water mostly during periods of high rainfall. About 55 percent of Spreckels Ditch at Pāpa'a'ea is unlined open-ditch sections with walls made of earthen material or stacked rocks and a gravel bottom (fig. 8*A*). Open-ditch sections at the diversion intakes are partially lined with armored cut-stone on one or both walls and have a gravel bottom (fig. 8*B*).

Manuel Luis, Center, and Lowrie Ditches.-The Manuel Luis, Center, and Lowrie Ditches are located below the New Hāmākua and Kauhikoa Ditches. Stream reaches are used to convey water between the three ditches, making them interconnected. Manuel Luis Ditch, located between altitudes of 720 and 940 ft, begins at Punalau Stream and extends to Waikamoi Stream, where the ditch water is transferred to Center Ditch. Reaches of Puohokamoa Stream convey ditch water between sections of the Manuel Luis Ditch. Excluding the stream reaches that convey ditch water, Manuel Luis Ditch is about 1.8 miles in length, about 1 mile of which is tunnels and the remainder of which is mostly unlined open ditches (fig. 9A). Center Ditch, located between altitudes of 660 and 740 ft, conveys water for 2.2 miles from Waikamoi Stream to Nailiilihaele Stream where the ditch water is transferred to Lowrie Ditch. About 69 percent of Center Ditch is tunnels, and the remaining 31 percent is mostly unlined open ditches (fig. 9B) with very few lined and partially lined open-ditch sections. Lowrie Ditch is the longest of the three ditches and it conveys water for 12.4 miles from Nailiilihaele Stream near an altitude of 680 ft to Māliko Gulch near an altitude of 280 ft. About 4.6 miles (37 percent) of the ditch is tunnels and the remaining 7.8 miles is mostly unlined open ditches. The unlined open-ditch sections of the Manuel Luis and Center Ditches are very similar with gravel bottoms and walls made of earthen material on one side and stacked rocks on the other, whereas those of the Lowrie Ditch have mostly earthen walls and bottoms (fig. 9C). Lowrie Ditch had one of the last remaining wood flumes of the EMI diversion system, and it was replaced in October 2011 with a stainless-steel flume (fig. 9D) (Garret Hew, EMI, oral commun., November 22, 2011).

Ha 'ikū Ditch.—Ha 'ikū Ditch is located at the lowest altitude of all the ditches in the EMI diversion system. It conveys water for 9.7 miles from Kailua Stream to Māliko Gulch almost entirely by tunnels. Open-ditch sections constitute only about 0.4 miles of the Ha'ikū Ditch, and they are limited to concrete flumes (fig. 10) and lined diversion intakes. **Table 1.** Summary of ditch characteristics for the East Maui Irrigation diversion system, east Maui, Hawai'i.

[Approximate ditch lengths in miles. Sum of individual lengths may not add up to total due to rounding]

	Total length		Open ditch				
Ditch system	of ditch ^a	Tunnel	Lined	Partially lined	Unlined		
Koʻolau	10.20	7.70	2.47	0.02	0		
Wailoa	9.56	9.49	0.07	0	0		
Spreckels	3.58	2.00	0.01	1.28	0.29		
New Hāmākua	8.05	5.61	0.13	0.86	1.44		
Kauhikoa	4.96	4.78	0.16	0.02	0		
Spreckels at Pāpa'a'ea	1.04	0.42	0.01	0.03	0.57		
Manuel Luis	1.79	0.97	0	0.06	0.76		
Center	2.20	1.51	0.11	0.04	0.54		
Lowrie	12.41	4.61	0.21	0.13	7.46		
Haʻikū	9.68	9.30	0.38	0	0		
Total	63.47	46.41	3.53	2.45	11.08		

^a Total length of ditch excludes abandoned ditch sections and streams used for ditch-water conveyance.



**Figure 4.** Photographs of two flumes that are part of the East Maui Irrigation diversion system, east Maui, Hawai'i. *A*, Concrete-lined flume along the Wailoa Ditch at 'Ōpana. *B*, Stainless-steel flume along the Lowrie Ditch near Kuiaha Gulch, also known as Labasan flume.



**Figure 5.** Photographs of two sections of the Ko'olau Ditch, East Maui Irrigation diversion system, east Maui, Hawai'i. *A*, Lined open-ditch section near Makapipi Stream with armored cut-stone walls and concrete bottom. *B*, Lined open-ditch section near Waiohue Stream with concrete walls and bottom.



**Figure 6.** Photographs of two sections of the Spreckels Ditch, East Maui Irrigation diversion system, east Maui, Hawai'i. *A*, Haipua'ena Stream used as ditch-water conveyance. *B*, An open-ditch section that is both unlined and partially lined.



**Figure 8.** Photographs of two sections of the Spreckels Ditch at Pāpa'a'ea, East Maui Irrigation diversion system, east Maui, Hawai'i. *A*, Unlined open-ditch section near Ka'aiea Gulch. *B*, Partially lined open-ditch section near Ka'aiea Gulch diversion intake.

**Figure 7.** Photographs of three sections of the New Hāmākua and Kauhikoa Ditches, East Maui Irrigation diversion system, east Maui, Hawai'i. *A*, New Hāmākua Ditch, unlined open-ditch section at 'O'opuola Stream. *B*, New Hāmākua Ditch, partially lined open-ditch section near Waipi'o Stream. *C*, Kauhikoa Ditch, lined open-ditch section at 'Ōpana Stream.



**Figure 9.** Photographs of Manuel Luis, Center, and Lowrie Ditches, East Maui Irrigation diversion system, east Maui, Hawai'i. *A*, Manuel Luis Ditch, unlined open-ditch section near Puohokamoa Stream. *B*, Center Ditch, unlined open-ditch section between Kōlea and Punalu'u Streams. *C*, Lowrie Ditch, unlined open-ditch section near Māliko Gulch. *D*, Lowrie Ditch, old wood flume and replacement stainless-steel flume near Pe'ahi Reservoir (photograph by Garret Hew, East Maui Irrigation Company).



Figure 10. Photographs of two sections of the Ha'ikū Ditch, East Maui Irrigation diversion system, east Maui, Hawai'i. A, Eby Flume at Manawaiiao Stream. B, Shirota Flume at Kuiaha Gulch.

#### Seepage Runs

A seepage run in a diversion system consists of making multiple discharge measurements at nearly the same time along the selected reach. These same-day discharge measurements can be used to estimate seepage loss and gain rates over the measurement reaches. Conducting seepage runs in a diversion system is challenging because both natural (variations in rainfall and streamflow) and human (diversionsystem manipulations) factors can result in changing flow conditions. Flow in a ditch is affected by inflows from multiple stream diversion intakes and outflows into other ditches and streams. Given the frequent rainfall in the study area, surface runoff and overflow ditches that convey water from one ditch to another could very quickly affect flow in the entire EMI diversion system. In some cases, rainfall may only affect flows in the upper ditches, while flows in the lower ditches remain relatively stable. Furthermore, regular maintenance and repair of the EMI diversion system may disrupt ditch flow and restrict access into certain areas. These potential alterations in flow present complications when scheduling and conducting seepage runs.

Within the EMI diversion system, seepage-run measurement reaches were chosen on the basis of the following criteria: (1) reaches are representative of the different characteristics identified during the field inspections along each of the ditches; (2) reaches are as long as possible to increase the possibility of measuring representative seepage losses or gains and to minimize the effects of anomalous localized conditions on the overall average seepage rates; and (3) reaches have minimal or no additional diversion inflows and outflows, thereby reducing the inherent error introduced with each additional measurement that is required to characterize seepage rates within the measurement reaches. Seepage runs were not conducted in Spreckels Ditch because EMI was repairing the ditch at the time of the study.

Seepage runs were done on days when flow was generally stable in the ditch reaches where discharge measurements were made. Stable flow conditions were documented by recording the height of water surface, commonly referred to as gage height or stage, during the time when discharge measurements were being made. Whether a change in stage causes a substantial change in flow depends on the geometry and slope of the ditch in the vicinity of the cross section where the discharge measurement is being made, as well as the magnitude of flow. In some cases, discharges in the lower ditches were measured just before a change in flow condition was detected because the stage was continuously monitored during the discharge measurements. Depending on the number of diversion inflows and outflows and the need for repeat discharge measurements, a total of two to five discharge measurements were made at each seepage-run measurement reach at nearly the same time on the same day. Seepage losses and gains within the measurement reaches that were visually detected were estimated by a field technician if the flows were too low to measure with the available instruments.

Each discharge measurement made for this study was assigned one of four ratings—excellent, good, fair, or poor. The rating of a discharge measurement is a subjective evaluation of the measurement made by the field technician. The purpose of the rating is to qualitatively account for some of the factors that could potentially affect the accuracy of the discharge measurement. These factors include, but are not limited to, the condition of the measuring instrument, characteristics of the measurement cross section, spacing and number of observation verticals in a measurement cross section, changing stage, measurement of depth and velocity, and environment (Rantz and others, 1982, p. 179–80). Discharge measurements made during this study were generally rated good or fair, with a few measurements rated poor because of the characteristics of the measurement cross section.

Replicate measurements were made immediately following the first measurement at a number of randomly selected seepage-run discharge-measurement stations. This was done to address uncertainty associated with factors affecting the accuracy of a discharge measurement. Repeating the discharge measurement under changing measurement conditions-that is, different field technician, instrument, and (or) measurement cross section-could potentially reduce that uncertainty (Turnipseed and Sauer, 2010; Rantz and others, 1982). According to the USGS Pacific Islands Water Science Center surface-water quality-assurance standards (Ronald Rickman, USGS, written commun., January 14, 2011), if the first measurement and the replicate measurement are made under stable flow conditions, the difference between the two measurements should satisfy at least one of two criteria. The first criterion, associated with the magnitude of the discharge, indicates that the difference between the replicate measurements should be (1) within 10 percent for discharges less than 1.0 cubic feet per second ( $ft^3/s$ ), (2) within 7 percent for discharges of 1.0 through 10.0 ft³/s, and (3) within 5 percent for discharges greater than  $10.0 \text{ ft}^3/\text{s}$ . The second criterion, associated with the accuracy rating assigned to the replicate measurements, indicates that the difference should be (1) within 5 percent for measurements rated good to excellent, (2) within 8 percent for measurements rated fair; and (3) within 10 percent for measurements rated poor. For those cases in which one of the two criteria was satisfied, the average of the first measurement and the replicate measurement(s) is used to represent the discharge at the seepage-run station. For cases in which the difference between the measurements does not fall within the percentages listed above, an additional measurement is made and the outlier measurement is not used in computing the average discharge.

#### Seepage Losses and Gains

Efficiency of a diversion system describes its function and performance in regards to the transport and (or) storage of the diverted water. For a well-maintained irrigationwater diversion system, seepage gains are typically favored and repairs are done to reduce the amount of seepage losses. Generally, seepage losses would be expected to be the highest for ditch reaches with large wetted perimeter (ditch surface in direct contact with water) and head (depth of water), all other factors being equal. If a ditch is not maintained properly and repairs are not made expeditiously to sections of the ditch in poor condition, the ditch condition would likely continue to degrade and seepage losses could increase over time. Seepage losses may also vary by irrigation season based on the length of time that the ditches transport water. The overflow ditches—New Hāmākua and Ha'ikū Ditch—sometimes run dry in the summer months when irrigation demand is high and available surface water is low. In this case, seepage losses may be more pronounced during initial wetting when flow in the ditches resumes.

The seepage loss or gain for each seepage-run measurement reach was computed as the difference between the downstream and upstream discharges, excluding any estimated or measured diversion inflows and outflows within the reach. The length of the seepage-run measurement reach was estimated from the USGS topographic map for east Maui as the horizontal distance in map view, using geographic information system (GIS) software. Seepage rate, expressed in cubic feet per second per mile of ditch (ft³/s/mi), is the ratio of estimated loss or gain to the length of the seepagerun measurement reach. The seepage rates are specific to the seepage-run measurement reaches where discharges were measured. The magnitude of the seepage loss or gain in a reach relative to the discharges in the reach may provide insight into the potential uncertainty in the estimated seepage loss or gain. In some instances, the estimated seepage losses and gains fall within the standard of error associated with the accuracy of the discharge measurements. For these cases, estimated seepage rates may represent the true seepage loss or gain within the measurement reaches. However, it is also possible that these seepage rates may reflect uncertainty in the discharge measurements.

About 15 miles of seepage-run measurement reaches were selected, 9 miles of which are open ditches and the remainder of which are tunnels (table 2). Seepage losses and gains were determined for about 52 percent of the 17 miles of open ditches identified during the ditch characteristics field inspections. Ditch characteristics for each of the seepage-run measurement reaches are shown in the appendix. Excluding Spreckels Ditch, where no seepage runs were conducted because of ongoing maintenance and repair, six out of the nine ditches that are part of the EMI diversion system have more than half of their identified open-ditch reaches measured in seepage runs. Wailoa, Kauhikoa, and Ha'ikū Ditches have fewer open-ditch seepage-run measurement reaches because the ditches are mostly tunnels. Seepage runs in partially lined open-ditch reaches are limited, because these types of ditch reaches typically exist in very short reaches at diversion intakes and areas where repairs have been made. For this study, a total of 55 seepage-run discharge-measurement stations (table 3) were established, and 87 discharge measurements were made during a period of 11 days in June, August, and September of 2011. Table 4 lists the seepage-run measurement reaches and their associated discharge measurements, seepage loss and gain estimates, length of the measurement reach, and seepagerate estimates. An abbreviated station identifier (station ID) is assigned to each seepage-run discharge-measurement station for ease of reference in the report. The station ID is composed

 Table 2.
 Summary of ditch characteristics for seepage-run measurement reaches of the East Maui Irrigation diversion system, east Maui, Hawai'i.

[Approximate ditch lengths in miles;, seepage run not condu	ucted on Spreckels Ditch. Sum
of individual lengths may not add up to total due to rounding]	

	Total length of		Open ditch				
Ditch system	measurement reach ^a	Tunnel	Lined	Partially lined	Unlined		
Koʻolau	1.44	0.10	1.34	0	0		
Wailoa	0.59	0.57	0.02	0	0		
Spreckels							
New Hāmākua	1.97	1.00	0	0.23	0.75		
Kauhikoa	1.61	1.51	0.08	0.02	0		
Spreckels at Pāpa'a'ea	0.43	0.08	0	0.03	0.32		
Manuel Luis	0.93	0.53	0	0.02	0.38		
Center	0.86	0.39	0	0.03	0.45		
Lowrie	6.05	1.02	0.05	0.08	4.90		
Haʻikū	0.84	0.73	0.11	0	0		
Total	14.72	5.93	1.60	0.41	6.79		

^a Total length of ditch excludes abandoned ditch sections and streams used for ditch-water conveyance.

#### Table 3. Seepage-run discharge-measurement stations on the East Maui Irrigation diversion system, east Maui, Hawai'i.

[Station ID, station identifier that is also referenced in table 4; USGS, U.S. Geological Survey; NWIS, National Water Information System; DS, downstream; US, upstream; nr, near; Rd, road]

Station	USGS Station	Station name in USGS	Altitude,	Coordinates ^b		
ID	number	NWIS database	in feet ^a	Latitude	Longitude	
K1	204812156061401	Koolau Ditch at Makapipi tunnel, Maui, HI	1,290	20°48'12.0"	156°06'13.8"	
K2	204818156062401	Koolau Ditch DS overflow nr Makapipi, Maui, HI	1,309	20°48'18.0"	156°06'24.5"	
K3	204818156062501	Koolau Ditch .27 mi DS Makapipi tunnel, Maui, HI	1,306	20°48'18.3"	156°06'24.9"	
K4	204822156063801	Koolau Ditch US of Awaimakaino input, Maui, HI	1,297	20°48'22.3"	156°06'37.7"	
K5	204822156063802	Awaimakaino input nr Koolau Ditch, Maui, HI	1,297	20°48'22.5"	156°06'37.8"	
K6	204824156064201	Koolau Ditch nr Hanawi, Maui, HI	1,304	20°48'24.6"	156°06'42.1"	
K7	204853156071901	Koolau Ditch nr Puakea, Maui, HI	1,302	20°48'52.8"	156°07'19.4"	
K8	204856156072901	Koolau Ditch nr Waiohue, Maui, HI	1,299	20°48'56.3"	156°07'29.2"	
K9	204857156074001	Koolau Ditch DS Puaakaa input, Maui, HI	1,277	20°48'57.0"	156°07'40.6"	
K10	204903156074901	Koolau Ditch nr Kopiliula, Maui, HI	1,311	20°49'03.2"	156°07'48.7"	
K11	204928156100901	Koolau Ditch nr Kaleomaui Stream, Maui, HI	1,241	20°49'27.9"	156°10'09.0"	
K12	16523000	Koolau Ditch near Keanae, Maui, HI	1,235	20°49'41.6"	156°10'21.1"	
W1	205259156155001	Wailoa Ditch at Halehaku Flume, Maui, HI	1,206	20°52'58.5"	156°15'49.8"	
W2	205302156162301	Wailoa Ditch at Opana Flume, Maui, HI	1,182	20°53'02.0"	156°16'22.6"	
NH1	205226156125501	New Hamakua Ditch nr Nailiilihaele, Maui, HI	1,197	20°52'26.5"	156°12'55.2"	
NH2	205231156131501	New Hamakua Ditch at Kailua, Maui, HI	1,163	20°52'30.7"	156°13'14.6"	
NH3	205233156131801	New Hamakua Ditch at Ohanui, Maui, HI	1,191	20°52'32.9"	156°13'17.7"	
NH4	205247156133701	New Hamakua Ditch at Hoalua, Maui, HI	1,190	20°52'46.8"	156°13'37.0"	
NH5	205306156135201	New Hamakua Ditch nr Hanehoi, Maui, HI	1,185	20°53'06.0"	156°13'51.7"	
NH6	205309156141901	New Hamakua Ditch at Waipio, Maui, HI	1,198	20°53'09.3"	156°14'18.9"	
KH1	205341156162901	Kauhikoa Ditch US of Opana Basin, Maui, HI	1,039	20°53'41.1"	156°16'29.4"	
KH2	205335156173701	Calasa intake nr Kauhikoa Ditch, Maui, HI	1,042	20°53'34.8"	156°17'36.8"	
KH3	205336156174801	Kauhikoa Ditch US of Silva Intake, Maui, HI	1,004	20°53'36.2"	156°17'47.8"	
SP1	205218156115301	Spreckels-Papaaea DS Kaaiea input, Maui, HI	944	20°52'18.0"	156°11'52.9"	

 Table 3.
 Seepage-run discharge-measurement stations on the East Maui Irrigation diversion system, east Maui, Hawai'i.

 —Continued

[Station ID, station identifier that is also referenced in table 4; USGS, U.S. Geological Survey; NWIS, National Water Information System; DS, downstream; US, upstream; nr, near; Rd, road]

Station	Station USGS Station Station name in USGS		Altitude,	<b>Coordinates</b> ^b		
ID	number	NWIS database	in feet ^a	Latitude	Longitude	
SP2	205226156115801	Spreckels-Papaaea US Makanali input, Maui, HI	944	20°52'26.2"	156°11'58.1"	
SP3	205241156121501	Spreckels-Papaaea nr Oopuola, Maui, HI	839	20°52'41.2"	156°12'15.3"	
SP4	205247156121401	Spreckels-Papaaea at Papaaea flume, Maui, HI	831	20°52'47.2"	156°12'14.0"	
ML1	205126156103801	Manuel Luis Ditch nr Punalau, Maui, HI	953	20°51'25.8"	156°10'38.5"	
ML2	16541500	Manuel Luis Ditch at Puohokamoa Stream, Maui, HI	910	20°51'36.2"	156°10'49.2"	
ML3	205146156105701	Manuel Luis Ditch nr Puohokamoa, Maui, HI	915	20°51'45.7"	156°10'57.1"	
ML4	205152156110501	Manuel Luis Ditch nr Wahinepee Rd, Maui, HI	913	20°51'51.6"	156°11'05.4"	
ML5	205203156111401	Manuel Luis Ditch DS Wahinepee input, Maui, HI	892	20°52'03.2"	156°11'13.8"	
ML6	205212156112001	Manuel Luis Ditch nr Waikamoi, Maui, HI	746	20°52'12.4"	156°11'20.4"	
C1	205222156112401	Center Ditch DS of Kolea input, Maui, HI	747	20°52'22.4"	156°11'24.2"	
C2	205241156113301	Center Ditch US of Punaluu input, Maui, HI	719	20°52'41.5"	156°11'33.5"	
C3	205244156114601	Center Ditch DS of Makanali intake, Maui, HI	711	20°52'44.5"	156°11'46.5"	
C4	205238156120101	Center Ditch US of Oopuola intake, Maui, HI	701	20°52'38.5"	156°12'01.4"	
L1	205335156124801	Lowrie Ditch DS Kailua intake, Maui, HI	671	20°53'34.8"	156°12'47.6"	
L2	205341156130901	Lowrie Ditch nr Hoalua, Maui, HI	666	20°53'41.0"	156°13'08.7"	
L3	205342156131301	Lowrie Ditch DS Hoalua intake, Maui, HI	640	20°53'41.7"	156°13'12.5"	
L4	205342156132401	Lowrie Ditch US Hanehoi intake, Maui, HI	628	20°53'42.3"	156°13'24.1"	
L5	205417156144001	Lowrie Ditch DS Hoolawanui intake, Maui, HI	618	20°54'17.4"	156°14'39.6"	
L6	205435156145801	Lowrie Ditch US Honopou intake, Maui, HI	599	20°54'35.0"	156°14'57.7"	
L7	205437156150101	Lowrie Ditch DS siphon at Honopou, Maui, HI	613	20°54'37.2"	156°15'00.7"	
L8	205438156153101	Lowrie Ditch US Kapalaalea input, Maui, HI	603	20°54'38.1"	156°15'31.1"	
L9	205509156163502	Peahi flume leak nr Lowrie Ditch, Maui, HI	563	20°55'08.8"	156°16'35.4"	
L10	205509156163501	Lowrie Ditch DS of Peahi flume, Maui, HI	562	20°55'09.1"	156°16'35.0"	
L11	205453156172801	Lowrie Ditch nr Kaupakulua, Maui, HI	593	20°54'53.5"	156°17'28.4"	
L12	205458156175701	Lowrie Ditch DS Kaupakulua Reservoir, Maui, HI	523	20°54'57.7"	156°17'56.9"	
L13	205458156183601	Lowrie Ditch US siphon at Kuiaha, Maui, HI	555	20°54'58.5"	156°18'35.6"	
H1	205537156173301	Haiku Ditch at Eby Flume, Maui, HI	395	20°55'37.4"	156°17'33.0"	
H2	205534156175701	East Kaupakulua Gulch US Haiku Ditch, Maui, HI	352	20°55'33.6"	156°17'57.3"	
H3	205535156175901	Haiku Ditch at Kaupakulua, Maui, HI	360	20°55'34.8"	156°17'59.2"	
H4	205528156182301	Haiku Ditch at Libby Flume, Maui, HI	350	20°55'27.8"	156°18'22.8"	
H5	205522156184101	Haiku Ditch at Shirota Flume, Maui, HI	309	20°55'22.1"	156°18'40.8"	

^a Altitude values interpolated from USGS 1:24,000-scale digital hypsography data.

^b Latitude and longitude coordinates in North American Datum of 1983.

of one to two letters representing the ditch, followed by a number indicating the location of the station relative to its adjacent stations—for example, station K1 is four stations upstream from station K5 along Ko'olau Ditch. For seepage-run discharge-measurement stations with replicate measurements, the average of all discharge measurements were used to compute seepage losses and gains except at station ML4 in which only the second and third discharge measurements were used because those two measurements were most consistent.

Ko'olau and Wailoa Ditches.—A total of six seepagerun measurement reaches, which consist mainly of lined open

ditches, were selected along the Ko'olau Ditch. Discharge measurements were made on June 13–14 and September 12, 2011, and the discharges ranged from 2.34 ft³/s near Hanawī Stream (station K4) to 44.4 ft³/s near Ke'anae (station K11). Estimated seepage rates generally showed losses that ranged from 0.94 to 3.0 ft³/s/mi, except in the 0.20-mile reach between stations K9 and K10 that had a seepage-gain rate of 3 ft³/s/mi as shown by discharge measurements made on June 14, 2011. Seepage losses and gains for three of the seepage-run measurement reaches were within 5 percent of the upstream discharges in the measurement reaches. Two seepage runs—from stations K1 to K2 and K9 to

K10-were repeated because the differences between the upstream and downstream discharges from the first set of discharge measurements were relatively large, and they departed from the general range of seepage losses and gains observed at the other measurement reaches. A second set of measurements was made for those seepage-run measurement reaches, and the seepage rates estimated from the second set of discharge measurements fell within the general range of seepage losses and gains. The seepage rates associated with the initial seepage runs (June 13, 2011) between K1 and K2 and between K9 and K10 may reflect instrument error, measurement error, or unexpected changes at the diversion structures that affected the ditch flow for a short period of time. Additional measurements in these reaches would reduce uncertainty in estimated seepage rates.

Wailoa Ditch has only one seepage-run measurement reach because the ditch is almost entirely tunnel with very few open-ditch sections where discharge measurements could be made. Wailoa Ditch typically transports a majority of the diverted water in the EMI diversion system and it has an average flow of 110 Mgal/d (Gingerich, 1999, p. 15). The discharges measured on September 13, 2011, indicated a flow of about 88 ft³/s at the concrete flume near 'Ōpana Stream. Discharge measurements made for this study showed a seepage-gain rate of 5.2 ft³/s/mi between station W1 at Halehaku flume and station W2 at 'Ōpana flume. The seepage gain was within 5 percent of the upstream discharge in the measurement reach.

New Hāmākua and Kauhikoa Ditches.—The three seepage-run measurement reaches of the New Hāmākua Ditch are mostly tunnels and unlined open-ditches. Partially lined open-ditch reaches are located at the diversion intakes, which were not diverting water at the time of the seepage runs. Kauhikoa Ditch has only one seepage-run measurement reach, generally of tunnel construction, because the ditch has very few open-ditch sections where discharge measurements could be made. Discharge measurements for New Hāmākua Ditch made on August 10, 2011, ranged from 0.52 ft³/s near Nailiilihaele (station NH1) to 1.15 ft³/s near Hanehoi (station NH5) and at Waipi'o (station NH6). Estimated seepage rates showed gains that ranged from 0.04 to 0.49 ft³/s/mi within the seepage-run measurement reaches. Only one out of the three measurement reaches had seepage gains within 5 percent of the upstream discharge in the measurement reach. Discharges measured in Kauhikoa Ditch on September 13, 2011, showed a seepage-gain rate of about 0.20 ft³/s/mi between station KH1 near 'Ōpana Stream and station KH3 near East Kuiaha Gulch.

Spreckels Ditch at Pāpa'a'ea.—The Spreckels Ditch at Pāpa'a'ea has two seepage-run measurement reaches, and they are almost entirely unlined open ditches. Both sets of discharge measurements made on June 16, 2011, indicated seepage losses.

*Manuel Luis, Center, and Lowrie Ditches.*—The Manuel Luis Ditch has three seepage-run measurement reaches, and they are mainly tunnel and unlined open ditches. Discharge measurements made on June 15, 2011, ranged from 0.24 ft³/s near Puohokamoa Stream near the beginning of the ditch (station ML2) to 1.19 ft³/s near Waikamoi Stream (station ML6) upstream of where ditch water is conveyed to Center Ditch. Seepage rates were variable, with both losses and gains throughout the seepage-run measurement reaches. The largest estimated seepage-loss rate was 0.3 ft³/s/mi between stations ML1 and ML2, a reach that was almost all tunnel construction.

The two seepage-run measurement reaches selected for the Center Ditch are mostly tunnel and unlined open ditches. Discharge measurements made on June 16, 2011, varied between 3.24 ft³/s near Kōlea Stream (station C1) and 4.03 ft³/s near Makanali Stream (station C3). The discharge measurements showed a seepage-gain rate of 0.45 ft³/s/mi in the upstream measurement reach (stations C1 to C2) and a seepage-loss rate of 1.1 ft³/s/mi at the downstream measurement reach (stations C3 to C4). The seepage flows were within 8 percent of the upstream discharges in the measurement reaches.

Lowrie Ditch has six seepage-run measurement reaches, and they are mostly unlined open ditches, except the reach between stations L1 and L2 that is mostly tunnel. Seepage runs were made before the Pe'ahi flume was replaced with a stainless-steel flume (fig. 9D); therefore, flume leakage measurements at station L9 no longer apply to the current condition of the flume. A seepage run on Lowrie Ditch was attempted on June 17, 2011 and was aborted due to heavy rain. Successful seepage-run discharge measurements were made on August 8–9, 2011, and the flows varied between 15.2 ft³/s near Kailua Stream (station L1) and 41.3 ft³/s near Kuiaha Gulch (station L13). Half of the seepage-run measurement reaches had seepage-gain rates between 1.7 and 3.1 ft³/s/mi, whereas the other half had seepageloss rates of 0.1 to 1 ft³/s/mi. Four of the seepage-run measurement reaches had seepage flows within 5 percent of the upstream discharges in the reaches.

*Ha'ikū Ditch.*—Two seepage-run measurement reaches were selected for the Ha'ikū Ditch, and both reaches are mainly of tunnel construction. Discharge measurements made on August 11, 2011, ranged from  $3.05 \text{ ft}^3$ /s near East Kuiaha Gulch (station H4) to 22.2 ft³/s near Manawaiiao Stream (station H1) and near Kaupakulua Gulch (station H3). Discharge measurements showed a seepage-loss rate of 0.8 ft³/s/mi in the upstream seepage-run measurement reach (stations H1 to H3) and a seepage-run measurement reach (stations H4 to H5). These seepage flows were within 5 percent of the upstream discharges in the measurement reaches. **Table 4.** Seepage-run measurement reaches with associated discharge measurements, estimated seepage losses and gains, length of measurement reach, and estimated seepage rates of the East Maui Irrigation diversion system, east Maui, Hawai'i.

[Station ID, station identifier that is also referenced in table 3; USGS; U.S. Geological Survey; NWIS, National Water Information System; HST, Hawai'i Standard Time;  $ft^3/s$ , cubic feet per second; mi, mile;  $ft^3/s/mi$ , cubic feet per second per mile of ditch; DS, downstream; US, upstream; nr, near; Rd, road; N.A., not applicable; discharge values that are underlined indicate diversion inflow within the seepage-run measurement reach; seepage rates in **bold** denote rates that departed from the general range of seepage rates observed at other seepage-run measurement reaches]

Station	Station name in USGS NWIS database	Date Time		Dis- Measure- charge ment		ure- Seepage loss nt <u>or gain</u>		Length of meaurement	Seepage rate	
U			(HST)	(ft ³ /s)	rating	(ft³/s)	(percent)	section (mi)	(ft³/s/mi)	
		Koʻolau an	d Wailo	a Ditches	5					
K1	Koolau Ditch at Makapipi tunnel, Maui, HI	06/13/11	1126	8.53	Good	-2.75	-32.2	0.26	-11	
K2	Koolau Ditch DS overflow nr Makapipi, Maui, HI	06/13/11	1130	5.78	Fair					
K3	Koolau Ditch .27 mi DS Makapipi tunnel, Maui, HI	06/13/11	1152	6.17	Fair	-1.15	-18.6	0.38	-3.0	
K4	Koolau Ditch US of Awaimakaino input, Maui, HI	06/13/11	1224	5.72	Good					
K5	Awaimakaino input nr Koolau Ditch, Maui, HI	06/13/11	1230	<u>1.60</u>	Good					
K6	Koolau Ditch nr Hanawi, Maui, HI	06/13/11	1307	6.62	Fair					
K1	Koolau Ditch at Makapipi tunnel, Maui, HI	06/13/11	1329	6.94	Good	-0.56	-8.4	0.26	-2.2	
K1	Koolau Ditch at Makapipi tunnel, Maui, HI	06/13/11	1353	6.43	Good					
K2	Koolau Ditch DS overflow nr Makapipi, Maui, HI	06/13/11	1400	6.12	Good					
K7	Koolau Ditch nr Puakea, Maui, HI	06/13/11	1615	20.4	Good	-0.2	-1.0	0.19	-1.0	
K8	Koolau Ditch nr Waiohue, Maui, HI	06/13/11	1614	20.2	Good					
K9	Koolau Ditch DS Puakaa input, Maui, HI	06/13/11	1754	25.0	Fair	4.2	16.8	0.20	21	
K10	Koolau Ditch nr Kopiliula, Maui, HI	06/13/11	1740	29.2	Good					
K9	Koolau Ditch DS Puakaa input, Maui, HI	06/14/11	1145	25.2	Good	0.6	2.4	0.20	3	
K10	Koolau Ditch nr Kopiliula, Maui, HI	06/14/11	1118	25.8	Good					
K11	Koolau Ditch nr Kaleomaui Stream, Maui, HI	06/14/11	1428	44.1	Fair	-0.6	-1.4	0.41	-2	
K11	Koolau Ditch nr Kaleomaui Stream, Maui, HI	06/14/11	1500	44.4	Fair					
K12	Koolau Ditch near Keanae, Maui, HI	06/14/11	1424	42.9	Good					
K12	Koolau Ditch near Keanae, Maui, HI	06/14/11	1501	44.3	Good					
K1	Koolau Ditch at Makapipi tunnel, Maui, HI	09/12/11	1038	2.80	Good	-0.52	-17.9	0.55	-0.94	
K1	Koolau Ditch at Makapipi tunnel, Maui, HI	09/12/11	1104	2.96	Good					
K1	Koolau Ditch at Makapipi tunnel, Maui, HI	09/12/11	1131	2.93	Good					
K4	Koolau Ditch US of Awaimakaino input, Maui, HI	09/12/11	1050	2.43	Good					
K4	Koolau Ditch US of Awaimakaino input, Maui, HI	09/12/11	1123	2.34	Good					
W1	Wailoa Ditch at Halehaku Flume, Maui, HI	09/13/11	1333	85.3	Fair	3.1	3.6	0.59	5.2	
W2	Wailoa Ditch at Opana Flume, Maui, HI	09/13/11	1356	88.4	Fair					
	New	Hāmākua	and Kau	uhikoa Dit	tches					
NH1	New Hamakua Ditch nr Nailiilihaele, Maui, HI	08/10/11	1047	0.57	Good	0.22	40.7	0.45	0.49	
NH1	New Hamakua Ditch nr Nailiilihaele, Maui, HI	08/10/11	1110	0.52	Good					
NH2	New Hamakua Ditch at Kailua, Maui, HI	08/10/11	1111	0.76	Fair					
NH3	New Hamakua Ditch at Ohanui, Maui, HI	08/10/11	1313	0.83	Good	0.24	28.9	0.80	0.30	
NH4	New Hamakua Ditch at Hoalua, Maui, HI	08/10/11	1315	1.07	Good					
NH5	New Hamakua Ditch nr Hanehoi, Maui, HI	08/10/11	1444	1.09	Good	0.03	2.7	0.72	0.04	
NH5	New Hamakua Ditch nr Hanehoi, Maui, HI	08/10/11	1516	1.15	Good					
NH5	New Hamakua Ditch nr Hanehoi, Maui, HI	08/10/11	1544	1.12	Good					
NH6	New Hamakua Ditch at Waipio, Maui, HI	08/10/11	1503	1.15	Fair					
KH1	Kauhikoa Ditch US of Opana Basin, Maui, HI	09/13/11	1031	1.35	Good	0.32	23.9	1.61	0.20	
KH1	Kauhikoa Ditch US of Opana Basin, Maui, HI	09/13/11	1104	1.33	Good					
KH2	Calasa intake nr Kauhikoa Ditch, Maui, HI	09/13/11	0921	0.040	<u>)</u> Poor					
KH3	Kauhikoa Ditch US of Silva Intake, Maui, HI	09/13/11	1021	1.74	Good					
KH3	Kauhikoa Ditch US of Silva Intake, Maui, HI	09/13/11	1103	1.65	Good					

#### 18 Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i

**Table 4.** Seepage-run measurement reaches with associated discharge measurements, estimated seepage losses and gains, length of measurement reach, and estimated seepage rates of the East Maui Irrigation diversion system, east Maui, Hawai'i.—Continued

[Station ID, station identifier that is also referenced in table 3; USGS; U.S. Geological Survey; NWIS, National Water Information System; HST, Hawai'i Standard Time; ft³/s, cubic feet per second; mi, mile; ft³/s/mi, cubic feet per second per mile of ditch; DS, downstream; US, upstream; nr, near; Rd, road; N.A., not applicable; discharge values that are underlined indicate diversion inflow within the seepage-run measurement reach; seepage rates in **bold** denote rates that departed from the general range of seepage rates observed at other seepage-run measurement reaches]

Station		Time Dis- Measure- Seepage loss Length of		Seepage					
	Station name in USGS NWIS database	Date	(HST)	charge	ment	or gain		meaurement	rate
				(ft³/s)	rating	(ft³/s)	(percent)	section (mi)	(ft³/s/mi)
	S	preckels [	Ditch at	Pāpa'a'e	a				
SP1	Spreckels-Papaaea DS Kaaiea input, Maui, HI	06/16/11	1202	0.29	Good	-0.20	-71.4	0.26	-0.77
SP1	Spreckels-Papaaea DS Kaaiea input, Maui, HI	06/16/11	1221	0.28	Good				
SP2	Spreckels-Papaaea US Makanali input, Maui, HI	06/16/11	1219	0.080	Good				
SP2	Spreckels-Papaaea US Makanali input, Maui, HI	06/16/11	1237	0.090	Good				
SP3	Spreckels-Papaaea nr Oopuola, Maui, HI	06/16/11	1405	1.02	Good	-0.13	-12.7	0.15	-0.87
SP4	Spreckels-Papaaea at Papaaea flume, Maui, HI	06/16/11	1355	0.89	Good				
	Manuel	Luis, Cen	iter, and	Lowrie I	Ditches				
ML1	Manuel Luis Ditch nr Punalau, Maui, HI	06/15/11	1100	0.33	Fair	-0.09	-27.3	0.28	-0.3
ML2	Manuel Luis Ditch at Puohokamoa Stream, Maui, HI	06/15/11	1102	0.24	Fair				
ML3	Manuel Luis Ditch nr Puohokamoa, Maui, HI	06/15/11	1209	0.82	Good	-0.06	-7.5	0.35	-0.2
ML3	Manuel Luis Ditch nr Puohokamoa, Maui, HI	06/15/11	1241	0.79	Good				
ML4	Manuel Luis Ditch nr Wahinepee Rd, Maui, HI	06/15/11	1225	0.88	Good				
ML4	Manuel Luis Ditch nr Wahinepee Rd, Maui, HI	06/15/11	1245	0.71	Good				
ML4	Manuel Luis Ditch nr Wahinepee Rd, Maui, HI	06/15/11	1308	0.78	Good				
ML5	Manuel Luis Ditch DS Wahinepee input, Maui, HI	06/15/11	1442	1.15	Fair	0.04	3.5	0.30	0.1
ML6	Manuel Luis Ditch nr Waikamoi, Maui, HI	06/15/11	1449	1.19	Fair				
C1	Center Ditch DS of Kolea input, Maui, HI	06/16/11	0939	3.35	Fair	0.26	7.9	0.58	0.45
C1	Center Ditch DS of Kolea input, Maui, HI	06/16/11	1011	3.24	Fair				
C2	Center Ditch US of Punaluu input, Maui, HI	06/16/11	1000	3.61	Good				
C2	Center Ditch US of Punaluu input, Maui, HI	06/16/11	1046	3.51	Good				
C3	Center Ditch DS of Makanali intake, Maui, HI	06/16/11	1515	4.03	Good	-0.31	-7.7	0.28	-1.1
C4	Center Ditch US of Oopuola intake, Maui, HI	06/16/11	1523	3.72	Fair				
L1	Lowrie Ditch DS Kailua intake, Maui, HI	08/08/11	1040	15.6	Fair	1.0	6.5	0.43	2.3
L1	Lowrie Ditch DS Kailua intake, Maui, HI	08/08/11	1125	15.2	Fair				
L2	Lowrie Ditch nr Hoalua, Maui, HI	08/08/11	1052	16.9	Good				
L2	Lowrie Ditch nr Hoalua, Maui, HI	08/08/11	1125	16.0	Good				
L3	Lowrie Ditch DS Hoalua intake, Maui, HI	08/08/11	1238	18.7	Fair	-0.7	-3.7	0.66	-1
L4	Lowrie Ditch US Hanehoi intake, Maui, HI	08/08/11	1249	18.0	Good				
L5	Lowrie Ditch DS Hoolawanui intake, Maui, HI	08/08/11	1441	18.8	Fair	2.1	11.2	0.67	3.1
L6	Lowrie Ditch US Honopou intake, Maui, HI	08/08/11	1516	20.9	Good				
L7	Lowrie Ditch DS siphon at Honopou, Maui, HI	08/09/11	0956	30.6	Good	-0.5	-1.6	1.10	-0.4
L7	Lowrie Ditch DS siphon at Honopou, Maui, HI	08/09/11	1033	31.0	Good				
L8	Lowrie Ditch US Kapalaalea input, Maui, HI	08/09/11	1008	30.3	Good				
L9	Peahi flume leak nr Lowrie Ditch, Maui, HI	06/17/11	0936	0.10	Fair	N.A.	N.A.	N.A.	N.A.
L9	Peahi flume leak nr Lowrie Ditch, Maui, HI	06/17/11	0945	0.090	Fair				
L9	Peahi flume leak nr Lowrie Ditch, Maui, HI	08/09/11	1228	0.24	Fair				
L9	Peahi flume leak nr Lowrie Ditch, Maui, HI	08/09/11	1240	0.24	Fair				
L10	Lowrie Ditch DS of Peahi flume, Maui, HI	08/09/11	1221	32.8	Fair	-0.3	-0.9	2.23	-0.1
L10	Lowrie Ditch DS of Peahi flume, Maui, HI	08/09/11	1251	31.6	Fair				
L11	Lowrie Ditch nr Kaupakulua, Maui, HI	08/09/11	1223	31.9	Good				
L12	Lowrie Ditch DS Kaupakulua Reservoir, Maui, HI	08/09/11	1436	39.7	Good	1.6	4.0	0.95	1.7
L13	Lowrie Ditch US siphon at Kuiaha, Maui, HI	08/09/11	1449	41.3	Fair				

**Table 4.** Seepage-run measurement reaches with associated discharge measurements, estimated seepage losses and gains, length of measurement reach, and estimated seepage rates of the East Maui Irrigation diversion system, east Maui, Hawai'i.—Continued

[Station ID, station identifier that is also referenced in table 3; USGS; U.S. Geological Survey; NWIS, National Water Information System; HST, Hawai'i Standard Time; ft³/s, cubic feet per second; mi, mile; ft³/s/mi, cubic feet per second per mile of ditch; DS, downstream; US, upstream; nr, near; Rd, road; N.A., not applicable; discharge values that are underlined indicate diversion inflow within the seepage-run measurement reach; seepage rates in **bold** denote rates that departed from the general range of seepage rates observed at other seepage-run measurement reaches]

Station ID	Station name in USGS NWIS database	Date	Time (HST)	Dis- charge (ft ³ /s)	Measure- ment rating	Seep or (ft ³ /s)	age loss r gain (percent)	Length of meaurement section (mi)	Seepage rate (ft ³ /s/mi)		
Ha'ikū Ditch											
H1	Haiku Ditch at Eby Flume, Maui, HI	08/11/11	1431	22.2	Good	-0.4	-1.8	0.49	-0.8		
H2	East Kaupakulua Gulch US Haiku Ditch, Maui, HI	08/11/11	1426	<u>0.040</u>	Poor						
H3	Haiku Ditch at Kaupakulua, Maui, HI	08/11/11	1410	22.2	Good						
H3	Haiku Ditch at Kaupakulua, Maui, HI	08/11/11	1443	21.5	Good						
H4	Haiku Ditch at Libby Flume, Maui, HI	08/11/11	1231	3.05	Good	0.06	2.0	0.35	0.2		
H5	Haiku Ditch at Shirota Flume, Maui, HI	08/11/11	1221	3.11	Poor						

## **Summary and Conclusions**

In response to CWRM's need for determining efficiency of the EMI diversion system, the USGS conducted a field study from March to October 2011 to assess the amount of seepage losses and gains in the four primary ditches of the diversion system. The four primary ditches of the EMI diversion system are the Wailoa, New Hāmākua, Lowrie, and Ha'ikū Ditches. Additional ditches that connect to the primary ditches include the Koʻolau, Spreckels, Kauhikoa, Spreckels at Pāpa'a'ea, Manuel Luis, and Center Ditches. The first part of this study characterized the individual ditch systems from Makapipi Stream to Maliko Gulch as tunnel or open ditch and as lined, partially lined, and unlined for the open ditches. The second part of this study involved making a series of sameday discharge measurements or seepage runs along selected reaches in the diversion system to determine seepage losses and gains. Seepage rates, expressed in cubic feet per second per mile of ditch, were computed. No seepage runs were made in Spreckels Ditch, because the ditch was under repair during the time of the study.

Ditch characteristics for about 63 miles of the EMI diversion system, excluding abandoned ditches and stream conveyances, were identified during field reconnaissance. The longest ditch in the EMI diversion system is Lowrie Ditch (12.4 miles), followed by Ko'olau, Ha'ikū, and Wailoa Ditches that are each about 10 miles in length. Within the EMI diversion system, about 17 miles of open ditches were surveyed, in which 11 miles are unlined, 3.5 miles are lined, and 2.5 miles are partially lined. The Wailoa, Kauhikoa, and Ha'ikū Ditches have greater than 96 percent of their lengths as tunnels, with very few lined open-ditch sections and those are mostly concrete flumes. More than half of Lowrie Ditch and Spreckels Ditch at Pāpa'a'ea are open-ditch sections are scarce, and they are most common in the Spreckels and New Hāmākua Ditches. Because

EMI regularly maintains and repairs its diversion system, the ditch characteristics documented in this report are only representative of the 2011 study period.

Discharge measurements were made along 26 seepage-run measurement reaches during relatively stable flow conditions in June, August, and September of 2011. Results indicate that Ko'olau Ditch and Spreckels Ditch at Papa'a'ea generally had seepage losses within the measurement reaches. Wailoa and Kauhikoa Ditches each had only one seepage-run measurement reach and both of them had seepage gains. Manuel Luis, Center, Lowrie, and Ha'ikū Ditches had variable seepage losses and gains in the seepage-run measurement reaches. Seepage-loss rates in the EMI diversion system generally ranged from 0.1 to 3.0 ft³/s/mi, and seepage-gain rates ranged from 0.04 to 5.2 ft³/s/mi, with the exception of two measurement reaches along Ko'olau Ditch that had seepage flows outside of the general range of seepage losses and gains. Discharge measurements in the open-ditch seepage-run measurement reaches-lined and unlined-generally indicated seepage losses, whereas measurements in the tunnel reaches generally indicated seepage gains. No partially lined open-ditch measurement reaches were selected, because they were limited to very short reaches at diversion intakes and repaired sections of the ditch. Three seepage-run measurement reaches do not have a dominant ditch characteristic, and they consisted of fairly similar distributions of tunnel and unlined open-ditch sections. These three seepage-run measurement reaches had seepage gains.

The seepage loss or gain for each of the seepagerun measurement reaches was computed as the difference between the downstream and upstream flows, excluding any estimated or measured diversion inflows and outflows within the seepage-run measurement reach. The seepage rates were only applicable to the measurement reaches where discharges were measured. Typically, seepage flows cannot be visually

#### 20 Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i

detected, especially in tunnels, and multiple seepage losses and gains may be occurring simultaneously at different locations along a ditch. Some of the factors that affect ditch seepage flow include ditch size and construction, frequency of maintenance and repair, wetted perimeter, and head. In some cases, the estimated seepage losses and gains fall within the standard of error associated with the accuracy of the discharge measurements. For these cases, estimated seepage rates may represent the true seepage loss or gain within the measurement reaches. However, it is also possible that these seepage rates may reflect uncertainty in the discharge measurements. Uncertainty in measured seepage losses and gains for individual ditches in the EMI diversion system can be reduced with additional measurements. Also, discharge measurements are needed to characterize seepage losses and gains for parts of the EMI diversion system that were not considered in this study, including the Spreckels Ditch that was being repaired at the time of this study.

## **References Cited**

- Giambelluca, T.W., Chen, Q., Frazier, A.G., Price, J.P., Chen, Y.-L., Chu, P.-S., Eischeid, J., and Delparte, D., 2011, The rainfall atlas of Hawai'i: University of Hawai'i at Mānoa Web site, accessed December 22, 2011 at http://rainfall. geography.hawaii.edu.
- Gingerich, S.B., 1999, Ground-water occurrence and contribution to streamflow, northeast Maui, Hawai'i: U.S. Geological Survey Water-Resources Investigations Report 99-4090, 69 p.

- Hawaiian Commercial and Sugar Company, 2010, Appendix B—Water lost from the EMI System; Submission to State of Hawai'i Department of Land and Natural Resources, Commission on Water Resource Management March 19, 2010: accessed October 28, 2011, at http://hawaii.gov/dlnr/ cwrm/activity/iifsmaui1/PR201001.pdf.
- Kumu Pono Associates, LLC, 2001, Wai o ke ola: He wahi moʻolelo no Maui Hikina—A collection of native traditions and historical accounts of the lands of Hāmākua Poko, Hāmākua Loa and Koʻolau, Maui Hikina (East Maui), Island of Maui: Hilo, Hawaiʻi, Kumu Pono Associates, LLC, report prepared for East Maui Irrigation Company, 544 p.
- Rantz, S.E., and others, 1982, Measurements and computation of streamflow, volumes 1 and 2: U.S. Geological Survey Water-Supply Paper 2175, 631 p.
- Schroeder, T.A., 1993, Climate controls, in M. Sanderson, ed., Prevailing trade winds, weather and climate in Hawai'i: Honolulu, Hawai'i, University of Hawai'i Press, 12–36 p.
- State of Hawai'i Department of Land and Natural Resources, 2010, Staff submittal for the meeting of the Commission on Water Resource Management on May 25, 2010, Pā'ia, Maui: State of Hawai'i Department of Land and Natural Resources online archive accessed October 12, 2011, at http://www. state.hi.us/dlnr/cwrm/newsevents_commissionmtg.htm.
- Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap A8, 87 p. (Also available at http://pubs.usgs.gov/tm/tm3-a8/.)
- Wilcox, C., 1996, Sugar water; Hawaii's plantation ditches: Honolulu, University of Hawai'i Press, 191 p.

Appendix—Ditch characteristics and seepage rates of the East Maui Irrigation diversion system, east Maui, Hawai'i



22 Measurements of Seepage Losses and Gains, East Maui Irrigation Diversion System, Maui, Hawai'i

Appendix. Ditch characteristics and seepage rates of the East Maui Irrigation (EMI) diversion system, east Maui, Hawai'i.



Note: Enlarging the image when viewing on screen is recommended to see labels more clearly.

This page left intentionally blank.

Produced in the Western Region, Menlo Park, California Manuscript approved for publication, May 25, 2012 Edited by James Hendley II Layout by Jeanne S. DiLeo