COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII

PETITION TO AMEND INTERIM	)	Case No. CCH-MA13-01
INSTREAM FLOW STANDARDS FOR	)	
HONOPOU, HANEHOI/PUOLUA (HUELO),	)	
WAIKAMOI, ALO, WAHINEPEE,	)	
PUOHOKAMOA, HAIPUAENA,	)	
PUNALAU/KOLEA, HONOMANU,	)	
NUAAILUA, PIINAAU, PALAUHULU,	)	
OHIA (WAIANU), WAIOKAMILO,	)	
KUALANI (HAMAU), WAILUANUI,	)	
WAIKANI, WEST WAILUAIKI, EAST	)	
WAILUAIKI, KOPILIULA, PUAKAA,	)	
WAIOHUE, PAAKEA, WAIAAKA,	)	
KAPAULA, HANAWI, AND MAKAPIPI	)	
STREAMS	)	
	)	

HEARINGS OFFICER'S

PROPOSED FINDINGS OF FACT, CONCLUSIONS OF LAW, &

DECISION AND ORDER

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Attachments:

Exhibit C-1: EMI Map of the Ditch System

Exhibit C-33: Diagram of the EMI Ditch System and the HC&S Ditch and Reservoir System

Hearings Officer's Proposed Findings of Fact, Conclusions of Law, and Decision and Order

The Hearings Officer makes the following Findings of Fact ("FOF"), Conclusions of Law ("COL"), and Decision and Order ("D&O"), based on the records maintained by the Commission on Water Resource Management, Department of Land and Natural Resources ("Commission") on contested case number CCH-MA13-01, Petition to Amend Interim Instream Flow Standards for Honopou, Hanehoi/Puolua (Huelo), Waikamoi, Alo, Wahinepee, Puohokamoa, Haipuaena, Punalau/Kolea, Honomanu, Nuaailua, Piinau, Palauhulu, Ohia (Waianu), Waiokamilo, Kualani (Hamau), Wailuanui, Waikani, West Wailuaiki, East Wailuaiki, Kopiliula, Puakaa, Waiohue, Paakea, Waiaaka, Kapaula, Hanawi, and Makapipi Streams, and the witness testimonies and exhibits presented and accepted into evidence.

If any statement denominated a COL is more properly considered a FOF, then it should be treated as an FOF; and conversely, if any statement denominated as a FOF is more properly considered a COL, then it should be treated as a COL.

Proposed FOF not incorporated in this D&Or have been excluded because they may be duplicative, not relevant, not material, taken out of context, contrary (in whole or in part) to the found facts, an opinion (in whole or in part), contradicted by other evidence, or contrary to law. Proposed FOF that have been incorporated may have minor modifications or corrections that do not substantially alter the meaning of the original findings.

I. FINDINGS OF FACT[1]

A. Sequence of Events Leading to the Contested Case

1. On May 24, 2001, the Native Hawaiian Legal Corporation ("NHLC") filed 27 Petitions to Amend the IIFS for 27 East Maui streams on behalf of Nā Moku `Aupuni `O Koolau Hui ("Nā

[1] References to the record are enclosed in parentheses, followed by a party's proposed Finding of Fact ("FOF"), if accepted. FOF from the re-opened hearing are identified as "on reopening"; e.g., "HC&S" versus "HC&S on reopening." "Exh." refers to exhibits accompanying written or oral testimony, followed by the exhibit number and page or table number, if necessary. Written testimony is referred to as follows: name of the witness, the type of written testimony, and the page number or paragraph of that testimony. "WDT" means written direct testimony or witness statement; and "WRT" means written responsive testimony or the written rebuttal testimony to the written responsive testimony. Written testimony from the reopened hearing is further identified by the date. Oral testimony is referred to as follows: name of the witness, the date of the transcript ("Tr."), and the page number.

Moku"), Beatrice Kepani Kekahuna, Marjorie Wallett, and Elizabeth Lehua Lapenia[2]. The petitions were accepted on July 13, 2001. (Commission meeting of August 28, 2008, p. 1.)

2. By a letter dated July 26, 2001, NHLC memorialized its conversation with Commission staff and reiterated its request for the Commission to focus its efforts to restore streamflow to Honopou, Hanehoi, Kualani, Piinau, Palauhulu, Waiokamilo, and Wailuanui streams. (*Id.*)

3. Including the addition of Puolua (Huelo) Stream, the tributary of Hanehoi Stream, these eight streams were eventually organized into five surface water hydrologic units: 1) Honopou (6034) surface water hydrologic unit contains Honopou Stream; 2) Hanehoi (6037) contains Hanehoi and Puolua (Huelo) Streams; 3) Piinaau (6053) contains Piinaau and Palauhulu Streams; 4) Waiokamilo (6055) contains Waiokamilo and Kualani Streams; and 5) Wailuanui (6056) contains Wailuanui Stream.[3] (Exh. C-85, pp. 1-2.)

4. From July 2001, there were meetings, site visits, and discussions among the interested parties regarding the possibility of a collaborative effort to carry out stream studies for the area. On March 20, 2002, the Commission approved a cooperative agreement between the United States Geological Survey ("USGS") and the Commission for the Water Resources Investigations for Northeast Maui streams. The Study was to run from October 2, 2002 to September 30, 2005. The study was completed in January 2006. (*Id.*)

5. On May 29, 2008, NHLC filed a complaint on behalf of Nā Moku, Beatrice Kekahuna, Marjorie Wallet, and Maui Tomorrow Foundation, Inc. ("MTF"), alleging that Hawaiian Commercial and Sugar Company ("HC&S") was wasting water, based on testimony of an HC&S employee who testified at the Board of Land and Natural Resources ("BLNR") contested case hearing on November 15, 2005. The waste complaint was resolved after staff corresponded with the parties. (Staff Submittal to Clarify the Scope of the Proceedings for the Contested Case Hearing on Remand from the Intermediate Court of Appeals No. CAAP-10-0000161, August 20, 2014, p. 2.)

6. On August 18, 2008, HC&S requested that the Commission consolidate all 27 previously filed petitions into one and to consider amending the IIFS for all 27 streams in one unified proceeding, which the Commission denied on September 24, 2008. (Staff submittal, August 28, 2008, p. 2; Exh. C-89, p. 9.)

[2] The Commission was notified by letter on May 10, 2007, that NHLC no longer represented Ms. Lapenia.

[3] The petition to amend the IIFS for Waikani Waterfall (Stream) was consolidated with and addressed as part of the petition to amend the IIFS for East and West Wailuanui Streams, hereinafter referred to as "Wailuanui Stream." (Staff submittal, September 24, 2008, p. 2.)

7. On September 25, 2008, the Commission voted to accept staff's recommendation to accept 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. (*Ibid.*, p. 30.)

8. Six of the eight streams in these five surface water hydrologic units had some diverted water restored, for a total of 4.5 mgd (7 cfs)[4]: 1) Honopou Stream; 2) Hanehoi Stream; 3) Puolua (Huelo) Stream; 4) Palauhulu Stream; 5) Waiokamilo Stream; and 6) Wailuanui Stream. Two streams, Piinaau and Kualani Streams, were not restored. (Exh. C-85, pp. 60-62; Exh. C-103, p. 4.)

9. In accepting staff's recommendation, the Commission added three amendments, the first of which was that "(m)oving forward on the staff's recommendation is the first step in (an) integrated approach to all 27 (twenty-seven) streams that are the subject of these petitions." Then Chair Thielen had stated in the preceding discussion that "if people are not happy at the end of the year, when the Commission makes any decisions, they would have the ability to request a contested case hearing at that time. Cooperation now is not a waiver of any body's rights to contest that at a later date." After the vote to accept staff's recommendation with amendments, Chair Thielen stated that "the main thing that was passed today is setting minimum instream flow standards that require some infrastructure change, require some evaluation, cooperation and then coming back to the Commission and making final recommendations for the entire 27 stream units." (Exhs. C-89, pp. 27, 30-31.)

10. On December 16-17, 2009, the Commission met to consider staff's recommendations for the remaining 19 streams. Additional information was requested before the Commission would make its decision, including a focus on seasonal IIFS—i.e., different IIFS for wet versus dry seasons. (Exhs. C-90, C-106.)

11. On May 25, 2010, the Commission voted to amend the IIFS through a seasonal approach to address habitat availability for native stream animals for six of the remaining 19 streams, with winter total restorative amounts of 9.45 mgd, and summer restoration reduced to 1.11 mgd. (Exh. HO-1.).)

12. Together with the additions for the first eight streams (six of which were amended) that totaled 4.5 mgd (*supra*,FOF 8), total stream restorations for the 27 streams were as follows: 12 of

[4] But see FOF 202, *infra*, where the total is 4.65 mgd.

27 streams restored by a total of 13.95 mgd in the wet season, reduced to 5.61 mgd in the dry season.

13. Commission staff had estimated total diversions by East Maui Irrigation (EMI) as ranging from 134 mgd in the winter months to 268 mgd in the summer months, averaging about 167 mgd. (Exh. C-85, p. 22; Exh. C-103, p. 18, table 4.)

14. Increasing the IIFS for 12 of the 27 streams by 13.95 mgd in the wet (winter) season, and reducing the total for these 12 streams to 5.61 mgd in the dry (summer) season, resulted in:

a) winter months: 13.95 mgd returned to the streams, leaving 120.05 (134 – 13.95) mgd to continue to be diverted; and

b) summer months: 5.61 mgd returned to the streams, leaving 262.39 (268 – 5.61) mgd to continue to be diverted.

c) Thus, in the winter months, 10.4 (13.95/134) percent of diversions would be returned to the streams, and in the summer months, 2.1 (5.61/268) percent would be returned.

15. HC&S had submitted a consultant's paper on September 12, 2008, *Importance of the Hawaiian Commercial & Sugar Company to the Hawaii Economy and Conditions for Its Survival: A consultant Paper by Leroy O. Laney, Ph.D.* Commission staff stated that "HC&S plays an important role in Maui's economy…however, the paper fails to provide any data with regards to water usage by HC&S or any data that demonstrates the impacts of specific reductions in water availability." (Exh. C-85, p.4.)

16. HC&S had calculated its water usage as 5,064 gallons per acre per day (gad) in the winter months and 10,128 gad in the summer months, but Commission staff found this to be high and had calculated average irrigation needs for sugarcane to range from 1,400 to 6, 000 gad. (Exh. C-85, p. 8.)

17. Despite these earlier conclusions by Commission staff that HC&S's water usage was too high (*supra*, FOF 15-16), in its May 25, 2010 submittal, staff stated the following, based on additional information provided by HC&S: "On average, streamflow provides 167 mgd of water to the plantation with an additional 72 mgd from ground water sources. Evidently, the plantation's water needs greatly exceed surface water sources otherwise HC&S would not expend the cost to pump water from its brackish water wells to supplement surface water sources. Pumping costs can range from $32 to $290 per million gallons (*citation omitted*). With decreasing trends in streamflow, east Maui streams will continue to be an insufficient supply of

surface water needs for the plantation regardless of interim IFS adoption (*footnote omitted*). (Exh." C-103, p. 14-15.)

18. Staff did not attempt to reconcile its May 25, 2010 opinion with its earlier September 24, 2008 opinion, nor did the Commission discuss this issue before reaching its decision on the remaining 19 streams. (Exhs. C-91, E-60.)

19. At the end of the May 25, 2010 meeting, petitioners requested a contested case, and on June 3, 2010, Nā Moku filed a Petition for a Contested Case for "(p)etitioners right to sufficient stream flow to support the exercise of their traditional and customary native Hawaiian rights to growing kalo and gathering in, among, and around East Maui streams and estuaries and the exercise of other rights for religious, cultural and subsistence purposes. Specifically, the rights of members to engage in such practices in, on, and near Waikamoi, Puohokamoa, Haipuaena, Punalau/Kolea, Honomanu, West Wailuaiki, East Wailuaiki, Kopiliula and Puakaa, Waiohue, Paakea, Kapaula, Hanawi streams from HRS § 1-1 and HRS § 7-1 and protected under HRS § 174-101." (Exhs. C-91, E-60, p. 50, C-92, p. 3.)

20. Petitioner's request for a contested case identified five of the six streams that had their IIFS amended, and eight of the 13 streams that had been left at their status quo IIFS in the Commission's May 25, 2010 decision. (Staff Submittal on the request for a contested case hearing, October 18, 2010, p. 4, table 1.)

21. On June 3, 2010, County of Maui, Department of Water Supply ("MDWS"), also had filed a contested case petition, citing as its reasons that: 1) "any decision will directly affect MDWS's ability to provide water to homes, farms, schools, hospitals, churches, and businesses in Upcountry Maui, as MDWS's Upcountry System relies heavily on surface water"; and 2) "MDWS is the public water supplier for the County. MDWS is in the best position to represent the public's interest in continued use of these resources for the Upcountry Maui public water supply." (Application to be a Party in a Contested Case Hearing Before the Commission on Water Resource Management, June3, 2010, p. 2.)

22. On October 18, 2010, the Commission voted to deny the petition on the basis that "(n)either petitioner has a property interest in the determination of the public's interest in stream flows," and "(t)he amendment of the interim IFS for the subject streams was couched in terms of flows required at a particular point in the stream. The Commission's decision did not give any party any rights or privileges in the stream flows." Therefore, "it is clear there was no requirement for the Commission to hold a contested case hearing prior to making a decision on

the amendment of interim IFS for the 16 hydrologic units in east Maui." (Exh. C-93, p. 5, pp. 3-4.)

23. On November 17, 2010, Nā Moku filed a timely notice of appeal, contending that the Commission erred in: 1) concluding that Nā Moku had no right to a contested case hearing; and 2) reaching its underlying decision regarding IIFS amendment for the nineteen streams at issue. (*In Re Petition to Amend Interim Instream Flow Standardsfor Waikamoi, Puohokamoa, Haipuaena, Punalau/Kolea, Honomanu, West Wailuaiki, East Wailuaiki, Kopiliula, Puakaa, Waiohue, Paakea, Kapaula and Hanawi Streams,* Hawai`i Intermediate Court of Appeals, CAAP-10-0000161, November 30, 2012, pp. 2-3.)

24. On November 30, 2012, the Intermediate Court of Appeals vacated the Commission's October 18, 2010 denial of Nā Moku's Petition for Hearing and remanded the matter to the Commission with instructions to grant Nā Moku's Petition for Hearing and to conduct a contested case hearing pursuant to HRS Chapter 91 and in accordance with state law. In its ruling, the Intermediate Court Appeals concluded that "(t)he May 25, 2010 meeting, at which the Commission reached an IIFS determination for the nineteen streams, did not comply with the adjudicatory procedures of HAPA (Hawai`i Administrative Procedures Act). Among other things, the Commission did not produce a written decision accompanied by findings of fact and conclusions of law. We consequently decline Nā Moku's invitation to address the merits of whether the Commission erred in reaching its determination on the petitions to amend the IIFS for the nineteen streams, as argued in the parties' briefs. This matter is to be properly presented, argued, and decided pursuant to an HRS chapter 91 contested case hearing conducted by the Commission, the body statutorily empowered to make this determination." (*Ibid.*, pp. 7-8.)

25. On January 29, 2014, Lawrence Miike[5] was appointed Hearings Officer:

a. On March 4, 2014, a prehearing conference was held to establish timetables for the contested case proceedings (Minute Order #1, February 25, 2014), and

b. on April 21, 2014, Nā Moku, MDWS, Alexander & Baldwin, Inc./EMI ("HC&S"),[6] Hawaii Farm Bureau Federation, and MTF, were granted standing. (Minute Order #2, April 21, 2014.)

[5] Dr. Miike was a member of the Commission from 1994 to 1998 and from 2004 to 2012. He was a member of the Commission at the time of its September 24, 2008 decision on the first eight streams, the May 25, 2010 decision on the remaining 19 streams, and the October 18, 2010 decision to deny standing to Nā Moku. Dr. Miike voted to approve the staff recommendation (with amendments) on the first eight streams, dissented from the majority's approval of the remaining 19 streams, and did not attend the meeting where the Commission denied standing to Nā Moku.

26. On May 13, 2014, MTF withdrew as a party to the contested case, without prejudice to the ability of its supporters, Neola Caveny and Ernest Shupp, to continue as parties, but on June 6, 2014, MTF requested that it be reinstated as a party to the contested case, and the request was granted on June 9, 2014. ((Letter of May 13, 2014, from Isaac Hall, attorney for Maui Tomorrow Foundation, Inc.; Minute Order #6, May 28, 2014; Minute Order #8, June 9, 2014.)

27. On June 30, 2014, a hearing was held to address the Hearings Officer's proposal that the contested case must address all 27 streams in an integrative approach and not just the thirteen streams named in the request for the contested case. (Minute Order #7, May 30, 2014; Transcript of due process hearing, June 30, 2014.)

28. The Hearings Officer ruled that all 27 streams would be addressed in the contested case, because:

a. the Commission's decision on the first eight streams amended the staff recommendation to state that "(m)oving forward on the staff's recommendation is the first step in (an) integrated approach to all 27 (twenty-seven) streams that are the subject of these petitions," FOF 9, *supra*;

b. the Intermediate Court of Appeals had ruled that "(t)he May 25, 2010 meeting, at which the Commission reached an IIFS determination for the nineteen streams, did not comply with the adjudicatory procedures of HAPA (Hawai`i Administrative Procedures Act). Among other things, the Commission did not produce a written decision accompanied by findings of fact and conclusions of law. We consequently decline Nā Moku's invitation to address the merits of whether the Commission erred in reaching its determination on the petitions to amend the IIFS for the nineteen streams, as argued in the parties' briefs. This matter is to be properly presented, argued, and decided pursuant to an HRS chapter 91 contested case hearing conducted by the Commission, the body statutorily empowered to make this determination," FOF 24, *supra*;

c. neither the Commission's decision on the first eight streams nor its decision on the remaining 19 streams met the legal requirements for establishing IIFS, as those decisions did not "weigh the importance of the present or potential instream values with the importance of the present or potential uses of water for noninstream purposes, including the economic impact of restricting such uses," H.R.S. § 174C-71(2)(D); and

[6] Alexander and Baldwin, Inc./EMI was named as the party granted standing.

d. the Commission cannot evaluate the cumulative impact of existing and proposed diversions on trust purposes without assessing the impacts of diversions on all 27 streams. (Transcript of due process hearing, June 30, 2013, pp. 28-41.)

29. On July 16, 2014, the Commission met to discuss a Proposed Procedural Order to conduct a Contested Case Hearing for all twenty-seven (27) streams, and on August 20, 2014, the Commission voted to authorize, order, delegate, and direct the Hearings Officer to conduct a Contested Case Hearing on Petitions to Amend the Interim Instream Flow Standards for all twenty seven (27) Petitions and streams filed by NHLC. (Proposed Procedural Order to clarify the scope of the proceeding and Contested Case Hearing, July 16, 2014; Minutes of the Commission Meeting of August 20, 2014, pp. 9-10.)

30. On September 8, 2014, a notice was published, announcing that the Contested Case Hearing would address all twenty seven (27) petitions. (Maui News, September 8, 2014.)

31. On November 13, 2014, a standing hearing was held to address three applications to be additional parties in the Contested Case Hearing. Jeffrey Paisner was granted standing. John Blumer-Buell and Nikhilananda were denied standing but could testify at the hearing. (Minute Order # 10, October 28, 2014; Minute Order # 11, December 4, 2014.)

32. On January 7, 2015, a minute order was issued, standardizing the captions for the contested case hearing, because differing versions had been used by the parties and the Commission staff. (Minute Order # 13, January 7, 2015.)

33. Between March 2, 2015 and April 2, 2015, 15 days of hearings were held, during which 36 witnesses testified and an additional 16 witness statements and approximately 550 exhibits were introduced into evidence.

34. On October 2, 2015, Nā Moku and MTF jointly, HC&S, and MDWS submitted their FOF, COL, and D&O to the hearings officer. Jeffrey Paisner and Hawaii Farm Bureau Federation did not submit any FOF, COL, and D&O.

35. On January 6, 2016, A&B announced that HC&S was terminating its sugarcane cultivation and was transitioning to a diversified farm model. The short-term impact would be a significant reduction of its use of East Maui surface water, and for the long-term, its water needs would increase to support diversified agriculture, though most likely less than what it consumes currently. (Exh. C-153; Minute Order # 18, March 10, 2016.) [HC&S on reopening, FOF 45; MTF on reopening, FOF 4, 107.]

36. On January 15, 2016, the hearings officer submitted his Proposed FOF, COL, and D&O ("1/15/16 Proposed Decision") to the Commission and the parties, and on February 29, 2016, the parties submitted their exceptions to the Hearings Officer's Proposed Decision. (Minute Order # 16, January 15, 2016.) [HC&S on reopening, FOF 46-47.]

37. On March 10, 2016, CWRM directed the Hearings Officer to "reopen the hearing to address A&B's decision of January 6, 2016 to change HC&S's business operations from farming sugar to a diversified agricultural model." (Minute Order # 18, March 10, 2016.) [HC&S on reopening, FOF 47.]

38. On April 1, 2016, the Hearings Officer recommended that the scope of the re-opened hearing include the following areas:

a. HC&S/A&B's current and future use of surface waters and the impact on the groundwater sources for its cental Maui fields of HC&S's cessation of sugar operations;

b. the impact of HC&S's cessation of sugar operations on MCWS's use of surface water;

c. Maui County's position on the future use of the central Maui fields; and

d. how EMI is managing the decrease in diversions, how it would manage the interim restorations, and any issues concerning the integrity of the EMI ditch system with the current and any future changes in ofstream diversions.

(Minute Order # 19, April 1, 2016.) [HC&S on reopening, FOF 48.]

39. On April 20, 2016, A&B announced that it had decided to fully and permanently restore the East Maui streams identified in 2001 by CWRM and NHLC on behalf of its clients. On April 22, 2016, A&B sent a letter to CWRM confirming this intent. The streams are: Honopou, Hanehoi (including Puolua), Waiokamilo, Kualani,[7] Piinaau, Palauhulu, and East and West Wailuanui. (Volner, WDT, 10/17/16, ¶ 8; Exh. C-154.) [HC&S on reopening, FOF 49; MTF on reopening, FOF 45; Nā Moku on reopening, FOF 7.]

40. On May 31, 2016, the Hearings Officer issued an "Amended Recommendation Re Interim Restoration of Stream Flows," adopting A&B/EMI's proposed phasing of the streams for full and permanent restoration and leaving in place his original interim restoration recommendation of April 1, 2016 of 18.00 – 18.60 mgd of the approximately 43.82 mgd of

[7] Although this stream continues to be referred to as "Kualani," it is in fact the easternmost tributary of Waiokamilo Stream and now known as "East Waiokamilo Stream." Kualani Stream is below the EMI ditch system and has never been diverted, *infra*, FOF 62, 184, 186

ground-water (base flows, BFQ_{50}) Commission staff had estimated that EMI had diverted historically. [Nā Moku on reopening, FOF 6, 8.]

41. On July 18, 2016, the Commission issued an "Order Re Interim Restoration of Stream Flow," affirming the Hearings Officer's amended interim recommendation and further ordered that the ten (10) streams A&B/EMI had stated were undiverted remain that way until further notice: Waiokamilo, Wailuanui (East and West), Makapipi, Hanawi, Waiohue, East Wailuaiki, West Wailuaiki, Waikamoi, Kopiliula, and Puakaa. [Nā Moku on reopening, FOF 9.]

42. On August 18, 2016, CWRM approved the listing of the issues in Minute Order 19, *supra*, FOF 38. ("Order Regarding the Scope of the Re-opened Hearing to Address the Cessation of Sugar Operations by HC&S.") [HC&S on reopening, FOF 50; MTF on reopening, FOF 12; Nā Moku on reopening, FOF 10.]

43. On December 9, 2016, the Board of Land and Natural Resources ("BLNR") issued a temporary, one-year holdover of A&B/EMI's East Maui water licenses subject to the Commission's Interim Restoration Order and to EMI ceasing all diversions of Honomanu Stream for the duration of the one-year holdover period (through December 2017). (Tr., 2/9/17, p. 539, l. 6 to p. 540, l. 2.) [Nā Moku on reopening, FOF 11.]

44. The re-opened evidentiary hearing was conducted on February, 6, 8, and 9, 2017. The parties were to file their Proposed FOF, COL and D&O on April 7, 2017, but on April 5, 2017, MDWS requested tha the proceedings be reopened, and on April 6, 2017. The Hearings Officer suspended the deadline for submission to provide MDWS the opportunity to petition the Commission to again re-open the hearings, and MDWS filed its Motion to Reopen Evidence on April 13, 2017, and MTF and Na Moku filed their Memoranda in Opposition on April 20, 2017. [HC&S on reopening, FOF 51; MTF on reopening, FOF 13-17; Nā Moku on reopening, FOF 12.]

45. The Hearings Officer circulated a draft recommendation for denial of the Motion for consideration by the parties in a telephone conference on May 4, 2017. On May 10, 2017, he submitted his recommendation for denial of the Motion, and on May 31, 2017, the Commission denied the Motion. ("Order Denying County of Maui, Department of Water Supply's Motion to Reopen Evidence Dated April 13, 2017," May 31, 2017.) [MTF on reopening, FOF 18-20.]

46. Proposed FOF, COL, and D&O were to be filed by June 7, 2017, and Objections were to be filed by June 19, 2017. (Minute Order 27, May 31, 2017.) [MTF on reopening, FOF 21.]

47. On ______ the Hearings Officer submitted his Proposed FOF, COL, and D&O to the Commission and the Parties.

B. The EMI-State Watershed Leases

48. "Since the 1930s, the Territory and then the State issued water permits to Alexander & Baldwin, Inc., Hawaiian Commercial & Sugar Co, and East Maui Irrigation Company, Ltd. (EMI) for the diversion of water from streams in East Maui. The collection system consist(ed) of 388 separate intakes, 24 miles of ditches, and fifty miles of tunnels, as well as numerous small dams, intakes, pipes, and flumes (*citation omitted*). With few exceptions, the diversions capture all of the base flow, which represents the ground-water contribution to total stream flow, and an unknown percentage of total stream flow[8] at each crossing...The source of diverted water is a watershed with an area of about 56,000 acres, about two-thirds of which is owned by the State (*citation omitted*) and managed by the State Department of Land and Natural Resources." (Gingerich, S.B., 2005, "Median and Low-Flow Characteristics for Streams under Natural and Diverted Conditions, Northeast Maui, Hawaii: Honolulu, HI, U.S. Geological Survey, Scientific Investigation Report 2004-5262, 72 pp., at p. 1, referenced by Stephen B. Gingerich, Transcript, March 3, 2015, p. 49 [*hereinafter*, "2005 Flow Study"].)

49. The leases cover four watersheds of approximately 50,000 acres, of which 33,000 acres are owned by the State, and 17,000 acres are owned by EMI. (Garrett Hew, WDT, ¶ 4.)

50. EMI pays the State $160,000 a year for the right to divert stream waters from the approximately 33,000 acres it leases. (Garrett Hew, Tr., March 17, 2015, pp. 198-200.)

51. The lease between the State and EMI traces back to a September 13, 1876 agreement. Construction of the ditch system began in the 1870's. (Exh. C-2; Garrett Hew, WDT, ¶ 5.)

52. Since 1938, the leases have been governed by an agreement dated March 18, 1938 between the Territory of Hawaii and EMI. The last long-term licenses were issued in the 1950s and 1960s, and following their expiration, annual revocable licenses were issued by the Board of Land and Natural Resources ("BLNR"). The licenses are currently in holdover status due to the contested case hearing that is pending before BLNR. (Exhs. C-3 to C-11; Garrett Hew, WDT, ¶¶ 6, 8-11.)

[8] ground water, plus freshet ("normal" rainfall) and storm waters.

53. Prior to 1985-86, the State contracted with the U.S. Geological Survey ("USGS.") to operate gaging stations in various locations in the Ditch system to measure the volume of water collected in each license area from State lands. Beginning with fiscal year 1985-1986, the State no longer contracted with USGS for this service, and EMI took over the operation of the ditch gages and reports the license yields directly to the State. Since 1988 EMI reports a single annual yield to the State, aggregating the readings at the western end of the license areas at Honopou Stream and applying a single factor of 70 percent, based on a comparison of average yields reported by USGS in prior years and a series of studies from 1949 to 1985. (Garrett Hew, WDT, ¶ 12, 13, 15; Exh. C-16.)

54. From east to west, the watersheds are:

a. Nahiku: between the Nahiku Homesteads and the easterly boundary of the Keanae license area. (Exh. C-10, p. 2.)

b. Keanae: between and including the easterly watershed of Waiaaka Stream and the westerly watershed of Piinau Stream. (Exh. C-8, p. 2.)

c. Honomanu: between and including Nuaailua and Haipuena Streams and tributaries. (Exh. C-6, ¶ 4.)

d. Huelo: between and including Puohokamoa and Honopou Streams and their tributaries. (Exh. C-4, p. 2.)

55. EMI's meters measure ditch flows at the boundary of each license area and at its gauging station at Maliko Gulch. EMI contracts with USGS to maintain its gauging stations at the Honopou boundary to measure the aggregate amount of water diverted out of the four East Maui license areas at each of the following ditches: Wailoa, New Hāmākua, Lowrie, and Ha`iku. (Hew, Tr., 2/6/17, p. 98, ll. 6-16; p. 149, ll. 11-15, p. 151, ll. 17-18.) [Nā Moku on reopening, FOF 31-32.]

56. License-area yields from 1985-1988 were as follows:

	% of total	% from government lands	% from private lands
Nāhiku:	12.9	95	5
Ke`anae	25.7	79	21
Honomanu	19.8	47	53
Huelo	41.7	64	36
	100.1 (from rounding)		

(Exh. C-12, at 5; C-13, at 2; C-14, at 2.) [Nā Moku on reopening, FOF 38.]

57. From east to west, the State leases begin at Nahiku and end at Honopou Stream, and the East Maui Ditch System continues to collect stream waters between Honopou Stream and Maliko Gulch on EMI's and other private landowners' lands. These streams contribute about 7 percent of total ditch flows, with the lease lands contributing 93 percent, *infra*, FOF 445. The sugar cane fields of HC&S begin west of Maliko Gulch. (*See* Exh. C-1, attached.)

58. Streams in the lands leased from the State not only traverse EMI lands on their way to the ocean, but also traverse other private landowners' lands, particularly as the streams near the ocean. (*See* Exh. C-1, attached.)

59. The 1876 agreement between the State and EMI recognized the existence of other property owners, stating that "existing rights or present tenants of said lands or occupiers along said streams shall in no wise be lessened or affected injuriously by reason of anything hereinbefore granted or covenanted." (Exhibit C-2, pp. 2-3; Garrett Hew, Tr., March 17, 2015, pp, 161-169.)

60. Each of the four leases continues to recognize the rights of other property owners "for domestic purposes and the irrigation of kuleanas entitled to the same." (Exh. C-4, ¶ 6; Exh. C-6, ¶ 6; Exh. C-8, p. 2; Exh. C-10, p. 2.)

C. The East Maui Streams

61. There are 24, not 27, streams that are the subject of this contested case:

a. Waikani is not a stream but a waterfall on Wailuanui Stream. (Garrett Hew, WDT, ¶ 36.)

b. Alo is a tributary of Waikamoi Stream. (*See* Exh. C-1, attached.)

c. Puakaa is a tributary of Kopiliula Stream, *infra*, FOF 126;

d. Piinaau and Palauhulu are separate streams but join together before reaching the ocean, *infra*, FOF 171-172.

62. EMI and MDWS have diverted 22 of these 24 streams:

a. Kualani (also known as "Hamau") and Ohia (also known as "Waianu") Streams are both below the EMI ditch system and have never been diverted. (Garrett Hew, WDT, ¶ 36.)

63. EMI's and MDWS's ditches divert more than these 22 streams. (*See* Exhs. C-1 and C-33, attached.) From east to west, the streams that are in each of the state watershed leases are as follows. Streams subject to this contested case are underlined and identified with an asterisk:

a) Nahiku lease area:

1. <u>Makapipi Stream*</u>
2. <u>Hanawi Stream*</u>
3. <u>Kapaula Stream*</u>

b) Keanae lease area:

4. <u>Waiaaka Stream*</u>
5. <u>Paakea Stream*</u>
6. <u>Waiohue Stream*</u>
7. <u>Kopiliula Stream*</u> (Puakaa tributary[9])
8. <u>East Wailuaiki Stream*</u>
9. <u>West Wailuaiki Stream*</u>
10. <u>Wailuanui Stream*</u> (Waikani waterfall, *supra*, FOF 61)
11. <u>Kualani (or Hamau) Stream*</u> (below ditch system, *supra*, FOF 62)
12. <u>Waiokamilo Stream*</u>
13. <u>Ohia (or Waianu) Stream*</u> (below ditch system, *supra*, FOF 62)
14. <u>Palauhulu Stream*</u> (Hauoli Wahine and Kano tributaries)
15. <u>Piinaau Stream*</u>

c) Honomanu lease area:

16. <u>Nuaailua Stream*</u>
17. <u>Honomanu Stream*</u>
18. <u>Punalau Stream*</u> (Kolea and Ulunui tributaries)
19. <u>Haipuaena Stream*</u>

d) Huelo lease area:

20. <u>Puohokamoa Stream*</u>
21. <u>Wahinepee Stream*</u>
22. <u>Waikamoi Stream*</u> (Alo tributary)
23. Kolea Stream
24. Punaluu Stream

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[9] Puakaa Stream is listed as an independent stream in the Petition, but on the map (*see* Exh. C-1, attached), it is a tributary of Kopiliula Stream.

25. Kaaiea Stream

26. Oopuola Stream (Makanali tributary)

27. Puehu Stream

28. Nailiilihaele Stream

29. Kailua Stream

30. Hanahana Stream (Ohanui tributary)

31. Hoalua Stream

32. Hanehoi Stream* (Huelo [also known as Puolua] tributary)

33. Waipio Stream

34. Mokupapa Stream

35. Hoolawa Stream (Hoolawa ili and Hoolawa nui tributaries)

36. Honopou Stream* (Puniawa tributary)

64. Additional streams between Honopou Stream and Maliko Gulch (*See* Exhs. C-1 and C-33, attached) include:

37. Kapalaalaea Stream (Piilo`i tributary)

38. Halehaku Stream (Waihee, Makaa, Kaulu, Palama, Opana tributaries)

39. Keali Stream

40. Manawaiianu Stream

41. Opaepilau Gulch (labeled as a stream in Exh. C-33)

42. Lilikoi Gulch (labeled as a stream in Exh. C-33)

65. Exhibit C-33 needs explanation in that:

a) In the Nahiku lease area, Kapaula Stream is not depicted.

b) In the Keanae lease area, Paakea, Waiohue, East Wailuaiki, West Wailuaiki, Wailuanui, Waiakamilo, and Palauhulu Streams are not depicted. Of these, EMI has stated that it no longer diverts Waiakamilo. (Garrett Hew, WDT, ¶ 33; Garrett Hew, Tr., March 17, 2015, pp. 125, 128.)

c) In the Honomanu lease area, Kolea Stream is a branch of Punalau Stream, *supra*, FOF 63 (stream # 18).

d. In the Huelo lease area:

1. Alo Stream is a tributary of Waikamoi Stream.

2. Ohanui Stream is a tributary of Hanahana Stream.

3. Huelo (Puolua) Stream is a tributary of Hanehoi Stream.

4. Kolea Stream is not depicted, but there is a Kolea reservoir.

5. Wahinepee, Punaluu, Puehu, and Mokupapa Streams are not depicted.

6. Hoolawa ili and Hoolawa nui are tributaries of Hoolawa Stream.

e. In the area between Honopou Stream and Maliko Gulch:

1. There is no Kapalaalaea Stream, but an unidentified stream flows into Kapalaalaea Reservoir.

2. Opana Stream is one of the tributaries of Halehaku Stream.

3. EMI states that Opana, Opaepilau, and Lilikoi Streams are not diverted at the Wailoa Ditch (but are diverted at the lower ditches). (Garrett Hew, Tr., March 18, 2015, p. 176.)

4. Keali and Manawaiianu Streams are below the Wailoa Ditch and not depicted, *see* Exh. C-1, attached.

D. Stream Diversions

1. EMI's Ditch System

66. The Ditch system was constructed in phases, beginning in the 1870s and extending to the completion of the current system in 1923. (Garrett Hew, WDT, ¶ 5.)

67. From mauka to makai, the major ditches that cross Honopou Stream (the western boundary of the state lease areas) are the Wailoa Ditch, the New Hamakua Ditch, the Lowrie Ditch, and the Haiku Ditch. The major ditches that cross Maliko Gulch, the border between EMI's ditch system and HC&S's sugarcane fields, are the Wailoa Ditch, the Kauhikoa Ditch, the Lowrie Ditch, and the Haiku Ditch. (*See* Exh. C-33, attached.)

68. Water sold to MDWS from EMI's Haiku Uka watershed (collected through MDWS's Waikamoi Upper Flume and Waikamoi Lower Pipeline, *see* Exh. C-33, and described, *infra*, at FOF 71, is removed east of Honopou Stream and is therefore not captured by the gages at Honopou and need to be added to the amounts measured at Honopou for total license area yields. (Garrett Hew, WDT, ¶ 12.)

69. EMI records the amount of water delivered to HC&S at gages in the four ditches that cross Maliko Gulch. Most of the recorded flows are from the four license areas, which end at

Honopou Stream, but some water is collected in streams between Honopou Stream and Maliko Gulch. (Garrett Hew, WDT, ¶ 24.)

70. The delivery capacity of the EMI system is 450 mgd. The long-term average delivery by EMI to HC&S has been 165 mgd, but since 1999, deliveries have decreased significantly, and in the ten year period from 2004-2013, the average delivery was 126 mgd. (Garrett Hew, WDT, ¶ 23, 30.)

71. The HC&S irrigation system is designed to operate at the maximum extent possible on gravity flow from higher to lower elevations, so it is critical that the maximum amount of water possible is taken into the HC&S system at the Wailoa Ditch, the ditch at the highest elevation, which has a capacity of 195 mgd. (Garrett Hew, WDT, ¶ 28.)

72. When the Wailoa Ditch is filled to capacity, it overflows into the New Hamakua Ditch via the streams. Once the New Hamakua has reached capacity, it overflows via the streams into the Lowrie Ditch. And if the Lowrie is filled to capacity, it overflows into the Haiku Ditch via the streams. (Garrett Hew, Tr., March 18, 2015, p. 144.)

73. Surface water flows from East Maui can fluctuate tremendously from day to day and cannot be relied on at times to meet the irrigation requirements of HC&S. When the Wailoa ditch flow is extremely low, the lower ditches have little or no water. (Garrett Hew, WDT, ¶ 29.)

74. At Honopou:

a. for the Wailoa Ditch from 1922 to 1987, daily flows ranged from 1.8 to 328 cubic feet per second (cfs), or 1.16 to 212 mgd,[10] averaging 108.8 mgd, with flows less than 42.46 mgd for five days out of a year;

b. for the New Hamakua Ditch from 1918 to 1985, daily flows ranged from zero to 120.2 mgd, averaging 2.89 mgd, with flows less than 0.27 mgd for four days out of a year;

c. for the Old Hamakua Ditch from 1918 to 1965, daily flows ranged from zero to 39.43 mgd, averaging 0.05 mgd, with flows lowest in June and averaging 0.03 mgd;

d. for the Lowrie Ditch from 1910 to 1985, daily flows ranged from zero to 74.97 mgd, averaging 16.23 mgd, with flows less than 2.72 mgd for five days out of a year; and

[10] 1 cfs equals 0.6463 mgd.

e. for the Haiku Ditch from 1910-1985, daily flows ranged from zero to135.1 mgd, averaging 2.84 mgd, with flows less than 0.36 mgd three days out of a year.(Exh. C-101, pp. 74-77.)

75. Thus, historically, the combined flows of these ditches at Honopou Stream, the end of the flows collected from the four license areas, *supra*, FOF 69, averaged 130.81 mgd, nearly all from the Wailoa Ditch (108.8 mgd). If we assume that the lowest and highest flows occurred in the ditches at approximately the same time, the lowest combined flow was 1.16 mgd (all from the Wailoa Ditch), and the highest flow was 581.52 mgd, *supra*, FOF 74.

76. There are primarily four ways to reduce the amount of water that is collected and transported in the EMI ditch system: 1) on streams that have controlled diversions, by closing or reducing the diversion intake gate openings; 2) on stream diversions that have sluice gates, by partially or completely opening the sluice gates; 3) on streams that have radial gates between the diversions and the ditch, by completely closing the radial gates; and 4) by partially or or completely closing the gates on the main control points on the ditches themselves to limit the amount of water that can pass each control point, the effect of which is to redirect any excess water into the stream crossed by the ditch where the control point is located. (Hew, WDT, 10/16/16, ¶ 3.) [HC&S on reopening, FOF 78.]

77. Controlled diversions have intake gate openings, which are typically constructed with wooden boards or metal plates, used to regulate how much water can flow from the stream into the diversion structure. (Hew, WDT, 10/17/16, ¶ 4.) [HC&S on reopening, FOF 79.]

78. Sluice gates are openings within the basin of the diversions that can be opened to discharge the water collected in the diversion back into the stream. Periodically opening sluice gates to flush out silt, gravel, and other debris that collects in the diversion structures is one of the normal means of maintaining the proper functioning of the ditch system. The effect of opening a sluice gate is to return water to the stream after it has entered the diversion structure. It may not always cause 100% of the water that entered the diversion to be discharged back into the stream, because during periods of heavy rainfall, water may back up in the diversion faster than it can be discharged through the sluice gate, in which case some water will still enter the ditch. During most flow conditions, however, completely opening the sluice gate will return practically all of the water to the stream. (Hew, WDT, 10/17/16, ¶ 5.) [HC&S on reopening, FOF 80.]

79. Radial gates are located along the tunnel reaches of the ditch and were designed to automatically open or close in relation to the water level in the tunnel. The gates are controlled

by a float located in a float chamber in the tunnel that is connected to a cable that lifts or lowers the radial gate, depending on the water level in the tunnel. The operation of the gate can be adjusted by piping water to the float chamber and closing the drain valve on the chamber to raise the float to maintain the gate in the closed position. (Hew, WDT, 10/17/16, ¶ 6.) [HC&S on reopening, FOF 81.]

80. There are several main ditch control points on each of the ditches: 1) 6 on the Koolau Ditch; 2) 4 on the Spreckels Ditch; 3) 3 on the Manuel Luis/Center Ditch; 4) 2 on the Wailoa Ditch/Tunnel; 5) 4 on the New Hamakua Ditch; 6) 3 on the Lowrie Ditch; and 7) 2 on the Haiku Ditch. (Hew, WDT, 10/17/16, ¶ 7.) [HC&S on reopening, FOF 82.]

81. EMI manages the reduction in diversions through a combination of measures that involve adjusting the intake control gates on the streams with controlled diversions, opening the sluice gates at the diversion on streams that have sluice gates, adjusting the operation of radial gates on the streams that have radial gates, and partially or completely closing the gates on main ditch control points. The precise combination of measures at any point in time depends on the amount of water to serve the needs of HC&S and MDWS, and the amount of rainfall that is occurring in the watersheds that span the ditch system. (Hew, WDT, 10/17/16, ¶ 8.) [HC&S on reopening, FOF 83.]

82. At the time of the hearing, EMI had closed the intakes on all of the streams with controlled diversions, opened the sluice gates on the majority of the diversions that have sluice gates, closed the radial gates on a couple of streams with radial gates, and has closed the 6 main ditch control points on the Koolau Ditch. The sluice gates have been opened on Nua`ailua Stream, Alo Stream, and Waikamoi Stream on the Center Ditch, and three of the four sluice gates of the main intakes on Honomanū Stream. One of the sluice gates on Honomanū Stream cannot be opened because it is inoperable, but water is released into the west tributary of Honomanū Stream (Uluwini Stream) further down at a control gate in the Spreckels Ditch. (Hew, Tr., 2/6/17, p. 94, ll. 11-23, p. 95, l. 19 to p. 96, l. 12.) [HC&S on reopening, FOF 84.]

83. The effect of these measures is to rely principally on water entering the ditch system west of Pi`ina`au Stream (i.e., from the Honomanu and Huelo license areas) to meet the current level of reduced needs of HC&S and MDWS. With these measures in place, water flows in the Wailoa Ditch at Maliko Gulch have been reduced to 20-25 mgd. (Hew, WDT, 10/17/16, ¶ 9.) [HC&S on reopening, FOF 84.]

84. The Wailoa Ditch is the highest of EMI's ditches. Nearly all the flows from the four license areas are from the Wailoa Ditch (83%). When the flow in the Wailoa Ditch is extremely low, there are little or no flows in the lower ditches. FOF 67-71, *supra*.)

85. Under drought conditions, a different set of gate adjustments would be implemented, because EMI expects that it would not be possible to meet even the current lowered needs without importing water from further east, in the Nahiku and Ke`anae areas, where base flows are more reliable and there is a ground water contribution to the Koolau Ditch, in order to maintain a consistent flow in the Wailoa Ditch. (Hew, WDT, 10/17/16, ¶ 10.) [HC&S on reopening, FOF 85.]

86. As irrigation requirements increase from the ongoing implementation of diversified agriculture, EMI expects to implement a selective opening of board gates, readjusting the opening of sluice gates, resetting of radial gates, and readjusting of main ditch control gates to increase the amount of water brought into the ditch system. These measures will be dictated by the flow levels needed at Maliko Gulch and the rainfall patterns throughout the East Maui watersheds. (Hew, WDT, 10/17/16, ¶ 11.) [HC&S on reopening, FOF 86.]

87. With regard to the implementation of the restoration of the streams that A&B has stated it will permanently restore, EMI has: 1) closed the intakes and opened the sluice gates on the diversions on East and West Wailuanui Streams on the Koolau Ditch; 2) opened the sluice gate on Palauhulu Stream on the Koolau Ditch; 3) opened the sluice gates on the diversions on Hanehoi and Puolua Streams on the Haiku Ditch; and 4) opened the sluice gate and closed the radial gate on the Wailoa Ditch, made modifications to the intake on the New Hamakua Ditch, opened the sluice gate and closed the intake diversion on the Lowrie Ditch, and modified the diversion on the Haiku Ditch on Honopou Stream. (Hew, WDT, 10/17/16, ¶ 12.) [HC&S on reopening, FOF 87.]

88. Further measures to achieve the full and permanent restoration of these streams cannot be taken until EMI obtains all necessary permits and government approvals. On September 16, 2016, EMI submitted its applications to abandon the following stream diversions: Honopou, Hanehoi (Puolua), Waiokamilo, Kualani,[11] Piinaau, Palauhulu, and East and West Wailuanui Streams. Other pending approvals and concurrences will be needed from the County of Maui,

[11] "Kualani" as used here refers to the easternmost tributary of Waiokamilo Stream, now known as East Waiokamilo Stream, which was mistaken for Kualani Stream, which is below the ditch system and not diverted, *supra*, FOF 62, *infra*, FOF 184, 186.

DLNR's Office of Conservation and Coastal Lands, and the U.S. Army Corps of Engineers. (Hew, WDT, 10/17/16, ¶¶ 13-14.) [HC&S on reopening, FOF 88.]

89. The reduction in diversions does not by itself compromise the structural integrity of the EMI ditch system so long as the complete system, including the open ditches and roadways, continues to be maintained as a single, coordinated system. Consistently reduced flows will increase the amount of maintenance required of the open ditches in the system, because it will increase the surface areas that will need to be periodically cleared of vegetation. (Hew, WDT, 10/17/16, ¶¶ 15.) [HC&S on reopening, FOF 90.]

2. MDWS

90. MDWS receives water from EMI through:

a. groundwater from a development tunnel in the Koolau Ditch for the Nahiku community;

b. streams in EMI's Haiku Uka watershed through the upper and lower Waikamoi flumes that MDWS maintains to serve its Olinda/Upper Kula and Piiholo water treatment plants;

c. water from the Wailoa Ditch after it enters HC&S's lands to serve its Kamole water treatment plant; and

d. non-potable water from HC&S's Hamakua Ditch at Reservoir 40 to serve the Kula Agricultural Park. (Garrett Hew, WDT, ¶ 20;Garrett Hew, Tr., March 18, 2015, pp. 192-193; David Taylor, WDT, ¶ 7; Exh. C-33.)

91. MDWS diverts stream water directly through its upper and lower Waikamoi flumes, and receives stream waters from EMI's Wailoa Ditch and its continuation as HC&S's Hamakua Ditch, *see* Exh. C-33, attached.

92. The upper Waikamoi flume diverts water from the Waikamoi, Puohokamoa, and Haipuena Streams to the Olinda/Upper Kula water treatment facility. Water for this facility is stored in the 30-million gallon Waikamoi reservoirs and the 100-million gallon Kahakapao reservoirs, *see* Exh. C-33, attached. The Olinda facility's average daily production is 1.6 mgd, with a capacity of 2 mgd. (David Taylor, WDT, ¶ 11; Exh. B-3, p. 25; David Taylor, Tr., March 11, 2015, pp. 47, 140.) [MDWS FOF 25.]

93. The lower Waikamoi flume diverts water from the Waikamoi, Puohokamoa, Haipuaena and Honomanu Streams to the Piiholo water treatment facility. Water for this facility is store in the 50-million gallon Piiholo Reservoir, *see* Exh. C-33, attached. The Piiholo facility's average daily production is 2.5 mgd, with a capacity of 5 mgd. (David Taylor, WDT, ¶ 10; Eh. B-3, p. 25; David Taylor, Tr., March 11, 2015, p. 47.) [MDWS FOF 24.]

94. The stream flows are variable, so the reservoirs provide storage so that there is a relatively constant amount of water available to the treatment facilities, regardless of streamflow. (David Taylor, Tr., March 11, 2015, p. 49.)

95. There are no gages on the Waikamoi flumes, so there is no way to measure the amount of water being diverted from the streams. Because the new upper Waikamoi flume isn't going to be leaking, MDWS assumes that everything that goes in will come out. MDWS measures the reservoir levels every day, so once the new flume is functional, MDWS will be able to calculate how much water is coming from the flume on days when the main intake from the dam is dry, which is most of the days. All of the water coming in will be from the flume. (David Taylor, Tr.,March 11, 2015, pp. 59-60.)

96. EMI's Wailoa ditch, which diverts multiple streams (*see* Exh. C-33 and FOF 65, *supra*), is the source of water for MDWS's Kamole water treatment facility. The Kamole facility's average daily production is 3.6 mgd, with a capacity of 6 mgd. This capacity could be expanded relatively quickly, should MDWS have assurances of greater access to water, as evidenced by recent upgrads to the `Īao Surface Water Treatment Plant. (David Taylor, WDT, ¶ 9; Exh. B-3, p. 24; David Taylor, Tr., March 11, 2015, p. 47; Taylor, Supplemental Declaration on Reopening, ¶¶ 3-9; Exhs. B-073, B-074.) [MDWS FOF 23; MDWS on reopening, FOF 77.]

97. MDWS owns the upper and lower Waikamoi flumes and has a contract with EMI to service the diversions to keep them clear. MDWS takes water directly from the Wailoa ditch. (David Taylor, Tr., March 11, 2015, p. 53.)

98. HC&S's Hamakua ditch (the western extension of the Wailoa ditch), at reservoir 40 (*see* Exh. C-33, attached), is the source of water for Kula Agricultural Park, where two reservoirs have a total capacity of 5.4 million gallons. The Park consists of 31 farm lots which range in size from 7 to 29 acres, and which are owned by the County of Maui. Individual lots are metered and billed by MDWS. (David Taylor, WDT, ¶ 13; Exh. B-4.) [MDWS FOF 27.]

99. MDWS pays EMI $0.06 per thousand gallons ($60/million gallons). (Garrett Hew, WDT, ¶ 21.)

100. The original contract between MDWS and EMI was entered into in 1961, which was replaced by a 1973 "Memorandum of Understanding" with a term of 20 years. Since its expiration, there have been a total of 8 extensions. After the lapse of the most recent extension, EMI has continued to provide water to MDWS through a memorandum dated April 13, 2000. (David Taylor, WDT, ¶ 15; Exhs. B-5-15.) [MDWS FOF 29.]

101. The memorandum provides that MDWS will receive 12 mgd from the Wailoa ditch with an option for an additional 4 mgd, for a total of 16 mgd. During periods of low flow, no water will be diverted to lower-elevation ditches, and MDWS will receive a minimum allotment of 8.2 mgd and HC&S will also receive 8.2 mgd. If these minimum amounts cannot be delivered, MDWS and HC&S will receive prorated shares of the water available. (David Taylor, WDT, ¶ 15; Exh. B-5; David Taylor, Tr., March 11, 2015, pp. 53-54; Garrett Hew, Tr., March 18, 2015, pp. 146-147.) [MDWS FOF 30.]

102. Average daily use by MDWS from the Wailoa ditch is 7.1 mgd, which includes water for the Kamole facility, averaging 3.6 mgd (*see* FOF 96, *supra*), and the Kula Agricultural Park. (David Taylor, Tr., March 11, 2015, pp. 81-83.)

E. Estimates of Stream Flows

103. Prior to the partial restorations of twelve streams in 2008 and 2010, *supra*, FOF 8, 10, and subsequent installation of gages in these streams, there were only four active gages, one each in Hanawi Stream, West Wailuaiki Stream, Waiokamilo Stream, and Honopou Stream (which is outside the study area to be described, *infra*). (2005 Flow Study, p.4 and Table 1; Exh. C-101, p. 28; Exh. C-85, 47.)

104. Gages had been previously installed on a number of streams for various periods of time and for various years. For example, Makapipi Stream had a gage at 920 feet elevation between 1932-1945; Hanawi Stream had gages at 500 feet elevation between 1932-1947 and again between 1992-1995, and at 1,318 feet elevation between 1914-1915 and again between 1921-Present; and West Wailuaiki Stream had a gage at 1343 feet elevation between 1914-1917 and again between 1921-Present. (2005 Flow Study, Table 1.)

105. In 2002 to 2005, USGS conducted studies to: 1) assess the effects of existing diversions on flows of perennial streams in northeast Maui, 2) characterize the effects of diversions on instream temperature variations, and 3) estimate the effects that streamflow restoration (full or

partial) would have on the availability of habitat for native stream fauna (fish, shrimp and mollusks) in northeast Maui. The study area contained 22 named streams from the drainage basins of Makapipi Stream in the east to Kolea Stream to the west (Streams # 1 and #24 in FOF 63, *supra*). (2005 Flow Study, p. 3.) The first study is summarized in this section. The second and third studies are summarized in the next section.

106. Stream flows under natural (undiverted) and diverted conditions were estimated for 21[12] streams, using a combination of continuous-record gaging-station data, low-flow measurements, and values determined from regression equations developed for the study. For the drainage basin for each continuous-record gaged site and selected ungaged sites, morphometric, geologic, soil, and rainfall characteristics were quantified. Regression equations relating the non-diverted streamflow statistics to basin characteristics of the gaged basins were developed. Regression equations were also used to estimate stream flow at selected ungaged diverted and undiverted sites. (2005 Flow Study, p. 1.)

107. Estimates were made for 50 percent and 95 percent duration total flow (TFQ) and base flow (BFQ).[13] (2005 Flow Study, p. 1.)

108. A 50 percent duration flow (median streamflow; Q_{50}) means that, for a specific period of time, half of the measured stream flow was greater than the Q_{50} value, and half was less. For example, for measurements of total flows in a particular stream for the specified period of time: 1) if TFQ_{50} = 25 mgd, then total stream flow was above 25 mgd half of the time and below 25 mgd half of the time,; and 2) if TFQ_{95} = 2 mgd, total stream flow was above 2 mgd 95 percent of the time and below 2 mgd 5 percent of the time. (2004 Flow Study, p. 4.) [HC&S FOF 2.]

109. Relative errors between observed and estimated flows ranged from 10 to 20 percent for the 50-percent duration total flow and base flow, and from 29 to 56 percent for the 95-percent duration total flow and base flow. (2004 Flow Study, p. 1.) Errors are higher for lower flows because, for the same absolute error in flow, the relative error in percent increases as the actual flow decreases. (2005 Flow Study, p. 43.) [HC&S FOF 11.]

110. East of Keanae Valley, the 95-percent duration discharge equation generally underestimated total flow (TFQ_{95}), due to gains in flow from groundwater discharge, and within

[12] No estimates were made for Piinau Stream because the regression equations were not valid for this stream and reliable flow measurements were lacking (2004 Flow Study, p. 63.)

[13] Base flow is the groundwater contribution to flow; total flow includes all sources; i.e., ground, freshet ("normal" rainfall) and storm waters.

and west of Keanae Valley, the equation generally overestimated total flow, due to loss of water at lower elevations. (2005 Flow Study, pp. 1, 58.) [HC&S FOF 6.B.]

111. An extreme example of the limitations of the model is Piinau Stream:

> Estimates of flow-duration statistics for Piinau Stream determined from the regression equations are the highest of any sites in the study area...yet the flow observations, although scarce, indicate that flows are much lower than estimated. The stream channel was dry between 1,200 ft and 600 ft altitude...and only a trickle of flow was observed upstream of the 1,300-ft diversion. A recent (2001) large landslide, which covered the stream at about 1,000 ft altitude and filled most of the stream channel downstream to 600 ft altitude with gravel, cobbles, and boulders, complicates flow in the stream. This basin has the highest rainfall and MAXELEV (maximum elevation) in the study area and both are above the range of characteristics used to develop the flow-duration equations. Because the regression equations are not valid for this stream and reliable flow measurements are lacking, no estimates of stream statistics were made for Piinau Stream. (2005 Flow Study, p. 63.)

112. Reduction in 50- and 95-percent flows in stream reaches affected by the diversions throughout the study area averaged 58-60 percent. (2005 Flow Study, p. 1.) Average reduction in the low flow of streams due to diversions ranged from 55 to 60 percent. (2005 Flow Study, p. 70; Stephen B. Gingerich, WDT, p. 2.) [Nā Moku/MTF FOF 235.]

F. Restoration Potential

1. The 2005 Habitat Study

113. The purposes of the second and third studies in 2002 to 2005, *supra*, FOF 105, were to characterize the effects of diversions on instream temperature variations, and to estimate the effects that streamflow restoration (full or partial) would have on the availability of habitat for native stream fauna (fish, shrimp and mollusks). (Exh. E-69: Gingerich, S.B. and Wolff, R.H., 2005, "Effects of Surface-Water Diversions on Habitat Availability for Native Macro-Fauna, Northeast Maui," Hawaii: U.S. Geological Survey Scientific Investigations Report 2005-5213, 93 pp., referenced by Stephen B. Gingerich, Transcript, March 3, 2015, p. 49 [*hereinafter*, "2005 Habitat Study"].)

114. In general, the stream temperatures measured at any of the monitoring sites were not elevated enough to adversely affect the growth or mortality of native fish, shrimp, and mollusks or to cause wetland taro to be susceptible to fungi and associated rotting diseases. (2005 Habitat Study, p. 1.)

115. The Physical Habitat Simulation System (PHABSIM), which incorporates hydrology, stream morphology and microhabitat preferences, was used to simulate habitat/discharge relations for various species and life stages, and to provide quantitative habitat comparisons at different streamflows of interest. Estimates were made of the availability of aquatic habitat for diverted and undiverted conditions and to produce a relation between discharge and habitat availability. Habitat-duration curves show the percentage of time that indicated habitat conditions would be equaled or exceeded and are based on the available estimates of flow duration at each stream reach developed in the 2005 Flow Study for Q_{50} and Q_{95} of total and base flows. (2005 Habitat Study, pp. 1, 51-52.)

116. The area of usable bed habitat was estimated over a range of streamflows that includes the diverted and natural base-flow estimates. The results are also presented as habitat relative to natural conditions with 100 percent of natural habitat at natural median base flow (BFQ_{50}) and 0 percent of habitat at 0 streamflow. In general, the models show a decrease in habitat for all species as streamflow is decreased from natural conditions. (2005 Habitat Study, pp. 51-52.) [Nā Moku/MTF FOF 250.]

117. The relative amount of expected natural habitat (H) expected at 50 percent of natural median base flow ranges from 70 to 92 percent (H_{70-92}), and maintaining 90 percent of natural median base flow results in 94 to 101 percent of expected natural habitat (H_{94-101}) in the stream reaches. (2005 Habitat Study, p. 52.)

118. For East Maui streams, it is estimated that 64 percent of natural median base flow ($0.64xBFQ_{50}$) is required to provide 90 percent of the natural habitat (H_{90}). The flow requirements for each stream reach were provided by the USGS in terms of cubic feet per second (cfs) for all petitioned streams except for Piinaau, Honopou, and Hanehoi streams. (Stephen B. Gingerich, WDT, Summary Table.) [Nā Moku/MTF FOF 258.]

119. Many factors that affect the presence of native aquatic species in northeast Maui were beyond the scope of the USGS study and were not addressed, including:

a. What is the effect of alien species on the migration and living conditions of the native species?

b. What is the fate of animals upon reaching a dry stream reach during upstream migration?

c. At what rate and at what locations will native species populations return to natural levels if diversions were removed?

d. Why were opae seen in abundance above the major diversions but oopu alamoo were not observed at all?

e. To what extent do native and alien species use the diversion ditches and tunnels for migration between streams?

f. What is the effect of taro lo`i on the migration and life cycles of native species?

g. What are the effects of stream diversions on native aquatic insect species?

(Stephen B. Gingerich, WDT, pp. 4-5.) [Nā Moku/MTF FOF 256.]

2. The 2009 Habitat Availability Study

120. After release of the two USGS reports, USGS provided Commission staff with relative estimates of the change in aquatic habitat due to surface-water diversions. (Stephen B. Gingerich, WDT, October 31, 2014, p. 4.)

121. The resulting "2009 Habitat Availability Study" (Glenn R. Higashi, WDT, Appendix A: Parham, J.E. *et al.*, "The Use of Hawaiian Stream Habitat Evaluation Procedure to Provide Biological Resource Assessment in Support of Instream Flow Standards for East Maui Streams," Bishop Museum and Division of Aquatic Resources, Department of Land and Natural Resources, November 20, 2009) had four goals:

1. explain the influence of stream diversions on the distribution and habitat availability of native stream animals;

2. provide documentation of the model's design, underlying data structure, and application;

3. show changes in habitat availability for native amphidromous animals on a stream-by-stream basis; and

4. prioritize habitat and passage restoration actions among the streams of concern in East Maui. (Glen R. Higashi, WDT, ¶ 3.) [Nā Moku/MTF FOF 269.]

122. Of the 27 streams that were the subject of this contested case, the 2009 Habitat Availability Study addressed only the 19 streams remaining after the Commission's September 25, 2008 order amending the IIFS for 6 of 8 streams, where instream flow for taro cultivation was the main concern, *supra*, FOF 8. (Glen R. Higashi, WDT, ¶ 19.) [Nā Moku/MTF FOF 271.]

123. The Study stated that the 19 streams comprised 16 distinct streams and their tributaries, but only explained that Waiaaka Stream was left out because it was not in DAR's stream codes,

database, or GIS coverages. Puakaa Stream is a tributary of Kopiliula Stream, *supra*, FOF 63, ft. 9. Wahinepee Stream was left out without explanation. (2009 Habitat Availability Study, Table 1.)

124. Minimum viable habitat flow (H_{min}) for the maintenance of suitable instream habitat was defined as 64% of Median Base Flow ($0.64xBFQ_{50}$) (also defined as H_{90} by USGS studies, *supra*, FOF 118), which was expected to produce suitable conditions for growth, reproduction, and recruitment of native stream animals. (Glen R. Higashi, WDT, Appendix D, p. 4.)

125. Habitat less than H_{90} was not expected to result in viable flow rates for the protection of native aquatic biota. There is no linear relationship between the amount of habitat and the number of animals. H_{70}, or twenty percent less habitat than H_{90}, would not result in only 20 percent less animals; nor would H_{50}, which is twenty percent less than H_{70}, result in only an additional 20 percent less animals. (Glen R. Higashi, WDT, Appendix D, p. 2.)

126. The 16 streams in the study, with their corresponding numbers in FOF 63, *supra*, were:

a. Makapipi Stream,[1]
b. Hanawi Stream,[2]
c. Kapaula Stream,[3]
d. Paakea Stream,[5]
e. Waiohue Stream,[6]
f. Kopiliula Stream[7] (and its tributary, Puakaa Stream[7])
g. East Wailuaiki Stream,[8]
h. West Wailuaiki Stream,[9]
i. Ohia Stream,[13]
j. Nuaailua Stream,[16]
k. Honomanu Stream,[17]
l. Punalau Stream,[18]
m. Haipuaena Stream,[19]
n. Puohokamoa Stream,[20]
o. Waikamoi Stream,[22]
p. Kolea Stream.[23] (Glen R. Higashi, WDT, Appendix A, Table 1.)

127. The Division of Aquatic Resources ("DAR"), recommended the restoration of the following eight streams, in descending order of habitat units restored:

a. Honomanu Stream: 11.6 kilometers (km) of Habitat Units;

b. Puohokamoa Stream: 7.6 km of Habitat Units;

c. Waikamoi Stream: 5.8 km of Habitat Units;

d. Kopiliula Stream (and its tributary, Puakaa Stream): 5.1 km of Habitat Units;

e. East Wailuaiki Stream: 4.4 km of Habitat Units;

f. West Wailuaiki Stream: 4.0 km of Habitat Units;

g. Makapipi Stream: 3.8 km of Habitat Units; and

h. Hanawi Stream: 3.5 km of Habitat Units.

(Glen R. Higashi, WDT, Appendix B, pp. 3-4.)

128. Flow restoration for these eight streams would result in 45.8 km out of a total of 67.3 km, or 68 percent of the 16 streams. (Glen R. Higashi, WDT, Appendix B, p. 4.)

129. Restoration of fish passage and restoration of suitable habitat forming flows at a small number of key locations can result in large amounts of potential habitat to become available for native animals. (Glen R. Higashi, WDT, Appendix A, p. 77.)

130. Restoration of an upstream diversion is not useful without first improving diversions downstream. (*Ibid*.)

131. DAR recommended that all existing diversions on these eight streams be modified to increase suitable instream habitat, minimize the entrainment of larvae, and to allow for animal passage for the recruiting post-larvae. (Glen R. Higashi, WDT, ¶ 8.) [Na Moku, FOF 278.]

132. DAR also commented that:

a. The restoration of suitable flows to a single stream is more appropriate than the return of inadequate flows to multiple streams.

b. Restoration of streams should be spread out in a geographic sense. This will provide greater protection against localized habitat disruptions, a wider benefit to estuarine and nursery habitat for nearshore marine species, and result in more comprehensive ecosystem function across the entire east Maui sector. (Glen R. Higashi, WDT, Appendix D, p. 3.)

133. DAR later reconsidered its initial list of 8 streams on the basis of:

a. the amount of habitat currently lost to diversions;

b. seasonality (wet versus dry seasons) was considered by setting minimum connectivity flows in the dry season and minimum habitat flow in the wet season;

c. issues relating to losing reaches, which eliminated Honomanu and Makapipi streams;

d. streams most biologically impacted by dewatering;

e. the number and difficulty of modifying diversions;

f. the efficient use of water in terms of habitat units restored per cfs of water returned;

g. whether restoration of stream flow along a given segment of a stream involved the comingling of stream and ditch waters; and

h. to geographically distribute the streams proposed for restoration across the entire East Maui ecosystem. (Glen R. Higashi, WDT, Appendix C, p. 2.)

134. Honomanu and Makapipi streams were eliminated after consultation with CWRM, USGS and Bishop Museum on the basis of concerns over losing reaches and replaced with Waiohue and Haipuena streams. DAR's estimates of the undiverted BFQ_{50} flows and 64 percent of BFQ_{50} (H_{90}) flows for the revised list of eight streams were as follows, in order of DAR's priority ranking:[14]

	Median undiverted base stream flow below lower most diversion (Undiverted BFQ_{50})	64 percent of BFQ_{50}, or H_{90} flows
East Wailuaiki Stream	4.52 mgd (7.0 cfs)	2.91 mgd (4.5 cfs)
West Wailuaiki Stream	4.52 mgd (7.0 cfs)	2.91 mgd (4.5 cfs)
Puohokamoa Stream	6.79 mgd (10.5 cfs)	4.33 mgd (6.7 cfs)
Waikamoi Stream	4.46 mgd (6.9 cfs)	2.84 mgd (4.4 cfs)
Kopiliula Stream	5.17 mgd (8.0 cfs)	3.30 mgd (5.1 cfs)
Haipuaena Stream	3.36 mgd (5.2 cfs)	2.13 mgd (3.3 cfs)
Waiohue Stream	4.39 mgd (6.8 cfs)	2.78 mgd (4.3 cfs)
Hanawi Stream	no flow recommended, only modification of diversion for passage	

(Glen R. Higashi, WDT, Appendix D, p. 5.)

135. For these eight streams, the amounts that would be needed to bring stream flows under diverted conditions to 64 percent of BFQ_{50}, or the minimum habitat needed for growth, reproduction, and recruitment of native stream animals, were as follows:

East Wailuaiki Stream: 2.07 mgd (3.2 cfs)

West Wailuiki Stream: 2.26 mgd (3.5 cfs)

Puohokamoa Stream: 3.49 mgd (5.4 cfs)

[14] cfs converted to mgd: 1 cfs = 0.6463 mgd.

Waikamoi Stream:	1.68 mgd (2.6 cfs)
Kopiliula Stream:	1.94 mgd (3.0 cfs)
Haipuaena Stream:	1.62 mgd (2.5 cfs)
Waiohue Stream:	1.75 mgd (2.7 cfs)
Hanawi Stream:	modification only of diversion for passage
Total:	14.81 mgd (22.9 cfs)

(Glenn R. Higashi, WDT, Appendix C, Table 1.)

G. The September 25, 2008 Commission Order

136. On September 25, 2008, the Commission voted to accept staff's recommendation to restore six of eight streams for a total of 4.5 mgd: 1) Honopou Stream; 2) Hanehoi Stream; 3) Puolua (Huelo) Stream; 4) Palauhulu Stream; 5) Waiokamilo Stream; and 6) Wailuanui Stream. Two streams, Piinaau and Kualani Streams, were not restored, *supra*, FOF 8.

1**. Honopou Stream**

137. The Wailoa, New Hamakua, Lowrie, and Haiku ditches diverted water from Honopou Stream. There is one active gaging station above the Wailoa ditch, and there were three other now-inactive stations below the New Hamakua, Lowrie, and Haiku ditches, respectively. Data from these gages were used instead of the estimates from the 2004 Stream Flow study. Furthermore, Honopou Stream is outside the study area, which would have made the use of the 2005 Stream Flow study for Honopou Stream questionable. (Exh. C-85, pp. 10, 16.)

138. Honopou is a gaining stream, and the average annual groundwater contribution from the stretch from the Wailoa ditch to the Haiku ditch (1.78 cfs, or 1.15 mgd) equals the groundwater (base flow) contribution above the Wailoa ditch (1.78 cfs, or 1.15 mgd), so under undiverted conditions, the base flow below the Haiku ditch would be twice that above the Wailoa ditch. Despite this doubling of base flow as measured by gages above the Wailoa ditch and below the Haiku ditch, the four ditches reduce total stream flow (Q_{50}) by 50 percent, from 2.4 cfs (1.55 mgd) above the Wailoa ditch to 1.2 cfs (0.775 mgd). below the Haiku ditch. (Exh. C-85, pp. 10, 16.)

139. The 2005 Flow Study had comparable percentages of reduced stream flows due to the diversions: 1) reduction in 50- and 95-percent flows in stream reaches affected by the diversions throughout the study area averaged 58-60 percent; and 2) average reduction in the low flow of streams due to diversions ranged from 55 to 60 percent, *supra*, FOF 112.

140. The 2008 Commission decision allowed the continued diversion at Wailoa ditch but minimal or no diversions of low flows (base flows) at the lower ditches; leaving an estimated 1.78 cfs (1.15 mgd) just below the Haiku ditch. Since Honopou Stream continues to gain an unknown amount of water below the Haiku ditch, the IIFS just below the Haiku ditch was set at 2.00 cfs, or 1.29 mgd. (Exh. C-85, pp. 14, 16.)

141. A second IIFS was established downstream of taro and domestic diversions below the Haiku ditch, to prevent drying of the stream and increase the continuity of flow to enhance biological integrity in the stream. This IIFS was established at the Q_{90} above the Wailoa ditch, or 0.47mgd (0.72 cfs). This resulted in 0.82 mgd (1.29 - 0.47 mgd) available to the taro and domestic diversions, and 0.47 mgd to increase continuity of flow to the ocean. There was no explanation of why 0.82 mgd would meet the needs of domestic and taro users, nor why the downstream IIFS of 0.47 mgd was for only continuity of flow to establish biological connectivity instead of a larger IIFS to increase stream habitat to enable reproduction. (Exh. C-85, pp. 14-16.)

142. Even though both total and base flows were reduced by about 50 percent by the diversions, using base flow to amend the IIFS was justified by the conclusion that "(g)round water contribution estimates instead of total flow estimates are used because major diversion structures are generally assumed to capture the majority of the base flow, which is assumed to be mostly ground water flow." (Exh. C-85, p. 14.)

143. In setting the first IIFS at 2.00 cfs, the amendment added 0.22 cfs to 1.78 cfs to account for an unknown gain in the amount of water below the Haiku ditch, *supra*, FOF 140. But base flows below the Haiku ditch were available, with Q_{90} at 0.51 cfs, so the amended IIFS should have been increased to 2.29 instead of to 2.00 cfs, or 1.48 mgd instead of 1.29 mgd. (Exh. C-85, p. 16.)

144. This would have increased the available water for domestic and taro users from 0.82 mgd to 1.01 mgd.

145. Base flow was defined as the Q_{70} to Q_{90} flows. In using the base flows instead of total flows, the amended IIFS also chose the lower number of base flow, while recognizing that "the median base flow could also be as high as Q_{70} or 70 percent of total flow." (Exh. C-85, p. 14.)

146. Using Q_{90}, the first IIFS was increased from 0.51 cfs to 2.00 cfs. Using Q_{70}, the increase would have added 0.87 to 1.78 cfs, or 2.65 cfs (1.71 mgd), compared with 1.48 mgd for Q_{90}, *supra*, FOF 143. (C-85, pp. 14-16.)

147. Using Q_{90}, the second IIFS was established at 0.72 cfs (0.47 mgd), the Q_{90} above the Wailoa ditch, *supra*, FOF 141, replacing the measured Q_{90} of 0.51 cfs at the site. Using Q_{70}, the measurement at the site was 0.87 cfs, and would have been replaced by the Q_{70} above the Wailoa ditch, or 1.4 cfs (0.90 mgd). (C-85, p. 16.)

148. Therefore, adding the measured Q_{90} and Q_{70} values at the first IIFS site instead of hypothesizing what those numbers might be, and using Q_{70} instead of Q_{90} values for base flow:

a. The IIFS at the first site could have been 1.71 mgd instead of 1.48 mgd or 1.29 mgd, *supra*, FOF 143, 146; and

b. The IIFS at the second site could have been 0.90 mgd instead of 0.47 mgd, *supra*, FOF 147.

149. Under the assumptions underlying FOF 148, *supra*, the amount of water available to domestic and taro users below the Haiku ditch would have increased from 0.82 (1.29 - 0.47) mgd to 1.01 (1.48 - 0.47) mgd under the Q_{90} flows, and would have decreased slightly from 0.82 mgd to 0.81 (1.71 - 0.9) mgd under the Q_{70} flows; however, under the Q_{70} flows, water at the second IIFS site to increase stream flow to enhance biological integrity would have increased from 0.47 mgd to 0.90 mgd.

150. The total flow restored to Honopou Stream was 1.29 mgd, with 0.82 mgd available to the taro and domestic diversions, and 0.47 mgd for enhancing continuity of flow to the ocean, *supra*, FOF 140-141.

151. Commission staff noted that there was an estimated 35 acres cultivable for taro, and that Honopou residents do not receive water from a county water system. (Exh. C-85, pp. 11, 13.) There was no explanation on how the 0.82 mgd for taro and domestic diversions would meet these needs.

152. Nā Moku members claim 6.17 acres for taro cultivation and an additional 17.82 acres for cultivable agriculture, for a total of 23.99 acres fed by Honopou Stream, claiming either appurtenant or traditional and customary native Hawaiian rights to a sufficient amount of stream water to irrigate the taro lo`i contained within this acreage. (Exh. A-173.) [Nā Moku FOF 554-556.]

153. Teri Gomes, Nā Moku's expert witness, was not able to quantify the portion of a parcel that was actually farmed in taro nor the percentage of each parcel actually contained in lo`i or farmed in taro at the time of the Mahele and put the entire parcel in taro when she couldn't tell what portion was in taro. (Teri Gomes, Tr., March 4, 2015, p. 137; Tr., April 1, 2015, pp. 18, 40.)

154. Gomes also placed the parcel in the cultivable agriculture category when land was awarded without specificity of use. (Teri Gomes, Tr., April 1, 2015, pp. 19, 32.)

155. On the other hand, HC&S contended that specific locations for properties currently being used or planned to be used for taro cultivation amounted to only two acres. The total of 23.99 acres that Nā Moku members claimed was simply the parcels that Lurlyn Scott described in her Declaration as parcels in which her family has an interest, and are the same properties that her cousins referenced in their Declarations. (Lurlyn Scott, WDT, ¶ 30; Tr., March 4, 2015, p. 193.) [HC&S FOF 111-112.]

2. Hanehoi Stream and its tributary Puolua (also known as "Huelo")

156. The Wailoa, New Hamakua, Lowrie, and Haiku Ditches diverted water from Hanehoi Stream, and the Lowrie and Haiku Ditches diverted water from the Puolua tributary. Measured stream flow data are limited for Hanehoi/Puolua Streams, so flow statistics were estimated with regression equations. The estimated BFQ_{50} undiverted flow of Hanehoi Stream is 1.64 mgd (2.54 cfs) below the Lowrie Ditch and above the Haiku Ditch. The estimated BFQ_{50} undiverted flow of Puolua (Huelo) Stream is 0.69 mgd (1.07 cfs) below the Lowrie Ditch and above the Haiku Ditch and 0.95 mgd (1.47 cfs) below the Haiku Ditch. The estimated BFQ_{50} undiverted flow at the mouth of Hanehoi Stream is 3.46 mgd (5.35 cfs). Hanehoi/Puolua are outside the 2005 Flow Study area in which the regression equations were developed, so the estimated flow statistics may not be representative of the flow conditions in Hanehoi and Puolua (Huelo) Streams. (Exh. C-85, p. 20, 26.)

157. There are no data on whether Hanehoi and Puolua Streams are losing or gaining flow from groundwater. There is currently very little flow in Hanehoi Stream, but residents reported that the streams had continuously flow before the 1960s except in times of drought, and archaeological evidence of extensive taro lo`i along the lower reaches of the streams suggests that water was once readily available . Streamflow data from long-term gaging stations around

the islands indicate that monthly mean total and base flows have generally decreased from the 1940s to 2002, which is consistent with decreasing rainfall trends statewide. (C-85, p. 20.)

158. A diversion for domestic purposes serves approximately 30 families, or approximately 100 people in the Huelo community. There is rarely water available in residents' sections of the streams under present conditions, so they are not using stream water for their crops. (Exh. C-85, pp. 21-22.)

159. As in the case of Honopou Stream, base flow was defined as the Q_{70} to Q_{90} flows. For Honopou Stream, the lower flow of Q_{90} was used instead of the Q_{70}, *supra*, FOF 145-146. For Hanehoi and Puolua Streams, the regression equation estimates were made for TFQ_{50} and TFQ_{95} and BFQ_{50} and BFQ_{95} (TF is total flow, and BF is base flow). TFQ is the same as Q. For Hanehoi Stream, the lower flow (BFQ_{95} instead of the BFQ_{50}) was again used, as it had been for Honopou Stream. But note that TFQ_{95} is lower than the definition of base flow (Q_{70} to Q_{90} flows), and BFQ_{95} is lower than TFQ_{95}. For example, between the Lowrie and Haiku Ditches, for Hanehoi Stream, the estimated TFQ_{95} was 0.81 mgd (1.26 cfs) and BFQ_{95} was 0.74 mgd (1.15 cfs).(Exh. C-85, pp. 24, 26.)

160. Two IIFS were established below the Haiku Ditch and above the confluence of the two streams: 1) for Hanehoi Stream, 0.41 mgd (0.63 cfs); and 2) for the Puolua Stream tributary, 0.57 mgd (0.89 cfs). (C-85, p. 24.)

161. Theses two IIFS were arrived at in the following way:

a. The natural, undiverted BFQ_{95} just above the terminal waterfall at the mouth of Hanehoi Stream was estimated at 1.96 mgd (3.04 cfs). Half, or 0.98 mgd (1.52 cfs), was assumed to maintain biological integrity of the stream. (In the 2005 Habitat Availability Study, when 50 percent of natural base flow [BFQ_{50}, not the smaller BFQ_{95} as used for these two streams] is present in the stream, potentially 80 to 90 percent of the natural habitat for selected native aquatic species is available. Although Hanehoi Stream was not part of the study area, the Study was the best information available.)

b. Since there is no information available on whether Hanehoi Stream is losing or gaining groundwater, the assumption was made that Hanehoi Stream and its tributary, Puolua Stream, contribute to the natural, undiverted flow just above the terminal waterfall. (Exh. C-85, p. 24.)

162. For the Puolua tributary, the IIFS was set at 0.57 mgd (0.89 cfs), the estimated, natural, undiverted flow at that site. For Hanehoi Stream, the IIFS would be 0.41 mgd (0.63 cfs, the remainder after subtracting 0.57 mgd (0.89 cfs) from 0.98 mgd (1.52 cfs). (Exh. C-85, p. 24.)

163. A third IIFS of 0.74 mgd (1.15 cfs) was established further upstream on Hanehoi Stream above the Lowrie Ditch, the estimated undiverted BFQ_{95} below the Lowrie Ditch. (Exh. C-85, p. 25.)

164. No IIFS was proposed for the stream mouth because of the small number of registered surface water users below the confluence of the streams, and because of the terminal waterfall. (Exh. C-85, p. 25.)

165. The purpose of the first two IIFS, *supra*, FOF 160, was to ensure that an adequate amount of surface water reaches users downstream of the Haiku Ditch. (Exh. C-85, p. 24.)

166. The purpose of the third IIFS was to provide adequate surface water for domestic use of the Huelo community. (Exh. C-85, p. 25.)

167. Note that there is a conflict between how the first two IIFS were arrived at and the stated purpose of those IIFS. The sum of the two IIFS, 0.98 mgd (1.52 cfs), *supra*, FOF 162, was based on maintaining the biological integrity of the stream, but the purpose of those IIFS was to ensure that an adequate amount of surface water reaches users downstream of the Haiku Ditch, *supra*, FOF 165. Moreover, no IIFS was proposed for the stream mouth, which means that all of the water at the IIFS on Hanehoi Stream and its Puolua tributary could be diverted from the streams below those locations, so there would be no improvement in the biological integrity of the stream.

168. As a consequence, although the sum of the first two IIFS was to improve the biological integrity of the stream, operatively, the flows could be completely diverted for offstream uses, leading to no biological enhancement of the streams. Furthermore, as with Honopou Stream, *supra*, FOF 141, there is no explanation on how the quantities chosen would provide an adequate amount of surface water for users downstream of the Haiku Ditch, *supra*, FOF 165.

169. While not identifying specific acres, Nā Moku contends that insufficient water and lands that have either appurtenant or riparian rights require that both Hanehoi and Puolua Streams be returned to their natural base flows (BFQ_{50}): 1) for Hanehoi Stream, 1.64 mgd (2.54 cfs) at the selected ungaged site between the Lowrie and Haiku Ditch; and 2) 0.95 mgd (1.47 cfs) at the selected ungaged site below the Haiku Ditch for Puolua Stream. This would increase the IIFS for

Hanehoi Stream from 0.74 mgd to 1.64 mgd, and for Puolua Stream, from 0.57 mgd to 0.95 mgd. (Exh. C-85, p. 26.) [Nā Moku/MTF FOF 783-784, 806, 810, 819, 840.]

170. On the other hand, HC&S noted that CWRM identified an estimated cultivable area of 2.3 acres, and identified two parties who are or who would like to cultivate taro on four acres, as well as one person who has a parcel adjacent to Hanehoi Stream and would like to exercise her riparian rights. (Exh. C-85, p. 21; Ernest Schupp, WDT, ¶¶ 3, 9, 13; *see generally,* Neola Caveny, WDT; *see generally*, Solomon Lee, WDT.) [HC&S FOF 154-161.]

3. Piinaau and Palauhulu Streams

171. Piinaau and Palauhulu Streams have historically been diverted by the Koolau Ditch (east of and flowing into the Wailoa Ditch; *see* Exhs. C-1 and C-33, attached:

a. Piinaau Stream is dry immediately downstream of the Koolau Ditch, possibly from infiltration losses and diversions at the Ditch. Actual flow measurements are not available because of geographic inaccessibility and a major landslide in 2001.

b. Palauhulu Stream gains flow (averaging 2.7 mgd) from Plunkett Spring below the Ditch. The lower reach is dry from infiltration losses above Store Spring, below which the stream gains an unknown amount of flow from the spring.

c. There was one now-inactive gaging station on Palauhulu Stream just before its confluence with Piinaau Stream. Streamflow statistics were estimated with regression equations from the 2005 Flow Study and low-flow (diverted conditions) measurements.

(Exh. C-85, pp. 30, 36.)

172. For Piinaau Stream, the Commission kept the status quo IIFS at its lower reach at 40 feet elevation, upstream from its confluence with Palauhulu Stream. A flow value could not be determined due to the large uncertainty in the hydrological data. Moreover, with the current flow, the stream exhibited rich native species diversity, offered a variety of recreational and aesthetic opportunities, and the two registered diversions had not indicated a lack of water availability. (Exh. C-85, p. 33.)

173. For Palauhulu Stream, a IIFS was established at 3.56 mgd (5.50 cfs) near 80 feet elevation, upstream of its confluence with Piinaau Stream, to ensure that the proposed flow reaches downstream users in Keanae peninsula. This was half of the estimated undiverted base flow at the site of 7.12 mgd (11 cfs). Since estimated diverted flow was 3.10 mgd (4.79 cfs),

there was a net addition of 0.46 mgd (0.71 cfs). A second IIFS was not proposed at the stream mouth, because the amount of water flowing from both streams into the estuary, Waialohe Pond, was deemed adequate. (Exh. C-85, pp. 34-35, 36.)

174. Median base flow (BFQ_{50}) was used to establish the IIFS, in contrast with Honopou Stream, where Q_{90} was used, *supra*, FOF 145, 146, and Hanehoi and Puolua Streams, where BFQ_{95} was used, *supra*, FOF 159. (Exh. C-85, p. 34.) Part of the reason was that "(m)edian base flow is used as a standard to determine the relative native species habitat availability in a USGS study, which will be important for future comparisons," and that "(i)f flow is restored to 50 percent of natural base flow, potentially 80 to 90 percent of native habitat is available in Palauhulu Stream upstream of the confluence." (Exh. C-85, p. 34.) It was not explained why BFQ_{50} was not used for the previously described streams, nor why habitat availability was the basis for the amended IIFS, when taro cultivation was the focus.

175. Commission staff identified eight diversions for domestic use, irrigation of taro and other crops and for livestock, for an estimated cultivable area of 106 acres. The Keanae complex, with about 107 lo`i, which has decreased by half since 1903, is fed by Palauhulu Stream. The Keanae Arboretum complex, with 14 lo`i, is fed by Piinaau Stream. (Exh. C-85, p. 31.)

176. Nā Moku claimed that Palauhulu Stream was the water source for 27.195 acres, 24.595 for taro in Keanae, and an addditional 2.6 acres in cultivable acreage. (Exh. A-173, Teri Gomes, Tr., April 1, 2015, p. 7.) [Na Moku/MTF FOF 571-573.]

177. HC&S contends that no person came forth to assert a claim for water from Piinaau Stream, and that the entire Keanae lo`i complex comprises only 10.53 acres. (Garret Hew, WDT, ¶ 29; Exh. C-108, figure 3, p. 57.; Exh. C-109; Exh. C-110.) [HC&S FOF 318-320.]

4. Waiokamilo Stream

178. Waiokamilo Stream is diverted by the Koolau Ditch. It is generally a losing stream. The 2005 Flow Study indicated that it is dry immediately downstream of the Ditch, then gains about 3.8 mgd from Akeke (Banana) Spring. Thereafter, the stream loses flow to ground water, minor diversions, and a known losing reach near Dams 2 and 3. (Exh. C-85, p. 40.)

179. In March 2007, the Board of Land and Natural Resources' ("BLNR") issued an interim order to release 6 mgd into Waiokamilo Stream below Dam 3. (Exh. C-83, p. 46.)

180. In July 2007, as a result of the interim order, a USGS gaging station was installed near Dam 3. Streamflow statistics at ungaged sites were estimated with regression equations and low-flow measurements. (Exh. C-85, pp. 40, 47.)

181. In the September 25, 2008 Commission order, an IIFS of 3.17 mgd (4.9 cfs) was established near Dam 3 at the site of the USGS gage. This was the median total flow (T_{50}, also described as TFQ_{50}), or the total flow in the stream without diversions at the Koolau Ditch. The estimate of the total undiverted flow: 1) just below the Koolau Ditch was TFQ_{50} = 4.52 mgd (7 cfs); 2) below Akeke (Banana) Spring, TFQ_{50} was estimated at 6.46 mgd (10 cfs); but 3) TFQ_{50} was measured at the USGS gaging station at 3.17 mgd (4.9 cfs), likely due to losing reaches between the Spring and Dam 3, *supra*, FOF 178. (Exh. C-85, pp. 43-44, 47.)

182. Below the IIFS established at 3.17 mgd (4.9 cfs) near Dam 3 at the site of the USGS gage, Waiokamilo Stream gains flows at 250 feet elevation from what was thought was Kualani Stream and at 240 feet from an unnamed spring, so that just above the terminal waterfall, TFQ_{50} without diversions was estimated at 5.62 mgd (8.7 cfs). (Exh. C-85, p. 47.)

183. What was thought to be Kualani Stream served as a conduit for the Lakini auwai system. Water from Waiokamilo Stream was diverted into the Lakini system and joined Kualani Stream before reaching Dam 1, after which it is diverted for taro cultivation in the Lakini taro patches and in Wailua Valley further downstream. (Exh. C-85, pp. 45, 47.)

184. After investigation, what was thought to be Kualani Stream was actually the most eastern tributary of Waiokamilo Stream. (Garrett Hew, Tr., April 1, 2015, p. 126; Dean Ueno, Tr. March 2, 2015, p. 43.).)

185. The IIFS at Dam 3 was the total flow in the stream without diversions at the Koolau Ditch, yet the TFQ_{50} of 3.17 mgd was only half of the 6 mgd that BLNR had ordered released at the same point in March 2007, *supra*, FOF 179.

186. EMI claimed that it had sealed up all its diversions on Waiokamilo Stream, including the intake on what was thought was Kualani Stream, and thereby was no longer diverting any water from Waiokamilo Stream. Dean Uyeno of the Commission staff also stated that what was thought was Kualani Stream, but now is known as East Waiokamilo Stream, was not being diverted. (Garrett Hew, Tr., March 17, 2015, pp. 125, 128-129; Dean Uyeno, Tr., March 2, 2015, pp. 41-43.)

187. Commission staff estimated that there were 515 cultivable acres with Waiokamilo Stream as its source. (Exh. C-85, p. 41.)

188. The Wailuanui lo`i complex relies on three different sources of water, two of which are associated with Waiokamilo Stream and one with Wailuanui Stream. (Exh. cC-85, p. 52.)

189. Nā Moku claimed that 60.767 acres, 44.474 acres in taro and 16.293 cultivable acres, are fed by Waiokamilo and Kualani Streams; 22.448 cultivable taro acres are fed by Wailuanui and Kualani Streams; and 5 acres in Waianu Valley, between Wailuanui and Keanae, are fed by Waiokamilo Stream. (Exh. A-173; Isaac Kanoa, WDT, ¶ 6.) [Nā Moku/MTF FOF 595, 606.]

190. Because what was thought was Kualani Stream is actually the east branch of Waiokamilo Stream, Nā Moku's revised claim is that 65.767 acres are fed by Waiokamilo Stream, and 22.448 acres are fed by Wailuanui and Waiokamilo Streams.

191. HC&S states that EMI is no longer diverting Waiokamilo Stream. (Garrett Hew, WDT, ¶ 35; Tr., March 17, 2015, pp. 128-129; Exh. C-52, pp. 56-67; Exh. C-147, pp. 84-96.) [HC&S FOF 365.]

5. Wailuanui Stream

192. Streamflow statistics were estimated by regression equations, estimating that Wailuanui Stream gains flow from the lower reaches of its tributaries to the coast. Average annual groundwater gains upstream of Koolau Ditch for East and West Wailuanui are 1.7 mgd and 2.2 mgd, respectively. Between the Ditch and the lowest USGS ungaged site, Wailuanui Stream gains an average of 0.8 mgd. (Exh. C-85, p. 51.)

193. Koolau Ditch is the only diversion capturing <u>base</u> flow and could reduce natural <u>total</u> flow by 84 percent. A number of other diversions between the lowest stream gage and the coast could reduce natural <u>total</u> flow by 85 percent. (Exh. C-85, p. 51.)

194. The IIFS was established at 1.97 mgd (3.05 cfs) at 620 feet elevation, downstream of the Koolau Ditch and below the confluence of East and West Wailuanui Streams. Estimated diverted flow at this site was 0.65 mgd (1.0 cfs), so there would be a net addition of 1.32 mgd (2.05 cfs). The estimated BFQ_{50} of undiverted flow at this location is 3.94 mgd (6.1 cfs). (Exh. C-85, pp. 54, 56.)

195. The IIFS is half of the BFQ_{50} of 3.94 mgd (6.1 cfs) and was established on the rationale that with half of median base flow, potentially 80 to 90 percent of natural habitat will be available, as well as providing more surface water to the downstream users, the majority of whom are downstream of the IIFS location. (Exh. C-85, p. 55.)

196. The IIFS of 0.71 mgd (1.1 cfs), BFQ_{50} of diverted flow, was kept at the status quo further downstream below Waikani Falls. At this location, the estimated BFQ_{50} of undiverted flow is 4.33 mgd (6.7 cfs), and 64 percent of BFQ_{50}, or H_{90}, would be 2.77mgd (4.33 cfs). Therefore, the status quo IIFS would be less than that needed for growth, reproduction, and recruitment of native stream animals. (Exh. C-85, p. 56.)

197. There are two declared diversions for taro cultivation with an estimated cultivable area of 350 acres, but the Wailuanui lo`i complex relies on water from both Waiokamilo and Wailuanui Streams, and Commission staff had estimated that there were 515 cultivable acres with Waiokamilo Stream as its source, *supra*, FOF 187. Therefore, these two areas have undetermined overlaps, and the total would be less than the sum of the two. (Exh. C-85, p. 52.)

198. As noted earlier, *supra*, FOF 189, Nā Moku contends that 22.448 acres are fed by Wailuanui and Waiokamilo Streams.

199. HC&S contends that "the Wailua (Waikani) complex" is the lo`i system that is irrigated solely with water from Wailuanui Stream, and as of the summer of 2006, it comprised 2.80 acres. Furthermore, HC&S contends that it is now substantially, if not entirely, removed from taro production despite an increased, consistent flow of 2 to 3 mgd since the Commission's 2008 decision. (Garret Hew, WDT, ¶¶ 36-38; Exh. C-108; Norman "Bush" Martin, Tr., March 9, 2015, pp. 185-189; Dan Clark, Tr., March 10, 2015, pp. 113-117; Uyeno, December 18, 2014 written report, p. 30.) [HC&S FOF 387-389, 393.]

200. HC&S further contends that the record does not include an adequate breakdown of the parcels and acreage that Nā Moku has identified as owned by its members in the vicinity of Wailuanui Stream that may have been previously irrigated with Wailuanui Stream water. [HC&S FOF 391.]

6. Summary and Analysis

a. Use of Different Reference Flows

201. The September 25, 2008 Commission order was said to have restored 4.5 mgd (7 cfs) to six of the eight streams, *supra*, FOF 8. If there were estimated diverted flows at the IIFS sites, those would be subtracted from the IIFS to compute net restorations. If there were only estimated undiverted flows at the IIFS sites, then the IIFS were assumed to be the net restorations:

Honopou Stream:	1.29 - 0.14 =	1.15 mgd	(based on TFQ_{90} flows)
Hanehoi Stream:		0.74 mgd	(based on BFQ_{95} flows)
		0.41 mgd	(based on BFQ_{95} flows)
Puolua Stream:		0.57 mgd	(based on BFQ_{95} flows)
Palauhulu Stream:	3.56 - 3.10 =	0.46 mgd	(based on BFQ_{50} flows)
Waiokamilo Stream:		3.17 mgd	(based on TFQ_{50} flows)
Wailuanui Stream:	1.97 - 0.65 =	1.32 mgd	(based on BFQ_{50} flows)
Total:		7.82 mgd	

202. If the 3.17 mgd for Waiokamilo Stream is left out because BLNR had previously ordered that the flow be increased to 6 mgd at the IIFS site, *supra*, FOF 179, the total restorations would be 4.65 mgd (7.19 cfs).

203. The summary table provided by Commission staff are nearly identical to the numbers (without Waiokamilo Stream) in FOF 201, *supra*, except that Honopou is listed at 1.21 mgd instead of 1.15 mgd, and Palauhulu Stream is listed at 0.45 mgd instead of 0.46 mgd. That table summarizes the restoration amounts at 4.7 mgd instead of 4.65 mgd. This discrepancy may be due to the Commission staff's use of BFQ_{50} or TFQ_{70} in arriving at their numbers. (Exh. HO-1, footnote 1.) Commission staff also stated that the restoration amounts did not consider Honopou, Hanehoi, and Puolua Streams, but they are in fact included, with the IIFS assumed to be the net restoration, *supra*, FOF 201. (Exh. HO-1, footnote 2 and column titled "Restoration Amount, Wet Season.")

204. There was also no uniformity in that four different reference flows (TFQ_{90}, BFQ_{95}, BFQ_{50}, and TFQ_{50}) were used to calculate restoration amounts, *supra*, FOF 201. Commission staff had defined base flow (BFQ) as the Q_{70} to Q_{90} flows, *supra*, FOF 145; but for Honopou Stream, they had chosen the low end (Q_{90}), and for Hanehoi and Puolua Streams, had chosen an even smaller reference flow, BFQ_{95}. Furthermore, in the summary table, staff "assumed that Q_{70} and BFQ_{50} represent median base flow in the streams." (Exh. HO-1, footnote 1.)

205. Therefore, for Honopou, Hanehoi, and Puolua Streams, less than median base flows formed the basis for restoration amounts, *supra*, FOF 201, and for Palauhulu and Wailuanui Streams, *supra*, FOF 174, 195, only half of the median base flows were restored.

206. The choice of reference flows makes a significant difference in the amount of flow restored. For example, restorations for both Hanehoi and Puolua Streams used BFQ_{95} instead of BFQ_{50} flows, *supra*, FOF 201. Had BFQ_{50} been used, the restoration amounts for Hanehoi

Stream would have increased from 0.74 mgd to 1.64 mgd, and from 0.41 mgd to 0.78 mgd, respectively; and for Puolua Stream, the restoration would have increased from 0.57 mgd to 0.95 mgd. (Exh. C-85, pp. 24-26.)

207. Finally, the use of TFQ_{50} flows for Waiokamilo Stream is explained by the fact that it was no longer being diverted, *supra*, FOF 186, and TFQ_{50} should represent median undiverted total flow. However, the TFQ_{50} of 3.17 mgd, which represents <u>all</u> of the total flow, is substantially less than the 6 mgd that BLNR had ordered in March 2007 to be restored, *supra*, FOF 179.

208. In the 2007 BLNR order, it had conservatively estimated that the flow above Dams 2 and 3 was 3 mgd, and that EMI had measured it at 3.57 mgd and 3.85 mgd on July 26, 2005, comparable to flows measured by EMI in 1981. It ordered that current diversions be decreased so that flows below Dam 3 increased to 6 mgd on a monthly moving average on an annual basis. (Exh. C-83, pp. 28, 31, 46.)

209. However, total flows after diversions were sealed only averaged 3.17 mgd (4.9 cfs) over 8 months of measurements beginning on September 1, 2007. (Exh. C-85, p. 44.)

b. Taro Water Requirements

210. Paul Reppun, a taro farmer who testified as an expert on taro cultivation in the Nā Wai `Ehā proceeding as well as in the instant proceeding, had opined that the water requirements of kalo lo`i ranges from 100,000 to 300,000 gad. (Paul Reppun, WDT, Exh. A, p. 5; Tr., March 4, 2015, p. 43.) [HC&S FOF 84.]

211. In the contested case hearing on petitions to amend the IIFS for Nā Wai `Ehā streams, the Commission had concluded that on kuleana lands, 130,000 to 150,000 gad of flow-through water was sufficient for proper kalo cultivation, with 15,000 to 40,000 gad of net loss between lo`i inflow and outflow from evaporation, transpiration, and percolation through the bottoms and leakage through the banks, with most of the loss through percolation and leakage. (Exh. C-120, p. 120, COL 54-56; p. 168, COL 219 (citations omitted).) [HC&S FOF 83.]

212. The Commission's estimate was based on its finding that the kuleana lands in the Nā Wai `Ehā case receive more than 130,000 to 150,000 gad for their kalo lo`i, including the 50 percent of time that no water is needed to flow into the lo`i. This would be equivalent to 260,000 to 300,000 gad for the 50 percent of the time that water is flowing, amounts that would be sufficient

to meet even Reppun's estimate of 100,000 to 300,000 gad for sufficient flow. (Exh. C-120, p. 120, COL 56.)

213. In the instant proceeding, Reppun stated that his estimate of 100,000 to 300,000 gad took into account the 50 percent of time that no water is needed (but *see* FOF 215, 236, *infra*) and that any figure can be assumed to be an average resulting from such parameters as percolation rates, weather, season, location on the stream relative to other diversions, initial water temperature, and rate of dilution of used water. (Paul Reppun, Tr., March 4, 2015, p. 43; WDT, Exh. A, p. 6.)

214. However, the utility of using a general water requirement is questionable, as even Reppun opined, "there is no one definitive answer." (Paul Reppun, Tr., March 4, 2015, p.19.)

215. Reppun's use of the 100,000 to 300,000 gad figure is predicated on when the taro needs the most water, not an average over the course of the entire crop cycle, which he had claimed: "but the important thing is that when it does need the most water, it can be severely--the crop can be severely damaged if it doesn't get that. And so it's that peak period of time, which during the summer months, during the hottest times, the longest days, also happens to be the time that everybody else needs the most water, and also the stream needs the most water." (Paul Reppun, Tr., March 4, 2015, p. 19.)

216. The temperature of 27^{0}C (80.6^{0}F) is the threshold point at which wetland kalo becomes more susceptible to fungi and rotting diseases. (Paul Reppun, Tr., March 4, 2015, p. 27; Exh. C-108, p. 1.) [HC&S FOF 86.]

217. Water temperature in a lo`i complex is dependent on variables such as the amount and temperature of the inflow, the amount of foliage cover, and the size of the complex, and different factors in a lo`i can contribute to how soon and how quickly taro rot occurs. (Paul Reppun, Tr., March 4, 2015, pp. 31-33.) [HC&S FOF 88-89.]

218. Reppun participated in a 2007 USGS study designed to collect baseline flow--what the farmers were actually using--and temperature data from kalo cultivation areas on Kauai, Oahu, Maui, and Hawaii. "All we did was look at quantities of water and correlate that to temperature." (Paul Reppun, Tr., March 4, 2015, p. 26; Exh. C-108.)

219. The area of a lo`i complex included the cultivated and fallow lo`i banks, pathways, and auwai inside the perimeter of each complex. (Exh. C-108, pp. 5-6.)

220. Water need for kalo cultivation depends on the crop stage, and in order to assure consistency of the data collected at the various sites, only lo`i with crops near the harvesting stage (continuous flooding of the mature crop) were selected for water-temperature data

collection. Data was collected in the dry season (June - October), when water requirements for cooling kalo approach upper limits. Flow measurements generally were made during the warmest part of the day, and temperature measurements were made every 15 minutes at each site for about a 2-month period. (Exh. C-108, p. 1.)

221. The Maui part of the study measured three areas, all on the windward side: 1) Waihee, 2) Wailua, and 3) Keanae. (Exh. C-108, p. 43.)

222. Three lo`i complexes in Wailua were studied: Lakini, Wailua, and Waikani. Lakini and Wailua receive diverted water from Waiokamilo Stream, and Waikani receives diverted water from Wailuanui Stream. All the active lo`i in Keanae were treated as one complex, which receives diverted water from Palauhulu Stream. (Exh. C-108, p. 43.)

223. The acreage for these complexes were:

Lakini: 0.74 acres
Wailua: 3.32 acres
Waikani: 2.80 acres
Keanae: 10.53 acres (Exh. C-108, p. 44, Table 5.)

224. The average inflow value for the 19 lo`i complexes across the four islands that were studied was 260,000 gad, and the median inflow value was 150,000 gad. The average inflow value for the 17 windward lo`i complexes was 270,000 gad, and the median inflow value was 150,000 gad. (Exh. C-108, p. 1.)

225. Inflow measurements on July 30, 2006 and on September 21, 2006 were:

Lakini: 750,000 gad and 550,000 gad (for 0.74 acres)
Wailua: 180,000 gad and 140,000 gad (for 3.32 acres)
Waikani: 190,000 and 93,000 gad (for 2.80 acres)
Keanae: 180,000 gad and 150,000 gad (for 10.53 acres) (Exh. C-108, p. 44.)

226. Of the 17 (of 19) lo`i complexes where water inflow values were measured, only three had inflow temperatures that rose above 27^0C. (Exh. C-108, pp. 1.)

227. Lakini, Wailua, Waikani, and Keanae had inflow temperatures well below 27^0C, with Keanae having the lowest inflow temperature of all lo`i complexes in the study at 20.0^0C. (Exh. C-108, pp. 1, 51, 53, 56, 58.)

228. Outflow temperature was not measured for Wailua, and there was an equipment malfunction at Keanae. For Lakini, temperatures exceeded 27^0C 16.9 percent of the time, with the earliest time of day at 1015 hours and the latest, at 1800 hours; peak temperatures occurred

between 1300 and 1815 hours. For Waikani, temperatures exceeded 27^0C 29.1 percent of the time, with the earliest time of day at 0000 hours and the latest, at 2345 hours; peak temperatures occurred between 1400 and 2045 hours. (Exh. C-108, p. 45.)

229. The time that 27^0C was exceeded did not occur every day. Although the study did not summarize these data, the graphs indicate that one-half to two-thirds of the time, temperatures exceeded 27^0C for several hours a day. (Exh. C-108, pp. 51, 56.)

230. Reppun is of the opinion that 77^0F is the point at which rot begins to accelerate, and as rot begins to accelerate, it doesn't necessarily reach unacceptable levels until a little bit higher temperature, and he is of the opinion that 27^0C (80.6^0F) is about that point where it starts to really climb. (Paul Reppun, Tr., March 4, 2015, pp. 27-28.)

231. Reppun is of the opinion that the percent of the time that outflows exceed 27^0C is the most important factor. (Paul Reppun, Tr., March 4, 2015, p. 69.)

232. Reppun also opines that the cooler the water that comes into the lo`i, the better, and the water flowing out of the lo`i should be 77^0F or less. (Paul Reppun, Tr., March 4, 2015, pp. 51, 62.)

233. Aside from such things as the stage of the crop, temperature of the inflows, the amount of sunlight, etc., there are management practices that the farmer can engage in to maximize the cooling effect of the water. The main one is to increase the depth of the water, which would increase the cooling capacity of the water. That takes more water. (Paul Reppun, Tr., March 4, 2015, p. 59.)

234. If you begin to have rot, then you rest your field and change it from a wetland ecosystem to a dry land ecosystem. (Paul Reppun, Tr., March 4, 2015, p. 33.)

235. Questioned on the 0.74-acre Lakini lo`i complex using 550,000 to 750,000 gad, *supra*, FOF 223, 225, Reppun was of the opinion that the capacity of that amount of water was enormous relative to the size of the area, that the water was not going to heat up very much at all, and that the amount was more than adequate. (Paul Reppun, Tr., March 4, 2015, p. 73.)

236. Reppun's opinion that taro water requirements are approximately 100,000 to 300,000 gad does not mean that these amounts are daily averages during a crop cycle, but an approximation of the amount required when maximum inflow is required to prevent rot. Nor is 100,000 to 300,000 gad the maximum of the amount so required. Reppun's principal point is that when lo`i waters are most susceptible to reach temperatures that accelerate rot, sufficient inflow waters need to be available to keep water temperatures below the threshold for rot.

c. Acreage in Taro

237. In total, the acreage claimed by Nā Moku as being either in taro or cultivable agriculture was 136.18 acres for Honopou, Palauhulu, Waiokamilo, and Wailuanui Streams, s*upra*, FOF 152, 176, 189, 190.[15] (Teri Gomes, Tr., April 1, 2015, p. 11, 13.)

238. Nā Moku identified no acreage for Hanehoi and Puolua Streams, but contended that insufficient water and lands that have either appurtenant or riparian rights require that both Hanehoi and Puolua Streams be returned to their natural base flows (BFQ_{50}), *supra*, FOF 169; while HC&S noted that the Commission identified an estimated cultivable area of 2.3 acres, and identified two parties who are or who would like to cultivate taro on four acres, as well as one person who has a parcel adjacent to Hanehoi Stream and would like to exercise her riparian rights, *supra*, FOF 170.

239. Teri Gomes, Na Moku's expert witness, put the entire parcel in taro when she couldn't tell what portion was in taro. In her previous testimony before BLNR, she had reduced the acreage by 10 percent, but was not instructed to do so in the present contested case. (Teri Gomes, Tr., April 1, 2015, pp. 14, 18, 40.)

240. Gomes also placed the parcel in the cultivable agriculture category when land was awarded without specificity of use, because most parcels awarded at the time of the Mahele were used for agricultural purposes and she had already eliminated house lots, cemeteries, and churches. (Teri Gomes, Tr., April 1, 2015, pp. 19, 32.)

241. Therefore, Na Moku's own expert witness conceded that these acreages are overstated by an unknown amount for taro cultivation and cultivable agriculture.

d. Revised IIFS to Meet Taro Water Needs

242. The Commission's order identified the acreage of taro for each stream through the undocumented declarations of registered diverters, with a total of 1006 acres plus water for domestic needs, *supra*, FOF 151, 158, 175, 187, 197, but did not attempt to evaluate these claims nor relate these acres to the amount of water added to the streams in the revised IIFS.

[15] The total acreage under FOF 152, 176, 189, and 190 is 139.4 acres, but there is some overlap because some acres are fed by both Waokamilo and Wailuanui Streams, *supra*, FOF 189-190.

243. It has further been noted that different reference flows were used to amend the IIFS, *supra*, FOF 201-208.

244. Commission staff stated that their efforts were based on looking at the lower Q values, the low flow values, in order to make sure that it would always be met, to make sure that the downstream users would always have a set amount of water, and conceded that such an approach could amend the IIFS lower than what taro farmers might need. (Dean Uyeno, Tr., March 2, 2015, p. 122.)

e. Habitat Improvement

245. For East Maui streams, it is estimated that 64 percent of natural median base flow ($0.64xBFQ_{50}$) would be required to provide 90 percent of the natural habitat (H_{90}), *supra*, FOF 118, which is expected to produce suitable conditions for growth, reproduction, and recruitment of native stream animals, *supra*, FOF 124.

246. Habitat less than H_{90} would not result in viable flow rates for the protection of native aquatic biota. There is no linear relationship between the amount of habitat and the number of animals. H_{70}, or twenty percent less habitat than H_{90}, would not result in only 20 percent less animals; nor would H_{50}, which is twenty percent less than H_{70}, result in only an additional 20 percent less animals, *supra*, FOF 125.

247. The 2008 Commission decision restored only enough water to Honopou Stream for continuity of flow, not growth, reproduction, and recruitment of native stream animals, *supra*, FOF 141.

248. For Hanehoi Stream, half of the BFQ_{95} (not the much larger BFQ_{50}) flow, or $0.50xBFQ_{95}$ was restored, *supra*, FOF 161. Thus, not only was the smaller base flow used as a reference, but the percent of such flow was only 50 percent, not 64 percent. Furthermore, although the amended IIFS was to improve the biological integrity of the stream, operatively, the flows could be completely diverted for offstream uses, *supra*, FOF 168.

249. For Palauhulu Stream, restoration was for half of BFQ_{50}, or $0.50xBFQ_{50}$, less than the $0.64xBFQ_{50}$, and flow at the mouth was deemed adequate, although it is unclear if that flow met the $0.64BFQ_{50}$ requirement, *supra*, FOF 173-174.

250. For Waiokamilo Stream, the total flow of 3.17 mgd was restored (TFQ_{50}), which cannot meet the BLNR order to have a total of 6 mgd flowing in the stream, supra, FOF 181, 185. If this

total flow is really equivalent to H_{100}, however, the principal purpose of BLNR's order and the cessation of diversions were to increase the availability of stream water for taro growing. So how much of the stream water is used by the taro farmers will determine whether habitat restoration takes place.

251. Finally, for Wailuanui Stream, restoration was for half of BFQ_{50}, or $0.50xBFQ_{50}$, less than the $0.64xBFQ_{50}$ needed for habitat restoration, *supra*, FOF 195. Furthermore, the increased flows can be diverted by downstream users, further compromising habitat improvement, *supra*, FOF 196.

H. The May 25, 2010 Commission Order

252. On May 25, 2010, the Commission voted to amend the IIFS through a seasonal approach for six of the remaining 19 streams, with winter total restorative amounts of 9.45 mgd, and summer restoration reduced to 1.11 mgd, *supra*, FOF 11.

253. Winter restorative flows were established at 64 percent of BFQ_{50} (H_{90} or $H_{minimum}$) to maintain minimum viable habitat for native stream animals, while summer restorative flows were established at 20 percent of BFQ_{50} ($C_{minimum}$) to maintain minimum connectivity for animals to survive in shallow pools without suitable long-term growth or reproduction of native stream animals. (Exh. C-103, pp. 9, 11.)

254. A comparison between annual and seasonal approaches is summarized as follows:

	Annual approach	Seasonal approach
Instream uses	helps restore streams to their natural flow pattern for the full year	helps restore streams to their natural flow pattern for part of the year
	greater biological benefit as the higher flows support annual growth and reproduction of native stream animals	results in semi-annual growth and reproduction with recruitment and survival during the alternate six months
noninstream uses	less stream water available for agricultural and domestic needs in the summer when demands are high	streamflows provide more water for agricultural and domestic needs in the summer season when demands are higher than in winter
	one-time diversion modification needed for stable IIFS	more complex diversion modification needed for flexible IIFS and oversight of semi-

annual modifications required (Exh. C-103, p. 14.)

255. Together with the additions for the first eight streams (six of which were amended) that totaled 4.5 mgd (*supra*,FOF 8), total stream restorations for the 27 streams were as follows: 12 of 27 streams restored by a total of 13.76 mgd in the wet season, reduced to 5.61 mgd in the dry season, *supra*, FOF 12.

256. By comparison, Commission staff had estimated total diversions by East Maui Irrigation (EMI) as ranging from 134 mgd in the winter months to 268 mgd in the summer months, averaging about 167 mgd, *supra*, FOF 13.

257. Of the eight (nine, counting Puakaa Stream as separate from Kopiliula Stream, *supra*, FOF 127) streams recommended by DAR for restoration, *supra*, FOF 134, Commission staff recommended five--Waikamoi, East Wailuaiki, West Wailuaiki, Waiohue, and Hanawi Streams--and added one, Makapipi Stream. (Exh. C-103. p. 19.)

258. The flow rates for H_{90} or $H_{minimum}$ calculated by Commission staff were similar but not the same as DAR's recommended flows in the wet season, because DAR calculated IIFS for the lower and middle reaches of the streams, while Commission staff calculated IIFS near potential monitoring stations. (Exh. C-103, p. 17.)

259. Commission staff's recommendations, which were accepted by the Commission, were as follows:

a. Waikamoi Stream: "supports DAR's position of a geographic approach to flow restoration. A geographic approach means restoring flow to streams both east and west of Keanae Valley. Benefits of this approach include biological diversity in the East Maui area, and regional diversity in traditional gathering opportunities...(I)t is the only stream out of the three recommended DAR streams located west of Keanae Valley that is not used for conveyance along its main reach. Many area residents also expressed interests in gathering native animals from this stream." (Exh. C-103, p. 19.)

b. West Wailuaiki and East Wailuaiki Streams: flow restoration in these streams "will result in the most biological return from additional flow. The presence of an estuary in both streams further enhances the biological diversity of the stream. In addition, flow restoration provides increased opportunities for traditional gathering that area residents currently want to practice." (Exh. C-103, p. 19.)

c. Waiohue Stream: "is also proposed for flow restoration for similar reasons that East and West Wailuaiki Streams were selected. The presence of an estuary further enhances the biological diversity of the stream...(R)esidents testified to gathering vegetation and stream animals in Waiohue Stream." (Exh. C-103, p. 19.)

d. Hanawi Stream: "minimal flow is needed to achieve the desired biological diversity and impacts to HC&S would be negligible. Modification of the diversion would serve mainly to create a wetted pathway for stream animal connectivity from the diversion to the ocean. The interim IFS for Hanawi Stream is an exception to the staff"s approach to calculating the interim IFS because the stream has adequate flow to sustain a viable biota population. As recommended by DAR, the biological health of the stream could be further improved simply by providing connectivity in the dry reach immediately below the diversion. For this reason, staff established the monitoring site directly below the ditch at an interim IFS of 0.1 cfs to ensure a wetted pathway." (Exh. C-103, p. 19.)

e. Makapipi Stream: "Apart from DAR's priority streams, staff recommends restoration for Makapipi Stream because the Nahiku community relies heavily on the stream for cultural practices, recreation, and other instream uses. With the uncertainty of gaining and losing reaches along most of the stream's course to the ocean, it is not known whether restored flow will result in continuous stream flow from the headwaters to the stream mouth. A coordinated study of a short-term release of water past the one major EMI diversion should be sufficient to determine the sustainability of the proposed standard (0.60 mgd [0.93 cfs], which is TFQ_{70}, or BFQ_{50}, just upstream of Hana Highway)." (Exh. C-103, pp. 19-20.)

260. Commission staff did not recommend DAR's selection of Puohokamoa, Haipuaena, and Kopiliula Streams, reasoning that these streams are used for conveyance, more water may exist in the portion of the stream used for conveyance than would naturally occur, and any interim IFS should be based on the surface water available within the given hydrological unit. (Exh. C-103, p. 20.)

a. For Kopiliula Stream, conveyance was described as "ditch," and DAR had recommended bypassing the area of commingling of the ditch and stream water with a box flume. (Glenn Higashi, Tr., March 16, 2015, p. 171. [Nā Moku/MTF FOF 362.]

b. For Puohokamoa Stream, conveyance was described as "overflow" at the Spreckels Ditch and "??" at the Manuel Luis Ditch. (Exh. C-103, p. 1-5.)

c. For Haipuaena Stream, conveyance was described as "S-7, Punalau" at the Spreckels Ditch. ("S-7, Punalau" refers to the Spreckels Ditch intake on Punalau Stream, which is immediately east of Haipuaena Stream. S-8 is the Spreckels Ditch intake for Haipuaena Stream.) (Exh. C-103, p. 1-7.)

261. However, during the contested case hearing, Garrett Hew of EMI agreed that there's no identification of particular conveyance streams. If storm waters overflow a ditch, the water goes into the stream and then hits the next ditch downstream. There are no actual conveyance ditches or designated conveyance streams in the system. (Garrett Hew, Tr., March 18, 2015, pp. 144-145.)

262. For Puakaa Stream, minimum connectivity as for Hanawi Stream, *supra*, FOF 259(d), was not recommended, because the habitat unit gain would be only 300 meters compared to over 1300 meters for Hanawi Stream, and the cost and effort to modify the diversion to allow for connectivity was better spent in Hanawi Stream. (Exh. C-103, p. 20.)

263. For the remaining nine streams--Alo (a tributary of Waikamoi Stream), Wahinepee, Punalau, Honomanu, Nuaailua, Ohia, Paakea, Waiaaka, and Kapaula Streams--flow restoration was not recommended because these streams would not result in significant biological return from additional flow. Instead, staff recommended establishing measurable status quo flows at specific locations along each stream." (Exh. C-103, p. 20.)

264. The revised IIFS for these six streams were as follows:

	Wet season (winter)	Dry season (summer)
Waikamoi Stream	1.81 mgd (2.80 cfs)	0
West Wailuaiki Stream	2.46 mgd (3.80 cfs)	0.26 mgd (0.40 cfs)
East Wailuaiki Stream	2.39 mgd (3.70 cfs)	0.13 mgd (0.20 cfs)
Waiohue Stream	2.07 mgd (3.20 cfs)	0.06 mgd (0.10 cfs)
Hanawi Stream (annual)	0.06 mgd (0.10 cfs)	0.06 mgd (0.10 cfs)
Makapipi Stream (annual)	0.60 mgd (0.93 cfs)	0.60 mgd (0.93 cfs)
Total:	9.39 mgd (14.53 cfs)	0.57 mgd (1.73 cfs)

265. The total restoration amounts for the wet season are slightly less than the sum of the IIFS by 0.13 mgd (0.20 cfs), because Waikamoi Stream was restored by 1.68 mgd (2.60 cfs) to bring its IIFS to 1.81 mgd (2.80 cfs), while the other streams' revised IIFS are equal to the restoration amounts. (Exh. HO-1.)

266. Thus, total wet season restoration for these six streams was 9.26 mgd (14.33 cfs), and total dry season restoration was 0.57 mgd (1.73 cfs).

267. Together with the six streams whose IIFS were increased 4.7 mgd (7.27 cfs) on an annual basis in September 2008 primarily for taro growing and domestic uses, *supra*, FOF 203, total wet season and dry season restorations for these twelve streams were:

Wet season: 13.96 mgd (21.60 cfs)

Dry season: 5.27 mgd (8.15 cfs)

268. There are small inconsistencies in the totals for the first six streams in 2008 and for the six streams in 2010, *supra*, FOF 8, 11, 12, 14, 203, as well in the summary table provided by Commission staff at the contested case hearing (Exh. HO-1). For example, the summary table prepared by Commission staff identified wet season total restoration as 13.97 mgd (21.62 cfs), and dry season total restoration of 5.83 mgd (9.02 cfs). (Exh. HO-1.) However, these differences are insignificant when contrasted to the total amounts diverted for offstream uses by East Maui Irrigation (EMI); namely, from 134 mgd in the winter months to 268 mgd in the summer months, averaging about 167 mgd, *supra*, FOF 13, 256.

I. Impact of the Commission's Orders

1. Adequacy of Increased Flows from the 2008 Order for Taro Growing and Domestic Uses

269. In amending the IIFS, different reference flows were used, and the choice of reference flow significantly affected the amount of water restored, *supra*, FOF 205-206.

270. At the contested case hearing, Commission staff confirmed that the intent of the IIFS meant there would always be that amount of flow in the stream, and that "(w)hat we're trying to do is in using the low flow BF values was to insure that there would always be (that) amount of water in the stream;" "our efforts were based on looking at the lower Q values, the low flow values, in order to make sure that it would always be met;" "we wanted to go with the lower number to assure that the amount would be there for the majority of the time." (Dean Uyeno, Tr., March 2, 2015, pp. 91, 121-122, 128-129, 153.)

271. Staff also confirmed that complaints of taro farmers that they were not getting enough water was not material to whether or not they would have changed their decision to recommend higher releases into the stream: "No. The point was to make sure that the IFS was being met at the IFS point." (Dean Uyeno, Tr., March 2, 2015, p. 64.)

272. Nā Moku didn't provide data on their needs for water, and the documentation for the amended IIFS were addressed by Commission staff. (Exchange between the Hearings Officer and Alan Murakami, attorney for Nā Moku, Tr., March 2, 2015, pp. 45-48.)

273. However, at the conclusion of the Commission's meeting on the September 25, 2008 order, then Chair Thielen stated that: "We recognize that the numbers for the minimum amount of stream flow standard that is in the staff's recommendations for each of the streams(s) may not be the number that the taro farmers and the community want, but on the other hand you've been taking after the diversion. Under this transition the stream would get that amount first and it may be found over the course of the year some requirements may be met or not." (Exh. C-89, p. 31.)

274. The recommended IIFS were for increased water for taro growing and domestic use, and improving habitat for native stream animals, *supra*, FOF 141, 150, 162, 165, 166, 173, 174, 179, 195.

275. In the implementation, among other things, Commission staff has learned that: 1) the regression estimates used for flows had, in many cases, overstated what those flows would be, so if the sluice gates on the ditches are opened, there still may not be enough flow to meet the amended IIFS; and 2) in Wailuanui and Keanae, the Koolau Ditch has only been taking, for the most part, water generated by rainfall, and spring water below the Ditch is what the taro farmers have access to. (Dean Ueno, Tr., March 2, 2015, pp. 30-31.)

276. Whatever basis is used to amend the IIFS, there is a natural variability in stream flow which may dip below the IIFS, generally due to periods of low rainfall, so guaranteeing that a specific flow is always in the stream and still meet the objective of the IIFS is not possible. (Dean Ueno, Tr., March 2, 2015, p. 87, 92-94.)

277. At the time of the 2008 Commission Order, the 2005 Habitat Study was available, but the 2009 Habitat Availability Study was not. (FOF 113-135.) Therefore, Commission staff did not know that the minimum flow level necessary for suitable habitat availability (H_{90}) for growth, reproduction, and recruitment of native stream animals was 64 percent of BFQ_{50}.

2. Adequacy of Increased Flows from the 2010 Order for Increases in Native Stream Animals

a. Impact of Seasonal Flows

278. To detect if seasonal flow changes mandated by the 2010 Commission resulted in positive changes in a stream over time, monitoring stations were established in three of the four streams for which seasonal IIFS (winter versus summer flows) had been established--East Wailuaiki, West Wailuaiki, and Waiohue Streams, *supra*, FOF 264. Surveys began prior to the water restoration and continued for two years after flow restoration commenced.(Glenn Higashi, WDT, Appendix E, pp. 5, 7.)

279. The monitoring effort did not include an assessment of whether or not the winter flows, based on 64 percent of estimated BFQ_{50}, had in fact achieved the minimum habitat of H_{90} necessary for growth, reproduction, and recruitment of native stream animals. (*Ibid*., pp. 4-49.) Moreover, it is possible that the 64 percent level set by USGS may not be sufficient. (Glenn Higashi, Tr., March 16, 2015, pp. 223-224.)

280. The focus of the monitoring effort was to determine if the return of water had an effect on the habitat and abundance of stream animals and focused on three broad areas: 1) changes in the quantity of physical habitat; 2) changes to the population structure of native stream animals; and 3) changes in connectivity between the lower and upper stream areas. (*Ibid.*, pp. 1, 4, 11.)

281. The correlation between return flows, habitat, and biota was weak. This may have been due to a number of factors including: changing environmental conditions (e.g., rainfall, drought, flash flooding), short monitoring period (< 4 years), and/or that summer flows were detrimental to gains in habitat and biota from the winter flows. (*Ibid.*, p. 2.)

282. While not definitive, some general conclusions were suggested by the study:

> Some changes to instream habitat at the upper survey stations were observed in response to the higher wintertime flow releases. In general, dry, disconnected or slow-water habitats were replaced by more connected swift-water habitats. These improvements to instream habitat reflected a change to a more stream-like environment. Based on our knowledge of stream animals found in mid to upper stream reaches, these changes should result in more suitable instream habitat. In contrast to the improvements observed at upper stations during the wintertime flow releases, the lower summer flows showed little or no habitat improvement.
>
> In the upper stations of all streams, stream animal assemblages did not show the healthy characteristics. In general, we did not see consistent patterns of occurrence, growth in numbers, or increases in size classes of the animals. As expected based on its habitat and range distribution, *Atyoida bisulcata*[16] was the most common species and some recruitment and growth were observed in East and West Wailua Iki streams.While conditions may have been suitable for *A. bisulcata*, few *Lentipes concolor*, *Sicyopterus*

[16] A small shrimp or opae.

> *stimpsoni*, and *Neritina granosa*[17] were observed in the upper stations suggesting poor quality habitat for these species over time.
>
> At the lower monitoring stations, little change was observed to instream habitat with respect to either winter or summer flow releases. This was not an unexpected result. The lower stations were just upstream from the stream mouth and had perennial flow prior to the flow restorations. In the lower stations of all streams, the stream animal assemblages appear healthy and diverse with good recruitment from the ocean and display composition structure typical of Hawaiian streams. A range of size classes for most stream animals were observed and this pattern likely reflects that suitable conditions existed for feeding, growth, courtship and reproduction.
>
> In our assessment of connectivity, we only observed consistent recruitment of small individuals for *Atyoida bisulcata* to the upper stations over time suggesting that adequate connectivity flows were present. While the upper sites showed some connectivity for *A. bisulcata*, we did not observe increases in recruitment numbers comparing post-release periods to pre-release periods for *Lentipes concolor, Sicyopterus stimpsoni*, or *Neritina granosa*. This result suggests that flows for connectivity may have been insufficient for these species. (*Ibid.*, pp. 1-2.)

283. There is no evidence that the summertime flows were advantageous to the animals. The concept of varying flow over times is well supported in fisheries, but in this case it was not. For example, if the wintertime flows had been returned during the summer and complete flow restoration had been done in the winter, that would have been a seasonal flow approach, and we might have seen completely different results. (James Parham, Tr., March 16, 2015, pp. 62-63.)

284. "Overall, the seasonal flow hypothesis (higher winter flows and lower summer flows) was conceptually coherent, yet not supported by the data. The lack of support for the seasonal flow hypothesis may reflect that the prescribed flow amounts were insufficient (i.e. needed higher flows in summer) or that a year round minimum flow is more appropriate for East Maui streams." (Glenn Higashi, WDT, Appendix E, p. 2.)

b. Makapipi Stream

285. The other three streams whose IIFS were amended were Waikamoi, Hanawi, and Makapipi. Waikamoi Stream's IIFS was amended for seasonal flows but was not selected for the evaluation. Hanawi Stream's IIFS was amended to provide connectivity to the ocean, because the stream has adequate flow to sustain a viable biota population, and only minimal flow was needed

[17] two fish or o'opu, and a mollusk or hihiwai.

to create a wetted pathway for stream animal connectivity from the diversion to the ocean, *supra*, FOF 259(d).

286. Makapipi Stream was preliminarily selected for restoration, because the Nahiku community relies heavily on the stream for cultural practices, recreation, and other instream uses. However, with the uncertainty of gaining and losing reaches along most of the stream's course to the ocean, it is not known whether restored flow will result in continuous stream flow from the headwaters to the stream mouth. Therefore, a short-term release of water past the one major EMI diversion was ordered to determine the sustainability of the proposed standard of 0.60 mgd (0.93 cfs), TFQ_{70} or BFQ_{50}, just upstream of Hana Highway, *supra*, FOF 259(e).

287. When the sluice gates on the Koolau Ditch were partially opened to allow the majority of the water in Makapipi Stream to flow downstream of the diversion, flows ranged from 0.87 mgd (1.35 cfs) on September 14, 2010 to 0.76 mgd (1.18 cfs) on September 17, 2010. Daily site visits during September 13-17, 2010, indicated zero flow at the Hana Highway Bridge, located about two-thirds of a mile downstream of the diversion. A 1,000-foot reach upstream of the Hana Highway Bridge was dry, with the exception of a few isolated pools of water, and there was no indication of recent streamflow. The precise location where the stream went dry farther upstream was not determined, because it could not be safely accessed on foot. Much of the lower sections of the stream below the highway was largely dry, with isolated reaches with pools of water. (Exh. C-54, p. 1; Dean Uyeno, Tr., March 3, 2015, p. 48.) [HC&S FOF 573.]

J. Neither the 2008 nor 2010 Commission Orders Balanced Instream versus Noninstream Uses

1. The 2008 Order was Intended to be Provisional

288. The 2008 Order addressing eight streams was intended to be provisional and revisited for a final determine for these eight streams when the IIFS for the remaining nineteen streams were addressed:

> In accepting staff's recommendation, the Commission added three amendments, the first of which was that "(m)oving forward on the staff's recommendation is the first step in (an) integrated approach to all 27 (twenty-seven) streams that are the subject of these petitions." Then Chair Thielen had stated in the preceding discussion that "if people are not happy at the end of the year, when the Commission makes any decisions, they would have the ability to request a contested case hearing at that time. Cooperation now

is not a waiver of any body's rights to contest that at a later date." After the vote to accept staff's recommendation with amendments, Chair Thielen stated that "the main thing that was passed today is setting minimum instream flow standards that require some infrastructure change, require some evaluation, cooperation and then coming back to the Commission and making final recommendations for the entire 27 stream units," *supra*, FOF 9.

289. However, Commission staff operated on the premise that complaints of taro farmers that they were not getting enough water was not material to whether or not they would have recommended higher releases into the stream, *supra*, FOF 272.

290. Thus, there was no evaluation on which to base an integrated approach to make final recommendations for all 27 streams.

2. The 2010 Order Did not Revisit the 2008 Order nor Balance Instream versus Noninstream Uses

291. The 2010 order focused only on amending the IIFS for the remaining 19 streams, *supra*, FOF 10, 11.

292. More specifically, the Commission focused only on native stream animals and did not balance instream versus noninstream uses, *supra*, FOF 11, 18, 252.

293. On Nā Moku's appeal of the Commission's denial of its request for a contested case hearing, the Intermediate Court of Appeals vacated the Commission's denial and remanded the matter to the Commission with instructions to grant Nā Moku's Petition for Hearing and to conduct a contested case hearing pursuant to HRS Chapter 91 and in accordance with state law, *supra*, FOF 24.

294. The Intermediate Court of Appeals declined to address the merits of whether the Commission erred in reaching its determination on the petitions to amend the IIFS for the nineteen streams and stated that the matter would be properly presented, argued, and decided pursuant to an HRS chapter 91 contested case hearing conducted by the Commission, *supra*, FOF 24.

295. The Hearings Officer subsequently proposed, and the Commission accepted and so ordered, that the Contested Case Hearing address all twenty-seven petitions and streams filed by Nā Moku, *supra*, FOF 27-29.

K. Instream Uses

296. Beneficial instream uses for significant purposes are <u>located in the stream</u> and achieved by leaving the water in the stream. They include, but are not limited to:

a. maintenance of fish and wildlife habitats

b. outdoor recreational activities;

c. maintenance of ecosystems such as estuaries, wetlands, and stream vegetation;

d. aesthetic values such as waterfalls and scenic waterways;

e. navigation;

f. instream hydropower generation;

g. maintenance of water quality;

h. the conveyance of irrigation and domestic water supplies to downstream points of diversion; and

i. the protection of traditional and customary Hawaiian rights. (HRS § 174C-3.)

297. "Navigation" and "<u>instream</u> hydropower generation (*emphasis added*)" are not relevant to the East Maui streams.

298. "Maintenance of fish and wildlife habitats" has been addressed, *supra*, in section I.F, habitat restoration potential; section I.H, the Commission's 2010 order; and section I.I, the impact of that order. Further analysis on stream habitat is provided, *infra*, on the exercise of traditional and customary Hawaiian rights.

299. That portion of stream flows to satisfy appurtenant rights is included in "the conveyance of irrigation and domestic water supplies to downstream points of diversion," and is an instream use. The exercise of appurtenant rights is a noninstream use, because it is carried out on appurtenant lands and not within the streams from which those appurtenant rights are derived.

300. The adequacy of the increased flows to meet taro grower and domestic uses was addressed in section I.I.i, *supra*. Further analysis on taro growing and domestic uses is provided, *infra*, on the exercise of traditional and customary Hawaiian rights.

301. "Outdoor Recreational Activities":

From east to west, Makapipi, Hanawi, Waiohue, East Wailuaiki, West Wailuaiki, Wailuanui, Waiokamilo, Ohia, Honomanu, Waikamoi, Hanehoi, and Honopou streams have significant outdoor recreational activities, including in some cases swimming and/or fishing, and nearly all including scenic views for recreational and sometimes for educational purposes.

(Makapipi IFSAR § 5.0, p. 50; Exh. A-1; Hanawi IFSAR § 5.0, p. 54; Lucien De Naie, WDT; East Wailuaiki IFSAR § 5.0, p. 52; West Wailuaiki IFSAR § 7.0, p. 56; Wailuanui IFSAR § 5.0, pp. 43-44; Waiokamilo IFSAR § 5.0, p. 40; Ohia IFSAR § 5.0, p. 43; Honomanu IFSAR § 5.0, p. 56; Camp, WDT; Exh. E-71; Neola Caveny, WDT; Exh. E-24; Lurlyn Scott, WDT, ¶¶ 24-25; Julien P. Allen Jaccintho, WDT ¶ 9. [HC&S FOF 264, 334, 354, 378, 406, 427, 553, 576; Na Moku FOF 387, 396, 404, 405, 414, 416, 420-423, 428, 435, 438, 440.]

302. "Maintenance of Ecosystems Such as Estuaries, Wetlands, and Stream Vegetation":

From east to west, all of the streams except Waiaaka and Ohia Streams have seasonal, non-tidal palustrine wetlands, in the upper watershed of the hydrologic unit. East Wailuaiki, West Wailuaiki, and Waiohue Streams also have estuaries. (Waiaaka IFSAR § 6.0, pp. 51-53; Ohia IFSAR § 6.0, pp. 46-48; Exh. C-103, p. 19.) [HC&S FOF 421, 433, 466, 513.)

303. "Aesthetic Values Such as Waterfalls and Scenic Waterways":

Waterfalls, some including plunge pools at their base, and to a lesser extent, springs, constitute the principal aesthetic values in the East Maui streams. From east to west, the streams include Makapipi, Hanawi, Kapaula, Waiaaka, Paakea, Waiohue, Kopiliula, West Wailuaiki, East Wailuaiki, Wailuanui, Waiokamilo, Palauhulu, Piinaau, Honomanu, Punalau, Haipuaena, Puohokamoa, Waikamoi, and Honopou. (Makapipi IFSAR § 7.0, p. 62; Hanawi IFSAR § 7.0, p. 61; Kapaula IFSAR § 7.0, p. 62; Waiaaka IFSAR § 7.0, p. 59; Paakea IFSAR § 7.0, p.64; Waiohue IFSAR § 7.0, p. 64; Kopiliula IFSAR § 7.0, p. 67; East Wailuaiki IFSAR § 7.0, p. 64; West Wailuaiki IFSAR § 7.0, p. 63; Wailuanui IFSAR § 7.0, p. 56; Waiokamil59;o IFSAR § 7.0, p. 52; Palauhulu IFSAR § 7.0, p. 55; Honomanu IFSAR § 7.0, p. 69; Punalau IFSAR § 7.0, p. 59; Haipuaena IFSAR § 7.0, p. 65; Puohokamoa IFSAR § 7.0, p. 66; Waikamoi IFSAR § 7.0, p. 72; Exh. C-101, p. 48.) [HC&S FOF 103, 182, 203, 226, 246, 266, 309, 356, 380, 408, 429, 453, 474, 494, 514, 535, 555, 578.]

304. "Maintenance of Water Quality":

Streams that appear on the 2006 List of Impaired Waters in Hawaii, Clean Water Act § 303(d), include, from east to west, Hanawi, Puakaa, East Wailuaiki, West Wailuaiki, Ohia, Honomanu, Punalau, Haipuaena, Puohokamoa, and Waikamoi streams. (Hanawi IFSAR § 10.0, pp. 74-75; Puakaa IFSAR § 10.0, pp. 75-76; East Wailuaiki IFSAR § 10.0, pp. 71-72;West Wailuaiki IFSAR § 10.0,pp. 70-71; Ohia IFSAR § 10.0, pp. 57-58; Honomanu IFSAR § 10.0, pp. 76-78; Punalau IFSAR § 10.0, pp. 65-66, 74; Haipuaena IFSAR § 10.0, pp. 72-74;

Puohokamoa IFSAR § 10.0, p. 4; Waikamoi IFSAR § 10, pp. 80-81.) [HC&S FOF 185, 206, 229, 249, 269, 339, 411, 432, 456, 558.]

1. Protection of Traditional and Customary Native Hawaiian Rights

305. Maintenance of fish and wildlife habitats to enable gathering of stream animals and increased flows to enable the exercise of appurtenant rights constitute the instream exercise of "traditional and customary native Hawaiian rights."

a. Gathering of Stream Animals

306. Both the 2008 and 2010 Commission orders did not result in increased populations of stream animals, nor any signs of growth, reproduction, and recruitment.

307. In the 2008 Commission order, except for Waiokamilo Stream, which had been returned to full natural flow by a previous order of BLNR, all of the other streams' flow levels were established below 64 percent of BFQ_{50}, the minimum flow level necessary for suitable habitat availability (H_{90}) for growth, reproduction, and recruitment of native stream animals, *supra*, FOF 277.

308. In the 2010 Commission order, evaluation of the seasonal flows ordered for four of the six streams resulted in: 1) no evidence that the summertime flows were advantageous to the animals, *supra*, FOF 283; 2) the lack of support for the seasonal flow hypothesis may reflect that the prescribed flow amounts were insufficient (i.e. needed higher flows in summer) or that a year round minimum flow is more appropriate for East Maui streams, *supra*, FOF 284; and 3) the monitoring effort did not include an assessment of whether or not the winter flows, based on 64 percent of estimated BFQ_{50}, had in fact achieved the minimum habitat of H_{90} necessary for growth, reproduction, and recruitment of native stream animals; moreover, it is possible that the 64 percent level set by USGS may not be sufficient, *supra*, FOF 279.

309. In the 2010 Commission order, Hanawi Stream was only modified to provide connectivity in the dry reach immediately below the diversion, because it had been concluded that the stream had adequate flow to sustain a viable biota population, *supra*, FOF 259.d. No evaluation was conducted to confirm that the expected results had been achieved in both connectivity and sustaining viable stream animal populations.

b. Exercise of Appurtenant Rights

310. In total, the acreage claimed by Nā Moku as being either in taro or cultivable agriculture was 136.18 acres for Honopou, Palauhulu, Waiokamilo, and Wailuanui Streams, s*upra*, FOF 237.

311. Nā Moku identified no acreage for Hanehoi and Puolua Streams, but contended that insufficient water and lands that have either appurtenant or riparian rights require that both Hanehoi and Puolua Streams be returned to their natural base flows (BFQ_{50}), *supra*, FOF 238.

312. Teri Gomes, Nā Moku's expert witness, conceded that these acreages are overstated by an unknown amount for taro cultivation and cultivable agriculture, *supra*, FOF 241. She put the entire parcel in taro when she couldn't tell what portion was in taro. In her previous testimony before BLNR, she had reduced the acreage by 10 percent, but was not instructed to do so in the present contested case, *supra*, FOF 239. She also placed the parcel in the cultivable agriculture category when land was awarded without specificity of use, because most parcels awarded at the time of the Mahele were used for agricultural purposes and she had already eliminated house lots, cemeteries, and churches, *supra*, FOF 240.

313. The 136.18 acres claimed by Nā Moku for Honopou, Palauhulu, Waiokamilo, and Wailuanui Streams were comprised of the following areas:

a.	Keanae (Palauhulu Stream):	27.195 acres;
b.	Wailua: (Waiokamilo and	27.73 acres
	Wailuanui Streams)	33.035 acres
		24.227 acres
c.	Honopou: (Honopou Stream)	<u>23.99 acres</u>
	Total:	136.18 acres

(Teri Gomes, WDT, pp. 3-36, 38-39.)

314. Nā Moku had claimed that 60.767 acres, 44.474 acres in taro and 16.293 cultivable acres, are fed by Waiokamilo and Kualani Streams, 22.448 cultivable taro acres are fed by Wailuanui and Kualani Streams, and 5 acres in Waianu Valley, between Wailuanui and Keanae, are fed by Waiokamilo Stream. *supra*, FOF 189. Because what was thought was Kualani Stream is actually the east branch of Waiokamilo Stream, Nā Moku's revised claim is that 65.767 acres are fed by Waiokamilo Stream, and 22.448 acres are fed by Wailuanui and Waiokamilo Streams, *supra*, FOF 190. The total of 88.22 acres (65.767 plus 22.448 acres) is slightly larger than the total of

the three Wailua areas of 84.99 acres (27.73 + 33.035 + 24.227), *supra*, FOF 313, which is likely due to some overlap of acres ascribed to both Wailuanui and Waiokamilo Streams.

315. The breakdown of each of the four groups in FOF 313, *supra*, is:

Keanae:	22 taro lots:	13.475 acres	(0.07 to 2.27[18] acres in size)
	4 agriculture lots	7.00 acres	
	5 ili (land area)	5.49 acres	
	1 conservation	0.18 acres	
	1 wetland	1.05 acres	
Total	33 parcels	27.195 acres	
Wailua:	10 taro lots:	8.02 acres	(0.125 to 2.75[19] acres in size)
	7 agriculture lots	11.86 acres	
	1 ili (land area)	0.42 acres	
	4 mo`o (narrow strip of land)	7.43 acres	
Total	22 parcels	27.73 acres	
Wailua:	10 taro lots	9.22 acres	(0.162 to 2.67[20] acres)
	9 agriculture lots	11.23 acres	
	5 mo`o (narrow strip of land)	12.03 acres	
	1 kula (plain) and home lot	0.216 acres	
	1 pond	0.338 acres	
Total:	26 parcels	33.035 acres	
Wailua:	24 taro lots	12.92 acres	(0.08 to 0.83[21] acres in size)
	9 agriculture lots	5.006 acres	
	4 mo`o (narrow strip of land)	4.98 acres	
	1 ili (land area)	1.32 acres	
Total:	38 parcels	24.227 acres	

[18] described as a poalima, or chief's terraced plantation, with 6 lo`i.
[19] described s containing 26 lo`i.
[20] described as containing 10 lo`i.
[21] described as a taro lot.

Honopou:	1 lot, consisting of 22.81 acres that included:		
		taro lot	3.32 acres
		unspecified	8 acres
		poalima (chief's terraced plantation)	1.67 acres[22]
		land along three streams	9.82 acres
	poalima (chief's terraced plantation)		0.08 acres
	taro lot and kula		1.10 acres
Total:	3 parcels		23.99 acres

(Teri Gomes, WDT, pp. 3-36, 38-39.)

316. The lots, whether for taro, agriculture, ili, or mo`o, are relatively small. The largest of the taro lots was 3.32 acres, and the great majority of the taro lots were less than one acre in size.

317. Teri Gomes, Nā Moku's expert witness, had placed the entire parcel in taro when she couldn't tell what portion was in taro. In her previous testimony before BLNR, she had reduced the acreage by 10 percent, but was not instructed to do so in the present contested case, *supra*, FOF 239, 312.

318. Counting only the taro lots and the poalima:

Keanae:	13.475 out of 27.195 acres	less 10%:	12.13 acres
Wailua:	8.02 out of 27.73 acres	less 10%:	7.22 acres
Wailua:	9.22 out of 33.035 acres	less 10%:	8.30 acres
Wailua:	12.92 out of 24.227 acres	less 10%:	11.63 acres
Honopou:	6.17 out of 23.99 acres	less 10%:	5.55 acres

319. However, all except one of these 69 parcels were identified as only taro lots, with the exception being 1.10 acres in Honopou, described as a taro lot and kula, *supra*, FOF 315.

320. Gomes also placed the parcel in the cultivable agriculture category when land was awarded without specificity of use, because most parcels awarded at the time of the Mahele were used for agricultural purposes and she had already eliminated house lots, cemeteries, and churches, *supra*, FOF 240, 312.

321. However, cultivable agriculture is not equivalent to wetland taro: 1) taro lots were specified as so; and 2) there were other types of agriculture at the time of the Mahele, which used

[22] quantity arrived at as being the remainder, because lot sizes were identified for only 3 of the 4 lots in the grant.

much less water for growing crops. Therefore, while the cultivable agriculture category was entitled to water from the time of the Mahele, that amount would be much less than for taro.

322. Counting the agricultural lots:

Keanae:	7.00 acres
Wailua:	11.86 acres
Wailua:	11.23 acres
Wailua:	5.006 acres

323. The Honopou acreage of 23.99 acres also included 9.82 acres along three streams, *supra*, FOF 315, which were probably agricultural, as it ran along streams (*See*, *infra*, FOF 324).

324. Nā Moku also submitted other exhibits for:

Keanae, consisting of 397.41 acres:

Taro and house lot along Hamau (Kualani) Stream:	9.20 acres
Agricultural lot running along Palauhulu Stream:	13.70 acres
Agricultural lot running along Wailua(nui) Stream:	103.82 acres
Agricultural lot running along the Ditch of Wailua:	151.65 acres

Waianu, consisting of 160.50 acres:

Agricultural lot running from the mountain to the sea:	107 acres
Agricultural lot running from the government road to the sea:	53.50 acres

Honopou, consisting of 2.07 acres, although the total of the parcels is 0.624 acres:

Taro and pasture:	0.154 acres
Taro and pasture:	0.47 acres

Makapipi, consisting of 4.17 acres:

Agricultural lot running along Haiha Stream:	4.17 acres

(Teri Gomes, WDT, pp. 36-40.)

325. For Keanae, HC&S contends that there are only 10.53 acres, supra, FOF 177, referring to the USGS study, *supra*, FOF 223, compared to the 13.475 acres as estimated in FOF 318, *supra*.

326. For Wailua, HC&S contends that it no longer diverts Waiokamilo Stream, *supra*, FOF 191, that Wailuanui Stream is the sole water source for only 2.80 acres, *supra*, FOF 199, but does not address the acreage that is watered by both streams.

327. For Honopou, HC&S contends that there are only 2 acres in taro, *supra*, FOF 155, compared to 6.17 acres as estimated in FOF 318, *supra*.

328. Nā Moku had identified no acreage for Hanehoi and Puolua Streams, but contended that insufficient water and lands that have either appurtenant or riparian rights require that both Hanehoi and Puolua Streams be returned to their natural base flows (BFQ_{50}), *supra*, FOF 238. HC&S noted that CWRM identified an estimated cultivable area of 2.3 acres, and identified two parties who are or who would like to cultivate taro on four acres, as well as one person who has a parcel adjacent to Hanehoi Stream and would like to exercise her riparian rights, *supra*, FOF 170.

329. Nā Moku submitted one exhibit for Makapipi Stream on a 4.17-acre lot for agricultural purposes running along Haiha Stream, *supra*, FOF 324. HC&S noted that CWRM had records for two diversions for taro cultivation, and that Jeffrey Paisner owns property that abuts Makapipi Stream but has no firsthand knowledge that taro was cultivated on his property. (Makapipi IFSAR § 12.0, p. 84; Jeffrey Paisner, WDT, §§ 5-6.) [HC&S FOF 584-586.]

L. Noninstream Uses

1. HC&S

a. Irrigation Requirements

330. Approximately 30,000 acres (the "East Maui Fields") of HC&S's 35,000-acre sugarcane plantation can be serviced by surface water from EMI or brackish groundwater pumped from within the boundaries of the plantation, but not water from the West Maui ditch system. From 2008-2013, HC&S actively cultivated sugarcane on an average of 28,941 acres of its East Maui Fields. (Rick Volner, WDT, ¶ 2; Garret Hew, WDT, ¶ 25; Rick Volner, Tr., March 23, 2015, p. 27; Exhs. C-35 and C-137.) [HC&S FOF 590-592.]

331. From 2008 to 2013, HC&S received 113.71mgd[23] from surface water deliveries and 69.90 mgd in pumped groundwater for a combined total of 183.61 mgd, 62 percent from surface water and 38 percent from groundwater. (Exh. C-137, columns B and C.) [HC&S FOF 629.A.]

332. The use of those waters as reported by HC&S was as follows:

a. Sugarcane irrigation: 132.45 mgd

[23] HC&S reports its water deliveries and usage in millions of gallons per year, and those numbers have been divided by 365 to arrive at daily totals. For example, the 113.71 mgd in surface water deliveries was reported as 41,505 million gallons per year.

b.	MDWS:		2.83 mgd
c.	HC&S Industrial:		6.25 mgd
d.	Other:		0.41 mgd
		Total:	141.94 mgd
		Remainder:	41.67 mgd (183.61 - 141.94 mgd)

(Exh. C-137; Rich Volner, Tr., March 23, 2015, pp. 23-30.)

333. MDWS's usage is at the Kamole Weir and Kula Agricultural Park. Industrial usage at HC&S was used in the factory, power plant, mixing fertilizer solutions, and anything else to support the farming and factory operations, one of the largest uses being cane cleaning. "Other" was water for tenants that were on the HC&S property, such as Ameron and for a period of time, Monsanto. (Rich Volner, Tr., March 23, 2015, pp. 23-26.))

334. After these three user categories, all of the remaining water was used for sugarcane irrigation. The unaccounted remainder was ascribed to system losses, consisting of seepage, evaporation, and miscellaneous losses, such as back-flushing of filters, drip tube ruptures or breaks, animal damage, pipeline breaks, misreported irrigation (if they are not applying the correct hours to the amount that they ran), testing of systems prior to planting, or where water is taken out of the system but not accounted for in daily irrigation. (Rick Volner, Tr., March 23, 2015, pp. 26, 30-31, 140.) [HC&S FOF 637.]

335. The 132.45 mgd for sugarcane irrigation, divided by the 28,941 irrigated acres, *supra*, FOF 330, was the gallons per acre per day, or 4,577 gad. (Exh. C-137.)

336. Compared to the actual irrigation of 4,577 gad that HC&S was able to deliver to its fields, it had contended that irrigation requirements were 5,146 gpad, resulting in 89 percent of irrigation requirements being met from 2008 to 2013. (Exh. C-137.)

337. The 1/15/16 Proposed Decision had concluded that 4,844 gad was a reasonable estimate of irrigation requirements for HC&S's East Maui fields. (1/15/16, Proposed Decision, FOF 337, 346.)

338. On January 6, 2016, A&B announced its decision to cease sugar cultivation upon completion of the 2016 harvest and that it was transitioning HC&S to a diversified farm model, the goal of which is to retain as much of the plantation in agricultural use as possible with a mix of crops and agricultural activities that will be economically viable. The sugar plantation ceased operations as of December 30, 2016. (Exh. C-153; Volner, Tr., 2/8/17, p. 245, ll. 6-9.) [HC&S on reopening, FOF 337-339.]

339. Under its Diversified Agricultural Plan, HC&S is seeking large-scale agricultural uses as well as smaller agricultural uses and considering how the various uses impact one another rather than putting relatively small amounts of acreage into use in an expedient, ad hoc fashion. (Volner, Tr. 2/6/17, p. 210, ll. 14-18, p. 214, l. 15 to p. 215, l. 5.) [HC&S on reopening, FOF 340.]

340. In siting the differing uses throughout the former sugar lands, HC&S considered, among other things, varying soil types, rainfall, solar radiation, elevation, and the relative tolerance of the different crops to irrigation with brackish water. Thus, in general, crops with a lower tolerance for irrigation with brackish water are sited in the higher elevations which do not have access to well water. On the other hand, grasses, bioenergy crops, and crops raised for animal feed, which have a suspected relatively higher tolerance for irrigation that is supplemented with brackish water, are sited in the lower elevations where HC&S has historically used its brackish water wells to supplement surface water imported from EMI, in the east, and the Nā Wai `Ehā streams, in the west, to meet the irrigation needs of approximately 35,000 acres of sugar cultivation. (Volner, WDT, 10/17/16, ¶ 16; Volner, Tr., 2/6/17, p. 181, ll. 15-21.) [HC&S on reopening, FOF 343.]

341. The Diversified Agricultural Plan envisions irrigating 26,996 acres (28,941 acres had been previously irrigated in sugar cane, *supra*, FOF 330) of former sugar fields that were previously irrigated with a combination of surface water delivered by EMI and brackish water pumped from HC&S's brackish water wells. An additional 3,954 acres are planned for unirrigated livestock pastures on the eastern edge of the plantation where there is expected to be sufficient rainfall to support this use, plus 227 acres of unirrigated forestry, for a total of 31,177 acres. (Exh. C-156-A; Volner, WDT, 10/17/16, ¶ 17.) [HC&S on reopening, FOF 344.[24]]

342. The irrigation requirement for each crop is determined by applying the appropriate crop co-efficient to the average daily evapotranspiration rates for the fields in question, crediting average rainfall, and expressing the remaining requirement in gallons per acre per day ("gpad"). The data used to calculate the water requirements for the crops is drawn from 14 weather stations strategically located throughout the plantation by representative region that have been consistently operated for many years. (Exhs. C-156-A at 1, C-157-A; Volner, WDT, 10/17/16, ¶ 18; Volner, WRT, 1/20/17, ¶ 8.) [HC&S on reopening, FOF 345.]

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[24] As explained below, HC&S's proposed FOF are in error on a number of mathematical calculations. For example, the 3,954 acres planned for unirrigated livestock pasture and 227acres of unirrigated forestry are in addition to—not subtracted from—the 26,996 acres. <u>See</u>, *infra*, FOF 343.

343. HC&S's forecast of the irrigation requirements for 26,996 acres of its East Maui fields is as follows:[25]

use	acres	gpad	mgd	% total water
pasture, unirrigated	3,954	---		0.0
pasture, irrigated	3,037	1,704	5.18	5.8
dairy, irrigated (surface only)	2,483	1,384	3.44	3.9
dairy, irrigated	1,972	2,297	4.53	5.1
forestry, unirrigated	227	---		0.0
agricultural park (surface only)	717	2,448	1.76	2.0
diversified agriculture (surface only)	2,830	2,510	7.10	8.0
diversified agriculture	2,000	2,753	5.51	6.2
orchard crops (surface only)	2,212	5,154	11.40	12.8
orchard crops	1,554	5,765	8.96	10.0
beverage crops (surface only)	901	5,096	4.59	5.1
pongamia	2,113	4,478	9.46	10.6
biogas feedstock area	820	3,565	2.92	3.3
mechanically harvested row crops	6,357	3,835	24.38	27.3
Total acres:	31,177			
Irrigated acres:	26,996	3,305	89.23	100%

(Exhs. C-156-A at 1, C-157-A; Volner, WDT, 10/17/16, ¶ 18; Volner, WRT, 1/20/17, ¶ 8.) [HC&S on reopening, FOF 345.[26]]

344. The forecasted water requirements continue to evolve and will not become final "until every acre has been planted back in another agricultural use." Diversified agricultural uses will also be subject to change, because some of HC&S's potential partners and lessees are expected to rotate multiple crops that could potentially have different crop coefficients. And it is unknown whether every single one of these diversified agricultural uses will come to fruition because so many basic questions about the company's potential agricultural operations remain unanswered. (Volner, Tr., 2/6/17, p, 160, l. 21 to p. 161, l. 2, p. 175, ll. 2-4.) [Nā Moku on reopening, FOF 63, 65-66.]

[25] HC&S does not explain the higher requirements for trees, ranging from 4,478 gad for pongamia to 5,765 gad for orchard crops, compared to diversified agriculture, ranging from 2,448 gad for the agricultural park to 3,835 gad for row crops.

[26] Table in FOF 345 has been corrected for mathematical errors: 1) total acreage is 31,177, not 26,996; 2) irrigated acres is 26,996, not 23,042 as stated in HC&S on reopening, FOF 344; and 3) mgd is 89.23, not 32.587.

345. MTF's report, "Mālama `Āina: A Conversation About Maui's Farming Future," claims that water use can be reduced by 10 to 50 percent through the use of regenerative agricultural methods, including: a) rebuilding the soil to increase its water holding capacity; b) reducing water use by selection of crops that are adapted to the local climate; c) reducing evapotranspiration and harvesting atmospheric moisture by planting multi-function windbreaks; d) adjusting the shape and orientation of fields and grading the site to maximize rainwater harvesting, promote soil infiltration, increase groundwater recharge, and allow storage of storm-water runoff. (Exh. E-160.) [Nā Moku on reopening, FOF 83-84.]

346. The Diversified Agricultural Plan is broken down loosely into uses that A&B plans to self-perform and uses that A&B is hoping to partner with others. (Schreck, Tr., 2/8/17, p. 289, ll. 5-9.) [HC&S on reopening, FOF 349.]

347. Of the 26,996 acres, they are willing to look at a number of different arrangements from leases all the way to being completely vertically integrated in whatever crop or production they decide to pursue. At this time, in addition to the 3,954 acres in livestock unirrigated, HC&S intends to retain for itself: a) the 3,037 acres in livestock irrigated, b) the 6,357 acres in mechanically harvested row crops, c) the 2,113 acres of pongamia orchards, and d) the 820 acres of biogas feedstock crops. (Volner, Tr., 2/6/17, p. 192, l. 22 to p. 193, l. 17.) (Nā Moku on reopening, FOF 72.]

348. The aggregate irrigation requirement for the 26,996 acres is 3,305 gpad, or an average daily requirement of 89.23 mgd, *supra*, FOF 343. Accounting for estimated losses of 22.7% due to seepage, evaporation, and other system losses, the gross amount of water to yield the net irrigation requirement of 89.23 mgd is 115.46 mgd (1.294 x 89.23). (Exhs. C-137, C-156-A; Volner, WDT, 10/17/16, ¶ 19.) [HC&S on reopening, FOF 346.]

349. The gross irrigation requirement for acreage that is 100 percent dependent on surface water breaks down as follows:

Agricultural Park	717 acres @ 2,448 gpad	1.75 mgd
Dairy	2,483 acres @ 1,384 gpad	3.44 mgd
Diversified Ag.	2,830 acres @ 2,510 gpad	7.10 mgd
Orchard Crops	2,212 acres @ 5,154 gpad	11.40 mgd
Beverage Crops	901 acres @ 5,096 gpad	4.59 mgd
Total acres:	9,143 acres	
Total Irrigation Requirement		28.28 mgd

Gross Irrigation Requirement		36.59 mgd (1.294 x 28.28 mgd)[27]	

(Exhs. C-156-A, C-157-A.) [HC&S on reopening, FOF 347.]

350. The gross irrigation requirement for acreage with access to well water breaks down as follows:

Irrigated Pasture	3,037 acres @ 1,704 gpad	5.17 mgd
Irrigated Dairy	1,972 acres @ 2,297 gpad	4.53 mgd
Diversified Agriculture	2,000 acres @ 2,753 gpad	5.51 mgd
Orchard Crops	1,554 acres @ 5,765 gpad	8.96 mgd
Pongamia	2,113 acres @ 4,478 gpad	9.46 mgd
Biogas Feedstock	820 acres @ 3,565 gpad	2.92 mgd
Row Crops	6,357 acres @ 3,835 gpad	24.38 mgd
Total acres:	17,853 acres	
Total Irrigation Requirement		60.93 mgd
Gross Irrigation Requirement		78.84 mgd (1.294 x 60.93 mgd)

(Exhs., C-156-A, C-157-A.) [HC&S on reopening, FOF 348.]

351. A&B has performed a high-level analysis of potential markets available for Hawai`i farmers and focused on markets for Hawai`i-produced products that are imported widely, including, for example, beef and energy, which is why it has focused so far on the pasturing project and the renewable energy bioenergy projects. It has also looked at the general farming community in Hawai`i and production markets and tried to assess what may be viable as future lessees take these lands into diversified agriculture production. (Schreck, Tr. 2/8/17, p. 289, l. 12 to p. 290, l. 4.) [HC&S on reopening, FOF 350.]

352. HC&S has received approximately 250 inquiries about leasing former sugar lands for agricultural activities since the cessation of sugar cultivation. Of these 250 inquiries, HC&S is investigating over 60 that it has determined to be possible prospects meriting further review. If all of the possible lease projects were successfully sited on former sugar lands and mutual agreements were reached on lease terms, the aggregate acreage required would rough total 19,500 acres. (Schreck, WRT, 1/20/17, ¶ 8.) [HC&S on reopening, FOF 351.]

353. HC&S states that virtually every prospective lessee has raised the topic of water for irrigation, and A&B's current inability to provide assurances regarding whether and how much irrigation water can be made available to lessees from the EMI ditch system is a major obstacle

[27] 36.59 mgd includes 22.7% in losses, or 8.31 mgd. Therefore, 36.59 mgd(28.28 + 8.31) is the gross irrigation amount.

to procuring commitments from prospective lessees who need some assurance in order to justify committing the necessary capital to develop a new agricultural operation. HC&S states that no farmers have been willing to commit to cultivation absent some assurance as to the quantity and quality of water and cost. (Schreck, WRT, 1/20/17, ¶ 9; Voner, Tr., 2/8/17, p. 268, l. 25 to p. 269, l. 20; Schreck, Tr., 2/8/17, p. 295, l. 20 to p. 296, l. 5.) [HC&S on reopening, FOF 352.]

354. At this time, HC&S's water use is limited to irrigation of diversified agricultural test crops, irrigation of cover crops to minimize soil erosion, and miscellaneous uses such as industrial wash water, firefighting, and dust control. (Volner, WDT, 10/17/16, ¶¶ 3, 11; Volner, Tr., 2/6/17, p. 182, l. 21 to p. 183, l. 1.) [HC&S on reopening, FOF 353.] [HC&S on reopening, FOF 89.]

355. EMI is currently diverting approximately 20 mgd: approximately 6-8 mgd is used by the County of Maui for its Kula Agricultural Park and Kamole Treatment Plant; 1 mgd is used for HC&S's cattle operation; 2 mgd is used for HC&S's bioenergy crops; and 6 mgd is used for maintenance of HC&S's reservoirs for fire protection. Seepage loss accounts for the balance of approximately 4 mgd (Hew, Tr., 2/6/17, p. 107, ll. 11-20.)

356. HC&S is currently cultivating test crops, has completed harvesting of over 180 acres of bioenergy crops, and is preparing for the cultivation of approximately 500 acres for large-scale row testing. (Volner, Tr., 2/6/17, p. 168, ll. 8-23.) [HC&S on reopening, FOF 354.]

357. HC&S is also moving the cultivation of bioenergy crops into the commercialization phase. For example, it has entered into a commercial feedstock agreement to provide biogas feedstock to a company under contract with the County to provide power for the Kahului Wastewater Treatment Facility. The expansion to 500 acres of row-crop testing supports this initiative. (Volner, Tr., 2/6/17, p. 179, l. 25 to p. 180, l. 6; Volner, Tr., 2/8/17, p. 265, l. 14 to p. 267, l. 11.) [HC&S on reopening, FOF 355.]

358. The projects currently planned for 2017 at the time of the reopened hearing include:

a. A pasturing agreement with Maui Cattle Co. to populate the 4,000 acres being converted to grazing pasture by fencing, seeding with signal grass, and—in certain areas—installing supplemental irrigation;

b. responding to a utility-issued RFI designating lands that are suitable for renewable energy development (solar, wind, bioenergy), and making those lands available in any subsequent RFPs for the siting of renewable generating assets on Maui;

c. the sale of approximately 850 acres of land to the County for an agricultural park (originally estimated as 717 acres, *supra*, FOF 343);

d. the establishment of approximately 100 acres of oilseed orchards—the first phase of a planned 250 acres (out of a total 2,113 acres in the Diversified Agricultural Plan, *supra*, FOF 343; and

e. the execution of a commercial feedstock agreement for anaerobic digestion crop feedstocks and the associated use of innovative farming techniques to expand HC&S's bioenergy and grain crop rotation on up to 500 acres.

(Schreck, WRT, 1/20/17, ¶ 6.) [HC&S on reopening, FOF 342.]

359. Albert Perez, Executive Director of MTF and recognized during the hearing as an expert in planning, was of the opinion that "at a minimum, a plan consists of steps that you are going to take in the future, you have to declare what your goal is and have some steps that you're going to take, identify the resources with which you're going to take those steps...(W)hen you're talking about a business plan, you have to do market analysis, you have to figure out what the landed cost of the product is going to be when you produce that." (Perez, Tr., 2/8/17, p. 423, l. 20 to p. 427, l. 2.) [Nā Moku on reopening, FOF 59.]

360. Volner of HC&S stated that they do not have any formal steps to implement the plan, have various timelines associated with projects they are currently working on, and that it is very difficult to put timelines on potentially leasing property to other diversified agriculture farmers and getting people on the property without some certainty regarding water. They have no timelines other than on the ones they are actively managing, and the potential tenants would be the ones who would set timelines for their projects. They have internal financing models on how they will executive their own plans, but other operators and tenants are best suited to execute the other portions of the plan. (Volner, Tr., 2/8/17, p. 255, l. 14 to p. 258, l. 2.)

b. Losses

1. EMI

361. From March to October 2011, USGS conducted a field study of the EMI ditch system to document the location of tunnels and open-ditch sections and to determine seepage losses and gains along selected reaches. (Cheng, C.L., 2012, "Measurements of Seepage Losses and Gains,

East Maui Irrigation Diversion System, Maui, Hawaii," US Geological Survey Open-File Report 2012-1115, 23 p. ("USGS 2012 Seepage Report"), presented at the CWRM meeting of January 23, 2013. ("USGS 2013 Presentation") [Nā Moku/MTF FOF 1064.]

362. The EMI diversion system begins at Makapipi Stream in the east and ends at Maliko Gulch in the west. It consists of four primary ditches known as the Wailoa, New Hamakua, Lowrie, and Haiku ditches. Additional ditches that connect to the four primary ditches include the Koolau, Spreckels, Kauhikoa, Spreckels at Papaaea, Manuel Luis, and Center ditches. (USGS 2012 Seepage Report, p. 1.)

363. Ditch characteristics for about 63 miles of the EMI system, excluding abandoned ditches and stream conveyances, were characterized. About 46 miles (73%) of the surveyed diversion system are tunnels, and 17 miles (27%) are open ditches, of which 3.5 miles (6%)are lined, 2.5 miles (4%) are partially lined(4%), and 11 miles (17%) are unlined. (*Id*.)

364. Tunnels, covered and/or underground, include culverts, siphons and pipes. Lined ditches have concrete ditch bottom and walls, steel ditch bottoms and walls, or concrete ditch bottoms and armored cut-stone walls. Partially lined ditches have earthen material on the ditch bottom and one wall and lined on the other wall; earthen material on the ditch bottom and lined on both walls; or a lined ditch bottom and earthen material on both walls. Unlined ditches have earthen material on bottom and both walls. (USGS 2013 Presentation.)

365. The Wailoa, Kauhikoa, and Haiku ditches have greater than 96 percent of their total length as tunnels, whereas more than half of the Lowrie ditch and Spreckels ditch at Papaaea are open ditches. About 70 percent of the total length of lined open ditches in the EMI diversion system is located along the Koolau ditch, whereas about 67 percent of the total length of unlined open ditches is located along the Lowrie ditch. Less than 4 percent is partially lined open ditches, and about half is in the Spreckels ditch. (USGS 2012 Seepage Report, p. 1.)

366. Discharge measurements were made along 26 seepage-run measurement reaches that are about a total of 15 miles in length. The seepage run measurement reaches represent 23 percent of the total length of ditches in the EMI system. (*Id*.)

367. The results were as follows:

Range of ditch flows (mgd)	seepage losses and gains (mgd)	seepage losses and gains, in percentage of ditch flows
>19	-0.39 to 2	-1.6% to 4%
9.7 to 19	-0.26 to 1.4	-3.7% to 11%

1.3 to 5.2	-0.78 to 0.17	-20% to 8%
0 to 1.3	-0.13 to 0.21	-71% to 41%

Measurement reach lengths range from 0.15 to 2.23 miles. (USGS 2013 Presentation.)

368. Koolau and Spreckels ditches generally had seepage losses. Wailoa, Kauhikoa, and New Hamakua ditches had seepage gains. The Manuel Luis, Center, Lowrie, and Haiku ditches had variable seepage losses and gains. Open ditch measurement reaches generally had seepage losses that ranged from 0.1 cfs (0.06 mgd) per mile at the Lowrie ditch to 3.0 cfs (1.94 mgd) per mile at the Koolau ditch. Tunnel measurement reaches generally had seepage gains that ranged from 0.1 cfs (0.06 mgd) per mile at the Manuel Luis ditch to 5.2 cfs (3.36 mgd) per mile at the Wailoa ditch. (USGS 2012 Seepage Report, p. 1.)

369. Thus, because both open ditches and tunnels in the EMI diversion system not only incur seepage losses but also gains from groundwater, especially in the tunnels, it is not clear whether net seepage losses even occur in the EMI diversion system. At low flows, the USGS study results show that losses are greater than gains, but at higher flows, gains are greater than losses, *supra*, FOF 367.

2. HC&S

370. For 1986 to 2013, HC&S accounted for "system inefficiencies, installation, and terrain inconsistencies" separately from "system losses due to seepage and evaporation of transportation and storage system." "System inefficiencies, etc." assumed that "effective water needed" was 80 percent of "gross water needed" and were incorporated into HC&S's irrigation requirements, which used an 80 percent efficiency factor in calculating its water requirements. (Exh. C-74.) The 1/15/16 Proposed Decision had concluded that, for purposes of estimating HC&S's irrigation needs, an 85 percent efficiency factor should be used instead. (1/15/16 Proposed Decision, FOF 328-337.) "System losses, etc." was estimated at 10 percent of the water needed to irrigate 30,000 acres, but no analysis was provided for this estimate. (Exh. C-74.)

371. Based on this information, *supra*, FOF 370, system losses would be 10 percent of the water required to irrigate 28,941 acres, or 4,844 gad x 28,941 acres x 0.1 = 14.02 mgd. (The information provided by HC&S identified water requirements as 7,396 gad and acreage as 30,000, but reasonable water requirements had been found to be 4,844 gad, *supra*, FOF 337, and

irrigated acres—as opposed to the total East Maui fields of 30,000 acres—had been assumed to be the 28,941 acres identified by HC&S in its 2008 to 2013 data.)

372. For 1986 to 2009, all water needs were lumped together in a single number of 9,019 gad, not only including irrigation requirements but also system losses, irrigation inefficiencies, and industry (factory) needs, so system losses cannot be estimated. (1/15/16 Proposed Decision, FOF 322.)

373. For 2008 to 2013, HC&S characterized all water that could not be accounted as "seepage, evaporation and miscellaneous system losses." Total surface and ground water deliveries were 183.61 mgd and unaccounted water was 41.67 mgd, or 22.7 percent of surface water delivered and ground water pumped. (1/15/16 Proposed Decision FOF 312-313, 315; (Exh. C-137.)

374. Estimating seepage and evaporation losses by way of direct measurement would require closing sections of the ditches and reservoirs, allowing the water to remain in those structures for a period of time, and taking before and after readings. This is impractical to do on a large scale because it would have interrupted plantation operations. (Garret Hew, WDT, ¶ 10; Garret Hew, Tr., March 17, 215, pp. 184, 186.) [HC&S FOF 636.]

375. As an alternative to direct measurement, HC&S calculated the amount of water that cannot be accounted for, *supra*, FOF 373.

376. To obtain a benchmark against which the estimated 22.7 percent loss rate could be compared, HC&S consulted the National Engineering Handbook published by the Soil Conservation Service of the U.S. Department of Agriculture ("USDA"), which provides seepage rate factors that can be applied to various sections of HC&S's system. HC&S calculated the average surface area under water for each type of material that holds or conveys the water (i.e., lined or unlined ditches or reservoirs). For each type of material, HC&S selected a relatively low seepage factor along with a relatively high seepage factor from the USDA Handbook and applied each factor to the estimated surface area under water to calculate what would represent low seepage loss and high seepage loss in the HC&S system per USDA's standards. Based on the foregoing calculations, a low seepage loss per day was estimated to be 30.75 mgd, or 16.76 percent of average daily water deliveries of surface and ground water of 183.61 mgd; a high seepage loss per day was estimated to be 65.06 mgd, or 35.46 percent of average daily water deliveries. (Garret Hew, WDT, ¶¶ 11-12; Exh. C-138, Figure 2-50; Exh. C-139.) [HC&S FOF 638.]

377. To account for loss due to evaporation, HC&S estimated the average daily amount of evaporation from the surface of the water contained in the same ditches and reservoirs as those considered in estimating the seepage losses. The average daily evaporation rate of 0.40 acre-inches was multiplied by the average daily surface area of the water in the system (243.48 acres), which yielded an average daily evaporation loss rate of 2.64 mgd. Added to the high and low seepage calculations, an estimated range of losses from both seepage and evaporation was 33.40 mgd, or 18.20 percent of average daily water deliveries, to 67.70 percent, or 36.90 percent of average daily water deliveries. (Garret Hew, WDT, ¶ 13; Exh. C-139.) [HC&S FOF 639.]

378. The average of the high and low estimated losses from seepage and evaporation is 27.55 percent, and HC&S's losses of 22.7 percent fell below this average. (Exh. C-139.) [HC&S FOF 640.]

379. HC&S's losses of 22.7 percent included not only seepage and evaporation losses, but also miscellaneous losses such as back-flushing of filters, drip tube ruptures or breaks, animal damage, pipeline breaks, misreported irrigation (if they are not applying the correct hours to the amount that they ran), testing of systems prior to planting, or where water is taken out of the system but not accounted for in daily irrigation. (1/15/16 Proposed Decision, FOF 315.)

380. In the Nā Wai `Ehā contested case hearing, the Commission identified a number of other factors that could contribute to miscellaneous losses, describing such losses in HC&S's field operations as "plausible and reasonable factors that would significantly increase their actual irrigation requirements" and ascribing such losses as the equivalent of 5 percent of irrigation requirements. (Exh. C-120, COL 79, 90-91.)

381. Five percent of irrigation requirements would be 7.01 mgd (4,844 gad x 28,941 acres x 0.05 = 7.01) mgd, losses that are “plausible and reasonable."

382. Of HC&S's unaccounted water of 41.67 mgd, or 22.7 percent of surface water delivered and ground water pumped, *supra*, FOF 373, 34.66 mgd (41.67 mgd minus 7.01 mgd), or 18.9 percent, would be ascribed to seepage and evaporation losses. This percentage is nearly equal to the low seepage rate of 18.20 percent as calculated under USDA's standards, *supra*, FOF 377.

383. Thus, HC&S's system losses of 22.7 percent (41.67 mgd of 183.61 mgd of surface water delivered and ground water pumped) were reasonable losses under sugarcane cultivation. Because the same distribution system would be used for diversified agriculture, the same rate of 22.7 percent losses should be applicable.

c. Alternate Sources

1. Ground Water

384. HC&S's irrigation structure includes 15 brackish water wells and associated pumps with a total pumping capacity of 228 mgd, which may be used to supplement surface water to irrigate 17,200 acres of the approximately 30,000 acres serviced by waters from the EMI Ditch system. (Exh. C-33; Exh. C-35; Exh. E-76 at 3 (PDF); Garret Hew WDT, ¶ 25.) [HC&S FOF 606; Nā Moku/MTF FOF 997.]

385. The remaining 12,800 acres cannot be serviced by pumped ground water on a consistent basis. Ground water can be delivered to 7,000 acres via a shared pipeline that served as a penstock line for a hydroelectric unit for the majority of the year. This pump system was designed and built to be an emergency water source for high-elevation fields in the event of extreme drought, rather than a primary source of water. The system consists of a booster pump system that diverts primary ground water at the Lowrie Ditch level to a higher elevation. (Rick Volner, WDT, ¶ 19.) [HC&S FOF 645.]

386. The maximum instantaneous pumping capacity of wells that can service the East Maui fields is 215 mgd. However, the true instantaneous pumping capacity of the wells—i.e., the most HC&S can pump over 3 to 5 days—was 115 mgd to 120 mgd. Sump levels in the wells start to drop when pumping reaches 115 mgd to 120 mgd, especially in the summer months where there is little recharge. Further lowering of the sump levels could cause severe mechanical damage to the pumps. (Rick Volner, Tr., March 23, 2015, pp. 16-19.) [HC&S FOF 611.]

387. In contrast, by 1931, HC&S had been able to pump 144 mgd, and in dry times, pumps supplied up to 45 percent of the irrigation water. And as late as a 1996 Memorandum of Understanding between EMI, MDWS, and others, ground water was described as supplying 45 percent of HC&S's irrigation needs. (Exh. E-92, p. 121; Exh. E-110, p. 1.) [Nā Moku/MTF FOF 1126, 1129.]

388. From 2008 to 2013, HC&S pumped an annual average of 25,512 million gallons, or 69.90 mgd, for use on the East Maui fields, including mill use. (Exh. C-137, Column C.) [HC&S FOF 619.]

389. From 1986 to 2009, HC&S pumped an average of 72 mgd; and from 1986 to 2013, an average of 71 mgd. Compared to service water deliveries during these times, the amounts and percentage of totals were as follows:

	Total	Surface water/percent	Ground water/percent
1986-2013:	224 mgd	153 mgd (68%)	71 mgd (32%)
1986-2009:	239 mgd	167 mgd (70%)	72 mgd (30%)
2008-2013:	184 mgd	114 mgd (62%)	70 mgd (38%)

(Exhs. C-74, C-103, pp. 14-15, C-137.)

390. Under sugarcane cultivation, ground water contributions to total irrigation uses had remained constant at or near 70 mgd, or about half of the 1931 pumping, and about 60 percent of what HC&S claimed was the present capacity, *supra*, FOF 386-387. The percent of total rose from 30 percent in 1986 to 2009 to 38 percent in 2008 to 2013, because surface water contributions decreased from 167 mgd to 114 mgd, while ground water contributions remained the same, even though ground water contributions could have been increased by another 45 mgd to 50 mgd *supra*, FOF 386.

391. While HC&S was engaged in sugarcane cultivation, by using about 70 mgd of a ground-water usable capacity of 115 mgd to 120 mgd, HC&S had an additional ground water source of up to 45 to 50 mgd for a period of 3-5 days before sump levels in the wells start to drop, *supra*, FOF 386.

392. This potential capacity might have been less, because a reduction in surface water importation coupled with an increase in ground water pumping would have likely increased aquifer salinity levels, especially in the summer months when pumping was highest. (Exh. C-71, Appendix A, p. E-2 and exhibit E-3.) [HC&S FOF 646.]

393. It is unclear what the direct relationship is of recharge from surface water importation to the underlying groundwater aquifer. HC&S historically supplemented surface water with pumped groundwater on a seasonal basis, and on an aggregate basis, constituted between 20 to 30 percent of total water use when HC&S was cultivating sugarcane. The amount of groundwater historically used was far in excess of the published sustainable yields of the underlying aquifers, which was made possible by the large volumes of surface water. (Volner, WDT, 10/17/16, ¶ 23; Volner, Tr., 2/6/17, p. 161, ll. 9-21, p. 163, ll. 16-21.) [HC&S on reopening, FOF 387, 394.]

394. Although the crops conceptually planned for the area that can access groundwater are known to be tolerant to some levels of brackish water irrigation, the precise tolerance levels and the impacts of prolonged uses of brackish water on these crops are presently unknown. Sugarcane was by far the most tolerant crop to brackish water. When these fields were planted in sugarcane, well water was being applied during dry periods to a crop with a twenty-four-month crop cycle. The crops currently planned for those acres will generally have much shorter crop cycles than sugarcane, so they will have less time to recover from sustained periods of reliance upon brackish water during dry periods, and thus will be generally be more vulnerable to the negative impacts on crop growth associated with prolonged exposure to brackish water. As with sugarcane cultivation, the prolonged or primary use of brackish water could have additional negative impacts on soil health with the buildup of minerals and salts without adequate surface water to flush these constituents. (Volner, WDT, 10/17/16, ¶ 24; Volner, Tr., 2/6/17, p. 162, ll. 8-14.) [HC&S on reopening, FOF 389.]

395. The transition to diversified agriculture will bring several key changes that will impact the utility and reliability of brackish groundwater resources in the future—reduced recharge from lower levels of irrigation of the overlying lands, uncertain tolerance of diversified agriculture crops to heavy reliance on brackish water, the higher costs associated with well water versus surface water, and the higher economic hurdles related to higher costs of investment in new agricultural ventures versus ongoing sugar operations where the major investments had already been made. (Volner, WDT, 10/17/16, ¶ 22.) [HC&S on reopening, FOF 388.]

396. Given that the future crops will generally be less tolerant to brackish water than sugarcane and that the amount of surface water imported from East Maui is expected to be reduced to meet the amended IIFS, HC&S believes that it is not reasonable to assume that use of groundwater will be within the historical range of 20 to 30 percent of total water use and believes that a sustainable level of groundwater use will more likely be within the range of 0 to 20 percent of total water use. However, HC&S has not commissioned any expert to ascertain the brackish water tolerance or the impact of prolonged use of brackish water for any of its proposed uses. (Volner, Tr., 2/6/17, p. 163, l. 21 to p. 164, l. 1, p. 202, ll. 2-24, p. 221, l. 23 to p. 222, l. 7.) [HC&S on reopening, FOF 395; Nā Moku on reopening, FOF 97-98, 103-105.]

397. Taking into consideration the factors identified in FOF 392-396, *supra*, an analysis of what would be reasonable estimates of the groundwater alternative from HC&S's wells to EMI ditch surface water is provided on the section on "Economic Impacts," *infra*, with an estimate of

17.84 mgd or less of brackish well water, *infra*, FOF 431. This would comprise 20 percent of the estimated irrigation requirements of 89.21 mgd for the 26,996 acres of diversified agriculture, *supra*, FOF 349-350. Including system losses of 22.7 percent, *infra*, FOF 383, gross irrigation requirements would be 115.43 mgd, *supra*, FOF 349-350, of which 23.09 mgd would be brackish well water, *infra*, FOF 441.

2. Additional Reservoirs

398. Reservoirs would be most valuable as a water source in the summer months, when it's dry and HC&S's daily irrigation needs would be at their maximum. (Rick Volner, Tr., March 23, 2015, p. 33.)

399. Storing water in the existing reservoirs or lining them to reduce or eliminate seepage would not provide large amounts of new water, because in the summer months the water is not being put in the reservoirs, and if it is, it's put in and taken out relatively quickly. (Rick Volner, Tr., March 23, 2015, p. 35.)

400. The 36 reservoirs located throughout the plantation range in size from 4 million gallons to 80 million gallons, which are a total of 862 million gallons at full capacity, only a five- to ten-day supply for the approximately 12,800 acres that are serviced by these reservoirs. The reservoirs are primarily holding ponds where water is collected and distributed for irrigation or other uses on a daily basis. Only when ditch flows are high do they have the ability to store additional water. (Exh. C-68, pp. 5-6.)

401. A reservoir would need to have an extremely large storage capacity to meet demands for a prolonged period of time during the summer months when water would be the most valuable. To be of most value, a large reservoir would need to be located at the highest elevation at the head of the Wailoa Ditch, above Paia or Haliimaile, which supplies the greatest amount of water to HC&S, so as to maximize the ability of the reservoir to supply water to various parts of the plantation during dry periods. (Rick Volner, Tr., March 23, 2015, pp. 32-33.) [HC&S FOF 659.

402. In the 1960s, HC&S internally considered building such a large reservoir, but decided not to pursue it after a study indicated that a billion-gallon reservoir would provide only a 10-day supply of water. HC&S's daily water needs at that time were in the range of 200 mgd to 300 mgd, and even a billion-gallon reservoir would provide 200 mgd for only five days. (Garret Hew, Tr., March 18, 2015, p. 236; Rick Volner, Tr., March 23, 2015, P. 33.) [HC&S FOF 658.]

403. Assuming that there is a reduction of stream water and not a total cessation, smaller deficits would mean that a billion-gallon reservoir could provide, for example, 40 mgd for 25 days.

404. However, there are some complexities with how you would fill such a large reservoir. Even if the Wailoa Ditch were flowing at capacity in the summertime, it would make more sense to apply that water as quickly as possible to the fields to avoid having system losses or to reduce system losses instead of trying to store it and meter it out. (Rick Volner, Tr., March 23, 2105, pp. 34-35.)

405. Ever since the Kaloko Dam incident on Kauai, all dam structures are highly scrutinized by the state. Constructing a large dam today will require much more scrutiny, much more oversight, than previously constructed reservoirs, and community opposition would also be expected. Any dam that would be sited would be at the highest elevation possible, and that would be above either Paia or Haliimaile. (Rick Volner, Tr., March 23, 2015, p. 34.)

406. A billion-gallon reservoir is approximately 3,800 acre-feet. If the reservoir is 10 feet deep, it would occupy approximately 30 acres. It would be very difficult to site a reservoir that large at the highest elevation on the plantation. (Garret Hew, Tr. March 18, 2015, p. 98; Rick Volner, Tr., March 23, 2015, p. 33.) [HC&S FOF 660.]

407. The cost of building a billion-gallon reservoir would depend on a number of factors, including terrain, acquisition of land, and permitting. In 2009, HC&S estimated that building a billion-gallon reservoir on Maui would cost well in excess of $150 million. (Exh. C-68, p. 6.) [HC&S FOF 663.]

408. HC&S has not considered building a large number of small reservoirs at the top of the plantation, because they wouldn't have the benefit that a large reservoir at the highest elevation, the most eastward end of the plantation, would have. This would be where the largest supply comes in, the Wailoa ditch. (Rick Volner, Tr., March 23, 2015, pp. 142-143.)

3. Recycled Wastewater

409. Nā Moku/MTF proposed a number of FOF on the use of wastewater for sugarcane irrigation, based on the December 20, 2010, Central Maui Recycled Water Verification Study. (Nā Moku/MTF Proposed FOF 973-985.)

410. Nā Moku/MTF contended that "(f)unds in the County budget have been set aside for an R-1 upgrade and transmission lines at the Kahului plant. What remains to be decided is where these lines would be placed." (Nā Moku/MTF Proposed FOF 974.) No reference accompanies this proposed FOF. What is in the record is the response of Irene Bowie, Executive Director of MTF:

A. There has been ongoing conversation, and I've talked with staff in the Department of Environmental Management about funding for that, and the county has looked to put money into the budget. I believe in the 2015 budget there is money set aside.

And also Department of Transportation Airports Division was willing to put money into a line that would go to the airport.

(Irene Bowie, Tr., March 23, 2015, p. 167.)

"Funding for the distribution system could come jointly from Hawaii Department of Transportation, Airports Division, HC&S and others." (Irene Bowie, WDT, ¶ 14.) [Nā Moku/MTF FOF 976.]

411. Irene Bowie, Executive Director of MTF, makes a number of statements that do not distinguish the use of wastewater from the Kahului Wastewater Reclamation Facility ("WWRF") on HC&S's West Maui versus East Maui fields, *infra*, FOF 412-416.

412. Nā Moku/MTF contends that "Option 2 on page 8 of the Central Maui Recycled Water Verification Study proposes a distribution system from the Kahului WWRF to Kanaha Beach Park and Kahului Airport that could be extended to HC&S fields north of the airport." (Exhs. E-88, E-88-A, E-126.) (Na Moku/MTF FOF 975.]

413. However, the study proposal was for a distribution system to Kanaha Beach Park and Kahului Airport, and it was Irene Bowie's suggestion "that it could conceivably go on out to the fields in the north side of HC&S's plantation." (Irene Bowie, Tr., March 23, 2015, p. 166.)

414. The HC&S fields immediately north of the airport are irrigated by either EMI ditch water or HC&S wells. (Exh. C-35.)

415. The other options identified by Irene Bowie pertain to HC&S's West Maui fields: 1) a proposed pipeline along Kaahumanu Avenue to reach existing Maui Land and Pine ("ML&P") pipe lines that used to carry wastewater from its cannery operations to HC&S's seed cane fields; and 2) pumping R-1 water from the WWRF directly to HC&S's reservoir, are all in the West Maui fields. (Exh. C-120, FOF 506, p. 86; Exh. C-119, p. 36.)

416. In order to realize the use of WWRF R-1 water on HC&S's East Maui fields immediately north of Kahului Airport, the following must be completed: 1) upgrade of the Kahului WWRF to R-1 water capability, with an estimated cost in December 2010 of $4,965,000 (Exh. E-88, p.6);

2) a pipeline to Kahului Airport, and 3) a dedicated HC&S pipeline from that point to its East Maui fields above the airport.

417. Furthermore, there is presently only 2.95 mgd to 4.2 mgd of R-2 available on a consistent basis, and the current dry-weather flow capacity of the WWRF is 7.9 mgd. (Exh. C-119, p. 36; Exh. E-88, pp. 2, 6.)

4. Maui Land and Pine

418. Nā Moku/MTF contends that Maui Land and Pine (MLP) relied on EMI for irrigation water for 2,800 acres of its 6,000 acres, or approximately 4.5 mgd, and that 4.5 mg can be deducted from any determination of actual need for HC&S because MLP has gone out of business. (Exh. C-85, p. 32.) [Nā Moku/MTF FOF 1108-1113.]

419. However, MLP and HC&S had a transportation agreement, and not a water-use agreement, for use of the EMI transmission system to transport water MLP pumped into the EMI ditch at Nahiku for use on its pineapple fields. Furthermore, EMI/HC&S does not intend to use water from the well in the future, because the pump is small, and the cost of electricity outweighs the use of that water. (Exh. E-107; Garret Hew, Tr., March 18, 2015, pp. 165-166.) [Nā Moku/MTF FOF 1109-1110, 113.]

d. Economic Impact

420. Under sugarcane cultivation, of the approximately 30,000 acres served by the EMI Ditch system, approximately 12,800 acres were entirely dependent on surface water—except for 7,000 acres that can be irrigated with brackish well water in the event of extreme drought through a booster pump system—while the remaining approximately 17,200 acres could also be served from brackish water wells, *supra*, FOF 384-385.

421. Under full buildout of the Diversified Agricultural Plan, approximately 9,143 acres will only have access to surface water, and 17,853 acres to both surface and brackish well water, *supra*, FOF 349-350.

422. Under sugarcane cultivation, brackish well water had contributed about 70 mgd, representing about 30 percent of total irrigation from 1986 to 2009 and rising to 38 percent of

total irrigation from 2008 to 2013, because surface water contributions had decreased from 167 mgd to 114 mgd during the same time periods, *supra*, FOF 389-390.

423. But the percent of brackish water on the approximately 17,200 acres of sugarcane fields that had access to well water would have been much higher than 38 percent. Of the 132 mgd total irrigation water, *supra*, FOF 316, 43 percent (12,800 acres/30,000 acres), or 57 mgd, would have been used on the approximately 12,800 acres that had access only to surface water, leaving 75 mgd of surface water to be used with 70 mgd of brackish well water on the remaining 17,200 acres.[28] Thus, when brackish water comprised 38 percent of total irrigation, it comprised 48 (70/145) percent of the water applied on the acres on which it could be used.

424. The estimated requirements under full buildout of the Diversified Agricultural Plan are 28.28 mgd for the 9,143 acres with access only to surface water, and 60.93 mgd for the 17,853 acres with access to both surface and well water, *supra*, FOF 349-350, for a total of 89.21 mgd.[29]

425. If we assume that the same historical use of 70 mgd of brackish well water is used, that would require only 19.21 mgd of surface water, or 60.6 percent brackish well water and 39.4 percent surface water, about double the percent of brackish well water used for sugarcane cultivation, *supra*, FOF 422.

426. Moreover, only 19.21 mgd of surface water would be available for the 28.28 mgd required on the 9,143 acres with access only to surface water, leaving none for the remaining 17,853 acres. As a result, a large percent of the 9,143 acres would not be irrigated, and while 70 mgd of brackish water would be available for the 60.93 mgd required for the 17,853 acres, 100 percent of irrigation requirements would come from brackish well water.

427. If the same proportion is used as was historically applied in sugarcane cultivation, or 30-38 percent, *supra*, FOF 422, of the total estimated irrigation requirements of 89.21 mgd, at 30 percent brackish water of total water, 26.76 mgd would be brackish water, and 62.45 mgd would be surface water. At 38 percent, brackish water would be 33.90 mgd, and surface water would be 55.31 mgd. However, again, 28.28 mgd of the surface water would have to be applied to 9,143 acres with access only to surface water: a) at 30 percent brackish water of total water: leaving 34.17 mgd (62.45 – 28.28) mgd of surface water for use with 26.76 mgd of brackish water on the remaining 17,853 acres, or 44 percent brackish water; and b) at 38 percent brackish water of total

[28] The actual acreage in sugarcane cultivation was 28,941 acres of the approximately 30,000 acres with access to EMI ditch water.

[29] The estimated gross irrigation requirement was 115.43 mgd, but that included system losses.

water: leaving 27.03 (55.31 – 28.28) mgd of surface water for use with 33.90 mgd of brackish water, or 61 percent brackish water.

428. Under sugarcane cultivation, when 70 mgd of brackish water was 38 percent of total water, brackish water was 48 percent on the fields with access to both surface and well water, *supra*, FOF 423. Under diversified agriculture, there would be 100 percent brackish water on the fields with access to both surface and well water when well water was 70 mgd; 61 percent brackish water when well water was 38 percent of total water; and 44 percent brackish water when well water was 30 percent of total water.

429. Volner of HC&S was of the opinion that, given that the future crops will generally be less tolerant to brackish water than sugarcane and that the amount of surface water imported from East Maui is expected to be reduced to meet the amended IIFS, it is not reasonable to assume that use of groundwater will be within the historical range of 20 to 30 percent of total water use and believes that a sustainable level of groundwater use will more likely be within the range of 0 to 20 percent of total water use, *supra*, FOF 397.

430. At 20 percent of total water use, brackish water would comprise 17.84 mgd of the total requirement of 89.21 mgd. 28.28 mgd of the 71.37 (89.21 – 17.84) mgd of surface water would be used on 9,143 acres with access only to surface water, and 43.09 (71.37 – 28.28) mgd would be left for the 17,853 acres with access to both surface and well water. Thus, of the 60.93 mgd required for the 17,853 acres, 17.84 (60.93 – 43.09) mgd, or 29 percent, would be brackish water, and 55.75 mgd, or 71 percent, would be surface water. This is compared to 48 percent brackish water when sugarcane was being irrigated, *supra*, FOF 423.

431. To summarize:

a. Total sugarcane irrigation used 70 mgd of brackish water, which was 30 percent of total irrigation from 1986-2009, rising to 38 percent in 2008-2013. On those fields with access to both surface and brackish water, the percent of brackish water was 48 percent from 2008-2013, *supra*, FOF 423.

b. For diversified agriculture:

i. If 70 mgd of brackish water is used as was historically used for sugarcane irrigation, of the 89.21 mgd water requirements for diversified agriculture, the percent of brackish water for total requirements would be 78 percent, only 19.21 mgd of surface water would be available for the 28.28 mgd required on the 9,143 acres with access only to surface water, leaving none for the remaining 17,853 acres. As a result, a large percent of the 9,143 acres would not be irrigated, and while 70 mgd of brackish water would be available for the 60.93 mgd required for the 17,853 acres, 100 percent of irrigation requirements would come from brackish well water, *supra*, FOF 425-426.

ii. For fields with access to both surface and brackish water, the amounts of brackish water that would represent lower percentages than the 48 percent when sugarcane was being irrigated would be: 1) 26.76 mgd, which represents 30 percent of total water and 44 percent on fields with access to both surface and well water; and 2) 17.84 mgd, which represents 20 percent of total water and 29 percent on fields with access to both surface and well water, *supra*, FOF 427-430.

432. The Wailoa Ditch and Kauhikoa Ditch (from the New Hamakua Ditch), the two uppermost ditches, irrigated the approximately 12,800 acres of former sugarcane lands with access only to surface water, and the lower ditches, the Lowrie Ditch and Haiku Ditch, irrigated the remaining 17,800 acres that had access to both surface and well water. Water from the two upper ditches can be dropped down to the two lower ditches. (Volner, WDT, 12/30/14, ¶¶ 68-69; Hew, WDT, 12/30/14, ¶ 28; Hew, Tr., March 18, 2015, p. 144; *See* Exh. C-33, attached.)

433. Under the Diversified Agricultural Plan, the 9,143 acres with access only to surface water would be served by the Wailoa and Kauhikoa Ditches, and the 17,853 acres with access to both surface and well water would be served primarily by the Lowrie and Haiku Ditches. Reduced deliveries to the Wailoa Ditch and Kauhikoa Ditch would reduce water available to irrigate the 9,143 acres that cannot be irrigated with ground water; and reduced deliveries to the Lowrie Ditch and Haiku Ditch could be compensated for by dropping water down from the Wailoa and Kauhikoa Ditches or by increased pumping of brackish ground water, although limited by the amount of brackish water that could be applied to crops less tolerant of brackish water than sugarcane, *supra*, FOF 431. (*See also* Exh. C-33 for the HC&S water distribution system west of Maliko Gulch.)

434. The estimated gross requirements (including system losses) under full buildout of the Diversified Agricultural Plan are 36.59 mgd for the 9,143 acres with access only to surface water, and 78.84 mgd for the 17,853 acres with access to both surface and well water, for a total of 115.43 mgd *supra*, FOF 349-350.

435. Therefore, if and when the Diversified Agricultural Plan is fully built out, 36.59 mgd would be required from the Wailoa and Kauhikoa ditches.

436. From FY 2010-2011 to 2013-2014, at Honopou Stream, the western end of the four EMI-State Watershed leases, the Wailoa Ditch averaged 83.06 mgd, and the New Hamakua Ditch (Kauhikoa Ditch) averaged 11.67 mgd, with additional amounts diverted from the streams between Honopou Stream and Maliko Gulch, *supra*, FOF 74. (Exh. C-16.[30])

437. Therefore, about 39 percent (36.59 mgd/94.73 mgd) of the flows from the four EMI-State Watershed leases in the Wailoa and Kauhikoa Ditches would satisfy the projected, full buildout of the Diversified Agricultural Plan's 9,143 acres that are entirely dependent on surface water.

438. The 17,853 acres with access to both surface and well water, for which 78.84 mgd of a combination of surface and well water would be required, are served primarily by the Lowrie and Haiku Ditches, *supra*, FOF 433-434.

439. From FY 2010-2011 to 2013-2014, at Honopou Stream, the western end of the four EMI-State Watershed leases, the Lowrie Ditch averaged 10.69 mgd, and the Haiku Ditch averaged 3.47 mgd, for a total of 14.16 mgd, with additional amounts diverted from the streams between Honopou Stream and Maliko Gulch, *supra*, FOF 74. (Exh. C-16.)

440. Without supplemental surface water dropped down from the Wailoa and Kauhikoa Ditches, using all of the 14.16 mgd of surface water from the Lowrie and Haiku Ditches originating from the leased lands would require 64.68 mgd of brackish well water. This would be equivalent to 56 percent (64.68 mgd/115.43 mgd) of total requirements and 82 percent (64.68 mgd/78.84 mgd) of requirements for the 17,853 acres with access to both surface and well water.

441. If brackish well water were 20, 30, or 38 percent of total gross requirements of 115.43 mgd, brackish water would be 29 (23.09/78.84) , 44 (34.62/78.84), or 56 (43.86/78.84)percent, respectively, of the 78.84 mgd irrigation requirements for the 17,853 acres with access to both surface and well water, *supra*, FOF 428, 430.

442. With brackish water at 29 percent of 78.84 mgd, 55.75 mgd of surface water would be needed; at 44 percent, 44.22 mgd of surface water would be needed; and at 56 per cent, 34.69 mgd of surface water would be needed. The Lowrie and Haiku Ditches could provide only 14.16 mgd, *supra*, FOF 439, so an additional 41.59, 30.06, or 20.53 mgd would have to be dropped down from the Wailoa and Kauhikoa Ditches.

443. Added to the 36.59 mgd that would irrigate the 9,143 acres that are entirely dependent on surface water, total surface water needed would be: a) 92.34 mgd (36.59 mgd + 55.75 mgd): with

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[30] Ditch flows are measured by monthly and yearly flows, and they have been converted into mgd. For example, for the Wailoa Ditch, yearly flows were 25,398, 35,875, 32,695, and 27,300 million gallons, for a total of 121,268 million gallons, for an average of 30,317 million gallons a year. Divided by 365 days results in 83.06 mgd.

brackish water at 29 percent on the fields that have access to both surface and well water; b) 80.81 mgd (36.59 mgd + 44.22 mgd): with brackish water at 44 percent on fields that have access to both surface and well water; and c) 71.28 mgd (36.59 + 34.69): with brackish water at 56 percent on fields that have access to both surface and well water, *supra*, FOF 441.

444. An average of 108.89 mgd was diverted from the four EMI-State Watershed leases through the four ditches during 2010-2011 to 2013-2014, *supra*, FOF 436, 439. Even the scenario with the least amount of brackish water (29%) on the fields that have access to both surface and well water in FOF 443, *supra*, would use less surface water than was available: 92.57 mgd versus 108.89 mgd available surface water from the lease lands.

445. During this same period, an additional 8.59 mgd was added to the ditches from the streams between Honopou Stream and Maliko Gulch. This amount represented 7 percent of the flows arriving at Maliko Gulch, with 93 percent originating from the four EMI-State Watershed lease areas.

Fiscal Year[31]	Maliko Gulch	Honopou Stream	Difference
2010-2011	100.64 mgd	92.58 mgd	8.06 mgd
2011-2012	140.89 mgd	132.96 mgd	7.93 mgd
2012-2013	129.17 mgd	116.59 mgd	12.58 mgd
2013-2014	99.21 mgd	93.44 mgd	5.77 mgd
Average:	117.48 mgd	108.89 mgd	8.59 mgd

(Exhs. C-16, C-34.)

446. If brackish well water were 20, 30, or 38 percent of total requirements, brackish water would be 29, 44, or 56 percent, respectively, of the 78.84 mgd irrigation requirements for the 17,853 acres with access to both surface and well water, *supra*, FOF 441.

447. Subtracting the 8.59 mgd added to the ditch system after Honopou Stream from the surface water needed under the three scenarios, *supra*, FOF 446, surface water required from the four lease areas would decrease from 92.34 mgd to 83.75 mgd, from 80.81 mgd to 72.22 mgd, and from 71.28 mgd to 62.69 mgd, respectively, *supra*, FOF 443.

448. In sum, assuming a gross irrigation requirement of 115.43 mgd for diversified agriculture after full buildout of 26,996 acres, of which approximately 9,143 acres would only have access

[31] Ditch flows at Honopou Stream were reported by fiscal years ending on June 30 (Exh. C-16, C-17, p.1), while ditch flows at Maliko Gulch were reported by month and year. Therefore, the Maliko Gulch measurements were converted to a year consisting of July 1 to June 30 of the following year; e.g. July 1, 2010 to June 30, 2011 for FY 2010-2011.

to surface water, and 17,853 acres would have access to both surface and brackish well water, *supra*, FOF 349-350, 421:

a. If brackish well water were 20, 30, or 38 percent of total requirements, brackish water would be 29, 44, or 56 percent, respectively, of the 78.84 mgd gross irrigation requirements for the 17,853 acres with access to both surface and well water, *supra*, FOF 441;

b. After subtracting the 8.59 mgd of waters arriving at Maliko Gulch that are diverted from streams after the EMI-State lease lands that end at Honopou Stream:

i. if brackish well water were 23.09 mgd (20% of total water), 83.75 mgd (92.34 - 8.59) of the 108.89 mgd diverted from the EMI-State lease lands would be required;

ii. if brackish well water were 34.62 mgd (30% of total water), 72.22 (80.81 – 8.59) mgd of the 108.89 mgd diverted from the EMI-State lease lands would be required;

iii. if brackish well water were 43.86 mgd (38% of total water), 62.98 (71.28[32] – 8.59) mgd of the 108.89 mgd diverted from the EMI-State lease lands would be required, *supra*, FOF 443.

449. Finally, when sugarcane was being cultivated, HC&S had estimated that current pumping costs were $439/mgd into the Lowrie Ditch and $205/mgd into the Haiku Ditch. (1/15/16, Proposed Decision, FOF 442.) Therefore, current pumping costs would be: a) 23.09 mgd: $4773 to $10,137 per day; b) 34.63 mgd: $7,099 to $15,202 per day; and c) 43.86 mgd: $8,991 to $19,255 per day.

2. MDWS

a. Uses

450. MDWS is the sole municipal water provider for the County of Maui. The MDWS Upcountry Water System serves the communities of Kula, Haiku, Makawao, Pukalani, Haliimaile, Waiakoa, Keokea, Waiohuli, Ulupalakua, Kanaio, Olinda, Omaopio, Kula Kai, and Pulehu. (David Taylor, WDT, David Taylor, Tr., March 11, 2015, p. 41.) [MDWS FOF 13.]

[32] Sum of 43.86 mgd well water and 71.28 mgd surface water is 115.14 mgd and not 115.43 mgd because of rounding.

451. The population served by the MDWS upcountry system is projected at 35,251 people and includes several businesses, churches, Kamehameha Schools, Hawaiian Homelands, and government facilities. By 2030, the population is anticipated to grow by about 8,424 to a total of 43,675. (Michele McLean, WDT, ¶5; Exh. B- David Taylor, WDT, ¶ 6; David Taylor, Tr., March 11, 2015, p. 41; Michele McLean, Tr., March 12, 2015, pp. 120-127; Exhs. B-1, B-18, B-58.) [MDWS FOF 15, 34.]

452. Approximately 60 percent of MDWS's system is used domestically, and the remaining 40 percent for agricultural purposes. (David Taylor, WDT, ¶ 17; Exh. B-2, pp. 1-2; David Taylor, Tr., March 11, 2015, pp. 44-47.) [MDWS FOF 21.]

453. Approximately 80 to 90 percent of the water delivered within the upcountry system comes from surface water sources, either directly or by way of various raw water storage facilities. (David Taylor, WDT, ¶¶ 7-8, 18; Exh. B-2, Table 2; David Taylor, Tr., March 11, 2015, p. 44.) [MDWS FOF 20.]

454. MDWS relies on three surface water sources, one of which is delivered by EMI through the Wailoa Ditch, and the other two through two MDWS higher-elevation aqueducts maintained by EMI that transport water to Olinda and Kula, under a contractual agreement originated under the 193 East Maui Water Agreement and subsequent agreements. (Exhs. B-5, B-6, B-7, C-3.) [Na Moku/MTF FOF 844.]

455.

Water Treatment Plant ("WTP")	Elevation	Conveyance System	Production Capacity	Average Production
Olinda	4,200 feet	Upper Kula Flume	2.0 mgd	1.6 mgd
Piiholo	2,900 feet	Lower Kula Flume	5.0 mgd	2.5 mgd
Kamole-Weir	1,120 feet	Wailoa Ditch	6.0 mgd	3.6 mgd

(David Taylor, WDT, ¶ 9-11; David Taylor, Tr., March 11, 2015, p. 47; Exh. B-3, pp. 24-25; Exh. B-16, pp. 6-7.) [MDWS FOF 23-25; Nā Moku/MTF FOF 844.]

456. The Olinda facility diverts water from the Waikamoi, Puohokamoa, and Haipuaena streams. Water is stored in the 30-million gallon Waikamoi Reservoirs (two, at 15 million gallons each) and the 100-million gallon Kahakapao Reservoir. (David Taylor, WDT, ¶ 11; Exh. B-3, p. 25; David Taylor, Tr., March 11, 2015, p. 47.) [MDWS FOF 25.]

457. The Piiholo facility diverts water from the Waikamoi, Puohokamoa, Haipuaena, and Honomanu streams into the 50-million gallon Piiholo Reservoir. (David Taylor, WDT, ¶ 10; David Taylor, Tr., March 11, 2015, p. 47; Exh. B-3, p. 25.) [MDWS FOF 24.]

458. The Kamole-Weir facility, which has no reservoir, relies on water from the Wailoa Ditch, which diverts water from Honopou, Hanehoi, Puolua, Alo, Waikamoi, Puohokamoa, Haipuaena, Kolea, Punalau, Honomanu, Nuaailua, Piinaau, Paluhulu, East and West Wailuanui, West Wailuaiki, East Wailuaiki, Kopiliula, Puakaa, Waiohue, Paakea, Waiaaka, Kapaula, Hanawi, and Makapipi streams. (David Taylor, WDT, ¶ 9; David Taylor, Tr., March 11, 205, p. 47; Exh. B-3, p. 24.) [MDWS FOF 23.]

459. Besides its customers on the Upcountry Water System, *supra*, FOF 450, MDWS also provides non-potable water to the Kula Agricultural Park ("KAP") through diversions from the same streams which serve the Kamole-Weir WTP through the Wailoa Ditch. Water is stored in two reservoirs with a total capacity of 5.4 million gallons. KAP consists of 31 farm lots ranging in size from 7 to 29 acres, and which are owned by the County of Maui. The individual lots are metered and billed by MDWS. (David Taylor, WDT, ¶ 13; Exh. B-4.) [MDWS FOF 27.]

460. MDWS receives its surface water under a series of contracts with EMI. The original contract was entered into in 1961, and the "Master Water Agreement" was replaced by a 1973 "Memorandum of Understanding" as the primary contract, which had a term of 20 years. Since its expiration, there have been a total of 8 extensions, and after the lapse of the most recent extension, water has continued to be provided through a "Memorandum of Understanding Concerning Settlement of Water and Related Issues" dated April 13, 2000 ("MOU"). (David Taylor, WDT, ¶15; Exhs. B-5 to B-15.) [MDWS FOF 29.]

461. The MOU provides that MDWS will receive 12 mgd with an option for an additional 4 mgd, for a total of 16 mgd. During low-flow periods, the County and HC&S will both receive a minimum allotment of 8.2 mgd. If these minimum amounts cannot be delivered, MDWS and HC&S will receive prorated shares of the water that is available. (David Taylor, WDT, ¶ 15; David Taylor, Tr., March 11, 2015, pp. 53-54; Exh. B-15.) [MDWS FOF 30.]

462. Approximately 80 to 90 percent of the water delivered within the upcountry system comes from surface water sources, *supra*, FOF 453, with the remaining 10 to 20 percent coming from a series of basal aquifer wells. The Haiku Well can produce 0.5 mgd, the Pookela Well, 1.3 mgd, and the two Kaupakalua wells, 1.6 mgd, for a total of 3.4 mgd. (Exh. B-16, p. 8.) [Na Moku/MTF FOF 850.]

463. In times of emergency, MDWS may also draw 1.5 mgd from the Hamakuapoko Wells. This water, however, is only available during times of emergency due to concerns over pesticides from former pineapple production. (David Taylor, Tr., March 11, 2015, pp. 61-62.)

464. The combined surface and ground water sources have a production capacity of 17.9 mgd: 13.0 mgd from surface water, *supra*, FOF 455, and 4.9 mgd from ground water (including 1.5 mgd in emergencies from the Hamakuapoko wells), *supra*, FOF 462-463.

465. However, due to occasional maintenance requirements and limitations on the use of the Hamakuapoko Wells, reliable capacity stands at 9.1 mgd. This is premised on the following sources not being available: 1) the largest surface-water facility, the Kamole-Weir at 6.0 mgd production capacity; 2) the Pookela Well at 1.3 mgd production capacity; and 3) Hamakuapoko Wells at 1.5 mgd, which is only available at times of emergency. These three sources total 8.8 mgd, potentially reducing total production capacity of 17.9 mgd to 9.1 mgd. (David Taylor, Tr., March 12, 2015, pp. 68-69.)

466. Customer usage based on meter readings between 2004 and 2013 average 7.9 mgd, varying between 6 mgd and 10 mgd. (Exhs. B-2; B-16, p. 3, table 3; B-21, p. 14, figure 1.) [MDWS FOF 33.]

467. There are currently 9,865 water connections to the Upcountry System. As of June 30, 2014, there were 1,852 applicants on the County's waiting list for new water connections. MDWS contends that if all were connected to the Upcountry System, water demand would increase by approximately 7.5 mgd, or 95 percent of current usage of 7.9 mgd, *supra,* FOF 466. However, because of the high cost of these connections, approximately half of the applicants who have been offered new meters have declined, and MDWS anticipates that this trend will continue, leaving demand at about 3.75 mgd. For the purposes of planning for the development of infrastructure, however, MDWS relies upon the full amount of this projected need due to uncertainties in anticipating future needs. (David Taylor, WDT, ¶¶ 20-23; Taylor, Tr., 2/8/17, p. 375, l. 13 to p. 376, l. 25.) [MDWS on reopening, FOF 471.)

468. MDWS explained that its current 9,865 water connections use an average of 7.9 mgd, and it expects that the additional 1,852 applicants, if meters are granted, would increase usage by 7.5 mgd, or 95 percent, because some of those applicants are asking for multiple meters for subdivisions. Therefore, 1,852 applicants represent many, many more actual meters. Staff engineers went through each of the applications, did an estimate for each one, and came up with the increased usage of 7.5 mgd. (David Taylor, Tr., March 11, 2015, p. 67-69.)

469. MDWS also expects that by 2030 the population of the area served by the Upcountry System will grow by about 8,424, from 35,251 to 43, 675, with a predicted additional need for water of 1.65 mgd. (Michele McLean, WDT, ¶ 5; Michele McLean, Tr., March 12, 2015, pp. 120-127; David Taylor, WDT, ¶ 24; David Taylor, Tr., March 11, 2015, pp. 76-78; Exhs. B-1; B-2, amended table 5; B-16, table 3;B-18; B-58.) [MDWS FOF 34-35.]

470. MDWS anticipates that it will need to develop between 4.2 mgd and 7.95 mgd to meet demands through 2030, including present use, expected increased demand due to population growth, and a percentage of new connections from the current priority list for meters. (David Taylor, WDT, ¶ 25.)

b. Losses

471. The 1.1-mile Waikamoi Flume transports surface water from the intakes at Waikamoi, Puohokamoa, and Haipuaena streams to the Olinda WTP. Water is stored in the 30-million gallon Waikamoi Reservoirs (two, at 15 million gallons each) and the 100-million gallon Kahakapao Reservoir, *supra*, FOF 456.

472. Over the years, the Waikamoi Flume became so leaky that MDWS estimated it lost as much as 40 percent of total flow through cracks and holes along its whole length. (Exh. B-54, pp. 27-29; Exh. E-114, p. 8.) [Nā Moku/MTF FOF 907-908.]

473. MDWS could not measure actual losses, because it had no mechanism for quantifying water levels at either the intake or discharge sites of the Waikamoi Flume. (David Taylor, First Supplemental Declaration, ¶ 5.) [Nā Moku/MTF FOF 911.]

474. If the reliable capacity of the Olinda WTP is the reported 1.6 mgd, *supra*, FOF 455, then the flume could have wasted as much as 0.64 mgd (1.6 mgd x 0.40) at that level of operation. (Nā Moku/MTF FOF 910.)

475. MDWS has just completed replacing the entire Waikamoi Flume. (David Taylor, Tr., March 11, 2015, pp. 55-59.)

476. Because the new flume isn't going to be leaking, MDWS assumes that everything going in will come out. They measure the reservoir levels every day, and also know how much water is taken out to the water treatment plant. So MDWS will be able to calculate how much water is coming from the flume on days when the main intake from the dam is dry, which is most of the days. All of the water coming in will be from the flume, so MDWS will be able to quantify how

much water comes in from the flume most of the time. (David Taylor, Tr., March 11, 2015, p. 60.)

477. There is no way to accurately compare intake versus outtake of the Waikamoi Flume prior to versus completion of the replacement flume. (David Taylor, Tr., March 11, 2015, p. 60.)

478. Further, the two 15 million-gallon Waikamoi reservoirs as well as the 2 million-gallon on-site basin at the Olinda WTP have just been relined. (David Taylor, Tr., March 11, 2015, p. 54-55.)

c. Alternate Sources

479. MDWS has no plans to drill new production wells to serve the Upcountry areas at the present time. They are very expensive, use a lot of energy, and there are some legal and procedural difficulties:

1. Water is very heavy, so moving it to higher elevations takes a lot of energy. Because a lot of the Upcountry System is at 1,000 to 4,000 feet and the basal aquifer is roughly at sea level, moving water is projected to cost $1.64 per thousand gallons for distribution from the Kamole-Weir WTP, $4.07 per thousand gallons at the Piiholo WTP, and $5.93 per thousand gallons at the Olinda WTP. On top of pumping costs, increased reliance on ground water sources would require substantial initial capital expenditures and on-going maintenance. Ground water development also involves risks due to the uncertainty of the quantity and quality of water that will be present. MDWS's current charges for water only average about $4 per thousand gallons, so just the electrical costs is more than what MDWS charges overall for its entire operation. (David Taylor, Tr., March 11, 2015, pp. 62-65; David Taylor, Tr., March 12, 2015, pp. 17-19, 52; Exh. B-16, pp. 10, 14, 16.) [MDWS FOF 39-43.]

2. MDWS has entered into a Consent Decree in the case of Coalition to Protect East Maui Water Resources v. Board of Water Supply, County of Maui, Civil No. 03-1-0008(3), December 2003, which requires that MDWS conduct vigorous cost/benefit analyses of other water source options before developing ground water in the East Maui region. On several occasions, MDWS has tried but been unsuccessful in working within the framework of the consent decree to develop new ground water sources. (David

Taylor, WDT, ¶¶ 29-30; David Taylor, Second Supplemental Declaration, ¶¶ 26-28; David Taylor, Tr., March 11, 2015, pp. 64-65; Exhs. B-19, B-20, B-52.

480. New raw water storage facilities, which would be fed by streams in times of water surplus for use during times of low flows, are an additional means by which MDWS could mitigate the effects of stream flow restoration:

1. Currently, MDWS is considering construction of a 100- to 200-million gallon reservoir at the Kamole-Weir WTP, which has no reservoir, *supra*, FOF 458, and has allocated $1.5 million in its FY2015 budget toward land acquisition for a possible reservoir. The total six-year estimated cost for the project is $25.25 million. No money has been allocated for design or construction. (David Taylor, First Supplemental Declaration, ¶¶ 10-11; David Taylor, Second Supplemental Declaration, ¶ 24; David Taylor, Tr., March 11, 2015, pp. 50-53; Exhs. B-16, p. 13 table 13; E-124.) [MDWS FOF 45-46.]

2. Like new basal groundwater source development, development of new raw water storage would require significant initial capital expenditures and on-going maintenance costs. (David Taylor, Tr., March 12, 2015, pp. 19-24; Exh. B-16, pp. 14, 16 table 4.) [MDWS FOF 47.]

481. Raw water storage at the Kamole WTP is more cost-effective than providing backup capacity by extensive additions of basal groundwater wells, which require high long-term energy expenditures. (Exh. E-147, p. 48.) [Nā Moku/MTF FOF 952-953.]

482. Reservoirs mitigate fluctuations in both stream flow and consumer demand, and mitigations in fluctuations in stream flow allow more of it to be used at the proper time; i.e., during drier times when it is most needed for irrigation, by making more water available without simultaneously taking directly from the water source being protected. (David Taylor, WDT, ¶ 10; Richard Mayer, Supplemental Declaration, ¶¶ 13-14.) [Nā Moku/MTF FOF 949-950.]

d. Economic Impact

483. A study conducted for the Draft "Maui Water Use and Development Plan ("WUDP") Upcountry Final Strategies Report" (July 25, 2009) examined the impacts of amended IIFS on drought period reliable capacity at the Kamole-Weir water treatment plant. (Exh. E-130.)

484. In 2014, MDWS also commissioned an engineering analysis of the impact to MDWS if the County's use of East Maui surface water were reduced or eliminated, based on documents provided by MDWS, including the July 25, 2009 Draft WUDP for MDWS's Upcountry System. (Exh. B-16.)

485. The 2014 review and analysis compared new groundwater sources versus construction of raw water storage reservoirs to mitigate Upcountry drought conditions. New reservoirs carry high capital costs but have lower operation and maintenance costs compared to groundwater wells. New wells carry relatively lower capital costs but also require transmission and storage improvements to be integrated into the existing water delivery systems, have risks associated with the uncertainty of the quantity and quality of water that will be present, and have higher operational costs due to the costs of pumping ground water from basal aquifers at sea level to the Upcountry system. (Exh. B-16, p. 14.)

486. Life-cycle cost comparisons were made, with new ground water sources and construction of storage reservoirs carrying similar life-cycle costs. Life-cycle costs incorporate capital, operating, and maintenance costs over a defined planning period and include inflationary effects. Over a 25-year period, both new ground water wells and reservoirs would cost about $33-$35/thousand gallons, for a total of $250 to $260 million for each strategy. (Exh. B-16, p. 15.)

487. The Kamole-Weir WTP has no storage reservoir, while both the Olinda and Piiholo WTPs have reservoirs, *supra*, FOF 456-458. The Kamole-Weir WTP has a production capacity of 6 mgd and an average production of 3.6 mgd, *supra*, FOF 455.

488. Under the MOU between EMI and MDWS, MDWS can receive 12 mgd with an option for an additional 4 mgd, for a total of 16 mgd. During low-flow periods when ditch flows are greater than 16.4 mgd, both will receive a minimum allotment of 8.2 mgd. If these minimum amounts cannot be delivered, both will receive prorated shares of the water that is available, *supra*, FOF 460-461. In recent periods of low Wailoa Ditch flow, EMI has not restricted the allotment of water to MDWS according to the terms of the agreement, and MDWS withdrawals have been limited only by the amounts of water available in the ditch and the physical limitations of the existing Kamole-Weir WTP intake structures. During drought conditions, MDWS may withdraw 6 mgd, and what remains is used by HC&S for irrigation. (Exhs. E-130, p. 4; Exh. B-16, p. 10.)

489. For the period 1922 to 1987, flows in the Wailoa Ditch exceeded 40 mgd more than 90 percent of the time and exceeded 20 mgd more than 99 percent of the time. (Exh. E-130, p. 4.)

490. Assuming a drought period exists if water available to MDWS is less than the 6 mgd capacity of the Kamole-Weir WTP, recent existing reliability was 4.5 mgd drought period yield, with raw water requirements assumed to be 5.0 mgd to provide 4.5 mgd of potable water capacity.[33] (Exh. E-130, p.6.)

4691. For the 23,680-day period of record from 1922 to 1987, assuming a daily withdrawal of 5.0 mgd from the Wailoa Ditch, there was deficient water on 54 days (0.23 percent of the time) with a maximum of 16 consecutive days of deficiency. (Exh. E-130, p. 7.)

492. For the ten-year period 2001 to 2011, the number of days when the Wailoa Ditch flow was less than 20 mgd was 50 days, and the longest continuous span of no flow was 5 days. (Exh. B-16, p. 11 table 12.)

493. There would be little or no impact if Wailoa Ditch flows were reduced 15 mgd. MDWS would not have full access to the 6 mgd capacity of the Kamole-Weir WTP for 5 days, the same as for the period 2001 to 2011, *supra*, FOF 492, and less than the maximum of 16 days for the period 1922 to 1987, *supra*, FOF 491. (David Taylor, Tr., March 11, 2015, pp. 145-146; Exh. B-16, p. 16.)

494. With a 20 mgd reduction in Wailoa Ditch flow and assuming a daily drought period withdrawal of 5.0 mgd, *supra*, FOF 490, there would not be sufficient water to provide reliable drought period capacity without some mitigating actions. For a 23,680 day period, *supra*, FOF 491, 5.0 mgd would not be able to be withdrawn for 822 days or 3.47 percent, with 54 consecutive days of deficiency. (Exh. E-130, p. 9.)

495. Note, however, that the deficiency only means that 5 mgd could not be withdrawn. Lesser amounts could still be withdrawn from the Wailoa Ditch. Furthermore, while the study defined drought period deficiency as being less than 4.6 mgd of a total capacity of 6 mgd, actual use from the Kamole-Weir WTP has been 3.6 mgd out of the total capacity of 6 mgd, *supra*, FOF 455.

496. With the addition of a 100-million gallon reservoir at the Kamole-Weir WTP, the drought period reliable yield with the 20 mgd reduction in Wailoa Ditch flow would be 4.6 mgd, approximately equal to the existing WTP reliable yield without reductions in ditch flows. (Exh. E-130, p. 10.)

497. With a 200-million gallon reservoir, the drought period reliable yield with the 20 mgd reduction in Wailoa Ditch flow increases to 7.1 mgd, an increase of 2.4 mgd compared to a 100-

[33] The study uses 4.5 mgd or 4.6 mgd for various reasons. 4.6 mgd will be used to simplify the discussion.

million gallon reservoir and greater than the total capacity of 6 mgd of the Kamole-Weir WTP. (Exh. E-130, p. 10.)

498. Estimated costs of a 100- to 200-million reservoir at the Kamole-Weir WTP are $25.25 million, *supra*, FOF 480, and life-cycle costs over 25 years are estimated at $33 per thousand gallons or $250 million, *supra*, FOF 486. (Exh. B-16, p. 15.)

M. Future Land Use of the Central Maui Fields

499. The lands that had been utilized by HC&S for sugar cultivation are predominantly zoned as Agricultural District and are situated in the State Agricultural District. (McLean, WDT, /16, ¶ 4.) [MDWS on reopening, FOF 503.]

500. The use of land designated as Agricultural District is limited to agriculture; land conservation; agricultural parks; animal and livestock raising (including animal feed lots and sales yards); private agricultural parks; minor utility facilities; retention, restoration, rehabilitation, or improvement of buildings, sites, or cultural landscapes of historical or archaeological significance; or solar energy facilities. Accessory uses are allowed but must be "incidental or subordinate to, or customarily used in conjunction with" one of the allowed uses. (Maui County Code ("MCC") §§ 19.30A.050(A), (B).) [MDWS on reopening, FOF 505.]

501. The minimum lot area for property zoned Agricultural District is two acres, with a minimum width of 200 feet; the size of farm dwellings is limited to 10% of the total lot area with a maximum height of 30 feet; and while agricultural lots may be subdivided, there are limits on the maximum number of subdivided lots. (MCC §§ 19.30A.030(A), (B), (D), (E), (G).)).) [MDWS on reopening, FOF 507.]

502. The Countywide Policy Plan ("CPP") was adopted in 2010 to provide an over-arching values statement and policy framework for development of the Maui Island Plan/General Plan 2030 and the community plans. The CPP sets forth "a series of broad themes and goals, each supported by more specific objectives, policies and implementing actions." (Aoki, WDT, 10/17/16, ¶ 5; Exh. B-064, p. 43.) [MDWS on reopening, FOF 508.]

503. Core principles of the CPP include:

a. to "protect the natural environment" to "improve the opportunity to experience the natural beauty and native biodiversity of the islands for present and future generations" through policies that "protect and provide ongoing care for important scenic vista, view plances, landscapes and open-space resources";

b. to "promote sustainable land use and growth management," with the objective to "improve planning for and management of agricultural land and rural areas" through policies that "protect prime, productive, and potentially productive agricultural lands to maintain the islands' agricultural and rural identities and economies," "discouraging developing or subdividing agriculturally designated lands when non-agricultural activies would be primary uses," and "conduct agricultural development planning to facilitate robust and sustainable agricultural activities"; and

c. to "strengthen the local economy," with objectives such as to "diversify and expand sustainable forms of agriculture" through policies that "prioritize the use of agricultural land to feed the local population and promote the use of agricultural lands for sustainable and diversified agricultural activities," "assist farmers to help make Maui County more self-sufficient in food production," "support ordinances, programs and policies that keep agricultural land and water available and affordable to farmers," and "support cooperatives and other types of nontraditional and communal farming efforts."

(Aoki, WDT, 10/17/16, ¶¶ 4-6; Exh. B-064, pp. 46, 61, 75.) [MDWS on reopening, FOF 509-511.]

504. Keeping HC&S/A&B's lands in agriculture would promote the CPP's core principle of maintaining open space and protecting scenic views. (Aoki, WDT, 10/17/16, ¶ 6.)

505. Long-term planning for the County of Maui is controlled by the Maui Island Plan/General Plan 2030 ("MIP"), which was officially adopted in 2012, and which is "a blue print that provides direction for future growth, the economy, and social and environmental decisions on the island through 2030" and which "established a vision, founded on core values that break down into goals, objectives, policies, and actions." (Aoki, WDT, 10/17/16, ¶ 7; Exh. B-065, p. 1-1.) [MDWS on reopening, FOF 512-513.]

506. One of the guiding principles of the Direct Growth Plan of MIP states:

> <u>Protect open space and working agricultural landscapes</u>: In light of continuing urbanization, the protection of agricultural and open-space resources will depend on a healthy agricultural industry and progressive planning and regulation. Planning should utilize agricultural lands as a tool to define the edges of existing and planned urban communities, apply innovative site design, create buffers along roadways, provide visual relief and preserve scenic views.

(Exh. B-067, pp. 8-10.) [MDWS on reopening, FOF 517.]

507. The MIP recognizes that “preserving agricultural lands is important for the long term sustainability of Maui,” and cites multiple reasons for the importance of maintaining agriculture, such as “agriculture creates a diversity of jobs, generates tax revenue, and produces a variety of crops for different local and export markets,” “benefits Maui’s tourism industry by providing green landscapes and enhancing the island’s sense of place,” and “protects land use options for future generations.” (Exh. B-063, pp. 7-3, 7-7.) [MDWS on reopening, FOF 514.]

508. Goals of the MIP include:

a. “Maui will have a diversified agricultural industry contributing to greater economic, food, and energy security and prosperity,” which will be pursued through policies that “strive to substitute food/agricultural product imports with a reliable supply of locally produced food and agricultural products,” “encourage growing a diverse variety of crops and livestock to ensure the stewardship of our land while safeguarding consumer safety and “promote the development of locally-grown and ecologically-sound biofuels, aquaculture and forest products.”

b. “Reduce the island’s dependence on off-island agricultural products…” through policies that “support an incentive package for productive Agricultural Lands which aims to ensure agricultural viability for small and commercial-scale agricultural producers” and “actively look to acquire land and provide infrastructure to expand the agricultural park and establish new agricultural parks.” (Exh. B-066, pp. 4-19, 4-20, B-063, p. 7-9.) [MDWS on reopening, FOF 519, 521.]

509. Objectives include to “significantly reduce the loss of productive agricultural lands” through policies that “strongly discourage the conversion of productive and important agricultural lands (such as sugar, pineapple and other produce lands) to rural or urban use…”, “provide incentives for landowners to preserve and protect agricultural lands from development…”, “support and promote the viability of Maui’s agricultural businesses…”, and “maintain or increase agriculture’s share of the total island economy” through policies “encouraging the continued viability of sugar cane production, or other agricultural crops, in central Maui and all of Maui island.” (Exhs. B-063, pp. 7-8, B-066, pp. 4-20.) [MDWS on reopening, FOF 515-516.]

510. Community plans set for the current and anticipated conditions of the designated region, and advance planning goals, objectives, policies, and implementation considerations to guide decision making for the region that is consistent with the Maui Island Plan/General Plan, while

recognizing the unique values and attributes of Maui's different communities. (Aoki, WDT, 10/17/16, ¶ 12.) [MDWS on reopening, FOF 522.]

511. The central Maui fields fall within four Community Plan Districts:

a. The Makawao-Pukalani-Kula/Upcountry Maui Community Plan ("MPKCP") was adopted in 1996 and includes the town of Makawao, Pukalani, Kula, Ulupalakua, Haliimaile, Waiakoa, Keokea, Waiohuli, Kanaio, Olinda, Omaopio, and Pulehu, as well as the Kula Agricultural Park.

i. The MPKCP encourages policies that "provide for the preservation and enhancement of agricultural lands and operations, emphasizing the importance of promoting diversified agriculture to the region's economic base and lifestyle," "protect existing agricultural operations from urban encroachment," "preserve agriculture by actively promoting locally grown agricultural products," "encourage the continuation of sugar, pineapple, cattle ranching, and diversified agriculture as major agricultural activities in the region and at the same time encourage the pursuit of alternative agricultural activities," "encourage the development of cooperative agricultural development programs between the County and the Department of Hawaiian Home Lands to support diversified agricultural pursuits."

ii. In terms of land use, the MPKCP calls for the development of policies which "recognize the value of open space, including agricultural lands and view planes to preserve the region's rural character," "discourage speculation of agricultural lands," " encourage land use patterns that will…support the long term viability of agriculture," "encourage the use of mechanisms such as land trusts and farm trusts to preserve open space and agricultural activity," "make available agricultural lands for those who wish to farm," and "explore the development of an additional Ag park."

iii. The MPKCP's environmental recommendations encourage policies that would "preserve environmental resources by maintaining important agricultural lands as an integral part of the open space setting in each community," and "recognize agricultural lands as an essential ingredient to the upcountry atmosphere."

(Aoki, WDT, 10/17/16, ¶¶ 12-13, 15; Aoki, Tr., 2/8/17, p. 396, ll. 12-22; Exhs. B-068, B-069, pp. 18-20, 23, 26, 30.) [MDWS on reopening, FOF 523-528.]

b. The Paia-Haiku/North Maui Community Plan ("PHCP") was adopted in 1995 and includes the towns of Spreckelsville, Paia, Haiku, Kuau, Kuaiha, and Pauwela.

i. For land use, the PHCP promotes policies that "ensure that appropriate lands are available to support the region's current and future agricultural industries, including sugar, pineapple, diversified agriculture and aquaculture" and "identify prime or productive agricultural lands and develop appropriate regulations for their protection."

ii. Policies promoted by the PHCP for economic activity include "(m)aintain(ing) agriculture as the primary economic activity. Enhance opportunities for the cultivation and processing of local agricultural products and encourage the establishment of agricultural parks and support services (i.e., co-op facilities for distribution, marketing and sales) to enhance diversified agricultural activities," and " encourage the State Department of Agriculture to draft or propose a master plan to promote diversified agriculture by expanding agricultural programs, identifying the specific uses of those agricultural lands, and locating a site(s) for an agricultural park."

(Aoki, WDT, 10/17/16, ¶ 17; Exh. B-070, p. 14.) [MDWS on reopening, FOF 529-531.]

c. The Wailuku-Kahului/Central Maui Community Plan ("WKCP") was adopted in 2002 and includes the communities of Wailuku, Kahului, Waiehu, Waihee, Waikapu, and Puunene.

i. In terms of economic activity, the WKCP promotes policies that "support agricultural production so agriculture can continue to provide employment and contribute to the region's economic well-being" and "support the establishment of agricultural parks for truck farming, piggery operations, bee keeping and other diversified agricultural operations, within large unsubdivided agricultural parcels and in locations that are compatible with residential uses."

ii. In regards to the environment, the WKCP encourages policies that "preserve agricultural lands as a major element of the open space setting that which borders the various communities within the planning region. The close relationship between open space and developed areas is an important characteristic of community form."

iii. In regards to land use, the WKCP encourages policies that will "ensure that adequate lands are available to support the region's present and future agricultural activities," "identify prime or productive agricultural lands, and develop appropriate regulations for their protection."

(Aoki, WDT, 10/17/16, ¶ 19; Exh. B-071, pp. 12-14, 26.) [MDWS on reopening, FOF 532-535.]

d. The Kihei-Makena/South Maui Community Plan ("KMCP") was adopted in 1998 and includes the towns of Kihei, Wailea, Makena, and Maalaea.

i. KMCP promotes land-use policies that would "prevent urbanization of important agricultural lands" and "allow special permits in the State Agricultural Districts to accommodate unusual yet reasonable uses including: (1) limited agriculturally related commercial, public and quasi-public uses serving the immediate community; (2) uses clearly accessory or subordinate to a principal agricultural use on the property; (3) public facility uses such as utility installations or landfills whose location depends on technical considerations; and (4) extractive industries such as quarrying, where the operation would not adversely affect the environment or surrounding agricultural uses."

ii. MCP promotes economic policies that "provide for the preservation and enhancement of important agricultural lands for a variety of agricultural uses, including sugar cane, diversified agriculture and aquaculture."

(Aoki, WDT, 10/17/16, ¶ 21; Exh. B-072, pp. 18-19.) [MDWS on reopening, FOF 536-538.]

512. The County of Maui has expressed that it "is in strong support of keeping the lands used by HC&S/A&B in agriculture." The County's position "is largely premised on the policies set forth in Maui Island Plan/General Plan 2030, the Countywide Policy Plan, and the various Community Plans, which promote a variety of interests including economic diversity, maintenance of view planes, open space and fire protection." (MDWS Opening Brief at 5; MDWS Rebbutal Brief at 6; Exhs. B-063, pp. 7-2 to 7-10, B-064, pp. 46, 60, 61, 75.) [HC&S on reopening, FOF 418.]

513. MTF states that "we do want to see agriculture on this land and we do support stream flow being set at a level that would allow that, but we do also think this an opportunity to provide for some of those instream uses that, unfortunately, had to be left at the door…" "You can't have long-term, viable agriculture if you're not making a profit," and MTF supports commercial, for-profit agriculture. (Perez, Tr., 2/8/17, p. 435, ll. 14-18, p. 437, ll. 1-11.)

514. MTF's report *Mālama `Āina: A Conversation About Maui's Farming Future* notes that "(t)he closure of the HC&S sugarcane enterprise is an opening to the next generation of diversified farm businesses," and that HC&S's "large, consolidated 35,000-acre block of central Maui farmland can be used to generate multiple income streams while growing food and fuel profitably for local consumption and value-added export." (Exh. E-160, *preface* and p. 1.) [HC&S on reopening, FOF 419.]

515. 22,254 acres of land irrigated with East Maui stream water are designated as Important Agricultural Lands ("IAL") pursuant to HRS Chapter 205, Part III. The IAL designation "is a commitment to keep these lands in productive agriculture over the long term." (Volner, WDT, 10/17/16, ¶ 12.) [HC&S on reopening, FOF 423.]

516. MTF states that "We know that there was a purchase and sale agreement as far back as in July (for 339 acres)…So to me that's just consistent with the overall business model that we're going to hold the land until we can either sell it or develop it. I think that the lands that are in important agricultural designation are—have a higher likelihood of staying in agriculture for a long time, which we would prefer and we would encourage, but those lands that are not in IAL designation, I consider that to be a temporary predevelopment phase and I don't think those lands should receive the same weight when we're considering setting stream flow standards." (Perez, Tr., 2/8/17, p. 433, l. 12 to p. 434, l. 6.)

N. EMI's Management of the Diversions and the Interim Restorations, and Any Issues Concerning the Integrity of the EMI Ditch System

517. The ways to reduce the amount of water that is collected and transported in the EMI ditch system were previously described:

a. There are primarily four ways to reduce the amount of water that is collected and transported in the EMI ditch system: 1) on streams that have controlled diversions, by closing or reducing the diversion intake gate openings; 2) on stream diversions that have sluice gates, by partially or completely opening the sluice gates; 3) on streams that have radial gates between the diversions and the ditch, by completely closing the radial gates; and 4) by partially or or completely closing the gates on the main control points on the ditches themselves to limit the amount of water that can pass each control point, the effect of which is to redirect any excess water into the stream crossed by the ditch where the control point is located, *supra*, FOF 76.

b. Controlled diversions have intake gate openings, which are typically constructed with wooden boards or metal plates, used to regulate how much water can flow from the stream into the diversion structure, *supra*, FOF 77.

c. Sluice gates are openings within the basin of the diversions that can be opened to discharge the water collected in the diversion back into the stream. Periodically opening sluice gates to flush out silt, gravel, and other debris that collects in the diversion structures is one of the normal means of maintaining the proper functioning of the ditch system. The effect of opening a sluice gate is to return water to the stream after it has entered the diversion structure. It may not always cause 100% of the water that entered the diversion to be discharged back into the stream, because during periods of heavy rainfall, water may back up in the diversion faster than it can be discharged through the sluice gate, in which case some water will still enter the ditch. During most flow conditions, however, completely opening the sluice gate will return practically all of the water to the stream, *supra*, FOF 78.

d. Radial gates are located along the tunnel reaches of the ditch and were designed to automatically open or close in relation to the water level in the tunnel. The gates are controlled by a float located in a float chamber in the tunnel that is connected to a cable that lifts or lowers the radial gate, depending on the water level in the tunnel. The operation of the gate can be adjusted by piping water to the float chamber and closing the drain valve on the chamber to raise the float to maintain the gate in the closed position, *supra*, FOF 79.

e. There are several main ditch control points on each of the ditches: 1) 6 on the Koolau Ditch; 2) 4 on the Spreckels Ditch; 3) 3 on the Manuel Luis/Center Ditch; 4) 2 on the Wailoa Ditch/Tunnel; 5) 4 on the New Hamakua Ditch; 6) 3 on the Lowrie Ditch; and 7) 2 on the Haiku Ditch, *supra*, FOF 80.

f. EMI manages the reduction in diversions through a combination of measures that involve adjusting the intake control gates on the streams with controlled diversions, opening the sluice gates at the diversion on streams that have sluice gates, adjusting the operation of radial gates on the streams that have radial gates, and partially or completely closing the gates on main ditch control points. The precise combination of measures at any point in time depends on the amount of water to serve the needs of HC&S and MDWS, and the amount of rainfall that is occurring in the watersheds that span the ditch system, *supra*, FOF 81.

518. The closures of intakes to meet the current level of reduced needs of HC&S and MDWS were also previously described:

a. At the time of the hearing, EMI had closed the intakes on all of the streams with controlled diversions, opened the sluice gates on the majority of the diversions that have sluice gates, closed the radial gates on a couple of streams with radial gates, and has closed the 6 main ditch control points on the Koolau Ditch. The sluice gates have been opened on Nua`ailua Stream, Alo Stream, and Waikamoi Stream on the Center Ditch, and three of the four sluice gates of the main intakes on Honomanū Stream. One of the sluice gates on Honomanū Stream cannot be opened because it is inoperable, but water is released into the west tributary of Honomanū Stream (Uluwini Stream) further down at a control gate in the Spreckels Ditch, *supra*, FOF 82.

b. The effect of these measures is to rely principally on water entering the ditch system west of Pi`ina`au Stream (i.e., from the Honomanu and Huelo license areas) to meet the current level of reduced needs of HC&S and MDWS. With these measures in place, water flows in the Wailoa Ditch at Maliko Gulch have been reduced to 20-25 mgd, *supra*, FOF 83.

c. The Wailoa Ditch is the highest of EMI's ditches. Nearly all the flows from the four license areas are from the Wailoa Ditch (83%). When the flow in the Wailoa Ditch is extremely low, there are little or no flows in the lower ditches. Under drought conditions, a different set of gate adjustments would be implemented, because EMI expects that it would not be possible to meet even the current lowered needs without importing water from further east, in the Nahiku and Ke`anae areas, where base flows are more reliable and there is a ground water contribution to the Koolau Ditch, in order to maintain a consistent flow in the Wailoa Ditch, *supra*, FOF 84-85.

d. As irrigation requirements increase from the ongoing implementation of diversified agriculture, EMI expects to implement a selective opening of board gates, readjusting the opening of sluice gates, resetting of radial gates, and readjusting of main ditch control gates to increase the amount of water brought into the ditch system. These measures will be dictated by the flow levels needed at Maliko Gulch and the rainfall patterns throughout the East Maui watersheds, supra, FOF 86.

519. Also previously described is the state of implementation to restore the streams that EMI has agreed to fully and permanently restore (from west to east: Honopou, Hanehoi [and its tributary, Puolua], Piinaau, Palauhulu, Waiokamilo, Kualani,[34] and East and West Wailuanui Streams):

a. EMI has: 1) closed the intakes and opened the sluice gates on the diversions on East and West Wailuanui Streams on the Koolau Ditch; 2) opened the sluice gate on Palauhulu Stream on the Koolau Ditch; 3) opened the sluice gates on the diversions on Hanehoi and Puolua Streams on the Haiku Ditch; and 4) opened the sluice gate and closed the radial gate on the Wailoa Ditch, made modifications to the intake on the New Hamakua Ditch, opened the sluice gate and closed the intake diversion on the Lowrie Ditch, and modified the diversion on the Haiku Ditch on Honopou Stream, *supra*, FOF 87.

b. Further measures to achieve the full and permanent restoration of these streams will be taken after EMI obtains all the necessary permits and government approvals. On September 16, 2016, EMI submitted its applications to abandon the following stream diversions: Honopou, Hanehoi (Puolua), Piinaau, Palauhulu, Waiokamilo (and its easternmost tributary, East Waiokamilo Stream, previously misidentified as Kualani Stream), and East and West Wailuanui Streams. Other pending approvals and concurrences will be needed from the County of Maui, DLNR's Office of Conservation and Coastal Lands, and the U.S. Army Corps of Engineers, *supra*, FOF 88.

520. The reduction in diversions does not by itself compromise the structural integrity of the EMI ditch system so long as the complete system, including the open ditches and roadways, continues to be maintained as a single, coordinated system. Consistently reduced flows will increase the amount of maintenance required of the open ditches in the system, because it will increase the surface areas that will need to be periodically cleared of vegetation, *supra*, FOF 89.

[34] Actually, the most eastern tributary of Waiokamilo Stream and now known as "East Waiokamilo Stream," *supra*, FOF 184, 186.

II. CONCLUSIONS OF LAW

A. Authority and Exclusive Jurisdiction of the Commission

1. "'Water' or 'waters of the State' means any and all water on or beneath the surface of the ground, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground." (HRS § 174C-3.)

2. "All waters of the State are subject to regulation under the provisions of this chapter unless specifically exempted. No provision of this chapter shall apply to coastal waters. Nothing in this chapter to the contrary shall restrict the planning or zoning power of any county under chapter 46." (HRS § 174C-4 (a).)

3. "No state or county government agency may enforce any statute, rule, or order affecting the waters of the State controlled under the provisions of this chapter, whether enacted or promulgated before or after July 1, 1987, inconsistent with the provisions of this chapter. Nothing in this chapter to the contrary shall restrict the power of any county to plan or zone as provided in chapter 46." (HRS § 174C-4 (b).)

4. The Commission "shall have exclusive jurisdiction and final authority in all matters relating to implementation and administration of the state water code, except as specifically provided in this chapter." (HRS § 174C-7.)

5. "The commission shall have jurisdiction statewide to hear any dispute regarding water resource protection, water permits, or constitutionally protected water interests, or where there is insufficient water to meet competing needs for water, whether or not the area involved has been designated as a water management area under this chapter. The final decision on any matter shall be made by the Commission." (HRS § 174C-10.)

6. In March 2007, BLNR had issued an interim order to release 6 mgd into Waiokamilo Stream below Dam 3. After USGS installed a gaging station near Dam 3, total flow in the stream without diversions at the Koolau Ditch was only 3.17 mgd (TFQ_{50}), and in the Commission's September 25, 2008 order, an IIFS of 3.17 mgd was established at the site of the USGS gauge. (FOF 180-181, 185.)

7. On December 9, 2016, BLNR issued a temporary, one-year holdover of A&B/EMI's East Maui water licenses subject to the Commission's July 18, 2016 Interim Restoration Order and to

EMI ceasing all diversions of Honomanu Stream for the duration of the one-year holdover period (through December 207). (FOF 41, 43.)

8. Neither BLNR's March 2007 order on Waiokamilo Stream nor its December 2016 order on Honomanu Stream was within its authority, *supra*, COL 3-5.

9. Subsequent to BLNR's March 2007 order, the Commission established an IIFS of 3.17 mgd, representing total stream flow and after discovering that the 6 mgd ordered by BLNR could not be attained. The Commission had been under no legal obligation to recognize and implement the BLNR's order, but it could adopt the BLNR order as its own. (*In re Water Use Permit Applications ["Waiāhole II"]*, 105 Haw. 1, 19, 93 P. 3d 643, 661 [2004].)

10. The Commission's July 18, 2016 Interim Restoration Order did not include Honomalu Stream, but the BLNR's December 9, 2016 order explicitly added Honomanu Stream to the streams that A&B/EMI had stated were undiverted and which the Commission had ordered to remain undiverted until further notice. (FOF 41, 43.) BLNR had no authority to add Honomanu Stream.

11. On April 20, 2016, A&B announced that it had decided to fully and permanently restore the East Maui streams identified in 2001 by the Commission and NHLC on behalf of its clients; i.e., Honopou, Hanehoi (including Puolua), Waiokamilo, Kualani, Piinaau, Palauhulu, and East and West Wailuanui streams, *supra*, FOF 39. A&B can take such action, but it in no way affects the IIFS for these streams, which await the decision of the Commission in this CCH. The Commission's prior decisions on September 25, 2008 on these streams except for Kualani (now recognized as a tributary of Waiokamilo Stream) and Piinaau, and on May 25, 2010 on the remaining 19 streams, six of which were restored on a seasonal basis, did not meet the legal requirements for establishing IIFS. The current restorations of these streams, including the order by the Commission that the ten streams[35] that A&B had stated were undiverted, remain diverted until further notice, do not establish IIFS but are only interim orders until the IIFS are established. (FOF 7-8, 11, 41.)

12. The Commission has the sole authority to issue orders affecting the East Maui streams in this CCH, which are specified in the D&O, *infra*.

B. Burden of Proof

[35] Waiokamilo, Wailuanui (East and West), Makapipi, Hanawi, Waiohue, East Wailuaiki, West Waiuaiki, Waikamoi, Kopiliula,and Puakaa streams.

13. "In the context of IIFS petitions, the water code does not place a burden of proof on any particular party; instead, the water code and our case law interpreting the code have affirmed the Commission's duty to establish IIFS that 'protect instream values to the extent practicable' and 'protect the public interest.'" (*Waiāhole II*, 105 Haw. at 11, 93 P. 3d at 653.)

14. The CCH was being held to establish IIFS and not to determine nor limit which parties may use waters available after the IIFS are established. (HRS § 174C-71 (2) (D).)

15. Legal conclusions made in this proceeding pertaining to a particular party's water rights, traditional and customary rights, water use requirements, alternative water sources, and system losses are made without prejudice to the rights of any party and the Commission to revisit these issues in any proceeding involving the use of water from any of the East Maui streams that are the subject of this contested case hearing. The burden of proof with respect to such issues will be upon the petitioner rather than upon the Commission.

16. There is no "class of potential reasonable and beneficial users" that is grandfathered by their inclusion in the balancing of instream and noninstream uses in establishing the IIFS. (Contrary to: MTF, "Proposed Findings of Fact, Conclusions of Law and Decision and Order of Maui Tomorrow Foundation, Inc. and its Supporters on Re-opened Evidentiary Hearing, June 7, 2017, FOF 11.)

C. Standard of Proof

17. In setting an IIFS, the Commission "need only reasonably estimate instream and offstream demands." ((*In re `Īao Ground Water Management Area High-Level Surface Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihe`e River and Waiehu, `Īao, and Waikapu Streams Contested Case Hearing* ["*Nā Wai `Ehā*"], 128 Haw. 228, 258; 287 P.3d 129, 159 [2012].); (*In re Water Use Permit Applications* ["*Waiāhole I*"], 94 Haw. 97, 155 n.60; 9 P.3d 409, 467 [2000].)

18. "In requiring the Commission to establish instream flow standards at an early planning stage, the Code contemplates the designation of the standards based not only on scientifically proven facts, but also on future predictions, generalized assumptions, and policy judgments." (*Waiāhole I*, 94 Haw. at 155; 9 P.3d at 467.)

D. Interim Instream Flow Standards (IIFS)

19. "'Instream flow standard' means a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses." (HRS § 174C-3.)

20. "In considering a petition to adopt an interim instream flow standard, the commission shall weigh the importance of the present or potential instream values with the importance of the present or potential uses of water for noninstream purposes, including the economic impact of restricting such uses." (HRS § 174C-71 (2) (D).)

21. "'Instream use' means beneficial uses of stream water for significant purposes <u>which are located in the stream</u> and which are achieved by leaving the water in the stream (*emphasis added*). Instream use(s) 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." (HRS § 174C-3.)

22. "'Noninstream use' means the use of stream water that is diverted or removed from its stream channel and includes the use of stream water outside the channel for domestic, agricultural, and industrial purposes." (HRS § 174C-3.)

23. "Interim instream flow standards may be adopted on a stream-by-stream basis or may consist of a general instream flow standard applicable to all streams within a specified area." (HRS § 174C-7 (2) (F).)

24. The East Maui streams "controlled" by the EMI ditch system qualifies as a "hydrologically controllable area," and consolidated amendments to the IIFS of the East Maui streams are not precluded.

a. The Court has concluded that consolidated regulation of separate water management areas was not precluded when a water delivery system draws water from several different water management areas. "HRS § 174C-50 (h) addresses competition arising between existing uses when 'they draw water from the same hydrologically controllable area and the aggregate quantity of water consumed by the users exceeds the appropriate sustainable yield or instream flow standards established pursuant to law for the area (*emphasis in original*).' The Code defines 'hydrologic unit' as 'a surface drainage area or a ground water basin or a combination of the two,' HRS § 174C-3, but does not define a 'hydrologically controllable area.' The plain reading of the latter term indicates that the area 'controlled' by the ditch system qualifies, irrespective of 'hydrologic units.'" (*Waiāhole I*, 94 Haw. at 174; 9 P.3d at 486.)

b. In the context of amendments to the IIFS, the same logic should apply: the East Maui streams "controlled" by the EMI ditch system qualifies as a "hydrologically controllable area," and consolidated amendments to the IIFS of the East Maui streams are not precluded.

c. Thus, stream-by-stream amendments will be adopted, *supra*, COL 23, but consolidated within the context of the impact of the EMI ditch system on the streams it has been diverting.

25. The value of water that is diverted, only to be lost due to avoidable or unreasonable circumstances, is unlikely to outweigh the value of retaining the water for instream uses. Therefore, the Commission should consider whether system losses experienced by diverters are unreasonable, and whether reduction of such losses is reasonably practicable. (*Nā Wai `Ehā*, 128 Haw. at 257-258, 287 P.3d at 158-159.)

26. The availability of alternative water sources is a consideration in the weighing of instream values with noninstream purposes when establishing IIFS, because the availability of alternative sources diminishes the "importance" of diverting stream water for noninstream use. (*Nā Wai `Ehā*, 128 Haw. at 259, 287 P.3d at 160.)

27. Considering whether alternative water resources are practicable innately requires prioritizing among public trust resources, and the Commission would fail to fulfill its duty, under the Water Code and the public trust doctrine, of considering whether practicable alternatives exist if it fails to prioritize among public trust resources. (*Waiāhole II*, 105 Haw. at 20, 93 P.3d at 662.)

28. On the second remand in the Waiāhole Ditch contested case, the Commission had ruled that both nonpotable Waiāhole Ditch water and potable Waipahu-Waiawa Aquifer water were available for nonpotable purposes after taking into consideration cost, existing technology, and logistics. The Commission then ruled that nonpotable water was available for its highest and best use, agriculture, and that potable groundwater was not the highest and best use for agricultural irrigation. The Commission then ruled that the Waipahu-Waiawa Aquifer was not a practicable alternative to Ditch water. (CWRM, "Findings of Fact, Conclusions of Law, and Decision and Order, In re Water Use Permit Applications: On Second Remand ("D&O III")," December 13, 2006, COL 45.)

29. On review of the Commission's D&O III, the Intermediate Court of Appeals found that: a) it was consistent with the analytical framework established by the Hawai`i Supreme Court, *supra*, COL 27; and b) even though there was no immediate need to use the Aquifer for drinking water, the Commission was entitled to consider the future water needs of Hawai`i and its people in fulfilling the State's obligation to protect, control and regulate the use of Hawai`i's resources for the benefit of its people. (*In Re Water Use Permit Applications*, 130 Haw. 346, 310 P.3d 1047 [2010].)

30. In this CCH, the public trust resources that are to be prioritized are both nonpotable water sources for nonpotable purposes; i.e., surface water from the East Maui streams and ground water from wells on A&B's East Maui fields. While the wells are on A&B's lands, they have correlative rights to and not ownership of, the underlying aquifer, *Waiāhole I*, 94 Haw. at 181 n.97; 9 P.3d at 493 n. 97, which is a public trust resource, *supra*, COL 1. The Commission's analysis is provided, *infra*, when it addresses groundwater alternatives for HC&S.

1. Instream Values

31. Of the instream values identified in COL 21, *supra*, the principal uses in the East Maui streams are the exercise of appurtenant and riparian water rights; gathering of fish, mollusks, and crustaceans; and the exercise of traditional and customary Hawaiian rights. Gathering of stream animals and stream flows to enable the downstream exercise of appurtenant and riparian rights constitute the instream exercise of traditional and customary Hawaiian rights. (FOF 305.)

32. Petitioners' use of water for growing wetland taro, for other agricultural uses, and for domestic household uses are also noninstream uses but are addressed as instream uses because

their uses are met by "the conveyance of irrigation and domestic water supplies to downstream points of diversion," supra, COL 21. Furthermore, in the weighing of instream values versus noninstream values, the Commission must consider the economic impact of <u>restricting</u> noninstream uses, *supra*, COL 20, but petitioners' are asking for <u>more</u> water for their agricultural and domestic household uses.

a. Conveyance of Water for Appurtenant and Riparian Uses

1. Appurtenant and Riparian Rights

33. There are no designated surface water management areas under HRS §§ 174C-45 and 174C-46 in the East Maui region from which the EMI Ditch System diverts water.

34. Water rights in non-designated areas are governed by the common law. (*Koolau Agr. Co. v. Commission on Water Resource Management* ["*Koolau*"], 83 Haw. 484, 491; 927 P.2d 1367, 1374 [1996]).

35. Appurtenant rights and riparian rights are the common law surface water rights.

36. Appurtenant rights are rights to the use of water utilized by parcels of land at the time of their original conversion into fee simple land, when title was confirmed by the Land Commission Award and title conveyed by the issuance of a Royal Patent. (*Reppun v. Board of Water Supply* ["*Reppun*"], 65 Haw. 531, 551; 656 P.2d 57, 71 [1982].)

37. When "the same parcel of land is being utilized to cultivate traditional products by means approximating those utilized at the time of the Mahele, there is sufficient evidence to give rise to a presumption that the amount of water diverted for such cultivation sufficiently approximates the quantity of the appurtenant water rights to which that land is entitled." (*Reppun*, 65 Haw. at 554; 656 P.2d at 72.)

38. Appurtenant rights are superior to riparian rights as they constituted an easement in favor of the property with the appurtenant right as the dominant estate. (*Reppun*, 65 Haw. at 551; 656 P.2d at 71; *Peck v. Bailey*, 8 Haw. 658, 662 [1867].)

39. Under riparian rights, owners of land adjacent to a natural watercourse are entitled to its use, no one owns the water, and the rights of one owner is not superior to another's. (*McBryde v. Robinson* ("*McBryde*"), 54 Haw. 174, at 198; 504 P.2d 1330, at 1344 [1973]; *aff'd on rehearing*,

55 Haw. 260; 517 P.2d [1973]; *appeal dismissed for want of jurisdiction and cert. denied*, 417 U.S. 962 [1974].)

40. Surface water rights are limited to the base flows. "(T)itle to water was reserved to the State for the common good when parcels of land were allotted to the awardee under the mahele. Thus 'storm and freshet' water is the property of the State." (*McBryde*, 54 Haw. at 199-200; 504 P.2d at 1345.)

41. The exclusive purpose of the statutory imposition of riparian rights in this jurisdiction was to enable tenants of ahupuaa to make productive use of their lands. (*Reppun*, 65 Haw. at 553; 656 P.2d at 72.)

42. There is no right to divert water by non-riparian landowners, but such diversions are permissible if they are reasonable and beneficial. (*Robinson v. Ariyoshi*, 65 Haw. 641, 648-650; 658 P.2d 287, 294-295 [1982].)

43. The continuing use of the waters of the stream by non-riparian landowners is contingent on a demonstration that such use will not harm the established rights of others. (*Reppun*, 65 Haw. at 554; 656 P.2d at 72.)

44. Such non-riparian diversions will be restrained only if a riparian owner can demonstrate actual harm to his/her own reasonable use of those waters. (*Reppun*, 65 Haw. at 553; 656 P.2d at 72.)

45. Where water has been improperly diverted by a public entity for actual public use, a complainant may not obtain injunctive relief against the diversion to which a public use has attached at the time suit is filed, unless the court finds that another public interest of substantially the same magnitude as that of the public's interest in adequate water will be advanced by injunctive relief. A public use attaches at the time the water is actually used by the public and only to the extent of such actual use. In the case of prior attachment, damages rather than injunctive relief would be the preferred solution. In the case of gradually increasing water diversion, the point at which the public use doctrine becomes operational is when the diversion causes harm to the complainants, and not when the complaint is filed. (*Reppun*, 65 Haw. at 565; 656 P.2d at 79.)

46. Since the 1982 *Reppun* decision, "domestic use of the general public" has been identified as a public trust purpose (*Waiāhole I*, 94 Haw. at 136-138, 9 P.3d at 448-450), thereby conflicting with the rights of riparian and appurtenant rightsholders to seek injunctive relief or damages under the public use doctrine, *supra*, COL 45.

47. For non-public-entity diverters, riparian and appurtenant rightsholders are entitled to waters sufficient to cultivate their crops in the manner in which they were accustomed prior to the diversions that led to a damaging of their crops. (*Reppun*, 65 Haw. at 553; 656 P.2d at 72.)

2. Appurtenant and Riparian Uses

48. Appurtenant and riparian rights are limited to the base flows, and storm and freshet water is the property of the State, *supra*, COL 40, which the State may assign or apportion among users in the public interest.

49. Appurtenant rights are superior to riparian rights, *supra*, COL 38.

50. The amount of water accompanying the appurtenant right is determined by its use on the property at the time of the Mahele, while a riparian right is not superior to the rights of other riparian landowners and the amount of water is determined by whether its use is reasonable and beneficial, *supra*, COL 36-37, 39.

51. The continuing use of stream waters by non-riparian landowners is permissible if the use is reasonable and beneficial and will not harm the established rights of appurtenant and riparian landowners, *supra*, COL 42-43.

52. Such non-riparian diversions will be restrained only if a riparian landowner can demonstrate actual harm to his/her own reasonable use of those waters, *supra*, COL 44.

53. Parties with appurtenant and riparian rights were harmed by the EMI Ditch diversions. (FOF 112, 204-206, 244, 269-276.)

3. Water Requirements

54. Approximately 94.721 acres have appurtenant rights, 49.805 acres for taro lo`i and 44.916 acres for other types of agricultural uses. (FOF 318-323.)

55. These acres are located in the following areas and watered by the following streams:

	Taro Lo`i	Other Agriculture	Source of Stream Water
Keanae	13.475 acres	7.00 acres	Palauhulu Stream
Wailua	30.160 acres	28.096 acres	Waiokamilo & Wailuanui Streams
Honopou	6.17 acres	9.82 acres	Honopou Stream

(FOF 313-323.)

56. In addition, the following areas and streams have some acreage identified with use of stream waters:

	Taro Lo`i	Other Agriculture	Source of Stream Water
Hanehoi	2.3 acres	?	Hanehoi & Puolua Streams
Makapipi	4.17 acres	3.25 acres	Makapipi Stream

The "other agriculture" category is for riparian rights: 1) a parcel adjacent to Hanehoi Stream for which the owner would like to exercise her riparian rights, and 2) for Jeffrey Paisner's property adjacent to Makapipi Stream.

(FOF 170, 238, 324, 329.)

57. The acres have not been reduced by 10 percent, as Na Moku's expert witness had done in a previous proceeding. (FOF 312, 318.) Instead, when accounting for water for the "other agriculture" category, the water assigned to "taro lo`i" is assumed to be more than enough to meet the irrigation requirements of the "other agriculture" category, *infra*, COL 70-71.

58. In the Nā Wai `Ehā contested case, the Commission had adopted a water budget of 130,000 to 150,000 gad for taro lo`i, which the Commission reaffirms here for East Maui. (FOF 211.)

59. Given the approximately half of the crop cycle that no water is needed to flow into the lo`i, the Commission's water budget means that average flow requirements for the half of the time that flow is needed would be 260,000 to 300,000 gad. On the other hand, Reppun contends that the water budget should be 100,000 to 300,000 gad, even when taking into consideration the 50 percent of time that no water is flowing into the lo`i. Reppun's requirements would translate into an average of 200,000 to 600,000 gad when inflow is needed. (FOF 213.)

60. On the other hand, Reppun also concludes that any general water requirement is questionable because there is no definitive answer, and that the average is a result of such parameters as percolation rates, weather, season, location on the stream relative to other diversions, initial water temperature, and rate of dilution of used water. Reppun's use of the 100,000 to 300,000 gad figure is predicated on when the taro needs the most water: the summer months, the hottest times, the longest days. (FOF 213-215.)

61. The temperature of 27^{o}C (80.6^{o}F) is the threshold point at which wetland kalo beccomes more susceptible to fungi and rotting diseases. (FOF 216.)

62. Reppun participated in a 2007 USGS study of what farmers were actually using, which looked at quantities of water and correlated that to temperature. To assure consistency of data,

only lo`i with crops near harvesting (continuous flooding of the mature crop) was studied in the dry season (June to October), when water requirements for cooling kalo approach upper limits. (FOF 218-220.)

63. Keanae and Wailua (Lakini, Wailua, and Waikani) in East Maui were part of the areas studied. Keanae receives water from Palauhulu Stream, Lakini and Wailua receive water from Waiokamilo Stream, and Waikani receives water from Wailuanui Stream. (FOF 222.)

64. Inflow measurements on July 30, 2006 and September 21, 2006 were as follows:

Keanae:	180,000 gad and 150,000 gad (for 10.53 acres)
Waikani:	190,000 gad and 93,000 gad (for 2.80 acres)
Wailua:	180,000 gad and 140,000 gad (for 3.32 acres)
Lakini:	750,000 gad and 550,000 gad (for 0.74 acres)

(FOF 225.)

65. All taro complexes had inflow temperatures well below 27ºC. (FOF 227.)

66. Outflow temperatures were not measured at Wailua, and there was an equipment malfunction at Keanae. (FOF 228.)

67. For Lakini and Waikani, temperatures exceeded 27ºC for several hours a day for one-half to two-thirds of the time: 16.9 percent of the time for Lakini and 29.1 percent of the time for Waikani. Reppun is of the opinion that percent of time that outflows exceed 27ºC is the most important factor. (FOF 228, 231.)

68. For Lakini, Reppun was of the opinion that the water was not going to heat up very much at all, given the enormous amount of water relative to the size of the area, and that the amount was more than adequate. (FOF 235.)

69. The Commission's water budget of 130,000 to 150,000 gad translates to an average of 260,000 gad to 300,000 gad for the time when water is needed to flow into the lo`i, *supra*, COL 58-59. The USGS study focused on the times when water requirements were at their maximum, and for which much more water than 260,000 gad to 300,000 gad would be available without exceeding the limits of the water budget. Thus, there would likely have been sufficient water to significantly reduce the percent of time that temperatures for these taro complexes exceeded 27ºC and still stay within the limits of an overall water budget of 130,000 gad to 150,000 gad for a crop cycle.

70. Applying a water budget of 130,000 to 150,000 gad to the acreage in COL 33-34, *supra*, results in the following water requirements from the identified streams.

Palauhulu:	13.475 acres x (130,000 to 150,000 gad) = 1.75 mgd - 2.02 mgd
Waiokamilo & Wailuanui:	30.160 acres x (130,000 to 150,000 gad) = 3.92 mgd - 4.52 mgd
Honopou:	6.17 acres x (130,000 to 150,000 gad) = 0.80 mgd - 0.93 mgd
Hanehoi/Puoloa:	2.3 acres x (130,000 to 150,000 gad) = 0.30 mgd - 0.35 mgd
Makapipi:	4.17 acres x (130,000 to 150,000 gad) = 0.54 mgd - 0.63 mgd

71. These requirements should also meet the requirements for acres in "other agriculture," because the acreage has not been reduced by 10 percent, which Na Moku's expert did not do for this contested case, *supra*, COL 57, and water requirements for "other agriculture" are far less than for taro lo`i. For example, for Palauhulu Stream, 10 percent of 13.475 acres is 1.348 acres, and multiplying by 130,000 gad to 150,000 gad, 0.18 mgd to 0.20 mgd would be available for 7.00 acres for "other agriculture," or 25,714 gad to 28,571 gad. For Waiokamilo and Wailuanui Streams, the comparable water available for other agricultural uses would be 13,880 gad to 16,728 gad; for Honopou Stream, available water would be 8,168 gad to 9,425 gad; and for Makapipi Stream, available water would be 16,680 gad to 19,246 gad, all far in excess of any agricultural requirements other than taro lo`i (*see*, COL 55, *supra*, for other agriculture acreage).

72. Furthermore, the taro lo`i water requirements are for flow-through amounts, most of which will exit the lo`i complex and then may either flow into another lo`i complex or back into the stream. Thus, much of the 130,000 to 150,000 taro lo`i water requirements will be available for use by others such as for downstream lo`i complexes and other agricultural uses, or for increased stream flow for improved stream animal habitat.

73. The 2008 Commission order made the following amounts of water available in these streams:

Palauhulu:	3.56 mgd (for taro)
Waiokamilo & Wailuanui:	Waiokamilo: 3.17 mgd for taro and domestic Wailuanui: 1.26 mgd for taro and habitat
Honopou:	1.29 mgd[36]: 0.82 mgd for taro and domestic; 0.47 mgd for habitat
Hanehoi/Puoloa:	1.72 mgd: 0.98 mgd for taro; 0.74 mgd for Huelo community
Makapipi Stream:	not included in 2008 Commission order

(FOF 140-141, 160-166, 173, 181, 194-196.)

[36] In actuality, 1.15 mgd (1.7 cfs) was added just below the Haiku Ditch, then the IIFS was raised to 1.29 mgd (2.00 cfs) because Honopou Stream gains an unknown amount below the Haiku Ditch. (FOF 121.)

74. However, the existing stream flows at these locations were either unknown or estimates from the modeling effort, *supra*, FOF 103-112, 201, and were to be confirmed after initial implementation, but, as described earlier, *supra*, FOF 269-277, no evaluation of whether or not the purposes of the amended IIFS were met have been conducted.

75. As can be seen by comparing COLs 70 and 73, *supra*, had the 2008 Commission order been able to be implemented, the water requirements would have been met with waters from Honopou and Waiokamilo/Wailuanui Streams, and exceeded for irrigation from Palauhulu and Hanehoi/Puolua Streams. However, in the implementation, Commission staff has learned that: 1) the regression estimates used for flows had, in many cases, overstated what those flows would be, so if the sluice gates on the ditches are opened, there still may not be enough flow to meet the amended IIFS; 2) there is a natural variability in stream flow which may dip below the IIFS, generally due to periods of low rainfall, so guaranteeing that a specific flow is always in the stream and still meet the objective of the IIFS is not possible; and 3) in Wailuanui and Keanae, the Koolau Ditch has only been taking, for the most part, water generated by rainfall, and spring water below the Ditch is what the taro farmers have access to. (FOF 275-276.)

b. Maintenance of Fish and Wildlife habitats

76. Incorporating hydrology, stream morphology, and microhabitat preferences, a model of stream systems was used to simulate habitat/discharge relationships for various species and their life stages, and to provide quantitative habitat comparisions at different streamflows. (FOF 115.)

77. For East Maui streams, 64 percent of natural median base flow ($0.64xBFQ_{50}$) is required to provide 90 percent of the natural habitat (H_{90}), or the minimum viable habitat flow (H_{min}) expected to produce suitable conditions for growth, reproduction, and recruitment of native stream animals. (FOF 118, 124.)

78. Habitat less than H_{90} would not result in viable flow rates for growth, reproduction, and recruitment. There is no linear relationship between the amount of habitat and the number of animals. H_{70}, or twenty percent less habitat than H_{90}, would not result in only 20 percent less animals; nor would H_{50}, which is twenty percent less than H_{70}, result in only an additional 20 percent less animals. (FOF 125.)

79. A geographic approach to stream restoration was taken in the Commission's 2010 order, meaning that flows were restored in selected streams both east and west of Keanae Valley.

Benefits of this approach included biological diversity in the East Maui area, and regional diversity in traditional gathering opportunities. (FOF 259a.)

80. A geographic approach to stream restoration is in compliance with the Code:

a. "Interim instream flow standards may be adopted on a stream-by-stream basis or may consist of a general instream flow standard applicable to all streams within a specified area," HRS § 174C-71(2)(F), *supra*, COL 23.

b. Each of the streams in this contested case has been and will be addressed on a stream-by-stream basis, and the Code does not prohibit evaluating each stream's contribution to a geographic approach to stream restoration in amending (or not) its IIFS.

81. A geographic approach is the most feasible method of restoring streams that are collectively diverted by EMI's Ditch System:

a. The EMI Ditch System qualifies as a "hydrologically controllable area," and a geographic approach, or consolidated amendments to the IIFS, of the East Maui streams are not precluded, *supra*, COL 24.

82. Streams were selected which would result in the most biological return from additional flow. (FOF 259b.)

83. Final selections were as follows, with the Commission adopting its staff selections:

Division of Aquatic Resources (DAR)	Commission Staff
East Wailuaiki Stream	East Wailuaiki Stream
West Wailuaiki Stream	West Wailuaiki Stream
Puohokamoa Stream	
Waikamoi Stream	Waikamoi Stream
Kopiliula Stream	
Haipuaena Stream	
Waiohue Stream	Waiohue Stream
Hanawi Stream	Hanawi Stream
	Makapipi Stream

(FOF 134, 257.)

84. Puohokamoa, Haipuaena, and Kopiliula Streams were not selected by Commission staff, reasoning that these streams are used for conveyance, more water may exist in the portion of the stream used for conveyance than would naturally occur, and any interim IFS should be based on the surface water available within the given hydrological unit. (FOF 260.)

a. However, during the contested case hearing, Garrett Hew of EMI agreed that there's no identification of particular conveyance streams. If storm waters overflow a ditch, the water goes into the stream and then hits the next ditch downstream. There are no actual conveyance ditches or designated conveyance streams in the system. (FOF 261.)

85. For Hanawi Stream modification of the diversion would serve mainly to create a wetted pathway for stream animal connectivity from the diversion to the ocean. The stream already had adequate flow to sustain a viable biota population, but the biological health of the stream could be further improved simply by providing connectivity through a wetted pathway in the dry reach immediately below the diversion. (FOF 259d.)

86. Makapipi Stream was selected by the Commission staff because the Nahiku community relies heavily on the stream for cultural practices, recreation, and other instream uses. But with the uncertainty of gaining and losing reaches along most of the stream's course to the ocean, it was not known whether restored flow will result in continuous stream flow from the headwaters to the stream mouth. Thus, a short-term release of water past the one major EMI diversion was made to determine the sustainability of the proposed IIFS of 0.60 mgd (BFQ_{50}), just upstream of Hana Highway. (FOF 259e.)

a. Flows ranging from 0.76 mgd to 0.87 mgd were released from the Koolau Ditch in September 2010, but no flow was observed at the Hana Highway Bridge located about two-thirds of a mile downstream of the diversion. A 1,000-foot reach upstream of the Hana Highway Bridge was dry, with the exception of a few isolated pools of water, and there was no indication of recent streamflow. The precise location where the stream went dry farther upstream was not determined, because it could not be safely accessed on foot. Much of the lower sections of the stream below the highway was largely dry, with isolated reaches with pools of water. (FOF 287.)

87. The seasonal approach of the Commission's 2010 order established winter flows at 64 percent of BFQ_{50} (H_{90}) and summer flows at 20 percent of BFQ_{50} for the remaining four streams: East Wailuaiki, West Wailuaiki, Waiohue, and Waikamoi Streams. Although flow rates less than 64 percent of BFQ_{50} would not result in habitat sufficient for growth, reproduction, and recruitment, *supra*, COL 78, the rationale was that it would provide minimum connectivity for native stream animals to survive in shallow pools without long-term growth or reproduction. (FOF 253.)

88. Three of these streams, with the exception of Waikamoi Stream, were studied, with the following results:

a. There was no evidence that the summertime flows were advantageous to the animals. The concept of varying flow over times is well supported in fisheries, but in this case it was not. For example, if the wintertime flows had been returned during the summer and complete flow restoration had been done in the winter, that would have been a seasonal flow approach, and completely different results might have been seen. (FOF 283.)

b. Overall, the seasonal flow hypothesis (higher winter flows and lower summer flows) was conceptually coherent but not supported by the data. The lack of support for the seasonal flow hypothesis may reflect that the prescribed flow amounts were insufficient (i.e. needed higher flows in summer) or that a year round minimum flow is more appropriate for East Maui streams. (FOF 284.)

89. Finally, of the six streams addressed in the Commission's 2008 order, besides increases in the IIFS for taro and/or domestic uses, improvements in stream habitat was among the objectives, but none of the amended IIFS reached the level of 64 percent of BFQ_{50} (H_{90}). (FOF 277.)

a. Waiakamilo Stream was restored to its non-diverted state, but the focus was on taro and domestic uses, and the IIFS at the lowest reach was left at the status quo, diverted state. (Exh. C-85, p. 44-45.)

c. Protection of Traditional and Customary Native Hawaiian Rights

90. In the context of amendments to the IIFS for the East Maui streams that are the subject of this contested case, instream exercise of traditional and customary Hawaiian rights are at issue, and not all such rights that may be exercised in the East Maui watersheds and nearshore ocean, *supra*, COL 21.

91. One of the public trust purposes is native Hawaiian and traditional and customary rights, including appurtenant rights. *(Waiāhole I,* 94 Haw. at 136-138, 9 P.3d at 448-450.)

a. Appurtenant rights are property rights to the use of water utilized by parcels of land at the time of their original conversion into fee simple land, when title was confirmed by the Land Commission Award and title conveyed by the issuance of a Royal Patent, *supra*, COL 36.

b. Traditional and customary Hawaiian rights are personal rights "customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua`a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights." (Haw. State Constitution, Article XII, § 7.)

92. In order to qualify as traditional and customary Hawaiian rights, gathering of stream animals and the exercise of appurtenant rights must meet the following criteria:

a. it is being exercised by descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778 (Haw. State Constitution, Article XII, § 7);

b. there are six elements essential to traditional and customary native Hawaiian practices: 1) the purpose is to fulfill a responsibility related to subsistence, cultural, or religious needs of the practitioner's family; 2) the practitioner learned the practice from an elder; 3) the practitioner is connected to the location of practice, either through a family tradition or because that was the location of the practitioner's education; 4) the practitioner has taken responsibility for the care of the location; 5) the practice is not for a commercial purpose; and 6) the practice is consistent with custom. (*State v Pratt["Pratt"]*, 127 Haw. 206, at 209; 277 P.3d 300, at 303 [2012].)

c. There is an adequate foundation connecting the claimed right to a firmly rooted traditional or customary native Hawaiian practice traceable to at least November 25, 1892, when the State adopted English common law with exceptions that included "established by Hawaiian usage." (HRS Ch. 1, § 1-1; *State v Zimring [I]*, 52 Haw. 472, at 475; 479 P.2d 202, at 204 [1970]; *Public Access Shoreline Hawaii v Hawaii County Planning Commission ["PASH"]*, 79 Haw. 425, at 447; 903 P.2d 1246, at 1268 [1995]; *cert. denied* 517 U.S. 1163; 116 S.Ct. 1559; 134 L.Ed. 660 [1996].)

1. "(I)t is established that the application of a custom has continued in a particular area (*emphasis added*)." (*PASH*, 79 Haw. 525, at 442; P. 2d 1246, at 1263.)

2. Through expert testimony and kama`āina witness testimony, claimants can personally trace their practices in the subject area to a period prior to

November 25, 1892. (*State of Hawaii v Hanapi*, 89 Haw. 177, at186-187 n.12; 970 P.2d 485, at 495 n. 12 [1998].)

93. Therefore, not all appurtenant rightsholders have traditional and customary Hawaiian rights, because appurtenant rights are property rights held by any owner of the appurtenant lands, while traditional and customary Hawaiian rights are personal rights.

94. The record is not clear whether any person holds traditional and customary Hawaiian rights in the East Maui area, whether for gathering rights or for farming in traditional and customary ways. There was testimony that at least some Nā Moku members gathered for subsistence and cultural purposes in the East Maui area, and wetland taro was being grown or attempted to be grown with traditional and customary practices, sometimes by members who have lived in the area for generations. (*See*, Edward Wendt, WDT, ¶ 2; Edward Wendt, Tr., March 9, 2015, p. 8; Terrance Akuna, Tr., March 10, 2015, pp. 17-19; Norman Martin, Tr., March 9, 2015, pp. 113-114; Jerome Kekiwi, Tr., March 9, 2015, p. 202; Joseph Young, Tr., March 9, 2015, pp. 222-223.)

95. For the purposes of this contested case to amend the IIFS, it will be assumed that at least some persons have traditional and customary Hawaiian rights to gather stream animals and farm wetland taro in the East Maui area.

96. Therefore, the Commission must make specific findings and conclusions on:

a. the identity and scope of valued cultural, historical, or natural resources in the area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area;

b. the extent to which those resources will be affected or impaired by the proposed action; and

c. the feasible[37] action, if any, to be taken to reasonably protect native Hawaiian rights if they are found to exist. (*Ka Pa`akai O Ka`aina v Land Use Commission***,** 94 Haw. 31, at 47; 7 P.3d 1068, at 1084 [2000].)

97. The petition area covers four watersheds of approximately 50,000 acres, of which 33,000 acres are owned by the State, and 17,000 acres are owned by EMI. (FOF 49.) Traditional and customary native Hawaiian rights are exercised in the streams in the form of subsistence gathering of native fish, mollusks, and crustaceans, and stream flows are diverted for the

[37] "Feasible" is defined as a "balancing of benefits and costs," and not whether the action is "capable of achievement." *Waiāhole I*, 94 Haw. at 141 n. 39; 9 P.3d 409, at 453 n. 39.

cultivation of wetland taro, other agricultural uses, and domestic uses that can be traced back to the Mahele. (FOF 305.)

98. The proposed actions will not impair these resources but instead they will be improved by increasing stream flows. (*See* the September 25, 2008 Commission Order, FOF 136-209, and the May 25, 2010 Commission Order, FOF 252-287, and the Decision and Order, *infra*.)

99. The feasible actions, or a balancing of benefits and costs, that are being undertaken in this contested case are "to weigh the importance of the present or potential instream values with the importance of the present or potential uses of water for noninstream purposes, including the economic impact of restricting such uses." (HRS § 174C-71 [2] [D].)

d. Estuaries and Wetlands; Recreational Activities; Waterfalls; Water Quality

100. Navigation and instream hydropower generation are not uses in the East Maui streams. (FOF 297.)

101. Maintenance of ecosystems such as estuaries, wetlands, and stream vegetation:

a. East Wailuaiki, West Wailuaiki, and Waiohue streams have estuaries; and

b. from east to west, all of the streams except Waiaaka and Ohia Streams have seasonal, non-tidal palustrine wetlands in the upper watershed of the hydrological unit.

(FOF 302.)

102. Outdoor recreational activities:

a. from east to west, Makapipi, Hanawi, Waiohue, East Wailuaiki, West Wailuaiki, Wailuanui, Waiokamilo, Ohia, Honomanu, Waikamoi, Hanehoi, and Honopou streams have outdoor recreational activities, and nearly all include scenic views. (FOF 301.)

103. Aesthetic values such as waterfalls and scenic waterways:

a. Waterfalls, some including plunge pools at their base, and to a lesser extent, springs, constitute the principal aesthetic values in the East Maui streams. From east to west, the streams include Makapipi, Hanawi, Kapaula, Waiaaka, Paakea, Waiohue, Kopiliula, West Wailuaiki, East Wailuaiki, Wailuanui, Waiokamilo, Palauhulu, Piinaau, Honomanu, Punalau, Haipuaena, Puohokamoa, Waikamoi, and Honopou. (FOF 303.)

104. Maintenance of water quality:

a. Streams that appear on the 2006 List of Impaired Waters in Hawaii, Clean Water Act § 303(d), include, from east to west, Hanawi, Puakaa, East Wailuaiki, West

Wailuaiki, Ohia, Honomanu, Punalau, Haipuaena, Puohokamoa, and Waikamoi streams. (FOF 304.)

105. Streams that have had their IIFS increased to address wetland taro and domestic uses and/or habitat improvement for native stream animals include (FOF 136-200, 252-268):

a. Honopou: also on the list for palustrine wetlands, aesthetic values and outdoor recreation.

b. Hanehoi/Puolua: also on the list for palustrine wetlands and outdoor recreation.

c. Palauhulu: also on the list for palustrine wetlands and aesthetic values.

d. Waiokamilo: also on the list for palustrine wetlands, outdoor recreation, and aesthetic values.

e. Wailuanui: also on the list for palustrine wetlands, outdoor recreation, and aesthetic values.

f. Waikamoi: also on the list for palustrine wetlands, outdoor recreation, aesthetic values, and impaired water quality.

g. East Wailuaiki: also on the list for estuaries, palustrine wetlands, outdoor recreation, aesthetic values, and impaired water quality.

h. West Wailuaiki: also on the list for estuaries, palustrine wetlands, outdoor recreation, aesthetic values, and impaired water quality.

i. Waiohue: also on the list for estuaries, palustrine wetlands, outdoor recreation, and aesthetic values.

j. Hanawi: also on the list for palustrine wetlands, aesthetic values, and impaired water quality.

k. Makapipi: palustrine wetlands, outdoor recreation, and aesthetic values.

106. Therefore, these other instream uses are substantially represented by the streams that have had their IIFS increased by the two previous Commission decisions in 2008 and 2010.

2. Noninstream Uses

a. HC&S

i. Requirements

107. The conversion from sugarcane to diversified agriculture irrigation is similar to the conversion that was taking place in leeward O`ahu at the time of the Waiāhole Ditch Contested Case. Not only were IIFS for the windward streams that were being diverted by the Waiāhole Ditch system to be determined, but also water-use permit applications ("WUPAs"), including those for the fields that were being converted to diversified agriculture. One principal issue was determining the sufficiency of evidence to meet the water-use permit requirements for what were embryonic agricultural operations. In Waiāhole, it was the permit applicants' burden to provide evidence that met the requirements of HRS ¶¶ 174C-49 (conditions for a permit) or 174C-50 (existing uses). In this Contested Case, it is the Commission's burden, as it was in the Waiāhole Ditch Contested Case, to provide evidence of "the present or potential uses of water for noninstream purposes, including the economic impact of restricting such uses," in its balancing of instream and noninstream values. (HRS ¶ 174C-71 [2] [D].) Furthermore, in establishing IIFS, the standard of proof for the Commission is less than for water-use permit applicants: "In requiring the Commission to establish instream flow standards at an early planning stage, the Code contemplates the designation of the standards based not only on scientifically proven facts, but also on future predictions, generalized assumptions, and policy judgments," *supra*, COL 18.

108. In Waiāhole, the Commission on remand from *Waiāhole I* clarified the terms "arable," "cultivated," and "planted" as follows:

> Arable land is land that is able to be cultivated but not necessarily in cultivation. Cultivated land goes through the cycle of being plowed, planted, harvested, plowed under and left to rest (either with or without cover crops), then plowed and planted, etc. Planted means when the plants are actually present. So you may be planted three or four months a year, but you're in cultivation continuously throughout the year. (CWRM, "Findings of Fact, Conclusions of Law, and Decision and Order, In re Water Use Permit Applications: On First Remand ("D&O II")," at 74, December 28, 2001.)

109. In *Waiāhole II*, the Hawai`i Supreme Court responded as follows:

> It is the Water Commission's daunting task to synthesize the evidence and reach a conclusion while balancing various interests and accounting for the public trust. In the instant case, the Water Commission considered testimony that each planted acre, depending on the crop, require(s) anywhere between 1,800 to 54,000 gallons of water per day, and averaging 7,500 gallons per day. In diversified agriculture, farmers plant only one-third to one-half of their cultivated acres at any given time. In addition, because rotating the fields in diversified agriculture makes it difficult to specify the water need for a particular acre, the Water Commission decided to consider average water use for

cultivated acres. Based on the evidence presented, the Water Commission concluded that 2,500 gallons of water per cultivated acre per day was sufficient for diversified agriculture. Inasmuch as the Water Commission articulated its reasoning with sufficient clarity in its D&O II, we cannot say that the Water Commission's decision was clearly erroneous. The Water Commission's allocation off 22,500 gallons of water per cultivated acre per day appears to be based on the best information currently available. (*Waiāhole II*, 105 Haw. at , 93 P.3d at ..)

110. In this Contested Case, the Commission has evaluated the best information currently available from HC&S and articulated its reasoning with sufficient clarity, *supra*, FOF 339-360, to meet the standard articulated in *Waiāhole II*. Moreover, in establishing IIFS, the standard of proof for the Commission is less than for water-use permit applicants, *supra*, COL 107.

111. The aggregate irrigation requirement for the 26,996 acres is 3,305 gpad, or an average daily requirement of 89.21 mgd. Accounting for estimated losses of 22.7% due to seepage, evaporation, and other system losses, *supra*, FOF 312-315, 399, the gross amount of water to yield the net irrigation requirement of 89.21 mgd is 115.43 mgd (1.294 x 89.21),[38] *supra*, FOF 343, 348.

ii. Losses

112. Reasonable system losses are 22.7 percent of total irrigation requirements. (FOF 370-382.) For its estimated irrigation requirements of 89.21 mgd, losses would be 26.22 mgd, for a gross irrigation requirement of 115.43 mgd. (FOF 349-350.)

iii. Alternative Sources

113. Additional reservoirs, recycled wastewater, and Maui Land and Pine are not reasonable alternatives based on analyses of costs, technology, and logistics. In the future, 2.95 mgd to 4.2 mgd—and up to a capacity of 7.9 mgd—might be available from the Kahalui Wastewater Reclamation Facility ("WWRF"), but in order to realize the use of WWRF R-1 water on the East Maui fields immediately north of Kahalui Airport, the following must be completed: 1) upgrade of the WWRF from R-2 to R-1 water capability, with an estimated cost in December 2010 of

[38] 115.43 mgd includes 22.7 percent in losses, or 26.22 mgd. Therefore, 115.43 mgd (89.21 mgd + 26.22 mgd) is the gross irrigation requirement. Numbers are not exact due to rounding.

$4,965,000; 2) a pipeline to Kahului Airport; and 3) a dedicated pipeline from that point to the East Maui fields above the airport. (FOF 398-419.)

114. A&B has correlative rights to the brackish water underlying its lands, but it does not own the water, which is a public trust resource, as is the surface waters that are diverted by the EMI Ditch system, *supra*, COL 30.

115. Considering whether alternative water sources are practicable innately requires prioritizing among public trust resources, *supra*, COLs 27-29.

116. Both surface and brackish groundwater are nonpotable public trust resources available for nonpotable use—agriculture.

117. There are no absolute priorities among trust purposes, and resource protection is not a "categorical imperative." Reason and necessity dictate that the public trust may have to accommodate offstream diversions inconsistent with the mandate of protection, to the unavoidable impairment of public instream uses and values. (*Waiāhole I*, 94 Haw. at 141-142, 9 P.3d at 453-454.)

118. With sugarcane irrigation, brackish ground-water usable capacity was 115 mgd to 120 mgd, limited by a likely increase in aquifer salinity levels, especially in the summer months when pumping was highest. (FOF 391-392.)

119. The brackish water wells could be used to irrigate 17,200 acres of the approximately 30,000 acres serviced by waters from the EMI Ditch System. (FOF 384-385.)

120. Under sugarcane cultivation, brackish well water had contributed about 70 mgd, representing about 30 percent of total irrigation from 1986 to 2009 and rising to 38 percent of total irrigation from 2008 to 2013, because surface water contributions had decreased from 167 mgd to 114 mgd during the same time periods. (FOF 389-390, 422.)

121. But the percent of brackish water on the approximately 17,200 acres of sugarcane fields that had access to well water would have been much higher than 38 percent. Of the 132 mgd total irrigation water, *supra*, FOF 332, 43 percent (12,800 acres/30,000 acres), or 57 mgd, would have been used on the approximately 12,800 acres that had access only to surface water, leaving 75 mgd of surface water to be used with 70 mgd of brackish well water on the remaining 17,200 acres.[39] Thus, when brackish water comprised 38 percent of total irrigation, it comprised 48 (70/145) percent of the water applied on the acres on which it could be used. (FOF 423.)

122. For diversified agriculture:

[39] The actual acreage in sugarcane cultivation was 28,941 acres of the approximately 30,000 acres with access to EMI ditch water.

a. If 70 mgd of brackish water is used as was historically used for sugarcane irrigation, of the 89.21 mgd water requirements for diversified agriculture, the percent of brackish water for total requirements would be 78 percent, only 19.21 mgd of surface water would be available for the 28.28 mgd required on the 9,143 acres with access only to surface water, leaving none for the remaining 17,853 acres. As a result, a large percent of the 9,143 acres would not be irrigated, and while 70 mgd of brackish water would be available for the 60.93 mgd required for the 17,853 acres, 100 percent of irrigation requirements would come from brackish well water. (FOF 425-426).

b.. For fields with access to both surface and brackish water, the amounts of brackish water that would represent lower percentages than the 48 percent when sugarcane was being irrigated would be: 1) 26.76 mgd, which represents 30 percent of total water and 44 percent on fields with access to both surface and well water; and 2) 17.84 mgd, which represents 20 percent of total water and 29 percent on fields with access to both surface and well water. (FOF 427-430.)

123. 26.76 mgd of well water would represent 30 percent of total and result in only a small decrease in the percent of well water from sugarcane cultivation to diversified agriculture—48 to 44 percent—on the fields with access to both surface and well water and not enough to mitigate the expected negative effects of brackish water. (FOF 393-397.)

124. 17.84 mgd of well water would represent 20 percent of total water and 29 percent on fields with accesss to both surface and well water, reducing the proportion of well water from nearly half (44%) to less than a third (29%) of total water on those fields.

125. The impact on diversions of surface water is calculated as follows:

a. An average of 109 mgd was diverted from the four EMI-State Watershed leases in FYs 2011-2014, and during this same period, the streams between Honopou Stream and Maliko Gulch contributed an additional 8.59 mgd. (FOF 436, 439, 445.)

b. Gross irrigation requirements, including system losses, would be 115.43 mgd versus irrigation requirements of 89.21 mgd (the amount applied to the cultivated fields).

c. Adding service delivery losses of 22.7 percent, to deliver 26.76 mgd and 17.84 mgd, respectively, to the fields with access to both surface and well water, *supra*, COLs 123-124, would take 34.62 mgd and 23.09 mgd, respectively.

d. The amount of surface water needed when well water contributed 26.76 mgd would be 80.81 (115.43 – 34.62) and 92.34 (115.43 – 23.09) mgd when well water contributed 17.84 mgd.

126. Subtracting the 8.59 mgd contributed by streams after the lease lands (between Honopou Stream and Maliko Gulch), the amount of water needed would be:

a. 72.22 (80.81 -8.59) mgd: when well water is 30 percent of total irrigation requirements and 44 percent on the fields with access to surface and well water.

b. 83.75 (92.34 – 8.59) mgd: when well water is 20 percent of total irrigation requirements and 29 percent on the fields with access to surface and well water.

127. Therefore, 11.53 (83.75 – 72.22) mgd in additional surface water would mean the difference between irrigation that might not support diversified agriculture (44% well water of total water on fields irrigated with both surface and well water) and irrigation that would be tolerated by diversified agriculture.

128. In prioritizing between the two public trust resources of surface and well water, *supra*, COL 115, the Commission finds that:

a. surface water is practicably available after appurtenant and riparian uses are met on a stream-by-stream basis and stream habitats are restored on a geographic basis, *supra*, COL 24; and

b. brackish well water is practicably available up to 23.09 mgd, beyond which increasing well water to levels close to that when sugarcane was being irrigated would reduce the yield or the acreage of the 17,853 acres planned for cultivation that has access to both surface and well water, *supra*, COLs 123-124.

iv. Economic Impact

129. If surface water does not replace 11.53 mgd of well water, *supra*, COL 127, the cost of increased pumping of well water for an additional 11.53 mgd would have been $439/mgd into the Lowrie Ditch and $205/mgd into the Haiku Ditch in 2010 dollars, *supra*, FOF 449. For 11.53 mgd, daily pumping costs would be $2,364 to $5,061. In addition, crop yields on the 17,853 acres irrigated with both surface and well water would decrease by an unknown amount because of higher levels of salt in the irrigation water, or more of the 17,853 acres would have to be left

fallow in the rotation of crops, *supra*, COL 108-109, so that less well water would be used to increased the ratio of surface-to-brackish water.

130. Keeping the East Maui fields in agriculture is important to the long-term sustainability of Maui; and a diversified agricultural industry contributes to greater economic, food, and energy security and prosperity and protects open space and working agricultural landscapes. (FOF 506-507.)

131. In this early stage of transforming from sugarcane to diversified agriculture cultivation on A&B's East Maui fields, the forecasted water requirements continue to evolve and will not become final until every acre has been planted back in another agricultural use. Diversified agricultural uses will also be subject to change, because some potential partners and lessees are expected to rotate multiple crops that could potentially have different crop coefficients. And it is unknown whether every single one of these diversified agricultural uses will come to fruition because so many basic questions about the company's potential agricultural operations remain unanswered. (FOF 344.)

133. The estimated water requirements will change not only because some potential partners and lessees are expected to rotate multiple crops that could potentially have different crop coefficients, *supra*, COL 130, but also because water requirements could change significantly through the use of regenerative agricultural methods. (FOF 345.)

133. Finally, the acreage estimated to need irrigation—26,996 acres—is bound to shrink in the future from Maui's urban growth. The designation of "Important Agricultural Lands" is a commitment to keep these lands in productive agriculture over the long term, and 22,254 acres are so designated. (FOF 515.) Thus, it is not improbable that diversified agriculture will be maintained over the long term on these acres and not on all the acres currently estimated to be in diversified agriculture.

b. MDWS

i. Uses

134. MDWS provides two types of surface water to its users: 1) potable water from its Olinda, Piiholo, and Kamole WTPs, with a combined capacity of 13 mgd and an average daily production of 7.7 mgd; and 2) non-potable water from HC&S's Hamakua Ditch at Reservoir 40

for the Kula Agricultural Park, with two reservoirs with a total capacity of 5.4 million gallons and average daily use of 3.5 mgd. (FOF 90, 92-93, 96, 98, 102.)

135. Current unmet demand is approximately 3.75 mgd, and by 2030, there is a predicted additional need for 1.65 mgd. MDWS anticipates it will need to develop between 4.2 mgd and 7.95 mgd to meet demands through 2030. (FOF 437, 439-440.)

136. MDWS is a purveyor of domestic water uses of the general public, particularly drinking. In this capacity, MDWS serves one of the purposes of the public trust, *supra*, COL 46.

137. "Domestic use" as defined in the Code is distinct from "domestic uses of the general public." In the Code, "'(d)omestic use' means any use of water <u>for individual personal needs</u> and for household purposes such as drinking, bathing, heating, cooking, noncommercial gardening, and sanitation (*emphasis added*)." (HRS § 174C-3.) The purpose of this definition in the Code is to exempt individual users from the permit provisions of the Code: "(N)o permit shall be required for domestic consumption of water by individual users..." (HRS § 174C-48 (a).) On the other hand, "domestic uses of the general public" acknowledges "the general public's need for water," and "the public trust applies with equal impact upon the control of drinking water reserves (*quotation marks in original deleted*) ." (*Waiāhole I*, 94 Haw. at 136-138; 9 P.3d at 448-450.)

138. MDWS is also a non-riparian diverter of East Maui stream waters, and under the common law, its continuing use of stream waters is permissible if the use is reasonable and beneficial and will not actually harm the established rights of appurtenant and riparian landowners. (COL 51-52.)

139. The Public Trust Doctrine applies in all situations, whether or not in a water management area, and whether or not the common law applies. (*Waiāhole I*, 94 Haw. at 133, 9 p.3d at 445.)

140. For MDWS's use of East Maui stream waters, there is a potential conflict between the public trust doctrine and the common law. Under the public trust doctrine, there is a presumption in favor of trust purposes, and competing water uses must be weighed on a case-by-case basis. Under the common law, MDWS's use must not actually harm the established rights of appurtenant and riparian landowners. While some appurtenant rightsholders are also likely to have traditional and customary Hawaiian rights in their exercise of appurtenant rights, *supra*, COLs 93-94, and also have a presumption in their favor, they do not have priority over MDWS as a purveyor of domestic water uses of the general public, and competing uses must still be weighed on a case-by-case basis according to any appropriate standards provided by law.

141. MDWS is a public entity for actual public use. If MDWS's diversions are ruled improper, appurtenant and riparian rightsholders cannot obtain injunctive relief (but may seek damages) against MDWS because of the public use doctrine, *supra*, COL 45.

ii. Losses

142. The 1.1-mile Upper Waikamoi Flume, which serves the Olinda WTP, was estimated to lose as much as 40 percent of total flow through cracks and holes along its whole length. Actual losses could not be measured, because MDWS had no mechanism for quantifying water levels at either the intake or discharge sites of the flume. If reliable capacity of the Olinda WTP is the reported 1.6 mgd, then the flume could have lost as much as 0.64 mgd (1.6 mgd x 0.40) at that level of operation. (FOF 441-444.)

143. MDWS has just completed replacing the entire flume, as well as completely relining the two 15 million-gallon Waikamoi reservoirs and the 2 million-gallon on-site basin a the Olinda WTP. (FOF 445, 448.)

144. With the new flume, MDWS will be able to calculate how much water is coming from the flume on days when the main intake from the dam is dry, which is most of the days. (FOF 446.)

iii. Alternative Sources

145. New reservoirs, which would be fed by streams in times of water surplus for use during times of low flows, are not alternatives to using stream waters but a means of mitigating the impacts of reduced availability of stream waters. Reservoirs mitigate fluctuations in both stream flow and consumer demand, and mitigations in fluctuations in stream flow allow more of it to be used at the proper time. (FOF 450, 452.)

146. New production wells are not an alternative to serve the Upcountry areas in the immediate and intermediate future. Water is heavy, so moving it to higher elevations such as where much of the Upcountry System is located, at 1000 to 4000 feet, from basal aquifers at sea level is projected to cost $1.64 per thousand gallons for distribution from the Kamole-Weir WTP, $4.07 per thousand gallons at the Piiholo WTP, and $593 per thousand gallons at the Olinda WTP. MDWS's current charges for water only average about $4 per thousand gallons, so

just the electrical costs to pump the water is more than what MDWS charges overall for its entire operation. On top of pumping costs, there would be substantial initial capital expenditures and on-going maintenance. (FOF 449.)

147. MDWS has also entered into a Consent Decree, which requires that MDWS conduct vigorous cost/benefit analyses of other water source options before developing ground water in the East Maui region, and has tried unsuccessfully on several occasions to work within the framework of the consent decree to develop new ground water sources. (FOF 449.)

iv. Economic Impact

148. Under the MOU between EMI and MDWS, MDWS can receive 12 mgd with an option for an additional 4 mgd, for a total of 16 mgd. During low-flow periods when ditch flows are greater than 16.4 mgd, both will receive a minimum allotment of 8.2 mgd. If these minimum amounts cannot be delivered, both will receive prorated shares of the water that is available. In recent periods of low Wailoa Ditch flow, EMI has not restricted the allotment of water to MDWS according to the terms of the agreement, and MDWS withdrawals have been limited only by the amounts of water available in the ditch and the physical limitations of the existing Kamole-Weir WTP intake structures. During drought conditions, MDWS may withdraw 6 mgd, and what remains is used by HC&S for irrigation. (FOF 458.)

149. There would be little or no impact if Wailoa Ditch flows were reduced 15 mgd. MDWS would not have full access to the 6 mgd capacity of the Kamole-Weir WTP for 5 days, the same as for the period 2001 to 2011, and less than the maximum of 16 days for the period 1922 to 1987. (FOF 463.)

150. With a 20 mgd reduction in Wailoa Ditch flow and assuming a daily drought period withdrawal of 5.0 mgd, there would not be sufficient water to provide reliable drought period capacity without some mitigating actions. The deficiency only means that 5 mgd could not be withdrawn. Lesser amounts could still be withdrawn from the Wailoa Ditch. Furthermore, while the study defined drought period deficiency as being less than 4.6 mgd of a total capacity of 6 mgd, actual use from the Kamole-Weir WTP has been 3.6 mgd out of the total capacity of 6 mgd. (FOF 464-465.)

151. With the addition of a 100-million gallon reservoir at the Kamole-Weir WTP, the drought period reliable yield with the 20 mgd reduction in Wailoa Ditch flow would be 4.6 mgd,

approximately equal to the existing WTP reliable yield without reductions in ditch flows. (FOF 466.)

152. With a 200-million gallon reservoir, the drought period reliable yield with the 20 mgd reduction in Wailoa Ditch flow increases to 7.1 mgd, an increase of 2.4 mgd compared to a 100-million gallon reservoir and greater than the total capacity of 6 mgd of the Kamole-Weir WTP. (FOF 467.)

153. Estimated costs of a 100- to 200-million reservoir at the Kamole-Weir WTP are $25.25 million, and life-cycle costs over 25 years are estimated at $33 per thousand gallons or $250 million. (FOF 468.)

E. Streams That Have Been or Were Proposed to be Amended

154. Stream restoration for appurtenant uses was the focus of the September 25, 2008 Commission Order and done on a stream-by-stream basis for water rights associated with specific streams. (FOF 2, 3, 8-9.)

155. A geographic approach to stream restoration was taken in the Commission's 2010 order, meaning that flows were restored in selected streams both east and west of Keanae Valley. Benefits of this approach included biological diversity in the East Maui area, and regional diversity in traditional gathering opportunities. (FOF 259a.)

156. The East Maui streams diverted by EMI's Ditch System are in a hydrologically controllable area, and consolidated amendments to their IIFS are not precluded, *supra*, COL 24.

157. A geographic approach to stream restoration is in compliance with the Code, *supra*, COL 80.

158. A geographic approach is the most feasible method of restoring streams that are collectively diverted by EMI's Ditch System, *supra*, COL 81; and streams were selected which would result in the most biological return from additional flow. (FOF 259b.)

1. The Commission’s 2008 Order: Stream-by-Stream Amendments for Appurtenant and Riparian Uses

159. The streams in the September 25, 2008 Commission Order addressed the taro and domestic water needs of Nā Moku members, and were done on a stream-by-stream basis. There were eight streams addressed: Honopou, Hanehoi and its tributary Puolua (Huelo), Piinau, Palauhulu, Waiokamilo, Kualani, and Wailuanui Streams, *supra*, FOF 3.

160. Six of the eight streams had some diverted water restored, for a net restoration of 4.65 mgd (7.19 cfs), *supra*, FOF 201-202. Because estimates of flows under diverted conditions were available for some streams, after adding the restored amounts to existing flows, available stream water was 11.71 mgd (18.12 cfs). Water would be available for the following streams, along with estimated requirements, *supra*, COL 70, 73:

	Available water	Requirements
Palauhulu:	3.56 mgd	1.75-2.02 mgd for taro
Waiokamilo &	3.17 mgd	3.92-4.52 mgd for taro
Wailuanui:	1.97 mgd	
Honopou:	1.29 mgd (0.82 mgd for taro and domestic; 0.47 mgd for habitat)	0.80-0.93 mgd for taro
Hanehoi/Puoloa:	1.72 mgd: (0.98 mgd for taro; 0.74 mgd for Huelo community)	0.30-0.35 mgd for taro

161. For Palauhulu and Hanehoi/Puoloa Streams, taro water requirements are greatly exceeded. Moreover, the taro lo`i water requirements are for flow-through amounts, most of which will exit the lo`i complex and then may either flow into another lo`i complex or back into the stream. Thus, much of the 130,000 to 150,000 taro lo`i water requirements will be available for use by others such as for downstream lo`i complexes and other agricultural uses, or for increased stream flow for improved stream animal habitat, *supra*, COL 72.

a. There are 15,000 to 40,000 gad of net loss between lo`i inflow and outflow from evaporation, transpiration, and percolation through the bottoms and leakage through the banks, with most of the loss through percolation and leakage. (FOF 211.) Of the 130,000 to 150,000 gad of in-flow water, a minimum of 90,000 to 110,000 gad to a maximum of 115,000 to 135,000 gad will out-flow, with much if not most available to downstream lo`i or returned to the stream.

162. However, it is unclear whether or not these amended IIFS were achieved. Commission staff concentrated on making sure that a specific amount of water was always present in the stream, and that the complaints of taro farmers that they were not getting enough water was not material to whether or not staff would have changed their decision to recommend higher releases into the stream. Therefore, most of the amended IIFS were based on low-flow values. (FOF 244.) However, even at the flow values used by Commission staff, the comparision with water requirements has found that such quantities would have been sufficient and even excessive for Palauhulu and Hanehoi/Puolua Streams, *supra*, COL 70, 73, 75. Therefore, it is most likely that the amended IIFS were never fully implemented: either through Commission staff striving to achieve constant IIFS and therefore setting them lower than intended, or to insufficient water in the ditches to restore the streams to the levels intended.

163. Of the two remaining streams, Kualani Stream was first thought to be the easternmost tributary of Waiokamilo Stream and had its IIFS kept at the status quo, but it was subsequently determined to be a separate stream that is below the EMI Ditch System and has never been diverted. (FOF 62, 184.)

164. Piinaau Stream was kept at its status quo IIFS at its lower reach at 40 feet elevation, upstream from its confluence with Palauhulu Stream. Piinaau Stream is dry immediately downstream of the Koolau Ditch, possibly from infiltration losses and diversions at the Ditch. Actual flow measurements are not available because of geographic inaccessibility and a major landslide in 2001. A flow value could not be determined due to the large uncertainty in the hydrological data. Moreover, even with the current flow, the stream exhibited rich native species diversity, offered a variety of recreational and aesthetic opportunities, and the two registered diversions had not indicated a lack of water availability. (FOF 171-72.)

2. The Commission's 2010 Order: Amendments through the Geographic Approach for Stream Restoration

165. Five streams were partially restored to increase habitat availability, and a short-term release of water into Makapipi Stream was conducted to see if a continuous flow from the headwaters to the stream mouth could be achieved. (FOF 259.)

a. The short-term release into Makapipi Stream was unsuccessful in achieving continuous flow. (FOF 287.)

b. For Hanawi Stream, it had adequate flow to sustain native animal populations, but there was a dry reach immediately below the Koolau Ditch, so 0.06 mgd (0.1 cfs) was released to create a wetted pathway from the Ditch to the ocean. (FOF 259.)

c. For Waikamoi, East Wailuaiki, West Wailuaiki, and Waiohue Streams, seasonal restorations were implemented, with wet season (winter) flows set at 64 percent of BFQ_{50} to achieve H_{90} and dry season (summer) flows reduced 20 percent of BFQ_{50} to maintain minimum connectivity for native stream animals to survive in shallow pools without suitable long-term growth or reproduction. (FOF 253.)

166. The results of the evaluation of the seasonal approach were as follows:

a. There was no evidence that the summertime flows were advantageous to the animals. The concept of varying flow over times is well supported in fisheries, but in this case it was not. For example, if the wintertime flows had been returned during the summer and complete flow restoration had been done in the winter, that would have been a seasonal flow approach, and the results might have been completely different. (FOF 283.)

b. Overall, the seasonal flow hypothesis (higher winter flows and lower summer flows) was conceptually coherent, yet not supported by the data. The lack of support for the seasonal flow hypothesis may reflect that the prescribed flow amounts were insufficient (i.e. needed higher flows in summer) or that a year round minimum flow is more appropriate for East Maui streams. (FOF 284.)

3. Reliability of the Estimated Stream Flows

167. Prior to the partial restorations of twelve streams in 2008 and 2010 and subsequent installation of gages in these streams, there were only four active gages, one each in Hanawi Stream, West Wailuaiki Stream, Waiokamilo Stream, and Honopou Stream (which is outside the study area to be described, *infra*). (FOF 103.) Gages had been previously installed on a number of streams for various periods of time and for various years. For example, Makapipi Stream had a gage at 920 feet elevation between 1932-1945; Hanawi Stream had gages at 500 feet elevation between 1932-1947 and again between 1992-1995, and at 1,318 feet elevation between 1914-1915 and again between 1921-Present; and West Wailuaiki Stream had a gage at 1343 feet elevation between 1914-1917 and again between 1921-Present. (FOF 104.)

168. USGS's 2005 Stream Flow Study estimated stream flows under natural (undiverted) and diverted conditions for 21 streams, using a combination of continuous-record gaging-station data, low-flow measurements, and values determined from regression equations developed for the study. For the drainage basin for each continuous-record gaged site and selected ungaged sites, morphometric, geologic, soil, and rainfall characteristics were quantified. Regression equations relating the non-diverted streamflow statistics to basin characteristics of the gaged basins were developed. Regression equations were also used to estimate stream flow at selected ungaged diverted and undiverted sites. (FOF 105-106.)

169. Estimates were made for 50 percent and 95 percent duration total flow (TFQ) and base flow (BFQ). Base flow is the groundwater contribution to flow. Total flow includes all sources; i.e., ground, freshet ("normal" rainfall) and storm waters. A 50 percent duration flow (median streamflow; Q_{50}) means that, for a specific period of time, half of the measured stream flow was greater than the Q_{50} value, and half was less. For example, for measurements of total flows in a particular stream for the specified period of time: 1) if TFQ_{50} = 25 mgd, then total stream flow was above 25 mgd half of the time and below 25 mgd half of the time,; and 2) if TFQ_{95} = 2 mgd, total stream flow was above 2 mgd 95 percent of the time and below 2 mgd 5 percent of the time. (FOF 107-108.)

170. Relative errors between observed and estimated flows ranged from 10 to 20 percent for the 50-percent duration total flow and base flow, and from 29 to 56 percent for the 95-percent duration total flow and base flow. Errors are higher for lower flows because, for the same absolute error in flow, the relative error in percent increases as the actual flow decreases. (FOF 109.)

171. East of Keanae Valley, the 95-percent duration discharge equation generally underestimated total flow (TFQ_{95}), due to gains in flow from groundwater discharge, and within and west of Keanae Valley, the equation generally overestimated total flow, due to loss of water at lower elevations. (FOF 110.)

172. Therefore, when the amended IIFS for both the 2008 and 2010 Commission Orders were approved, it was intended that streamflows be monitored at the proposed IIFS locations, and the IIFS be revised if necessary. (Exh. C-85, p. 63; Exh. C-103, p. 26.)

173. Commission staff has since learned that: 1) the regression estimates used for flows had, in many cases, overstated what those flows would be, so if the sluice gates on the ditches are opened, there still may not be enough flow to meet the amended IIFS; 2) there is a natural

variability in stream flow which may dip below the IIFS, generally due to periods of low rainfall, so guaranteeing that a specific flow is always in the stream and still meet the objective of the IIFS is not possible; and 3) in Wailuanui and Keanae, the Koolau Ditch has only been taking, for the most part, water generated by rainfall, and spring water below the Ditch is what the taro farmers have access to. (FOF 275-276.)

4. Implementation of the Previously Amended IIFS

In addition to whether or not the amended IIFS were achieved, *supra*, COL 172, there are implementation issues that have to be clarified and resolved:

174. Meeting the amended IIFS:

a. "'Instream flow standard' means a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses," *supra*, COL 19.

b. This definition does not limit "a quantity or flow of water or depth of water" to a specific quantity that must be present at the specific location at all times. In fact, the very definitions of "base flow (BFQ)" and "total flow (TFQ or Q)" recognize that stream flows vary, even base flows. BFQ and TFQ are expressed in terms of the percent of time the referenced quantity was present in the stream, *see* COL 168, *supra*. Thus, when all diversions onWaiokamilo Stream were closed, total undiverted flow was expressed as TFQ_{50} or Q_{50}, meaning that the median flow, or the Q_{50}, was 3.17 mgd. (FOF 181.) It does not mean that 3.17 mgd was present at the IIFS location at all times. It means that half of the time, the amount was greater than 3.17 mgd, and the other half of the time, less than 3.17 mgd. As a further example of variations in stream flow, for the Wailoa Ditch, which diverts multiple streams, daily flows between 1922 to 1987 ranged from only 1.16 mgd to as much as 212 mgd. (FOF 74.)

c. Thus, to have a specific quantity in a specific location in a stream cannot be achieved, and an IIFS must be achieved by an average of multiple measurements at the specified location. Furthermore, it would be technically difficult to adjust releases so that the median (half of measurements greater, and half, less) is achieved. Instead, it would probably be easier that the amended IIFS equal the mean or average of all readings. This would be similar to the quantities under water-use permits, in which 12-month moving averages are used to monitor water use, instead of the permitted amount being the maximum amount that could be used under the permit. In the latter instance, over a defined period of time, permit holders would always be limited to using less than what was allowed under their permits.

174. Release of water to meet the amended IIFS.

a. A similar situation would exist to that which was just immediately discussed, *supra*, COL 173, if the release of water was capped at the quantity needed to meet the IIFS. For example, suppose an IIFS is established at 2.0 mgd immediately downstream of a diversion, and the stream is dry at that point. If the diversion from the stream into a ditch were modified to allow the first 2.0 mgd to continue downstream, stream flows 2.0 mgd or less would remain in the stream. However, when the stream flow is greater than 2.0 mgd, flows over 2.0 mgd would be diverted into the ditch. Thus, the stream flow at the IIFS location would always be 2.0 mgd or less, and the mean and median would always be less than 2.0 mgd, because there would be no flows higher than 2.0 mgd to balance against the flows less than 2.0 mgd.

b. Thus, amended IIFS cannot be met unless there are continual adjustments to the ditch modifications, or if the amount allowed to continue downstream is higher than the target IIFS. Either approach presents operational difficulties.

175. Almost all of the stream flows on which the amended IIFS are based are estimates and not observed measurements. (FOF 103-112.) Therefore:

a. In some cases, actual flows may be insufficient to meet the amended IIFS.

b. Values assigned to TFQ and BFQ flows have relative errors ranging from 10 to 20 percent for TFQ_{50} and BFQ_{50} and from 29 to 56 percent for TFQ_{95} and BFQ_{95}. (FOF 109.) The use of BFQ_{50} in determining viable stream habitat (64 percent of $BFQ_{50} = H_{90}$) may result in inaccurate habitat values, and in the evaluation of the effect of increased stream flows from the 2010 Commission Order, the monitoring effort did not include an assessment of whether or not the winter flows, based on 64 percent of BFQ_{50}, had in fact achieved the minimum habitat of H_{90} necessary for growth, reproduction, and recruitment of native stream animals. (FOF 279.)

5. The January 15, 2016 Proposed Order

176. The proposed amended IIFS of January 15, 2016 would have restored the following amounts of flow:

	Amount Restored
Palauhulu Stream	0
Waiokamilo Stream	0
Wailuanui Stream	2.06 mgd (3.19 cfs)
Honopou Stream	2.17 mgd (3.36 cfs)
Hanehoi/Puolua Streams	3.30 mgd (5.12 cfs)
East Wailuaiki Stream	2.39 mgd (3.70 cfs)
West Wailuaiki Stream	2.46 mgd (3.80 cfs)
Waikamoi Stream	1.68 mgd (2.60 cfs)
Waiohue Stream	2.07 mgd (3.20 cfs)
Hanawi Stream	0.06 mgd (0.10 cfs)
Kopiliula/Puakaa Streams	1.81 mgd (2.81 cfs)
Kopiliula 1.75 mgd (2.70 cfs)	
Puakaa 0.06 mgd (0.10 cfs)	
Makapipi Stream	0.60 mgd (0.93 cfs)
Total (with Makapipi Stream):	18.60 mgd (28.80 cfs)
Total (without Makapipi Stream)	18.00 mgd (27.87 cfs)

(1/15/16 Proposed Order, COL 242.)

177. Palauhulu Stream's 2008 amended IIFS of 3.56 mgd would have been amended back to the status quo diverted state, because the IIFS of 3.10 mgd under diverted conditions would have been enough to meet estimated irrigation requirements. (1/15/16 Proposed Order, COLs 178-179.)

178. Waiokamilo Stream was no longer diverted due to BLNR's ordering 6 mgd to be restored; but without diversions, flow was only 3.17 mgd, not 6 mgd. (1/15/16 Proposed Order FOF 160, 162.)

179. The amended IIFS for Palauhulu, Waiokamilo, Wailuanui, Honopou, and Hanehoi/Puolua Streams were expected to provide sufficient flows for irrigation and domestic uses. (1/15/16 Proposed Order, COL 243.)

180. The amended IIFS for Wailuanui, Honopou, and Hanehoi/Puolua Streams also included additional flows for stream habitat restoration, *infra*, COL 182. (1/15/16 Proposed Order, FOF 188, 195, 206.)

181. Whether flows can be increased to serve irrigation requirements from Makapipi Stream were to be determined by a longer test period than initially conducted. (1/15/16 Proposed Order, COL 244.)

182. Flows sufficient to enable growth, reproduction, and recruitment of native stream animals would also have been restored by further amending the IIFS from the 2008 and 2010 Orders for Wailuanui, Honopou, Hanehoi/Puolua, East Wailuaiki, West Wailuaiki, Waikamoi, and Waiohue Streams. The wetted pathway established in the 2010 Order for Hanawi Stream was kept, and Kopiliula/Puakaa Streams had their IIFS amended for stream restoration. (1/15/16 Proposed Order, COL 245.)

183. Kualani and Ohia Streams are below the EMI Ditch system and have never been diverted. (FOF 62.)

184. The IIFS of the remaining 10 streams were kept at their status quo flows as designated on October 8, 1988; i.e., as they were being diverted at that date: Kapaula, Waiaaka, Paakea, Nuaailua, Honomanu, Punalau/Kolea, Haipuaena, Puohokama, and Wahinepee Streams. (1/15/16 Proposed Order, COL 228-238.)

185. Excluding Hanehoi and Piinaau Streams, for which there were no data, Commission staff has estimated that approximately 57.46 mgd (88.90 cfs) of groundwater (base flows, BFQ_{50}) had been diverted by EMI from the streams that were the subject of this contested case, and the total amount diverted by EMI should be calculated from total median flow (TFQ_{50}) to include the contribution of rainfall. (Ueno, Supplemental Testimony, February 24, 2017.)

186. Based on the foregoing premises, the amended IIFS would have restored about (18.00 - 18.60)/57.46, or 31 to 32 percent of base flows that EMI had previously diverted from the 22 of 24 streams that are the subject of this contested case.

187. The amount of total flows diverted from these streams could be calculated but was not presented in this contested case. Moreover, the EMI Ditch System diverts a total of about 42 streams (FOF 63.)

188. From 2008 to 2013, deliveries at Maliko Gulch averaged 117.48 mgd, of which 108.89 mgd originated from the State-EMI lease lands as measured at Honopou Stream. (FOF 445.)

189. MDWS receives surface water from its Upper and Lower Kula flumes and from the Wailoa Ditch. Water collected through the Upper and Lower Kula flumes is removed east of Honopou Stream and not captured by the gages at Honopou Stream. (FOF 68.) The average

production at its Olinda and Piiholo Wastewater Treatment Plants, which receive water from the Upper and Lower Kula flumes, was a total of 4.1 mgd. (FOF 455.)

190. Thus, approximately 113 (108.89 + 4.1) mgd is diverted from the lease lands, including rain water and diversions from other than the 22 streams that are the subject of this contested case. The proposed increase of 18 mgd in the January 15, 2016 Proposed Order would have been about 16 percent of total diversions from 36 streams, *supra*, FOF 63, compared to 31 percent of diverted base flows from the 22 streams,[40] *supra*, COL 186.

F. Balancing of Instream Values and Noninstream Uses

1. Instream Values

a. Reliability of the Estimated Stream Flows

191. COLs 167-173, *supra*, summarized the reliability of the estimated stream flows, which were derived from the USGS's 2005 Stream Flow Study. (FOF 105-106.)

192. Estimates were made for 50 percent and 95 percent duration total flow (TFQ) and base flow (BFQ). (FOF 107-108.) Relative errors between observed and estimated flows ranged from 10 to 20 percent for the 50-percent duration total flow and base flow, and from 29 to 56 percent for the 95-percent duration total flow and base flow. Errors are higher for lower flows because, for the same absolute error in flow, the relative error in percent increases as the actual flow decreases. (FOF 109.) East of Keanae Valley, the 95-percent duration discharge equation generally underestimated total flow (TFQ_{95}), due to gains in flow from groundwater discharge, and within and west of Keanae Valley, the equation generally overestimated total flow, due to loss of water at lower elevations. (FOF 110.)

193. Therefore, when the amended IIFS for both the 2008 and 2010 Commission Orders were approved, it was intended that streamflows be monitored at the proposed IIFS locations, and the IIFS be revised if necessary. (Exh. C-85, p. 63; Exh. C-103, p. 26.)

194. Commission staff has since learned that: 1) the regression estimates used for flows had, in many cases, overstated what those flows would be, so if the sluice gates on the ditches are opened, there still may not be enough flow to meet the amended IIFS; 2) there is a natural

[40] But see the discussion of subsequent estimates of natural and diverted flows provided by Commission staff, *infra*, COL 195.

variability in stream flow which may dip below the IIFS, generally due to periods of low rainfall, so guaranteeing that a specific flow is always in the stream and still meet the objective of the IIFS is not possible; and 3) in Wailuanui and Keanae, the Koolau Ditch has only been taking, for the most part, water generated by rainfall, and spring water below the Ditch is what the taro farmers have access to. (FOF 275-276.)

195. The latest Commission staff's efforts to estimate stream flows, still based primarily on USGS's 2005 study, continue to raise questions on the reliability of specific flows generated by USGS's study and extrapolated by the staff. For example, the USGS estimate included Ohia Stream, which is below the Ditch system, *supra*, FOF 62. Waiokamilo Stream is estimated at 5.62 mgd (8.7 cfs) and was probably the basis for BLNR's ordering that 6 mgd be returned to the stream; however, after restoration, natural flow turned out to be 3.17 mgd, *supra*, FOF 185. Wailuanui Stream is estimated to have an undiverted base flow of 6.1 cfs and a diverted base flow of 1.0 cfs. The Koolau Ditch is the only diversion capturing base flow (FOF 193), but has only been taking, for the most part, water generated by rainfall, *supra*, COL 194. (Gingerich, WT, 10/31/14, summary table; Ueno, Supplemental Testimony, 2/24/17.)

196. Therefore, the Commission cannot rely solely on specific quantities of flows to amend the IIFS until and if such amounts can be reliably determined by actual stream-flow data.

b. Conveyance of Water for Appurtenant and Riparian Uses, Including Such Uses that have Native Hawaiian Traditional and Customary Rights

197. The Commission amends the IIFS for the following streams through a stream-by-stream approach for appurtenant and riparian uses, including such uses that have native Hawaiian traditional and customary rights. From east to west:

a. Makapipi Stream;
b. Wailuanui Stream;
c. Waiokamilo Stream;
d. Palauhulu Stream;
e. Hanehoi/Puolua Stream; and
f. Honopou Stream.

198. Of the streams having amended IIFS for appurtenant and riparian uses, the amended IIFS for Makapipi Stream, Wailuanui Stream, Hanehoi/Puolua Stream, and Honopou Stream will also include stream habitat restoration for fish and other stream animals. Waiokamilo Stream is no longer diverted and its flow of 3.17 mgd meets irrigation requirements, with no additional flows that could be applied to improve stream habitat. There is also no data to calculate flows needed to meet habitat requirements. (January 15, 2016 Proposed Order, COL 182.) For Palauhulu Stream it is questionable whether releases from the Koolau Ditch would reach the dry reach from infiltration losses above its confluence with Piinaau Stream and Store Spring, because for the most part, the Koolau Ditch has been taking water generated from rainfall, and spring water below the Ditch is what the taro farmers have access to. In addition, the gain in habitat would be small. (January 15, 2016 Proposed Order, COL 176-177.) For Piinaau Stream, see COL 200, *infra*.

199. A&B is ceasing all diversions on the streams that were partially restored by the Commission's 2008 Order, plus the two streams that were not: Honopou, Hanehoi/Puolua, Palauhulu, Waiokamilo, and Wailuanui, plus Piinaau and Kualani. (FOF 39.)

200. Presumably, "Kualani" is what was thought to be a tributary of Waiokamilo Stream and now named "East Waiokamilo." (FOF 184.) Kualani Stream itself is below the EMI Ditch system and has never been diverted. (FOF 62.) Piinaau Stream joins Palauhulu Stream before reaching the ocean and was not amended in the Commission's 2008 Order because: 1) a flow value could not be determined due to large uncertainty in the hydrological data; and 2) with the diverted state, the stream still exhibited rich native species diversity, offered a variety of recreational and aesthetic opportunities, and the two registered diversions (other than EMI's) had not indicated a lack of water availability. (FOF 172.)

201. In addition to these streams, A&B is no longer diverting Makapipi, Hanawi, Waiohue, East Wailuaiki, West Wailuaiki, Waikamoi, and Kopiliula/Puakaa Streams and has been ordered by the Commission that they remain undiverted until further notice. (FOF 41.)

202. Of these seven streams, six were the subject of the Commission's 2010 Order on stream restoration, and the seventh, Kopiliula/Puakaa Stream, would have been added under the 2016 Proposed Order. (FOF 259, COL 176.)

203. The Commission adds Makapipi Stream to the five streams that A&B has committed to permanently ceasing all diversions:

a. The streams that will remain undiverted are Makapipi, Wailuanui, Waiokamilo, Pahauluu, Hanehoi/Puolua, and Honopou.

b. Although A&B has committed to permanently ceasing diversions on Piinaau Stream, in its diverted state, the stream still exhibited rich native species diversity, offered a variety of recreational and aesthetic opportunities, and the two registered diversions (other than EMI's) had not indicated a lack of water availability, *supra*, COL 204. A&B is not prohibited from ceasing diversions, however, only that the Commission has determined that Piinaau Stream should be included in the streams from which future noninstream uses may be drawn. To avoid waste, Piinaau Stream waters should remain in the stream until needed in the future.

204. Surface water rights are limited to the base flows, and rain and storm waters are the property of the state, *supra*, COL 40, 48. The Commission therefore has the power to allocate rain and storm waters and must weigh competing public and private water uses on a case-by-case basis. (*Waiāhole I*, 94 Haw. at 142; 9 P.3d at 454.)

205. Appurtenant and riparian users can only access the natural flow of waters in the stream, so rather than trying to estimate how much water is needed and amending the IIFS accordingly, the Commission's approach is to establish the IIFS as that in the stream's undiverted state, with one important limitation. Without setting an IIFS at a specific location, that would mean that the IIFS anywhere in the stream would be the flow that is naturally present and not diverted. This would have the effect of prohibiting any use for appurtenant and riparian purposes.

206. On the other hand, to allow unlimited diversions, the Commission would establish an IIFS at the lowest point in the stream as zero (0.00 mgd), meaning that all stream waters above that location could be diverted, leaving none to arrive at the location of the 0.00 mgd IIFS. This is the current situation with Waiokamilo Stream, where all of the undiverted flow of 3.17 mgd is used for appurtenant and riparian uses, *supra*, COL 198.

207. For Palauhulu Stream it is questionable whether releases from the Koolau Ditch would reach the dry reach from infiltration losses above its confluence with Piinaau Stream and Store Spring, because for the most part, the Koolau Ditch has been taking water generated from rainfall, and spring water below the Ditch is what the taro farmers have access to. In addition, the gain in habitat would be small. (January 15, 2016 Proposed Order, COL 176-177.)

208. Makapipi Stream, Wailuanui Stream, Hanehoi/Puolua Stream, and Honopou Stream will also include stream habitat restoration for fish and other stream animals and will have IIFS near their mouth.

c. Stream Habitat Restoration for Fish and Other Stream Animals, Including Gathering of Such Stream Resources under Native Hawaiian Traditional and Customary Rights

209. The Commission amends the IIFS for the following streams through a geographic approach for stream habitat restoration for fish and other stream animals, including gathering of such stream resources under native Hawaiian traditional and customary rights. From east to west:

a. Makapipi Stream;
b. Hanawi Stream;
c. Waiohue Stream;
d. Kopiliula/Puakaa Stream;
e. East Wailuaiki Stream;
f. West Wailuaiki Stream;
g. Wailuanui Stream;
h. Waikamoi Stream;
i. Hanehoi/Puolua Stream; and
j. Honopou Stream.

210. Of the streams having amended IIFS for appurtenant and riparian uses, *supra*, COL 201, the amended IIFS for Makapipi Stream, Wailuanui Stream, and Hanehoi/Puolua Stream include stream habitat restoration for fish and other stream animals.

211. The amended IIFS for these 10 streams will be the H_{90} as specified in the 2016 Proposed Order, *supra*, COL 180-182 (1/15/16 Proposed Order, FOF 183-224, 242.) In that Proposed Order, it was still to be determined whether or not Makapipi Stream could flow continuously to the ocean, and that issue will be addressed in more detail.

212. The never-diverted flows of Kualani and Ohia Streams continue to provide their natural habitats.

d. Estuaries and Wetlands; Recreational Activities; Waterfalls; Water Quality

213. East Wailuaiki, West Wailuaiki and Waiohue Streams are the three streams with estuaries, *supra*, COL 101, and all are included for habitat restoration.

214. All streams except for Waiaaka Stream and Ohia Stream have palustrial wetlands in the upper watershed of the hydrological unit and have not been affected by the diversions, *supra*, COL 101.

215. Of the streams with outdoor recreational activities and scenic views, *supra*, COL 102, all except for Ohia Stream will have increased flows.

216. Waterfalls, some including plunge pools at their base, and to a lesser extent, springs, constitute the principal aesthetic values in the East Maui streams, *supra*, COL 103. Of the 19 streams with aesthetic values, 11 will have increased flows

217. Of the 10 streams that appear on the 2006 List of Impaired Waters in Hawaii, *supra*, COL 104, four will have their flows increased and Ohia Stream is below the Ditch system and is not diverted. (FOF 62.)

2. Noninstream Values

a. HC&S

218. The aggregate irrigation requirement for the 26,996 acres is 3,305 gpad, or an average daily requirement of 89.21 mgd, *supra*, COL 111.

219. Reasonable system losses are 22.7 percent of total irrigation requirements. For estimated irrigation requirements of 89.21 mgd, losses would be 26.22 mgd, for a gross irrigation requirement of 115.43 mgd(1.294 x 89.21),[41], *supra*, COL 112.

220. Additional reservoirs, recycled wastewater, and Maui Land and Pine are not reasonable alternatives based on analyses of costs, technology, and logistics. In the future, 2.95 mgd to 4.2 mgd—and up to a capacity of 7.9 mgd—might be available from the Kahalui Wastewater Reclamation Facility ("WWRF"), but in order to realize the use of WWRF R-1 water on the East Maui fields immediately north of Kahalui Airport, the following must be completed: 1) upgrade

[41] 115.43 mgd includes 22.7 percent in losses, or 26.22 mgd. Therefore, 115.43 mgd (89.21 mgd + 26.22 mgd) is the gross irrigation requirement. Numbers are not exact due to rounding.

of the WWRF from R-2 to R-1 water capability, with an estimated cost in December 2010 of $4,965,000; 2) a pipeline to Kahului Airport; and 3) a dedicated pipeline from that point to the East Maui fields above the airport, *supra*, COL 113.

221. Brackish well water is practicably available up to 23.09 mgd, beyond which increasing well water to levels close to that when sugarcane was being irrigated would reduce the yield or the acreage of the 17,853 acres planned for cultivation that has access to both surface and well water because of higher levels of salt in the irrigation water, or more of the 17,853 acres would have to be left fallow in the rotation of crops, *supra*, COL 108-109, so that less well water would be used to increased the ratio of surface-to-brackish water, *supra*, COLs 118-129.

222. Therefore, of the estimated gross irrigation requirement of 115.43 mgd, *supra*, COL 219, well water could contribute 23.09 mgd, leaving 92.34 (115.43-23.09) mgd from surface water sources. Approximately 8.59 mgd is diverted by the streams after the lease lands (between Honopou Stream and Maliko Gulch), leaving 83.75 (92.34-8.59) mgd to be contributed by the streams in the lease lands, *supra*, COL 125-126.

223. While keeping the East Maui fields in agriculture is important to the long-term sustainability of Maui, the forecasted water requirements will continue to evolve, and the acreage estimated to need irrigation—26,996 acres—is bound to shrink in the future from Maui's urban growth. The designation of "Important Agricultural Lands" is a commitment to keep these lands in productive agriculture over the long term, and 22,254 acres are so designated. Thus, it is not improbable that diversified agriculture will be maintained over the long term on these acres and not on all the acres currently estimated to be in diversified agriculture, supra, COL 130-133.

b. MDWS

224. MDWS diverts water:

a. at its upper Waikamoi Flume from the Waikamoi, Puohokamoa, and Haipuena Streams (FOF 92);

b. at its lower Waikamoi Flume from the Waikamoi, Puohokamoa, Haipuaena, and Honomanu Streams (FOF 93); and

c. draws water from EMI's Wailoa Ditch, which diverts multiple streams, including all the streams for which amended IIFS are being proposed, except that Waiokamilo Stream is reported as no longer being diverted (FOF 186).

225. The Upper Waikamoi Flume diverts an average of 1.6 mgd from Waikamoi, Puohokamoa, and Haipuaena Streams for treatment into potable water at the Olinda WTP. (FOF 92.)

226. The 1.6 mgd represents 21 percent of the 7.7 mgd average daily potable water production for MDWS's Upcountry System. (FOF 92-93, 96.)

227. From upstream to below the Upper Waikamoi Flume, no habitat has been lost from either flow diversions or barriers on Waikamoi, Puohokamoa, or Haipuaena Streams. (2009 Habitat Availability Study (*see* FOF 121), p. 97, Table 13.)

228. The Lower Waikamoi Flume diverts an average of 2.5 mgd from Waikamoi, Puohokamoa, Haipuaena, and Honomanu Streams. (FOF 93.)

229. The 2.5 mgd represents 32 percent of the 7.7 mgd average daily potable water production for MDWS's Upcountry System. (FOF 92-93, 96.)

230. From below the Upper Waikamoi Flume to below the Lower Waikamoi Flume, Waikamoi Stream has lost 1.8 percent of total habitat units from flow diversion and 3.6 percent from a barrier. (2009 Habitat Availability Study, p. 96-97, Table 13.)

231. For restoration of flows to 64 percent of BFQ_{50}, or H_{90}, DAR had recommended no change at the Upper and Lower Kula Flumes except to address the barriers, recommending instead that flows be restored at the Wailoa Ditch or its counterparts (Ko'olau and Spreckels ditches) and lower for Waikamoi Stream. (Exh. C-103, p. 1-1.)

232. Thus, there are no competing costs and benefits between restoring Waikamoi Stream and continued diversions by MDWS at its Upper and Lower Waikamoi Flumes. MDWS could continue to divert 53 percent of potable water supplies for its Upcountry System, and Waikamoi Stream could be restored to H_{90}.

233. EMI's Wailoa ditch, which diverts multiple streams, including all of the streams for which increased IIFS are being proposed, is the source of water for MDWS's Kamole water treatment facility. The Kamole facility's average daily production is 3.6 mgd, with a capacity of 6 mgd. (FOF 96.)

234. HC&S's Hamakua ditch (the western extension of the Wailoa ditch), at reservoir 40, is the source of water for Kula Agricultural Park. (FOF 98.)

235. Average daily use by MDWS from the Wailoa ditch is 7.1 mgd, which includes water for the Kamole facility and Kula Agricultural Park. (FOF 102.)

236. The impact on MDWS's provision of water for upcountry Kula would be a potential loss of up to 47 percent (3.6 mgd/7.7 mgd) of its average daily potable water production, and loss of the only source of water for Kula Agricultural Park.

237. The proposed amended IIFS would come mostly from the Koolau Ditch, which becomes the Wailoa Ditch as water flows westerly toward HC&S's fields. (*See* Exh. C-1, attached.)

238. MDWS's agreement with EMI provides that MDWS will receive 12 mgd from the Wailoa ditch with an option for an additional 4 mgd. During periods of low flow, no water will be diverted to lower-elevation ditches, and MDWS will receive a minimum allotment of 8.2 mgd and HC&S will also receive 8.2 mgd. If these minimum amounts cannot be delivered, MDWS and HC&S will receive prorated shares of the water available. (FOF 101.)

239. Therefore, the proposed restored flows would come from HC&S's share of the water until Wailoa Ditch flows begin to drop below 16.4 mgd.

240. MDWS's use of 7.1 mgd of water from the Wailoa Ditch would seldom compete with the amended IIFS's increased needs, and if such competition occurs, it would be for only a few days a year. In the future, if MDWS receives the maximum amount under the agreement—16 mgd, *supra*, COL 238—and no amendments are made of the prorated, equal sharing of ditch flows of 16.4 mgd or less, MDWS would have a deficit of about 8 mgd or more. But EMI has not restricted the allotment of water to MDWS according to the terms of the agreement. (1/15/16 Proposed Order, FOF 492.)

241. Finally, resource protection—i.e., instream uses—is not a categorical imperative; there are no absolute priorities among trust purposes—e.g., between stream restoration and domestic uses of the general public, particularly drinking. (*Waiāhole I*, 94 Haw. at 142, 9 P.3d at 454.)

242. The Wailoa Ditch diverts the great majority of the East Maui streams, and any increased diversions to meet MDWS’s occasional deficits would be spread across these streams. Thus, the weighing of costs and benefits is in favor of MDWS's continued use of its share of Wailoa Ditch diversions.

G. Amended Interim Instream Flow Standards (IIFS)

1. Streams with Base Flows Fully Restored

243. Base flows are fully restored to:

a. Makapipi Stream;

b. Wailuanui Stream;

c. Waiokamilo Stream;

d. Palauhulu Stream;

e. Hanehoi/Puolua Stream; and

f. Honopou Stream.

244. Estimates of restorations are:

Makapipi Stream:		from zero base flows to 0.84 mgd (1.3 cfs);
Wailuanui Stream:		from 0.65 mgd (1.0 cfs) to 3.94 mgd (6.1 cfs);[42]
Waiokamilo Stream:		already fully restored at 3.17 mgd;
Palauhulu Stream:		from 3.10 mgd (4.8 cfs) to 7.11 mgd (11 cfs);
Hanehoi/Puolua Stream:		
	a. Puolua Stream:	from 0.71 mgd (1.1 cfs) to 0.97 mgd (1.5 cfs)
	b. Hanehoi Stream:	no data on diverted state, estimated natural flow of 2.52 mgd (3.9 cfs);
Honopou Stream:		from 0.78 mgd (1.2 cfs) to 4.20 mgd (6.5 cfs).

(Ueno, Supplemental Testimony, 2/24/17.)

245. The net restorations from diverted base flows to natural base flows are as follows:

Makapipi Stream:		0.84 mgd (1.3 cfs)
Wailuanui Stream:		3.29 mgd (5.1 cfs) (assuming 0.65 mgd of base flow had been diverted)
Waiokamilo Stream:		already fully restored at 3.17 mgd
Palauhulu Stream:		4.01 mgd (6.2 cfs)
Hanehoi//Puolua Stream:		
	a. Puolua Stream:	0.26 mgd (0.4 cfs)
	b. Hanehoi Stream:	2.52 mgd (3.9 cfs) (assuming all base flow had been diverted)
Honopou Stream:		3.42 mgd (5.3 cfs)
Net restorations:		14.34 mgd (22.2 cfs)

(Ueno, Supplemental Testimony, 2/24/17.)

[42] But see FOF 193 and COLs 194-195, *supra*, where only rainfall has been taken, for the most part from Wailuanui Stream.

2. Streams with $0.64BFQ_{50}$ or H_{90} Flows Restored

246. Stream restoration flows are established for:

1.	Makapipi Stream:*	0.54 mgd (0.83 cfs[43])
2.	Hanawi Stream:	0.06 mgd (0.10 cfs)[44]
3.	Waiohue Stream:	2.07 mgd (3.2 cfs)
4.	Kopiliula/ Puakaa Streams:	2.07 mgd (3.2 cfs) 0.45 mgd (0.7 cfs)
5.	East Wailuaiki Stream:	2.39 mgd (3.7 cfs)
6.	West Wailuaiki Stream:	2.46 mgd (3.8 cfs)
7.	Wailuanui Stream:*	2.52 mgd (3.9 cfs)
8.	Waikamoi Stream:	2.78 mgd (4.3 cfs)
9.	Hanehoi/ Puolua Streams:*	0.71 mgd (1.1 cfs) 0.06 mgd (0.1 cfs)
10.	Honopou Stream:*	2.71 mgd (4.2 cfs)

(Ueno, Supplemental Testimony, 2/24/17.)

247. H_{90} represents flows to establish sufficient habitat for the full growth and reproductive cycles of stream animals, are lower down in the stream, and are included in a stream's base flows. In effect, they establish the flow that must reach the designated H_{90} location in the stream.

248. The four streams marked with an asterisk (*) will also have their base flows fully restored, and H_{90} flows establish the limit of upstream diversions. For example, Honopou Stream will be restored to a base flow of 4.20 mgd, *supra*, COL 244. With a H_{90} of 2.71 mgd, *supra*, COL 246, upstream users could divert up to 1.49 mgd.

249. The remaining 6 streams require additional flows to increase diverted stream flows to the level of H_{90}. The estimated H_{90} flows, *supra*, COL 246, may be more than what additional flows would be required, because there may already be some flows at the designated H_{90} locations in the lower reaches of the streams. Estimated additional flows to reach H_{90} are as follows:

		H_{90} Flow	Existing Diverted Flow	Net Additions
1.	Hanawi Stream:	(wetted pathway only)		0.06 mgd

[43] Decimal point misplaced as 8.3 cfs instead of 0.83 cfs in Ueno, Supplemental Testimony, 2/24/17.

[44] H_{90} flow is estimated as 1.87 mgd (2.9 cfs), but a wetted pathway of 0.06 mgd was deemed sufficient, *supra,* FOF 259.

2.	Waiohue Stream:	2.07 mgd	0 mgd	2.07 mgd
3.	Kopiliula/	2.07 mgd	0 mgd	2.07 mgd
	Puakaa Stream:	0.45 mgd	0 mgd	0.45 mgd
4.	E. Wailuaiki Stream:	2.39 mgd	0 mgd	2.39 mgd
5.	W. Wailuaiki Stream:	2.46 mgd	0 mgd	2.46 mgd
6.	Waikamoi Stream:	2.78 mgd	0.13 mgd	2.65 mgd
			Total Additions	12.15 mgd

(Ueno, Supplemental Testimony, 2/24/17.)

250. Finally, the other two streams that have been or will be fully restored, Waiokamilo Stream and Pauluhulu Streams, will not have designated H_{90} flows, and without a requirement of a specified flow at the lower reaches to provide sufficient flow and connection to the ocean, upstream users could divert the entire stream flows.

251. For Waiokamilo Stream, the estimates were that undiverted flow would be 5.62 mgd (8.7 cfs) and H_{90} would be 3.62 mgd (5.6 cfs); but the actual, undiverted base flow is only 3.17 mgd—likely due to losing reaches below Akeke (Banana) Spring—and sufficient only to meet estimated irrigation requirements. (FOF 181.)

252. For Pauluhulu Stream, which joins Piinaau Stream before they reach the ocean, undiverted, natural flow was estimated at 7.11 mgd (11 cfs), diverted flow at 3.10 mgd (4.8 cfs), and H_{90} flow at 4.52 mgd (7.0 cfs). Piinaau Stream had no flow data, and a landslide complicates any estimates. (Ueno, Supplemental Testimony, 2/24/17.) The 2016 Proposed Order concluded that the estimated diverted flow of 3.10 mgd was more than sufficient to meet estimated irrigation requirements of 1.75 mgd to 2.02 mgd. The Commission’s 2008 Order had added 0.46 mgd, raising the IIFS to 3.56 mgd, and the 2016 Proposed Order would have reduced the IIFS back to 3.10 mgd. The reason for the increase of 0.46 mgd in the 2008 Order was to increase native habitat, but the 2008 Order did not have access to the 2009 Habitat Availability Study and did not explain why habitat availability was the basis for the amended IIFS, when taro cultivation was the focus of the amendment. (FOF 173-174.)

253. The 2016 Proposed Order did not increase stream flows for habitat restoration for the following reasons: 1) Piinaau Stream: a) no flow values and the landslide; and b) the stream already exhibited rich native species diversity, offered a variety of recreational and aesthetic opportunities, and the two registered diversions had not indicated a lack of water availability, FOF 172; and 2) Palauhulu Stream: a) the Koolau Ditch has been taking, for the most part, water generate by rainfall; b) above the confluence with Piinaau Stream and Store Spring, Palauhulu

Stream is dry from infiltration losses; c) it is questionable whether or not releases from the Koolau Ditch would reach the lower reaches; d) spring water below the Ditch is what farmers have access to; e) and the gain in habitat would be small, extending only from near Hana Highway to the dry reach. (1/15/16 Proposed Order, COLs 168-177.)

254. In sum, both Waiokamilo and Palauhulu Streams will not have H_{90} IIFS. If no IIFS are designated, the de facto IIFS would be undiverted stream flows from above the diversions to the stream mouths, and no water could be diverted for irrigation, because the stream flows in COL 244, *supra*, are at the same locations as the H_{90} at the lower reaches of the streams. The H_{90} flows have the effect of allowing irrigation diversions, but leaving enough in the stream such that there are H_{90} flows at the designated locations downstream before the stream waters flow into the ocean.

255. Waiokamilo Stream and Palauhulu Stream will have IIFS of zero (0.00 mgd) at their lowest reaches near Hana Highway. Thus, on both streams, irrigation diversions have no limits.

256. However, the situations of the two streams are different. Waiakomilo Stream's <u>entire natural flow</u> is required to meet estimated irrigation requirements, while it was concluded that Palauhulu's <u>diverted stream flow</u> meets estimated irrigation requirements, *supra*, COL 251-252.

257. While there are no H_{90} flows to set limits on the amount of water diverted, the common law of appurtenant and riparian rights and the public trust doctrine rule: 1) appurtenant rights are superior, *supra*, COL 38; 2) no riparian use is superior over that of others, *supra*, COL 39; and 3) The state water resources trust embodies a dual mandate of protection and maximum reasonable and beneficial use. "In short, the object is not maximum consumptive use, but rather the most equitable, reasonable, and beneficial allocation of state water resources, with full recognition that resource protection also constitutes use." (*Waiahole I*, 94 Haw. at 139-140, 9 P.3d at 451-452.)

258. In setting zero (0) IIFS at what would be the H_{90} locations, the Commission is in effect calling upon the communities that use those two streams to share the waters in an equitable and fair manner, including preserving waters for habitat restoration. For Waiokamilo Stream, it may only be providing a wetted pathway to the ocean. For Palauhulu Stream, it may be a balancing of allocating water between their irrigation needs and stream restoration, because of the stream's natural flow of 7.11 mgd, H_{90} is estimated at 4.52 mgd and irrigation requirements, at 1.75 mgd to 2.02 mgd. (Ueno, Supplemental Testimony, 2/24/17; 1/15/16 Proposed Order, COL 58.) Stream estimates have in many cases overstated what those flows would be, *supra*, COL 194.

259. This proposed, community-based approach to stream restoration is also meant to complement the science-based approach that led to the concept and quantification of H_{90}, which is still an unconfirmed hypothesis. (FOF 278-284.)

260. Finally, of the ten (10) streams that A&B had stated were now undiverted and which the Commission has ordered to remain undiverted until further notice, six are to be restored only for increased habitat—Hanawi, Waiohue, Kopiliula/Puakaa, East Wailuaiki, West Wailuaiki, and Waikamoi Streams. These streams will remain undiverted at least until EMI Ditch diversions increase to the point that their flows are required to meet HC&S's expanding irrigation requirements on their East Maui fields. So for these six streams, the approach that has been taken to restore fish and wildlife habitation—adding water to the minimal H_{90} flows—will be replaced by full restoration and eventually reducing stream flows to H_{90} or whichever flows turn out to be the threshold at which recruitment, retention, and reproduction of stream animals are negatively affected.

261. The practical effect is that there will be three classes of streams to test the H_{90} hypothesis and the larger issue of what threshold flows—not necessarily H_{90}—lead to successful stream habitat rehabilitation:

1. Makapipi, Wailuanui, Hanehoi/Puolua and Honopou Streams: H_{90} sets the floor for upstream diversions, which diversions may or may not reach.
2. Hanawi, Waiohue, Kopiliul/Puakaa, East Wailuaiki, West Wailuaiki, and Waikamoi Streams: H_{90} or its functional equivalent determined by reducing flows from natural levels.
3. Waiokamilo and Palauhulu Streams: Whether communities can share the waters in an equitable and fair manner, including allocating waters for habitat restoration.

3. Allocation of Freshet and Storm Waters

262. Common law appurtenant and riparian rights apply to the groundwater contribution to stream flows (BFQ_{50}), and the State owns freshet and storm waters, *supra*, COL 40.

263. For the streams whose base flows will be fully restored, *supra*, COL 243, freshet (rainfall) water is included in total flows.

264. For the streams that will have flows restored only for habitat, rainfall may be diverted into the EMI Ditch system but shall remain in the streams unless needed.

266. Storm waters may be diverted into the EMI Ditch system, for two primary purposes: 1) to mitigate the effects of flooding in downstream communities; and 2) to encourage the development of irrigation strategies that involve storm water, such as reservoirs for storage and retention basins to recharge the underlying aquifer.

4. Streams That Shall Remain at Status Quo Flows

266. Piinaau Stream will remain at its status quo flow as designated on October 8, 1988. Piinaaui Stream converges with Palauhulu Stream before they reach the ocean, and Palauhulu Stream will be fully restored. However, a flow value for Piinaau Stream could not be determined due to the large uncertainty in the hydrological data. Moreover, with the current flow, the stream exhibited rich native species diversity, offered a variety of recreational and aesthetic opportunities, and the two registered diversions had not indicated a lack of water availability, *supra*, COL 253. EMI has included Piinaau Stream among those it will be permanently restoring, *supra*, FOF 66, but it is not EMI's decision to establish IIFS nor is EMI required to continue diverting streams whose waters are available for diversion into the EMI Ditch system.

267. Kualani (also known as "Hamau") and Ohia (also known as "Waianu") Streams are below the EMI Ditch system and have never been diverted, *supra*, FOF 62, and will remain at their status quo flow as designated on October 8, 1988.

268. Of the 24 streams, *supra*, FOF 61, 63, the remaining nine streams are: Kapaula, Waiaaka, Paakea, Nuaailua, Honomanu, Punalau/Kolea, Haipuaena, Puohokamoa, and Wahinepee Streams, which shall remain at their status quo flows as designated on October 8, 1988.

III. DECISION AND ORDER

The CCH was being held to establish IIFS and not to determine nor limit which parties may use waters available after the IIFS are established. Legal conclusions made in this proceeding pertaining to a particular party's water rights, traditional and customary rights, water use requirements, alternative water sources, and system losses are made without prejudice to the rights of any party and the Commission to revisit these issues in any proceeding involving the use of water from any of the East Maui streams that are the subject of this contested case hearing. The burden of proof with respect to such issues will be upon the petitioner rather than upon the Commission.

In considering a petition to adopt IIFS, the Commission must weigh the importance of the present or potential instream values with the importance of the present or potential uses of water for noninstream purposes, including the economic impact of restricting such uses.

It is the Commission's duty to establish IIFS that protect instream values to the extent practicable and to protect the public interest.

The public interest includes not only protecting instream values but also preserving agricultural lands and assuring adequate water supplies for Maui.

The Commission needs only to reasonably estimate instream and offstream demands, and may base the IIFS not only on scientifically proven facts but also on future predictions, generalized assumptions, and policy judgments.

In amending the IIFS for the 24 streams that are the subject of this contested case, the Commission has increased flows for 12 of the 22 streams that have been diverted by the EMI Ditch system, adding approximately 26.49 mgd to the streams from their diverted base flows, including 6 streams that will have their flows returned to their undiverted, natural flows. An undetermined amount of rainwater would also be returned to these 6 streams. (FOF 243-249, 263.)

For noninstream uses, the Commission estimates that maximum requirements would be 83.75 mgd for HC&S and 16 mgd for MDWS. (FOF 448, 461.) However, HC&S’s projections are for 26,996 acres, of which 22,254 acres are Important Agricultural Lands, and the requirements for actual irrigated fields are bound to change, and total acreage may be reduced to as low as 22,254 acres due to the urbanization of Maui. (COLs 131-133.)For MDWS, 16 mgd is the maximum deliveries from EMI under the agreement, and projected future needs to 2030 are for an additional 4.2 mgd to 7.95 mgd in addition to the current 7.1 mgd delivered by the Wailoa Ditch. (FOF 461, 470.)

Between 2011-2014, approximately 108.89 mgd was diverted by EMI from the lease lands as measured at Honopou Stream. (FOF 444.) During this time, from the combined 2008 and 2010 Commission Orders, wet season restoration was 13.95 mgd and dry season restoration was 5.61 mgd. (FOF 14.) If we assume that these amounts would be included in the 26.49 mgd of base flows that will be returned to the streams, the additional restoration over the 2008 and

2010 Orders would be 12.54 mgd to 20.88 mgd, leaving 88.01 mgd to 96.35 mgd of the 108.89 mgd that was diverted.

Compared to the maximum requirements for HC&S of 83.75 mgd and MDWS of 16 mgd, the total of 99.75 mgd is only 3.4 mgd to 11.74 mgd short of the estimated surface water that would be available and well within what might be reasonably expected to be actually required in the future.

A. Amended IIFS

The Commission's Order of July 18, 2016 that Makapipi, Hanawi, Waiohue, Kopiliula/Puakaa, East Wailuaiki, West Wailuaiki, Wailuanui (East and West), Waiokamilo, and Waikamoi Streams remain undiverted is hereby rescinded, to be replaced by the following amended IIFS. EMI may continue to leave the streams undiverted that the Commission has not ordered to fully restore base flows, until EMI Ditch diversions increase to the point that their flows are required to meet HC&S's expanding irrigation requirements on their East Maui fields. (COL 260.)

The IIFS of the following streams are amended from their previous IIFS, at the approximate locations specified, with final locations approved by the Commission, if necessary, after implementation by Commission staff.

The IIFS are the estimated $0.64xBFQ_{50}$ (H_{90}) flows for stream restoration, and the numbers are only estimates, to be eventually confirmed by actual flows from which the H_{90} can be established, and for which stream restoration results in recruitment, retention, and reproduction of stream wildlife. The zero (0) IIFS for Waiokamilo and Palauhulu have been explained in COL 251-259, *supra*.

Makapipi Stream:	IIFS:	0.54 mgd (0.83 cfs)
	Location:	Downstream of Koolau Ditch, near Hana Highway
	Natural (undiverted) flow estimated at 0.84 mgd (1.3 cfs)	
	Amount available for diversions upstream: 0.30 mgd (0.47 cfs)	
Hanawi Stream:	IIFS:	0.06 mgd (0.10 cfs)
	Location:	Downstream of Koolau Ditch, near Hana Highway
	Diverted flow:	0.00 mgd (0.00 cfs)
	Amount available for diversions upstream: 0.00 mgd (0.00 cfs)	

Waiohue Stream: IIFS: 2.07 mgd (3.2 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Diverted flow: 0.00 mgd (0.00 cfs)
Amount available for diversions upstream: 0.00 mgd (0.00 cfs)

Kopiliula/ IIFS: 2.07 mgd (5.2 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Diverted flow: 0.00 mgd (0.00 cfs)
Amount available for diversions upstream: 0.00 mgd (0.00 cfs)

Puakaa Stream: IIFS: 0.45 mgd (0.7 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Diverted flow: 0.00 mgd (0.00 cfs)
Amount available for diversions upstream: 0.00 mgd (0.00 cfs)

East Wailuaiki Stream: IIFS: 2.39 mgd (3.7 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Diverted flow: 0.00 mgd (0.00 cfs)
Amount available for diversions upstream: 0.00 mgd (0.00 cfs)

West Wailuaiki Stream: IIFS: 2.46 mgd (3.8 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Diverted flow: 0.00 mgd (0.00 cfs)
Amount available for diversions upstream: 0.00 mgd (0.00 cfs)

Wailuanui Stream: IIFS: 2.52 mgd (3.9 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Natural (undiverted) flow estimated at 3.94 mgd (6.1 cfs)
Amount available for diversions upstream: 1.42 mgd (2.2 cfs)

Waiokamilo Stream: IIFS: 0.00 mgd (0.00 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Natural (undiverted) flow estimated at 3.17 mgd (4.90 cfs)
Amount available for diversions upstream: 3.17 mgd (4.90 cfs)

Palauhulu Stream: IIFS: 0.00 mgd (0.00 cfs)
Location: Downstream of Koolau Ditch, near Hana Highway
Natural (undiverted) flow estimated at 7.11 mgd (11 cfs)
Amount available for diversions upstream: 7.11 mgd (11 cfs)

Waikamoi Stream: IIFS: 2.78 mgd (4.3 cfs)

	Location:	Downstream of Koolau Ditch and downstream of confluence with Alo Stream, near Hana Highway
	Diverted flow estimated at 0.13 mgd (0.2 cfs)	
	Amount available for diversions upstream: 0.00 mgd (0.00 cfs)	
Hanehoi/	IIFS:	0.71 mgd (1.1 cfs)
	Location:	downstream of the Haiku Ditch.
	Natural (undiverted) flow estimated at 2.52 mgd (3.9 cfs)	
	Amount available for diversions upstream: 1.81 mgd (2.8 cfs)	
Puolua Stream:	IIFS:	0.06 mgd (0.1 cfs)
	Location:	downstream of the Haiku Ditch.
	Natural (undiverted) flow estimated at 0.97 mgd (1.5 cfs)	
	Amount available for diversions upstream: 0.91 mgd (1.4 cfs)	
Honopou Stream:	IIFS:	2.71 mgd (4.2 cfs)
	Location:	downstream of the Haiku Ditch.
	Natural (undiverted) flow estimated at 4.20 mgd (6.5 cfs)	
	Amount available for diversions upstream: 1.49 mgd (2.3 cfs)	

B. Status Quo IIFS

The remaining streams shall continue with their status quo IIFS as of October 8, 1988 (*See* COL 266-268).

C. Method of Monitoring

Monitoring of the IIFS will be through 12-month moving averages. This method recognizes that requiring a specific amount of flow at all times at a specific location is incompatible with the objectives of providing sufficient flow to meet irrigation and domestic requirements and/or providing sufficient habitat for growth, reproduction, and recruitment of native stream animals. (*See* COL 167-173, 191-196.)

D. Reporting

Approximately one year from the date of this Order, the following information shall be provided on a regular basis, the intervals to be determined after consultation with Commission staff:

a. Commission staff shall report on:

1. Whether or not continuous flow could be established in Makapipi Stream.

2. All other aspects of the implementation of the amended IIFS.

b. DAR is requested to report on:

1. The Commission has no authority over DAR and therefore requests that BLNR authorize DAR to perform the following tasks:

a. Whether or not the flows implemented for East Wailuaiki, West Wailuaiki, Waikamoi, and Waiohue Streams that were estimated at 64 percent of BFQ_{50} did in fact result in H_{90} habitat.

b. Whether or not the assumptions that there is a treshold and that it is H_{90} are inconclusive or conclusive.

c. How it will evaluate the three classes of restoration methods identified in COL 261 and discussed in COL 246-260, *supra*.

c. Nā Moku shall report on:

1. Adequacy of water deliveries in terms of inflow quantity and outflow water temperatures from Pauluhu Stream, Waiokamilo and Wailuanui Streams, Honopou Stream, and Hanehoi/Puolua Streams, including taro loi from which outflows continue to lower loi or return to the stream; and loi from which outflows are not reused or returned.

2. Actual and potential maintenance, irrigation and farming practices for more efficient use of stream waters.

3. Nā Moku members as "konohiki" for the streams that they use for irrigation and/or domestic uses, including managing their uses so that the downstream IIFS for habitat restoration are met.

d. EMI shall report on:

1. Modifications to diversions to meet the amended IIFS.

2. Water deliveries at Honopou Stream and Maliko Gulch, and any changes EMI ascribes to the amended IIFS.

3. Changes in stream diversions and ditch settings as HC&S's irrigation requirements increase.

e. HC&S shall report on:

1. Surface, pumped, and total water usage.

2. Crops and acreage planted.

3. Changes in its initial diversified agriculture plan, including major changes in type of crops planned and reduction of planned irrigation acres through changes in use or sales of land.

f. MDWS shall report on:

1. Water deliveries at the Upper Waikamoi Flume, including any amounts ascribed to reduced losses from replacing the flume.

2. The status of plans for a 100-million or 200-million gallon reservoir at the Kamole WTP.

EAST MAUI DITCH SYSTEM
NAHIKU TO MALIKO
EAST MAUI IRRIGATION COMPANY, LIMITED
PAIA, HAWAII
GRAPHIC SCALE IN FEET
0 1000 2000 3000 4000 5000
DATED: APRIL 1970
REVISED: JUNE 5, 2003
FEBRUARY 28, 2004
LEGEND
Gulches or Streams
Roads
Land Boundary Line
Ditches
Tunnels
Water Development Tunnels
Jeep Roads
Trails
Reservoirs
Water License Boundary Line
Water Measuring Station
Rain Gage
Triangulation Station
Ditch Trail Station
Intakes
LAND HOLDINGS
Government
East Maui Irrigation Company, Limited - Fee
E. M. I. Co., Ltd. et al - Undivided Fee
E. M. I. Co., Ltd. et al - Multiple Claim Fee
Alexander & Baldwin, Inc. - Fee
REVISED MAP PREPARED BY
RONALD M. FUKUMOTO ENGINEERING, INC.
C-1
PACIFIC OCEAN
PACIFIC OCEAN
HUELO LICENSE
G.L. 3578
Expires June 30, 1981
Government Water 64.49%
Private Water 35.51%
HONOMANU LICENSE
G.L. 3695
Expires June 30, 1986
Government Water 47.39%
Private Water 52.61%
KEANAE LICENSE
G.L. 3349
Expires June 30, 1971
Government Water 79.19%
Private Water 20.81%
NAHIKU LICENSE
G.L. 3505
Expires June 30, 1976
Government Water 95.02%
Private Water 4.98%
KOOLAU FOREST RESERVE
KOOLAU FOREST RESERVE
MAKAPUU
HAIKU DITCH
LOWRIE DITCH
NEW HAMAKUA DITCH
WAILOA DITCH
SPRECKELS DITCH
MANUEL LUIS DITCH
CENTER DITCH
KOOLAU DITCH
HAIKU
LOWRIE
WAILOA
KAMOLE WEIR
MAUNAOLU WEIR
MALIKO WEIR
MALIKO BAY
PAIA
KOKOMO
NAHIKU LANDING
WAILUA HOMESTEAD
KEANAE HOMESTEAD
6 FT. MODIFIED PARSHALL FLUME
MAKAWAO FOREST RESERVE

DIAGRAM OF HAWAIIAN COMMERCIAL & SUGAR CO. DITCH SYSTEM WITH DITCH & RESERVOIR CAPACITIES

C-33

FEBRUARY 2008