DEPARTMENT OF THE CORPORATION COUNSEL 205

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JAN - 6 2014

Attorneys for COUNTY OF MAUI,
DEPARTMENT OF WATER SUPPLY

COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII

'Iao Ground Water Management Area High-Level Source Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihe'e, Waiehu, 'Iao & Waikapu Streams Contested Case Hearing	Case No. CCH-MA06-01 COUNTY OF MAUI, DEPARTMENT OF WATER SUPPLY'S EXHIBIT LIST; EXHIBITS "B-R1" TO "B-R13"; CERTIFICATE OF SERVICE

COUNTY OF MAUI,
DEPARTMENT OF WATER SUPPLY'S EXHIBIT LIST

MDWS Exhibit No.	Description	References	Admitted in Evidence
B-R1	Second Amendment to Agreement Concerning Withdrawal From The Iao/Waikapu Ditch, dated February 27, 2008	DWS Trial Brief, p. 3; Declaration of David Taylor (hereafter, "Taylor Decl."), ¶ 12, 13.	

MDWS Exhibit No.	Description	References	Admitted in Evidence
B-R2	DWS's SWUPA-E, dated March 31, 2009	DWS Trial Brief, p. 3; Taylor Decl., ¶ 14.	
B-R3	DWS's SWUPA-N, dated March 31, 2009	DWS Trial Brief, p. 3; Taylor Decl., ¶ 14.	
B-R4	Letter from CWRM to DWS, dated April 23, 2009	DWS Trial Brief, p. 3; Taylor Decl., ¶ 14.	
B-R5	Letter from CWRM to DWS re DEC-ADM97-A1 Modification of Water Use Permit (WUP No. 699 to WUP No. 921) for Well No. 5332-05, dated June 2, 2011	DWS Trial Brief, p. 5.	
B-R6	Letter from CWRM to DWS re DEC-ADM97-A1 Modification of Water Use Permit (WUP No. 680 to WUP No. 920) for Well No. 5332-02, dated June 2, 2011	DWS Trial Brief, p. 5.	
B-R7	Maui County General Plan 2030 (Chapter 1: Population)	Declaration of Michele McLean (hereafter, "McLean Decl."), ¶ 19; Taylor Decl., ¶ 33.	
B-R8	Expert Report of Brown and Caldwell, dated December 27,2013	DWS Trial Brief, pp. 14-23; Declaration of Craig C. Lekven, P.E. (hereafter, "Lekven Decl."), ¶ 10.	
B-R9	Plaintiff's Motion to Enforce Consent Decree, filed February 28, 2013, in Civil No. 03-1-0008(3)	DWS Trial Brief, pp. 15, 16; Taylor Decl., ¶ 43.	

B-R10	Order Granting Plaintiff's Motion to Enforce Consent Decree, filed November 14, 2013, in Civil No. 03-1-0008(3)	DWS Trial Brief, p. 16; Taylor Decl., ¶ 43.	
B-R11	Maui County Department of Water Supply Water Conservation Efforts	DWS Trial Brief, pp. 19, 20; Declaration of Pamela Pogue (hereafter, "Pogue Decl."), ¶ 10.	
B-R12	Expert Report of Paul H. Brewbaker, Ph.D., dated December 31, 2013	DWS Trial Brief, pp. 23-27; Declaration of Paul H. Brewbaker, Ph.D. (hereafter, "Brewbaker Decl."), ¶ 11.	
B-R13	Maui County Water Use and Development Plan Central DWS District Plan Update - Exhibit A, dated November 16, 2010 (adopted by Ordinance No. 3804, effective December 27, 2010)	Taylor Decl., ¶ 33; Pogue Decl., ¶ 7.	

In addition to the above-listed exhibits, the County reserves the right to introduce other documents at the remand hearing for purposes of impeachment or rebuttal.

The County also requests that the Hearing Officer take Judicial Notice of all exhibits introduced in the original proceeding and the complete contents of the Commission on Water Resource Management's ("CWRM's") files relative to this matter, including all Water Use Permit Applications, all correspondence, and all other official filings relating to the subject of this contested case hearing.

The County also requests that the Hearing Officer take Judicial Notice of the Water Use Permits previously issued to the County Department of Water Supply for the basal and high-level portions of the Iao Aquifer, and the findings and conclusions of CWRM in connection therewith.

DATED: Wailuku, Maui, Hawaii, January 3, 2014

PATRICK K. WONG
Corporation Counsel
JENNIFER M.P.E. OANA
Deputy Corporation Counsel

Attorneys for
COUNTY OF MAUI, DEPARTMENT OF WATER SUPPLY

By _____
JENNIFER M.P.E. OANA
Deputy Corporation Counsel

SECOND AMENDMENT TO AGREEMENT CONCERNING
WITHDRAWAL FROM THE IAO/WAIKAPU DITCH

This Amendment is made this 27 day of February, 2008, by and between WAILUKU WATER COMPANY, LLC, a Hawaii limited liability company (successor in interest to Wailuku Agribusiness Co., Inc.), whose address is 255 East Waiko Road, Wailuku, Maui, Hawaii, 96793, hereinafter referred to as "Wailuku", and the COUNTY OF MAUI, through its DEPARTMENT OF WATER SUPPLY, whose address is 200 South High Street, Wailuku, Maui, Hawaii, 96793, hereinafter referred to as "DWS".

W I T N E S S E T H:

WHEREAS, Wailuku Agribusiness Co., Inc. and DWS entered into that certain unrecorded Agreement Concerning Withdrawal from the Iao/Waikapu Ditch dated June 9, 2004, hereinafter called "Agreement", wherein Wailuku Agribusiness Co., Inc. allowed DWS to withdraw surface water from the Iao/Waikapu Ditch for the purpose stated in said Agreement; and

WHEREAS, Wailuku Agribusiness Co., Inc. assigned its interest in said Agreement to Wailuku; and

WHEREAS, by agreement entitled "Amendment to Agreement Concerning Withdrawal from the Iao/Waikapu Ditch" dated November 29, 2007, the parties amended the Agreement by extending the term of the Agreement to February 29, 2008; and

WHEREAS, Wailuku and DWS wish to further amend the Agreement with respect to the term of the Agreement;

EXHIBIT "B-R1"

NOW, THEREFORE, the parties hereto agree that the Agreement is hereby amended to extend the term of the Agreement from March 1, 2008 to March 1, 2011, provided, however, as to the payment for the delivery of water by Wailuku to DWS, the price for delivery shall be amended to equal the tariff rate applicable to DWS, as determined by the Public Utility Commission (P.U.C.) of the State of Hawaii in Docket No. 2008-0025; said rate to commence upon on final order of the P.U.C. under the referenced docket, provided further the volume of water required to be delivered by Wailuku to DWS under this Agreement can be amended by Wailuku, at its discretion, after the Commission on Water Resource Management has determined the Interim Instream Flow Standards under Case No. CCH-MA06-01. Such modified volume shall be effective upon written notice of the same by Wailuku to DWS.

Wailuku and DWS agree that it is necessary for DWS to make certain changes to its in-take from the Iao/Waikapu Ditch in order for DWS to effectively withdraw surface water from the Iao/Waikapu Ditch for the purpose stated in this Agreement. DWS covenants that it will design such changes, such design being subject to Wailuku's reasonable written approval of the same, and DWS will complete the construction of such approved changes at its sole expense no later than six (6) months from the date of this Second Amendment. Failure by DWS to complete such

construction within said six (6) month period shall result in the right of Wailuku to terminate this Agreement by written notice to DWS.

No other amendments are made herein, and Wailuku and DWS do hereby ratify, confirm and acknowledge as being in full force and effect all of the terms and conditions of the Agreement not amended hereby.

IN WITNESS WHEREOF, Wailuku and DWS have executed this instrument the day and year first above written.

WAILUKU WATER COMPANY, LLC

By: _____
AVERY B. CHUMBLEY
Its Manager

"Wailuku"

COUNTY OF MAUI

By: _____
CHARMAINE TAVARES
Its Mayor

APPROVAL RECOMMENDED:

_____
JEFFREY ENG
Director of Water Supply

_____
KALBERT Y. YOUNG
Director of Finance

APPROVED AS TO FORM
AND LEGALITY:

_____
EDWARD S. KUSHI, JR.
Deputy Corporation Counsel
County of Maui

STATE OF HAWAII)
) SS.
COUNTY OF MAUI)

On this 3rd day of March, 2008, before me personally appeared AVERY B. CHUMBLEY, to me personally known, who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable, in the capacity shown, having been duly authorized to execute such instrument in such capacity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

L.S.

Notary Public, State of Hawaii

Print Name: Terianne L. Arreola

My commission expires: August 15, 2010

STATE OF HAWAII)
)SS.
COUNTY OF MAUI)

On this 27 day of February, 2008, before me personally appeared CHARMAINE TAVARES, to me personally known, who, being by me duly sworn or affirmed, did say that she is the Mayor of the County of Maui, a political subdivision of the State of Hawaii, and that the seal affixed to the foregoing instrument is the lawful seal of the said County of Maui, and that the said instrument was signed and sealed in behalf of said County of Maui by authority of its Charter, and the said CHARMAINE TAVARES acknowledged the said instrument to be the free act and deed of said County of Maui.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Linda K Tamashiro

Notary Public, State of Hawaii

Print Name: LINDA K. TAMASHIRO

My commission expires: 10/19/2010

LS

CHARMAINE TAVARES
Mayor

JEFFREY K. ENG
Director

ERIC H. YAMASHIGE, P.E., L.S.
Deputy Director

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

March 31, 2009

Honorable Laura H. Thielen, Chairperson
Commission on Water Resource Management
State of Hawaii Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Chairperson Thielen:

Subject: Application for Surface Water Use Permit for *Existing Use* in the Na Wai Eha, Maui, Surface Water Management Areas

Please find attached 15 copies of the Maui County Department of Water Supply's (DWS) "existing use" Water Use Permit Application Form SWUPA-E for 1.784 mgd from the Iao Ditch. In some instances, the format of the SWUPA-E form did not seem to be applicable to a municipal purveyor of water such as the DWS and we therefore provide supplemental and clarifying information to this form below.

Land Use Consistency and Efficiency
Land use consistency and efficiency of use must be described in relation to the Central Maui System as a whole, as Iao ditch along with DWS wells in Iao and Waihee aquifers are mixed so that the Iao ditch source can serve different areas within the system. In lieu of Table 2 "Land Use Consistency/Efficiency" on Form SWUPA-E, please find below water use categories, quantity in gallons per day, and number of services per water use category for existing uses with active consumption at the time of surface water management area designation. The requested amount of 1.784 mgd is DWS's highest monthly average withdrawal in the last ten years. While the current agreement with Wailuku Water Company (WWC) "Second Amendment to Agreement Concerning Withdrawal from the Iao/Waikapu Ditch" dated February 27, 2008 makes available 3.2 mgd and DWS has needs for greater withdrawals, these were limited by treatment plant capacity and the infrastructure at the time of designation. DWS has withdrawn municipal supply from Iao ditch since the 1930s. As the requested amount would serve existing uses throughout the Central Maui system, the requested amount per water use category from Iao ditch is the percentage of existing use that each water use category represents of the total water use for the Central Maui system.

The Department of Water Supply is an Equal Opportunity provider and employer. To file a complaint of discrimination, write: USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington DC 20250-9410. Or call (202) 720-5964 (voice and TDD)

EXHIBIT "B-R2"

Printed on recycled paper

Current state land use district and County zoning codes can not be identified for all existing individual meters on the Central Maui system. However, building permits for new homes and businesses requires underlying appropriate zoning and State land use district for approval.

Table 2: Land Use Consistency/Efficiency

Water Use Category	# Active Meters per 4/30/08	AVG Monthly Use per 4/30/08 in 1000 gal	AVG GPD/Water Use Category	AVG GPD/Meter	Water Use/Total Use	Requested Amount GPD
AGRICULTURE	19	6,410.01	210,164.26	11,061.28	1.051%	18,754.44
GOVERNMENT	203	55,033.67	1,804,382.62	8,888.58	9.026%	161,017.76
COMMERCIAL	874	72,327.85	2,371,404.92	2,713.28	11.862%	211,617.15
GOLF PRIVATE	2	14.5625	477.46	238.73	0.002%	42.61
HOTEL	71	57,992.66	1,901,398.77	26,780.26	9.511%	169,675.20
INDUSTRIAL	149	24,392.97	799,769.34	5,367.58	4.001%	71,369.05
IRRIGATION PRIVATE	42	5,815.25	190,663.85	4,539.62	0.954%	17,014.28
MULTI FAMILY	512	101,409.28	3,324,894.34	6,493.93	16.631%	296,703.73
MULTI FAMILY LOW RISE	9	5,933.82	194,551.48	21,616.83	0.973%	17,361.20
RELIGIOUS	84	3,322.02	108,918.77	1,296.65	0.545%	9,719.59
SCHOOL PRIVATE	1	107.195	3,514.59	3,514.59	0.018%	313.63
SINGLE FAMILY	16,830	275,727.31	9,040,239.75	537.15	45.220%	806,724.23
UNKNOWN	19	1,260.22	41,318.52	2,174.66	0.207%	3,687.14
	18,815	609,746.81	19,991,698.69		100.000%	**1,784,000.00**

Irrigation Information

At this time DWS does not serve non-potable water on our Central Maui system. Some preliminary research of potential commercial projects where reclaimed water can off-set potable sources have been initiated in the Water Use and Development Plan (WUDP) process. DWS strongly encourages new developments to utilize non-potable sources where available, such as on site brackish wells. Commercial properties are required to use reclaimed water for non potable needs if located within 100 feet of a R-1 reclaimed water distribution line.

Alternative Analysis

We note that the various categories on CWRM's Table 4 are not specified in the State Water Code. HRS § 174C-49 sets forth the criteria that applicants must meet. Nonetheless, DWS addresses each category on Table 4 to the best of its ability. In doing so, DWS does not waive its legal objections to the imposition of these specific categories. DWS has no real, practical alternatives to the requested existing uses. DWS has considered drilling new wells in the Northern portion of the Waihee aquifer and in the Kahakuloa aquifer, but CWRM has asked

DWS to limit its withdrawals from the Waihee aquifer, and recent discussions with USGS have led DWS to conclude that new wells in these areas may not be as productive or cost-effective as previously hoped. USGS has advised DWS that the Waikapu aquifer may be a better place to seek new sources of supply and since 2006 (FY 2007) DWS has budgeted and received County Council approval for well development in the Waikapu aquifer. However, the current sustainable yield of that aquifer is 3 mgd, and DWS faces competition from private landowners for the available water in the Waikapu aquifer.

Moreover, DWS is precluded from developing more wells in East Maui in the immediate future due to the entry on December 22, 2003 of a consent decree in The Coalition to Protect East Maui Water Resources et al. v. Board of Water Supply et al., Civil No. 03-1-0008(3). In that case, the Plaintiffs demanded that before looking to East Maui as a source of groundwater, DWS look first to surface water drawn from the Waikapu, Iao, and/or Waihee hydrologic units. Therefore, DWS has vigorously pursued surface water sources as required under the Consent Decree.

CWRM's chart does not include conservation as a specific category, but DWS recognizes that conservation efforts can be a very cost effective way to stretch a limited water supply. DWS's conservation efforts include a program that provides low-flow fixtures, free of charge, and public education programs. These efforts have been successful in reducing demand by about 500,000 gallons per day. DWS has stepped up conservation efforts with additional conservation staff responsible for leak detection in water systems, commercial and industrial operations, residences, and irrigation systems; repair or arranging for repair of leaks and other problems identified; replacement of fixtures as appropriate; suggestions for plant materials as appropriate; analysis and presentation of findings; and public presentations and meetings with community groups and homeowners' associations to increase awareness of and compliance with good conservation practices.

A request for a voluntary 10 % reduction in water use from customers on the Central Maui has been remarkably successful in achieving the voluntary cutback goal of 25.5 mgd, even in the dry summer months.

We respectfully request that the Commission on Water Resource Management issue an "existing use" Surface Water Use Permit to DWS for 1.784 mgd from the Iao Ditch. We also ask that you please copy Deputy Corporation Counsel Jane Lovell with all correspondence relating to this "existing use" application.

Sincerely,

Jeffrey K. Eng
Director
emb

c: Engineering Division
Jane Lovell, Deputy Corporation Counsel
Ed Kushi, Jr. Deputy Corporation Counsel

attachments:
Iao Ditch Water Use Permit Application Form SWUPA-E (15 copies) with 4 exhibits:
1. USGS Topographic map
2. Property Tax Map Key maps
3. Photographs of stream diversion and ditch intake
4. GIS maps of end use/service areas

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

APPLICATION FOR SURFACE WATER USE PERMIT FOR *EXISTING USE* IN THE NA WAI EHA, MAUI, SURFACE WATER MANAGEMENT AREAS

FORM SWUPA-E (NA WAI EHA, MAUI)

For detailed instructions on filling out this application, refer to the attached instructions.

For Official Use Only:

RECEIVED

09 APR 3 A8:56

Event ID:

APPLICANT INFORMATION: Note: In accordance with §174C-51(1)(B), HRS, *In the event a lessee, licensee, developer, or any other person with a terminable interest or estate in the land, which is the water source of the permitted water, applies for a water permit, the landowner shall also be stated as a joint applicant for the water permit.*

1. APPLICANT'S NAME	Applicant's Contact	2. SOURCE LANDOWNER'S NAME	Source Landowner's Contact
Maui County Department of Water Supply	Jeffrey K. Eng, Director	Not Applicable per HRS 174C-51(1)(B)	

Applicant's Mailing Address, or Principal Place of Business	Source Landowner's Mailing Address, or Principal Place of Business
200 S. High Street Wailuku, Hawaii 96793	

Applicant's Phone	Applicant's Fax	Applicant's E-mail	Source Landowner's Phone	Source Landowner's Fax	Source Landowner's E-mail
808 270 7816	808 270 7833	jeffrey.eng@co.maui.hi.us			

EXISTING SOURCE INFORMATION

The following must be attached before this application is accepted as complete:
- Portion of 7.5-Minute Series USGS topographic map (scale 1:24,000) labeled with stream and diversion locations and quad map name.
- Property Tax Map Key (TMK), showing stream or diversion location, and location of water use referenced to established property boundaries.
- Photograph(s) of the surface water diversion works and end use.

SURFACE WATER HYDROLOGIC UNIT AND CODE: ☐ Waihee/6022 ☐ Waiehu/6023 ☒ Iao/6024 ☐ Waikapu/6001

4a. TMK OF STREAM DIVERSION LOCATION: 3 (Zone) - 5 (Sector) - 003 (Plat) : 003 (Parcel)

4b. TMK OF DITCH DIVERSION LOCATION: 3 (Zone) - 5 (Sector) - 001 (Plat) : 067 (Parcel)

5. STREAM DIVERSION: How is water diverted from the stream to your property? Check all that apply.

☒ Pipe ☐ Pump ☒ Ditch/auwai ☐ Other Describe: From Iao stream to Iao-Waikapu ditch. Pipe from ditch to treatment plant

Is the diverted water returned to the stream or ditch? ☐ Yes. ☒ No. If yes, how much water is returned?

6. FLOW MEASUREMENT INFORMATION:

Does the stream diversion have a flowmeter with totalizer or other device to measure diverted amounts?

☒ Yes. Enter the installation date: Wailuku Water Co has meter at ditch intake, unknown installation date

Describe the device and enter measured amounts in Table 1. DWS effluent meters at each of three treatment plan filter units

☐ No. Explain how you are measuring flow to justify amounts shown in Table 1 in the space below

EXISTING USER INFORMATION

7. APPURTENANT RIGHT: Do you claim an appurtenant right for your water use? ☐ Yes ☒ No

If yes, has the appurtenant right been established by the courts or the Commission? ☐ Yes ☐ No

8. END USER INFORMATION: Are you an end user on an existing water system? ☐ Yes ☒ No

If yes, who is the operator of the water system?

9. REGISTRATION AND DECLARATION OF WATER USE: Do you have a Registration and Declaration of Water Use with the Commission?

☐ Yes. List the file reference name(s):

☒ No

10. STREAM DIVERSION WORKS PERMIT (SDWP):

Have you ever been issued a SDWP by the Commission?

☐ Yes. List the permit number(s):

☒ No

NOTE: Signing below indicates that the signatories understand and affirm that the information provided on this application is accurate and true to the best of their knowledge. Furthermore, the signatories understand that: 1) if necessary, further information may be required before the application is considered complete; 2) if a water use permit is granted by the Commission, this permit will be subject, but not limited, to any existing legal uses, changes in sustainable yields and instream flow standards, Hawaiian Home Lands uses, and any other conditions imposed by the Commission; and 3) **the applicant is responsible for paying the required public notice fees associated with this application.**

11. APPLICANT	12. SOURCE LANDOWNER
Signature: Jeffrey K. Eng	Signature
Jeffrey K. Eng, Director — Print	Not Applicable per HRS 174C-51(1)(B) — Print
3/31/09 — Date	Date

SURFACE WATER USE PERMIT APPLICATION
EXISTING USE (NA WAI EHA, MAUI)

TABLE 1: 12-MONTH AVERAGE DAILY USE
Measured or Calculated Use of Water at the Source or End Use
As of the Effective Date of Designation, April 30, 2008

MONTH / YEAR	AVERAGE DAILY USE FOR THE MONTH IN GALLONS PER DAY (GPD)	Check one item per box				OTHER Please describe
		METERED	ESTIMATED	ACTIVE BUT UNKNOWN	INACTIVE	
May 2007	1,263,000	☒	☐	☐	☐	
June 2007	1,573,000	☒	☐	☐	☐	
July 2007	1,444,000	☒	☐	☐	☐	
August 2007	1,388,000	☒	☐	☐	☐	
September 2007	1,370,000	☒	☐	☐	☐	
October 2007	1,730,000	☒	☐	☐	☐	
November 2007	1,680,000	☒	☐	☐	☐	
December 2007	728,000	☒	☐	☐	☐	
January 2008	1,121,000	☒	☐	☐	☐	
February 2008	1,073,000	☒	☐	☐	☐	
March 2008	1,515,000	☒	☐	☐	☐	
April 2008	1,498,000	☒	☐	☐	☐	
SUM OF AVERAGE DAILY USE FOR THE MONTH	16,383,000	GPD				
AVERAGE DAILY USE (Average of the above)	1,365,250	GPD				

SURFACE WATER USE PERMIT APPLICATION
EXISTING USE (NA WAI EHA, MAUI)

TABLE 2: LAND USE CONSISTENCY/EFFICIENCY

(Attach additional copies of Table 2 if necessary)

LAND USE CONSISTENCY						EFFICIENCY OF USE			
1. PURPOSE / WATER USE CATEGORY	2. USE TMK ATTACH THE FOLLOWING: • Property tax map, showing use location in reference to established property boundaries • Photograph of the area of use	3. STATE LAND USE DISTRICT	4. CDUP REQ'D Enter either: Yes and Date approved, or Yes and not acquired, or No	5. COUNTY ZONING CODE	6. SMAP REQ'D Enter either: Yes and Date approved, or Yes and not acquired, or No	7. REQUESTED QUANTITY OF USE Gallons per Day (GPD)	8. SUB-METERED? (Yes or No)	9. UNITS OR NET ACREAGE	10. APPLICANT'S JUSTIFICATION FOR REQUESTED QUANTITY OF USE FOR ITEM 7. If applicable, attach sheets to show how this number was calculated. For irrigation uses, fill in Table 3.
Uses that require **potable** (drinking) water									
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
					TOTAL POTABLE USE		GPD		
Uses that **do not** require potable water									
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
	____ - ____ - ____ : ____ Zone Sector Plat Parcel								
					TOTAL NON-POTABLE USE		GPD		
					TOTAL USE REQUESTED (Sum of Total Potable Use and Total Non-Potable Use above) =		GPD		

If total use requested is not equal to the total monthly average in Table 1, please explain.

In accordance with §174C-51(5), please explain if there are any limitations (legal, contractual, etc.) on the use(s) of water described above.

Per agreement entered into June 9, 2004, first amendment made November 29, 2007 and second amendment made February 27, 2008 DWS is entitled to withdraw up to 3.2G MGD except as notified by Wailuku Water Company when Ioa Stream flow is below 11.5 MGD as measured at the USGS gauging station at Iao Stream at Kepaniwai Park, Wailuku.

SURFACE WATER USE PERMIT APPLICATION
EXISTING USE (NA WAI EHA, MAUI)

TABLE 3: IRRIGATION INFORMATION

List all crops as separate line items and include landscape and golf course irrigation, grown in the 12 months prior to April 30, 2008. Attach additional copies of Table 3 if necessary.

1. USE TAX MAP KEY (TMK) Attach map outlining area and photo.	2. CROP	3. TOTAL ACREAGE	4. NET IRRIGATED ACREAGE	5. BEGIN ROWTH PERIOD (Month)	6. END GROWTH PERIOD (Month)	7. IRRIGATION SYSTEM (Refer to instructions.)	8. IRRIGATION PRACTICE (Refer to instructions.)
Zone - Sector - Plat : Parcel							
Zone - Sector - Plat : Parcel							
Zone - Sector - Plat : Parcel							
Zone - Sector - Plat : Parcel							
Zone - Sector - Plat : Parcel							
Zone - Sector - Plat : Parcel							
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Zone - Sector - Plat : Parcel							
Zone - Sector - Plat : Parcel							

SURFACE WATER USE PERMIT APPLICATION
EXISTING USE (NA WAI EHA, MAUI)

TABLE 4: ALTERNATIVES ANALYSIS

	Potable Alternatives Attach additional sheets if necessary.	**Non-Potable Alternatives** Attach additional sheets if necessary.
Municipal sources	Existing municipal sources are used to the extent possible with consideration to system capacity, water quality, pumping permits and various operational reasons to meet current demand	
Wastewater reuse		Expansion of the recycled water system require further quantification of end-uses and technical potential. Due to extensive capital costs and needed funding by private parties and other agencies in addition to DWS, this is a long-term goal, rather than an alternative that is available at this time.
Ditch system	DWS does not own or operate a ditch system and is using Iao/Waikapu ditch to serve current demand. DWS had preliminary discussions with Alexander & Baldwin concerning the potential for expansion of surface water treatment but ditch water availability dependson the Na Wai Eha stream water allocations.	
Desalinization	A plant for desalination of Central Maui brackish ground water for potable and non-potableneeds would have extensive energy needs and could potentially require new generation plants. Other issues are cost volatility, and disposal of brine. This strategy does not present a viable alternative to meet current demand	A plant for desalination of Central Maui brackish ground water for potable and non-potableneeds would have extensive energy needs and could potentially require new generation plants. Other issues are cost volatility, and disposal of brine. This strategy does not present a viable alternative to meet current demand
Ground water	Well development in the Northern Waihee, Kahakuloa, Waikapu, Haiku or Honpou aquifers may not be as productive or cost-effective as expected or feasible at all at this time. Any well development in either aquifer is a short to long term alternative that can not be developed in time to serve existing customers.	
Other (specify)	DWS conservation efforts include low-flow fixture distribution, public education , leak detection and water audits that are stepped up through additional conservation staff. Voluntary water restrictions on the Central Maui system have succeeded in achieving the voluntary cutback goal of 25.5 mgd.	

PUBLIC INTEREST

§174C-2(c) states that: *The state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.*

Explain below how the uses in your application are consistent with the public interest as described above. Attach additional sheets if necessary.

DWS'sexisting withdrawals from Iao ditch is mixed with Iao and Waihee aquifer sources to serve the Central Maui system. This public water supply system serves 21,270 meters in the communities extending from Waiehu, through Wailuku, Kahului, Puunene, Spreckelsville, Paia and Kuau in the North, and from Maalaea through Kihei to Makena in the South. Domestic uses, such as single-family and multi-family uses, account for about two-thirds of the Central Maui system services. The remaining one-third serves commercial, industrial, and agricultural uses. A portion of these uses serve non-potable uses and is supplemented by reclaimed and brackish water for irrigation. We understand that domestic uses are protected public trust uses. and are entitled to high priority under the public trust doctrine. CWRM concluded on February 15, 2006 and January 31, 2007 that DWS's basal source withdrawals serve the public interest. The Iao ditch withdrawals serve the public interest in the same way. DWS provides for the protection and preservation of ground and surface water resources through conservation and resource protection programs

SURFACE WATER USE PERMIT APPLICATION
EXISTING USE (NA WAI EHA, MAUI)

INSTRUCTIONS FOR FILLING OUT *FORM SWUPA-E*

This application form is to be used for actual **existing uses** as of the effective date of designation, April 30, 2008, for the Na Wai Eha Surface Water Management Areas. Based on the State Water Code, Section 174C, Part IV Regulation of Water Use, a completed application must be filed with the Commission on Water Resource Management (CWRM) no later than **April 30, 2009**, to qualify as an existing use. Failure to meet the filing deadline may cause your application to be considered a new use and require you to file an Application for Surface Water Use Permit for New Use.

If you are applying for a new surface water use, which are proposed uses after the date of designation, please use the Application for Surface Water Use Permit for New Use, **Form SWUPA-N**.

Information about surface water management areas and the current application forms are available at our website: http://www.hawaii.gov/dlnr/cwrm/; by contacting the Stream Protection and Management Branch at 587-0234; or sending an email to: dlnr.cwrm@hawaii.gov.

REQUIREMENTS FOR A COMPLETE APPLICATION Information must be legible. Therefore, please type or clearly print all information in ink.

a. Fill in the most recent application form.
b. Fill in every line on the application.
c. Enclose a check for the non-refundable filing fee of $25 payable to: Department of Land and Natural Resources.
d. Pay for the cost of publishing any required public notices related to your application.
e. Mark the source and end use locations on the appropriate USGS quad map and TMK map and attach to your application.
f. Attach photos showing your existing diversion, measuring device (if applicable) and end use areas.
g. Sign the application form. Both the applicant and the landowner of the source must sign the application form.
h. Submit one original and **15 copies** of the application form; one original and 15 copies of the attachments (instructions, maps, photos and any additional attachments) and filing fee to: Commission on Water Resource Management, P.O. Box 621, Honolulu, HI 96809.

The applicant **must** establish that the existing use of water is a reasonable and beneficial use. According to §174C-3 of the State Water Code: *"Reasonable-beneficial use" means the use of water in such a quantity as is necessary for economic and efficient utilization, for a purpose, and in a manner which is both reasonable and consistent with the state and county land use plans and the public interest.*

Furthermore, public interest is described in §174C-2(c) of the State Water Code which states that: *(t)he state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.*

LINE BY LINE INSTRUCTIONS FOR COMPLETING THE APPLICATION FORM

APPLICANT INFORMATION

1. APPLICANT'S NAME: Fill in the information for the applicant. This should be the entity that will be responsible for all conditions of the water use permit.
2. SOURCE LANDOWNER'S NAME: Fill in the information for the landowner of the property where the existing surface water diversion works is located. Note: in accordance with §174C-51(1)(B), *In the event a lessee, licensee, developer, or any other person with a terminable interest or estate in the land, which is the water source of the permitted water, applies for a water permit, the landowner shall also be stated as a joint applicant for the water permit.*

EXISTING SOURCE INFORMATION

3. SURFACE WATER HYDROLOGIC UNIT AND CODE: Check the appropriate box for the hydrologic unit name and hydrologic code where the source is located. The "source" is the stream, ditch, or conduit from which water is diverted to the user. For information on hydrologic unit names and unit codes please refer to the *Surface-Water Hydrologic Unit: A Management Tool for Instream Flow Standards* report available on the CWRM website at: http://www.hawaii.gov/dlnr/cwrm/, or contact CWRM staff at (808) 587-0234. You may also contact CWRM toll-free from Maui at: 984-2400, ext. 70234.

4a. TMK OF STREAM DIVERSION LOCATION: Fill in the current Tax Map Key (TMK) number of the parcel where the stream diversion is located if applicable. To find out your TMK number, call Maui County Real Property Tax Division at: (808) 270-7297, or check online at: www.mauipropertytax.com/

4b. TMK OF DITCH DIVERSION LOCATION: Fill in the current Tax Map Key (TMK) number of the parcel where the ditch diversion is located, if applicable.

5. STREAM DIVERSION: How is water diverted from the stream to your property? Check the appropriate box(es). Is the diverted water returned to the stream or ditch? Check "Yes" or "No." If yes, enter the amount of water returned.
6. FLOW MEASUREMENT INFORMATION: Check "Yes" or "No". If you have a working flowmeter with a totalizer, answer "Yes" to this question, and fill in the date that the flowmeter was installed and any other information you may have (manufacturer, serial number, etc.). A totalizer directly measures the total use for the source (similar to a car's odometer). Otherwise, answer "No" and explain how stream diversion is measured or estimated to justify amounts requested in Table 1

EXISTING USER INFORMATION

7. APPURTENANT RIGHT: An appurtenant water right is a legally recognized right to a specific amount of surface freshwater – usually from a stream – on the specific property that has that right. This right traces back to the first time the land was converted to fee simple title; i.e., the Great Mahele and the issuance of either a Land Commission Award or Royal Patent. The quantity of water under the appurtenant right is the amount that was being used on the land shortly before or at the time of the Mahele.
   Do you claim an appurtenant right for your water use? Check "Yes" or "No."
   If yes, has your appurtenant right been established by the courts or the Commission? Check "Yes" or "No."
8. END USER INFORMATION: Are you an end user on an existing water system? Check "Yes" or "No". If yes, please list the name of the water system operator.
9. REGISTRATION AND DECLARATION OF WATER USE: Do you have a Registration and Declaration of Water Use from the Commission? Check "Yes" or "No". If yes, please list the name of the registrant(s).
10. STREAM DIVERSION WORKS PERMIT (SDWP): Have you ever been issued a SDWP by the Commission? If yes, please list the permit number(s). Otherwise, check "No."
11. APPLICANT: Please sign and print your name, and date your application.
12. LANDOWNER: Please sign and print your name, and date your application. The landowner shall be the joint applicant in the event the applicant is a lessee, licensee, developer, or any other person with a terminable interest or estate in the land which is the water source of the permitted water. §174C-51(1)(B)

SURFACE WATER USE PERMIT APPLICATION
EXISTING USE (NA WAI EHA, MAUI)

TABLE 1: 12-MONTH AVERAGE DAILY USE - Measured or calculated use of water at the source or end use as of the effective date of designation, April 30, 2008.

Please fill out Table 1 to calculate your existing use as of the effective date of the designation, **April 30, 2008**, of the Na Wai Eha Surface Water Management Areas. The effective date of designation is the date of the publication of the public notice of the Commission designation action. The qualifying dates have been filled in for this application. Fill in as completely as possible.

The **12-month average** is the average daily use[a] of 12 months of consecutive use[b] from the last month[c] of the period.

a. Average daily use. This is the average daily use for one month in gallons per day (GPD). To calculate this average, take the total use (in gallons) for the month, and divide this amount by the number of days in the month.
b. 12 months of consecutive use. To calculate the average monthly withdrawal for 12 consecutive months of use, add the average daily use for all 12 months and divide that amount by 12.
c. Last month. The last month of the period is the effective date of designation, April 30, 2008.

Check only one of the following boxes per row in Table 1:

- Metered – data is based on an operational meter with a totalizer.
- Estimated – data is based on some indirect measurement technique (e.g. measured flow rate multiplied by time of operation).
- Active but unknown – source is active, but there is no means to measure or estimate flow coming from source.
- Inactive – source was not pumped or diverted for the month.
- Other - describe how water use was measured or calculated in this box.

TABLE 2: LAND USE CONSISTENCY/EFFICIENCY

1. PURPOSE / WATER USE CATEGORY: Choose one of the following purpose or category codes listed below for each row in Table 2. There may be several purpose/categories on a single TMK, and each purpose or category must be listed in a separate row. Attach additional copies if necessary.

AGRICULTURE	
AGRAQ	Aquatic Plants & Animals
AGRCP	Crops & Processing
AGRLI	Livestock & Processing, and Pasture
AGRON	Ornamental & Nursery Plants
AGROTH	Other
DOMESTIC	
DOM	Single & Multi Low-Rise & High-Rise Household
DOMN	Domestic (Non-residential)
DOMNCB	Commercial Businesses
DOMNRI	Religious Institutions
DOMNHOS	Hospitals
DOMNHOT	Hotels
DOMNOB	Office buildings
DOMNOTH	Domestic Non-Residential – Other
DOMNSC	Schools
INDUSTRIAL	
INDEL	Geothermal, Thermoelectric Cooling, Power Development
INDFP	Fire Protection
INDMI	Mining, Dust Control
INDOTH	Industrial – Other
IRRIGATION	
IRRGC	Golf Course
IRRHM	Habitat Maintenance
IRRHOT	Hotel
IRRLA	Landscape/Water Features
IRROTH	Other
IRRPA	Parks
IRRSC	Schools
MILITARY	
MIL	Military
MUNICIPAL	
MUNCO	County
MUNPR	Privately owned and operated but defined as a public system by the Department of Health
MUNST	State

2. USE TMK: The Tax Map Key number of the parcel over which the water is applied. There should only be one parcel for each line. Also, attach a TMK map(s) for the lots showing the boundaries of irrigated acreage, etc., as well as a photograph of the area of use.
3. STATE LAND USE DISTRICT: To find out the current Land Use District, contact the Land Use Commission at 587-3822.
4. CDUP REQUIRED: If a Conservation District Use Permit (CDUP) is required, enter either: "Yes" and the date the CDUP was approved if you have a CDUP applicable to this project; or "Yes" and "not acquired" in this box. If a CDUP is not required, enter "N" for no in this box. To check if your parcel is in the Conservation District, contact the Land Use Commission at 587-3822. If your parcel is in a Conservation District, contact the Department of Land and Natural Resources Office of Conservation and Coastal Lands at 587-0328 to find out if a CDUP is required.
5. COUNTY ZONING CODE: To find out the Zoning Code for your property, call Maui County Planning Department at 270-6279, or 270-7253
6. SMAP REQUIRED: If a Special Management Area Permit (SMAP) is required for this project, enter either: "Y" and the date SMAP was approved; or "Y" and "not acquired" in this box. If a SMAP is not required, enter "N" for no in this box. To find out if your property is in a Special Management Area and requires an SMAP, call Maui County Planning Department at 270-8205.
7. QUANTITY OF USE: Enter the quantity of use in gallons per day (GPD). Justification for the quantities requested may depend on your answers to items 8 and 9, and you should describe the justification in item 10.
8. SUBMETERED? (Y/N): If the specific use is submetered, enter "Y" for yes here. If it is not submetered, enter "N" for no. Submetering is specific to each line item.
9. UNITS OR ACREAGE: This is the value and category as the basis for calculating the duty. "Duty" is the amount of water used or requested for a "unit" over a specific time period, e.g. gallons per acre per day, or gallons/acre/day. "Unit" can mean dwelling units, or number of people, or animals. Examples to fill in for this category are: 400 dwelling units, 500 people, 3.74 acres.
10. APPLICANT'S JUSTIFICATION FOR REQUESTED QUANTITY OF USE FOR ITEM 7: Explain how you are justifying the amount you are requesting. Attach additional sheets if necessary.

TABLE 3: IRRIGATION INFORMATION

If you have grown crops in the year prior to the date of designation, please list all the crops (including landscape and golf course irrigation) that you have grown. Enter a single crop and single TMK per line. If you have multiple crops, list them all as separate line items. Attach additional copies of Table 3 if necessary.

1. USE TAX MAP KEY (TMK): Enter the parcel number where the crop is being grown. Attach a map outlining irrigated area(s) and photos.
2. CROP: Enter the crop type.
3. TOTAL ACREAGE: Enter the total acreage of the parcel listed.
4. NET IRRIGATED ACREAGE: Enter the acreage for the specific crop grown.
5. BEGIN GROWTH PERIOD (MONTH): This is the month of the start of the growth cycle. For perennial crops, list the 12th month prior to the date of designation.
6. END GROWTH PERIOD (MONTH): This is the month of the end of the growth cycle. For perennial crops, list the month of the date of designation.
7. IRRIGATION SYSTEM: Enter one of the following:

   - TRICKLE, DRIP
   - TRICKLE, SPRAY
   - MULTIPLE SPRINKLERS
   - SPRINKLER, CONTAINER NURSERY
   - SPRINKLER, LARGE GUNS
   - SEEPAGE, SUBIRRIGATION
   - CROWN FLOOD
   - FLOOD (TARO)
   - OTHER – Please describe.

8. IRRIGATION PRACTICE: Enter one of the following:

   - IRRIGATE TO FIELD CAPACITY
   - APPLY A FIXED DEPTH PER IRRIGATION
   - DEFICIT IRRIGATION
   - OTHER – Please describe.

TABLE 4: ALTERNATIVES ANALYSIS

Please address every alternative listed in Table 4 and whether or not they are available, for both potable and non-potable needs. Other alternatives on the last line may include stormwater reclamation, rainwater catchment, etc.

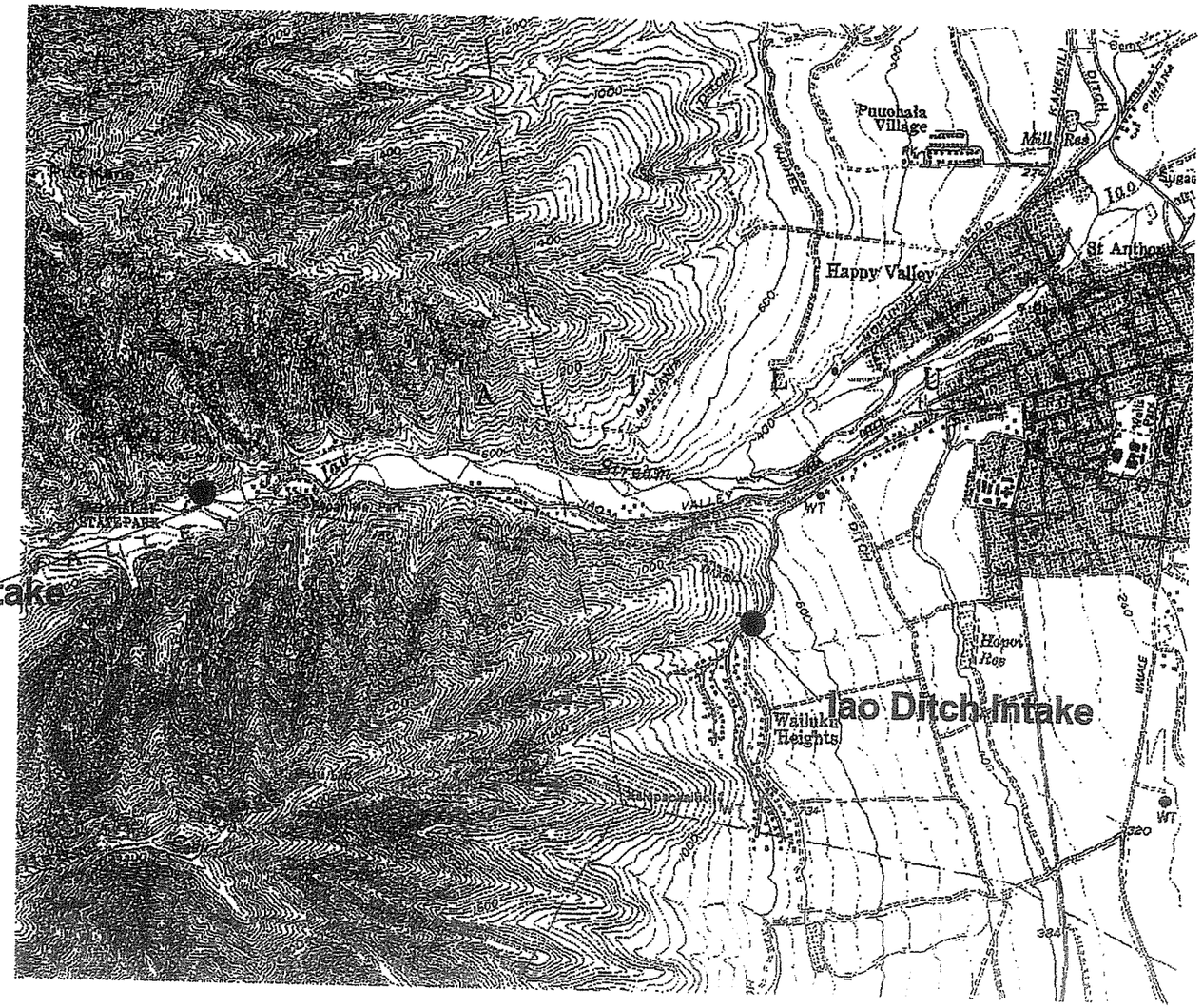
Surface water is defined in §174C-3 as *both contained surface water - that is, water upon the surface of the earth in bounds created naturally or artificially including, but not limited to, streams, other watercourses, lakes, reservoirs, and coastal waters subject to state jurisdiction - and diffused surface water - that is, water occurring upon the surface of the ground other than in contained waterbodies. Water from natural springs is surface water when it exits from the spring onto the earth's surface.*

PUBLIC INTEREST

Explain how the uses in your application are consistent with the public interest as described in §174C-2(c): *(t)he state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.*

EXHIBIT 1

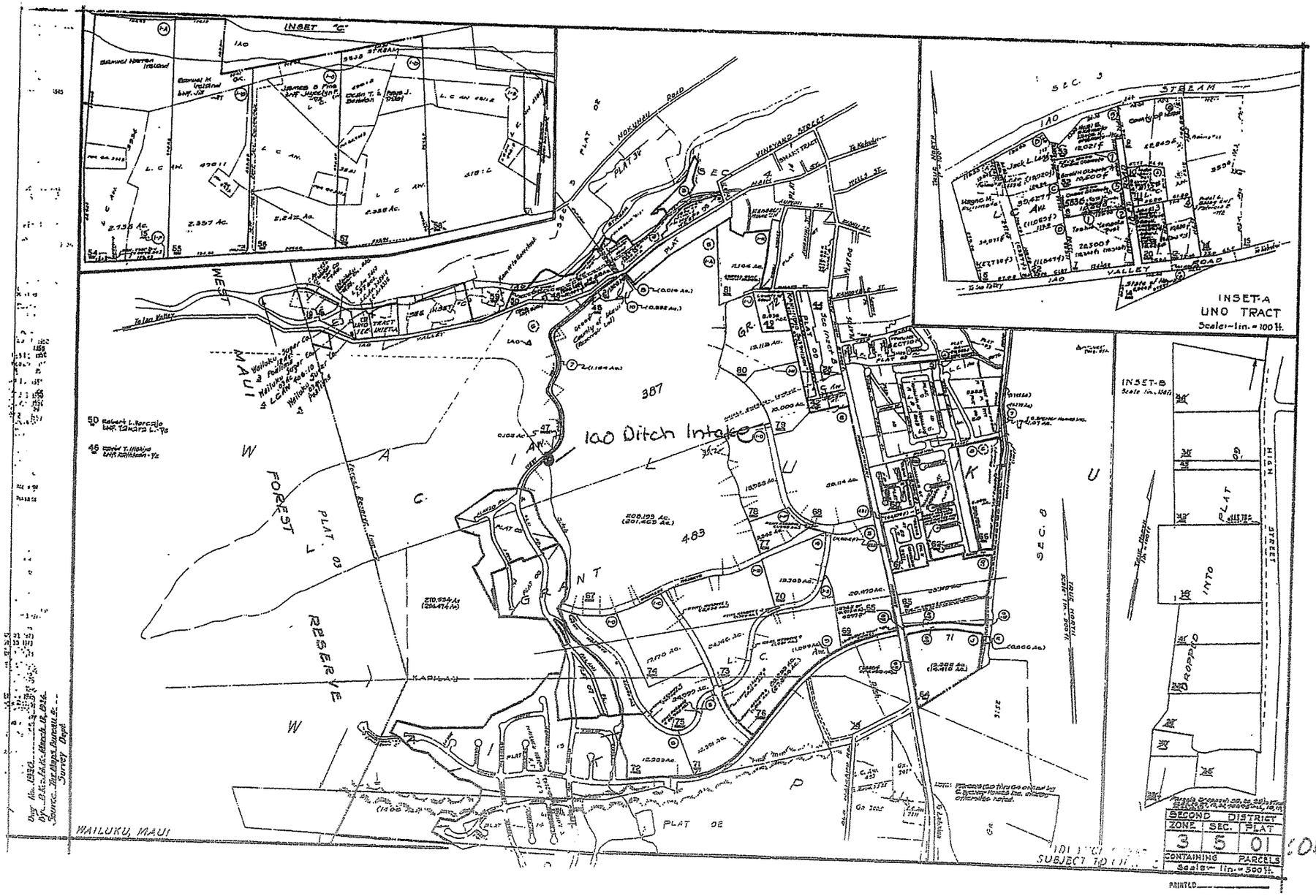
Iao Ditch, Wailuku, Maui, Hawaii



Iao Stream Intake

0 8000 16000 Feet

N


INSET "C"
INSET-A
UNO TRACT
Scale-1in.=100 ft.
INSET-B
Scale 1in.=100ft.
100 Ditch Intake
387
483
WAILUKU, MAUI
SECOND DISTRICT
ZONE 3
SEC. 5
PLAT 01
CONTAINING PARCELS
Scale-1in.=500ft.
PRINTED

Maui, HI, 2008-2009 - 2-3-3-003-003-0000, Sheet

Exhibit 26

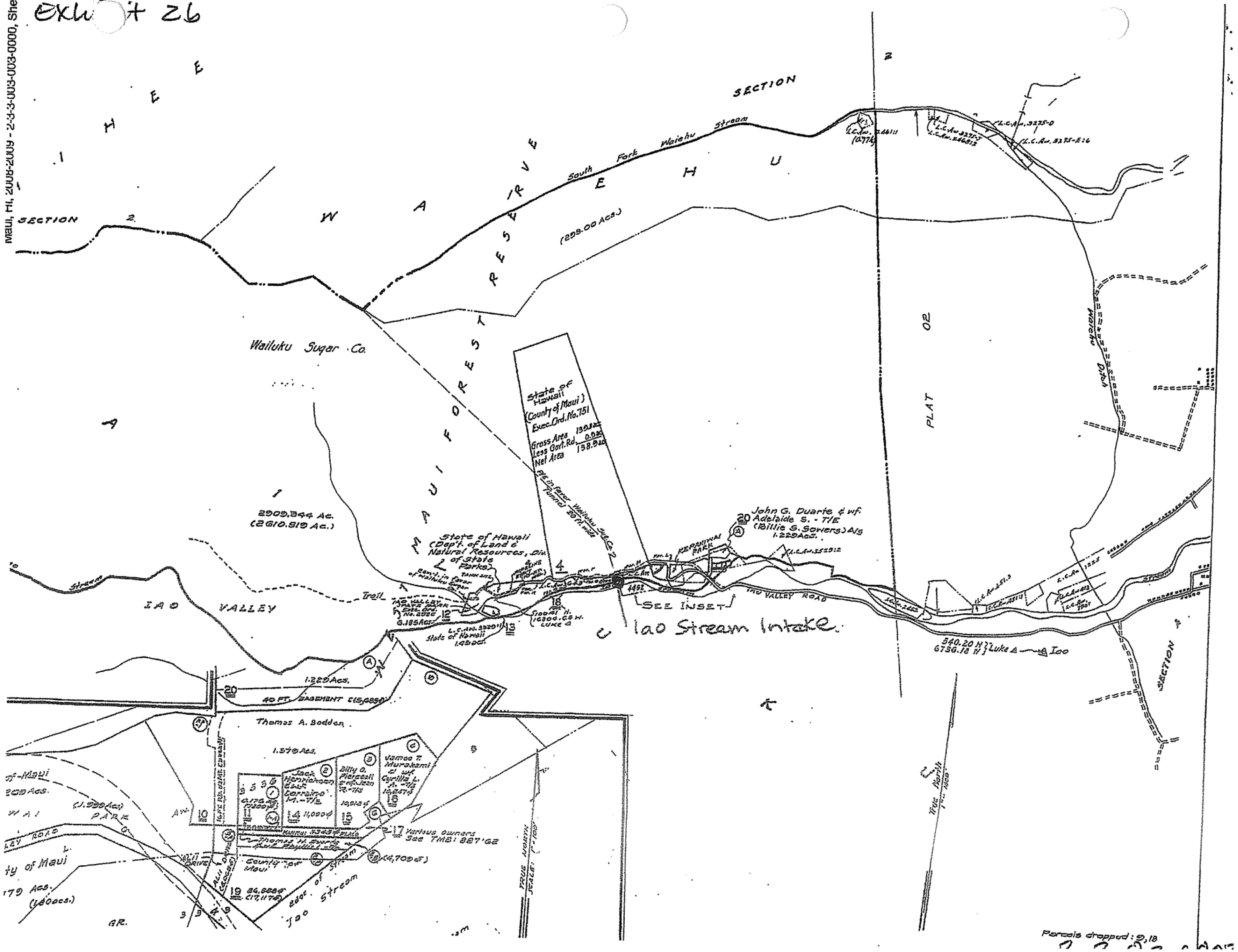
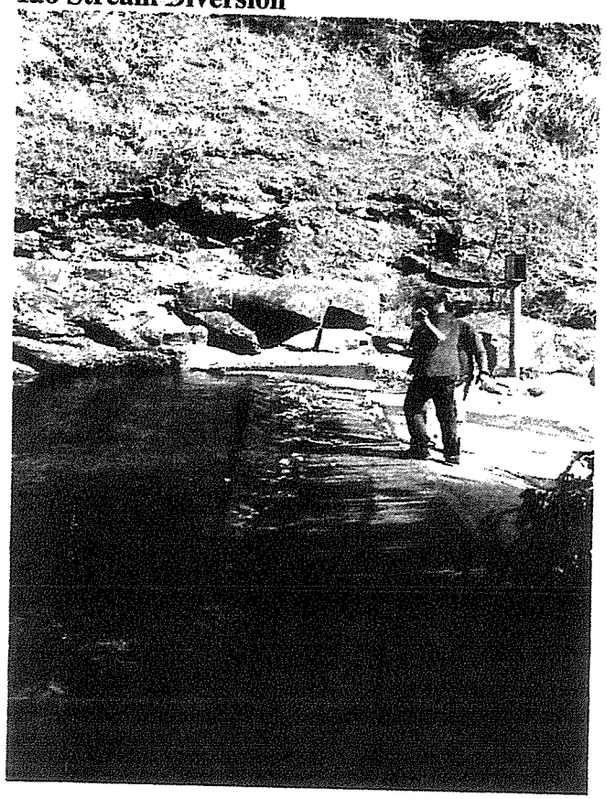
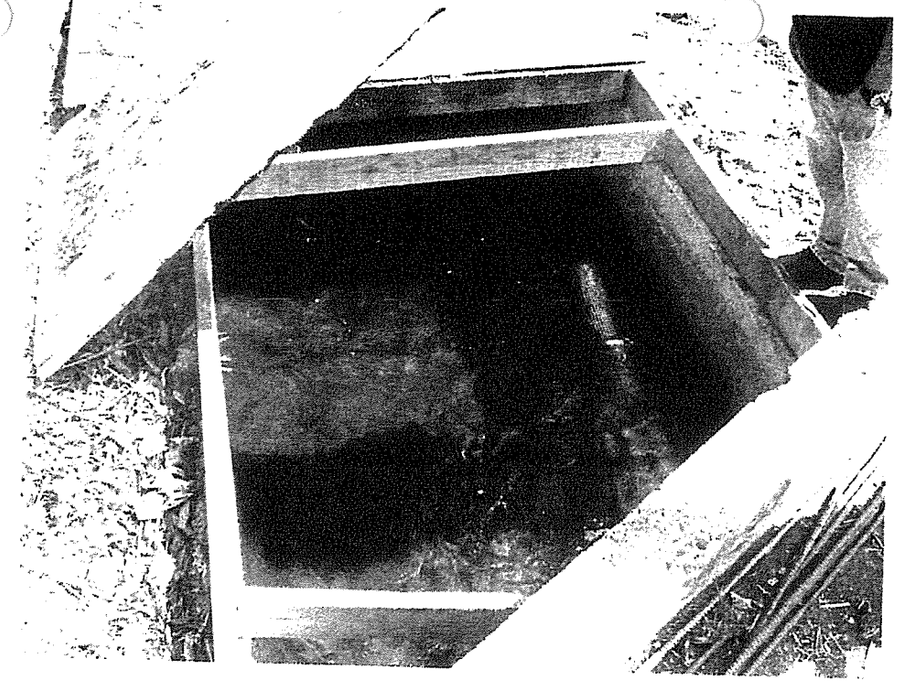


Exhibit 5

Iao Stream Diversion



Iao Ditch Intake



Iao Ditch Intake Improvements

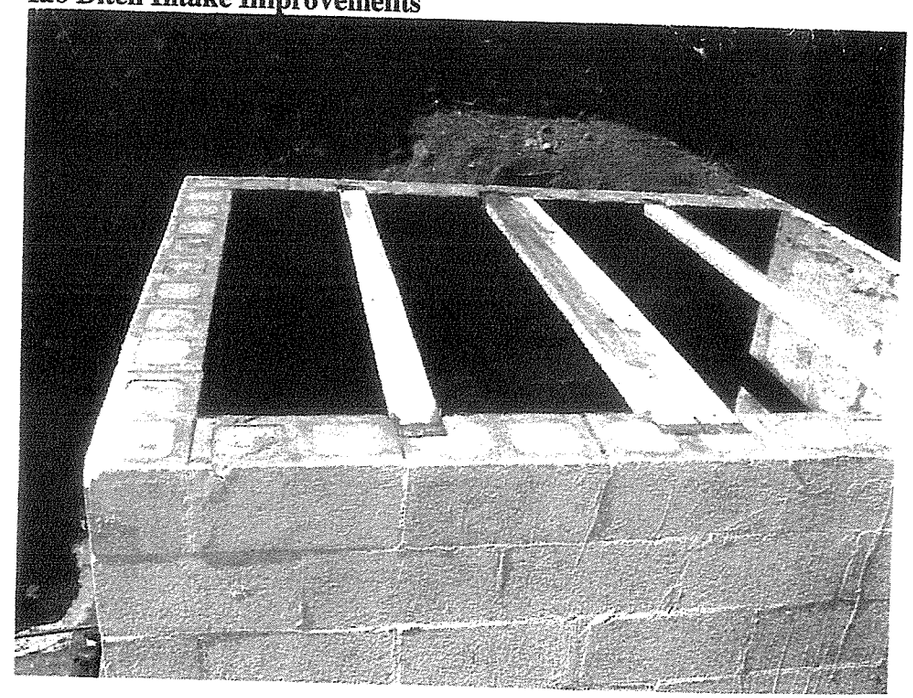
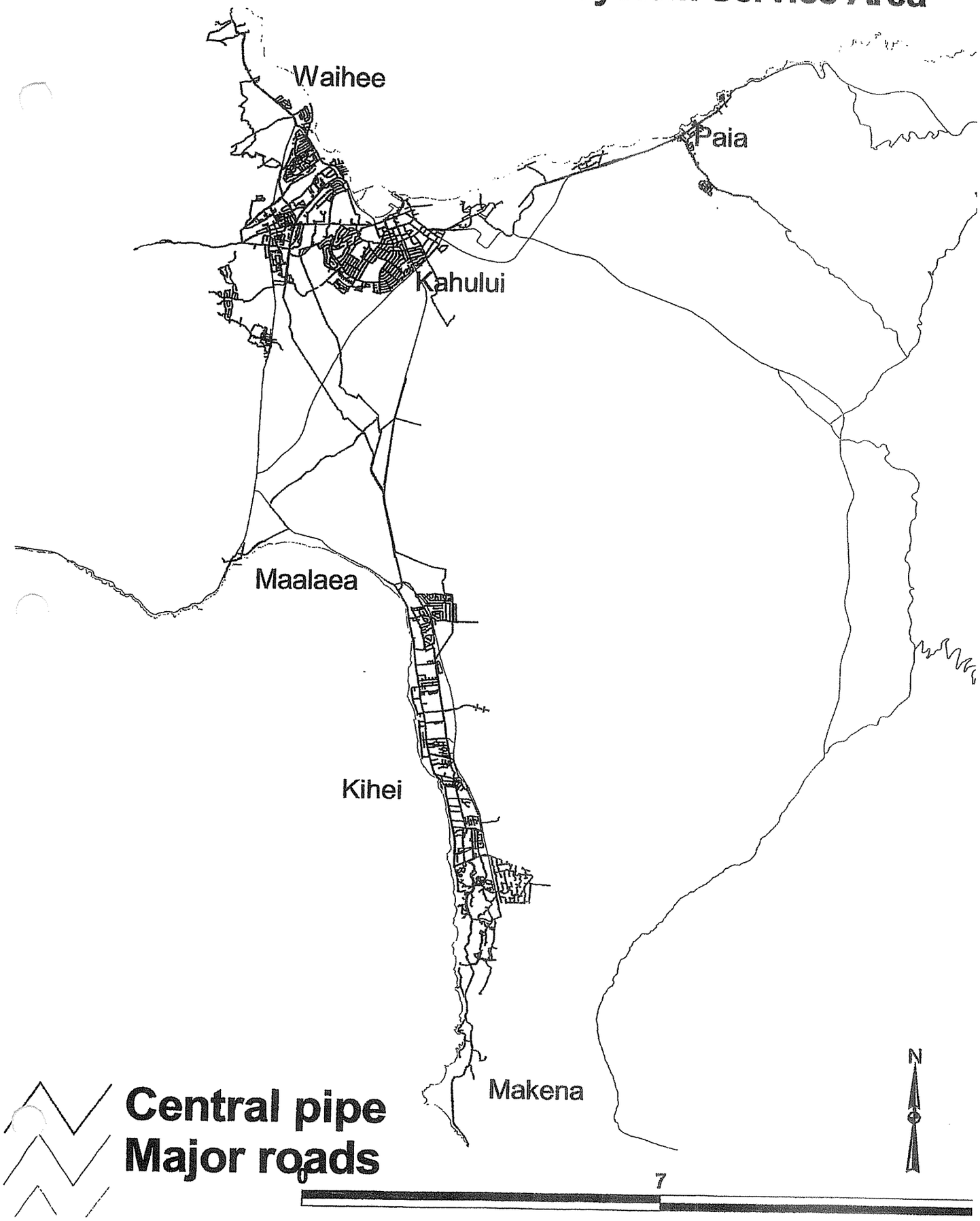


Exhibit 4 : Central Maui System Service Area



CHARMAINE TAVARES
Mayor

JEFFREY K. ENG
Director

ERIC H. YAMASHIGE, P.E., L.S.
Deputy Director

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

March 31, 2009

Honorable Laura H. Thielen, Chairperson
Commission on Water Resource Management
State of Hawaii Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Chairperson Thielen:

Subject: Application for Surface Water Use Permit for *New Use* in the Na Wai Eha, Maui, Surface Water Management Areas

Please find attached 15 copies of the Maui County Department of Water Supply's (DWS) "new use" Water Use Permit Application Form SWUPA-N for 1.416 mgd from the Iao Ditch. In some instances, the format of the SWUPA-N form did not seem to be applicable to a municipal purveyor of water such as DWS and we therefore provide supplemental and clarifying information to this form below.

Land Use Consistency and Efficiency
Land use consistency and efficiency of use must be described in relation to the Central Maui System as a whole, as Iao ditch along with DWS wells in Iao and Waihee aquifers are mixed so that the Iao ditch source can serve different areas within the system. In lieu of Table 1 "Land Use Consistency/Efficiency" on Form SWUPA-N, please find below water use categories, quantity in gallons per day, and number of services per water use category for active and inactive meters issued as of December 31, 2008. The requested amount of 1.416 mgd would allow withdrawals from Iao ditch within our allocation from Wailuku Water Company (WWC). Our current agreement with WWC "Second Amendment to Agreement Concerning Withdrawal from the Iao/Waikapu Ditch" dated February 27, 2008 makes available 3.2 mgd Improvements to the Iao ditch intake are completed which allow us to achieve optimum productivity of the Iao treatment plant. Please refer to attached pictures in exhibit 3. Increased withdrawals from Iao ditch would allow less reliance on South Waihee aquifer and increased DWS compliance with system standards. As stated in our existing use application for this source, DWS has withdrawn municipal supply from Iao ditch since the 1930s. The requested amount would serve existing and anticipated uses throughout the Central

The Department of Water Supply is an Equal Opportunity provider and employer. To file a complaint of discrimination, write: USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington DC 20250-9410. Or call (202) 720-5964 (voice and TDD)

EXHIBIT "B-R3"

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Maui system. Therefore the requested amount per water use category from Iao ditch is the percentage of active and inactive installed meter use that each water use category represents of the total water use for the Central Maui system.

Current state land use district and County zoning codes can not be identified for all existing individual meters on the Central Maui system. However, building permits for new homes and businesses requires underlying appropriate zoning and State land use district for approval.

Table 1: Land Use Consistency/Efficiency

Water Use Category	# Active meters per 12/31/08	AVG Use GPD per 12/31/08	AVG GPD/ service	# Inactive meters per 12/31/08	AVG Monthly Inferred Use per 12/31/08	AVG GPD/ service	Class Use /Total use in %	Requested amount GPD
AGRICULTURE	19	212,515	11,185				1.07%	15,093.50
GOVERNMENT	208	1,688,281	8,117	1	48,000	48,000	871.00%	123,316.28
COMMERCIAL	881	2,235,767	2,538	17	86,222	5,072	1165.00%	164,915.15
GOLF PRIVATE	2	357	179				0.00%	25.36
HOTEL	72	1,680,498	23,340				843.00%	1,119,354.39
INDUSTRIAL	149	720,981	4,839	3	13,700	4,567	368.00%	52,179.41
IRRIGATION PRIVATE	46	201,962	4,390	7	57,300	8,186	130.00%	18,413.62
MULTI FAMILY	512	3,032,910	5,924	8	114,411	14,301	1579.00%	223,532.89
MULTI FAMILY LOW RISE	9	175,340	19,482				88.00%	12,453.21
RELIGIOUS	84	100,826	1,200				51.00%	7,160.99
SCHOOL PRIVATE	1	3,637	3,637				2.00%	258.31
SINGLE FAMILY	17005	9,083,415	534	362	319,759	883	4716.00%	667,843.75
UNKNOWN	15	37,659	2,511	9	123,600	13,733	81.00%	11,453.13
TOTAL:	19,003	**19,174,148**		**407**	**762,992**		**100.00%**	**1,416,000.00**

Irrigation Information

At this time DWS does not serve non-potable water on our Central Maui system. Some preliminary research of potential commercial projects where reclaimed water can off-set potable sources have been initiated in the Water Use and Development Plan (WUDP) process. DWS strongly encourages new developments to utilize non-potable sources where available, such as on site brackish wells. Commercial properties are required to use reclaimed water for non potable needs if located within 100 feet of a R-1 reclaimed water distribution line

Alternative Analysis

DWS notes that the various categories on CWRM's Table 3 are not specified in the State Water Code. HRS § 174C-49 sets forth the criteria that applicants must meet. Nonetheless, DWS addresses each category on Table 3 to the best of its ability. In doing so, DWS does not waive its legal objections to the imposition of these specific categories. DWS has no real, practical alternatives to the requested new uses. DWS has considered drilling new wells in the Northern portion of the Waihee aquifer and in the Kahakuloa aquifer, but CWRM has asked DWS to limit

its withdrawals from the Waihee aquifer. Recent discussions with USGS have led DWS to conclude that new wells in these areas may not be as productive or cost-effective as previously hoped. USGS has advised DWS that the Waikapu aquifer may be a better place to seek new sources of supply and since 2006 (FY 2007) DWS has budgeted and received County Council approval for well development in the Waikapu aquifer. However, the current sustainable yield of that aquifer is 3 mgd, and DWS faces competition from private landowners for the available water in the Waikapu aquifer.

Moreover, DWS is precluded from developing more wells in East Maui in the immediate future due to the entry on December 22, 2003 of a consent decree in The Coalition to Protect East Maui Water Resources et al. v. Board of Water Supply et al., Civil No. 03-1-0008(3). In that case, the Plaintiffs demanded that before looking to East Maui as a source of groundwater, DWS look first to surface water drawn from the Waikapu, Iao, and/or Waihee hydrologic units. Therefore, DWS has vigorously pursued surface water sources as required under the Consent Decree.

CWRM's chart does not include conservation as a specific category, but DWS recognizes that conservation efforts can be a very cost effective way to stretch a limited water supply. DWS's conservation efforts include a program that provides low-flow fixtures, free of charge, and public education programs. These efforts have been successful in reducing demand by about 500,000 gallons per day. DWS has stepped up conservation efforts with additional conservation staff responsible for leak detection in water systems, commercial and industrial operations, residences, and irrigation systems; repair or arranging for repair of leaks and other problems identified; replacement of fixtures as appropriate; suggestions for plant materials as appropriate; analysis and presentation of findings; and public presentations and meetings with community groups and homeowners' associations to increase awareness of and compliance with good conservation practices.

A request for a voluntary 10 % reduction in water use from customers on the Central Maui has been remarkably successful in achieving the voluntary cutback goal of 25.5 mgd, even in the dry summer months.

We respectfully request that the Commission on Water Resource Management issue a "new use" Surface Water Use Permit to DWS for 1.416 mgd from the Iao Ditch. We also ask that you please copy Deputy Corporation Counsel Jane Lovell with all correspondence relating to this "new use" application.

Sincerely,

Jeffrey K. Eng
Director
emb

c: Engineering Division
Jane Lovell, Deputy Corporation Counsel
Ed Kushi, Jr. Deputy Corporation Counsel

attachments:
Iao Ditch Water Use Permit Application Form SWUPA-N (15 copies) with 4 exhibits:
1. USGS Topographic map
2. Property Tax Map Key maps
3. Photographs of stream diversion and ditch intake
4. GIS map of end use/service areas

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

APPLICATION FOR SURFACE WATER USE PERMIT FOR *PROPOSED NEW USE* IN A DESIGNATED SURFACE WATER MANAGEMENT AREA

FORM SWUPA-N

☒ Application for New use
☐ Application to Modify SWUP No. _____

For Official Use Only:

For detailed instructions on filling out this application form completely, refer to the attached instructions sheet.
Incomplete applications will not be accepted for processing.
The following must be attached before this application is accepted as complete:

- Portion of 7.5-Minute Series USGS topographic map (scale 1:24,000) labeled with stream and diversion location and the quad map name.
- Property tax map showing the stream or diversion location and location of water use referenced to established property boundaries.
- Photograph(s) of the surface water source, diversion and end use, if applicable.

APPLICANT INFORMATION:

NOTE: In accordance with HRS §174C-51(1)(B), *In the event a lessee, licensee, developer, or any other person with a terminable interest or estate in the land which is the water source of the permitted water, applies for a water permit, the landowner shall be stated as a joint applicant for the water permit.*

1. APPLICANT'S NAME	Applicant's Contact	2. SOURCE LANDOWNER'S NAME	Source Landowner's Contact
MAUI COUNTY DEPARTMENT OF WATER SUPPLY	Jeffrey K. Eng, Director	NOT APPLICABLE PER HRS 174C-51(1)(B)	
Applicant's Mailing Address, or Principal Place of Business		Source Landowner's Mailing Address, or Principal Place of Business	
200 S. High Street Wailuku, Hawaii 96793			

Applicant's Phone	Applicant's Fax	Applicant's E-mail	Source Landowner's Phone	Source Landowner's Fax	Source Landowner's E-mail
808 270 7816	808 270 7833	jeffrey.eng@co.maui.hi.us			

SOURCE INFORMATION

3. SURFACE WATER HYDROLOGIC UNIT: Island: MAUI Hydrologic Unit: IAO Hydrologic Unit Code: 6024

4. STREAM FLOW STANDARD (IFS) FOR HYDROLOGIC UNIT IF APPLICABLE: NOT ESTABLISHED

5. CAN YOUR PROPOSED USE(S) BE ACCOMMODATED WITHIN THE ABOVE AMOUNTS: ☒ Yes ☐ No

Explain how your proposed use(s) can be accommodated within the existing IFS for the above hydrologic unit:
NO IFS ESTABLISHED

6a. TMK OF PROPOSED STREAM DIVERSION LOCATION: 3 - 5 - 0 0 3 : 0 0 3 (Zone, Sec, Plat, Parcel)

6b. TMK OF PROPOSED DITCH DIVERSION LOCATION: 3 - 5 - 0 0 1 : 0 6 7 (Zone, Sec, Plat, Parcel)

7a. PROPOSED STREAM DIVERSION: How will water be diverted from the stream to your property? Check all that apply.
☒ Pipe ☐ Pump ☒ Ditch/auwai ☐ Other Describe: From Iao Stream to Iao-Waikapu ditch. Pipe from ditch to treatment plant

7b. WILL THE DIVERTED WATER BE RETURNED TO THE STREAM OR DITCH?
☐ Yes. How much water will be returned?
☒ No

8. PROPOSED FLOW MEASUREMENT INFORMATION:
Will the stream diversion have a flow meter with totalizer or other device to measure diverted amounts?
☒ Yes. List the manufacturer and describe the device . Wailuku Water Co's meter at ditch intake, unknown manufacturer. DWS effluent meters at each of three treatment plant filter units
☐ No. Explain how stream diversion will be measured or estimated to justify amounts requested in the space below.

PROPOSED USE INFORMATION HRS §174C-51(4), (5), (6)

9. TOTAL QUANTITY OF WATER REQUESTED: 1,416,000 gallons per day. See Table 1, Item14.

10. PROPOSED USE: Check all that apply. See Table 1, Item 1.
☐ Agriculture ☐ Domestic ☐ Industrial
☐ Irrigation ☐ Military ☒ Municipal

11. LOCATION OF PROPOSED WATER USE: Show the location of the proposed use on the same USGS and TMK maps as the proposed source location. Otherwise, attach similar maps. See Table 1, Item 2.

PROPOSED USER INFORMATION

12. APPURTENANT RIGHT: Do you claim an appurtenant right for your proposed water use? ☐ Yes ☒ No
If yes, has the appurtenant right been established by the courts or the Commission? ☐ Yes ☐ No

13. PROPOSED END USER INFORMATION: Will you be an end user on an existing water system?
☐ Yes. List the name of the system operator: ☒ No

14. REGISTRATION AND DECLARATION OF WATER USE: Do you have a Registration and Declaration of Water Use from the Commission?
☐ Yes. List the file reference name(s): ☒ No

15. STREAM DIVERSION WORKS PERMIT (SDWP): Do you have a SDWP from the Commission?
☐ Yes. List the permit number(s): ☒ No

NOTE: Signing below indicates that the signatories understand and affirm that the information provided on this application is accurate and true to the best of their knowledge. Furthermore, the signatories understand that: 1) if necessary, additional information may be required before the application is considered complete; 2) if a water use permit is granted by the Commission, this permit will be subject, but not limited to, any existing legal uses, changes in sustainable yields and instream flow standards, Hawaiian Home Lands uses, and any other conditions imposed by the Commission; and 3) **the applicant is responsible for paying the required public notice fees associated with this application.**

16. APPLICANT	17. SOURCE LANDOWNER
Signature: Jeffrey K. Eng	Signature:
Print: Jeffrey K. Eng	Print: Not Applicable per HRS 174C-51(1)(B)
Date: 3/31/09	Date:

APPLICATION FOR SURFACE WATER USE PERMIT - PROPOSED NEW USE

TABLE 1: LAND USE CONSISTENCY / EFFICIENCY

(Attach additional copies of Table1 if necessary.)

LAND USE CONSISTENCY						EFFICIENCY OF USE				
1	2	3	4	5	6	7	8	9	10	11
PURPOSE / WATER USE CATEGORY	TMK FOR PROPOSED LOCATION OF USE ATTACH THE FOLLOWING: • Property tax map, showing proposed location of use referenced to established property boundaries. • Photograph of the area of proposed use.	STATE LAND USE DISTRICT	CDUP REQ'D Check the appropriate box, and write in the date approved, if applicable.	COUNTY ZONING CODE	SMAP REQ'D Check the appropriate box, and write in the date approved, if applicable.	UNITS OR NET ACREAGE	GPD/UNIT or GPD/ACRE (Gallons per Day)	REQUESTED QUANTITY OF USE (GPD)	SUB-METERED? Check Yes or No	APPLICANT'S JUSTIFICATION FOR REQUESTED QUANTITY OF USE FOR ITEM 9. If applicable, attach sheets to show how this number was calculated. For irrigation uses, fill in Table 2.
Uses that require potable (drinking) water										
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
							TOTAL POTABLE USE	12	GPD	
Uses that do not require potable water										
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
	Zone - Sec - Plat : Parcel		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No		☐ Yes, date approved: / / ☐ Yes, not acquired ☐ No				☐ Yes ☐ No	
							TOTAL NON POTABLE USE	13	GPD	
							TOTAL QUANTITY OF WATER REQUESTED (Sum of Total Potable Use and Total Non-Potable Use above) =	14	GPD	

15. Please explain if there are any limitations (legal, contractual, etc.) on the use(s) of water described above. §174C-51(5) HRS

Per agreement with Wailuku Water Company LLC (WWC) entered into June 9, 2004, first amendment made November 29, 2007 and second amendment made February 27, 2008 DWS is entitled to withdraw up to 3.2GD except as notified by WWC when Iao Stream flow is below 11.5 MGD as measured at the USGS gauging station at Iao Stream at Kepaniwai Park, Wailuku.

TABLE 2: IRRIGATION INFORMATION

List all crops that will be grown as separate line items and include landscape and golf course irrigation.
Attach additional copies of Table 2 if necessary.

1	2	2	4	5	6	7	8
TMK OF PROPOSED LOCATION OF USE (Attach TMK map outlining area and photos for each proposed use.)	**CROP**	**TOTAL ACREAGE**	**NET IRRIGATED ACREAGE**	**BEGIN GROWTH PERIOD** (Month)	**END GROWTH PERIOD** (Month)	**IRRIGATION SYSTEM** (Refer to instructions.)	**IRRIGATION PRACTICE** (Refer to instructions.)
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							
Zone - Sec - Plat : Parcel							

9. COMMENTS:

At this time the Department does not serve non-potable water on our Central Maui system. While less than 2 percent of total Central Maui use is classified as irrigation meters, irrigation needs for other use categories could vary between 30 - 70 percent. Some preliminary research of potential commercial projects where reclaimed water can off-set potable sources have been initiated in the Water Use and Development Plan (WUDP) process. The Department strongly encourages new developments to utilize non-potable sources where available, such as on site brackish wells. Commercial properties are required to use reclaimed water for non potable needs if located within 100 feet of a R-1 reclaimed water distribution line

APPLICATION FOR SURFACE WATER USE PERMIT - PROPOSED NEW USE

TABLE 3: ALTERNATIVES ANALYSIS AND ADDITIONAL REQUIREMENTS

	A. Analysis of Potable Alternatives (Attach additional sheets if necessary.)	**B. Analysis of Non-Potable Alternatives** (Attach additional sheets if necessary.)
Municipal sources	Existing municipal sources are used to the extent possible with consideration to system capacity, water quality, pumping permits and various operational reasons to meet current demand	
Wastewater reuse		Expansion of the recycled water system require further quantification of end-uses and technical potential. Due to extensive capital costs and needed funding by private parties and other agencies in addition to DWS, this is a long-term goal, rather than an alternative that is available at this time
Ditch system	DWS does not own or operate a ditch system and is using Iao/Waikapu ditch to serve current demand. DWS had preliminary discussions with A&B concerning the potential for expansion of surface water treatment but ditch water availability dependson the Na Wai Eha allocations	
Desalinization	A plant for desalination of Central Maui brackish ground water for potable and non-potableneeds would have extensive energy needs and could potentially require new generation plants. Other	issues are cost volatility, and disposal of brine. This strategy does not present a viable alternative to meet current demand
Ground water	Well development in N. Waihee, Kahakuloa, Waikapu, Haiku or Honpou aquifers may not be as productive or cost-effective as expected or feasible at all at this time. The requested new use would allow less reliance on South Waihee aquifer	
Other (specify)	DWS conservation efforts include low-flow fixture distribution, public education , leak detection and water audits that are stepped up through additional conservation staff. Voluntary water restrictions on the Central Maui system have succeeded in achieving the voluntary cutback goal	of 25.5 mgd

C. ADDITIONAL REQUIREMENTS:

PUBLIC INTEREST Hawaii Revised Statutes §174C-2(c) states that: *The state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.*

1. Explain below how your proposed new use(s) will maximize beneficial use(s) and how they will be deemed to be in the public interest as defined by the State Water Code above.

DWS's withdrawals from Iao ditch is mixed with Iao and Waihee aquifer sources to serve the Central Maui system, which currently serves 21,450 meters. Domestic uses, such as single- and multi-family uses, account for about two-thirds of the Central Maui system services. The remaining one-third serves commercial, industrial, and agricultural uses A portion of these uses serve non-potable uses and is supplemented by reclaimed and brackish water for irrigation. We understand that domestic uses are protected public trust uses and are entitled to high priority under the public trust doctrine. CWRM concluded on February 15, 2006 and January 31, 2007 that DWS's basal source withdrawals serve the public interest. Iao ditch withdrawals serve the public interest in the same way. DWS provides for the protection and preservation of ground and surface water resources through conservation and resource protection programs.

2. Explain below how your proposed new use(s) will not interfere with any existing legal use(s).

Per agreement entered into June 9, 2004, first amendment made November 29, 2007 and second amendment made February 27, 2008 DWS is entitled to withdraw up to 3.2 MGD except as notified by WWC when Iao Stream flow is below 11.5 MGD as measured at the USGS gauging station at Iao Stream at Kepaniwai Park, Wailuku. The existing diversion from Iao stream by WWC is the Interim Instream Flow Standard (IIFS) and legal use. Acording to WWC's Opening Statement in Case No CCH-MA06-01, page 18 and Exhibit A, existing established uses (maximum potential diversion) from Iao stream represents 20 mgd diversion. 12 end users are identfied as withdrawing from Iao-Waikapu ditch of which DWS's allocation of 3.2 mgd is included. With the amendment of the IIFS, DWS supports returning water to the streams that is not a reasonable-beneficial use.

3. Explain below how your proposed new use(s) will not interfere with the rights of the Department of Hawaiian Home Lands as provided in Section 221 of the Hawaiian Homes Commission Act.

DWS's Central Maui system serves homes built by the Department of Hawaiian Homelands (DHHL). DWS places a high priority on DHHL residential projects and althouth DWS ceased to issue reservations in the Central Maui system post designation of Iao aquifer, exemptions were made for DHHL so that water could be secured for planned expansion of Hawaiian Home Lands residential projects.

APPLICATION FOR SURFACE WATER USE PERMIT
PROPOSED NEW USE

INSTRUCTIONS

is application form is for **new surface water uses** or for a modification of a previously approved water use permit in designated surface water management areas. New surface water uses are proposed uses after the effective date of designation of the surface water management area. Please check the appropriate box.

Do not use this form for existing surface water use applications. Existing surface water uses are actual uses before the effective date of designation. Please use Form SWUPA-E for existing uses.

Most questions can be addressed by visiting our website at: www.hawaii.gov/dlnr/cwrm, or contacting us at 587-0234, or by email at: dlnr.cwrm@hawaii.gov. The current application forms are also available at: www.hawaii.gov/dlnr/cwrm/resources_permits.htm.

REQUIREMENTS FOR A COMPLETE APPLICATION

1. Fill in the most recent application form. A current form is available at our web site or by contacting us at 587-0234.
2. Print in ink or type in the information on the application.
3. Fill in every item in the application form (page 1) and Tables 1, 2, and 3 as it relates to your proposed new use or permit modification.
4. Enclose a check for the non-refundable filing fee of $25 payable to: Department of Land and Natural Resources. Government agencies are not required to pay the filing fee.
5. Pay for the cost of publishing any required public notices related to your application. The current cost for publishing public notices is approximately $400.00. Commission staff will provide instructions later in the permit process regarding payment of these costs.
6. Mark the source and end use locations on the appropriate USGS quad map (scale 1:24,000) and property tax (TMK) map and attach these maps to your application.
7. Attach photos showing your existing diversion, measuring device(s) (if applicable) and end use areas.
8. Sign the application form in ink. Both the applicant and the landowner where the source is located must sign the application form.
9. Submit the original application and **15 copies** of the application form and all attachments (maps, photos and any other attachments) and filing fee to: Commission on Water Resource Management, P.O. Box 621, Honolulu, HI 96809.

ADDITIONAL REQUIREMENTS FOR A COMPLETED APPLICATION

Per Hawaii Revised Statutes §174C-49, the applicant must establish that the proposed new use of surface water:

1. Can be accommodated with the available water source.
2. Is a reasonable-beneficial use.*
3. Will not interfere with any existing legal use of water.
4. Is consistent with the public interest.**
5. Is consistent with state and county general plans and land use designations.
6. Is consistent with county land use plans and policies.
7. Will not interfere with the rights of the Department of Hawaiian Home Lands as provided in Section 221 of the Hawaiian Homes Commission Act.

*HRS §174C-3 of the State Water Code states: *"Reasonable-beneficial use" means the use of water in such a quantity as is necessary for economic and efficient utilization, for a purpose, and in a manner which is both reasonable and consistent with the state and county land use plans and the public interest.*

**HRS §174C-2(c) of the State Water Code states that: *(t)he state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.*

NOTE: Filling in the application from and Tables 1, 2, and 3 completely will address the requirements of HRS §174C-49.

LINE BY LINE INSTRUCTIONS ON APPLICATION

APPLICANT INFORMATION

In accordance with the Hawaii Water Code, both the applicant and the person who owns the property where the water source is located are required to apply for a water use permit. §174C-51(1)(B), HRS, states, *In the event a lessee, licensee, developer, or any other person with a terminable interest or estate in the land, which is the water source of the permitted water, applies for a water permit, the landowner shall also be stated as a joint applicant for the water permit.*

1. APPLICANT'S NAME: Fill in the information for the applicant. This should be the person who will be responsible for all conditions of the water use permit.
2. SOURCE LANDOWNER'S NAME: Fill in the information for the landowner of the property where the existing surface water diversion works is located.

SOURCE INFORMATION

3. SURFACE WATER HYDROLOGIC UNIT AND CODE: Enter the appropriate island, hydrologic unit name, and hydrologic code where the proposed source is located. The "source" is the stream from which water is diverted to the user. For information on hydrologic unit names and unit codes please refer to the *Surface Water Hydrologic Unit: A Management Tool for Instream Flow Standards* report available on the CWRM website at: http://www.hawaii.gov/dlnr/cwrm/, or contact CWRM staff at (808) 587-0234. You may also contact CWRM toll-free from Maui at: 984-2400, ext. 70234.

4. INSTREAM FLOW STANDARD (IFS) FOR HYDROLOGIC UNIT: Provide Instream Flow Standard (IFS) for hydrologic unit if available.
CAN YOUR PROPOSED USE BE ACCOMMODATED WITHIN THE ABOVE AMOUNTS: Check "Yes" or "No". Explain how your proposed use(s) can be accommodated within the Instream Flow Standard (IFS) for the above hydrologic unit.

6a. TMK OF PROPOSED STREAM DIVERSION LOCATION: Fill in the Tax Map Key (TMK) number of the tax parcel where the stream diversion will be located. Each tax parcel is issued a TMK number by the county property tax office and is defined as follows: 1st digit = (Island code), 2nd digit = Zone, 3rd digit = Section, Digits 4-6 = Plat, Digits 7-10 = Parcel, e.g. (1) 1-1-001:001. To find out your TMK number, call Maui County Real Property Tax Division at: (808) 270-7297, or check online at: www.mauipropertytax.com/

6b. TMK OF PROPOSED DITCH DIVERSION LOCATION: Fill in the Tax Map Key (TMK) number of the parcel where the proposed ditch diversion will be located.

7a. PROPOSED STREAM DIVERSION: How will water be diverted from the stream to your property? Check all the appropriate box(es).

7b. WILL THE DIVERTED WATER BE RETURNED TO THE STREAM OR DITCH? Check "Yes" or "No." If yes, enter the amount of water to be returned.

8. PROPOSED FLOW MEASUREMENT INFORMATION: Check "Yes" or "No". If yes, please describe the measuring device. A flowmeter with a totalizer will directly measure the total use for the source (similar to a car's odometer). If no, explain how stream diversion will be measured or estimated to justify amounts requested.

PROPOSED USE INFORMATION (HRS §174C-51(4), (5), (6))

9. TOTAL QUANTITY OF WATER REQUESTED: Enter the amount of water requested as gallons per day (GPD). Fill out Table 1 and enter the amount in Box 14, "Total Use Requested."

10. PROPOSED USE: Check all the boxes that apply for the proposed use. Refer to the instructions for Table 1: Land Use Consistency/Efficiency of Use, Item 1: Purpose/Water Use Category below to determine which water use category to use.

11. LOCATION OF PROPOSED WATER USE: Show the location of the proposed use on the same USGS and TMK maps as the proposed source location. Otherwise, attach similar maps and show the location of the proposed use.

PROPOSED USER INFORMATION

12. APPURTENANT RIGHT: An appurtenant water right is a legally recognized right to a specific amount of surface freshwater – usually from a stream – on the specific property that has that right. This right traces back to the first time the land was converted to fee simple title; i.e., the Great Mahele and the issuance of either a Land Commission Award or Royal Patent. The quantity of water under the appurtenant right is the amount that was being used on the land shortly before or at the time of the Mahele.
Do you claim an appurtenant right for your proposed water use? Check "Yes" or "No."
If yes, has your appurtenant right been established by the courts or the Commission? Check "Yes" or "No."

13. PROPOSED END USER INFORMATION: Will you be an end user on an existing water system? Check "Yes" or "No." If yes, please list the name of the water system operator.

14. REGISTRATION AND DECLARATION OF WATER USE: Do you have a Registration and Declaration of Water Use from the Commission? Check "Yes" or "No". If yes, list the name of the registrant(s).

15. STREAM DIVERSION WORKS PERMIT (SDWP): Have you ever been issued a SDWP by the Commission? If yes, please list the permit number(s). Otherwise, check "No."

16. APPLICANT: Sign and print your name, and date your application.

17. SOURCE LANDOWNER: Sign and print your name, and date your application. The landowner of the source shall be a joint applicant in the event the applicant is a lessee, licensee, developer, or any other person with a terminable interest or estate in the land which is the water source of the permitted water. §174C-51(1)(B)

TABLE 1: LAND USE CONSISTENCY / EFFICIENCY OF USE

Provide information on all of the proposed uses you are applying for or seeking to modify. In the space provided below the table or on a separate sheet, explain whether there are any limitations (e.g., a contract or other legal agreement(s)) on your proposed water use(s), as required by §174C-51(5), HRS.

1. PURPOSE / WATER USE CATEGORY: For each proposed use, choose one of the categories listed below and enter the appropriate code in the space provided (e.g. AGRAQ, IRRIG, etc.)

AGRICULTURE

AGRAQ	Aquatic Plants & Animals
AGRCP	Crops & Processing
AGRLI	Livestock & Processing, and Pasture
AGRON	Ornamental & Nursery Plants
AGROTH	Other

DOMESTIC

DOM	Single & Multi Low-Rise & High-Rise Household
DOMN	Domestic (Non-residential)
DOMNCB	Commercial Businesses
DOMNRI	Religious Institutions
DOMNHOS	Hospitals
DOMNHOT	Hotels
DOMNOB	Office buildings
DOMNOTH	Domestic Non-Residential – Other
DOMNSC	Schools

APPLICATION FOR SURFACE WATER USE PERMIT
PROPOSED NEW USE

INDUSTRIAL

INDEL	Geothermal, Thermoelectric Cooling, Power Development
INDFP	Fire Protection
INDMI	Mining, Dust Control
INDOTH	Industrial – Other

IRRIGATION

IRRGC	Golf Course
IRRHM	Habitat Maintenance
IRRHOT	Hotel
IRRLA	Landscape/Water Features
IRROTH	Other
IRRPA	Parks
IRRSC	Schools

MILITARY

MIL	Military

MUNICIPAL

MUNCO	County
MUNPR	Privately owned and operated but defined as a public system by the Department of Health
MUNST	State

2. USE TMK: The Tax Map Key number of the parcel over which the water will be applied. There should only be one parcel for each line. Also, attach a TMK map(s) for the lots showing the boundaries of irrigated acreage, etc., as well as a photograph of the area of use.
3. STATE LAND USE DISTRICT: To find out the current Land Use District, contact the Land Use Commission at 587-3822.
4. CDUP REQUIRED: If a Conservation District Use Permit (CDUP) is required, check "Yes" and enter the date CDUP was approved if you have a CDUP applicable to this project; or check "Yes, not acquired". If a CDUP is not required, check "No." To find out if your parcel is in the Conservation District, contact the Land Use Commission at 587-3822.
If your parcel is in a Conservation District, contact the Department of Land and Natural Resources Office of Conservation and Coastal Lands at 587-0328 to find out if a CDUP is required.
5. COUNTY ZONING CODE: To find out the Zoning Code for Na Wai Eha, contact Maui County Department of Planning at 270-6279 or 270-7253.
6. SMAP REQUIRED: If a Special Management Area Permit (SMAP) is required, check "Yes" and enter the date SMAP was approved if you have a SMAP applicable to this project; or check "Yes, not acquired". If a SMAP is not required, check "No." To find out if your parcel is in a Special Management Area and requires an SMAP, contact Maui County at 270-8205.
7. UNITS OR NET ACREAGE: This is the value and category as the basis for calculating the duty. "Duty" means the amount of water requested for a "unit" over a specific time period, e.g. gallons per acre per day, or gallons/acre/day. "Unit" can mean dwelling unit, or number of people, or animals. Some examples of this category include: 400 dwelling units, 500 people, and 3.74 acres.
8. GPD/UNIT or GPD/ACRE (GPD=gallons per day): Enter the gallons per day or gallons per acre for each water use category listed in Column #1.
9. REQUESTED QUANTITY OF USE (GPD): Enter the requested quantity of use in gallons per day (GPD) at build out after all phases of your project have been completed. The build out amount may differ from the four-year cumulative projected demand if your build out date extends beyond the cumulative projected four-year demand.
10. SUBMETERED? Is there a second measuring device or meter for another user? Check "Yes" or "No" if the specific use will be submetered or not. Submetering is specific to each line item.
11. APPLICANT'S JUSTIFICATION FOR QUANTITY OF REQUESTED USE FOR ITEM #9: Explain how you are justifying the amount(s) you are requesting for Item #9. Attach additional copies of Table 1 if necessary to show how this number was calculated. For irrigation uses, fill in Table 2.
12. TOTAL POTABLE USE: Add the quantities listed in the column above for potable water and enter the total potable use in gallons per day (GPD) here.
13. TOTAL NON-POTABLE USE: Add the quantities listed in the column above for uses that do not require potable water and enter the total non-potable use in gallons per day (GPD) here.
TOTAL QUANTITY OF WATER REQUESTED: Add the requested amounts listed on Box 13 and Box 14 and enter the total requested amount of both potable and non-potable uses here.
15. Please explain if there are any limitations (legal, contractual, etc.) on the use(s) of water described above. HRS §174C-51(5)

TABLE 2: IRRIGATION INFORMATION

On Table 2, provide the information requested for all the crops you are proposing to grow, including landscape and golf course turf and plants. Enter only one crop and one parcel number (TMK) per line. For multiple crops, list each one as a separate line item. All proposed or modified irrigation uses you are applying for must be listed. Attach additional copies of Table 2, if necessary.

1. USE TAX MAP KEY (TMK): Enter the parcel number where the crop will be grown. Also attach a property tax map with an outline around the area(s) of proposed use(s) and a photograph of each area of the proposed use.
2. CROP: Enter the crop type.
3. TOTAL ACREAGE: Enter the total acreage of the parcel listed.
4. NET IRRIGATED ACREAGE: Enter the acreage that the specific crop will be grown.
5. BEGIN GROWTH PERIOD (MONTH): This is the month of the start of the growth cycle.
6. END GROWTH PERIOD (MONTH): This is the month of the end of the growth cycle.
7. IRRIGATION SYSTEM: Enter one of the following:

TRICKLE, DRIP
TRICKLE, SPRAY
MULTIPLE SPRINKLERS

SPRINKLER, CONTAINER NURSERY
SPRINKLER, LARGE GUNS
SEEPAGE, SUBIRRIGATION
CROWN FLOOD
FLOOD (TARO)
OTHER – Please describe in the space provided for Comments.

8. IRRIGATION PRACTICE: Enter one of the following:

IRRIGATE TO FIELD CAPACITY
APPLY A FIXED DEPTH PER IRRIGATION
DEFICIT IRRIGATION
OTHER - Please describe in the space provided for COMMENTS below.

TABLE 3: ALTERNATIVES ANALYSIS AND ADDITIONAL REQUIREMENTS

A. ALTERNATIVES ANALYSIS: Please address each alternative and explain why they are or are not available for potable needs. Other alternatives on the last line may include stormwater reclamation, rainwater catchment, etc. that are not already listed above.

B. ALTERNATIVES ANALYSIS: Please address each alternative and explain why they are or are not available for non-potable needs. Other alternatives on the last line may include stormwater reclamation, rainwater catchment, etc. that are not already listed above.

Surface water is defined in §174C-3, HRS as: *...both contained surface water–that is, water upon the surface of the earth in bounds created naturally or artificially including, but not limited to, streams, other watercourses, lakes, reservoirs, and coastal waters subject to state jurisdiction–and diffused surface water–that is, water occurring upon the surface of the ground other than in contained waterbodies. Water from natural springs is surface water when it exits from the spring onto the earth's surface.*

ADDITIONAL REQUIREMENTS

1. Explain how your proposed new use(s) will maximize beneficial use(s) and how they will be deemed to be in the public interest as defined by the State Water Code below.

   Hawaii Revised Statutes §174C-2(c) states that: *The state water code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. However, adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation. Such objectives are declared to be in the public interest.*

2. Explain how your proposed new use(s) will not interfere with any existing legal use(s).

3. Explain how your proposed new use(s) will not interfere with the rights of the Department of Hawaiian Home Lands as provided in Section 221 of the Hawaiian Homes Commission Act. See below. To inquire about potential interference, you may contact the Department of Hawaiian Home Lands Planning Office at 586-3836.

   The State Water Code in §174C-101(a), HRS [Native Hawaiian water rights], states: *Provisions of this chapter shall not be construed to amend or modify rights or entitlements to water as provided for by the Hawaiian Homes Commission Act, 1920, as amended, and by chapters 167 and 168, relating to the Molokai irrigation system. Decisions of the commission on water resource management relating to the planning for, regulation, management, and conservation of water resources in the State shall, to the extent applicable and consistent with other legal requirements and authority, incorporate and protect adequate reserves of water for current and foreseeable development and use of Hawaiian home lands as set forth in section 221 of the Hawaiian Homes Commission Act.*

Exhibit 1

Iao Ditch, Wailuku, Maui, Hawaii

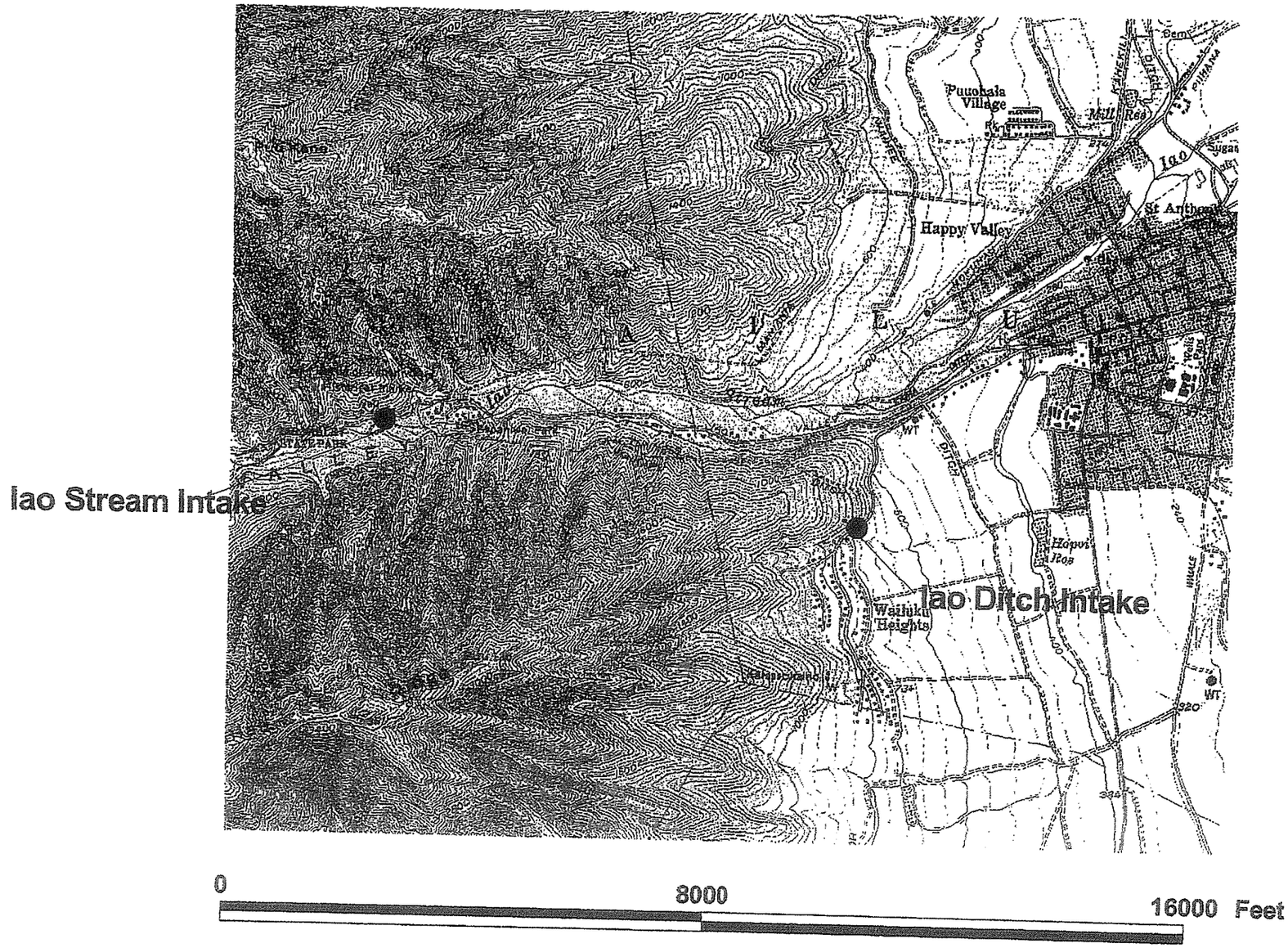
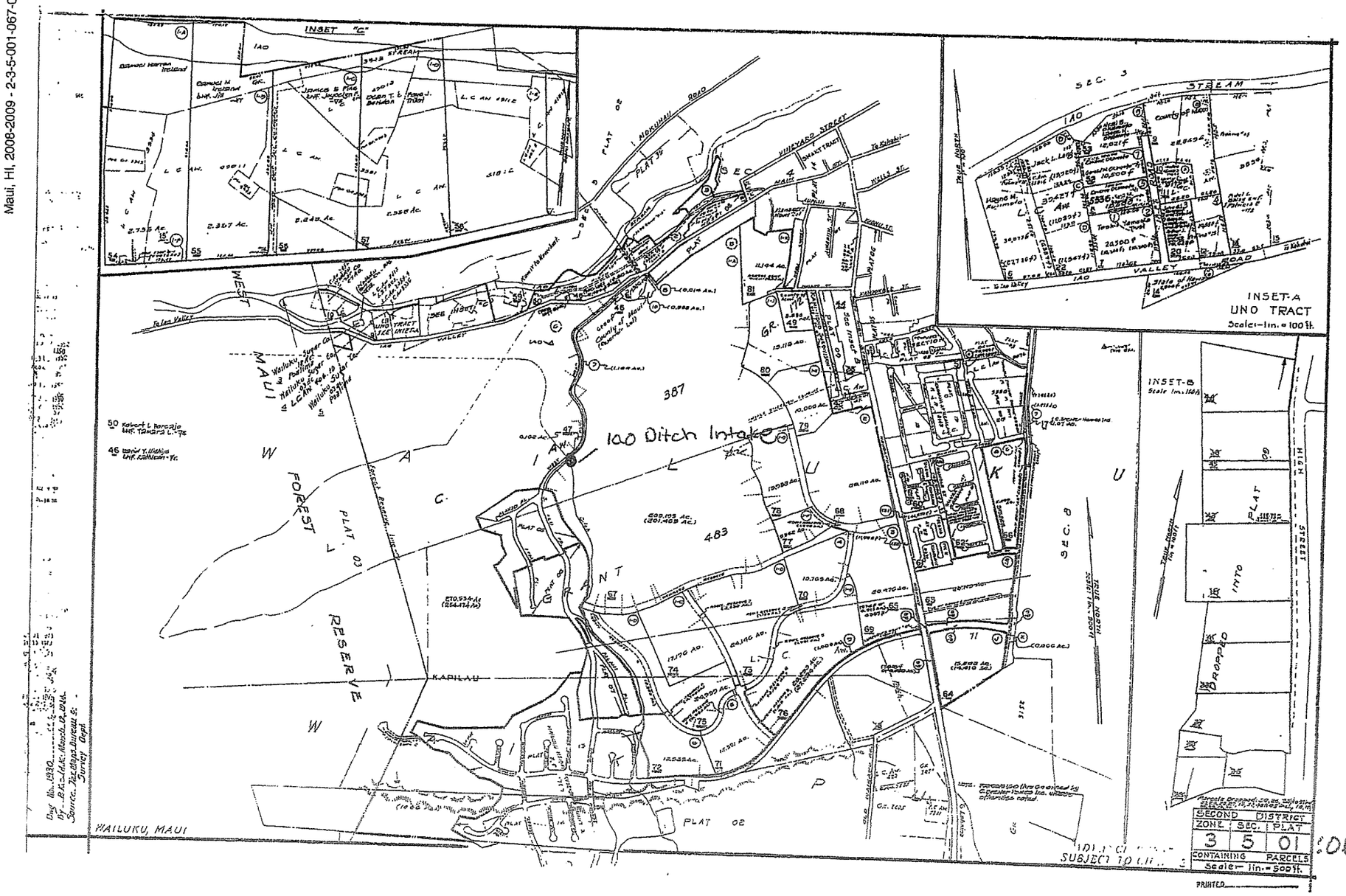


EXHIBIT 2A



067

Exhit 2b

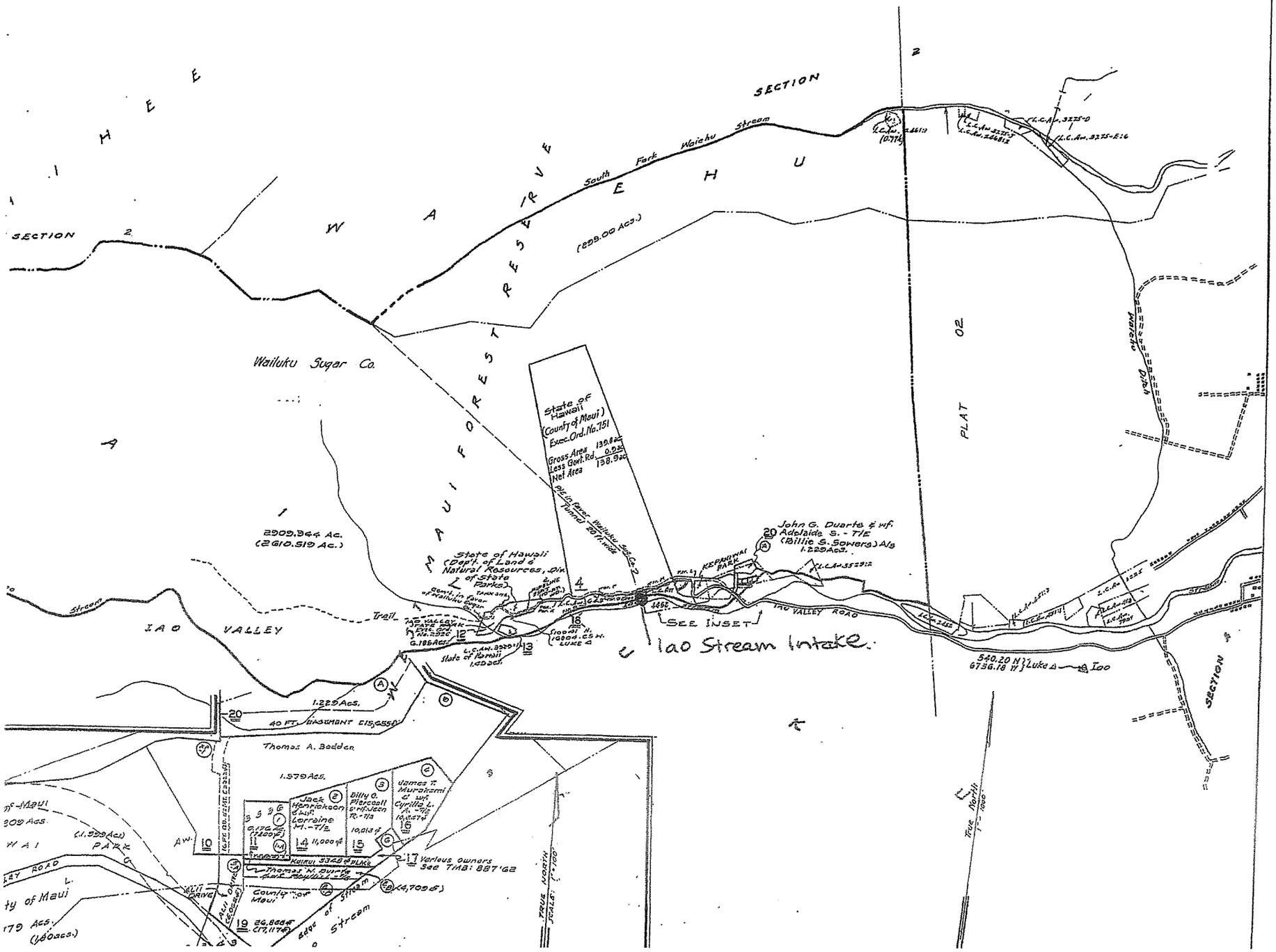
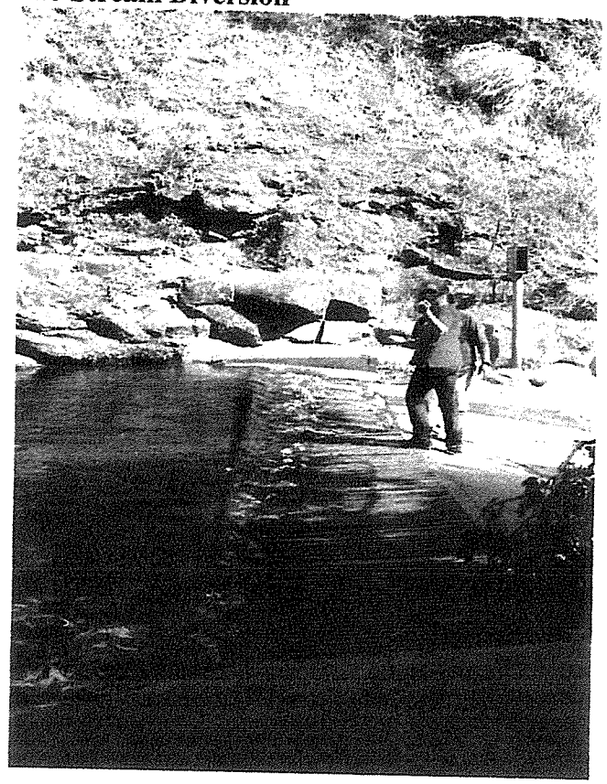
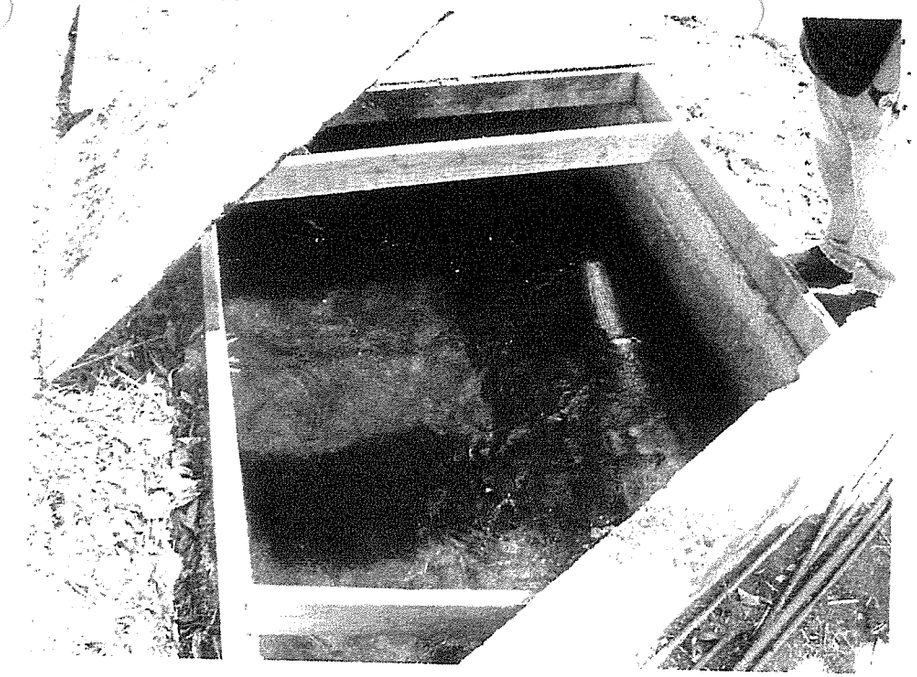

SECTION
South Fork Waiehu Stream
(229.00 Acs.)
Wailuku Sugar Co.
MAUI FOREST RESERVE
State of Hawaii (County of Maui) Exec. Ord. No. 751
Gross Area 130.8 ac
Less Govt. Rd. 0.9 ac
Net Area 129.9 ac
Pipe on Fence Tunnel 30 ft. wide
2909.344 Ac.
(2610.519 Ac.)
State of Hawaii (Dep't. of Land & Natural Resources, Div. of State Parks)
Govt. in Favor of Wailuku Sugar Co.
Tank and Pump
Stone Pipe (2003-00)
Stone Pipe (2003-00)
Iao Valley State Park Kia. 2232
6.185 Acs.
State of Hawaii 1.2000 Ac.
Trail
IAO VALLEY
Stream
John G. Duarte & wf. Adelaida S. - T/E (Billie S. Sowers) A/S 1.229 Acs.
KEPAUWAI PARK
IAO VALLEY ROAD
SEE INSET
Iao Stream Intake.
540.20 N
6736.18 W
Luke 4
Iao
1.229 Acs.
40 FT. EASEMENT
Thomas A. Bodden
1.579 Acs.
Jack Henriokeon & wife Lorraine M. - T/E
Billy O. Pitcairn & wf. Jean T. - T/E
James T. Murakami & wife Cynthia L. - T/E
11,000 sf
10,013 sf
Various Owners See TMB: 887'62
County of Maui
Thomas K. Duarte
Kaikui 5348 sf plus
(4,709 sf)
26,888 sf
Edge of Stream
TRUE NORTH
SCALE: 1" = 100'
PLAT 02
Intake
Pipe
SECTION

Exhibit 3

Iao Stream Diversion



Iao Ditch Intake



Iao Ditch Intake Improvements

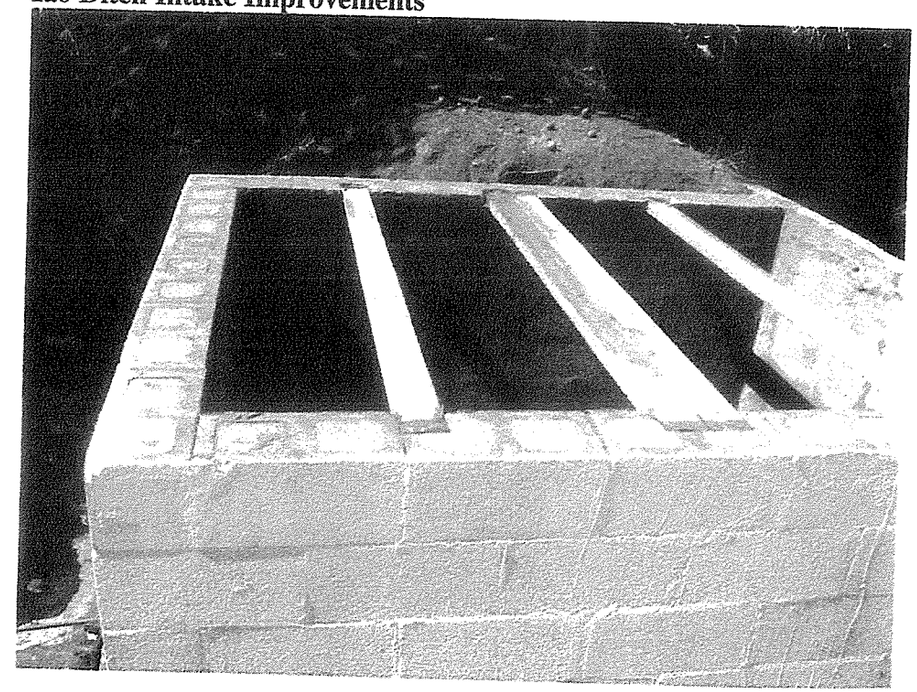
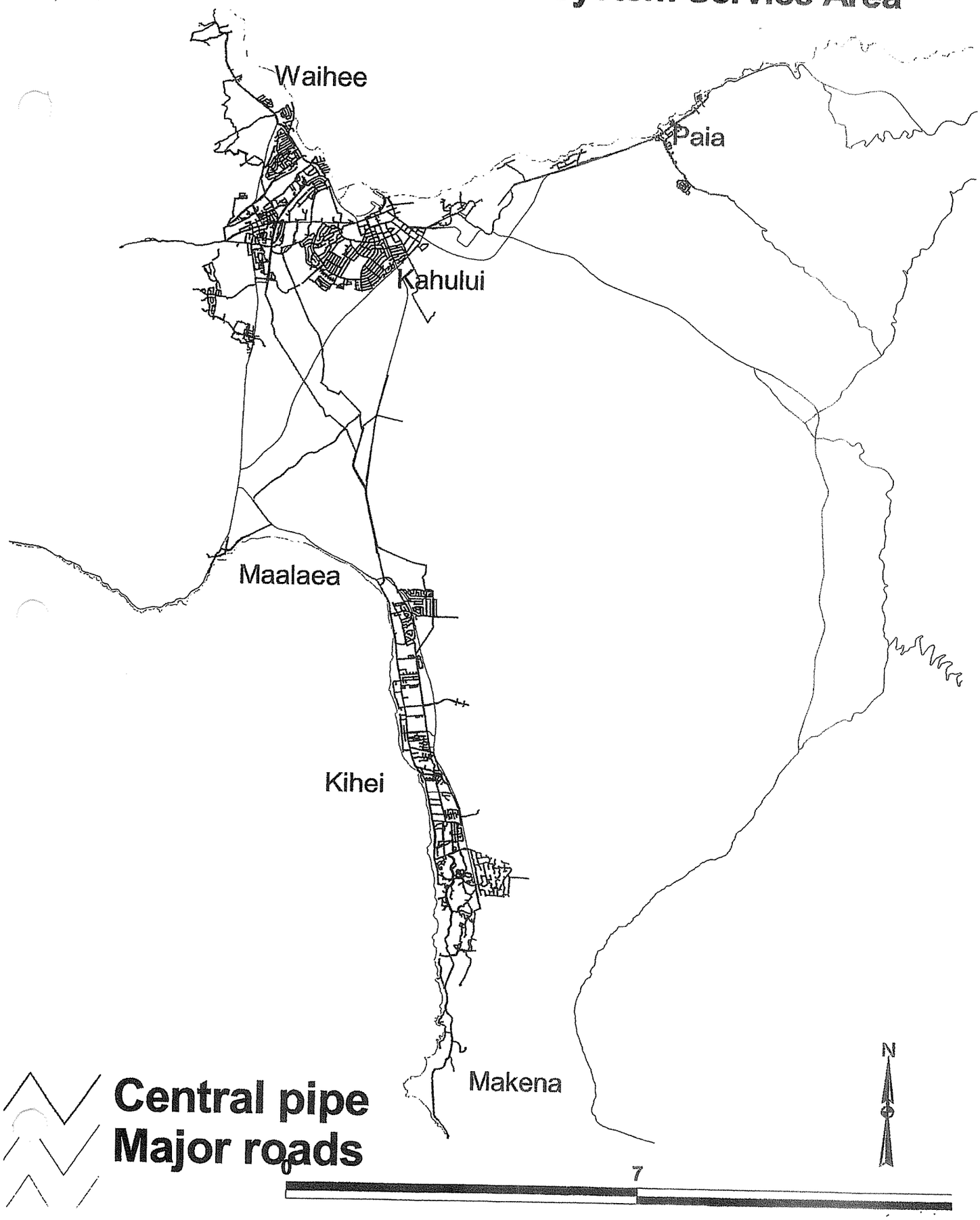


Exhibit 4 : Central Maui System Service Area



0409095 -
042709

LINDA LINGLE
GOVERNOR OF HAWAII

RECEIVED
2009 APR 27 AM 7:54
DEPT. OF WATER SUPPLY
COUNTY OF MAUI

LAURA H. THIELEN
CHAIRPERSON

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

KEN C. KAWAHARA, P.E.
DEPUTY DIRECTOR

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

April 23, 2009

Ref.: SWUP.2178.6

Mr. Jeffrey Eng, Director
Maui County Department of Water Supply
200 South High Street
Wailuku, HI 96793

Dear Mr. Eng:

Application for Surface Water Use Permit – Existing Use
Iao-Waikapu Ditch, Iao Stream
Na Wai Eha Surface Water Management Areas, Maui

We acknowledge receipt of your surface water use permit application for existing uses from the Iao-Waikapu Ditch in the Na Wai Eha Surface Water Management Areas on April 3, 2009. It was determined that your application was complete on April 16, 2009, after the Commission on Water Resource Management (Commission) adopted a Declaratory Ruling that Hawaii Revised Statutes Section 174C-51(1)(B) does not apply, that is, the source landowner's signature is not required, for surface water use permit applications for the Na Wai Eha Surface Water Management Areas, as long as the interests of the applicants are not as lessees, licensees, developers, or any other persons with a terminable interest or estate in the land which is the water source of the permitted water. You can expect your application to be processed within ninety (90) days from the date the Commission determined that your application was complete unless there are objections to your application.

Enclosed is a copy of the public notice for your water use permit application which will be published in the Maui News issues of April 27, 2009 and May 4, 2009. You will be required to pay for the cost of the public notice, which runs about $600. We will send you an invoice shortly after your notice is published.

Please be aware that there may be objections to your application. If objections are made, the objector is required to file such objections with the Commission and is also required to send you a copy of the objections.

You, or any other party, may respond to objections by filing a brief in support of your application with the Commission within ten (10) days of the filing of an objection. You, or the other party, must also send a copy of the response to the objector.

If you have any questions, please contact Robert Chong at (808) 587-0266, or toll free from Maui at 984-2400, extension 70266.

Sincerely,

KEN C. KAWAHARA, P.E.
Deputy Director

Enclosure

c Jane Lovell, County of Maui

EXHIBIT "B-R4"

PUBLIC NOTICE

Applications for Surface Water Use Permits – Existing Uses
Na Wai Eha Surface Water Management Areas
(Waihee, Waiehu, Iao and Waikapu Streams) Maui

The following applications for surface water use permits for existing uses have been received by the Commission on Water Resource Management and are hereby made public in accordance with Section 13-171, Hawaii Administrative Rules, "Designation and Regulation of Water Management Areas."

Applicant:	Maui County Department of Water Supply 200 South High Street Wailuku, HI 96793
Date Application Acknowledged as Complete:	April 16, 2009
Source Hydrologic Unit:	Iao Hydrologic Unit
Quantity Requested:	1,365,250 gallons per day
Existing Use of the Water:	Municipal water supply
Place of Water Use:	Maui County DWS Central Maui Service System
Location of the Diversion:	TMK: (2) 3-5-001:067

Applicant:	Kihei Garden & Landscaping Company, LLP P.O. Box 1058 Puunene, HI 96784
Date Application Acknowledged as Complete:	April 16, 2009
Source Hydrologic Unit:	Iao Hydrologic Unit
Quantity Requested:	33,261 gallons per day
Existing Use of the Water:	Irrigation of tropical landscape plants
Place of Water Use:	TMK: (2) 3-5-002:017
Location of the Diversion:	TMK: (2) 3-5-002:003

Applicant:	David Niehaus 1630 Piiholo Road Makawao, HI 96768
Date Application Acknowledged as Complete:	April 16, 2009
Source Hydrologic Unit:	Waikapu Hydrologic Unit
Quantity Requested:	48,000 gallons per day
Existing Use of the Water:	Taro cultivation and reforestation of native trees
Place of Water Use:	TMK: (2) 3-5-002:007
Location of the Diversion:	TMK: (2) 3-5-003:001 (Everett Ditch Intake)

Written objections or comments on the above applications may be filed by any person who has property interest in any land within the hydrologic unit of the source of water supply, any person who will be directly and immediately affected by the existing water use, or any other interested person. Written objections shall: (1) state property or other interest in the matter (provide TMK information); (2) set forth questions of procedure, fact, law, or policy, to which objections are taken; and (3) state all grounds for objections to the proposed permit. Written objections must be received by **May 18, 2009**. Objections must be sent to: 1) the Commission on Water Resource Management, P.O. Box 621, Honolulu, HI 96809 and 2) the applicant(s) at the above address(es).

COMMISSION ON WATER RESOURCE MANAGEMENT

Ken C. Kawa

KEN C. KAWAHARA, P.E.
Deputy Director

Dated: April 20, 2009

Publish in: Maui News issues of April 27, 2009, and May 4, 2009.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
SUMNER ERDMAN
LORETTA J. FUDDY, A.C.S.W., M.P.H.
NEAL S. FUJIWARA
DONNA FAY K. KIYOSAKI, P.E.
LAWRENCE H. MIIKE, M.D., J.D.

WILLIAM M. TAM
DEPUTY DIRECTOR

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

June 2, 2011

921.wup

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. David Taylor, Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, HI 96793

RECEIVED
COUNTY OF MAUI
2011 JUN -7 PM 2:53
DEPT. OF WATER SUPPLY

Dear Mr. Taylor:

DEC-ADM97-A1 Modification of Water Use Permit
(WUP No. 699 to WUP No. 921) for Well No. 5332-05
Iao Ground-Water Management Area, Maui

This is in response to your April 13, 2011 letter, requesting modification of water use permits for various municipal sources in the Iao Ground Water Management Area. This letter transmits your water use permit for Kepaniwai Well (Well No. 5332-05) for use of 0.791 million gallons per day (mgd) of water on a 12-month moving average basis that was administratively modified per Declaratory Ruling DEC-ADM97-A1 and supercedes the previous Water Use Permit Number listed above. As part of the Commission's approval, the following special conditions were added and are part of your permit under Standard Permit Condition 19:

Special Conditions

1. **The Commission delegates to the Maui Department of Water Supply the authority to allocate the use of water for municipal purposes, in accordance with §174C-48(b) HRS.**

2. **The Maui Department of Water Supply shall be exempt from the requirements of permit modifications as provided in §174C-57.**

3. **In the event that the tax map key at the location of the water use is changed, the permittee shall notify the Commission in writing of the tax map key change within thirty (30) days after the permittee receives notice of the tax map key change.**

4. **This water use permit has been administratively approved by the Chairperson under the provisions of the Commission's declaratory ruling DEC-ADM97-A1. Should any of the modified uses change in such a way that the uses do to not meet the following criteria, this permit shall be rendered invalid:**

   a. **The net change in permitted use within an aquifer is zero.**

EXHIBIT "B-R5"

b. The modification would result in more efficient and optimal operation of multiple sources under a single operator.

c. No adverse impacts to water resources or other existing legal uses are anticipated.

d. End use location and type remain unchanged.

5. Standard Condition 7 is amended as follows: Previous special conditions made by official Commission action on former water use permit approvals from the source(s) identified in this permit are incorporated unless specifically waived.

Enclosed with this letter of approval are the following:

1. Your water use permit.
2. Please continue to use your standard water use reporting form.

Please be sure to read the conditions of your approved permit.

We draw your attention to two key conditions of your permit that require your response. First, you are required to keep a record of your monthly total pumpage, water level, salinity, and water temperature. This information must be submitted to the Commission on a regular monthly basis using the enclosed water use report form. You should make copies of the enclosed report form as needed.

The previously accepted Iao Water Management Rule as your water shortage plan is still operative. Your water shortage plan simply identifies what you are willing to do should the Commission declare a water shortage situation in the Iao Ground-Water Management Area and can be as short as a one page letter. In a water shortage situation, the Commission may require temporary reductions in pumpage from all sources. The Commission is required, by law, to formulate a plan to implement such area-wide reductions, which should accommodate, include, and be consistent with your plans. Therefore, your help, by submitting your water shortage plan, is greatly needed in formulating the Commission's overall Water Shortage Plan.

If you have any questions, please call Charley Ice of the Commission staff at 587-0218.

Sincerely,

William Aila

for WILLIAM J. AILA, JR.
Chairperson

Attachment

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

GROUND WATER USE PERMIT

WUP NO. 921

PERMITTEE

Permittee/Water User		**Landowner of Source**	
Address	Maui Department of Water Supply	Address	Same
	200 South High Street		
	Wailuku, Hawaii 96793		

PERMITTED SOURCE INFORMATION

Island	Maui
Water Management Area	
Aquifer Sector	Wailuku
Aquifer System	Iao
System Sustainable Yield	20
Well Name	Kepaniwai
State Well No.	5332-05

PERMITTED USE INFORMATION

Reasonable beneficial use	Municipal
Withdrawal (12 month moving ave.)	0.791 mgd
Location of water use	
TMK #	Central Maui Service Area
State land use classification	NA
County zoning classification	NA

Pursuant to Hawaii's State Constitution, Article XI, Section 7, Hawaii Revised Statutes, Chapter 174C; Hawaii Administrative Rules, Chapters 13-167 through 13-171; and Hawaii decisional law and custom, the permittee is hereby authorized to use ground water from the sources and in the amount and from and upon the locations described above; subject however, to the requirements of law including but not limited to the following conditions:

1. The water described in this water use permit may only be taken from the location described and used for the reasonable beneficial use described at the location described above. Reasonable beneficial uses means "the use of water in such a quantity as is necessary for economic and efficient utilization which is both reasonable and consistent with State and County land use plans and the public interest." (HRS § 174C-3)

2. The right to use ground water is a shared use right.

3. The water use must at all times meet the requirements set forth in HRS § 174C-49(a), which means that it:

   a. Can be accommodated with the available water source;
   b. Is a reasonable-beneficial use as defined in HRS § 174C-3;
   c. Will not interfere with any existing legal use of water;
   d. Is consistent with the public interest;
   e. Is consistent with State and County general plans and land use designations;
   f. Is consistent with County land use plans and policies; and
   g. Will not interfere with the rights of the Department of Hawaiian Home Lands as provided in section 221 of the Hawaiian Homes Commission Act and HRS § 174C-101(a).

4. The ground water use here must not interfere with surface or other ground water rights or reservations.

5. The ground water use here must not interfere with interim or permanent instream flow standards. If it does, then:

   a. A separate water use permit for surface water must be obtained in the case an area is also designated as a surface water management area;
   b. The interim or permanent instream flow standard, as applicable, must be amended.

6. The water use authorized here is subject to the requirements of the Hawaiian Homes Commission Act, as amended, if applicable.

~~7. The water use permit application and submittal, as amended, approved by the Commission in its June 10, 2010 Decision and Order are incorporated into this permit by reference.~~

8. Any modification of the permit terms, conditions, or uses may only be made with the express written consent of the Commission.

9. This permit may be modified by the Commission and the amount of water initially granted to the permittee may be reduced if the Commission determines it is necessary to:

   a. protect the water sources (quantity or quality);
   b. meet other legal obligations including other correlative rights;
   c. insure adequate conservation measures;
   d. require efficiency of water uses;
   e. reserve water for future uses, provided that all legal existing uses of water as of June, 1987 shall be protected;
   f. meet legal obligations to the Department of Hawaiian Home Lands, if applicable; or
   g. carry out such other necessary and proper exercise of the State's and the Commission's police powers under law as may be required.

   Prior to any reduction, the Commission shall give notice of its proposed action to the permittee and provide the permittee an opportunity to be heard.

10. An approved flowmeter(s) must be installed to measure monthly withdrawals and a monthly record of withdrawals, salinity, temperature, and pumping times must be kept and reported to the Commission on Water Resource Management on forms provided by the Commission on a yearly basis (attached).

11. This permit shall be subject to the Commission's periodic review of the Iao Aquifer System's sustainable yield. The amount of water authorized by this permit may be reduced by the Commission if the sustainable yield of the Iao Aquifer System, or relevant modified aquifer(s), is reduced.

12. A permit may be transferred, in whole or in part, from the permittee to another, if:

    a. The conditions of use of the permit, including, but not limited to, place, quantity, and purpose of the use, remain the same; and
    b. The Commission is informed of the transfer within ninety days.

    Failure to inform the department of the transfer invalidates the transfer and constitutes a ground for revocation of the permit. A transfer, which involves a change in any condition of the permit, including a change in use covered in HRS § 174C-57, is also invalid and constitutes a ground for revocation.

13. The use(s) authorized by law and by this permit do not constitute ownership rights.

14. The permittee shall request modification of the permit as necessary to comply with all applicable laws, rules, and ordinances that will affect the permittee's water use.

15. The permittee understands that under HRS § 174C-58(4), that partial or total nonuse, for reasons other than conservation, of the water allowed by this permit for a period of four (4) continuous years or more may result in a permanent revocation as to the amount of water not in use. The Commission and the permittee may enter into a written agreement that, for reasons satisfactory to the Commission, any period of nonuse may not apply towards the four-year period. Any period of nonuse which is caused by a declaration of water shortage pursuant to section HRS § 174C-62 shall not apply towards the four-year period of forfeiture.

16. The permittee shall prepare and submit a water shortage plan within 30 days of the issuance of this permit as required by HAR § 13-171-42(c). The permittee's water shortage plan shall identify what the permittee is willing to do should the Commission declare a water shortage in the Iao Ground Water Management Area.

17. The water use permit shall be subject to the Commission's establishment of instream standards and policies relating to the Stream Protection and Management (SPAM) program, as well as legislative mandates to protect stream resources.

18. The permittee understands that any willful violation of any of the above conditions or any provisions of HRS § 174C or HAR § 13-171 may result in the suspension or revocation of this permit.

19. Special conditions in the attached cover transmittal letter are incorporated herein by reference.

for William A. Aila Jr.

WILLIAM J. AILA, JR., Chairperson
Commission on Water Resource Management

JUN 08 2011 P.33

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
SUMNER ERDMAN
LORETTA J. FUDDY, A.C.S.W., M.P.H.
NEAL S. FUJIWARA
DONNA FAY K. KIYOSAKI, P.E.
LAWRENCE H. MIIKE, M.D., J.D.

WILLIAM M. TAM
DEPUTY DIRECTOR

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

EVA

June 2, 2011

920.wup

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

RECEIVED
COUNTY OF MAUI
2011 JUN -7 PM 2:47
DEPT. OF WATER SUPPLY

Mr. David Taylor, Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, HI 96793

Dear Mr. Taylor:

DEC-ADM97-A1 Modification of Water Use Permit
(WUP No. 680 to WUP No. 920) for Well No. 5332-02
Iao Ground-Water Management Area, Maui

This is in response to your April 13, 2011 letter, requesting modification of water use permits for various municipal sources in the Iao Ground Water Management Area. This letter transmits your water use permit for Iao Tunnel (Kepaniwai) (Well No. 5332-02) for use of 1.610 million gallons per day (mgd) of water on a 12-month moving average basis that was administratively modified per Declaratory Ruling DEC-ADM97-A1 and supercedes the previous Water Use Permit Number listed above. As part of the Commission's approval, the following special conditions were added and are part of your permit under Standard Permit Condition 19:

Special Conditions

1. **The Commission delegates to the Maui Department of Water Supply the authority to allocate the use of water for municipal purposes, in accordance with §174C-48(b) HRS.**

2. **The Maui Department of Water Supply shall be exempt from the requirements of permit modifications as provided in §174C-57.,HRS.**

3. **In the event that the tax map key at the location of the water use is changed, the permittee shall notify the Commission in writing of the tax map key change within thirty (30) days after the permittee receives notice of the tax map key change.**

4. **This water use permit has been administratively approved by the Chairperson under the provisions of the Commission's declaratory ruling DEC-ADM97-A1. Should any of the modified uses change in such a way that the uses do to not meet the following criteria, this permit shall be rendered invalid:**

    a. **The net change in permitted use within an aquifer is zero.**

EXHIBIT "B-R6"

b. **The modification would result in more efficient and optimal operation of multiple sources under a single operator.**

c. **No adverse impacts to water resources or other existing legal uses are anticipated.**

d. **End use location and type remain unchanged.**

5. **Standard Condition 7 is amended as follows: Previous special conditions made by official Commission action on former water use permit approvals from the source(s) identified in this permit are incorporated unless specifically waived.**

Enclosed with this letter of approval are the following:

1. Your water use permit.
2. Please continue to use your standard water use reporting form.

Please be sure to read the conditions of your approved permit.

We draw your attention to two key conditions of your permit that require your response. First, you are required to keep a record of your monthly total pumpage, water level, salinity, and water temperature. This information must be submitted to the Commission on a regular monthly basis using the enclosed water use report form. You should make copies of the enclosed report form as needed.

The previously accepted Iao Water Management Rule as your water shortage plan is still operative. Your water shortage plan simply identifies what you are willing to do should the Commission declare a water shortage situation in the Iao Ground-Water Management Area and can be as short as a one page letter. In a water shortage situation, the Commission may require temporary reductions in pumpage from all sources. The Commission is required, by law, to formulate a plan to implement such area-wide reductions, which should accommodate, include, and be consistent with your plans. Therefore, your help, by submitting your water shortage plan, is greatly needed in formulating the Commission's overall Water Shortage Plan.

If you have any questions, please call Charley Ice of the Commission staff at 587-0218.

Sincerely,

Per WILLIAM J. AILA, JR.
Chairperson

Attachment

c: Wailuku Water Company

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

GROUND WATER USE PERMIT

WUP NO. 920

PERMITTEE

Permittee/Water User		**Landowner of Source**	
Address	Maui Department of Water Supply	Address	Maui Department of Water Supply and Wailuku Water Company
	200 South High Street		255 East Waiko Road
	Wailuku, Hawaii 96793		Wailuku, HI 96793

PERMITTED SOURCE INFORMATION

Island	Maui
Water Management Area	
Aquifer Sector	Wailuku
Aquifer System	Iao
System Sustainable Yield	20
Well Name	Iao Tunnel (Kepaniwai)
State Well No.	5332-02

PERMITTED USE INFORMATION

Reasonable beneficial use	Municipal
Withdrawal (12 month moving ave.)	1.610 mgd
Location of water use	
TMK #	Central Maui Service Area
State land use classification	NA
County zoning classification	NA

Pursuant to Hawaii's State Constitution, Article XI, Section 7, Hawaii Revised Statutes, Chapter 174C; Hawaii Administrative Rules, Chapters 13-167 through 13-171; and Hawaii decisional law and custom, the permittee is hereby authorized to use ground water from the sources and in the amount and from and upon the locations described above; subject however, to the requirements of law including but not limited to the following conditions:

1. The water described in this water use permit may only be taken from the location described and used for the reasonable beneficial use described at the location described above. Reasonable beneficial uses means "the use of water in such a quantity as is necessary for economic and efficient utilization which is both reasonable and consistent with State and County land use plans and the public interest." (HRS § 174C-3)

2. The right to use ground water is a shared use right.

3. The water use must at all times meet the requirements set forth in HRS § 174C-49(a), which means that it:

   a. Can be accommodated with the available water source;
   b. Is a reasonable-beneficial use as defined in HRS § 174C-3;
   c. Will not interfere with any existing legal use of water;
   d. Is consistent with the public interest;
   e. Is consistent with State and County general plans and land use designations;
   f. Is consistent with County land use plans and policies; and
   g. Will not interfere with the rights of the Department of Hawaiian Home Lands as provided in section 221 of the Hawaiian Homes Commission Act and HRS § 174C-101(a).

4. The ground water use here must not interfere with surface or other ground water rights or reservations.

5. The ground water use here must not interfere with interim or permanent instream flow standards. If it does, then:

   a. A separate water use permit for surface water must be obtained in the case an area is also designated as a surface water management area;
   b. The interim or permanent instream flow standard, as applicable, must be amended.

6. The water use authorized here is subject to the requirements of the Hawaiian Homes Commission Act, as amended, if applicable.

~~7. The water use permit application and submittal, as amended, approved by the Commission in its June 10, 2010 Decision and Order are incorporated into this permit by reference.~~

8. Any modification of the permit terms, conditions, or uses may only be made with the express written consent of the Commission.

9. This permit may be modified by the Commission and the amount of water initially granted to the permittee may be reduced if the Commission determines it is necessary to:

   a. protect the water sources (quantity or quality);
   b. meet other legal obligations including other correlative rights;
   c. insure adequate conservation measures;
   d. require efficiency of water uses;
   e. reserve water for future uses, provided that all legal existing uses of water as of June, 1987 shall be protected;
   f. meet legal obligations to the Department of Hawaiian Home Lands, if applicable; or
   g. carry out such other necessary and proper exercise of the State's and the Commission's police powers under law as may be required.

   Prior to any reduction, the Commission shall give notice of its proposed action to the permittee and provide the permittee an opportunity to be heard.

10. An approved flowmeter(s) must be installed to measure monthly withdrawals and a monthly record of withdrawals, salinity, temperature, and pumping times must be kept and reported to the Commission on Water Resource Management on forms provided by the Commission on a yearly basis (attached).

11. This permit shall be subject to the Commission's periodic review of the Iao Aquifer System's sustainable yield. The amount of water authorized by this permit may be reduced by the Commission if the sustainable yield of the Iao Aquifer System, or relevant modified aquifer(s), is reduced.

12. A permit may be transferred, in whole or in part, from the permittee to another, if:

    a. The conditions of use of the permit, including, but not limited to, place, quantity, and purpose of the use, remain the same; and
    b. The Commission is informed of the transfer within ninety days.

    Failure to inform the department of the transfer invalidates the transfer and constitutes a ground for revocation of the permit. A transfer, which involves a change in any condition of the permit, including a change in use covered in HRS § 174C-57, is also invalid and constitutes a ground for revocation.

13. The use(s) authorized by law and by this permit do not constitute ownership rights.

14. The permittee shall request modification of the permit as necessary to comply with all applicable laws, rules, and ordinances that will affect the permittee's water use.

15. The permittee understands that under HRS § 174C-58(4), that partial or total nonuse, for reasons other than conservation, of the water allowed by this permit for a period of four (4) continuous years or more may result in a permanent revocation as to the amount of water not in use. The Commission and the permittee may enter into a written agreement that, for reasons satisfactory to the Commission, any period of nonuse may not apply towards the four-year period. Any period of nonuse which is caused by a declaration of water shortage pursuant to section HRS § 174C-62 shall not apply towards the four-year period of forfeiture.

16. The permittee shall prepare and submit a water shortage plan within 30 days of the issuance of this permit as required by HAR § 13-171-42(c). The permittee's water shortage plan shall identify what the permittee is willing to do should the Commission declare a water shortage in the Iao Ground Water Management Area.

17. The water use permit shall be subject to the Commission's establishment of instream standards and policies relating to the Stream Protection and Management (SPAM) program, as well as legislative mandates to protect stream resources.

18. The permittee understands that any willful violation of any of the above conditions or any provisions of HRS § 174C or HAR § 13-171 may result in the suspension or revocation of this permit.

19. Special conditions in the attached cover transmittal letter are incorporated herein by reference.

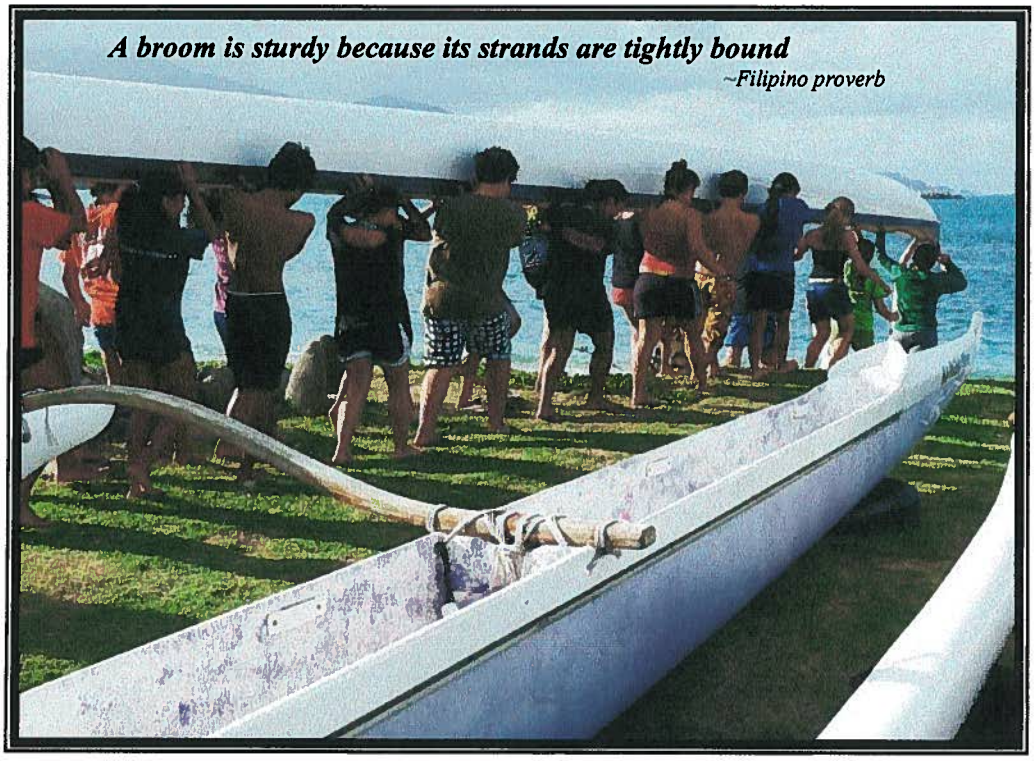
for William Aila

WILLIAM J. AILA, JR., Chairperson
Commission on Water Resource Management

Attachment

c: Wailuku Water Company

Chapter 1: Population



Canoe launch, Kahului.

Population change on the island is inevitable. In-migration and out-migration occur at different rates and for different reasons. Understanding that our overall population will likely follow recent upward trends, it is our responsibility to decide how we would like this growth to manifest itself. Population growth can have positive and negative impacts on the environment, socio-economic and cultural composition of the island, and visitor experience. Visitors and new residents may arrive to Maui with expectations and values that conflict with the local way of life, a lifestyle that has been rooted on Maui for generations.

EXHIBIT "B-R7"

The policies that are adopted to address the impacts of population change will ultimately define our expectations for the future, and are far more important than the population change itself.

Background Information

The 2030 Socio-Economic Forecast is a planning tool; it identifies future options for the community to consider. The community may want to adopt policies to achieve a specific outcome that differs from the forecasted outcome, and to minimize the undesirable impacts of current trends. The population projections are based on trends and model assumptions that are absent of policy changes or directives. The forecast affects both ongoing planning (project review and approval) and the desired future articulated by Maui's residents and political leaders (General Plan and Community Plans). Because a long-term forecast identifies long-term trends and omits short-term variations, there will be many surprises along the way, even if a forecast turns out to be highly accurate.

The forecast was based on projections developed by the State of Hawai`i Department of Business, Economic Development & Tourism (DBEDT). The forecast allocates expected countywide change to local areas. The DBEDT long-term econometric model draws on historical data over three decades, plus projections from DBEDT and national sources. The DBEDT model (and accordingly, the allocation model) is economically driven: industries that attract capital are taken as crucial to economic growth, which in turn leads to new jobs and increased population.

Historic Population Trends

To put population increase into perspective, it is appropriate to compare Maui Island's population increase to the other major islands in the Hawaiian chain throughout the recent past. It is evident from Table 1-1 (below) that while O`ahu experienced the most dramatic population increase during the 1950s, the other islands, including Maui, were impacted by the steepest increase in population between 1970 and 1990.

Table 1 - 1: State and Island Population 1960 - 2010

Area	1960	1970	1980	1990	2000	2010
State of Hawai`i	632,772	769,913	968,500	1,113,491	1,213,519	1,363,621
Island of O`ahu	500,409	630,528	764,600	838,534	876,156	953,207
Island of Hawai`i	61,332	63,468	92,900	121,572	149,244	185,406
Island of Maui	35,717	38,691	62,823	91,361	117,644	144,444
Island of Kaua`i	27,922	29,524	39,400	51,676	58,568	67,226

United States Census.

According to the 2030 Socio-Economic Forecast, the total population is not expected to increase equally throughout the island; rather, there are specific regions where population growth is more likely to occur at a higher rate than others.

Table 1 - 2: Community Plan Area Population 2000 – 2030

Community Plan Area	2000	2005	2010	2015	2020	2025	2030
West Maui	17,967	19,852	22,156	29,103	31,410	33,743	36,058
Kīhei-Mākena	22,870	25,609	27,244	37,850	40,850	43,885	46,896
Wailuku-Kahului	41,503	46,626	54,433	52,343	56,492	60,689	64,853
Makawao-Pukalani-Kula	21,571	23,176	25,198	23,919	25,815	27,732	29,635
Pā`ia-Ha`ikū	11,866	12,210	13,122	11,332	12,230	13,139	14,040
Hāna	1,867	1,998	2,291	2,541	2,743	2,947	3,149
Total Maui Island	**117,644**	**129,471**	**144,444**	**157,087**	**169,540**	**182,135**	**194,630**

U.S. Census Bureau, 2000; Socio-Economic Forecast, Maui County Department of Planning, 2006, revised 2012.

Demographic Conditions, Trends, and Projections

Some demographic trends embedded in the forecast are consistent with the current projections.

- Between 2010 and 2030, the island's resident population is expected to grow from 144,444 to 194,630, an increase of 35 percent.
- The island's resident population is expected to grow at nearly an identical rate as the *de facto* population.
- The population is aging; the median age increased from 34.1 to 36.2 years between 1990 and 2000.
- Households are becoming smaller over time; Maui's household size is projected to decline from 2.94 persons per household in 2000 to 2.66 persons per household in 2030.

Economic Factors

- Wage and salary jobs are expected to increase by about 1.1 percent annually.
- *Per capita* income will increase very little (in constant dollars).
- Visitor counts will increase by about 1 percent annually.
- Because of high occupancy rates, construction of new units is expected to resume, and the supply of visitor units is expected to grow at 1 percent annually.
- The past rate of growth in resident population, housing, and jobs is higher than the rate of visitor growth. This indicates that Maui's economy has diversified and is less driven by tourism than in the past.

Community Plan Area Findings

To project future employment and housing needs for the island's Community Plan Areas, the forecast model allocated households based on historic trends, availability of entitled lands for development or redevelopment, development constraints, and careful consideration of planned and proposed development projects. The forecast model recognized that relatively isolated areas – such as Hāna – depend much more on the success of one major employer than do others; therefore, an economic downturn can have a devastating impact. Map 1-1 depicts Maui's major employment and population centers. For planning purposes, it is important to provide resident housing near employment.

Community Plan Area	Characteristics
West Maui	In the 1990s, this area saw significant population and job growth. Looking to the future, these trends are projected to continue through 2030. Local development potential to monitor includes timeshare, large master-planned communities, and Hawaiian Homelands. Timeshares and other transient vacation rentals are of particular interest for the impact they may have on island-wide job distribution. Timeshares have higher occupancies than hotels, but employ fewer workers at the lodging site.
Kīhei-Mākena	This area has seen growth in the visitor industry, the technology sector, and expanding residential areas. It has had the smallest average household size, and anecdotally, its workforce is more transient than other areas. The forecast extends all these trends. Based in part on recent development proposals, the forecast shows stronger growth in residential units than in visitor units.

Community Plan Area	Characteristics
Wailuku-Kahului	This area remains the economic and population center of the island. In the 1990s, this area saw significant increases in trade, transportation, communications and utilities, and government jobs. Kahului Harbor is the port through which most cruise ship visitors reach Maui. The 2030 Socio-Economic Forecast suggests the Wailuku-Kahului Community Plan Area will grow faster than other parts of Maui, as former sugar lands are developed into residential subdivisions. Wailuku-Kahului is expected to maintain its status as home to more than a third of Maui's households.
Makawao-Pukalani-Kula	This area saw significant increases in population in the 1980s, but less growth subsequently. New development slowed because of water supply problems. Job growth occurred at a much faster rate, but the forecast calls for economic growth to continue at a slower pace. With only 1 job located in this area for every 2.5 households, most of the area's residents commute outside the area for work. This will continue to be the case; by 2030, the forecast shows only 2.1 local jobs per household .
Pā`ia-Ha`ikū	Since windsurfing became popular in the 1980s, this area has taken on new importance as the home of this sport. In the 1990s, upland regions saw new development of homes on large agricultural lots, with the area population increasing by 52 percent. In light of limited availability of suitable land for new homes, the forecast calls for much slower growth in housing and population.
Hāna	In recent years, this area has seen job losses and a decrease of children and young adults. Slow growth is projected over the planning period, provided the visitor economy remains healthy. Hāna has experienced new population resulting from in-migration.

CHALLENGES AND OPPORTUNITIES

The growth of Maui's resident and visitor population will create both challenges and opportunities. Population growth can exacerbate existing infrastructure-capacity deficiencies, place additional demands on environmental resources, foster shifts in the cultural and ethnic makeup of the population, and change the landscape. In addition, the loss of cultural identity and diversity has created social tensions that have increased over at least the last 20 years. The cultural understanding and sensitivity of new residents to the host culture has been a constant point of discussion throughout the MIP's public-engagement process.

Population Growth

Population growth can also contribute to the health of the community. Population growth is often necessary to maintain a growing economy, an expanding tax base, and employment opportunities. A host of negative social and economic conditions, such as unemployment, crime, family disintegration, and substance abuse, can be found in communities with longstanding population loss. Policies and actions to address population growth on Maui can be found throughout the MIP. Figure 1-1 depicts the projected growth in Maui's resident and *de facto* population to 2030.

Maui's population is aging; and recent data shows that trends related to Maui's aging population will be similar to the trends on the Mainland. Figure 1-2 portrays Maui's age distribution over time. This demographic change has significant impacts to public services as they relate to the elderly, including housing, transportation, health care, and elder care services.

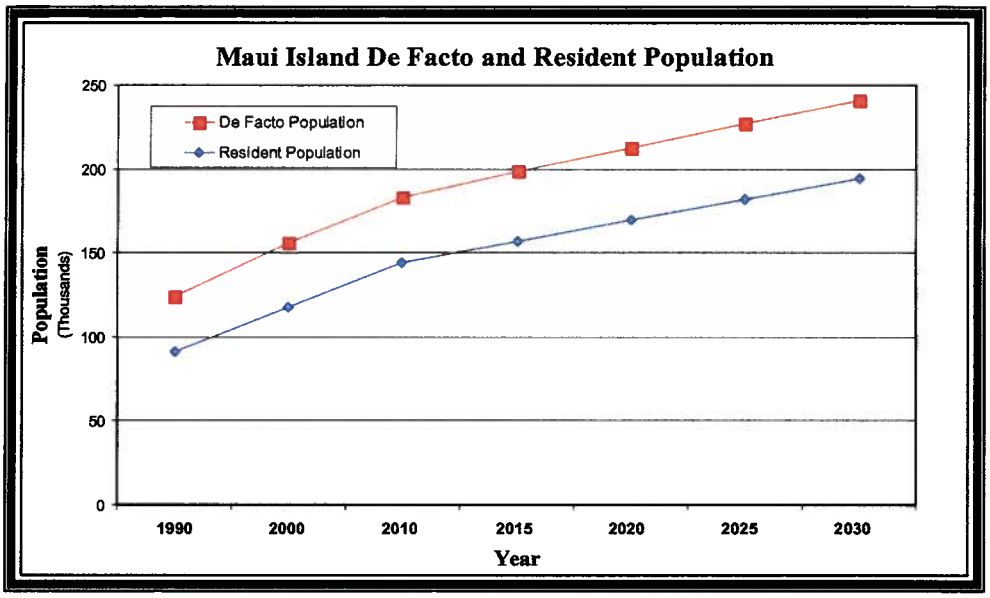


Figure 1 - 1. Maui Island Resident and De Facto Population Projections 1990 – 2030[1]

Aging Population

In addition to the challenge of providing more senior services, the wage-earning population that typically supports children and seniors will be proportionally smaller. Policies and actions to address the aging population can be found in this chapter as well as the Housing, Economic Development, Land Use, and Infrastructure and Public Facilities chapters.

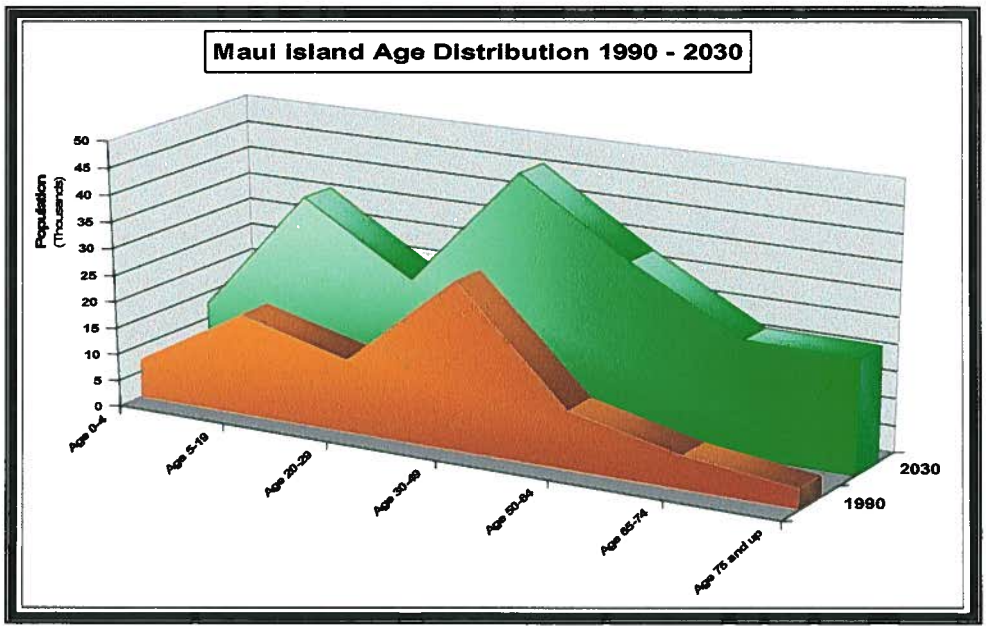


Figure 1 - 2. Maui Island Age Distribution 1990 – 2030.[2]

[1] Department of Business, Economic Development and Tourism, State of Hawai`i (2012). Population and Economic Projections for the State of Hawai`i to 2040 (March 2012).

Figure 1-3 compares the percentage of Mauians born in Hawai`i to the percentage born elsewhere. The percentage of those born in Hawai`i has dropped from 67 percent in 1980 to 53 percent in 2000. The out-migration of island residents is a result of Maui's high cost of housing, limited employment and educational opportunities, and the desire of some Maui residents to experience life outside of Hawai`i. Policies and actions to help provide a choice for island residents to remain on Maui can be found throughout the MIP.

Out-migration of Island Residents

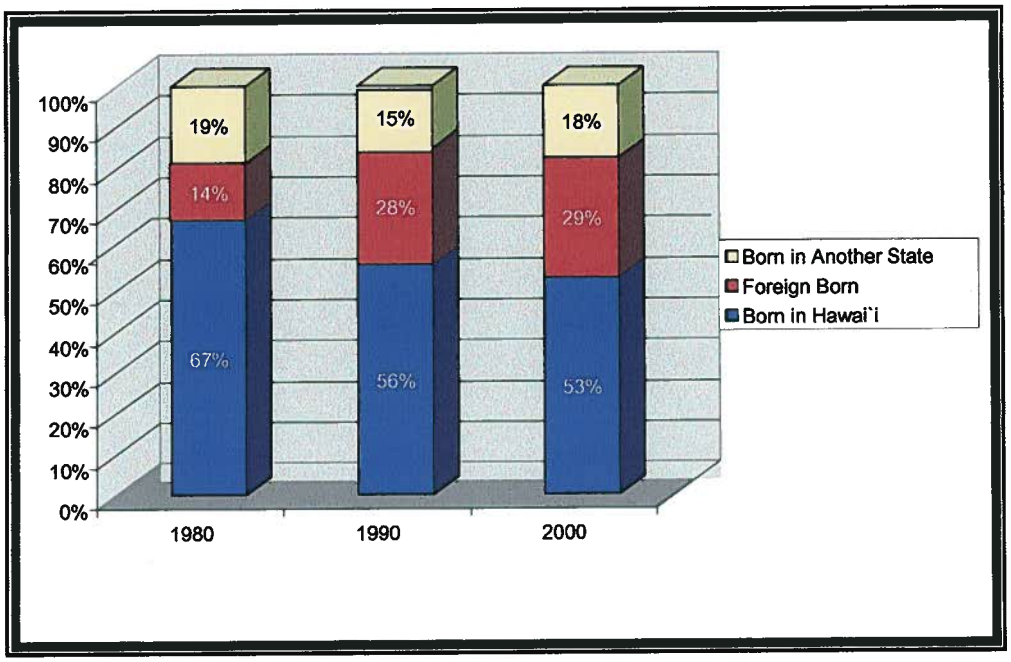


Figure 1 - 3. Maui Island Residents by Place of Birth 1980 – 2000. (Source: United States Census)

Ratio of Visitors to Residents

Figure 1-4 graphically depicts visitor/resident population trends from 1970 to the projection year of 2030. In 1970, the ratio of tourists to residents was approximately 1 to 20. This number has risen dramatically; by 2000, the ratio was approximately 1 to 3.

[2] Department of Business, Economic Development and Tourism, State of Hawai`i (2012). Population and Economic Projections for the State of Hawai`i to 2040 (March 2012)

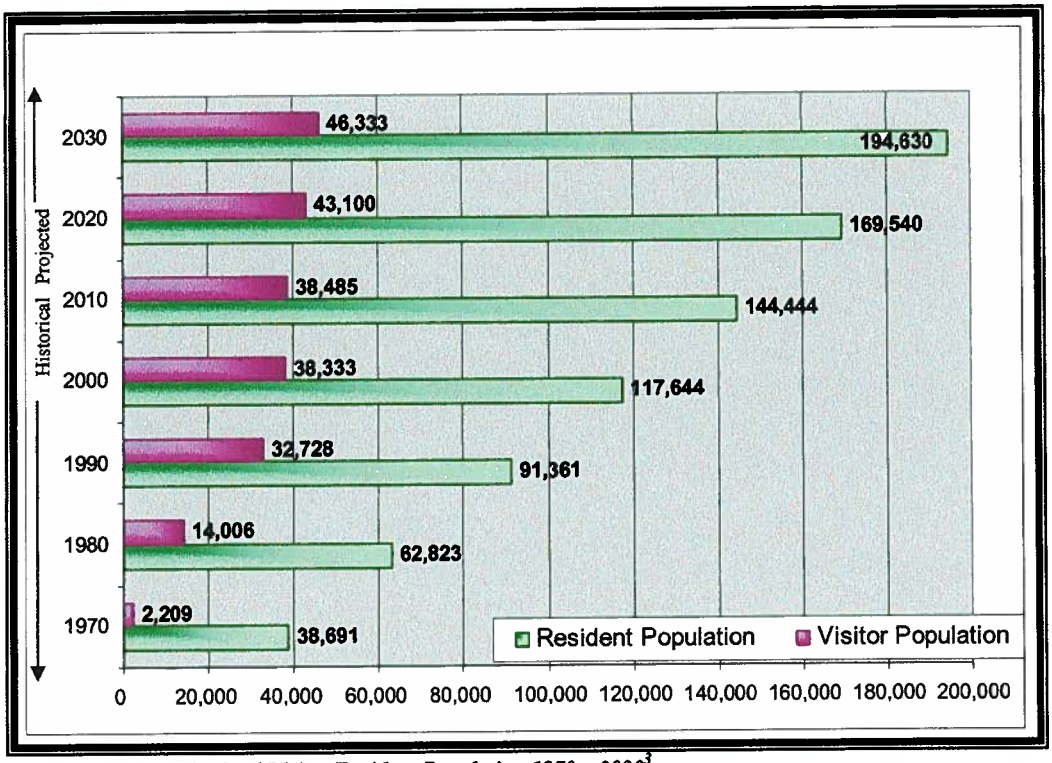


Figure 1 - 4. Maui Island Visitor/Resident Population 1970 – 2030[3].

GOAL, OBJECTIVES, POLICIES, AND ACTIONS

Goal:

1.1 Maui's people, values, and lifestyles thrive through strong, healthy, and vibrant island communities.

Objective:

1.1.1 Greater retention and return of island residents by providing viable work, education, and lifestyle options.

Policies:

1.1.1.a Expand programs that enable the community to meet the education, employment, housing, and social goals of youth and young adults.

[3] Population and Economic Projections for the State of Hawai`i to 2040 (March 2012).

1.1.1.b Expand housing, transportation, employment, and social opportunities to ensure residents are able to comfortably age within their communities.

1.1.1.c Measure and track resident satisfaction through surveys and community indicators.

1.1.1.d Support funding for transportation, housing, health care, recreation, and social service programs that help those with special needs (including the elderly and disabled).

Implementing Actions:

1.1.1-Action 1 Use an existing agency to facilitate education, employment, housing, social services, and other programs that help retain young adults on Maui.

1.1.1-Action 2 Identify existing and develop new funding sources for youth and family services (e.g., recreation, health care, education, housing, child care, etc.) and integrate such resources to achieve an effective outcome.

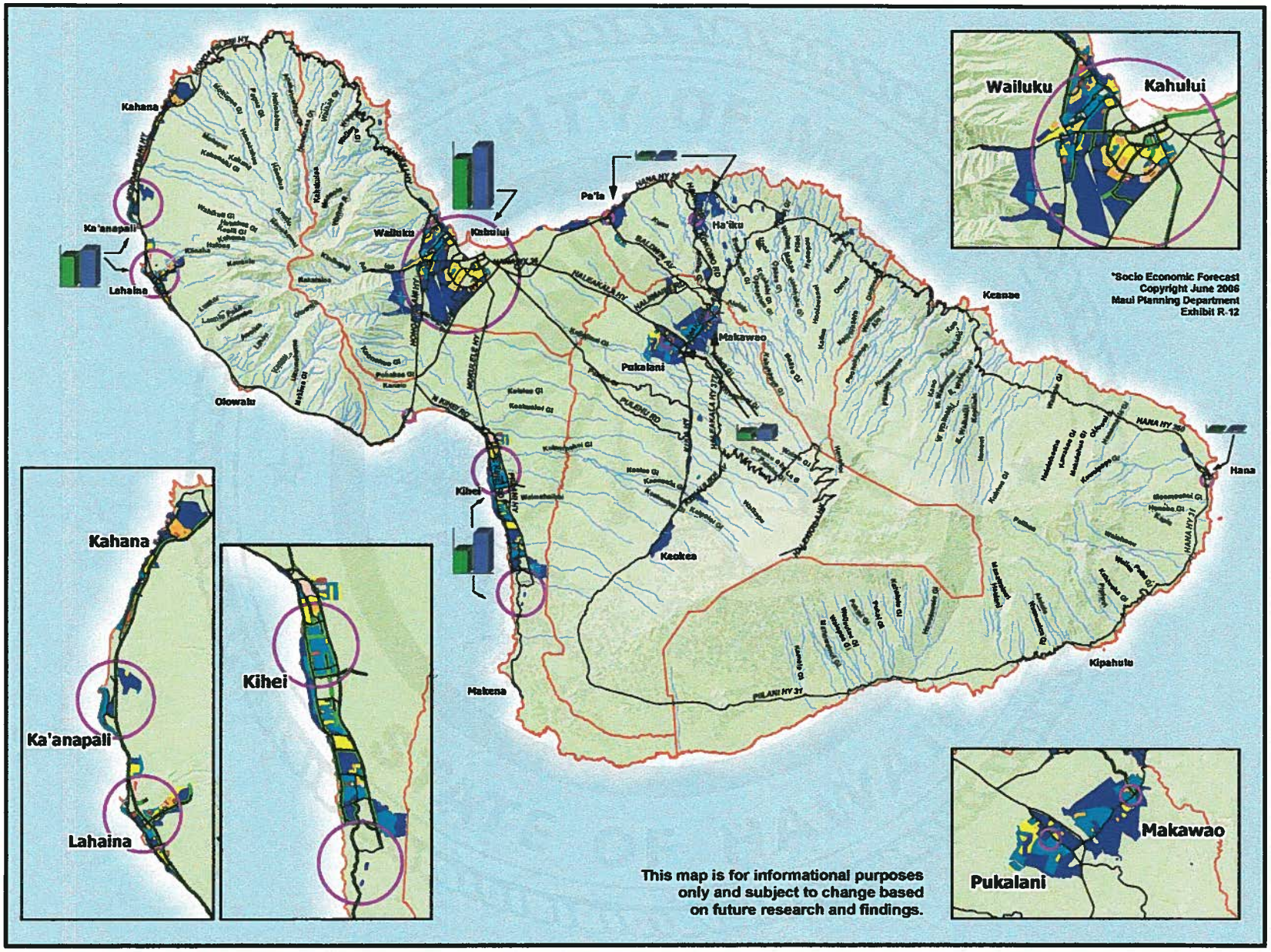
1.1.1-Action 3 Develop and regularly conduct a Community Satisfaction Survey to measure residents' quality-of-life, facilitate the development of informed policies/programs, and improve service delivery.

Employment & Population Density Map

Island of Maui

Background Map

For Informational Purposes Only



Legend

- Primary Road
- Stream
- Regional Economic Center
- Community Plan Boundary
- Topography - 100 ft contour

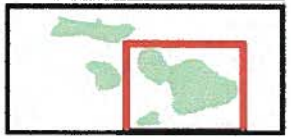
Jobs by Community Plan Areas*

- Jobs 2005
- Jobs 2030

Population Density

Per Acre by Census Block

- 0.0 - 1
- 1.1 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- 25.1 - 30
- 30.1 - 50
- 50.1 - 80
- 80.1 - 150



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This is not a zoning map. Please contact the Planning Department for Zoning confirmation

Prepared by:
Long Range Planning Division
Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Map 1-1

1955 Main Street, Suite 200
Wailuku, HI 96793

T: 808.244.7005
F: 808.244.9026

RECEIVED
CORPORATION COUNSEL

2013 DEC 27 AM 11: 52

Brown AND Caldwell

December 27, 2013

Ms. Jennifer Oana, Deputy Corporation Counsel
County of Maui
Department of the Corporation Counsel
200 South High Street, 3rd Floor
Wailuku, HI 96793

1055.145235

Subject: Iao Ground Water Management Area High-Level Source Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihee, Waiehu, Iao, & Waikapu Streams Contested Case Hearing before the Commission on Water Resources Management; Case No. CCH-MA06-01

Dear Ms. Oana,

At your request, Brown and Caldwell has reviewed the documents provided by the County of Maui and conducted an engineering analysis of the impact to the County of Maui Department of Water Supply (MDWS) should the Commission for Water Resources Management (CWRM) eliminate the County's allocation of flow of Na Wai Eha surface water. In addition, we have assessed the economic benefits to the County if it were to receive a larger allocation of Na Wai Eha surface water.

Qualifications

Brown and Caldwell is an environmental engineering and consulting firm with offices located nationwide. Brown and Caldwell has had an office on Maui for over 20 years, and we have assisted the County of Maui with planning and design of water and wastewater infrastructure projects throughout our period of presence on the island.

This report was prepared by Craig Lekven. Craig is a registered Professional Civil Engineer in Hawaii and California, and has 25 years of experience planning and designing water and wastewater infrastructure projects. Craig is the Supervising Engineer in Brown and Caldwell's Maui office, and has managed projects for the County of Maui throughout his 5 year tenure on the island.

Documents Reviewed

Table 1 lists the documents that were reviewed as part of the preparation of this report.

EXHIBIT "B-R8"

Table 1. Documents Reviewed

Ref. No.	Title	Author	Date
1	Central Maui Recycled Water Verification Study	County of Maui Department of Environmental Management, Wastewater Reclamation Division County of Maui Department of Water Supply, Water Resource Planning Division	December 2010
2	Central Maui Service Area (graphic)	County of Maui Department of Water Supply	November 29, 2013 [a]
3	North Central Service Area (graphic)	County of Maui Department of Water Supply	November 29, 2013 [a]
4	South Central Service Area (graphic)	County of Maui Department of Water Supply	November 29, 2013 [a]
5	Declaration of Jeffrey K. Eng	Jeffrey K. Eng	September 14, 2007
6	Central/South Maui Desalination Feasibility Study, Final Report	Brown and Caldwell	December 2006
7	Maui County Department of Water Supply Water Conservation Efforts	County of Maui Department of Water Supply	November 29, 2013 [a]
8	Maui County Water Use and Development Plan, Central District, Final Candidate Strategies Report, Report Review Draft	Carl Freedman, Haiku Design & Analysis	June 17, 2009
9	Findings of Fact, Conclusions of Law, and Decision and Order in the matter of the `Iao Ground Water Management Area High-Level Source Water-Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihee River and Waiehu, Iao, & Waikapu Streams Contested Case Hearing (CCH-MA06-01)	State of Hawaii Department of Land and Natural Resources Commission on Water Resources Management	June 10, 2010
10	Maui County Water Use and Development Plan, Central DWS District Plan Update	County of Maui Department of Water Supply	November 16, 2010
11	Maui Island Plan, Chapter 1: Population	Maui County Planning Department	December 28, 2012
12	Responsive Witness Statement of County of Maui Department of Water Supply in the Form of a Supplemental Declaration of Jeffrey K. Eng	Jeffrey K. Eng	October 26, 2007
13	Socio-Economic Forecast, The Economic Projections for the Maui County General Plan 2030	Maui County Planning Department	June 2006
14	South Maui R-1 Recycled Water Verification Study	County of Maui Department of Environmental Management, Wastewater Reclamation Division County of Maui Department of Water Supply, Water Resource Planning Division	December 2009
15	In re: Iao Ground Water Management Area High-Level Source Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihee River and Waiehu, Iao, and Waikapu Streams Contested Case Hearing	Supreme Court of Hawaii	August 15, 2012
16	MDWS spreadsheet "Billing MAV December 2007-2012"	County of Maui Department of Water Supply	December 10, 2013 [a]
17	2012 Iao Operational Costs – e-mail from Dave Taylor, Director of MDWS	County of Maui Department of Water Supply	December 12, 2013
18	Na Wai Eha – Questions and Answers from the Planning Department	County of Maui Department of Planning	December 9, 2013 [a]

[a] *No printed date on document; date shown is the PDF computer file date.*

Population Projections

The population of Maui Island (including both residents and visitors) is projected to grow in the future. Table 2 summarizes the island population projections [Reference 11]. The total island population is projected to increase a total of 58,034 residents and daily visitors between the year 2010 and 2030, a 32 percent increase.

Table 2. Maui Islandwide Population Projections

	Year		
Description	2010	2020	2030
Residents	144,444	169,540	194,630
Visitors	38,485	43,100	46,333
Total	182,929	212,640	240,963

Note: Values obtained from Reference 11.

Population projections have also been developed for the area that comprises the MDWS Central Service Area. Table 3 presents the population projections for the service area. The service area population is projected to increase by 36 percent from 2010 to the year 2030.

Table 3. Resident Population Projections for Central Maui Service Area

Description	Value
Year 2010 resident population	84,414
Year 2030 resident population	114,899
Resident population increase	30,485
Increase	36 percent

Source: Reference 18

Water Demand Projections

The demand for domestic water will grow as the population grows. MDWS has developed demand projections that are summarized in Table 4. MDWS has used the "baseline case" projection as the basis for its planning efforts.

Table 4. Central Maui District Water Demand Projections

	Average Annual Demand in Year		
Scenario	2010	2030	Increase
Low case	20.5 mgd	28.2 mgd	7.7 mgd
Medium low case		31.1 mgd	10.6 mgd
Baseline case		34.1 mgd	13.6 mgd
Medium high case		36.8 mgd	16.3 mgd
High case		39.9 mgd	19.4 mgd

Note: Values derived from References 10 and 16.

The values shown in Table 4 are average annual demands. Domestic water use varies throughout the year. Consumption will generally be greater during the summer months because customers will use more water for irrigation and other outdoor purposes. Water demand is typically lower than the annual average during the winter months because precipitation provides much of the water that landscapes require to thrive. A water utility must be able to provide water to meet its customers' demand needs at all times, and therefore must have capacity and water sources that are greater than the average annual demand. Water utilities consider the following factors when determining future needs:

- Peak day demands – to ensure enough water is available at all times.
- Reliability factors – to ensure sufficient water supply to its customers even if elements of the water supply system are offline for maintenance purposes.
- Unmetered losses – system leakage and other unmetered losses that are typical for all water distribution systems.

Table 5 summarizes the MDWS capacity needs to reliably meet the baseline case demand scenario.

Table 5. Central Maui District Average Production Capacity Needs

Description	Year		Increase
	2010	2030	
Average production	24.2 mgd [a]	37.9 mgd [b]	13.7 mgd

[a] *Reference 16.*

[b] *"Baseline case" demand scenario in Reference 10.*

Existing Sources for Central Maui Water System

Table 6 provides a summary of the sources that MDWS currently relies upon to supply its integrated Central Maui System.

Table 6. Available Source Based on Permit Limits and Operational Constraints

Name	Source System	Source Flow Limit (mgd)
Kepaniwai Well	Iao Aquifer – High Level Dike	0.791 [a]
Iao Tunnel	Iao Aquifer – High Level Dike	1.610 [a]
Iao Water Treatment Plant	Iao-Waikapu Ditch	1.700 [b]
Mokuhau Well 1	Iao Aquifer - Basal	1.500 [a]
Mokuhau Well 3	Iao Aquifer - Basal	2.353 [a]
Shaft 33	Iao Aquifer - Basal	5.015 [a]
Waiehu Heights 1	Iao Aquifer - Basal	0.200 [a]
Waiehu Heights 2	Iao Aquifer - Basal	0.800 [a]
Waihee Well 1	Iao Aquifer - Basal	1.900 [a]
Waihee Well 2	Iao Aquifer - Basal	1.500 [a]
Waihee Well 3	Iao Aquifer - Basal	3.400 [a]
North Waihee 1	Waihee Aquifer	4.000 [c]
North Waihee 2	Waihee Aquifer	
Kanoa 1	Waihee Aquifer	
Kanoa 2	Waihee Aquifer	
Maui Lani Well 5	Kahului Aquifer	1.200 [c]
Maui Lani Well 6	Kahului Aquifer	
Maui Lani Well 7	Kahului Aquifer	
Total		25.969

[a] *CWRM Water Use Permit.*

[b] *Current WTP reliable capacity.*

[c] *CWRM recommended limit for aquifer system.*

Strategies to Meet Future Demands

MDWS has evaluated five final candidate strategies (in Reference 10) to meet the long-term future demands in the Central Maui system:

- Northward basal groundwater development.
- Eastward basal groundwater development.
- Expand use of Na Wai Eha surface water.
- Desalination of brackish groundwater.
- Maximization of recycled water use and water conservation.

The strategies share common elements including:

- Projects that are in the process of being implemented but are not yet in service.
- Two new wells in the Waikapu aquifer to meet near-term needs.
- Backup and replacement wells for existing well systems.
- Conservation and efficiency measures.
- Exploratory and investigative measures.
- Watershed protection and restoration measures.
- Stream restoration measures.

All strategies consist of a group of projects designed to reliably meet the future water demands of the customers. Each strategy is discussed below.

Northward Basal Groundwater Development

The northward basal groundwater development strategy consists of adding new wells in the north side of the Waihee aquifer and in the Kahakuloa aquifer. A total of sixteen wells, plus transmission pipelines, storage tanks, and booster pump stations would be added to meet future needs.

The northward basal groundwater development strategy is not viable for MDWS. The CWRM has verbally asked MDWS to limit its withdrawals from the Waihee aquifer, and the United States Geological Survey (USGS) has indicated that wells in the Kahakuloa aquifer may not be as productive as hoped.

Eastward Basal Groundwater Development

The eastward basal groundwater development strategy consists of adding a series of new wells in the Haiku aquifer. MDWS evaluated a number of different potential configurations in the development of this strategy, and concluded the most cost effective system would be drill wells at the 1000-foot elevation. Transmission pipelines, storage tanks, and booster pump stations would be added to meet future needs.

MDWS entered into a Consent Decree in 2003 that requires that the Department vigorously investigate and pursue additional Na Wai Eha surface water and conduct rigorous cost/benefit analyses of other water source options before developing groundwater in the East Maui region. The Maui County Water Use and Development Plan and other studies constitute rigorous cost/benefit analyses of the available options. Development of eastward basal groundwater is a viable strategy to meet future needs from a technical perspective, however there are legal issues that must be resolved before MDWS can proceed with implementation.

Expand Use of Na Wai Eha Surface Water

MDWS currently has an agreement with Wailuku Water Company (WWC) for delivery of up to 3.2 mgd of surface water from the Iao-Waikapu Ditch. The water is treated at the Iao Water Treatment Plant (WTP) prior to introduction to the distribution system. The Iao WTP currently has a peak production capacity of 2.3 mgd, and MDWS is currently able to produce approximately 1.7 mgd. The WTP process can be expanded to deliver the full 3.2 mgd flow in the future.

MDWS has had discussions with Alexander and Baldwin (A&B) regarding construction of a new WTP to treat Na Wai Eha surface water. A&B has designed the Waiale WTP with 9.0 mgd of capacity in anticipation of future housing needs.

MDWS has evaluated a number of options in the development of the Na Wai Eha surface water strategy, including a WTP located in Waihee and the implementation of a surface water storage reservoir in conjunction with a new WTP. MDWS has determined that the most cost-effective way to implement the strategy to expand use of Na Wai Eha surface water is via construction of the Waiale WTP. However, implementation of the strategy would require a larger allocation of Na Wai Eha stream water.

Desalination of Brackish Groundwater

MDWS conducted a feasibility study that considered desalination of brackish groundwater or sea water (Reference 6). The study determined that desalination of brackish groundwater was the more cost-effective option of the two.

The desalination of brackish groundwater strategy includes the development of a 5.0 mgd reverse osmosis desalination facility in Central Maui to meet a portion of the future needs. Brackish groundwater would be pumped from the Kahului aquifer to supply the water treatment plant. The reverse osmosis process would remove salt and other minerals from the water to create potable water that would be introduced into the distribution system. The desalination process creates a brine residual liquid stream that requires disposal. Disposal via deep injection wells into salt water below the groundwater lens is considered to be the most practical and economical brine management solution.

The desalination of brackish groundwater strategy is considered feasible, but the desalination process is an expensive, complex, and energy-intensive way to meet future needs. The uncertainty associated with future energy

prices, and Maui's dependence on imported energy sources adds significant implementation risk to a desalination strategy to meet future needs. Furthermore, the environmental issues associated with brine disposal makes desalination an unattractive strategy when other viable sources are available.

Maximization of Recycled Water Use and Water Conservation

The maximization of recycled water use and water conservation strategy consists of significantly greater MDWS investment into measures to displace potable water use with recycled water and demand reduction via water conservation measures. Each is discussed separately below.

Use of Recycled Water

Recycled water is highly treated wastewater effluent that can be safely used for beneficial non-potable uses. Recycled water is sometimes referred to as "reclaimed water", but the term "recycled water" has been accepted as the standard industry term and will be used in this report. The State of Hawaii Department of Health (DOH) regulates the treatment and use of recycled water, and has established minimum treatment requirements for a variety of uses:

- R-1 recycled water has received the highest amount of treatment, including oxidation, filtration, and disinfection to meet the standards established by DOH.
- R-2 recycled water has been oxidized and disinfected to meet the standards established by DOH. Less disinfection is required for R-2 water than R-1 water.

Table 7 is a partial list of some of the allowable uses for R-1 and R-2 recycled water. As shown in the table, R-1 water may be used for irrigation purposes at locations where the public may come in direct contact with the recycled water. The use of R-2 water is generally allowed where public access is restricted or direct public contact is otherwise prevented by some means.

Table 7. Partial List of Allowable Recycled Water Uses

R-2 Recycled Water	R-1 Recycled Water
Subsurface irrigation of parks, golf courses, and schools	All uses allowed for R-2 recycled water
Any form of irrigation of fodder crops, or food crops that undergo extensive processing that render them free of viable pathogens,	Any form of irrigation of food crops, where the recycled water comes into contact with the edible portion of the crop
Any form of irrigation of cemeteries and freeway landscaping	Any form of irrigation of golf courses, parks, and schools
Any form of landscape irrigation where public access is limited	Any form of irrigation of pasture for milking animals
Construction water and dust control on unpaved roads	Fire control

The County of Maui Department of Environmental Management (DEM) owns and operates the Wailuku-Kahului Wastewater Reclamation Facility (WWRF) and the Kihei WWRF in the Central District. Both WWRFs currently produce recycled water, as summarized in Table 8.

Table 8. Central Maui Recycled Water Status

Description	Kihei WWRF	Wailuku-Kahului WWRF
Type of recycled water produced	R-1	R-2
Current uses	Landscape irrigation Agricultural irrigation Cooling water Fire control Toilet/urinal flushing Composting Erosion control Cattle watering	Irrigation of WWRF landscaping WWRF process uses Construction water Dust control
Average daily recycled water use	1.38 mgd	0.2 mgd
Percentage of total WWRF flow	38 percent	5 percent

Sources: References 1 and 14.

MDWS has included the use of recycled water as part of a strategy to meet future potable water needs. The strategy consists of using recycled water to displace current non-potable uses (e.g., irrigation), to allow the potable water to be used for other potable needs. The strategy also includes extensive water conservation measures, discussed further in the next section. Projects to increase recycled water use have been identified for both WWRFs.

Kihei WWRF: Water recycling can be expanded in Kihei by expanding the recycled water distribution pipeline system. The distribution system expansion options are summarized in Table 9. MDWS has included the listed projects in its strategy of maximization of recycled water use and water conservation.

Table 9. Recycled Water Use Expansion Options Identified for Kihei WWRF

Expansion Description	Estimated Peak Potable Water Displacement (mgd)	Capital Cost [a]
Waipulani Street / South Kihei Road	0.200	$1.36 million
Liloa Drive / Kihei High School	0.245	$1.28 million
North Kihei Road / South Collector Road	0.553	$4.25 million
Piilani Highway to Wailea Resort	1.196	$23.65 million
Total	2.194	$30.54 million

[a] *Adjusted to current (December 2012) dollars*

Unfortunately, there is insufficient R-1 water production at the Kihei WWRF to support all of the projects listed in the table. As with potable water, recycled water producers have to be able to meet their customers' needs at all times. Recycled water demand peaks during the summer months, and DEM estimates that it has as little as 1.0 mgd of excess recycled water available during the peak demand months of summer [Reference 14]. Therefore, only about 1.0 mgd of additional potable water displacement is possible, unless DEM were to supplement R-1 water

production with brackish groundwater or construct a seasonal storage reservoir at significant expense. The MDWS economic analyses in Reference 10 did not consider supplemental water or seasonal storage needs, which would increase the overall costs.

Wailuku-Kahului WWRF: Water recycling can be expanded at the Wailuku-Kahului WWRF by supplying R-2 water to a single user for sugar cane seed crop irrigation, or upgrading the treatment processes to produce R-1 water so that the recycled water can be supplied to multiple users. The R-2 approach would benefit DEM by reducing its reliance on injection wells for effluent disposal, and would benefit Hawaiian Commercial & Sugar (HC&S) by displacing irrigation water currently obtained from Na Wai Eha surface water (but at significantly higher cost). The estimated capital cost to supply R-2 water to HC&S is $12.3 million. The R-2 approach would not directly benefit MDWS in the form of potable water displacement. Upgrading the WWRF to produce R-1 water would provide the above benefits and also benefit MDWS in the form of potable water displacement.

DEM has identified projects to upgrade the Wailuku-Kahului WWRF to produce and distribute R-1 recycled water in the Kahului area. Table 10 summarizes the recycled water projects, and the estimates of the potable water that would be displaced to the benefit of MDWS.

Table 10. Recycled Water Projects Identified for Wailuku-Kahului WWRF

Description	Estimated Peak Potable Water Displacement (mgd)	Primary Users	Capital Cost [a]
R-1 upgrades at WWRF	0	Not applicable	$5.37 million
Distribution from WWRF to Maui Lani	0.191	17 properties, including Maui Lani Golf Course, Keopuolani Park, Maui Lani Park and Common areas, UH Maui, War Memorial Complex, Kaahumanu Center, Boys & Girls Club of Maui, and others. Most of the larger users currently use brackish groundwater for irrigation purposes.	$25.94 million
Distribution from WWRF to Kahului Airport	0.225	Kanaha Beach Park, Kahului Airport	$4.29 million
Distribution from Queen Kaahumanu Center to existing HC&S pipelines formerly used for pineapple cannery wastewater	0.185	HC&S Seed Cane, Maui High School, Kahului CC & Park, Kahului Elementary School, Hale Mahaolu	$2.00 million
Total	0.601		$37.60 million

[a] *Adjusted to current (December 2012) dollars*

The average day demand for recycled water will be less than the peak demand that occurs during the summer months. The ratio of peak demand to average annual demand is a function of climate conditions and the characteristics of the crop being irrigated. In Central Maui the average annual demand will be approximately 63 percent of the peak demand, based on other projects we've completed. Table 11 summarizes our estimate of the total potential average annual potable water displacement in the Central Maui District.

Table 11. Potential Potable Water Displacement in Central Maui by Recycled Water

Area	Peak Potable Water Displacement Potential (mgd)	Annual Average Potable Water Displacement Potential [a] (mgd)
Kihei WWRF	1.0	0.63
Wailuku-Kahului WWRF	0.601	0.38
Total Potential	1.601	1.01

[a] *Assumes average annual demand is 63 percent of peak demand.*

Conservation and Efficiency Measures

All of the strategies presented above include conservation and efficiency measures. MDWS' conservation measures have included:

- Leak detection and repair to reduce distribution system losses.
- Preventative and predictive maintenance to reduce system losses.
- Reclaimed water use that displaces potable water use, as described above.
- Back-up sources so that in the event of a major leak most areas can be isolated and served by alternate sources.
- Watershed and resource protection – MDWS funding to watershed partnerships has totaled $17.3 million from 1997 to the present.
- Low-flow fixture distribution, including showerheads, bathroom aerators, kitchen aerators, self-closing hose nozzles, and leak detection dye tablets.
- Water audits and direct fixture retrofits.
- Water conservation pricing to encourage conservation.
- Development of regulations related to water conservation.
- Public education and outreach activities.

MDWS' long-term planning efforts have also considered implementation of extensive water conservation measures as a strategy to meet future needs. Water conservation achievements are typically expressed as a percentage of the "technical potential". The technical potential is an estimate of the amount of water that could potentially be saved by implementing water conservation measures and practices. MDWS economic analyses have shown that a water conservation program goal to achieve 45 percent of the technical potential would yield the best economic returns. The types of conservation measures that have been identified as having good potential to help achieve 45 percent of the technical potential include:

- Residential / commercial audits and direct installation for indoor and landscape irrigation users.
- Education and publicity program to encourage water conservation and promote program participation.
- Direct installation of efficient fixtures at customer premises including toilets, showerhead, and sink faucet flow restrictors.
- Audits of existing irrigation system equipment and practices and specific resulting recommendations to customer to improve efficiency.
- Direct installation of targeted "high payback" fixtures in commercial premises.
- High efficiency fixture rebates.
- High efficiency washing machines.
- High efficiency toilets and waterless urinals.
- Hotel awards program.
- Building manager user groups and services.
- Agricultural user group and services.

Some water conservation measures will result in tangible source water savings that can be reliably allocated to new users, while other types of measures rely on customer behavioral changes that can relapse and diminish the water savings. For example, detecting and repairing distribution leaks results in water savings that can be safely allocated to new customers. However, measures that rely on customer behavioral changes present a challenge to water agencies as to whether or not the realized water savings can be safely allocated to new customers; if the behavior changes are not permanent the water savings are reduced and the water agency could end up being short of water. Therefore, some types of conservation measure savings can be safely used as equivalents to new source, but others cannot until the water agency is comfortable that the resulting savings are permanent.

Life-Cycle Cost Evaluations

Life-cycle cost comparisons were developed based on the information presented in References 1, 10, 14, and 17. The life-cycle costs incorporate capital, operating, and maintenance costs over a defined planning period, and include inflationary effects. The use of life-cycle costs allows evaluation of different alternatives on an equal basis. The life-cycle costs are expressed as the net present value (NPV) of all the costs incurred during the planning period. The NPV is the amount of money that would need to be set aside today at a defined interest (discount) rate to fund the project or strategy.

No independent verification of the reference cost estimates was possible due to the summarized nature of the reports. Costs were escalated to current (December 2013) dollars using Engineering News Record's 20-City Construction Cost Index (ENRCCI). The following assumptions were used to develop the life-cycle cost comparisons:

- 25-year planning period.
- The baseline case water demand projection results in a need for an additional 13.7 mgd average production rate at the end of the planning period.
- A linear increase in the production rate occurs over the planning period.
- Discount rate of 6 percent, for consistency with value used in References 8 and 10.
- Inflation rate of 3 percent, for consistency with value used in References 8 and 10.

Life Cycle Costs of Viable Strategies

Table 12 provides a summary of our analysis of the life-cycle costs of the viable strategies to meet future demands described above. The life-cycle and unit costs shown in Table 12 appear to be somewhat similar due to the programmatic nature of the MDWS analysis in Reference 10. All of the four strategies include common elements including backup wells, reservoirs, pipelines, booster pump stations, etc. The inclusion of the common elements tends to make all four options appear to have somewhat similar life-cycle costs and does not highlight the differences between the strategies. Our opinion of the implementation risk associated with each strategy highlights some of the differences associated with each strategy.

Table 12. Life-Cycle Costs of Viable Strategies to Meet Future Demands

Strategy	Life-Cycle Cost, NPV	Unit Cost	Opinion of Implementation Risk
Eastward basal groundwater development	$604 million	$9.67/kgal	Low, if legal issues can be resolved.
Expand use of Na Wai Eha surface water	$572 million	$9.15/kgal	Low, if water allocation can be obtained.
Desalination of brackish groundwater	$598 million	$9.57/kgal	High, due to energy price volatility and brine disposal challenges.
Maximization of recycled water use and water conservation	$578 million	$9.25/kgal	Medium, some types of conservation measures are dependent on permanent behavioral changes before water savings can be safely allocated to new users.

Note: kgal = 1,000 gallons

Economic Impact of Losing Existing Surface Water Allocation

The MDWS currently treats an average of approximately 1.7 mgd of Na Wai Eha surface water at the Iao WTP, and has an agreement with WWC for up to 3.2 mgd of water from the Iao-Waikapu Ditch. The current treatment capacity of the Iao WTP is 2.3 mgd, but the process can be expanded to 3.2 mgd. The Iao WTP is the lowest cost surface water source for MDWS because the raw water ditch that feeds the WTP is located at an elevation that allows the membrane filtration system to be pressurized without pumping. Electricity costs to pressurize membrane processes are typically significant if the water must be pumped, but at the Iao WTP the membranes are pressurized for free by gravity. If MDWS were to lose its ability to obtain up to 3.2 mgd of Na Wai Eha surface water it would have to replace the capacity with other sources.

The life-cycle costs associated with the Iao WTP were evaluated to assess the impact of losing the water allocation. The life-cycle costs for the facility include capital, operation & maintenance costs and membrane replacement costs. The membranes typically require replacement at 7-year intervals and represent a significant recurring expenditure for membrane WTPs. Four membrane replacement cycles were included in the 25-year analysis. Table 13 provides a summary of the life-cycle costs for the facility for three separate future operating scenarios.

Table 13. Iao WTP Life-Cycle Costs

Future Operating Scenario	Life-Cycle Cost	Unit Cost
1.7 mgd production (existing)	$21.5 million	$1.77 /kgal
2.3 mgd production (existing capacity)	$32.5 million	$1.55 /kgal
3.2 mgd production (full contract amount)	$40.1 million	$1.37 /kgal

If MDWS were to lose its ability to use up to 3.2 mgd of Na Wai Eha surface water it would need to replace the capacity and production with other, more expensive sources to meet the needs of its existing and future customers. The unit life-cycle costs for new sources were summarized in Table 12. Table 14 summarizes the significant potential economic impacts to MDWS if it lost the ability to treat Na Wai Eha surface water at the Iao WTP.

Table 14. Economic Impact of Losing 3.2 mgd Surface Water Allocation

Future Operating Scenario	Replacement Source Life-Cycle Cost	Iao WTP Life Cycle Value	Life-Cycle Economic Impact if Lost
1.7 mgd production (existing)	$143 - $150 million	$21.5 million	$116 million - $123 million
2.3 mgd production (existing capacity)	$194 - $203 million	$32.5 million	$162 million - $170 million
3.2 mgd production (full contract amount)	$270 - $282 million	$40.1 million	$230 million - $242 million

Economic Benefit of Increased Surface Water Allocation

MDWS will realize an economic benefit if a larger (up to 9.0 mgd) of Na Wai Eha surface water were made available for domestic use. Comparison of the life-cycle cost differences of the strategies listed in Table 13 shows that the economic benefit of being able to implement the strategy of expanding use of Na Wai Eha surface water is $6 million to $33 million depending on the higher-cost strategy that MDWS would otherwise implement.

Summary

MDWS will need to significantly increase its water production capacity in Central Maui to meet future customer needs. MDWS has identified four viable strategies to meet those needs. If MDWS were to lose its ability to treat up to 3.2 mgd of Na Wai Eha surface water the economic impact (loss) would be between $116 million and $242 million over a 25-year period. The economic benefit of a larger surface water allocation (up to 9.0 mgd) will be $6 million to $33 million over a 25-year period.

Brown and Caldwell appreciates that opportunity to assist you on this project. Should you have any questions, please do not hesitate to call me at 808-442-3301.

Very truly yours,

Brown and Caldwell

Craig C. Lekven, P.E.
Supervising Engineer

CCL:ic

CRAIG CARSTEN LEKVEN
LICENSED PROFESSIONAL ENGINEER
No. 13003-C
HAWAII, U.S.A.

EXP. 4/30/14

Limitations:

This document was prepared solely for the County of Maui Department of the Corporation Counsel in accordance with professional standards at the time the services were performed and in accordance with the contract between the County of Maui Department of the Corporation Counsel and Brown and Caldwell dated November 19, 2013. This document is governed by the specific scope of work authorized by the County of Maui Department of the Corporation Counsel; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by County of Maui Department of the Corporation Counsel and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Water Resources, The Sierra Club
and Mark Sheehan

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V. ISHIHARA, CLERK
SECOND CIRCUIT COURT
STATE OF HAWAII

IN THE CIRCUIT COURT OF THE SECOND CIRCUIT

STATE OF HAWAII

THE COALITION TO PROTECT EAST MAUI WATER RESOURCES, an unincorporated association; HUI ALANUI O MAKENA, a Hawaii non-profit corporation; THE SIERRA CLUB, a California non-profit corporation registered to do business in the State of Hawaii; MARK SHEEHAN; Plaintiffs, vs. THE BOARD OF WATER SUPPLY, COUNTY OF MAUI; DEPARTMENT OF WATER SUPPLY, COUNTY OF MAUI; COUNTY OF MAUI; GEORGE TENGAN, in his capacity as Director of the Water Department, County of Maui; and JOHN DOES 1-100; Defendants.	Civil No. 03-1-0008(3) (Declaratory Judgment and Other Civil Action) PLAINTIFFS' MOTION TO ENFORCE CONSENT DECREE, FOR DECLARATORY RELIEF, FOR TEMPORARY, PRELIMINARY AND PERMANENT INJUNCTION AND OTHER RELIEF; MEMORANDUM IN SUPPORT OF MOTION; DECLARATION OF ISAAC HALL; EXHIBITS "1"-"10"; NOTICE OF HEARING; CERTIFICATE OF SERVICE Hearing Date: April 24, 2013 Time; 8:30 a.m. Judge: Hon. Joseph E. Cardoza No Trial Date Set

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PLAINTIFFS' MOTION TO ENFORCE CONSENT DECREE, FOR DECLARATORY RELIEF, FOR TEMPORARY, PRELIMINARY AND PERMANENT INJUNCTION AND OTHER RELIEF

EXHIBIT "B-R9"

Plaintiffs the Coalition to Protect East Maui Water Resources, an unincorporated association; The Sierra Club, a California non-profit corporation registered to do business in the State of Hawaii, and Mark Sheehan ("Plaintiffs"), through counsel, hereby file this Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief against Defendants The Board of Water Supply, County of Maui; Department of Water Supply, County of Maui and David Taylor, in his capacity as Director of the Water Department, County of Maui [1] ("the County Defendants"). The bases for this Motion are set forth below:

A. The parties agreed to comply with the terms and conditions contained within the Consent Decree entered in this case on December 22, 2003 as the Orders of this Court.

B. The County Defendants are now violating the Consent Decree by putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" on February 19, 2013 for reasons including, but not limited to:

1. The test wells proposed by the County of Maui are not located "within one of the crosshatched areas shown on the maps" attached to the Consent Decree as Exhibit "B" as required by paragraph 8.2 of the Consent Decree.

2. The parties to the Consent Decree and the USGS have not agreed upon a test protocol to be implemented during the drilling of the test wells as required by paragraph 8.2 of the Consent Decree.

3. The County Defendants have not prepared or delivered to Plaintiffs certain studies which, after rigorous analysis, conclude that it would be Cost-Beneficial to return to East Maui to develop groundwater resources. Only after this pre-condition is satisfied can planning by the County Defendants to develop East Maui water resources "re-commence" including,

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[1] Pursuant to Hawai`i Rules of Civil Procedure ("HRCP") Rule 25(c), David Taylor, the current Director of the Department of Water Supply, may be substituted for George Tengan, who previously held that position.

but not limited to, the planning for and construction of two test and monitoring wells.

4. The County Defendants have indirectly re-commenced planning for the development of water resources in East Maui, without formally declaring the same in writing or first undertaking the required comprehensive planning;

5. The "test well" cannot be put out to bid or constructed until the EIS process has been initiated and completed pursuant to Chapter 343.

C. This Motion is filed to Enforce the Consent Decree and to obtain any declaratory and/or injunctive relief necessary to enforce the Consent Decree.

D. Plaintiffs request that this Court issue declaratory relief by ruling that the County Defendants are violating the Consent Decree in the manners described above and by issuing further Orders prohibiting Defendants, and all those acting by and through them, from taking some or all of the following actions in the procurement to construction process regarding the two monitoring wells, including but not limited to: (1) putting the construction of the two monitoring wells out to bid at this point in time, (2) awarding any Contract for the construction of the two monitoring wells, (3) expending any County funds upon or encumbering any County funds for the two test or monitoring wells, (4) using County lands for the two test or monitoring wells, (5) executing any Contract for the construction of the two monitoring wells, (6) issuing any Notice to Proceed for the construction of the two monitoring wells, and/or (7) commencing construction upon or constructing either or both of the test or monitoring wells, without first fully complying with the remaining terms in the Consent Decree.

E. Plaintiffs request that this Court issue an Order cancelling or voiding, because undertaken in violation of the Consent Decree, (1) the Notice to Bidders for the "Construction of Two Monitor Wells at the Kaupakalua Well Site" on February 19, 2013, (2) any award of a Contract for the construction of the two monitoring wells, (3) any authorization to expend any County funds

upon or encumber any County funds for the two test or monitoring wells, (4) any authorization to use County lands for the two test or monitoring wells, (5) any Contract executed for the construction of the two monitoring wells, (6) any issuance of any Notice to Proceed for the construction of the two monitoring wells, all without Defendants first fully complying with the remaining terms in the Consent Decree. Plaintiffs request that the Court also declare that it is in the best interest of the public that all bids be rejected under these circumstances and/or that the award of any contract be cancelled.

F. Plaintiffs seek temporary, preliminary and permanent injunctive relief enjoining the County Defendants, and all those acting by and through them, from (1) putting the construction of the two monitoring wells out to bid at this point in time, (2) awarding any Contract for the construction of the two monitoring wells, (3) expending any County funds upon or encumbering any County funds for the two test or monitoring wells, (4) using County lands for the two test or monitoring wells, (5) executing any Contract for the construction of the two monitoring wells, (6) issuing any Notice to Proceed for the construction of the two monitoring wells and/or (7) commencing construction upon or constructing either or both of the monitoring wells, without first fully complying with the remaining terms in the Consent Decree.

This Motion is based upon HRCP Rules 7, 57 and 65, the record and file to date, the attached Memorandum in Support of Motion, the Declaration of Isaac Hall, Exhibits "1" - "10" and such further evidence as may be adduced during the hearings on this Motion.

DATED: Wailuku, Maui, Hawaii 2.28.13

Isaac Hall, Esq.
Attorney for Plaintiffs
The Coalition to Protect East Maui Water Resources, The Sierra Club and Mark Sheehan

IN THE CIRCUIT COURT OF THE SECOND CIRCUIT

STATE OF HAWAII

THE COALITION TO PROTECT EAST MAUI WATER RESOURCES, et.al.; Plaintiffs, vs. THE BOARD OF WATER SUPPLY, COUNTY OF MAUI; et.al.; Defendants.	)	Civil No. 03-1-0008(3) (Declaratory Judgment and Other Civil Action) MEMORANDUM IN SUPPORT OF MOTION

MEMORANDUM IN SUPPORT OF MOTION

I. INTRODUCTION

The parties agreed to comply with the terms and conditions contained within the Consent Decree entered in this case on December 22, 2003 as Orders of this Court. The County Defendants are now violating the Consent Decree by putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" on February 19, 2013.

Plaintiffs request that this Court declare that Defendants are in violation of the Consent Decree for the reasons stated below and that the Court enter appropriate injunctive relief to prevent the violation of this Court's Orders.

II. STANDARDS OF REVIEW

A. A Motion to Enforce

Courts have the power to enforce their own Orders and Consent Decrees. HRS § 603-21.9. *Gilmartin v. Abastillas,* 10 Haw. App. 283, 869 P.2d 1346 (1994). "The interpretation or construction of a judgment, decree or order presents a questions of law for the courts.'" *Wohlschlegal v. Uhlmann-Kihei, Inc.,* 4 Haw.App. 123, 130-31. 662 P2d 505, 511 (1983).

B. Declaratory Relief

The Court has the power to terminate actual controversies between contending parties when the Court is satisfied that a declaratory order will serve to terminate the controversy. HRS § 632-1 and Rule 57 HRCP. *Dalton v. City and County of Honolulu*, 51 Haw. 400, 462 P.2d 199 (1969). Plaintiffs have standing to seek declaratory relief in this case.

C. Injunctive Relief

Plaintiffs are entitled to a preliminary injunction, even if the "traditional" analysis is required to be applied, to preserve the status quo until the rights of the parties can be fully and fairly determined on the merits. In *Life of the Land v. Ariyoshi*, 59 Haw. 156, 577 P.2d 1116 (1978), the Hawaii Supreme Court ruled, on page 158, that:

> A motion for temporary injunctive relief requires a determination whether, and if so what, action is appropriate to create or preserve a state of affairs such that the court will be able to render a meaningful decision on the merits.

The status quo should be maintained to conserve the equities of the parties; *Fleming v. Napili Kai, Ltd.*, 50 Haw. 66, 430, P.2d 316 (1967).

In *Life of the Land v. Ariyoshi*, 59 Haw. at 158, the Court adopted a three-prong test for determining whether interlocutory relief should be granted:

> (1) Is the Plaintiff likely to prevail on the merits? (2) Does the balance of irreparable damage favor the issuance of a temporary injunction? (3) Does the public interest support granting the injunction?

Our Intermediate Court of Appeals, in *Penn v. Transportation Lease Hawaii, Ltd.*, 2 Haw. App. 272 at 276 (1981), citing the *Life of the Land* test, noted that this is a flexible standard:

> ... the greater the probability the party seeking the injunction is likely to prevail on the merits, the less he has to show that the balance of irreparable damage favors issuance of the injunction.

Plaintiffs have suffered procedural and other harm sufficient to be entitled to an injunction. *Sierra Club v. Department of Transportation of the State of Hawai'i* (*Sierra Club I*), 115 Haw. 299, 167 P.3d 292 (2007); HRS § 603-21.9.

III. THE CONSENT DECREE AND DEFENDANTS' NOTICE TO BIDDERS

The parties resolved the issues raised in this case through the entry of the Consent Decree on December 22, 2003. See Exhibit "1" attached hereto. The Consent Decree is structured in an organized manner. The terms are to be performed sequentially. Once the actions required by the first terms have been completed, then performance of the following terms may be undertaken. Here the County Defendants are leaping to the construction of the "test well" addressed in Section 8 of the Consent Decree before complying fully with earlier terms in the Consent Decree.

The Defendants put two Monitoring Wells out to bid for construction, without first consulting with Plaintiffs, as required by the Consent Decree.[2] See Exhibit "2" attached hereto. Once Plaintiffs became aware that Defendants had put the two Monitoring Wells out to bid for construction Plaintiffs demanded that Defendants immediately cancel the Notice to Bidders. See letter dated February 19, 2013 attached hereto as Exhibit "3." Counsel for Defendants refused to agree and Plaintiffs have therefore been forced to file this Motion.

IV. THIS COURT SHOULD DECLARE THAT THE COUNTY DEFENDANTS ARE VIOLATING THE CONSENT DECREE BY PUTTING THE CONSTRUCTION OF THE TWO WELLS OUT TO BID, AS MATTERS OF FACT AND LAW

A. The Test Wells Are Not Located Where Agreed Upon in the Consent Decree

The parties agreed that the test wells in any new plan to develop groundwater resources in East Maui would be located "within one of the crosshatched areas shown on the maps" attached to the Consent Decree as Exhibit "B." [3] These cross-hatched areas were all in the vicinity of the EM Plan wells to be monitored at that time. The two Monitoring Wells now proposed by

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[2] See Paragraph 5.1 of the Consent Decree. The County Defendants have only consulted with Plaintiffs sporadically with long periods of time elapsing between consultations. See Declaration of Isaac Hall.

[3] See paragraph 8.2 of the Consent Decree: "The County is authorized to construct an additional well in the agreed-upon portion of the East Maui Region, **within one of the crosshatched areas shown on the maps attached hereto as Exhibit 'B'".** (Emphasis added.)

the County of Maui are located outside of the areas shown on Exhibit "B".[4] Plaintiffs have never agreed that the test wells can be constructed in any other location than where agreed upon in the Consent Decree. Defendants have never formally proposed to re-locate the well field to be monitored. Plaintiffs have never agreed that there may be more than one test or monitoring well.

B. The Parties Have Not Agreed Upon Protocol For the Test Pumping As Required in the Consent Decree

The parties to the Consent Decree and the USGS have not agreed upon a test protocol to be implemented during the drilling of the test wells as required by the Consent Decree. The purpose of the test protocol "shall be to determine whether or not pumping of groundwater by wells in the agreed-upon portion of the East Maui Region may have an impact upon streamflow in the streams in the agreed-upon portion of the East Maui Region." See paragraph 8.2 of the Consent Decree.[5] Plaintiffs have never reached an agreement with USGS or Defendants on any specific protocols. Proceeding unilaterally with the drilling of two test wells without any agreed upon test protocol undermines the whole purpose of conducting the testing in the first place which is to determine if pumping groundwater in the wells proposed for development in the area will have an impact on streams in the same area.

C. The County Has Not Prepared or Delivered to Plaintiffs Studies that Conclude, After Rigorous Analysis, That It Is Cost-Beneficial to Develop Groundwater Resources in East Maui

Paragraph 4 of the Consent Decree requires the County to conduct further studies and to provide these studies to Plaintiffs **before any further efforts** are made to develop groundwater resources in the area which is the

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[4] The USGS in its 2012 "test well" proposal to Defendants, on p. 16, admits that the Monitoring Wells are not located as designated in the Consent Decree: "...**the site is outside any of the defined zones stipulated in the Consent Decree and therefore drilling at this site must be approved by all involved parties.**" (Emphasis added.) See attached Exhibit "4."

[5] "During the drilling of this well, **a test protocol, agreed to by the parties** hereto and the USGS, shall be implemented, the purpose of which shall be to determine whether or not pumping groundwater by wells located in the agreed-upon portion of the East Maui Region may have an impact upon streamflow in streams in the agreed-upon portion of the East Maui Region." (Emphasis added.)

subject of the Consent Decree.[6] Plaintiffs sought to avoid becoming embroiled in further controversy with the County Defendants until these studies were completed. Paragraph 4.2 of the Consent Decree states:

> **Before any new project is planned** by the County of Maui to develop groundwater in the agreed-upon portion of the East Maui Region, **the County will undertake a Cost/Benefit Study of the surface and groundwater resources available in the Central Maui Region, Upcountry Maui Region and East Maui Region** and **conduct a rigorous Cost/Benefit analysis, including the evaluation of economic and environmental factors, of developing and transmitting these water resources. This Study shall address planning for stream restoration in the agreed-upon portion of the East Maui Region.** (Emphasis added.)

Paragraph 4.3 of the Consent Decree states that:

> **Before any new project is planned** by the County of Maui to develop groundwater in the agreed-upon portion of the East Maui Region, the County will vigorously investigate and pursue the availability of surface water from the Waikapu (60101), Iao (60102) and/or Waihee (60103) hydrologic units for public use by preparing a report which shall include a **rigorous analysis** of the costs and benefits of making these water resources part of Maui's public water system. (Emphasis added.)

Paragraph 4.4 of the Consent Decree states:

> **If the report** on the availability of surface waters in West Maui, referenced in § 4.3 above, does not result in a determination that a sufficient supply of water can be made available from these sources to meet the needs of County residents who can be served by these waters and should the Cost/Benefit Studies, **referenced in §§ 4.2 and 4.3 above, not result in a determination that it would be more cost/beneficial to develop water resources outside the agreed-upon portion of the East Maui Region, then the County may re-commence planning for a project to develop groundwater resources within the agreed-upon portion of the East Maui Region.** (Emphasis added.)

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[6] The title of Section 4 of the Consent Decree is: "Studies to be Conducted **Before Any Further Effort** is Made to Develop Groundwater Resources in the Agreed-Upon Portion of the East Maui Region." (Emphasis added.)

These studies have not been prepared or delivered to Plaintiffs. The completion of these studies is a "pre-condition" to the re-commencement of planning for a project to develop water resources in East Maui. Only if after rigorous study the County Defendants are able to conclude that it would be Cost-Beneficial to return to East Maui, can planning to develop East Maui water resources "re-commence." The County Defendants have re-commenced planning to develop groundwater resources in East Maui without these necessary studies.

D. The "Test Well" Cannot Be Put Out to Bid or Constructed Until the EIS Process Has Been Initiated and Completed Pursuant to Chapter 343

1. The County Defendants Cannot Put the Two Monitoring Wells Out To Bid Before A New EIS Process Is Initiated and Completed Pursuant to Chapter 343

Upon re-commencing plans to develop water resources in the East Maui Area, the County Defendants are required to prepare an Environmental Impact Statement ("EIS"), pursuant to HRS Chapter 343. Paragraph 7 of the Consent Decree addresses this EIS. Paragraph 7.1 states as follows:

> **Should the County, at some time in the future decide to develop additional groundwater resources in the agreed-upon portion of the East Maui Region**, the County shall not resubmit or incorporate by reference the EIS or the SEIS prepared for the former EM Plan. **The County shall, at the appropriate time, prepare a new EIS for any new plan to develop groundwater resources within the agreed-upon portion of the East Maui Region.** (Emphasis added.)

Defendants agreed to address issues including the following in the new EIS:

> **The County shall consider factors such as: existing aquifers, groundwater resources, streams, diversions, wells, private and public water systems, location of cesspools, socio-economic impacts, the impact of groundwater pumping on marine resources throughout the region, and plans for stream restoration.** (Emphasis added.)

See Paragraph 7.1 of the Consent Decree. The environmental impacts of a new EM Plan must be addressed comprehensively, at one time, together, in a single EIS. The issue of the impact of groundwater pumping on streamflow cannot be

studied first, separately, in a segmented manner, apart from all of the other environmental issues the County Defendants agreed to address in the EIS.

Now is the "appropriate time" to initiate the EIS process pursuant to the Consent Decree. Putting projects out to bid or lease cannot be divorced from post-bid exploration, development and production. *Bob Marshall Alliance v. Hodel*, 852 F. 2d 1223 (9th Cir.1988); *Conner v. Burford*, 848 F.2d 1441, 1446 (9th Cir.1988); *Thomas v. Peterson*, 753 F.2d 754 (9th Cir.1985) (EIS must consider cumulative environmental effects of agency action). An EIS must be prepared at the "earliest practicable time." HRS § 343-5(b) and (c).[7]

Defendants cannot put out to bid a component of the project without first having studied alternatives, particularly the "no action" alternative, in an EIS. An informed and rigorous consideration of all alternatives must take place before a project is implemented. There are alternatives to groundwater development in the Haiku area that must be studied in an EIS before the construction of two monitoring wells can be put out to bid.[8]

By putting out the two Monitoring Wells for bid and construction Defendants are illegally failing to study the "no action" alternative in the EIS. NEPA and HEPA require that alternatives — including the no-leasing option — be given full and meaningful consideration. *Bob Marshall Alliance v. Hodel*, 852 F. 2d 1223 (9th Cir.1988).[9] This "no action" alternative will be meaningless if the County puts out to bid two Monitoring Wells in these particular locations, for the reasons given above and for the additional reasons below.

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[7] The appropriate time for preparing an EIS is *prior* to a decision, when the decisionmaker retains a maximum range of options, to insure that ... environmental amenities and values may be given appropriate consideration in decisionmaking. The rationale behind this rule is that inflexibility may occur if delay in preparing an EIS is allowed: `After major investment of both time and money, it is likely that more environmental harm will be tolerated.' *Citizens v. County of Hawaii*, 91 Hawai`i 94, 979 P. 2d 1120 (1999).

[8] The USGS, in its 2012 Proposal to the County Defendants, admits, on p. 3, that there are alternative project areas, and, on p. 16, that alternative sites exist for the Monitoring Wells. See attached Exhibit "4."

[9] In Footnote 4, the Court states: "We observe that, by definition, the no-leasing option is no longer viable once the leases have been issued; it must be considered before any action is taken or the statutory mandate becomes ineffective." The same is true here with regard to the "no action" alternative on a test/monitoring well sited in Kaupakalua.

2. The Construction, Drilling and Testing of the "Test Well" Was Authorized to Gather Data and Information for an EIS

A test well, referred to as the "SEIS test well" (State Well No. 5418-01), located on Hogback Road in Haiku, was constructed, drilled and tested as part of the SEIS for the EM Plan dated October 2002. Judge Mossman entered an Order on August 23, 1994 in Civ. No. 93-0734(2) declaring the first EIS prepared for the EM Plan inadequate and ordering Defendants to prepare a Supplemental EIS ("SEIS"). See Exhibit "5" attached hereto. In the same case, this Court, on September 6, 2000, entered an Order (see Exhibit "6" attached hereto) authorizing the construction of test wells for the East Maui Water Development Plan SEIS, as follows:

> Defendants are hereby authorized to construct the following wells **for the purposes of gathering data and information for use in the Supplemental Environmental Impact Statement ("SEIS")** to be developed for the East Maui Water Development Plan ("EMDP"):
>
> 1. A single monitoring well ...
> 4. The monitoring well shall be used **thereafter** to monitor all wells drilled as part of the EMDP. (Emphasis added.) [10]

This monitoring well was thereafter referred to as the "SEIS test well" (State Well No. 5418-01), located on Hogback Road in Haiku. This "SEIS test well" was constructed, drilled and tested **as part of the SEIS for the EM Plan** dated October, 2002.

Section 8 of the Consent Decree, entitled "Use of the Test Well, the Test Well Data and Further Testing," provides, as follows:

> 8.1 The County Defendants and Plaintiffs have disagreed, with respect to the former SEIS test well (State Well No. 5418-01) located on Hogback Road in Haiku, about its construction, drilling and testing.

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[10] Hawaii's Environmental Impact Statement Rules provide, with regard to the contents of EISs, in HAR §11-200-14, that: "The EIS process shall involve at a minimum: identifying environmental concerns, **obtaining various relevant data, conducting necessary studies,** receiving public and agency input, evaluating alternatives, and proposing measures for avoiding, minimizing, rectifying or reducing adverse impacts." (Emphasis added.)

8.2 **The County will work with the USGS and a representative of Plaintiffs to develop an additional test well** in the agreed-upon portion of the East Maui Region **to investigate whether developing additional wells** in the agreed-upon portion of the East Maui Region **and placing State Well No. 5418-01 into production may adversely impact stream flows in streams, in the agreed-upon portion of the East Maui Region.** The County is authorized to construct an additional well in the agreed-upon portion of the East Maui Region, within one of the crosshatched areas shown on the maps attached hereto as Exhibit "B". This additional well shall only be used for the test purposes of gathering data and information. **During the drilling of this well, a test protocol, agreed to by the parties hereto and the USGS, shall be implemented, the purpose of which shall be to determine whether or not pumping groundwater by wells located in the agreed-upon portion of the East Maui Region may have an impact upon streamflow in streams in the agreed-upon portion of the East Maui Region.** Thereafter, this test well shall be dedicated for use by the County Defendants as a monitoring or observation well to monitor or observe the performance of the aquifer in the agreed-upon portion of the East Maui Region. This additional well shall not be used for production purposes.

The Consent Decree acknowledges that the parties disagreed about the "construction, drilling and testing" of the "SEIS test well" that was authorized by Court Order for the purpose of gathering "data and information" for use in the SEIS for the EM Plan. See Paragraph 8.1 above. The Consent Decree likewise provides for the construction, drilling and testing of "an additional test well" in the agreed upon portion of the East Maui Region. See Paragraph 8.2 above. This "additional test well" was to replace the "SEIS test well" because the parties had disagreed about the value of the information and data gathered as a result of the drilling of that particular test well. The parties agreed that "an additional test well" would need to be drilled, based upon protocol agreed to by the parties, and that "information and data" would need to be collected on the impacts of the groundwater pumping of the proposed wells on the streams within the sphere of influence. This "additional test well" is to perform the same function as the original test well: gathering data and information for use in the EIS for the new plan to develop water resources in East Maui, in accordance

with the prior Court Order and in accordance with HAR §11-200-14.

3. The Construction of the "Test Well", by Itself, Triggers the Requirement for the Preparation of An EIS

The County Defendants are proposing to construct two Monitoring Wells, in different locations, upon TMK No. (II) 2-7-015:038, a .708 acre parcel owned by the County of Maui. See Exhibit "7" attached hereto. One well is designated a "Deep Monitoring Well" to be drilled to a depth of 1,130 feet. The other well is designated a "Shallow Monitoring Well" to be drilled to a depth of 80 to 100 feet. See Exhibit "2d" attached hereto. This project occurs on "county land", a "trigger", by itself, for the preparation of an Environmental Assessment pursuant to HRS Chapter 343. See HRS § 343-5(a)(1).

In addition, the two Monitoring Wells will be constructed with County funds. The USGS Phase 2 "test well" proposal states that any test wells will be "contracted and funded by the MDWS" – Defendant DWS.[11]

4. The "Test Well" is Not A "Stand Alone" Project and Is A Component of a Larger Total Undertaking Requiring An EIS Pursuant to Chapter 343

The "test wells" are not a "stand alone" project and cannot be "segmented" from their later function which is to monitor the impact of the production wells, once they are constructed, on the aquifer. As such, these wells are components of the larger total undertaking – constituting an "effort" to implement a new plan and project to develop groundwater in East Maui. HAR § 11-200-7. Paragraph 8.2 of the Consent Decree provides that "The County is authorized to construct an additional well in the agreed-upon portion of the East Maui Region" to be used only for gathering data and information. However, Paragraph 8.2 continues:

> **Thereafter, this test well shall be dedicated for use by the County Defendants as a monitoring or observation well to monitor or observe the performance of the aquifer in the**

[11] See "Summary" in attached Exhibit "4. " The 2013 DWS Capital Improvement Budget now in effect for Maui County does not have any funds specifically set aside for the construction of "test wells" in the Paia-Haiku area or anywhere else on the Island of Maui.

agreed-upon portion of the East Maui Region. (Emphasis added).

The wells, thus, are to be designed and constructed first to be suitable for use as "test wells" for the purpose of gathering data and information for the preparation of the EIS on the impact of the pumping of the proposed wells on streamflow in the streams within the sphere of influence of the proposed wells.

The wells are also to be designed and constructed to be suitable **thereafter** (later in time) for use as "monitoring wells", to monitor or observe the impact on the aquifer that results from pumping the production wells in the well field, over the long term life of the project, for example to determine impacts of potential over-pumping on water quality, on the elevation of the water table and on the sustainable yield of the aquifer. This is consistent with the Court authorization for the earlier "test well."[12] The wells described in Paragraph 8.2 of the Decree are required to have the same two functions: first testing, then monitoring the impacts of the production wells on the aquifer.

E. The County Defendants Have Re-Commenced Planning to Develop Groundwater Resources within the Agreed-Upon Portion of the East Maui Region on an Ad Hoc Basis But NOT Based Upon Comprehensive Planning As Required By The Consent Decree and Law

1. Re-commencement of Planning on an Ad Hoc Basis

The County Defendants have never formally proposed a new plan to develop groundwater resources in East Maui or Haiku. Nor has the Maui County Council approved such a project.[13] Never-the-less, the County

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[12] This Court's Order, entered on September 6, 2000, authorized the construction of "a single monitoring well" (1) for the purposes of gathering data and information for use in the Supplemental Environmental Impact Statement ("SEIS") for the East Maui Water Development Plan SEIS and (2) **thereafter** to monitor all wells drilled as part of the EMDP.

[13] On p. 3 of Exhibit "8" it shows that there is $1,000,000 allocated in FY 2013 for "Countywide Source Development/Acquisition." The "Project Description" in the Budget for this allocation states: "This is a group of alternative proposals of either groundwater sources (wells) or surface water sources (diversions); final selection of any of the proposed alternatives will be based on policy direction and **will require Council approval**. Implementation of any of the proposed alternatives (including agreement/contracts/design/construction/etc.) **will take place soon after Council approval**. (Emphasis added.)

Defendants have re-commenced planning to develop additional groundwater resources in the agreed-upon portion of the East Maui Region before conducting the preliminary studies described above. The monitoring wells are component projects of this larger total undertaking. HAR § 11-200-7.

Defendant DWS and the USGS have entered into a Joint Funding Agreement for a cooperative study, paid for with federal and county funds, to assess groundwater availability in the Haiku, Honopou and Makawao Aquifers for future groundwater development. USGS has submitted a proposed Phase 2 "test well study" to Defendants dated July 2012. See attached Exhibit "4."

The County Defendants and USGS are focusing upon the Haiku, Honopou and Makawao Aquifers (mostly within the area subject to the Consent Decree) "for future groundwater development." The proposal states, on p. 2, that this is because of large population increases likewise increasing the demand for water from 22 mgd in 2005 to 34 mgd in 2030 in the Wailuku area and from 7.2 mgd in 2005 to 8.8 mgd in 2030 in the Upcountry area. This document states, on p. 2, that the Haiku, Honopou and Makawao Aquifers are "potential source areas for meeting this additional demand" with "the Haiku Aquifer System being the most desirable because of its lower altitude and proximity to the areas of need." See Exhibit "4" attached hereto.

The CIP now in effect for the DWS includes funding for "Source Improvements" in the Paia-Haiku area, consisting of three production (3) wells. For **Haiku Well 1**, design funds are provided for Fiscal Year ("FY") 2009 and construction funds for Haiku Well 1 in FY 2014 ($1,200,000) and in FY 2015 ($5,000,000). For **Haiku Well 2**, design funds are provided for FY 2015 ($250,000) and construction funds for Haiku Well 2 in FY 2016 ($1,200,000) and in FY 2018 ($3,500,000). **Haiku Well 3**, a third well, "may also be developed."[14] See Exhibit "8" attached hereto.

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[14] Section 2.80B.030.B. of the Maui County Code states that the County Budget is part of the planning process: "Preparation of County budgets and capital improvement programs shall implement the general plan to the extent practicable. The countywide policy plan, Maui island plan, and community plans authorized in this chapter are and shall be the general plan of the County, as provided by section 8-8.5 of the charter."

The County also presented Plaintiffs with a map of "Haiku Alternative Well Sites" that are all within the area subject to the terms and conditions contained within the Consent Decree. This new proposed well field is within the Haiku Aquifer, is consistent with the County/USGS focus on developing further groundwater resources within the area subject to the Consent Decree and the CIP funding for three production wells. See Exhibits "9a" and "9b" attached hereto.

The test wells proposed by the County DWS are located in the vicinity of the "Haiku Alternative Well Sites" or the new well field proposed by the County DWS within the area subject to the Consent Decree. The test wells, after drilling, become monitoring or observation wells to monitor or observe the performance of the aquifer in the agreed-upon portion of the East Maui Region.

2. The County Defendants Have Failed to Undertake the Required Comprehensive Planning Before Putting Out the Monitoring Wells to Bid

The administrative actions of all County agencies, including Defendants herein, must comply with and conform to the County General Plan as well as the local community plan, in this case, the Paia-Haiku Community Plan (1995). *Leone v. County of Maui,* 128 Haw.183, 284 P.3d 956 (Haw. App. 2012); *Pono v. Molokai Ranch, Ltd.*, 119 Hawai'i 164, 192, 194 P.3d 1126, 1154 (App. 2008). See Maui County Code § 2.80B.030.B.[15]

Putting the two Monitoring Wells out to bid for construction, at this juncture, is an action that is inconsistent with the goals, objectives, policies and implementing actions for "Water" contained within Paia-Haiku Community Plan (1995), enacted by Ordinance No. 2415 and effective on May 17,1995. See Exhibit "10" attached hereto. As implementing actions, this Plan requires:

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[15] "All agencies shall comply with the general plan" and "... "administrative actions by agencies shall conform to the general plan." See Footnote 8, on p. 967, of *Leone v. County of Maui,* 128 Haw.183, 284 P.3d 956 (Haw. App. 2012) that states: "The Maui County Code (MCC) renders the Community Plan binding on all county officials. MCC 2.80B.030(B) (2006).

1. **Prepare** or update **a water improvement master plan for the Pa`ia - Ha`iku region to be incorporated as a functional component of the Community Plan.**

2. **Update the County's Water Use and Development Plan** and estimated water use for the Pa`ia - Ha`iku region based on the adopted Community Plan and include a reserve capacity for drought conditions.

4. **Provide incentives for water conservation practices.**

Water Objectives of the Paia-Haiku Plan are to:

2. **Ensure that adequate water capacity is available for domestic and agricultural needs of the region.**

3. **Ensure that the development of new water sources does not adversely affect in-stream flows.**

6. **Ensure adequate supply of groundwater to residents of the region before water is transported to other regions of the island.** (Emphasis added.)

There is no "**water improvement master plan**" for the Paia-Haiku area that describes a new plan to develop groundwater resources in the area or the construction of two monitoring wells next to the Kaupakalua Well or addresses comprehensively the "Objectives" recited above. Nor has the County's "**Water Use and Development Plan**" been updated and approved by the CWRM. Defendants cannot put out to bid for construction the two Monitoring Wells that are components of a new plan to develop groundwater in East Maui without undertaking the comprehensive planning required for this significant project in the manners described above – without violating their duties to act in conformity with the Community Plan. These issues must all be rigorously analyzed in the studies required by Paragraph 4 of the Consent Decree.

V. PLAINTIFFS ARE ENTITLED TO INJUNCTIVE RELIEF TO PREVENT VIOLATIONS OF THIS COURT'S ORDERS

The County Defendants are committing clear violations of the Consent Decree. Plaintiffs are entitled to injunctive relief to prevent these violations of the Orders that this Court entered through the Consent Decree.

VI. CONCLUSION/ RELIEF REQUESTED

Based upon the foregoing Plaintiffs respectfully request that the Court grant the relief that follows:

A. That the Court grant this Motion to Enforce Consent Decree by declaring that the County Defendants are in violation of the Consent Decree as follows: (1) The test wells put out to bid by the County Defendants are not located where agreed upon in the Consent Decree; (2) The parties have not agreed upon protocol for the test pumping as required in the Consent Decree; (3) The County Defendants have not prepared or delivered to Plaintiffs studies that conclude, after rigorous analysis, that it is cost-beneficial to develop groundwater resources in East Maui before re-commencing planning groundwater development in East Maui and that the County Defendants have re-commenced such planning; and (4) The "test well" cannot be constructed until the EIS process has been initiated and completed pursuant to Chapter 343 and the County Defendants have not yet initiated this process;

B. That this Court grant the specific relief requested in Paragraphs D through F of the Motion which is restated and incorporated by reference;

C. That this Court grant all injunctive relief, temporary, preliminary and permanent, against the County Defendants, their contractors and all those working by and through them, enjoining any and all work on the two test and monitoring wells until full compliance with the terms of the Consent Decree is first demonstrated.

D. This Court award attorney's fees and costs to Plaintiffs and any other relief that this Court deems just and equitable.

DATED: Wailuku, Maui, Hawaii 2.28.13

Isaac Hall, Esq.
Attorney for Plaintiffs
The Coalition to Protect East Maui Water Resources, The Sierra Club and Mark Sheehan

IN THE CIRCUIT COURT OF THE SECOND CIRCUIT

STATE OF HAWAII

THE COALITION TO PROTECT EAST MAUI WATER RESOURCES, an unincorporated association; HUI ALANUI O MAKENA, a Hawaii non-profit corporation; THE SIERRA CLUB, a California non-profit corporation registered to do business in the State of Hawaii; MARK SHEEHAN; Plaintiffs, vs. THE BOARD OF WATER SUPPLY, COUNTY OF MAUI; DEPARTMENT OF WATER SUPPLY, COUNTY OF MAUI; COUNTY OF MAUI; GEORGE TENGAN, in his capacity as Director of the Water Department, County of Maui; and JOHN DOES 1-100; Defendants.	)	Civil No. 03-1-0008(3) (Declaratory Judgment and Other Civil Action) DECLARATION OF ISAAC HALL; EXHIBITS "1 - "10"

DECLARATION OF ISAAC HALL

1. My name is Isaac Hall; I am a resident of the County of Maui, State of Hawaii; I am an attorney licensed to practice law in the State of Hawaii and I represent Plaintiffs in this case.

2. This Declaration is made upon my personal knowledge and I am competent to testify about the matters contained herein, except where otherwise stated.

3. Attached to this motion as Exhibit "1" is a true copy of the "Consent Decree" entered in this case on December 22, 2003 as Orders of this Court.

4. Attached to this motion as Exhibit "2" are true copies of pertinent documents made available by the County Defendants on February 19, 2013 in putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site", as follows:

Exhibit "2a"	Notice to Bidders
Exhibit "2b"	Project Description
Exhibit "2c"	Special Provisions
Exhibit "2d"	Plans and Specifications

5. Attached to this motion as Exhibit "3" is a true copy of a letter from myself to Deputy Corporation Counsel Jane E. Lovell dated February 19, 2013 demanding that Defendants immediately cancel the Notice to Bidders for the construction of the two Monitoring Wells in violation of the Consent Decree.

6. Counsel for Defendants refused to agree and Plaintiffs have therefore been forced to file this Motion.

7. The County Defendants have only consulted with Plaintiffs sporadically with long periods of time elapsing between consultations.

8. Plaintiffs have never agreed that the test wells can be constructed in any other location than where agreed upon in the Consent Decree. Defendants have never formally proposed to re-locate the well field to be monitored. Plaintiffs have never agreed that there may be more than one test or monitoring well.

9. The parties to the Consent Decree and the USGS have not agreed upon a test protocol to be implemented during the drilling of the test wells as required by the Consent Decree.

10. The County Defendants have not prepared or delivered to Plaintiffs the studies required by Paragraph 4 of the Consent Decree.

11. Attached to this motion as Exhibit "4" are true copies of pertinent portions, pp. 1- 8 and pp. 16-17 of a USGS proposal, dated July 2012, entitled "Phase 2 – test well study", pursuant to an agreement for a cooperative study to assess groundwater availability in the Haiku, Honopou and Makawao Aquifers.

12. Attached to this motion as Exhibit "5" is a true copy of an Order entered by Judge Mossman on August 23, 1994 in Civ. No. 93-0734(2) declaring the first EIS prepared for the EM Plan inadequate and ordering Defendants to prepare a Supplemental EIS ("SEIS").

13. Attached to this motion as Exhibit "6" is a true copy of an Order entered by this Court, on September 6, 2000, in the same case, Civ. No. 93-0734(2), authorizing the construction of test wells for the East Maui Water Development Plan SEIS.

14. Attached to this motion as Exhibit "7" is a true copy of County of Maui official, public records demonstrating that the property upon which Defendants are proposing to construct the two Monitoring Wells, TMK No. (II) 2-7-015:038, .708 acres in size, is owned by the County of Maui and therefore is county land.

15. Attached to this motion as Exhibit "8" are true copies of pertinent portions of the approved 2013 Capital Improvement Project Budget for the Department of Water Supply.

16. Page 3 of Exhibit "8" shows that $1,000,000 is allocated in FY 2013 for "Countywide Source Development/Acquisition." The "Project Description" in the Budget for this allocation states:

> This is a group of alternative proposals of either groundwater sources (wells) or surface water sources (diversions); final selection of any of the proposed alternatives will be based on policy direction and **will require Council approval**. Implementation of any of the proposed alternatives (including agreement/contracts/design/ construction/etc.) **will take place soon after Council approval**. (Emphasis added.)

There is no documentation that the Maui County Council has ever approved a new plan to develop groundwater sources in the East Maui Region. The Capital Improvement Budget now in effect for Maui County does not have any funds specifically set aside for the construction of "test wells" in the Paia-Haiku area or anywhere else on the Island of Maui.

17. Attached to this motion as Exhibit "9a" is a true copy of a map of "Haiku Alternative Well Sites" that the County Defendants presented to Plaintiffs. Attached to this motion as Exhibit "9b" is a true copy of a map of "Haiku Alternative Well Sites" that the County Defendants presented to Plaintiffs indicating that all of the wells are within the area subject to the terms and conditions contained within the Consent Decree.

18. Attached to this motion as Exhibit "10" are true copies of pertinent portions of the goals, objectives, policies and implementing actions for "Water" contained within the Paia-Haiku Community Plan (1995), enacted by Ordinance No. 2415 and effective on May 17,1995.

19. There is no "water improvement master plan" for the Paia-Haiku area that describes a new plan to develop groundwater resources in the area or to construct two monitoring wells next to the Kaupakalua Well.

20. There is no County "Water Use and Development Plan" that has been updated and approved by the CWRM that describes a new plan to develop groundwater resources in the East Maui area or to construct two monitoring wells next to the Kaupakalua Well.

I declare under penalty of law that the foregoing is true and correct.

Executed on 2.28.13.

ISAAC HALL

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Attorney for Plaintiffs
The Coalition to Protect East Maui
Water Resources, The Sierra Club
and Mark Sheehan

RECEIVED
CORPORATION COUNSEL
2013 NOV 20 PM 2: 29

FILED
2013 NOV 14 PM 1: 16

J. KAYA, CLERK
SECOND CIRCUIT COURT
STATE OF HAWAII

IN THE CIRCUIT COURT OF THE SECOND CIRCUIT

STATE OF HAWAII

THE COALITION TO PROTECT EAST MAUI WATER RESOURCES, an unincorporated association; HUI ALANUI O MAKENA, a Hawaii non-profit corporation; THE SIERRA CLUB, a California non-profit corporation registered to do business in the State of Hawaii; MARK SHEEHAN; Plaintiffs, vs. THE BOARD OF WATER SUPPLY, COUNTY OF MAUI; DEPARTMENT OF WATER SUPPLY, COUNTY OF MAUI; COUNTY OF MAUI; GEORGE TENGAN, in his capacity as Director of the Water Department, County of Maui; and JOHN DOES 1-100; Defendants.	Civil No. 03-1-0008(3) (Declaratory Judgment and Other Civil Action) ORDER GRANTING PLAINTIFFS' MOTION TO ENFORCE CONSENT DECREE, FOR DECLARATORY RELIEF, FOR TEMPORARY, PRELIMINARY AND PERMANENT INJUNCTION AND OTHER RELIEF Hearing Date: April 24, 2013 Ruling Date: October 2, 2013 Time; 8:30 a.m. Judge: Hon. Joseph E. Cardoza No Trial Date Set

I hereby certify that this is a full, true and correct copy of the Original.

emc/motenf2

ORDER GRANTING
PLAINTIFFS' MOTION TO ENFORCE CONSENT DECREE,
FOR DECLARATORY RELIEF, FOR TEMPORARY, PRELIMINARY
AND PERMANENT INJUNCTION AND OTHER RELIEF

EXHIBIT "BR10"

The Court's ruling on "Plaintiffs' Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief" filed in the above-captioned case was scheduled for and took place on Wednesday, October 2, 2013 at 8:30 a.m. in the Second Circuit Courts before the Honorable Joseph E. Cardoza. Plaintiffs The Coalition to Protect East Maui Water Resources, The Sierra Club and Mark Sheehan (hereafter simply "Plaintiffs") were represented by Isaac Hall, Esq. Defendants The Board of Water Supply, County of Maui, The Department of Water Supply, County of Maui, The County of Maui and David Taylor, in his capacity as Director of the Water Department, County of Maui [1], (hereafter simply "Defendants") were represented by Deputy Corporation Counsel Caleb P. Rowe, Esq.

The Court has carefully considered the pleadings filed by the parties, the record and file to date, as well as the oral argument presented by the parties.

IT IS HEREBY ORDERED, ADJUDGED AND DECREED that "Plaintiffs' Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief" is hereby granted, pursuant to Rules 7, 52 and 65 of the Hawaii Rules of Civil Procedure, as follows:

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[1] Pursuant to Hawai`i Rules of Civil Procedure ("HRCP") Rule 25(c), David Taylor, the current Director of the Department of Water Supply, may be substituted for George Tengan, who previously held that position.

I.

1. This Court, in this Section I., enters the following findings of fact in support of this Order, as follows.

2. Plaintiffs and Defendants agreed to comply with the terms and conditions contained within the Consent Decree entered in this case on December 22, 2003 as the Orders of this Court.

3. Defendants, on February 19, 2013, put out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project, involving the construction of two test and monitoring wells in Kaupakalua, East Maui, on county-owned land, to be paid for with county funds, constituting the "test well" referenced in paragraph 8.2 of the Consent Decree (hereafter simply "the project").

4. Plaintiffs' Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief (hereafter simply "Plaintiffs' Motion") was filed on February 28, 2013 asserting, *inter alia*, that by putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project, Defendants were violating terms and conditions contained within the Consent Decree and that Defendants must be prohibited or restrained from violating the Consent Decree, as explained in more detail as follows.

5. Defendants filed their "Memorandum in Opposition to Plaintiffs' Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief on April 16, 2013.

6. Plaintiffs filed their Reply Memorandum in Support of Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief on April 19, 2013.

7. No evidentiary hearing on Plaintiffs' Motion was requested by Plaintiffs or Defendants.

8. A hearing on Plaintiffs' Motion was scheduled for and took place on April 24, 2013, during which oral argument was presented in favor of Plaintiffs' Motion by counsel for Plaintiffs and in opposition to Plaintiffs' Motion by counsel for Defendants.

9. Before the conclusion of the April 24, 2013 hearing the Court scheduled Friday, May 3, 2013 at 9:30 a.m. as the date and time at which the Court would issue its ruling on Plaintiffs' Motion.

10. Plaintiffs and Defendants thereafter entered five stipulations, approved by the Court, continuing the date and time for the Court's ruling on Plaintiffs' Motion, to allow the parties to consult with each other, ultimately until Wednesday, October 2, 2013 at 8:30 a.m., all on the condition that Defendants agree that they will not notify any bidder of the issuance of an award of any contract or execute any contract for the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project.

11. The parties informed the Court that, in the period of time that had elapsed, they had not been able to resolve the issues raised in Plaintiffs' Motion and were therefore ready to proceed with the Court's ruling on Wednesday, October 2, 2013 at 8:30 a.m.

12. Plaintiffs have presented clear and convincing evidence within "Plaintiffs' Motion to Enforce Consent Decree, for Declaratory Relief, for Temporary, Preliminary and Permanent Injunction and Other Relief" that in putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project on February 19, 2013, Defendants are violating unambiguous terms contained within the Consent Decree for reasons including, but not limited to:

a. The test wells proposed by Defendants are not located "within one of the crosshatched areas shown on the maps" attached to the Consent Decree as Exhibit "B," as is required by paragraph 8.2 of the Consent Decree.

b. The parties to the Consent Decree and the USGS have not agreed upon a test protocol to be implemented during the drilling of the test wells, as is required by paragraph 8.2 of the Consent Decree.

c. The Defendants have not prepared or delivered to Plaintiffs studies which, after rigorous analysis, conclude that it would be Cost-Beneficial to return to East Maui to plan the development of groundwater resources, as is required by paragraphs 4, 4.2, 4.3 and 4.4 of the Consent Decree. Only after this pre-condition is satisfied can planning by the Defendants to develop East Maui water resources "re-commence" including, but not limited to, the planning for and construction of the two test and monitoring wells.

d. The Defendants have re-commenced planning for the development of water resources in East Maui, for examples, through statements contained in the United States Geological Survey Phase 2 "test well study" to the effect that the Haiku, Honopou and Makawao Aquifers are potential source areas for meeting the asserted additional demand for water, with the Haiku Aquifer System being the most desirable (Exhibit "4", p. 2 attached to Plaintiffs' Motion), through the Defendants' proposed well field located within the Haiku Aquifer in East Maui (Exhibits "9a" and "9b" attached to Plaintiffs' Motion) and through the inclusion of funding for Haiku Wells 1, 2 and 3 in the East Maui area in the Maui County Council approved six year County CIP Budget beginning in Fiscal Year 2013 (Exhibit "8" attached to Plaintiffs' Motion).

e. The "test wells", as described in paragraph 8.2 of the Consent Decree as a two phased project, cannot be put out to bid or constructed until the EIS process has been initiated and completed pursuant to Chapter 343, as is required by paragraph 7 of the Consent Decree.

13. Plaintiffs request the following relief from this Court:

a. That this Court issue declaratory relief by ruling that the County Defendants are violating the Consent Decree in the manners described above and by issuing further Orders prohibiting Defendants, and all those acting by and through them, from taking the actions in the procurement to construction process regarding the "Construction of Two Monitor Wells at the

Kaupakalua Well Site" project or the two monitoring wells, which actions are described with particularity in paragraph 14. below.

b. That this Court issue an Order cancelling or voiding, because undertaken in violation of the Consent Decree, the actions in the procurement to construction process regarding the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project or the two monitoring wells, which actions are described with particularity in paragraph 14. below; and/or

c. That this Court issue temporary, preliminary and permanent injunctive relief enjoining the County Defendants, and all those acting by and through them, from taking any of the actions in the procurement to construction process regarding the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project or the two monitoring wells, which actions are described with particularity in paragraph 14. below.

14. Plaintiffs seek declaratory relief prohibiting Defendants and/or injunctive relief enjoining Defendants, and all those acting by and through them, from (1) putting the construction of the two monitoring wells out to bid at this point in time, (2) awarding any Contract for the construction of the two monitoring wells, (3) expending any County funds upon or encumbering any County funds for the two test or monitoring wells, (4) using County lands for the two test or monitoring wells, (5) executing any Contract for the construction of the two monitoring wells, (6) issuing any Notice to Proceed for the construction of the two monitoring wells and/or (7) commencing construction upon or constructing either or both of the monitoring wells, all without first

fully complying with the terms and conditions contained within the Consent Decree.

II.

1. This Court, in this Section II., enters the following conclusions of law, in support of this Order, as follows.

2. In paragraph 12.1 of the Consent Decree, Plaintiffs and Defendants reserved their respective rights to seek in this Court the enforcement of the terms and conditions contained within the Consent Decree and, therefore, this Court has jurisdiction over these matters.

3. Defendants have had adequate notice of Plaintiffs' Motion and the opportunity to respond to Plaintiffs' Motion.

4. Plaintiffs have met their burden of demonstrating that the Defendants are in violation of the Consent Decree by putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project on February 19, 2013.

5. The Court therefore declares that the Defendants are in clear violation of the Consent Decree in the manners described in Section I., paragraph 12 above, by putting out to bid the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project on February 19, 2013.

6. This Court has the inherent power to enforce its decrees, including this Consent Decree, and to make and award such orders, writs or decrees, including issuing injunctions, as may be necessary, in aid of its original

jurisdiction, to render its decrees and orders effective. HRS §§ 603-21.9(1) and (6).

7. Because the Court finds, determines and declares that the Defendants are in violation of the Consent Decree the injunctive relief requested by Plaintiffs shall issue to prevent violations of the Consent Decree as Orders of this Court and to maintain the status quo until compliance with the Consent Decree is achieved by Defendants.

8. Plaintiffs have satisfied the tests for injunctive relief to maintain the status quo as demonstrated in Plaintiffs' Motion: (1) Plaintiffs have prevailed on the merits of Plaintiffs' Motion, as determined herein; (2) the balance of irreparable damage favors the issuance of injunctive relief in that Plaintiffs have demonstrated procedural harm, as in *Sierra Club v. Department of Transportation of the State of Hawai'i ("Sierra Club I")*, 115 Hawai'i 299,167 P.3d 292 (2007) and (3) the public interest supports granting an injunction because protecting Plaintiffs' public participation rights is in the public interest; *KSOA v. County of Maui*, 86 Hawai`i 66, 947 P.2d 378 (1997). *Life of the Land v. Ariyoshi*, 59 Haw. 156,158, 577 P.2d 1116 (1978); *Office of Hawaiian Affairs v. Housing & Community Development Corp. of Hawaii*, 117 Hawai`i 174, 212, 177 P.3d 884, 922 (2008).

III.

1. This Court, in this Section III., enters its Decision and Order in support of this Order, granting injunctive relief, as follows.

2. An injunction is hereby entered enjoining the Defendants, and their subordinates, agents, attorneys, and all other persons acting in concert or participation with them who have actual knowledge of this Order, from taking any of the following actions in the procurement to construction process regarding the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project or the two monitoring wells:

a. Putting the construction of the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project out to bid at this point in time;

b. Awarding any Contract for the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project;

c. Expending any County funds upon or encumbering any County funds for the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project;

d. Using County lands for the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project;

e. Executing any Contract for the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project;

f. Issuing any Notice to Proceed for the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project; and/or

g. Commencing construction upon or constructing either or both of the two test or monitoring wells or the "Construction of Two Monitor Wells at the Kaupakalua Well Site" project.

3. This injunction shall remain in effect until Defendants establish to this Court that they are in full compliance with the terms and conditions contained within the Consent Decree entered in this case on December 22, 2003 as the Orders of this Court.

NOV 14 2013

DATED: Wailuku, Maui, Hawaii _____.

APPROVED AND SO ORDERED:

/S/ JOSEPH E. CARDOZA (SEAL)

_____

Judge of the Above-Entitled Court

APPROVED AS TO FORM:

_____

Patrick K. Wong
Corporation Counsel
Edward S. Kushi, Jr.
First Deputy Corporation Counsel
Moana M. Lutey
Richard B. Rost
Caleb P. Rowe
Deputies Corporation Counsel
Attorneys for Defendants
The Board of Water Supply, County of Maui, Department of Water Supply County of Maui, David Taylor, in his capacity as Director of the Water Department, County of Maui

Maui County Department of Water Supply
Water Conservation Efforts

The DWS maintains 750 miles of water lines, 145 storage tanks with 295 million gallons of water storage capacity, six water treatment facilities, and 35 groundwater sources for 35,562 customers. DWS employees maintain the water system 24/7. The DWS also works hard to sustain its water resources for the long term. We work closely with the State to ensure that our sources are protected for the public trust, that our customers will have continuous and reliable water supply.

The Maui County Department of Water Supply is developing and expanding its water conservation program, which includes both supply side and demand side measures.

Supply Side Water Conservation Measures

Supply-side measures to date include leak detection, preventive and predictive maintenance, use of reclaimed water and alternate system backups and resource protective measures

(1) Leak Detection:

An effective leak detection program is critical to identify unaccounted for water in order to proactively prevent as much water loss as feasible. There are major benefits to having a leak detection program that include the ability to: respond more quickly to identified leaks; find "hidden" leaks creating ongoing water loss; reduce pressure, especially during low demand; and replace aging and weakened pipe.

The Department of Water Supply Division of Water Resources & Planning employed two personnel primarily responsible for leak detection identification, assistance to field crews and property owners (only of the leak was on County property). Leak detection staff was sent out when a leak was suspected, either based on system performance, or flow and pressure monitoring undertaken as part of hydraulic model development or other efforts. A total of 361 miles of transmission lines were surveyed from FY 2008 - 2013; 88 leaks were found and repaired (mostly in the Central area).

(2) Preventive & Predictive Maintenance: This is two pronged. Facilities are regularly maintained and pumps are periodically calibrated. In the course of such maintenance, facilities are regularly checked for signs of wear. DWS also has a system inventory with age, diameter and material of lines and other facilities. Based upon the status and performance of system facilities, upon known inventory status and demand trends, DWS

EXHIBIT "BR11"

maintains a 30-year project list. This can help to reduce unaccounted-for water in the system by targeting old and substandard lines for replacement.

(3) Reclaimed Water Use: About 3.905 MGD is in use countywide with 1.8 MGD utilized in South Maui. As part of its Water Use & Development Plan process, DWS is currently investigating the costs and benefits of large scale capital investment to further expand reclaimed water use to offset potable use.

(3) Back-up Sources: In the event of a major leak, most areas of the Central system can be served by other sources so that any key portion of system could be valved off at need.

(4) Watershed & Resource Protection:
DWS has provided financial support to seven Watershed Partnerships on Maui and Molokai to ensure upland watersheds are fully functioning so fresh water resources can be utilized and enjoyed by the people of Hawaii in perpetuity. Since1995,wehavep rovided $8.12milliondollarsoffundingtosevenWatershedPartnershipscompriseatotal numberof54ofpartners.Thepartnersrepresentranchers,federal,state,countyandlocal government,waterutilities,largelandholders,firetaskforces,non-profits,non-government
associations,publiclandtrusts,theKingKamehamehaschoolsandmanyrepresentatives fromtheprivatebusinesssector.
All of these partners, including the County and State entities, are working in partnership to protect over 150,000 acres located within a key watershed area critical to future DWS water source protection, development and recharge.

The Watershed Partnerships collectively address a variety of threats to the watershed including activities such as: ungulate control through fencing and targeted hunting practices; eradication of invasive weeds and plants; reforestation and vegetation of upland areas and other habitats critical to the recharge and protection of water supply; and suppression and management of wild land fires resulting in the loss of forests. These efforts have successfully resulted in essential tangible outcomes and deliverables and include: fence installation, maintenance and monitoring resulting in a reduction in the feral animal populations; eradication of invasive weeds and plants (nearly 35,000 acres); hunting programs to increase access for hunters and reduce feral animal populations; restoration of forests with native species of plants and trees; documentation, protection and research of rare species; establishment of volunteer programs in all watersheds; interpretive hikes and field studies; resource monitoring and mapping; installations of trails, camps and helicopter landing zones; educational presentations and displays at public events and schools; and landscape level watershed protection through the protection and out planting of native plant species and Countywide community garden projects.

DWS FUNDING PROVIDED FOR LONG TERM PROTECTION OF WATER SOURCE THROUGH WATERSHED PARTNERSHIPS
[Table 1]

Watershed Entity	YEARS (FY)	Funding Amount
East Maui Watershed Partnership	2006 - 2014	$ 3,299,560.00
The Nature Conservancy - Waikamoi	1997 - 2014	$ 2,281,310.00
East Molokai – The Nature Conservancy	2000 - 2014	$ 871,600.00
Leeward Haleakala Watershed Restoration Partnership	2005 - 2014	$ 1,277,100.00
West Maui Mountains Watershed Partnership	1998 - 2014	$ 1,433,910.00
Maui Invasive Species Committee (MISC)	2000 - 2014	$ 5,429,956.00
Hawaii Agricultural Research Corporation (HARC)	2012 - 2014	$ 120,000.00
Pu'uKukui Watershed Partnership *	2014	$ 200,000.00
Maui Nui Botanical Garden	2004 - 2014	$ 480,000.00
SUB TOTAL (Central water system)	1995 - present	$ 1,913,910.00
TOTAL	1997 - present	$17,307,346.00

NOTES: refers to those partnerships whose work directly benefits the Central water system area.

* MISC does actively work within watersheds critical to Central DWS water sources, however it is difficult to accurately determine the exact amount of funding spent
** Pu'uKukui first received DWS funding during FY14

Demand Side Water Conservation Measures

Demand-side measures to date include low flow fixture distribution, a tiered rate structure, public education and outreach programs, and regulations as well as resource protection. Ongoing planning efforts are evaluating the benefits and costs of increased aggressiveness in these efforts.

(1) Low Flow Fixture Distribution

To date DWS has given out 36,481 low flow showerheads, 38,318 bathroom aerators, 24,524 kitchen aerators, 3,823 self-closing hose nozzles, and many more leak detection dye tablets, vs. a customer base of about 35,000 meters. (See Table 2)

LOW FLOW FIXTURE GIVE AWAY – 1998 – PRESENT
[Table 2]

District	Showerheads	Bath Faucet Aerators	Kitchen Faucet Aerators	Garden Hose Nozzles	Toilet Tank Bags
Central	23,000	24,768	15,687	14,251	2,478
UpCountry	9,230	9,707	6,308	6,331	783
Lahaina	2,340	2,336	1,545	1,293	436
Hana	355	358	265	242	21
Molokai	1,156	1,149	719	766	105
TOTAL	**36,481**	**38,318**	**24,524**	**22,883**	**3,823**

NOTE: For each fixture request there is a limit of two showerheads, 1 hose nozzle.
This accounting does not include the 2013 Maui County Fair giveaways.

(2) Water Audits/Retrofits

The Department co-funded its first direct install retrofits in the late 1990s with low flow toilets. However, no large scale programs were funded. More recently, smaller retrofit projects of high efficiency toilets have been installed in various County properties.

Ongoing retrofit trials include:

- **Ka Hale A Ke Ola,** a homeless resource center with about 70 units and two dormitories - 74 toilets, two urinals, 76 showers and 76 faucet aerators will be replaced with the most water efficient products available. Ka Hale A Ke Ola is located in the DWS Central Water System District in Wailuku.

- **Hale Makana O Waiale** is a low income housing complex with 200 units. Two Hundred showerheads, 200 bathroom and kitchen faucet aerators will be replaced with more water efficient models.Located in Wailuku.

- **Maui County Government Building** includes the 5th and 9th floors of the county building will be retrofitted with 10 waterless urinals, 22 dual flush toilets. Located in Wailuku.

- **Parks and Recreation** - DWS staff is working with Parks Department Staff to retrofit aquatic facilities with more efficient fixtures and conserve water in many other ways as well.

MAUI COUNTY DWS RETROFIT PROJECTS
[Table 3]

Facility	Location	No. of Toilets Replaced	No. of Showerheads Replaced	No. of Kitchen/bathroom Faucet aerators installed
Hale MahaoluElua	Kahului	173	181	181/180
Luana Gardens	Kahului	148	122	122/152
Hale MahaoluAhaki	Kahului	11-	110	110/110
Lahaina Surf	Lahaina	109	0	0
Komohana Hale	Lahaina	21	0	0
Hale Mahaolu Home Pumehana	Kaunakakai	0	86	0
Hale Mahaolu Retrofit	Kahului	278	278	278/278
Ka Hale O Ke'ola Resource Shelter	Wailuku	84	76	76
Mokuhau Apartment	Wailuku	16	16	32
TOTAL	10	939	869	799/720

The Water Use & Development Plan, currently in development, is evaluating the costs and benefits of high efficiency fixture rebates and direct installation programs as part of the Water Conservation Program. Ongoingtrials will help to provide some preliminary data on the effectiveness of some of these options. Longer term options for the future may also include review of various means of sub-metering multi-family units and multi-

purpose buildings. Studies indicate that metering un-metered units is among the most effective conservation measures, by billing explicitly for water use rather than hiding this cost in the rent.

(3) Water Conservation Pricing
DWS currently has a tiered rate structure to encourage conservation (Maui County Code Chapter 14.10). Data improvements under way could enable the Department to move toward a more aggressive tier structure.

(4) Regulations Related To Water Conservation
Maui County has the following existing regulation and rules that support water conservation:

1) Prohibition of discharging cooling system water into the public wastewater system (Maui County Code Title 14, Chapter 14.21A.015);

2) Plumbing code regulations that require low flow fixtures in new development (Maui County Code Title 16.20B);

3) Requirements that all commercial properties within 100' of a reclaimed water line utilize reclaimed water for irrigation and other non-potable uses (Maui County Code Title 20, Chapter 20.30.020A);

4) A water waste prohibition with provision for discontinuation of service where negligent or wasteful use of water exists (Maui County Code Title 14, Chapter 14.03.050);

5) A provision enabling the Water Director to enact special conservation measures in order to forestall water shortages (Maui County Code Title 14, Chapter 14.06.020).

In addition, acomprehensive conservation ordinance has been drafted, is planned to be included as part of the Maui Island Water Use and Development Plan and may be implemented in stages (Maui County Code Title 14, Chapters 14.02 and 14.03)

(5) Public Education & Outreach Activities

- Public Advertising - Conservation marketing efforts include public ads that run on all cable TV and local radio stations and newspapers to encourage water conservation. (See Table 4)

Maui County DWS Water Conservation Public Outreach and Education Activities [Table 4]

Water Conservation Outreach Measure	Cost	Comment
Public newspaper ads	$370,000	From 2003 to date, advertising in local newspapers (Maui and Molokai)
Public radio ads	~$262,000	From 2003 to date, was spent on advertising on local radio on stations (Pilipino station included).
Local TV and cable stations	$25,000	In FY 13 DWS entered into a MOA with the Honolulu Board of Water Supply to implement a Summer Water Conservation Program. This program is a multi-agency partnership to conserve water in Maui County and the City and County of Honolulu. A total of 1,278 conservation ads were aired on local and cable TV stations. Similar MOA was executed for FY 14.
Annual DWS poster contest	$23,000 in expenses $5,715 in prizes	This project is on its 5th year. A total of 1,713 public, private and home schooled students participated in the last four years. Cost incurred on supplies, certificates, advertising and printing of calendars and other misc. expenses
Native plant give away	10,000 native plants	Approximately 10,000 native plants were given away to the public from 2003 to date
Community Gardens	$28,400 spent on garden related materials and tools (does not include staff labor)	DWS supported the community gardens with native plants, irrigation materials, installation and staff time: • Ka Hale O Ke Ola • Maui College SLIM Community Garden • Lahainaluna High School Garden Project • Greenhouse • Pomaikai Elem School (2) Water Conservation Specialists spent 20% of their time per month as well as ~16 hours of weekend OT for the past 2 years

NOTE: native plants come through grant funding with the Maui Nui Botanical Gardens. Since 2003, they have received $480,000 watershed grantfunds from the DWS.

- Permit Review - The permit review process is also utilized as an educational tool, with use-specific conservation and site specific recommendations included in each review.

- Community Events - The DWS participates in about 25 public events per year, such as the County Fair, Earth Day and Taro festivals. (See Table 4)

- In order to provide demonstration and an ongoing educational facility with demonstration and participatory learning, the DWS funds the operations of The Maui Nui BotanicalGardens. (See Table 1)

- Expanded education and marketing efforts under consideration include targeted marketing survey and campaign development, a hotel awards program, a building manager users group, and an agricultural users group.

Maui County Department of Water Supply Participation in Community Public Education and Outreach Events
[Table 5]

COMMUNITY EVENT	FREQUENCY OF PARTICIPATION
Arbor Day	every year
Earth Day	every year
Earth Day - Molokai	4/21/06; 4/18/08; 4/17/09
East Maui Taro Festival	4/1/06; 4/26/08
Grand Wailea Health Fair	8/29/08; 9/18/09
Green Day at Four Seasons Hotel	6/5/2008
Haiku Community Assn Fair	3/11/2006
Haiku's Hoolaulea & Flower Fair	3/8/2008
Haiku's Mahalo Day	11/26/05; 3/11/06
Healthy Hawaii Expo	5/6/06; 6/16/07
Kihei Children & Youth Fair	10/18/08; 10/17/09
Kulamalu Fun Run	9/17/2005
Marriott Wailea Health Fair	4/29/2009
Maui Assn of Landscape Professionals	11/12/05; 11/11/06
Maui County Centennial Celebration	8/20/2005
Maui County Fair	every year
Maui Meadows HOA	9/4/2008
MCA Home Expo	every year
MECO in Our Community	every year
MNBG Native Plant Sale	every year

Molokai Health Fair	12/3/2005
Napuuwai Health Fair - Molokai	11/18/06; 12/1/07; 11/22/08
Old Lahaina Luau Fair	12/17/2008
S Maui Sustainability Fair	8/11/06; 10/9/08
Ulupalakua Thing	4/30/2005
Kula Community Assn Fair	2/21/2009
Upcountry Rotary Club Fair	4/23/2006
Upcountry Safe Water Fair	6/11/05; 2/21/09; 6/5/10
Upcountry Sustainability fair	8/1/2006
Waihee School Fair	1/30/2008
West Maui Safety Fair	4/9/05; 2/21/09; 6/5/10
West Maui Senior fair	10/7/2009
Whale Day	2/16/2008
Women's Health Fair	8/26/06; 9/1/07; 9/13/08; 9/19/09

(6) Water Conservation and Landscaping: Located in Wailuku, Maui DWS co-funds operations of the Maui Nui Botanical Gardens, and funded construction of its nursery and portions of other facilities and displays. (see Table 1) This provides a resource for promoting expertise in propagating and maintaining native plant materials, helps to increase the potential marketability of appropriate native plants, promotes a water conservation ethic, provides training on appropriate propagation, planting, irrigation and maintenance techniques, and generally helps to increase the likelihood of successful appropriate landscapes with a "Hawaiian Sense of Place". It also helps to protect watersheds by promoting native and non-invasive plants over potentially invasive species, providing for educational opportunities on the importance of the watershed and how to protect it, and serving as a major demonstration and educational facility. The nursery is also a source of native plants for Department outreach projects and give-aways. (See Table 5)

DWS developed (with help from the County arborist committee) and disseminated a brochure entitled "Saving Water in your Yard, What and How to Plant in your Area", which is distributed by the Maui Nui Botanical Garden as well as by the Department at events and with permit reviews. Future plans for landscape conservation include a conservation ordinance, landscape audit and retrofit program and smaller satellite demonstration projects. DWS is also investigating the costs and benefits of major capital expenditure in reclaimed water transmission to offset use of potable water in South Maui landscapes. The pending conservation ordinance includes mandatory watering schedules and irrigation efficiency measures among other requirements.

Ongoing Water Conservation Planning Efforts: Source options considered as part of the Water Use and Development Plan process will include consideration of extensive

conservation measures as a source supply. In order to displace or delay source development an aggressive program is required. Preliminary design of such a program is ongoing as part of the Water Use & Development Plan process. Anticipated program elements include targeted audit and direct install programs,rebates and incentives, expanded conservation requirements for landscaping, and other uses, expanded marketing efforts including user groups, such as a hotel awards program, a building manager information program, agricultural user working groups/services, as well as energy production and efficiency measures, continued watershed protection and restoration and possible major capital expenditure to support reclaimed water use.

EXPERT REPORT OF PAUL H. BREWBAKER, Ph.D.

At the request of the Maui County Department of Water Supply

on

Economic aspects of a petition to amend interim instream flow standards of Waihe'e River and Waiehu, Iao, and Waikapu Streams

December 31, 2013

EXHIBIT " B-R12"

1. I am Principal of TZ Economics, a Hawaii economics consultancy. For more than 25 years through 2009 I was professionally affiliated with Bank of Hawaii, retiring as a Senior Vice President and its Chief Economist. I served for much of the last 25 years as member and chair of the Hawaii Council on Revenues, the State of Hawaii's independent revenue-forecasting body. I graduated with honors from Stanford University in 1977 with an A.B. in Economics, completed all but the dissertation in the graduate economics program at the University of Wisconsin—Madison prior to entering banking, and received a Ph.D. in Economics at the University of Hawaii in 2004. I have taught economics almost continuously both in the University of Hawaii system and University of Wisconsin systems. I was retained by the Maui County Department of Water Supply to estimate economic consequences of restricting use of Na Wai Eha offstream flows. This note summarizes my expert opinion on the issue. A resume is attached in an Appendix.

2. The basis for the economic calculations in this report arises from the Hawaii State Water Code's directive that: "In considering a petition to adopt an interim instream flow standard, the [Water] 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* [emphasis added]."[1] This report provides estimates of the values of economic activity and real assets dependent on present Na Wai Eha water uses, contingent on potential future uses, and vulnerable to restriction of existing, offstream uses.

3. My analysis is calibrated to Maui County Department of Water Supply information that approximately 2-3 million gallons of up to 25 million gallons a day of municipal use derives from or may in the future derive from from Na Wai Eha sources. The relevant Central Maui System area comprises a little over half of Maui's population (0.54) and a little over half of Maui's housing stock (0.503).[2]

4. A permanent, ten percent reduction in potable water supply is analogous to a natural disaster with permanent economic consequences. Consider a drought one knew would never end, with the same effects. Relief from such loss through infrastructure investment would take a long time in Hawaii, where the ability to obtain entitlement for private *and* public capital formation faces significant political, regulatory, and legal hurdles.[3] Maui County's Department of Water Supply reports that even its *existing* infrastructure investment plans for alternate water sources would take up to a decade to implement.

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[1] Hawaii Revised Statutes Chapter 174C-71, Part IV. Instream Uses of Water, Paragraph 2.(D).

[2] Maui County reports 35,482 housing units of the 70,492 enumerated in the April 2010 census in the Central Maui Service area, and reports a population of 84,414 of the 153,924 enumerated in the census (http://dbedt.hawaii.gov/economic/databook/db2012).

[3] Richard K. Green, Stephen Malpezzi and Stephen K. Mayote (May 2005), "Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources," *American Economic Review* vol. **95**, no. 2, 334-339 document Honolulu's position as one of the *most* restrictive cities in America for homebuilding. Maui County's housing ordinance is more restrictive than Oahu's. Requirements such as those for environmental impact statements have contributed to a reduction in annual public capital formation in Hawaii, as a share of gross product, from 3.8 percent (1958-78) to 1.7 percent (1992-2012).

Unlike natural disasters which typically have transitory impacts, a permanent reduction in water supply to 90 percent of prior availability would rank among rare disasters with long-term adverse impacts.[4]

5. As a necessity, water use and population go together hand in hand. The correlation on Maui of water consumption with population (in natural logarithms) was 0.73 during the economic expansion from 1998-2007.[5] From 1950-1975, a period comprising both population growth and decline (Territorial Era migration to Oahu) the correlation was 0.78. On a (positive) scale of 0 to 1, 70-80 percent is high correlation between water and population on Maui.

6. Economic linkages with water also are strong on Maui. In the last business cycle (1998-2012), the trend elasticity of Maui water consumption with respect to Maui real per capita personal income was about 0.55, implying that each percentage point change in real per capita income *change* was associated with about a one-half percentage point change in water consumption.[6]

7. Strong co-movement between water and income characterized the recent recession-recovery cycle. A large reduction in water consumption and in real income accompanied the Great Recession on Maui (2007-2009; see fn. 5).[7] The correlation of Maui water consumption and Maui real per capita personal income (in natural logarithms) was 0.80 for

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[4] Eduardo Cavallo, Sebastian Galiani, Ilan Noy, and Juan Pantano (June 2010), "Catastrophic Natural Disasters and Economic Growth," **Inter-American Development Bank Working Paper No. IDB-WP-183**, find that only extremely large natural disasters have long-run negative effects of output growth, and then only when accompanied by radical political upheaval. However, John Lynham, Ilan Noy, and Jonathan Page (August 2010), "The 1960 Tsunami in Hawaii: Long Term Consequences of Costal [sic] Disaster," **University of Hawaii at Manoa Department of Economics Working Paper No. 12-16** use the Hilo's seismic event as natural experiment along with a unique control group—the remaining Hawaiian Islands—to find that unemployment was almost one-third higher and population nearly one-tenth lower, fifteen years after the tsunami, than would have been the case had the seismic event not occurred, with comparable reductions in numbers of employers and in Hawaii Island's principal export at the time, sugar.

[5] The year 1998 marked the first after an extended economic stagnation in which Maui real per capita personal income began to decline, in an expansion that extended through 2007, approximately Maui's last economic upswing. The National Bureau of Economic Research dates the milder dot.com recession from March-September 2001, and the Great Recession from December 2007-June 2009.

[6] The estimate takes into account productivity growth for the entire 1998-2011 sample period in the form of the decline in per capita Maui municipal water consumption from about 270 gallons/day in the late 1990s at the start of the expansion to about 245 gallons/day from 2004-2007 at the peak of the economic expansion. A regression estimating the elasticity of water consumption with respect to real per capita Maui personal income at 0.56, and the elasticity with respect to per capita water consumption at 0.18, explains about three-fourths of the variation in annual municipal water use (0.765). The elasticity estimates are statistically significant individually and jointly at the 99.9 percent level of confidence.

[7] Maui water consumption declined from 13.3 billion gallons in 2007 at the peak of the housing valuation cycle, to 12.1 billion gallons in 2009 (9 percent), and was 12.4 billion gallons as recently as 2012, still down 6 percent from the peak. Maui real per capita personal income declined 11.2 percent from 2007-2009, cumulatively, and in 2011 still was 9.7 percent lower than at the peak in 2007.

the economic expansion period 1998-2007. During the recession-recovery interval 2007-2011 that correlation rose to 0.979. Both the Great Recession and the economic expansion preceding it provide comparatively *large* co-movements with which to calibrate per capita economic sensitivities of municipal water consumption in the Central Maui System area.[8]

8. Correlation is not causation, and even elasticity estimates recovered from a regression rely on an underlying causality hypothesis, in this instance *from* income *to* water. Assuming that water is available at constant (marginal) cost the income elasticity explains by how much water consumption (demand) changes when real income changes. The economic question associated with causality running in the opposite direction, from water supply to real output or income requires knowledge of a production relationship. Estimation of this production function is beyond the scope of this assignment, but the causality *from* water *to* output (and income) also can be motivated intuitively in several ways consistent with the common notion the water is a "necessity."[9]

9. Trivially, the production function says, "output is zero when water is zero." (Kahoolawe provides a nearby example.) About 12-13 billion gallons of annual municipal water consumption on Maui is associated with $5-6 billion of Maui personal income annually. Highly correlated long-term co-movements of aggregate income and aggregate water consumption suggest that a fixed production coefficient (proportionate linkage between water and output) is plausible, especially when movements in *both* directions—up (0.8) and down (0.98)—are tight in the shorter-term.

10. A "free disposal" argument also supports nearly proportionate linkage in production between water and output. Economic recession reduced real income around 10 percent and reduced water consumption around 10 percent (see fn. 6). If water was *not* necessary for the last 10 percent of real income, it "freely could have been disposed," i.e. inconsequentially disposed literally by pouring it down the drain or, equivalently, *by not using it at all.* Instead, we observe that when output was 10 percent higher, so was water

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[8] In particular, though with limited numbers of observations, Maui water's income elasticity rose from 0.49 through end of economic expansion in 2007 to 0.69 during the subsequent economic recession and recovery.

[9]The State of Hawaii Department of Business, Economic Development, and Tourism (DBEDT) sustainable tourism model (2006) was designed to capture interdependencies of tourism as Hawaii's principle export with outputs of other industries as well as several natural resource dimensions of the economy, including water consumption. This computable general equilibrium model (CGE) was built on the State's input-output model of interindustry linkages, including many of the substitution responses highlighted in CGE (for example between labor and capital and, consequently, between tourism as an export and other industries). Data on infrastructure and natural resource systems, catalogued by the consulting firm Carter & Burgess, were "insufficient for the complete modeling effort," but the authors created synthetic models to translate visitor expenditure into *physical* quantities for water, sewarge, electricity, gas, and solid waste. "Not surprisingly, the higher the projection for visitor expenditures, the higher was the demand for infrastructure services," wrote the authors. "Most of this demand will not be generated directly by visitors, but rather by the growth in the resident population that is made possible through tourism activity and other income generating activity. This is an important point, because whatever is the mix of future economic activity in the state...there will likely be growth in the resident population, making increased demand for resources in the future nearly inevitable." In the study's base case long-term projections real visitor expenditure rose from $10.9 billion in 1997 to $17.3 billion in 2020, and real Hawaii GDP rose from $58.7 billion to $98.8 billion. Statewide water consumption rose from 100.4 billion to 139.2 billion gallons annually, 1997-2020. The implied income elasticity of water use, 0.567, is notably similar to the 0.556 estimate for Maui in the text.

use. If water "freely could have been disposed" but *wasn't*, it's much more likely that water *was* necessary for production. Ten percent more output necessitated 10 percent more municipal water use. This may not be as satisfying as empirically estimating an output elasticity for water around one, but the alternative of *merely coincidental* 10 percent decline of income and water use is so implausible as to be dismissed.

11. Highly correlated co-movement across economic boom and bust demonstrates the necessity of water for household, business, and government production. It's especially telling that water use rose *and* fell amid *large* economic gyrations.[10] If income and water use were moving by only a few percentage points in either direction, things might be different. Instead, both moved 10 percentage points in each direction in a highly correlated way. Taking away 10 percent of water or, say, wiping out 10 percent of the capital stock (as might a tsunami or hurricane), reduces output by a factor of proportionality close to 1 *because* it's a necessity. Along some margin capital may be substitutable for labor, but there is no substitute for water.

12. The key issue here is absence of significant input substitutability between water and other factors of production. The scope is limited for a "software solution," for changing factor intensities (say, a rise in the capital/labor ratio), or for some other long-term mitigation for loss of water. Even though the demand elasticity estimates suggest that a 10 percent change in output or income changes water use by 5 or 6 percent, working in the opposite direction water becomes more of a binding constraint. A 10 percent change in water supply shuts down part of the economy. As a necessity, water has few substitutes. There aren't easy workarounds in the event of its absence. In the event of its sudden absence, in a magnitude as large as 10 percent of existing municipal water use, the impacts are bound to be large and the ramifications economy-wide.

13. Therefore without the time, data, or actual assignment to estimate an aggregative production model of Maui output or (equivalently) income as a function of labor, physical capital—produced means of production—and natural capital, e.g. water, and energy, etc., I assert that in my professional economic opinion: (a) water is necessary for long-run output and, therefore, income; (b) in its absence there won't be any (output or income); and (c) recent, historically large economic movements of the last business cycle and highly correlated co-movements of water use and real income per capita over long periods support an hypothesis of nearly equi-proportionate co-movements in output (and income) as a function of water as an input to production. I stipulate that, strictly speaking, equi-proportionate co-movement may be an *upper* bound on the implied output elasticity of water.[11]

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[10] Moreover, correlation of water use and income (or, equivalently, output) in a business cycle marked by a notorious housing bubble on the upswing and the worst downturn since the Great Depression on the downswing, is a natural experiment in *extreme* co-movement. From boom to bust through recovery, the elasticity of Maui water use with respect to (real per capita) income are approximately 0.64 (1998-2007: boom), 0.79 (2007-2009: bust), 1.41 (2009-2011: recovery).

[11] Notwithstanding the economic recovery estimate for 2009-2011 of the income elasticity of water use *in excess of one*, as reported in fn. 8.

14. Half of Maui's houses and residents lie within, and plausibly at least half of Maui's value-added originates within, the Central Maui System area. The area comprises the major Wailuku-Kahului conurbation. The area's improved business, industrial, hotel, airport, and government TMK (Tax-Map Key) land comprises one-fifth of all Maui land in the State of Hawaii Land Use Commission's designated urban land district, and an even higher proportion of improved Maui TMK land. Its transient accommodations constitute two-fifths of Maui island's inventory.[12] My opinion is that up to half the Maui economy would be materially, adversely affected by an instantaneous, semi-permanent loss of roughly one-tenth of its water supply from restriction of offstream uses from Na Wai Eha sources.[13]

15. Personal income comprises approximately 85 percent of gross product, or value-added.[14] With about $6 billion in Maui personal income (in 2012 dollars, both from 2006-2008 and approaching that level again in 2011), this suggests that approximately $3 billion (in 2012 dollars) or half of Maui's economy is "at risk." Half of Maui's economy is exposed to the material, adverse effects of an instantaneous, semi-permanent ten percent loss in municipal water supply. In other words, up to $300 million in annual real personal income (in 2012 dollars)—up to ten percent of Maui's total—could be lost in the event of restriction of existing Department of Water Supply (DWS) offstream Na Wai Eha water uses.[15]

16. Lack of substitute water sources in the short-run and long-lead times for water infrastructure development mean that the present value of foregone output attributable to a semi-permanent, 10 percent reduction of municipal water supplies to the Central Maui System area would be substantial. Even if a replacement source could be brought on-line in a decade, after ten years the present value of losses of would be $2.4 billion, discounting future foregone annual aggregate income of $300 million by 4 percent. Just half that annual loss for only five years before complete replacement of lost municipal water still would cost Maui $670 million in foregone output.[16]

17. An aggregate output or income reduction summarizes many other facets of the adverse impacts of water restriction. Three additional dimensions of economic impacts are worth

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[12] The 2012 *Visitor Plant Inventory* enumerates 7,962 or 40.5 percent of Maui's 19,659 transient accommodation unit total located within the Kahului-Wailuku conurbation, and in the Maalaea and Kihei/Wailea/Makena resort areas.

[13] Short of estimating an intertemporal production function for Maui's economy (and that of the CMWSSA) including water as an input, this analysis estimates economic impact.

[14] Personal income excludes several items such as retained corporate earnings, indirect business taxes and depreciation included in gross product.

[15] At $6 billion in personal income a rough cut at Maui gross product would be around $7 billion, the actual size of value-added in Maui's economy. To bias the estimates downward, given the roughness of the estimates, the lower figure is used.

[16] Discounting at 7 percent a ten-year loss of $300 million would total $2.1 billion in present value foregone. A five year loss of $150 million would total $615 million.

mentioning. First, beyond output or income measures, transactions data provide a measure of the velocity of economic activity reflected in gross business receipts. Second, asset valuations may be eroded by significant negative changes in the economic outlook. Third, development of new residential and commercial structures to accommodate population growth would be constrained by restriction of Na Wai Eha offstream waters.

18. Twice a decade, an economic census delves into economic production detail at industry levels of granularity, by county. The 2007 economic census enumerated approximately $6.94 billion in gross receipts in Maui goods- and services-producing industries.[17] Using employment weights an additional $3.39 billion in receipts can be estimated for North American Industrial Classification System (NAICS) industries for which census data were not enumerated. Given its geography, the Central Maui System area comprises at least half of these estimated $10 billion in transactions flows. So, if only as a rough guide, up to ten percent of Maui transactions velocity, perhaps a half billion dollars in gross receipts, could be impaired by a ten percent reduction in municipal water use. Transactions are not a substitute for income or output measures, but give some flavor of the dimensionality of adverse affects associated with lost output.

19. Asset valuations broadly reflect economic expectations about the future. Residential real estate valuations alone constitute a significant portion of household wealth. Commercial real estate valuations also reflect the present value of potential future uses. Generally speaking, an asset's valuation approximates the present value of its future (net) incomes. For owner-occupied housing, those "incomes" partly are in-kind: in addition to capital gains an owner-occupant consumes housing services by living in the asset. Discounting tends to crush values arising in the distant future, and "the force of mortality" leads investors to value more highly those returns expected with more imminent dates in the near future. A prospective and immediate reduction in water supply of up to ten percent without replacement for up to a decade or more would constitute a shock that would significantly impair asset valuations. Loss of water, no less than an instantaneous disappearance of 10 percent of habitable land (as might be associated with a catastrophic seismic event such as a tsunami) or a sudden, 10 percent degradation of atmospheric quality (from air pollution), perceived as extending into the future, would be immediately reflected in declining asset valuations. Asset values would not rise because of a shortage of habitable units in the event of semi-permanent water shortage as is sometime (strangely) argued by opponents to residential development.[18]

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[17] The non-agricultural enumeration included manufacturing; wholesale and retail trades; professional, business, health care and social services; and accommodation and food services. Data for transportation, utilities, information, financial activities, private educational services and public services were not enumerated.

[18] Building fewer homes or removing existing homes does not increase wealth by creating shorter supplies over which mythical, wealthy offshore investors now must compete. Denying households water and driving them out of existence is *not* accretive to wealth in the aggregate. Investors are ever-present, and their wealth status mythical or otherwise is beside the point: every owner-occupant is—by definition—an investor. Catastrophic reduction in the natural resource endowment, like catastrophic reduction in the housing stock, does not increase asset values because asset values are based on expectations of future economic returns. Catastrophic wealth reduction—loss of natural resource endowments or of the physical housing stock—reduce expectations of future economic returns, causing asset prices to fall. Often, prices fall "too far." Think of it this way: after something really bad has happened, asset prices must fall, even overshooting long-term values, because only the probable compensation of outsized returns

20. The recent housing cycle provides a calibration benchmark: roughly a ten percent reduction in Maui real per capita income (and Maui water consumption) during the Great Recession of 2007-2009 was accompanied by a decrease in seasonally-adjusted, monthly, Maui single-family existing home prices of more than 50 percent. (Observed Maui condominium prices declined at least as much.) The phenomenon of extreme asset price "overshooting" displayed in this experience is *not* unique to the specific circumstances of the Great Recession. A sudden, semi-permanent reduction in water supply of up to ten percent, the possible equivalent experience of one just witnessed with a recent, ten percent contraction in Maui's economy, should be expected to depress real asset valuations by multiples of the underlying, proportionate reduction in water. How investors perceive the timing and likelihood of a recovery in asset valuations would depend critically on what is known about the pace of development of alternative water sources.[19] Again, wealth implosion is not a substitute for income or output loss, but such compression of household balance sheets can have extended debilitating economic impacts.

21. Property tax revenues derived from the existing 35,000 housing units and 4,000 acres of improved commercial and government lands in the Central Maui System area could significantly be impaired by a 10 percent water loss, if valuations decline by an even larger proportion than the 10-50 percent reduction in residential real estate valuations during the last downturn. The roughly $100 million in property tax revenues from the Central Maui System area include amounts from which County water resource development is financed along with other public services.[20]

22. More than 12,000 new housing units, mostly located in the Central Maui System area, are identified in Maui's Community Development Plans as necessary to accommodate population growth over the next 10-15 years. An estimated $10 million in annual Maui

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from unusually low prices will induce investors willingly to assume the risk of holding them if impaired fundamentally by whatever bad thing just happened. Loss of 10 percent of municipal water supplies would be a "really" bad thing. See Rudiger Dornbusch (1976) "Expectations and Exchange Rate Dynamics," *Journal of Political Economy* 84(6) 1161-1176 for the canonical treatment based on frictions, and Darrell Duffie (2010) "Asset-Price Dynamics with Slow-Moving Capital" *Journal of Finance* **65**(4) 1237-1267 extending frictions to rational inattention.

[19] Ownership of, and therefore the value of a house or industrial structure or the land upon which they stand can be thought of as a call option on the future stream of incomes (or uses) associated with ownership of the real asset struck at today's construction cost. Option valuations tend to be more volatile than the values of underlying assets. Indeed, option prices are used as a revelation mechanism with which to infer stock price volatility. So, like option prices, the values of real estate tend to fluctuate over a wider range than the actual experience of the economy in which the real assets are situated. (For one thing, not *only* what happens on Maui affects perceptions of asset values *on* Maui: bad things happening elsewhere, in California for example, can adversely affect perceptions of Maui asset values.) Because only about five percent of existing homes trade in a given year, even the house price volatility in the data extant might be an underestimate should water supplies for up to twice that fraction of housing units be restricted. As experienced during the recent recession, an implosion in asset values coincident to a reduction in real economic activity itself radiates outward with untoward consequences. Wealth reduction reshapes everything from consumer confidence to investor enthusiasm.

[20] The figure $100 million is an estimate blending Maui County Fiscal Year 2013 certified revenue ($97.2 million) and FY2014 estimated revenue ($102.7 million) for Wailuku, Waihee, Waikapu, Kahului, Kihei, and Makena.

County property tax revenues from 2014 onward are associated with these prospective residential developments, more than two-thirds of that total from projects that are already entitled, *ignoring* prospective future rates of home price appreciation.[21] County Department of Water Supply officials inform me that water resources already are a binding constraint on all forms of economic development on Maui. Restriction of existing offstream Na Wai Eha water uses would pre-empt the one-third increment to existing housing supply implied by planned developments. *In addition to the aforementioned adverse economic impacts*, this would cause the County perversely to forego most of the incipient property tax revenue upon which financing for future infrastructure investment would be predicated, including water supplies.[22]

23. Maui County's water availability policy requires, "verification of long-term, *reliable* supply of water before applicable subdivisions are approved [emphasis added]."[23] Of particular additional significance would be the diminution of Maui County's credibility as a municipal borrower associated with *unreliability* of commitments for future water provision, if a restriction of offstream Na Wai Eha water use is perceived by bond investors as jurisdictional reneging on prior commitments, foregoing future expected revenue.

24. The analogy between the economic consequences of instantaneous loss of up to ten percent of Central Maui System water supplies and those of a variety of catastrophic events cannot be overemphasized. Permanent reductions in habitable land area of ten percent or more attributable to seismic events provide some guidance. Biological, meteorological, and geopolitical events also provide other benchmarks for temporary losses of income or economic activity, typically through the transmission channel of Maui's principal export, tourism. Many of these adverse impacts are amplified by associated asset price movements. The possibility simply cannot be wished away that a period of up to a decade or more could transpire before alternative water sources can be politically vetted, development approved by regulatory authorities, physical capital formation financed and then undertaken. Maui's experience with extension of *existing* airport runways, not to mention interisland ferry service, suggests that waiting decades for public infrastructure development of alternative water resources is not unprecedented. Many would argue a long wait is likely, as this proceeding itself suggests. Typically, disasters that wipe out a tenth of employment, income, or a resource endowment are transitory in nature. Maui County cannot simply flip a switch and replace up to ten percent of existing water consumption. A semi-permanent

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[21] For example, this estimate assumes that the 9 percent appreciation in Maui single-family home prices, seasonally-adjusted from third quarter 2012 to third quarter 2013, the 14 percent appreciation in these prices between the first nine months of 2012 and 2013, and the annualized (compound annual) 12 percent appreciation in these prices in the first nine months of 2013 compared to the nine preceding months, do *not* inform expectations of appreciation for 2014 and beyond.

[22] Not only future revenues that support Maui's general bond obligations would be impaired, but Maui's credit quality would be damaged. Adverse impacts on Maui County's credit ratings *alone* would impair its borrowing capacity, independent of the impacts of foregone property tax revenues from pre-empted development, and in addition to the reduction in real estate valuations and associated property tax revenues attributable to the impairment of economic activity associated directly with a reduction of offstream Na Wai Eha water use.

[23] Maui County Code Chapter 14.12.010. Verification expires in two years.

and instantaneous reduction in available water resources would have an extended adverse impact on economic activity, income, and wealth in Maui.

25. Decision-makers should compare costs of restricting municipal use of Na Wai Eha waters to the potential environmental and cultural benefits of instream restoration. Econometric methods exist to quantify these benefits, enabling such comparisons. Pinning down the relevant middle ground between society's "willingness to pay" for instream restoration (a low number) and society's "willingness to accept compensation" not to restore instream flows (a high number) would enlighten policy. Quantifying the benefits of improving conditions for amphidromous species, facilitating customary practices, and reviving certain small-scale farming activities would clarify whether benefits approximate the hundreds of millions or billions of dollars that offstream restriction will cost Maui. This is especially important *at the margin*, when many alternative flowing streams on the island already provide the same opportunities for such species, practices, and farming. No such marginal water supply alternatives exist for municipal use within a relevant time frame.

26. In my professional opinion as an economist, a reduction of up to 10 percent in municipal water supply resources for the Central Maui System—half of Maui's economy, housing stock, and population—extending for years if not decades, would have a material, adverse economic impact. The impact would be akin to those associated with catastrophic seismic, meteorological, biological and geopolitical events that instantaneously reduce productive capacity and impair economic activity. The magnitudes of the costs associated with restriction of County Na Wai Eha municipal use rise to the hundreds of millions of dollars in terms of potential foregone incomes, to larger amounts in terms of transactions velocity, and to *billions* of dollars in wealth losses (taking into account *only* residential real assets). Present values of cumulative costs from the possibility of years of foregone municipal water and income total in the billions of dollars, discounting at reasonable rates. A plausibly comparable ten percent reduction in real per capita personal income *and* in water consumption associated with the natural experiment provided by the most recent business cycle on Maui, which also eroded real asset valuations by up to *fifty* percent, suggests that such a Na Wai Eha restriction would be as bad for the Maui economy as it gets.

Signed,

Paul H Brewbaker

Paul H. Brewbaker
Principal/Economist
TZ Economics
Kailua, Hawaii

December 31, 2013

Appendix 1: list of documents used in preparation of this report

Provided by Maui County:

W9 & Vendor File Action Form.pdf

Na Wai Eha "Questions and Answers from the Planning Department" (correspondence) (NaWaiEhaQAwTMK.doc)

Remand Issues.doc

Central South pipes tanks 2013.jpg

Central North pipes tanks 2013. jpg

Central Maui service area.jpg [*sic*]

Top Ten Taxes FY13-14.pdf

Top Ten Assessed FY13-14.pdf

FY13 vs. FY14 Approved Rates.xlsx

Water Commission Findings of Fact (June 10, 2010) (FOF COL D&O (2010-06-10).pdf)

Hawaii Supreme Court decision 128 Hawaii 228 (Supreme Court Decision (2012-08-15.pdf)

MCC Ch 14.12 Water Availability.pdf

MCC Ch 2.96 Residential Workforce Housing Policy.pdf

HRS 174C-71 Protection of instream uses.pdf

HRS Chapter 174C State Water Code.pdf

Correspondence on building permits (Re Na Wai Eha information.rtf)

nawaieha_jan2011-nov2013_open.pdf

nawaieha_jan2011-nov2013_all.pdf

applications_approvednotifed_dec2013.xls [*sic*]

Correspondence from Real Property/Finance (Copy of email from Jennifer.pdf)

Na Wai Eha RPA tax estatimates with entitlements_1.pdf [*sic*]

Na Wai Eha RPA rev estimate without entitlements_1.pdf

Email exchange forwarded by Jennifer Oana.pdf (same as Copy of email from Jennifer.pdf)

Other resources not *identified in footnotes*:

U.S. Bureau of the Census 2007 Economic Census:

Maui County Economic Census 2007 data.xls
Maui County Economic Census 2007 metadata.xls

Hawaii Department of Business, Economic Development and Tourism (DBEDT) *County Economic Trends*:

sectionA.xls
sectionB.xls
sectionC.xls
sectionD.xls
sectionE.xls
sectionF.xls
sectionG.xls
sectionH.xls

Other Hawaii DBEDT data:

Maui monthly economic indicators.xls
e8590hi.xls
e7080hi.xls
38084hi.xls
int90-00-c.xls
int90-00-m.xls
CO-EST00INT-01-15.xls
2010intercensal_us_hi.xls
PEP_2012_PEPANNCHG.xls
PEP_2012PEPTCOMP.xls
hi_subcount12_table_mauiplus.xls
PEP_2012_PEPAGESEX_state&counties.xls
2012_table5_num_chang.xls

PEP_2012_PEPS6H_all_bothyear
Monthly Energy Data through November 2012.xls
Monthly_Energy_Data.xls
small_area_economy_final.pdf

Natural resource economics references not *identified in footnotes*:

Borenstein, Severin (Winter 2012), "The Private and Public Economics of Renewable Electricity Generation," *Journal of Economic Perspectives* **26**:1, pp. 67-92.

Bowen, Richard L., James E. T. Moncur and Richard L. Pollock (1991), "Rent seeking, wealth transfers and water rights: The Hawaii case," *Natural Resources Journal* **31,** pp. 429-448.

Brooks A. Kaiser, Weninee Masathit, Basharat A. Pitafi, and James A. Roumasset (2003), "Efficient Water Allocation with Win-Win Conservation Surcharges: The Case of the Ko'olau Watershed," *processed* (personal copy)

Brooks Kaiser, Nancy Krause, Dee Mecham, Jessica Wooley, and James Roumasset, "Environmental Valuation and the Hawaiian Economy: Introduction and Executive Summary," *processed* (DRAFT; personal copy)

Dang, Phuong M. (December 2002) *Optimal Management of Renewable Resources: A Dynamic Model of Surface Water Contamination from Pesticide Use in Rice Production in the Mekong Delta, Vietnam*, University of Hawaii Ph.D. Thesis—Doctor of Philosophy in Agricultural and Resource Economics (uhm_phd_4240_r.pdf(SECURED))

Gopalakrishnan, C. and L.G. Cox (2003), "Water Consumption by the Visitor Industry: The Case of Hawaii" *International Journal of Water Resources Development* **19**(1), pp. 29-35.

Gopalakrishnan, C., J. Levy, K.W. Li, and K.W. Hipel (2005), "Water Allocation among Multiple Stakeholders: Conflict Analysis of the Waiahole Water Project, Hawaii," *International Journal of Water Resources Development* **21**, pp. 283-295.

Gopalakrishnan, C., P. Malla and G.H. Khaleghi (1996), "The Politics of Water in Hawaii : An Institutional Appraisal," *International Journal of Water Resources Development* **12**(3), pp. 297-310.

Gopalakrishnan, C., X. Tian and D. Tran (1993), "The Impact of Oil Price Shocks on Hawaii's Economy: A Case Study Using Vector Autoregression" *Energy Systems and Policy* **15**(4), pp. 295-305.

Hawaii Department of Business, Economic Development and Tourism (principal investigators: Denise Konan and Karl Kim) (April 2006), *Planning for Sustainable Tourism; Project Summary Report.* Honolulu.

Malla, P. and C. Gopalakrishnan (1995), "Conservation Effects of Irrigation Water Supply Pricing: A Case Study from Oahu, Hawaii," *International Journal of Water Resources Development* **11**(3), pp. 233-242.

Malla, P. and C. Gopalakrishnan (1999), "The Economics of Urban Water Demand: The Case of Industrial and Commercial Water Use in Hawaii," *Intl. J. Water Res. Devl* . **15**(3), pp. 367-74.

Moncur, James E. T. (1991) "Transaction Cost, Efficiency, and Institutional Change: Water for Honolulu," *Regional Development Dialogue* **12**(4), pp. 94-106.

Moncur, James E.T., and Richard L. Pollock (1996), "Accounting-induced distortion in public enterprise pricing," *Water Resources Research* **32**(11), pp. 3355-3360.

Moncur, James, James Roumasset, and Rodney Smith (May 1997), "Optimal Allocation of Ground and Surface Water in O'ahu: Water Wars in Paradise," *University of Hawaii at Manoa Department of Economics Working Paper No. 97-7.*

Roumasset, James and Christopher Wada (May 2009), "Integrated Management of the South Oahu Aquifer System: A Spatial and Temporal Approach," *University of Hawaii at Manoa Department of Economics Working Paper No. 09-2.*

Roumasset, James and Christopher Wada (July 30, 2010), "Optimal Provision and Finance of Ecosystem Services: the Case of Watershed Conservation and Groundwater Management," *University of Hawaii Economic Research Organization Working Paper No. 2010-12.*

Roumasset, James and Nori Tarui (September 13, 2010), "Governing the Resource: Scarcity-Induced Institutional Change," *University of Hawaii at Manoa Department of Economics Working Paper No. 10-15.*

Appendix 2 (*not updated to 2013*)

Paul H. Brewbaker, Ph. D.
Principal, TZ Economics

1-808-263-4327 (home)
1-808-220-1538 (cell)
paulbrewbaker@tzeconomics.com

606 Ululani Street
Kailua, Hawaii 96734-4430 USA

Paul H. Brewbaker is the principal of TZ Economics, a Hawaii economics consultancy doing non-financial corporate work, financial risk analytics, real estate development impact analysis and litigation support. His background is in research on the Hawaii economy and financial risk analytics from a 25-year affiliation with Bank of Hawaii. He is a graduate of Stanford University and received his Ph.D. from the University of Hawaii, both in economics. He also did graduate work at the University of Wisconsin, where he taught at Madison and Milwaukee, and is a lecturer in the University of Hawaii system. He is a member of the American Economic Association, the American Finance Association, and the National Association for Business Economics, and is a director of the Hawaii Economic Association.

EDUCATION

University of Hawaii at Manoa; Honolulu, Hawaii
Ph.D. Economics, 2004
Thesis: *Dynamic Models of Hotel Investment in Hawaii*
Worked under Professors James Mak, James Roumasset and James Moncur

University of Wisconsin—Madison; Madison, Wisconsin
(All but dissertation) Economics (1977-1980; 1982-83)
Fields: Economic Development, International Finance, Natural Resource Economics
Worked under Professors Jeffrey Williamson and Andre Sapir

Stanford University; Stanford, California
A.B. Economics, 1977 (also completed History major)
Extensive coursework under Professors Donald Harris, Jack Gurley and Duncan Foley

EMPLOYMENT HISTORY

Senior Vice President and Chief Economist, Treasury Division (2002-2009); *Vice President and Chief Economist*, Treasury Division (1995-2002); *Associate Economist*, Economics Department (1985-94); external consultant (country risk analysis), International Banking Division (1981-84), **Bank of Hawaii**, 130 Merchant Street, Honolulu, Hawaii 96813

As the bank's economist was a member of the Asset-Liability Committee and Quantitative Methods Control Committee, responsible for financial and economic risk analytics on the bank's balance sheet approximately $10 billion); and in the bank's Asset Management Group was a member of the Investment Strategy Committee and its Asset Allocation Subcommittee (approximately $10 billion assets under

management); began banking career as a regional economist doing country risk analysis when Bank of Hawaii had an extensive branch presence in East Asia and the Pacific Islands; acquired an expanded role in financial risk management and capital management subsequent to the Asian Financial Crisis (1997). First began working in banking as consulting economist while a graduate student and university lecturer (1981-84) doing country risk analytics prior to the Latin American Debt Crisis (1982).

Lecturer in Economics

University of Hawaii (1990-2012)
Taught undergraduate microeconomic and macroeconomic principles and intermediate theory; money and banking and financial economics; Hawaii's Economy (applied theory course); tourism economics (Graduate School of Travel Industry Management (TIM)); international finance (Shidler College of Business); lectured in International Executive MBA, Executive MBA and Executive TIM programs; recent courses include *Hawaii's Economy* (summer 2012), *Principles of Microeconomics*, *Principles of Macroeconomics* (2010-2011), *Money and Capital Markets* (2009-2010)

Hawaii Pacific University (1987-1995)
Taught undergraduate microeconomic principles and graduate economic statistics in the MBA program

University of Wisconsin—Madison (1977-80; 1982-84)
Taught undergraduate intermediate macroeconomic theory, economic development (1982-84); Teaching Assistant in microeconomic and macroeconomic principles (1977-80), and money and banking in the American Economic Association Summer Minorities Program (1982-84)

University of Wisconsin—Milwaukee (1980-81)
Taught international trade, international finance, and graduate international monetary theory

OTHER PROFESSIONAL TRAINING

Completed Risk "Financial Risk Management" one-week *Risk* training course (1999)

Completed Stanford Graduate School of Business "Credit Risk" one-week professional training course (2003, under Darrell Duffie and Ken Singleton)

Certified as an expert witness in economics in Hawaii District Court

PRESENTATIONS AND PUBLICATIONS

Presenter, "Hawaii (Western States Outlook)," at the Association for University Business Economic Research Annual Conference (October 2012)

Principal author, publisher and contributor to Bank of Hawaii's external economics publications (1985-2009), as manager of 10-person research department downsized after 1994 (c. Internet), including:

Hawaii Economic Trends (on-line periodical, 1995-2009)
Hawaii [*year*] (annual economic report, discontinued in 1999 (begun in 1949))
Construction in Hawaii [*year*] (annual construction report, discontinued in 1999 (begun in 1965))
Business Trends (bi-monthly periodical, discontinued in 1995)
Pacific Islands Economic Reports (French Polynesia, 1990; Fiji, 1992; discontinued c. 2001))

Presenter, "The Spice of Paradise," at the Western Economic Association Meetings (July 2008)

Author, "Tourism in Hawaii's Economy: A Reference Note," *Hawaii State Association of Counties Proceedings of the 1993 Annual Conference* (1993).

Contributing author, Randall Roth, *The Price of Paradise* (1992) Honolulu: Mutual Publishing.

Extensive media exposure in broadcast, in print and on-line; including various Hawaii media channels such as *Hawaii News Now*, *Honolulu Star-Advertiser*, *Pacific Business News*, *Civil Beat*, *Hawaii Business*, as well as Neighbor Island publications, and global media channels such as *The Wall Street Journal*, *The New York Times*, *The Los Angeles Times*, *NHK*, *PBS*, *CNN* and *Bloomberg*; contributor to the *Bloomberg* economic forecast survey.

Invited presenter at conferences, business and professional meetings, since 2009 (as a private economist):

Air Cargo Alliance of Hawaii (11/11/11) and as Hawaii Air Cargo Association (10/19/10, 10/20/09)
Alexander & Baldwin Corporation (investor presentation, 4/11/12)
American Marketing Association, Hawaii Chapter (3/14/12)
American Water Works Association (5/14/09)
Architects and Engineers Association (2/4/11)
Associated Builders & Contractors (2/21/12)
Association of Legal Administrators (forthcoming 11/14/12; 6/15/11; 7/21/10; 7/15/09)
Bank of Hawaii Private Client Group (11/4/09)
CCIM/IREM National Convention (10/17/09)
Chamber of Commerce of Hawaii (1/25/12)
Chamber of Commerce Young Professionals (10/12/11)
Chevron Hawaii (2/23/12; 3/1/12)
Coldwell Banker Hawaii (8/2/11)
Construction Financial Management Association (7/29/10; 4/7/09)
Council for Advancement and Support of Education (10/1/10)
Distinctive Homes Hawaii (8/14/12; 7/28/11)
East Oahu Realty (5/26/09)
East-West Center Jefferson Fellowship Awardees Conference (5/13/09)
FACE Hawaii Equity Summit (1/22/11)
Financial Professionals Association (11/5/09)
General Federation of Women's Clubs (6/26/09)
Haseko (public forum, 7/18/12)
Hawaii 50th Anniversary of Statehood Conference (8/21/09)
Hawaii Association of Mortgage Brokers (2/18/11; 5/12/09)
Hawaii Association of Public Accountants (6/9/11)
Hawaii Association of Realtors (10/27/10)
Hawaii Business Magazine (12/2/10)
Hawaii Carpenters Union (7/17/10)
Hawaii Council on Economic Education (3/15/12)
Hawaii County Boards of Review (5/15/09)
Hawaii Credit Union Accountants Association (12/17/10)
Hawaii Developers Council (11/18/11; 7/30/10)
Hawaii Economic Association (4/5/12; 10/1/10; 3/26/09)
Hawaii Employers Council (4/19/11; 11/19/09)
Hawaii Government Employees Association (10/14/11, forthcoming October/November 2012)
Hawaii Institute for Public Affairs (5/28/09)
Hawaii Island Board of Realtors (10/22/10)
Hawaii Land Use Commission (expert testimony, 3/16/12)
Hawaii Life (investor presentation, 5/18/12)
Hawaii Nature Conservancy (5/14/09)
Hawaii-Pacific Steel Framing Alliance (10/29/09)
Hawaii Pacific University EMBA/MBA program (7/29/09)
Hawaii Sheet Metal Workers Union (10/1/09)
Hawaii Social Science Association (5/4/09)
Hawaii Society of Business Professionals (5/14/11, forthcoming 9/20/12)
Hawaii Society of CPA (11/30/11)
Hawaii State Bar Association (5/28/09; 4/20/09)
Hawaii State House of Representatives Republican Caucus (10/11/11)
Hawaii State Legislature House Finance/Senate Ways & Means Committees (1/9/12; 1/7/11; 1/5/10)
Hawaii State Legislature House and Senate Labor Committee Joint Informational Briefing (4/7/09)
Hawaii Transportation Association (8/25/11; 8/26/10; 8/27/09)
Hawaii Union Builders (5/24/09)
Hawaii Workforce Development Council (2/24/11)
Hawaiian Tax Free Trust (forthcoming 10/27/12; 0/4/11; 9/30/10; 9/22/09)
Healthcare Association of Hawaii (11/4/09)
Hilton Hotels and Resorts (9/27/11)
HiComp (10/21/09)
Honolulu Board of Realtors Central Region (3/14/12; 3/9/11)
Honolulu Board of Realtors East Oahu Region (3/1/12; 2/3/11; 4/8/09)
Honolulu Board of Realtors Leeward Regional Group (3/21/12; 1/19/11)
Honolulu Board of Realtors North Shore Region (8/9/12; 2/10/11; 9/10/09)
Honolulu Board of Realtors Windward Region (1/26/12; 1/27/11)
HUD National Conference on Affordable Housing in High-Cost Metropolitan Areas (9/13/12)
Insights on PBS Hawaii (2/23/12, 9/13/12)

Institute for Internal Auditors (9/20/11)
International Brotherhood of Electrical Workers Local 1260 (4/2/09)
International Council of Shopping Centers (6/18/09)
Iolani School Economic Forum (4/1/09)
IREM/CCIM/BOMA (1/27/12, 1/13/11, 1/22/10)
Kahala Associates (11/18/11; 11/23/10)
Kahala Business Association (6/14/11; 4/21/09)
Kakaako Improvement Association (8/1/12)
Kaneohe Business Group (4/27/11, 6/24/09)
Kauai Board of Realtors (6/28/12; 8/31/11; 7/15/10; 8/7/09)
Kona Board of Realtors (10/28/11; 10/29/10)
Lambda Alpha Institute (5/27/11)
Land-O-Lakes Purina Feeds (6/14/11)
Lee Financial Group (9/22/10)
Masonry Institute of Hawaii (1/20/10)
McDonald's of Hawaii (9/29/09; 9/28/10)
Mortgage Bankers Association of Hawaii (6/28/12; 6/23/11; 1/19/10; 5/12/09)
NAIOP (6/29/12; 12/8/11)
National Association of Realtors (11/14/09)
North Shore Chamber of Commerce (5/17/12)
Oahu Filipino Community Council (6/12/11)
Pacific Asia Travel Association/Travel and Tourism Research Association (2/28/12; 2/16/11)
Pacific Building Trade Expo (11/9/10)
Pacific Century Fellows (12/16/10)
Pacific Club Distinguished Speaker Series (3/11/09)
PacPay Annual Meetings (5/5/2009)
Prudential Advantage Realty (9/16/11)
Prudential Locations (2/24/11; 2/18/10)
Realtors Association of Maui (7/13/12; 7/8/11; 7/16/10)
Risk and Insurance Management Society (3/19/09)
Rotary Club of Honolulu (9/15/09)
Rotary Club of Pearlridge (1/21/11)
Royal Hawaiian Center (4/13/11)
SCORE (4/4/12)
Structural Engineers Association of Hawaii/Cement and Concrete Products Industry of Hawaii (10/16/09)
Team Praxis (9/18/09)
U.S. Forest Service Institute for Pacific Islands Forestry (10/20/10)
UH Federal Credit Union (11/5/11)
United States Courts Ninth Circuit District Conference (4/9/09)
University of Hawaii at Hilo Speaker Series (forthcoming 9/26/12)
University of Wisconsin Alumni Association (5/27/09)
Urban Land Institute (12/13/10, 12/2/09)
West Oahu Economic Development Association (9/22/11)
Western States' Bar Conference (3/27/09)
Western States Petroleum Association (11/10/11; 10/15/09)
World Presidents Organization Hawaii Chapter (9/6/12)
Yale Class of 1951 Reunion (10/15/09)
Young Democrats of Hawaii (8/23/11)

PROFESSIONAL AND OTHER AFFILIATIONS

American Economic Association
American Finance Association
National Association for Business Economics
Hawaii Economic Association (board member, former President)
Member and Vice Chair, City and County of Honolulu Property Tax Advisory Commission (2011-12)
Member, Hawaii Long-Term Care Commission (2011)
Member and Chair, Hawaii Council on Revenues (State of Hawaii revenue forecasting body) (1992-2011)
Member, University of Hawaii School of Social Work Advisory Committee (2001-2008)
Member, American Bankers Association Economic Advisory Committee (2003-2006)
Member, Hawaii Public Television Foundation Board of Directors (during its privatization; late-1990s)

ORDINANCE NO. 3804

BILL NO. 92 (2010)
Draft 1

A BILL FOR AN ORDINANCE ADOPTING AN UPDATE TO THE WATER USE AND DEVELOPMENT PLAN FOR THE DEPARTMENT OF WATER SUPPLY'S CENTRAL MAUI DISTRICT PLAN

BE IT ORDAINED BY THE PEOPLE OF THE COUNTY OF MAUI:

SECTION 1. Pursuant to sections 14.02.020 and 14.02.040(3), Maui County Code, the document entitled "MAUI COUNTY WATER USE AND DEVELOPMENT PLAN CENTRAL DWS DISTRICT PLAN UPDATE", dated November 16, 2010, which is attached hereto and made a part hereof as Exhibit "A", is hereby adopted as an update to the County of Maui's water use and development plan.

SECTION 2. This ordinance shall take effect upon its approval.

APPROVED AS TO FORM
AND LEGALITY:

12/23/10

EDWARD S. KUSHI, JR.
Deputy Corporation Counsel
County of Maui
S:\ALL\ESK\Ords\Central Maui WUDP Update 2010.doc

EXHIBIT "B-R13"

Maui County Water Use and Development Plan

Central DWS District Plan Update

November 16, 2010

EXHIBIT A

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Introduction

The Central DWS District Plan Update is one component of a comprehensive update to the Maui County Water Use and Development Plan (WUDP). The Central DWS District Plan Update focuses on identifying the resources and actions to be implemented in conjunction with providing water services provided by the Maui County Department of Water Supply in the DWS Central District. Several forthcoming components of the WUDP update will address DWS services in other districts, services provided by non-DWS water purveyors, other water uses and general island-wide and county-wide issues.

The Central DWS District Plan Update is supported by several documents available for download from the Maui County Department of Water Supply (DWS) web site.[1] All documents remain in the form of "drafts" pending agency approval of the WUDP.

Water Use and Demand -- Department of Water Supply Systems (Draft), May 1, 2007

DWS Finance and System Economics (Draft), August 23, 2005

Resource Options (Draft), May 15, 2007

Candidate Strategies -- Central District Preliminary Draft, September 2006

Central District Final Candidate Strategies Report (Draft), June 17, 2009

Central District Final Candidate Strategies Report Appendix B: Characterization of Central District Specific Resource Options, November 27, 2009

1. Documents are available for download at the County of Maui web site at the following page: Department of Water Supply | Departments | Department of Water Supply | Resources and Planning Division | Water Use and Development Plan | Draft Water Use and Development Plan Chapters. As of the date of publication of this draft report the URL for this download page is: http://himauicounty.civicplus.com/index.asp?NID=767

Executive Summary

The WUDP update is prepared in accordance with the CWRM "Statewide Framework for Updating the Hawaii Water Plan". An "integrated resource planning" approach is used which includes identifying planning objectives, determining future water needs, identifying all feasible means to meet future water needs and determining, by careful analysis, the best strategy to meet the planning objectives and future needs.

The planning objectives for the Central District include a broad range of considerations including water service availability, reliability, quality, cost and broader considerations including protection of streams, water resources, cultural resources, sustainability, fairness, viability, and conformance with general and community plans. Strategies to meet future water needs were evaluated with respect to each of the planning objectives. Several programs and "resources" were incorporated into the strategies to address particular objectives as necessary.

Future water needs for the Central District were projected based on the planning assumptions currently being used in the preparation of the Maui general, island and community plan updates. A range of high, base, and low water projections was developed to address uncertainty in future water demand. Water consumption for the DWS Central District system is expected to grow from 22 million gallons per day (MGD) in 2005 to 34 MGD in 2030 (base case). Water production requirements are higher than consumption requirements by about ten percent to account for unmetered uses (such as fire protection and line flushing) and system losses.

A wide range of possible "resource options" was identified and considered. These included various options to provide new sources of water, options to conserve and use water more efficiently and options to protect stream and groundwater resources.

The most promising resource options were examined in detail using an integrated capacity expansion and production cost simulation model. This analysis tool evaluates various combinations of resources (candidate strategies) in the context of operation of the overall Central District water system.

The most promising candidate strategies (Final Candidate Strategies) were investigated, characterized and analyzed in greater detail. This is the subject of this report.

The Final Candidate Strategies presented in this report are:

A. Northward Basal Groundwater Well Development

B. Eastward Basal Groundwater Well Development

C. Na Wai Eha Surface Water Treatment

D. Desalination of Brackish Groundwater

E. Maximization of Water Conservation and Recycled Wastewater Use

As explained in this report, each of these strategies was examined in detail to determine possible policy issues, implementation variations, costs and impacts. The strategies were compared to one another regarding each of the planning objectives. Uncertainties regarding the pace of growth in water demand, future energy costs and the viability of the strategies were analyzed and considered. Based on all of the analyses and considerations, a Central DWS District Plan was developed that features the following principal recommendations:

SUMMARY OF CENTRAL DWS DISTRICT PLAN

SHORT-TERM RESOURCES

- Diligently acquire the committed and near-term supply resources that are currently planned and underway.
- Optimize production from existing resources.
- Continue and accelerate leak detection and repair programs.
- Explore demand response options.

LONG TERM RESOURCE ACQUISITION

- Monitor Na Wai Eha surface water proceedings.
- Proceed with WTP negotiations and approvals to the extent possible pending determination of assurance of long-term water availability and price.
- Consider alternate WTP locations and raw water storage reservoir configurations.
- Implement programmatic conservation measures.
- Substantially expand use of Kihei R-1 recycled wastewater to displace demand for potable water supply.
- Monitor ongoing feasibility and preserve options of other long-term strategies.

REGULATORY MECHANISMS

- Maintain and/or extend inverted-block and progressive rate designs.
- Review system expansion financing policies and/or establish sufficient system development fees.
- Establish water source development contract standards.
- Establish clear, meaningful criteria for determining availability of water and need for new system supply resources.

RESOURCE PROTECTION AND RESTORATION

- Watershed Protection and Restoration
  - Support watershed partnership agreements.
  - Support reforestation programs.
- Wellhead Protection
  - Implement a wellhead/aquifer protection ordinance for each island.
- Stream Restoration
  - Support appropriate amendment of interim and/or permanent instream flow standards by the CWRM.
  - Support programs to protect and restore streams.
  - Consider impacts on reliance on water from streams in County land use determinations.
- Protection of Cultural Resources
  - Support stream restoration measures.
  - Consult with the Burial Council and the local kuleana representatives for findings and recommendations regarding DWS proposed actions relevant to cultural resources.

ENERGY EFFICIENCY AND ENERGY PRODUCTION

Establish a DWS Energy Resource Coordinator position.

Identify and implement energy efficiency opportunities.

Identify and implement load management opportunities.

Identify and implement energy generation opportunities.

WATER ALLOCATION POLICIES

This section of the Recommended Central District Plan includes a discussion of the following subjects and possible approaches to establish water allocation policies:

Venues and Purposes for Allocations

Hierarchy of Priorities

Set-Asides

Allocations of Specific Water Sources to Land Use

Statements of Allocation Policies

Background and Context

The Hawaii State Water Plan and the Water Use and Development Plan

The Hawaii State Water Plan is required and specified as part of the State Water Code, Chapter 174C of the Hawaii Revised Statutes. The Water Use and Development Plan (WUDP) adopted by each county comprises one of the five principal components of the Hawaii State Water Plan:

- Water Resource Protection Plan - prepared by the State Commission on Water Resource Management (CWRM)
- Water Quality Plan - prepared by the State Department of Health (DOH)
- State Projects Plan - prepared by the Department of Land and Natural Resources (DLNR)
- Agricultural Water Use and Development Plan - prepared by the State Department of Agriculture (DOA)
- County Water Use and Development Plans - prepared by each county

In accordance with the State Water Code each county is required to prepare, periodically update and adopt its WUDP by ordinance. The CWRM must then adopt the WUDP as part of the Hawaii State Water Plan.

1990 Water Use and Development Plan and 1992 Draft Update

In 1990 each county in the State of Hawaii prepared and adopted its first WUDP. These WUDPs were adopted by the CWRM and were incorporated into the Hawaii State Water Plan. Each county prepared a 1992 draft update to the 1990 WUDPs. These draft WUDPs extended and updated the 1990 WUDPs but none were approved by the CWRM. The 1990 Maui County WUDP is the most recent WUDP adopted by the County and approved by the CWRM.

CWRM Framework

The CWRM adopted a "Statewide Framework for Updating the Hawaii Water Plan" (CWRM Framework) in February 2000. This document serves as a guideline to the state and county agencies to prepare each of the components of the Hawaii Water Plan.

The CWRM Framework provides detailed specifications for preparation of the county WUDPs including an Integrated Resource Planning (IRP) analytical process and a public participation process. The IRP process outlined in the CWRM Framework and utilized by the DWS in the current WUDP update is described in more detail below.

The Current Maui County Update of the WUDP

In accordance with the Framework, the Maui County DWS presented a "Project Description" to the Maui County Council and the CWRM outlining the process that would be used by the Department of Water Supply to prepare its update of the WUDP. The Maui County WUDP is being prepared in accordance with the guidelines specified in the CWRM Framework.

For the DWS Central District the development of the WUDP has progressed through most of the phases of the IRP process including identification of planning objectives, determination of water use demand projections, identification of supply and demand-side resource options and formulation and analysis of various sequences of options and "strategies."

All stages of the IRP process have been conducted openly with substantial public review by water advisory committees. There have been twelve public meetings of the Central District water advisory committee. Participation in the public meetings is open and unrestricted.

Several previous documents explain the analysis and progressive derivation of the components of the strategies included in the Final Candidate Strategies Report. The most recent versions of the documents below are available for download from the Department of Water Supply web site. All documents remain in the form of "drafts" pending agency approval of the WUDP.

Water Use and Demand -- Department of Water Supply Systems (Draft), May 1, 2007

DWS Finance and System Economics (Draft), August 23, 2005

Resource Options (Draft), May 15, 2007

Candidate Strategies -- Central District Preliminary Draft, September 2006

Final Candidate Strategies Analysis Update -- Central District, January 8, 2008

Final Candidate Strategies Analysis Update -- Central District, March 18, 2008

Final Candidate Strategies Report

The Central District Final Candidate Strategies Report was reviewed in draft form by the DWS, the Central District WUDP Water Advisory Committee and the Board of Water Supply. Several summary presentations were made to the Maui County Council Water Resources Committee, the Board of Water Supply and the CWRM. The draft dated June 17, 2009 was formally transmitted to the Board of Water Supply for public hearings and, along with the Board's recommendations was transmitted to the Water Resources Committee for consideration. As amended, the Final Candidate Strategies Report constitutes the Water Use and Development Plan Central DWS District Plan Update.

The Final Candidate Strategies Report builds upon the previous analyses described in the documents listed above. A brief description of the previous analyses is provided in the following section. Based on the previous analyses, updated information, and comments from the Water Advisory Committees, several "Final Candidate Strategies" were characterized. The Final Candidate Strategies include most of the previously considered strategies except that they are "reframed" and grouped to facilitate more rigorous analysis. The Final Candidate Strategies are identified and discussed in detail in a following section of this report.

Updated assumptions regarding the characteristics of the resource options incorporated in the Final Candidate Strategies are provided in Appendix B.

Description of the Analytical Process

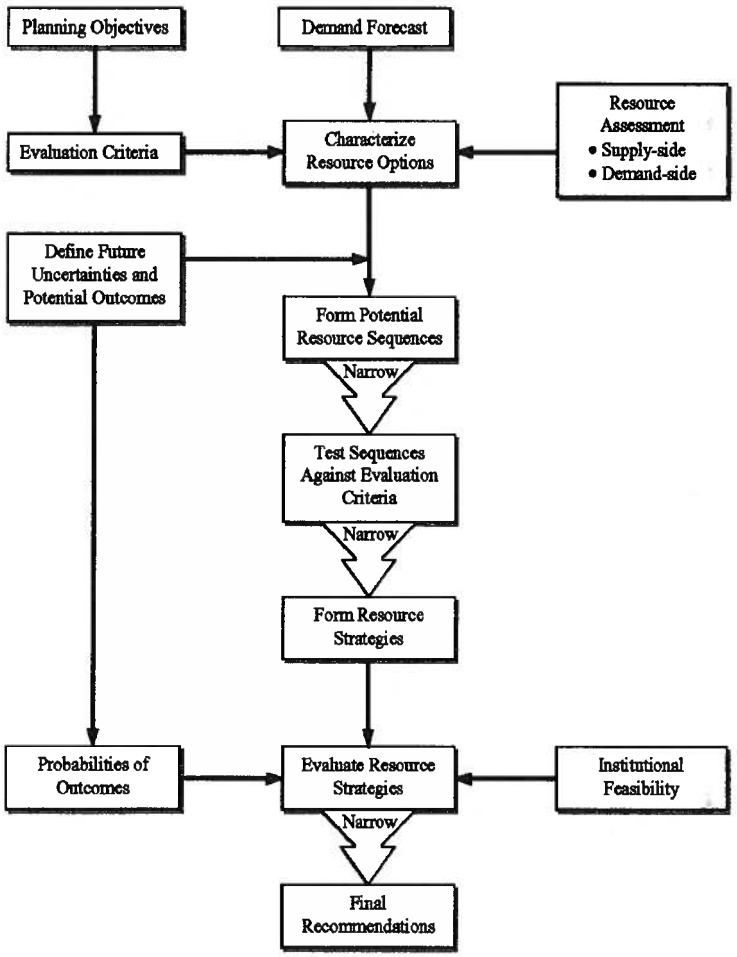
The Integrated Resource Planning Process

The CWRM Framework provides detailed specifications for the procedures to update the county WUDPs including an Integrated Resource Planning (IRP) process. The IRP process is adapted from similar planning procedures used widely in the electric power industry. IRP provides for "integration" of several types of planning components:

- Integration of conventional water supply resources with "demand-side" conservation resources (implemented on the customer "side" of the water meter)
- Integration of public participation in the planning process
- Integration of non-monetary, societal, cultural, environmental and economic consideration in long range utility planning

The IRP process begins with identification of the planning objectives that are to be fulfilled by the WUDP and used to evaluate the merits of alternate planning strategies. Long range projections of water needs are prepared to serve as the basis for water resource planning. A wide and inclusive spectrum of supply-side and demand-side resource options are identified and characterized. These resource options are considered and the more promising options are assembled into resource "strategies." Each strategy is a sequence of resource options designed to meet the water needs and planning objectives over a long term (twenty-five year) planning time frame.

Figure 2-2
ELEMENTS OF AN IRP PROCESS



The alternative "candidate" strategies are evaluated and compared to one another to determine a set of "Final Candidate Strategies" for rigorous analysis and consideration for the WUDP.

The IRP process implemented for the Central District is described below in greater detail.

Identification of Planning Objectives

A set of planning objectives was determined for the Central District based on input from the Central District Water Advisory Committee (Central WAC). At the first meeting of the Central WAC suggestions for planning objectives were solicited. A resulting extensive list of objectives, comments, policies and suggested resources was recorded. These were sorted and grouped to determine a more concise list of planning objectives. At subsequent Central WAC meetings the list of planning objectives was reviewed, extended and amended. The resulting list of planning objectives for the Central District is provided below:

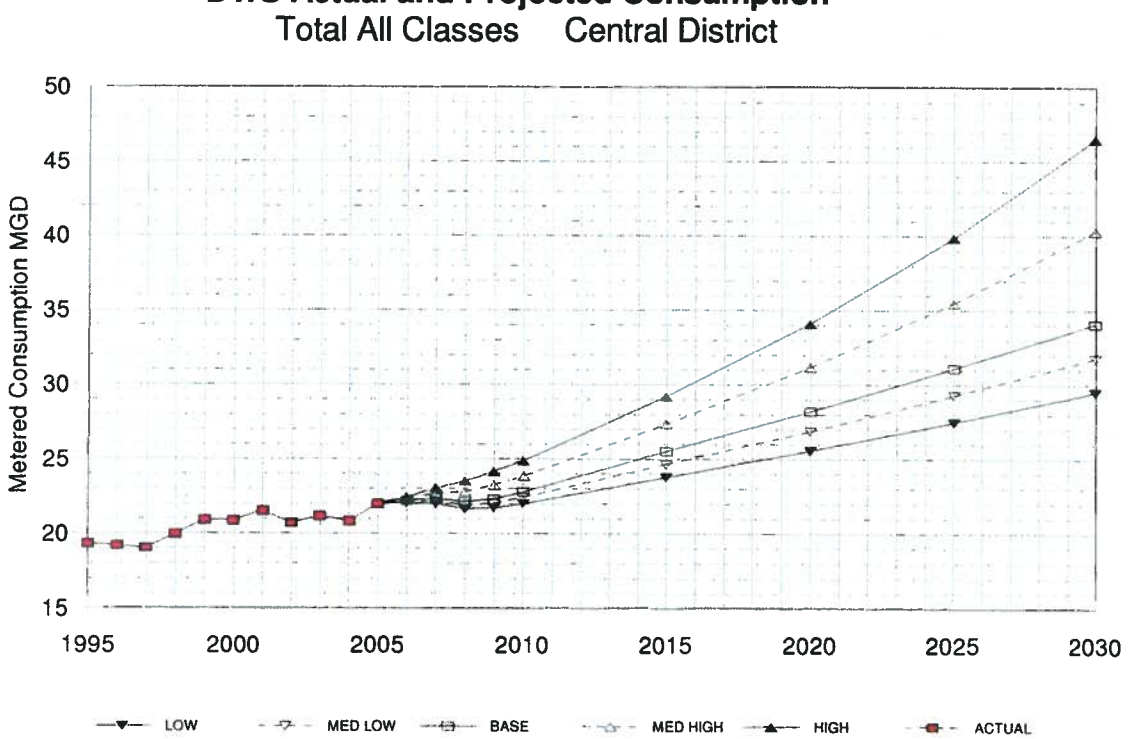
PLANNING OBJECTIVES

Availability	Provide Adequate Volume of Water Supply
DHHL	Provide For Department of Hawaiian Homelands Needs
Agriculture	Provide For Agricultural Needs
Cost	Minimize Cost of Water Supply
Efficiency	Maximize Efficiency of Water Use
Environment	Minimize Adverse Environmental Impacts
Resources	Protect Water Resources
Streams	Protect and Restore Streams
Culture	Protect Cultural Resources
Quality	Maximize Water Quality
Reliability	Maximize Reliability of Water Service
Equity	Manage Water Equitably
Sustainability	Maintain Sustainable Resources
Conformity	Maintain Consistency with General and Community Plans
Viability	Establish Viable Plans

Characterization of Long Range Water Demand

Projections of water demand for the twenty-five-year planning period were derived for the DWS Central District. The assumptions and procedures used to derive the projections are presented in detail in the *Water Use and Demand* chapter.

Water consumption for the Central District for the planning period is depicted in the chart and table below. A range of assumptions is considered that results in several scenarios including a base case and high, low, medium-high and medium-low water demand cases.



Actual and Projected Water Demand (Metered Consumption), DWS Central District, All Metered Uses.

ECONOMETRIC COMPOSITE WATER CONSUMPTION PROJECTIONS (Millions of Gallons per Day)

Land-Use Based Demographic Forecast (Base Case) with DWS Ranges **Calendar Year**

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030
Central														
	Low Case	21.570	21.483	21.106	21.105	21.391	21.690	21.989	22.289	22.590	22.892	24.537	26.152	27.759
	Medium Low Case	21.671	21.682	21.395	21.486	21.869	22.289	22.712	23.135	23.560	23.986	26.152	28.334	30.651
General	Base Case	21.772	21.881	21.685	21.869	22.348	22.892	23.438	23.986	24.537	25.090	27.759	30.651	33.648
	Medium High Case	21.887	22.107	22.014	22.302	22.892	23.538	24.187	24.839	25.494	26.152	29.488	32.889	36.352
	High Case	22.002	22.333	22.343	22.737	23.438	24.187	24.940	25.697	26.457	27.222	31.247	35.288	39.409
	Low Case	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
	Medium Low Case	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.455	0.455	0.456
Ag Potable	Base Case	0.454	0.454	0.454	0.454	0.454	0.455	0.455	0.455	0.455	0.455	0.456	0.457	0.458
	Medium High Case	0.454	0.454	0.454	0.454	0.455	0.455	0.455	0.455	0.456	0.456	0.457	0.458	0.460
	High Case	0.454	0.454	0.454	0.455	0.455	0.455	0.455	0.456	0.456	0.456	0.458	0.460	0.461
	Low Case	22.023	21.936	21.559	21.558	21.844	22.143	22.443	22.743	23.044	23.346	24.991	26.606	28.213
	Medium Low Case	22.125	22.136	21.849	21.940	22.323	22.744	23.166	23.589	24.015	24.441	26.607	28.789	31.107
Total Potable	Base Case	22.226	22.335	22.139	22.323	22.803	23.347	23.893	24.441	24.992	25.545	28.215	31.108	34.106
	Medium High Case	22.341	22.561	22.468	22.756	23.347	23.993	24.642	25.294	25.950	26.608	29.946	33.348	36.812
	High Case	22.455	22.787	22.797	23.191	23.893	24.642	25.395	26.152	26.913	27.678	31.704	35.748	39.871
	Low Case	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium Low Case	0	0	0	0	0	0	0	0	0	0	0	0	0
Ag Non Potable	Base Case	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medium High Case	0	0	0	0	0	0	0	0	0	0	0	0	0
	High Case	0	0	0	0	0	0	0	0	0	0	0	0	0
	Low Case	22.023	21.936	21.559	21.558	21.844	22.143	22.443	22.743	23.044	23.346	24.991	26.606	28.213
	Medium Low Case	22.125	22.136	21.849	21.940	22.323	22.744	23.166	23.589	24.015	24.441	26.607	28.789	31.107
Total	Base Case	22.226	22.335	22.139	22.323	22.803	23.347	23.893	24.441	24.992	25.545	28.215	31.108	34.106
	Medium High Case	22.341	22.561	22.468	22.756	23.347	23.993	24.642	25.294	25.950	26.608	29.946	33.348	36.812
	High Case	22.455	22.787	22.797	23.191	23.893	24.642	25.395	26.152	26.913	27.678	31.704	35.748	39.871

Actual and Projected Water Demand (Metered Consumption), DWS Central District, All Metered Uses.

The econometric model used to make the water consumption projections predicted reductions in consumption in the near term in the base case and low cases due to recent increases in water prices (despite continued increases in new customer accounts). Base case consumption for the year 2008 was predicted to be lower than prior years. Actual consumption for the year 2008 has been substantially lower and is more than one MGD lower than predicted by the model. The lower consumption is due in part to higher water prices (as predicted by the model) and in part to lower defacto population resulting from the recent economic downturn starting in mid-2008. The analyses described in this report presume that water demand will increase in the long term as shown, consistent with the assumptions in the socioeconomic studies prepared by the County supporting the current General Plan update process.

Central System
DWS Water Demand, Production and Source Use

1.046

Year	Water Demand Base Case v31 2 Metered Consumption kgals	MGD	Base Case v31 2006 Update Unmetered System kgals	MGD	% of Prod.	Water Demand Production Net to System kgals	MGD	Criteria Water Requirements Drought Demand Average Factor 1.000 Avg. MGD	Criteria Demand Peak Day Factor 1.500 Peak MGD	Criteria Production Peak Day w/Unmetered Peak MGD
1994	6,686,397	18.319	905,793	2.482	11.9%	7,592,190	20.801			
1995	7,060,694	19.344	1,016,696	2.785	12.6%	8,077,390	22.130			
1996	7,035,176	19.222	1,052,160	2.935	13.2%	8,087,336	22.157			
1997	6,951,254	19.045	871,515	2.388	11.1%	7,822,769	21.432			
1998	7,295,672	19.988	777,252	2.129	9.6%	8,072,924	22.118			
1999	7,638,004	20.926	633,538	1.736	7.7%	8,271,542	22.662			
2000	7,646,198	20.891	562,481	1.598	7.1%	8,208,678	22.490			
2001	7,849,841	21.506	396,199	1.085	4.8%	8,246,040	22.592			
2002	7,564,654	20.725	618,187	1.694	7.6%	8,182,842	22.419			
2003	7,730,701	21.180	839,374	2.300	9.8%	8,570,075	23.480			
2004	7,629,802	20.846	824,593	2.316	10.0%	8,454,395	23.163	20.846	31.270	33.586
2005	8,031,026	22.003	892,336	2.445	10.0%	8,923,362	24.448	22.003	33.004	35.449
2006	8,112,505	22.226	901,389	2.470	10.0%	9,013,895	24.696	22.226	33.339	35.809
2007	8,152,318	22.335	905,813	2.482	10.0%	9,058,131	24.817	22.335	33.503	35.984
2008	8,103,033	22.139	875,738	2.460	10.0%	8,978,771	24.599	22.139	33.209	35.669
2009	8,147,861	22.323	905,318	2.480	10.0%	9,053,179	24.803	22.323	33.484	35.965
2010	8,322,983	22.803	924,776	2.534	10.0%	9,247,759	25.336	22.803	34.204	36.738
2015	9,324,087	25.545	1,036,010	2.838	10.0%	10,360,097	28.384	25.545	38.318	41.157
2020	10,298,644	28.215	1,144,294	3.135	10.0%	11,442,937	31.351	28.215	42.323	45.458
2025	11,354,544	31.108	1,261,616	3.456	10.0%	12,616,160	34.565	31.108	46.663	50.119
2030	12,448,750	34.106	1,383,194	3.790	10.0%	13,831,945	37.896	34.106	51.159	54.949

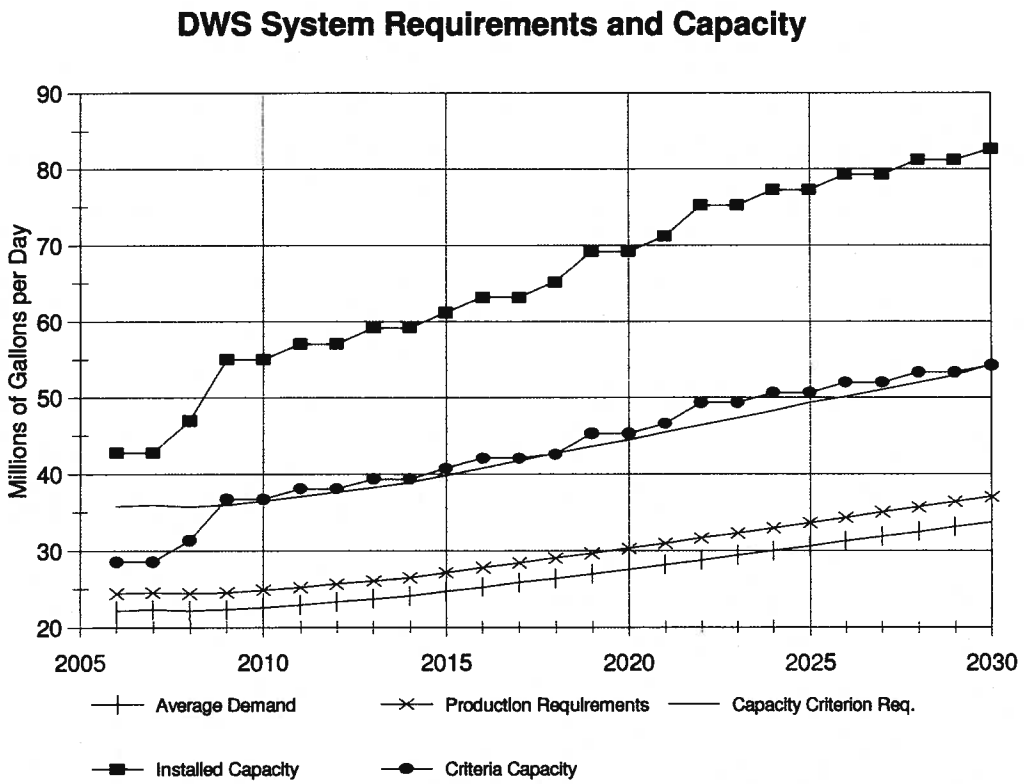
Projected Water Consumption, Production and Capacity Criteria Requirements, DWS Central District, All Metered Uses.

An integrated economic capacity expansion and production cost model was used in the analysis of the Final Candidate Strategies. (The integration model is described briefly in a section below and in more detail in the *Candidate Strategies* Chapter.) The table above shows the integration model's derivation of production requirements and capacity criteria requirements from projections of future water consumption.

Production requirements are the sum of water consumption and unmetered uses (including water used for fire protection, line flushing, theft and system losses). Production requirements are used by the integration model to determine water production costs.

Capacity criteria requirements are 1.5 times projected metered consumption plus unmetered demand (for the Central District system) and nominally represent the "peak day" requirements for purposes of determining the sufficiency of source water and production infrastructure.

In order to assure adequate water service capability and reliability there must be sufficient water sources and production infrastructure redundancy to meet the capacity criteria requirements. First, it is necessary to maintain sufficient water sources to provide the amount of water required (*water production capability*). Second, it is necessary to maintain sufficient equipment and infra-



Projected Water Consumption, Production and Capacity Criteria Requirements, With Reference Strategy (Northward Expansion) Capacity Additions

structure redundancy to meet maximum flow requirements even if some equipment is out of service (*system capacity*). In the analyses used in the WUDP, the system capacity necessary to meet the capacity criteria requirements is referred to as the "*criteria capacity*." For groundwater resources the criteria capacity is typically two thirds of the installed capacity. For surface water resources the criteria capacity is "derated" (reduced) from installed capacity based on the specific character of the source and treatment facilities. In each year of the analyses the water production capability of the system must meet or exceed the production requirements and the criteria capacity of the system must meet or exceed the capacity criteria requirements.

The chart above shows the projections of water consumption (base case), water production requirements, and the capacity criteria requirements calculated in the integration model. Also shown are the installed capacity and the criteria capacity of the resource additions in the reference strategy. The integration model "adds" additional resources to the system each year that additional criteria capacity of supply resources is needed to meet capacity criteria requirements or water production capability is needed to meet production requirements. Note that in the years prior to 2009 (the date by which sufficient committed short-term resources are assumed to be installed) there is not sufficient criteria capacity to meet the capacity criteria requirements.

Characterization of Specific Resource Options

Resource options are broadly defined to include any actions, programs or measures that serve to fulfill the planning objectives. Resource options include, for example, programs to protect and restore watersheds as well as conservation programs and rate design policies.

An extensive list of resource options was compiled and extended with review by the Central WAC. The resource options are documented in the previous *Resource Options* chapter.

Several specific supply resource options were identified for the DWS Central District system. For meaningful incorporation in the analysis of candidate strategies these resource options were characterized in detail and were classified as follows:

- **Committed Resource Options** -- options that are in the process of being implemented but are not yet in service.
- **Short-Term Resource Options** -- options that could mitigate immediate capacity reserve shortfalls.
- **Long-Term Resource Options** -- alternative options that would form the fundamental basis of the resource strategies and would address the identified planning objectives over the time frame of the planning period.
- **General Resource Options** -- options that are not exclusive and can be implemented in conjunction with most other combinations of options.

Option Name	Option Description	Plant Capacity		
		Installed	Criterion	Effective
		MGD	MGD	MGD
Well - Waikapu Tank (Committed)	New DWS Well at Existing Tank Site	2.016	1.344	0.000
Well - Iao Tank (Committed)	New DWS Well at Existing Tank Site	2.016	1.344	0.000
Well - Kupaa (Committed)	New DWS Well at New Site	2.016	1.344	0.000
Wells - Maui Lani (Committed)	(3) New Developer Wells at Maui Lani Site Turnkey transfer to DWS	2.160	1.440	1.000
Well - Waikapu South #1	New DWS Well at New Site 1400 GPM	2.016	1.344	1.344
Well - Waikapu South #2	New DWS Well at New Site 1400 GPM	2.016	1.344	0.656
Backup Well - Existing Well Site	New DWS Well at Existing Site	2.016	1.344	0.000
Well - Replacement for Shaft 33	New Developer Well at New Site	2.016	0.000	0.000

Supply Resource Option Characterization -- Committed, Short-Term and Backup Well Capacities

The Committed and Short-Term resource options shown above are included in each of the candidate strategies.

Option Name	Option Description	Plant Capacity		
		Installed	Criterion	Effective
		MGD	MGD	MGD
Wells - Maluhia (2)	(2) New DWS Wells at New Site 500GPM w/Transmission from Kupaa	1.440	0.960	0.672
Wells - Wailena (2)	(2) New DWS Wells at New Site 500GPM w/Transmission from Kupaa	1.440	0.960	0.672
Wells - Waipili (2)	(2) New DWS Wells at New Site 500GPM w/Transmission from Wailena Wells	1.440	0.960	0.672
Wells - Kahakuloa (4)	Four New DWS Wells at New Sites 500 GPM each w/Transmission from Waipili Wells w/Transmission upgrade Kupaa to Waipili to 30"	2.880	1.920	1.344
Wells - Waihali (2)	Two New DWS Wells at New Site 500 GPM w/Transmission from Kahakaloa Wells	1.440	0.960	0.672
Wells - Po'elua (4)	Four New DWS Wells at New Sites 500 GPM each w/Transmission from Waihali Wells	2.880	1.920	1.344
Wellfield - Haiku Aquifer (1500')	(8) New DWS Wells in Haiku Aquifer @ 1500' el. w/Transmission to Central System	16.128	10.752	10.752
Wellfield - Haiku Aquifer (1000')	(8) New DWS Wells in Haiku Aquifer @ 1000' el. w/Transmission to Central System	16.128	10.752	10.752
Wellfield - Waikamoi Aquifer Redesign	(20) New DWS Wells in Waikamoi Aquifer w/Transmission to Central System	10.000	6.667	6.667
Wellfield - Waikamoi w Ditch Transmission and WTP	(20) New DWS Wells in Honopou Aquifer w/Ditch Transmission to Central Maui	9.000	6.000	6.000

Supply Resource Option Characterization -- Groundwater Option Capacities

For each supply resource the installed capacity, criteria capacity and effective capacity are indicated. The installed capacity is the instantaneous rate at which the resource can produce water at full output. The criteria capacity is the amount of capacity applied towards meeting the system reliability standards. The effective capacity is the incremental amount of water that could be produced by the system with the addition of each resource.

For some resources that are in aquifers that are already at the sustainable yield the effective capacity is zero. Installation of such a resource could provide equipment redundancy and contribute towards system reliability but would not result in additional average water production capability.

The characteristics of each of these resource options are identified in substantial detail in the *Candidate Strategies* chapter. Updated detailed characterizations used in the analysis of the Final Candidate Strategies are provided in Appendix B to this report.

Option Name	Option Description	Plant Capacity		
		Installed	Criterion	Effective
		MGD	MGD	MGD
Waiale WTP @30cpkal	Surface Water Treatment Plant at Waiale Reservoir Construction by A&B	13.500	9.000	9.000
Waiale WTP @60cpkal	Surface Water Treatment Plant at Waiale Reservoir Construction by A&B	13.500	9.000	9.000
Waiale WTP @90cpkal	Surface Water Treatment Plant at Waiale Reservoir Construction by A&B	13.500	9.000	9.000
Waihee Location WTP @30cpkal	Surface Water Treatment Plant at Waiale Reservoir Specs per Waiale WTP	13.500	9.000	9.000
Waihee Location WTP @60cpkal	Surface Water Treatment Plant at Waiale Reservoir Specs per Waiale WTP	13.500	9.000	9.000
Waihee Location WTP @90cpkal	Surface Water Treatment Plant at Waiale Reservoir Specs per Waiale WTP	13.500	9.000	9.000
300 MG Reservoir and WTP	300 MG Reservoir w Reconfigured Iao Diversion w 10 MGD IFS w 6MGD Reliable Yield	9.000	6.000	6.000
1000 MG Reservoir and WTP	1000 MG Reservoir w Reconfigured Iao Diversion w 10 MGD IFS	13.500	9.000	9.000

Supply Resource Option Characterization -- Surface Water Option Capacities

Option Name	Option Description	Plant Capacity		
		Installed	Criterion	Effective
		MGD	MGD	MGD
Brackish Desalination - 2 Train	Brackish Water Desalination Plant per Brown & Caldwell	5.000	2.500	4.250
Brackish Desalination - 4 Train	Brackish Water Desalination Plant per Brown & Caldwell	5.000	4.250	4.250
Seawater Desalination - 2 Train	Brackish Water Desalination Plant per Brown & Caldwell	5.000	2.500	4.250
DEM Kihei R-1 So.Trans. 1.5MGD Displaced Potable	24,000' Line South of Kikei WWTP	1.500	1.500	1.500
DEM Kihei R-1 So.Trans. 1.0MGD Displaced Potable	24,000' Line South of Kikei WWTP	1.000	1.000	1.000
DEM Kihei R-1 So.Trans. 0.75MGD Displaced Potable	24,000' Line South of Kikei WWTP	0.750	0.750	0.750

Supply Resource Option Characterization -- Desalination and Reclaimed Water Treatment Option Capacities

Integrated Analysis of Candidate Strategies

The specific resource options and candidate strategies were analyzed in the "integrated" context of the operation of the DWS Central District system. An integration model was developed for the Central District system that serves as a capacity expansion and production cost model.

The integration model considers several factors including the following elements:

- The forecast of water demand for the twenty-five-year planning period (2006 - 2030)
- Average, annual peak, daily peak and drought year variability of water demand
- The characteristics and costs of operating the existing water system resources
- Inflation, escalation, cost of capital estimates and discounting assumptions
- Limits on allowed aquifer withdrawals
- System expansion criteria based on engineering capacity reserve standards
- Costs and characteristics of available resource options
- Forecast of electricity costs and calculation of system production costs

The integration model analyzes and calculates the following elements:

- Calculation of system fixed operation and maintenance costs
- Calculation of system capital costs
- Determination of annual and discounted planning period costs
  - Costs by category including variable, fixed O&M and capital costs
  - Costs by perspective including "utility", "total resource" and "participant" costs
  - Rate impacts stated as average annual rate increase and levelized rates.
  - Determination of unserved water demand and reserve capacity shortfalls
  - Tabular and graphic portrayal of input assumptions and analysis results

Using the integration model the analysis of the specific resource options and candidate strategies was conducted in several stages. These are documented in further detail in the *Candidate Strategies* chapter:

- **Determination of a Reference Strategy**: A base case sequence of resource options was determined to serve as a reference strategy against which other possible strategies were compared.
- **Integrated Analysis of Individual Resource Options**: Each of the principal resource options was analyzed in the integrated context of the operation of the DWS Central District system.
- **Formulation and Preliminary Optimization of Candidate Strategies**: Each principal resource option was analyzed to determine what combination of other resource options would best combine to comprise a candidate strategy.
- **Evaluation and Comparison of Candidate Strategies**: The candidate strategies were analyzed and compared.

The analysis of the candidate strategies is described in detail in the *Candidate Strategies* chapter.

Formulation and Analysis of Final Candidate Strategies

Several of the candidate strategies were formulated into "final" candidate strategies in order to facilitate more rigorous analysis and development of detail. Based on discussion with the Cen-

tral WAC, a "Maximization of Water Conservation and Recycled Wastewater Use" strategy was formulated. The list and analysis of Final Candidate Strategies was presented for review and discussion to the Water Advisory Committee, the Board of Water Supply and the Water Resources Committee of the Council. The Final Candidate Strategies and analysis are described in detail in the next section of this report.

Independent Components Considered in All Strategies

This section of the Final Candidate Strategies Report considers several resources and possible plan components that could be included in any of the Final Candidate Strategies. These "independent components" are presented below in two categories: (1) measures that apply primarily to the DWS water system and (2) measures that apply county-wide.

DWS System Measures

The following measures apply primarily to the DWS system. Measures that apply more broadly are listed in a following section on county-Wide Measures.

Demand-Side Management (Conservation) Programs

"Demand-side management" (DSM) is a utility industry term for actions taken by a utility to promote conservation by the utility's customers. Originally applied to the electric utilities and applied now also to gas and water utilities, DSM options have proven to be valuable "resources" to meet utility planning objectives.

DSM resource options are usually programs undertaken by a utility to encourage the use of efficient appliances or practices by its customers or to encourage customers to shift their time of use. DSM programs often provide for direct installation of efficient fixtures or appliances or use incentives such as monetary rebates to encourage purchase of efficient fixtures or appliances.

DSM programs are evaluated based on a comparison of the costs of programs to promote water savings with the costs the utility and its customers would otherwise incur to develop and operate new supply resources. For the Central District system, DSM conservation programs cost less than new supply resources.

- A conservation program spending $1 million per year for five years would reduce DWS expenditures by $9.4 million:
  - Capital requirements would be reduced by $4.2 million.
  - Operating costs would be reduced by $5.2 million (assuming the low energy price scenario).

DSM programs at a spending level of approximately $1 million per year (for the Central District system) are included in all of the Final Candidate Strategies. It is recommended that a DSM specialist be retained by the DWS to determine and assist the DWS to implement a portfolio of DSM programs including the following elements:

- Residential / commercial audit and direct installation program for indoor and landscape irrigation users
- Education and publicity program to encourage water conservation and promote program participation
- Direct installation of efficient fixtures at customer premises including toilet, showerhead and sink faucet flow restrictors
- Audit of existing irrigation system equipment and practices and specific resulting recommendations to customer to improve efficiency
- Direct installation of targeted "high payback" fixtures in commercial premises
- High efficiency fixture rebates
- High efficiency washing machines
- High efficiency toilets and waterless urinals
- Hotel awards program

- Building manager user group and services
- Agricultural user group and services

There are several issues associated with utility implementation of DSM programs that should be considered from a policy perspective:

- DSM programs, if cost-effective, will reduce total customer bills (utility revenue requirements). Rates, however, will not necessarily be reduced because effective DSM lowers the amount of water produced and sold. Lowering the volume of water sold in the long-term tends to increase rates since the fixed costs of the utility must be collected from fewer units of water sold.
- Program costs are supported by all utility ratepayers generally but provide more benefits to participating customers than non-participating customers. All customers benefit to some extent because DWS costs are reduced in the long term (if the DSM programs are, in fact, cost-effective) but non-participating customers may not have a net benefit if DSM implementation results in higher rates. For this reason it is important that all customers have some reasonable opportunity to participate in DSM programs.
- Mandatory codes and requirements are possible alternatives or complementary measures to DSM programs. Mandatory codes could be established that require installation of fixtures that are more efficient than existing federal standards or that restrict some types of water use. Mandatory measures are generally less expensive for the County to implement because they do not require utility expenditures on incentives to customers or program administration costs. In order to be effective, however, some programmatic enforcement measures may be required.

Supply-Side Leak Detection and Reduction Measures

The DWS examines its system for leaks in transmission and distribution pipes using special equipment designed for this purpose. Contractors are available to provide services to the DWS to conduct leak detection surveys using several techniques.

Supply-side leak detection and reduction is an option that is consistent with all other options under consideration and can be expected to be implemented on an ongoing basis to the extent that measures are determined to be cost-effective.

Recycled Water Use Options

The Maui Department of Environmental Management (DEM) is a purveyor of reclaimed "recycled" nonpotable water in the Central District areas. In the Central District, the DEM produces and distributes R-1 treated water from its Kihei wastewater facility and R-2 treated water from its Kahului facility. An existing ordinance requires commercial properties to use DEM recycled water for non-potable uses if the property is adjacent to DEM R-1 distribution lines.

Some DEM recycled water displaces DWS potable water use and some displaces brackish or other non-potable water source use. Displacement of DWS potable water by recycled water reduces the water and reserve capacity requirements of the DWS Central District system. Extension of DEM transmission and distribution lines to serve additional displacement of DWS potable water uses is a viable resource option that serves several WUDP planning objectives including: Availability, Cost, Efficiency, Environment, Sustainability and Reliability.

In one of the Final Candidate Strategies (Maximize Conservation and Use of Recycled Wastewater) the use of DEM water to displace DWS potable water demand is a featured resource. The expansion of the DEM distribution systems to displace potable water use is consistent with and can play a constructive role in any of the Final Candidate Strategies.

Production Energy Efficiency Measures

Energy use is a substantial component of DWS costs. Investments in energy efficient equipment can reduce long-term costs of providing water service. Measures to increase the energy efficiency of water production are consistent with any of the candidate strategies. Specific measures are included in the Recommendations section of this report.

Potential Power Management Services

The DWS is the largest single consumer of electricity on the Island of Maui. Most energy consumed by the DWS is used to operate motors for pumps that lift water to storage tanks and reservoirs. The DWS water storage capacity is not generally sufficient to provide classic "pumped storage" benefits for the electrical system by "firming" intermittent renewable energy sources. The DWS system does, however, have a unique capability to provide valuable short-term electric demand response needed by the island's electrical utility to manage growing penetrations of wind energy generation on the island electrical system. The more recent needs of the electrical system are for short-term "stabilizing" power management capability to accommodate growing proportions of variable renewable energy sources. The DWS can potentially provide economical short-term energy management services to help follow more rapidly changing "transients" as the output of renewable energy sources change during the course of each day. This capability has a value to the electric company which, if effectively implemented and negotiated, could benefit both Maui's electricity and water customers.

Energy Production Options

Energy production for use by the DWS is a potentially cost-effective option that would be consistent with any of the candidate strategies. One specific option using water from high-level tunnels to produce hydroelectric power was analyzed in the *Candidate Strategies* chapter. Wind generation is being analyzed in the Upcountry District Final Candidate Strategies Report.

Energy production and energy efficiency measures serve several of the WUDP planning objectives including: Cost, Efficiency, Environment, and Sustainability.

Water Rate Design and Pricing Policies

The design of water rates is an effective means to encourage efficient water use. The DWS now has an inclining-block water pricing structure. Each customer pays increasing rates for increasing volumes of metered water consumption. This is a means to encourage water conservation because the savings to the customer resulting from reduced consumption are based on the highest price block for the customer and are thus higher than the average cost of water. This subject is discussed in more detail in the *DWS Finance and System Economics* chapter of the WUDP. Specific recommendations are provided in the Recommendations section of this report.

Exploratory / Investigative Measures

Several potential supply resource options were identified that could ultimately contribute to the Central District DWS system but are not sufficiently proven or available to provide dependable components of current plan strategies. These options are included in each of the strategies as measures that could be further explored and/or investigated:

- Deep Aquifer Wells
- Perched Water Sources
- New Production Tunnels
- New Transmission from Existing Production Tunnels
- Directional "Deviated" Drilling

County - Wide Measures

The following measures apply broadly to Maui Island and the County as a whole, including matters pertaining to water uses not served by the DWS. In addition to the discussion provided below, island-wide and county-wide measures and policies, including inventory and discussion of traditional and customary uses, will be further addressed in a separate section of the WUDP dedicated to island-wide issues and water uses.

Watershed Protection and Restoration

Watershed protection and restoration measures are consistent with all of the candidate strategies and are presumed to be part of all of the candidate strategies. These measures will be discussed in detail in a separate section of the WUDP.

Maintaining healthy forests is essential to maintaining the healthy streams and groundwater aquifers that are the source of our water supplies. These resources need protection and, in some places, substantial restoration. Healthy forests invite and capture precipitation, retain water to replenish aquifers, maintain base flow in streams, prevent soil erosion and flooding and maintain stream water quality.

The DWS currently supports watershed partnership agreements, control of invasive species that threaten watershed areas and reforestation programs.

These measures serve several WUDP planning objectives, including: Environment, Sustainability, Quality, Streams and Resources.

Stream Restoration Measures

Stream restoration measures are consistent with any of the candidate strategies and may be an integral component of some of the surface water treatment strategies. The county has supported the establishment of amended interim instream flow standards for the Na Wai Eha streams taking the position that there is sufficient water in these streams to serve a balance of several uses.

Stream restoration measures affect several WUDP planning objectives including: Availability, Cost, Environment, Equity, Sustainability, Streams, Resources, Agriculture and Culture.

Wellhead Protection Ordinance

A wellhead protection ordinance was presented to the WAC and will be described in detail in a separate section of the WUDP. A wellhead protection ordinance would limit activities in areas around potable wells that could potentially contaminate groundwater aquifers.

A wellhead protection ordinance would serve several WUDP planning objectives including: Environment, Sustainability, Quality and Resources.

Well Development Policies and Regulation

Well development policies and regulation measures are possible options to ensure that wells are sited in suitable and preferred locations and that contracts for the development of water sources are fair and provide equitable benefits to developers and DWS customers. Provisions of a well development policy could address the following matters:

- Determination of well locations to ensure water quality and proximity to DWS water lines, minimize DWS system operation costs and provide wellhead protection and water quality
- Determination and denomination of source credits and water entitlements in source development contracts

Specific recommendations are provided in the Recommendations section of this report.

These measures would serve several WUDP planning objectives including: Cost, Efficiency, Environment, Quality and Resources.

Landscape Irrigation Efficiency Requirements

A draft conservation ordinance has been drafted for consideration by the County of Maui that includes landscape irrigation efficiency requirements. This ordinance will be described in a separate section of the WUDP. The proposed ordinance would reduce future water needs by limiting landscape irrigation uses to reasonable alternatives.

The proposed ordinance would serve several WUDP planning objectives including: Availability, Cost, Efficiency and Sustainability.

Drought Water Use Restrictions

Restrictions on water use during drought conditions is a demand management measure now used for the DWS Upcountry District system. If the Central District system relies increasingly on surface water sources, drought water restrictions could be a means to manage water demand and reduce system costs.

Several alternative forms of drought water restrictions are possible. The restrictions now applied to the Upcountry system limit water use for each customer based on historical metered consumption. Another way to implement drought water restrictions would be to limit the types of uses for which water could be used during drought conditions.

Final Candidate Strategies

In previous analyses, presentations and reports, various strategies were considered to meet the planning objectives for the DWS Central District. The "Final Candidate Strategies" for the Central District represent five fundamental alternative approaches to meet projected water needs for the twenty-five-year planning period. Each strategy is distinguished by a different featured major approach to meeting new water needs:

- **A. Northward Basal Groundwater Well Development**
- **B. Eastward Basal Groundwater Well Development**
- **C. Na Wai Eha Surface Water Treatment**
- **D. Desalination of Brackish Groundwater**
- **E. Maximization of Water Conservation and Recycled Wastewater Use**

In addition to these distinguishing features there are many components that are included in all the strategies. These include:

- **Existing Resources** -- Resources that are currently part of the DWS Central District system[2]
- **Committed and Near-Term Resources** -- New supply resources that are already in the process of acquisition, development or construction[3]
    - Maui Lani Wells (2010)
    - Kupaa Well (2010)
    - Iao Tank Site Well (2010)
    - Waikapu Tank Well (2010)
    - Waikapu South Wells (2011 and 2012)
- **Demand-Side Management (Water Conservation) Programs** -- Based on previous and updated analysis, a water conservation program is included in all strategies. The programs are designed to attain 15 percent of Central District technical conservation potential in a period of five years.[4]
- **Independent Components Considered in All Strategies** -- A list of independent resources and plan components that could be implemented in any of the Final Candidate Strategies was described in an earlier section of this report. It is presumed that these components would be included in any of the strategies but are not explicitly

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2. Several wells are planned in the vicinity of the existing Wailuku Shaft 33 well. These wells would replace the Shaft 33 well, which would then be retired. In the analyses it is assumed that these wells would replace the existing capacity and production of the Wailuku Shaft 33 well but would not add any new or additional capacity or production capability.

3. The dates assumed in the integration analyses supporting this report are earlier based on previous estimates of project completion dates. The use of earlier dates in the analyses underestimates the degree of shortfall in water system capacity standards in the next couple of years but does not affect later years or otherwise perturb the analysis of the Final Candidate Strategies. There is some possibility that one or more of these resources may be located at different locations in the Iao and Waikapu aquifers or may be constructed by non-DWS developers. Regardless of the specific location or developer, the general assumption in the analysis is that well capacity and limited water production capability will be developed in this general area to meet the projected Central District water demands.

4. In one Final Candidate Strategy, "Maximization of Water Conservation and Recycled Wastewater Use," more intensive conservation programs are included designed to reach 45 percent of technical conservation potential in a period of ten years.

evaluated in the economic analyses or considered in the comparisons between the Final Candidate Strategies.

General Characterization of Central District Strategy Analysis

All of the strategies are designed to meet the water needs of the Central District for the twenty-five-year planning period. Water need projections are based on the base case demographic projections that were prepared for and are being used in the current update of the Maui County General, Island and Community Plans.[5]

System Reliability and Expansion Criteria

In order to make meaningful comparisons of the economics of diverse resource strategies, it is necessary to apply system design reliability standards that are meaningful, consistent, specific and explicit. The objective of the economic analysis is to compare different approaches to providing water supply to meet projected needs over the planning period at a standard and consistent level of service reliability.

In order to ensure that sufficient and uniform water service capability and reliability is maintained it is necessary to consider two design criteria. First, it is necessary to maintain sufficient water sources to provide the amount of water required (water production capability). Second, it is necessary to maintain sufficient equipment and infrastructure redundancy to meet maximum production flow requirements even if some equipment is out of service (system capacity). The timing of the need for additional resources is determined considering both of these criteria. Regarding both criteria, it is prudent for purposes of long-range planning and economic analyses to apply some conservative assumptions to account for uncertainties regarding efficacy of resources and possible delays in implementation.

The water production capability of the existing Central System is modeled assuming that the Iao aquifer basal groundwater withdrawals are limited to 16 MGD (equal to 80% of the 20 MGD sustainable yield). This assumed level of production is lower than the currently permitted rate of withdrawal and provides an appropriate margin of conservatism to account for planning uncertainties.

The sufficiency of the system capacity of the Central District system is determined according to DWS system design reliability standards with some modifications.[6] The modified system design reliability standards are used in conjunction with maintaining sufficient water production capability to determine the dates that additional resources are necessary to ensure that the strategies provide sufficient and comparable levels of service reliability.

Currently the DWS Central System is deficient with respect to meeting system design capacity standards. The addition of the committed and near-term resources identified above is necessary as soon as possible. With the addition of these resources, however, the DWS would have sufficient water production capacity and capability to serve its needs until the year 2012.[7] With the

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5. Water demand projections are documented in detail in the *Water Use and Demand -- Department of Water Supply Systems* chapter, May 2007. These projections are based on the demographic projections in the Maui County Planning Department *Socio-Economic Forecast*, June 2006.

6. The system design standards used for planning purposes in the capacity expansion and production cost model used in the analyses presented in this section are a modification of the system standards for groundwater resources adopted collectively by the Hawaii county water departments. The standards applied here provide that sufficient installed well capacity must be maintained to supply the system day capacity (1.5 times average annual metered consumption) in sixteen hours of pumping (using two-thirds of installed pumping capacity). Surface water resources are assumed to contribute to system reliable capacity based on the Department of Health capacity deration based on allowed filtration flux with one filter train out of service.

addition of the DSM water conservation programs included in each of the Final Candidate Strategies, the next discretionary resource addition would be needed in the year 2013. Each of the final candidate resource strategies provides for the addition of new capacity by the year 2013.

Iterative Analysis and Public Review

The analyses supporting this report were conducted in several iterative rounds.

- First Round -- Presented to the Water Advisory Committee on January 8, 2008
    - Resources characterized in the Candidate Strategies report were configured into more completely integrated strategies.
    - Characterization of the resource option components were updated. This included updating and refinement of energy costs, project capital costs and expected well yields.
    - Conservation, wastewater recycling and raw water storage reservoir options were examined in more detail.
- Second Round -- Presented to the Water Advisory Committee on July 23, 2008
    - Comments received in presentations of the first round analyses to the DWS staff, the CWRM and the Maui County Board of Water Supply were incorporated.
    - Water conservation program characterization and analysis were refined. A DSM program design consultant was retained to review the analysis methods and assumptions and to make recommendations for a portfolio of conservation programs for the Maui districts.
    - Additional options and scenarios were examined, including expanded raw water storage reservoir scenarios, reconfiguration and optimization of the Eastward Basal Groundwater scenarios and a scenario incorporating ditch transport of water from East Maui to the Central District system.
    - The Northward Basal Groundwater Strategy was reconfigured based on updated information regarding the hydrology and expected well yields.
    - Recent higher energy costs were incorporated in the economic analysis.
    - Capital cost and depreciation accounting methods were refined.
    - A fifty-year economic study period was added to supplement the twenty-five year planning period. This was provided to more thoroughly account for the long-term operation cost benefits of some of the more capital-intensive resource options (large water storage reservoirs and major water transmission systems)
- Third Round -- Transmitted to the BWS for public hearing, review and recommendations
    - Economic analysis was presented for a range of possible future energy costs.
    - Strategies were refined based on updated information, comments received and ongoing review.
    - The "Reference Strategy" from previous analyses was retained as a basis for economic comparisons, but the reconfigured and updated Northward

7. For a discussion of the characterization of the dates additional resources are needed, see the section later in this report titled "Uncertainty and Contingency Planning".

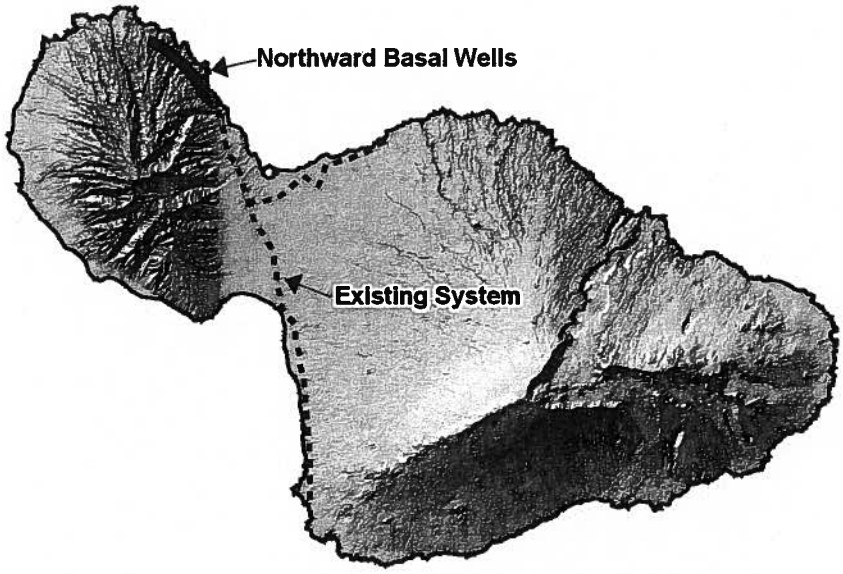
Basal Groundwater strategy resources were incorporated uniformly as follow-up resources in all strategies that require additional capacity towards the end of the planning period.

- Additional scenarios were examined based on Water Advisory Group requests.
- Optimization of the strategy configurations was re-examined based on the most recent assumptions.

- Fourth Round -- Presented in this Central District Plan Update
  - Analysis and recommendations were amended to incorporate results of the previously recommended study to examine and verify the feasibility of DEM Kihei WWTP R-1 recycled water options.
  - Text and recommendations were amended to consider updated circumstances including amendment of IIFS for Na Wai Eha streams.
  - Text was amended to reflect status of document as a plan update (rather than a review draft report).
  - Text and recommendations were amended as recommended by the DWS to incorporate public comment and BWS recommendations.
  - Amendments were incorporated as approved by the Council of the County of Maui.

A description of several more specific considerations and scenarios examined in the progressive rounds of analysis is provided in the discussion of the economic analysis for each of the Final Candidate Strategies below.

In addition to the features and components explicitly considered in the analysis of the Final Candidate Strategies, there are several independent components (described in a section below) that can be considered for implementation with any of the Final Candidate Strategies. These include measures that address county-wide planning objectives as well as measures to address DWS system objectives. For discussion of the independent components refer to the section above: *Independent Components Considered in All Strategies.*



A. Northward Basal Groundwater

Summary

This strategy features a series of basal groundwater wells located north of the current extent of the DWS Central District system in the north side of the Waihee aquifer and the Kahakuloa aquifer. The first phase of this strategy would be a substantial investment in water transmission across Makamakaole Gulch. The strategy would proceed in phases extending northward with additional wells with associated transmission, storage tanks and booster pumps:

All of the implementations of this strategy include a "basic" Demand-Side Management program that is designed to attain 15% of the water efficiency technical potential in a period of five years.[8]

Project Design Scenarios

Several project design alternatives were explored including variations in project extent, well locations and the number, size and expected yield of wells.

Reference Strategy Versus Updated Northward Basal Groundwater Strategy

An initial characterization of a northward basal well development strategy was used as the reference strategy in the previous candidate strategies analysis reported in the *Candidate Strategies Central District Preliminary Draft*, September 12, 2006. This strategy was selected as a reference strategy in that report because it is comprised of a series of incremental capacity additions which makes it a good basis for comparison with other strategies. The other strategies feature a single large capacity addition (such as a water treatment plant or very large transmission line) as a dominant capital expenditure.

The original reference strategy has been maintained as a reference strategy in the presentations of the economics of the Final Candidate Strategies. The reference strategy is not, however, one of the Final Candidate Strategies. The Northward Basal Groundwater strategy has been re-char-

8. The DSM program portfolio included in each of the Final Candidate Strategies is described in a separate section on this subject and in Appendix A.

acterized based on updated information about hydrology and expected well yield in the northern half of the Waihee aquifer and the Kahakuloa aquifer.

The initial reference strategy included three new wells in the northern half of the Waihee aquifer and three wells in the Kahakuloa aquifer. The revised Northward Basal Groundwater strategy includes twice as many, much smaller wells than the reference strategy and assumes costs that have been updated with more recent information. The revised Northward strategy is more expensive due to higher estimated project costs and lower expected production capability.[9]

To summarize, in the analyses presented in this report, the original reference strategy is still used as the zero point against which differences in strategy costs are compared but is not one of the Final Candidate Strategies. The Northward "reconfigured" Basal Groundwater strategy is also included for reference in the economic analyses and is one of the Final Candidate Strategies.

The final version of the Northward Basal Groundwater strategy is comprised of a series of phases extending northward with additional wells with associated transmission, storage tanks and booster pumps:[10]

- Maluhia (2) 500 GPM Wells -- North Waihee Aquifer, North of Makamakaole Gulch
- Wailena (2) 500 GPM Wells -- North Waihee Aquifer, Extending Further North
- Waipili (2) 500 GPM Wells -- North Waihee Aquifer, Extending Further North
- Kahakuloa (4) 500 GPM Wells -- Kahakuloa Aquifer, North of Kahakuloa Valley
- Waihali (2) 500 GPM Wells -- Kahakuloa Aquifer, Extending Further North
- Poelua (4) 500 GPM Wells -- Kahakuloa Aquifer, Extending Further North

Each of these phases is characterized in detail in Appendix B.

The sustainable yield of the Waihee aquifer is 8 MGD. The Northward basal well strategy assumes that 6.8 MGD would be withdrawn from this aquifer (85% of sustainable yield) including new and existing wells.

The sustainable yield of the Kahakuloa aquifer was lowered in the recent revision of the CWRM Water Resource Protection Plan (WRPP) from 8 MGD to 5 MGD. The WRPP states that the expected sustainable yield from this aquifer is uncertain and within a range of 5 MGD to 8 MGD. The Northward Basal Groundwater strategy assumes that 4.8 MGD would be withdrawn from this aquifer.

Policy and Feasibility Considerations

Kahakuloa Valley Impacts

This strategy would transport water from the Kahakuloa aquifer for Central District use. Although there would be no wells in the Kahakuloa valley there may be concerns from local residents. Impacts in the valley would include installation of the water transmission line, access roads and power lines. County water service could be made possible to the Kahakuloa Valley with this

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9. In the first two rounds of analysis of the Final Candidate Strategies, the reference strategy wells were also assumed to be implemented as follow-up resources in the other strategies when additional capacity or water production was required after implementation of the featured resources. In the analysis presented in this report any follow-up resources that are required are consistent with the revised Northward Basal Well strategy.

10. The names of most of the phases of the Northward Basal Groundwater strategy are changed from the previous Candidate Strategies report to reflect the fact that these are different well configurations and in order to more accurately match the place names of the vicinities of the areas the wells could be sited. No specific sites were identified in the analyses.

strategy. This strategy has not been presented to or reviewed by Kahakuloa area residents. Prior to any commitment to this strategy there should be outreach to provide information to and hear concerns from Kahakuloa Valley residents.

Uncertain Hydrology

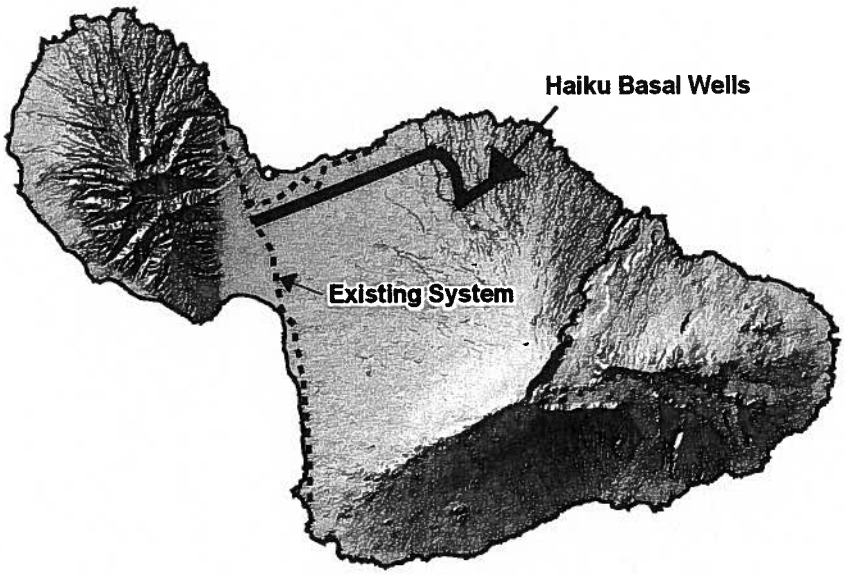
The hydrology of the North Waihee aquifer and the Kahakuloa aquifer is not well investigated and the productivity of wells in this area is unproven. Well efficacy should be demonstrated prior to substantial investments in transmission across Makamakaole Gulch.

As noted above, the sustainable yield of the Kahakuloa groundwater aquifer was recently lowered from 8 MGD to 5 MGD. Modeling being performed by the USGS indicates that the freshwatter lens of this aquifer is likely to be thinner than in the Iao and southern Waihee aquifer areas. This aquifer is therefore less promising for high-production large-capacity wells.

Economic Analysis

Economic analysis of this strategy was presented in the *Candidate Strategies* chapter and previous presentations to the Water Advisory Committee. The updated economic analysis of this strategy is presented in this report in the section below comparing the final resource strategies.

In all of the charts showing the results of the economic analyses presented in this report the original Northward Basal Groundwater strategy presented in the *Candidate Strategies* chapter is maintained as the "Reference Strategy" providing the "zero point" for the comparative economic charts. The reconfigured Northward Basal Groundwater Final Candidate Strategy is also included for reference in all of the comparative economic charts.



B. Eastward Basal Groundwater

Summary

This strategy features a series of new basal groundwater wells in the Haiku groundwater aquifer with water transmission to the DWS Central District system. As discussed below, several alternate configurations of this strategy were considered and analyzed but were rejected in favor of the Haiku aquifer strategy. Other configurations considered included transmission and development of wells in the Honopou and Waikamoi aquifers and use of the Lowrie Ditch to transmit water to the central Maui area.

Interconnection of the Central District and Upcountry District water systems was also considered and is discussed in this section. Since the development of a Haiku aquifer wellfield for the Central District would provide close proximity of major transmission components of these two water systems, interconnection could provide benefits to each system if the Haiku strategy were implemented. Interconnection in and of itself, however, does not provide a solution to the needs of the two water systems without development of new water sources.

All of the implementations of this strategy include a "basic" Demand-Side Management program that is designed to attain 15% of the water efficiency technical potential in a period of five years.[11]

The Eastward Basal Groundwater strategy is an expensive strategy because of the capital costs associated with the necessary transmission improvements and because energy requirements for pumping would be relatively high because of the elevation of the wells. Organized opposition to wells in the Haiku aquifer in the past led to litigation and a Consent Decree. As discussed below, several terms of the Consent Decree would have to be met before this strategy could be implemented.

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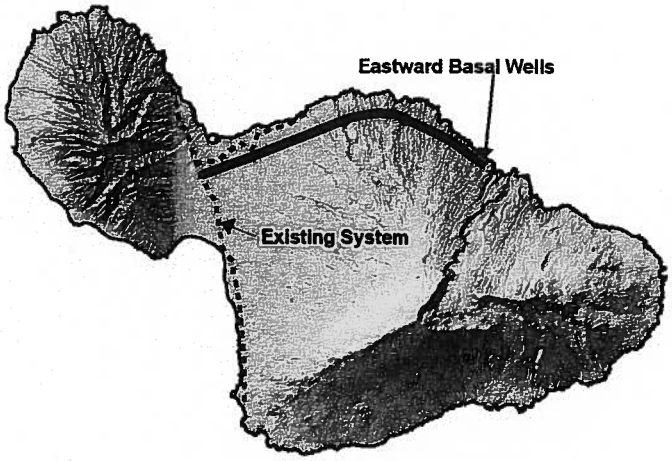
11. The DSM program included in each of the Final Candidate Strategies is described in a separate section on this subject and in Appendix A.

Project Design Scenarios

Well Field Location: Haiku vs. Honopou vs. Waikamoi



Several variations of this strategy were analyzed to determine the optimum location for wells. An initial round of analyses was conducted to determine whether it was more economical to locate wells in the Haiku aquifer or further east in the Honopou aquifer. Wells in the Haiku aquifer would need to be located at sufficient elevation to stay above groundwater contamination from historical and existing land uses. Wells at the higher elevation require additional costs to pump water. Wells located in the Honopou aquifer would require additional transmission system costs but could be located at a lower elevation and save long-term pumping power costs. The initial analysis compared Haiku wells located at 1500-foot elevation with wells located further east in the Honopou aquifer at an elevation of 600 feet.[12]

As a result of comments received from the DWS and the Central District Water Advisory Committee a second round of analyses was conducted with several modifications. The elevation of the wells in the Haiku area scenario was changed to 1000 feet to be consistent with the minimum elevation necessary to avoid groundwater contamination. The Honopou scenario was changed in several significant ways. First, the number and size of the wells was changed in consideration of the expected characteristics of the groundwater hydrology. Lower yields are expected from each well than was assumed in the initial analyses. A larger number of smaller wells was configured. Second, the well locations were moved further east to the Waikamoi aquifer in order to avoid drilling new wells above the existing wells and springs currently in use by Honopou residents. Third, costs of the water transmission system were updated based on more recent information.

Lowrie Ditch Water Transmission Scenario

In response to a suggestion made by a member of the Water Advisory Committee, an additional analysis was conducted to determine the economics of using the Lowrie ditch to transport water to the Central Maui area rather than the expensive transmission line. In this scenario, water from the wells would be pumped into the Lowrie ditch at approximately 600-foot elevation. Water would be taken from the ditch downstream eliminating a substantial length of new transmission pipe but requiring construction and operation of a water treatment plant to bring the water to potable standards.

The Lowrie Ditch is privately owned by HC&S and currently used for the transportation of irrigation water. Utilization of the ditch for transportation of water for public municipal purposes would require an agreement with HC&S.[13]

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12. A 600-foot wellhead elevation was analyzed because it provides approximately the minimum elevation to provide sufficient pressure to flow to the pressure gradient of the distant Central Maui DWS system.

13. This analysis was a prospective economic feasibility analysis. There was no verification of the capacity of the Lowrie Ditch to accommodate assumed additional water flow and no specific institutional or contractual issues were examined.

Interconnection Between Central and Upcountry District Water Systems

Interconnecting the Central DWS water system with the Upcountry DWS water system could provide benefits to the reliability and operation economics of one or both systems. The costs and benefits of interconnection of these systems were considered in the analysis of the Candidate Strategies. In particular the possibilities of (1) alternate uses of the Hamakuapoko wells, (2) expansion and interconnection of the Kamole Water Treatment Plant with the Central system and (3) dual purpose service of the East Maui basal well expansion strategy were considered. It was determined that each of these interconnection options provided some benefits, but none provided sufficient supplemental benefits to serve as the fundamental basis for a Final Candidate Strategy.

HAMAKUAPOKO WELLS

The Hamakuapoko wells are prohibited by county ordinance from serving potable uses. These wells could provide water to the EMI Hamakua ditch, possibly in trade for raw ditch water withdrawn by the DWS at other locations and/or times. This trading arrangement could provide additional potable production capability to the extent that it would allow the DWS to withdraw additional raw water from the EMI ditch system for either treatment for potable use or to displace use of existing uses of DWS potable water for irrigation uses. This option is potentially valuable as a reliability contingency measure during times of drought when Wailoa/Hamakua ditch flows are restricted, but it is not otherwise cost-effective due to the costs of pumping the basal groundwater from the Hamakuapoko wells to the elevation of the Hamakua ditch. This option would not provide sufficient additional effective water source to serve as the fundamental basis for a Final Candidate Strategy.

EXPANSION AND INTERCONNECTION OF THE KAMOLE WATER TREATMENT PLANT

Expansion and interconnection of the Kamole Water Treatment Plant with the Central system could provide a limited amount of additional redundancy of production equipment for the Central system and the Upcountry system (with the addition of sufficient additional booster pumps). The amount of this contribution is limited, however, because there would be some extended periods of time when all available source water to the Kamole WTP would be needed for existing source needs for the Upcountry system.

Some economic benefit would also result during times that ample water is available in the Wailoa ditch (supplying the Kamole WTP) that could serve the Central system and displace more expensive Central system resources. The costs of expanding the Kamole WTP, however, exceed these system operation efficiency benefits (even without considering the costs of necessary interconnecting transmission improvements).

Because the amount of water available to the DWS is ultimately limited by the flows in the Wailoa ditch and this capacity is currently relied upon to meet existing and future needs of the Upcountry system, this option would not provide any substantial additional new water sources that would effectively meet new water demands on either system.

Interconnection of the Kamole WTP with the Central District system would require an agreement with HC&S. One important consideration for any expansion of capacity for the Kamole WTP is the potential reduction in Wailoa Ditch stream flow which may result from pending actions to investigate and amend the interim instream flow standards for the East Maui streams that provide water to the ditch system.

DUAL PURPOSE SERVICE OF HAIKU AQUIFER BASAL WELLS

One of the Final Candidate Strategies for the DWS Central District is development of a series of wells at approximately 1000-foot elevation in the Haiku aquifer with new transmission to the Central system. Implementation of this strategy would provide a relatively inexpensive means to

interconnect the Central and Upcountry systems due to the proximity of substantial capacity transmission piping.

Interconnection could provide a limited amount of additional redundancy of production equipment for the Upcountry system with the addition of sufficient additional booster pumps. This is of limited value, however, since the Upcountry system is not limited by equipment redundancy but is limited instead by drought period source water availability. New resources planned for the Upcountry system are necessary to provide a reliable source of water during times of low production capability of the surface water sources during periods of drought. With the exception of booster pump capacity, the Upcountry system already has sufficient equipment capacity redundancy.

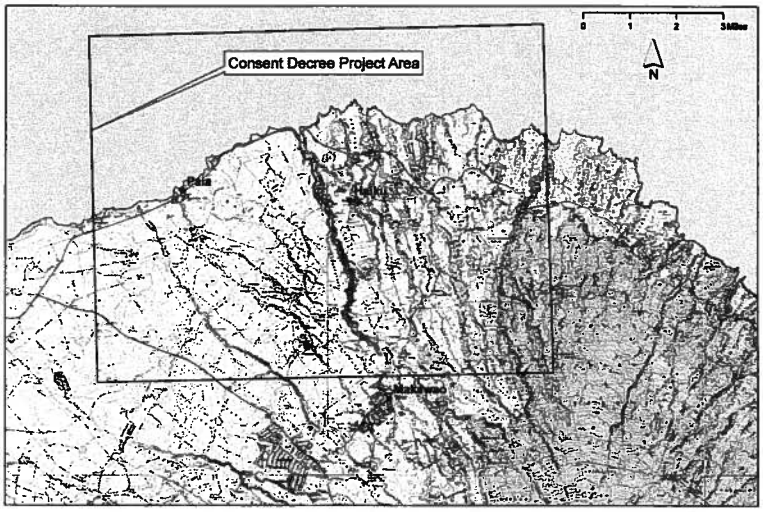
Interconnection would not provide substantial new drought period source water capability for the Upcountry system. The Haiku wells are relied upon in the Central District strategies to provide new effective source water production for the Central system. For periods of short duration, other water sources on the Central system could provide supplemental production to make up for water that would be required from the Haiku wells to meet upcountry needs. This would not be possible, however, for moderate or extended drought periods which typically last several months per year.

Interconnection would also provide economic benefits during times that ample water is available in the Wailoa ditch (supplying the Kamole WTP) that could serve the Central system and displace more expensive Central system resources. The costs of expanding the Kamole WTP for this purpose, however, exceed these system operation efficiency benefits (even without considering the costs of necessary interconnecting transmission improvements). It would not be economical to use treated water from the Lower Kula system or Upper Kula system to serve Central system needs. This would be possible only during wet winter months with ample surface water source flows and when upcountry storage reservoirs are full. These times tend to coincide with periods of minimum demand and lowest production costs on the Central system.

Although there are benefits to interconnecting water systems, interconnection of the Central and Upcountry systems would not, in itself, avoid the need to develop new water sources for both of these systems. Interconnection could provide a limited amount of additional redundancy in system capacity (equipment), but both systems are in need of new sources of water to meet growing water demand.

Policy and Feasibility Considerations

Compliance with EMPLAN Consent Decree



The 1990 Maui County WUDP identified the development of wells in the Haiku aquifer (and associated water transmission) as a featured strategy to supply water to the Central District system. A concurrent East Maui Water Study was commissioned to develop this strategy. The draft 1992 WUDP update (never adopted) also featured this strategy as the primary means to provide new Central District water supply. The project, named the East Maui Water Development Plan (EMPLAN), moved forward with preparation of

an environmental impact statement (EIS) and a supplemental EIS which were challenged in court. The court case was settled between the plaintiffs and the County by a Consent Decree.

The County is bound by a list of terms specified in the EMPLAN Consent Decree including the following:

- Only Phase I of the EMPLAN will be implemented until a completely new EIS is prepared. This includes construction of the Hamakuapoko wells and limited transmission connection to the Central District system.
- The County will not develop groundwater in an agreed-upon portion of the East Maui region until a rigorous cost/benefit analysis is performed which shall, among other things, address planning for stream restoration in the agreed-upon region.
- The County will "rigorously investigate and pursue the availability of surface water" from the Waikapu, Iao and Waihee areas including a rigorous cost/benefit analysis.
- Any new groundwater development projects in the agreed-upon East Maui region will be consistent with the County WUDP and the State Water Code.
- The County will work with the USGS and plaintiffs to develop a test well to determine whether development of groundwater resources in the agreed-upon East Maui region would affect surface water resources in the region.
- As long-term agricultural water needs are reduced, a stream restoration program will be studied, developed and initiated by the County.

Compliance with the terms of the EMPLAN Consent Decree would be necessary prior to development of wells within the EMPLAN area. This area is shown on the map above.

Potential Impacts of Groundwater Pumping on Existing Wells, Springs and Uses

In both the Haiku and Honopou aquifer areas there are existing wells, springs and surface water sources used by residents. Impacts of basal groundwater pumping in these areas upon these existing uses must be considered. Substantial concerns were raised by residents in these areas at the Water Advisory Committee meetings.

The impacts of basal groundwater pumping on down-gradient wells, springs and surface water sources in the Haiku aquifer have been debated previously in several venues, including agency and judicial reviews of the environmental assessments and environmental impact statements for the East Maui Water Plan. There are strongly held beliefs and no broad consensus regarding these potential impacts.

There has been substantially less discussion of impacts of basal well pumping in the Honopou aquifer. The hydrology of the Honopou aquifer differs from the Haiku aquifer in several respects. It is expected that the basal water lens is thinner in this area and expected well yields would be substantially lower for the wells contemplated at an elevation of approximately 600 feet. There are established uses in this area by residents at low elevations that could be affected by up-gradient wells.

Acceptance by East Aquifer Area Residents

At Water Advisory Group meetings substantial and passionate concerns were raised by Haiku and Honopou aquifer area residents regarding the impacts and propriety of developing basal groundwater wells in these aquifers. Concerns were expressed about impacts on area residents (discussed above) and regarding pumping water from these areas to serve distant uses.

Honopou area residents expressed frustration that they have suffered from decades of surface water diversions from the streams in their vicinity to support irrigation uses in the Central Maui area. The prospect of developing basal wells in these aquifers to serve additional uses in central Maui raised considerable concern and objections.

In order to address concerns from Honopou area residents, the Honopou aquifer scenario of the Eastward Basal Groundwater strategy was reconfigured to reach beyond the Honopou aquifer to the Waikamoi aquifer in an area with fewer existing down-gradient uses. This alternate scenario may not fully address the concerns of the Honopou area residents.

Acceptance by east aquifer area residents is both a policy and a tactical concern. The merits of concerns of the residents of these areas should be considered as a matter of policy. The passion of opposition of area residents and the potential for organized opposition to projects in these areas should also be considered as a tactical concern.

Efficacy and Water Quality of Wells at 1000-Foot Elevation

It is presumed in the economic analyses that wells at the 1000-foot elevation in the Haiku area will be productive and that they will be free of contamination from DBCP and other toxic chemicals used in the area in the past. Although the efficacy and the water quality at this elevation in this area are expected to be acceptable, this is yet untested. Prior to any commitment to this strategy and prior to substantial expenditures on the large costs of the associated transmission system, sufficient test wells should be drilled to verify production efficacy and water quality.

Capital Cost Financing

Development of basal wells in the Haiku, Honopou or Waikamoi aquifers would require substantial capital investments for water transmission improvements. Since completion of the major water transmission components of the strategy is necessary before any substantial water production could benefit the Central District system it is not possible to effectively "phase" the installation of water transmission. The full capital requirements of the strategy would have to be provided at the onset of implementation.

Economic Analysis

The economic analysis of the Eastward Basal Groundwater strategy was conducted in several iterative rounds. Analyses of wells in the Haiku area at 1500-ft. elevation and wells in the Honopou area at 600-ft. elevation were examined and presented in the *Candidate Strategies* chapter. In later analyses several additional scenarios were examined, including wells at a lower 1000 ft. elevation in the Haiku area, wells further east in the Waikamoi aquifer and use of the Lowrie Ditch to transmit water to the Central Maui region. These scenarios are described above. Alternate assumptions regarding possible future power costs were incorporated in several rounds of analyses. In the analyses presented in this report, strategies are characterized for two alternate electric power cost scenarios representing lower and higher future energy prices.

Economic analysis of the final resource strategies was performed using an integrated resource analysis model that was configured for the Central District system.

The results of the economic analyses are presented in charts that show the net present value of total DWS Central District system costs over a fifty-year study period. The charts show the net present value of the following cost categories for each of the strategies:

- Variable Operating Costs -- These are operating costs that vary as a direct function of the amount of water produced by each of the resources in the analysis in each year of the study period. These are primarily energy costs and costs for purchase of source water where applicable.
- Fixed Operating Costs -- These are operating costs that change with the addition of new resources but are not directly affected by the amount of water produced by each resource. These costs include the costs of maintaining and operating the existing system and new resources as they are added to the system, including labor, and an apportioned share of DWS administrative operations and repair expenses.

- Capital Costs -- These are the amortized capital carrying costs of the Central District system, including capital carrying charges (interest and depreciation) for new resource assets and depreciation and replacement costs for existing system assets.
- DSM Costs -- These are the total costs of implementing demand-side management (water conservation) programs, including the full measure and installation costs (whether borne by the program participant or by the utility and including any utility incentives) and costs to administer the programs.
- Total Costs -- These are the sum of the four categories of costs listed above.

Two types of charts are presented:

Total fifty-year study period costs for each strategy

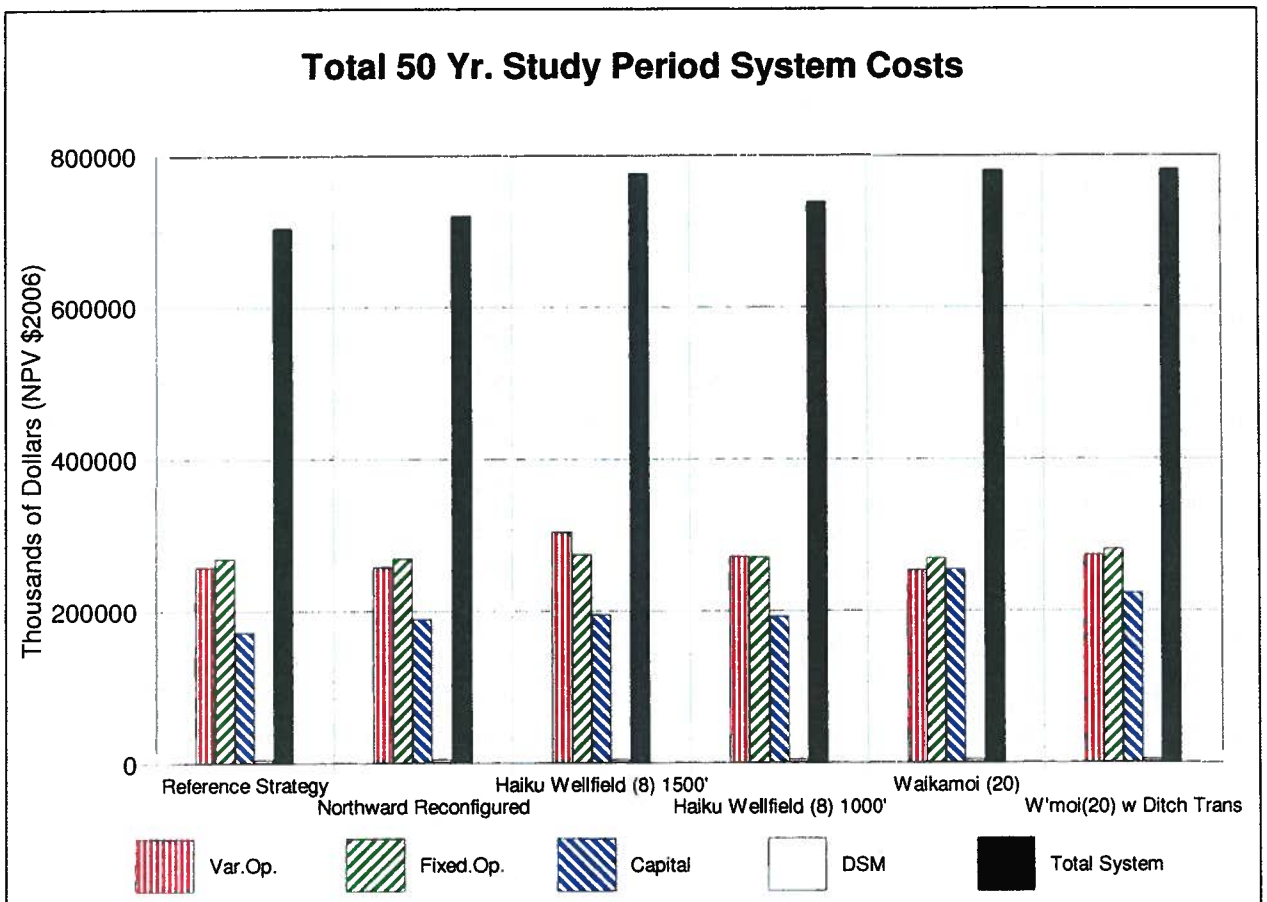
Differences in fifty-year study period costs with respect to a reference strategy

The first chart shows the total costs for the DWS Central District system for the fifty-year study period. Later charts show the same data presented as differences for each cost category for each strategy compared to a reference strategy. This format focuses on the differences between the strategies and makes differences easier to see. It is important to remember, however, that the costs represent total DWS system costs, not only the costs of the featured resources in each strategy.

The two strategies presented at the left of each chart are identical in all of the charts presented. The first strategy at the far left is the "Reference Strategy". This strategy provides the "zero point" for all of the charts that present costs as differences from the reference strategy. The second strategy from the left is the "Northward Reconfigured" basal well development strategy. This strategy is one of the Final Candidate Strategies and is provided in all of the charts as a standard basis of comparison and to indicate a reference for the magnitude of costs portrayed.[14]

Two charts are presented for each set of strategies that represent alternate energy cost scenarios. During the time in 2008 that the Final Candidate Strategies were analyzed and presented to the Water Advisory Committee, the cost of electrical power changed dramatically as crude oil prices increased from about $60 per barrel to $140 per barrel and then decreased again to about $60 per barrel. Energy costs are a significant component of the total costs of the DWS system. In order to consider the uncertainty regarding future energy costs a "low" energy cost scenario (starting at $75 per barrel) and a high energy cost scenario (starting at $125 per barrel) are pre-

14. This is convenient since the scale of charts varies considerably depending on which strategies are included in each chart.



Alternate Eastward Basal Groundwater Strategies
"Low" Energy Price Scenario: $75/bbl 2008 Equiv. Electric Power Costs Escalated at 1.0 % (Real) per Year

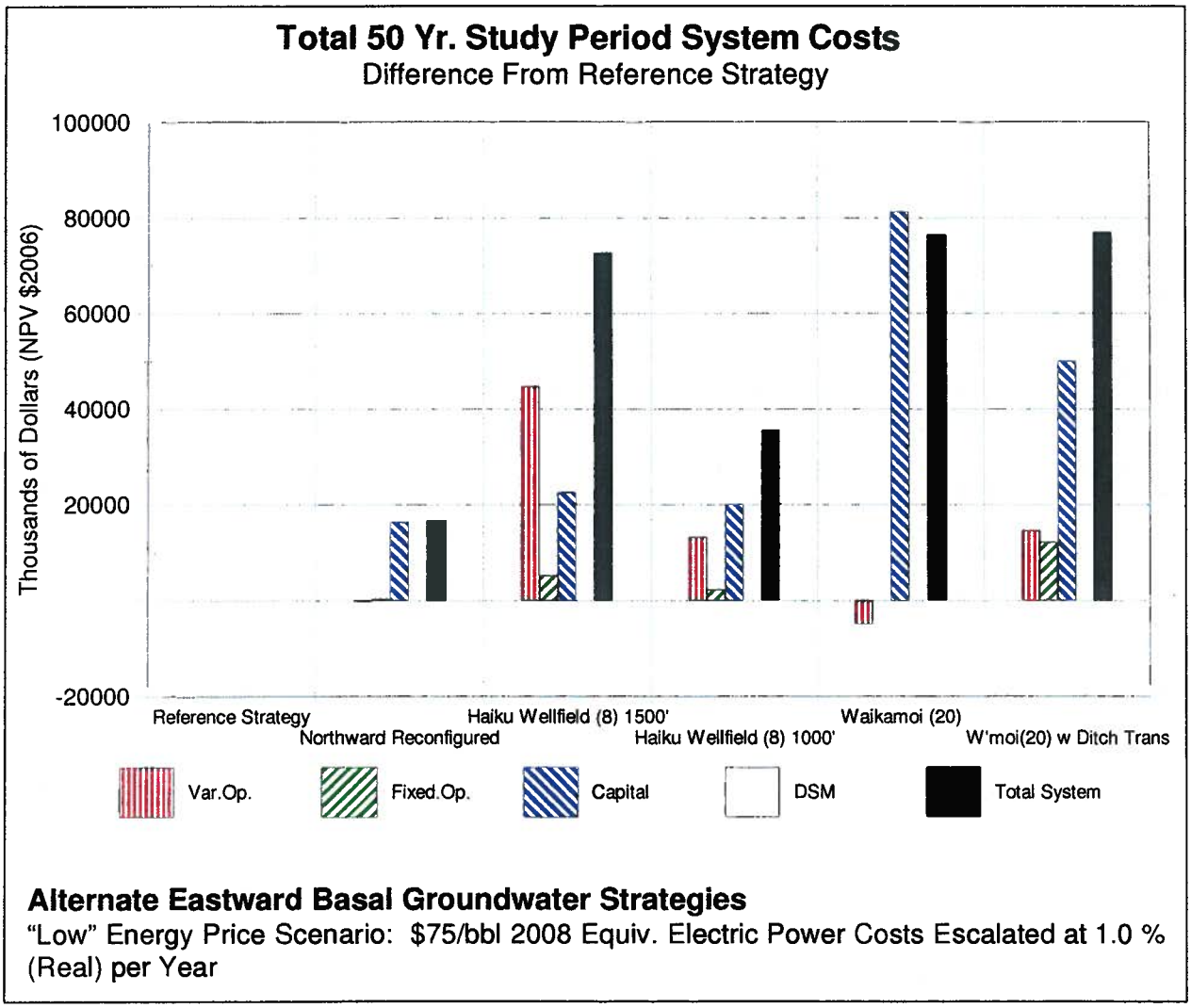
sented for each set of candidate strategies. In each scenario, energy costs are assumed to increase at a rate 1% higher than the rate of general inflation.[15]

Alternate Eastward Basal Groundwater Strategies

The chart above shows the net present values for the DWS Central District system over a fifty-year study period (2005 - 2055). Variable operating, fixed operating and capital costs are all substantial components of total costs in all strategies. The cost of the DSM (conservation) programs included in each of the strategies is a small component of costs.

The differences between the cost components of the strategies is discernible but is more clearly seen in the following chart that shows the same data presented as differences with respect to the Reference Strategy shown at the far left.

15. In addition to the analyses presented in this report several alternate assumptions regarding future energy prices were examined.

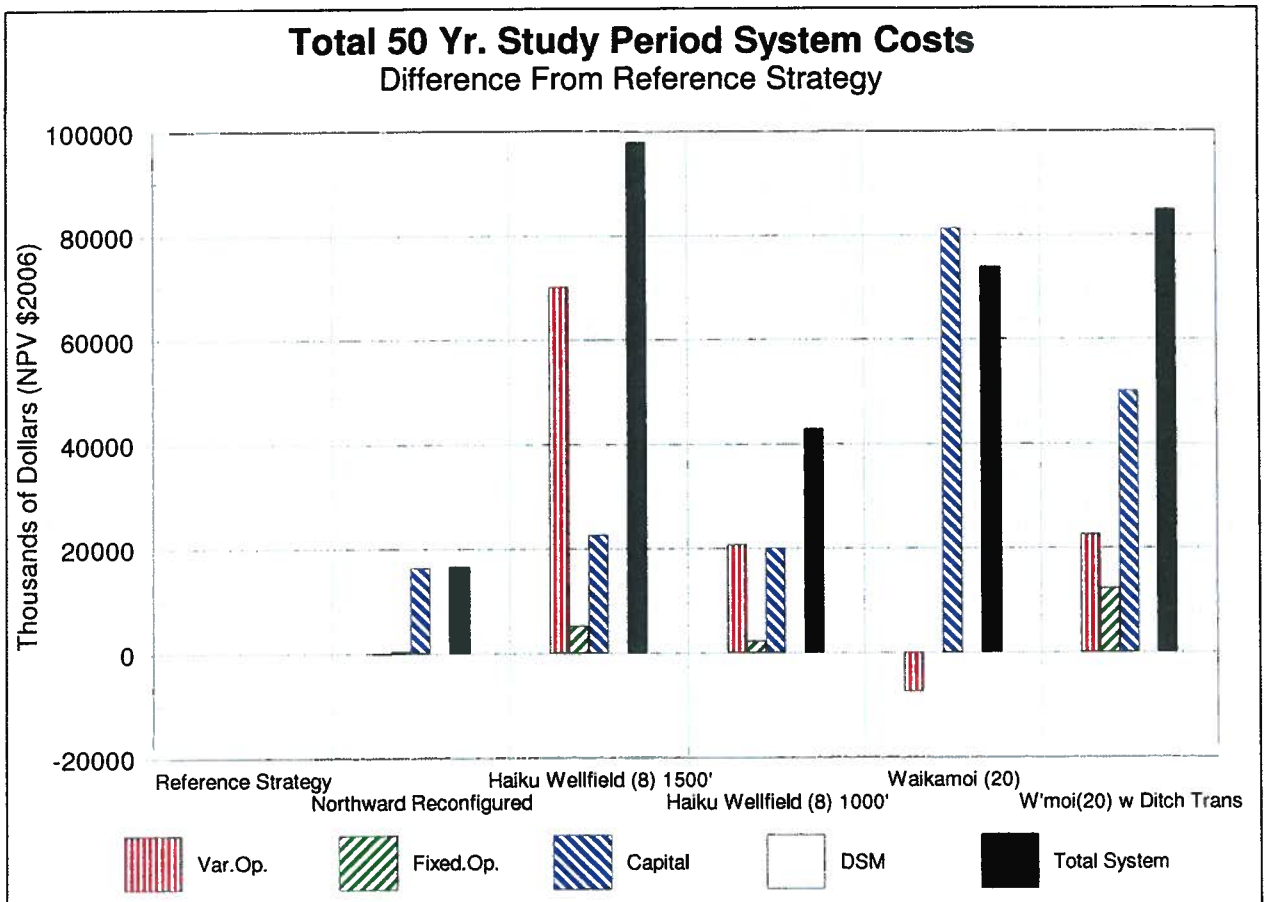


The chart above shows the same data as the previous chart, except all costs are portrayed as differences from the Reference Strategy costs at the far left. The "Northward Reconfigured" strategy is provided as a reference. Four strategies are shown for comparison in the center and right side of the chart.

The center two strategies are the Haiku Wellfield strategies featuring a series of eight basal wells in the Haiku aquifer with transmission to the Central District system. The difference between these strategies is the location and elevation of the wells (1500 ft. and 1000 ft.) which primarily affects variable operating costs (electrical energy for pumping) and to a lesser extent affects transmission capital costs. Locating the wells at the lower 1000-ft. elevation is more economical due to the lower electrical pumping costs.

The two strategies at the right are the Waikamoi Wellfield strategies with wells located at 600-ft. elevation further east in the Waikamoi aquifer. The Waikamoi strategy has substantially lower electrical pumping costs due to the lower elevation of the wells, but this is much more than offset by the higher capital costs of transmission to the farther Waikamoi aquifer. The rightmost strategy features the Waikamoi wellfield using the Lowrie Ditch to transfer water to a water treatment plant in the Central Maui area. This strategy has lower transmission costs than the Waikamoi strategy shown to its left but also has the additional capital and variable and fixed operating costs associated with constructing and operating the water treatment plant.

The Haiku wellfield strategy with wells at an elevation of 1000 ft. is the most economical of the Eastward Basal Groundwater options shown. This strategy is used to characterize the Eastward



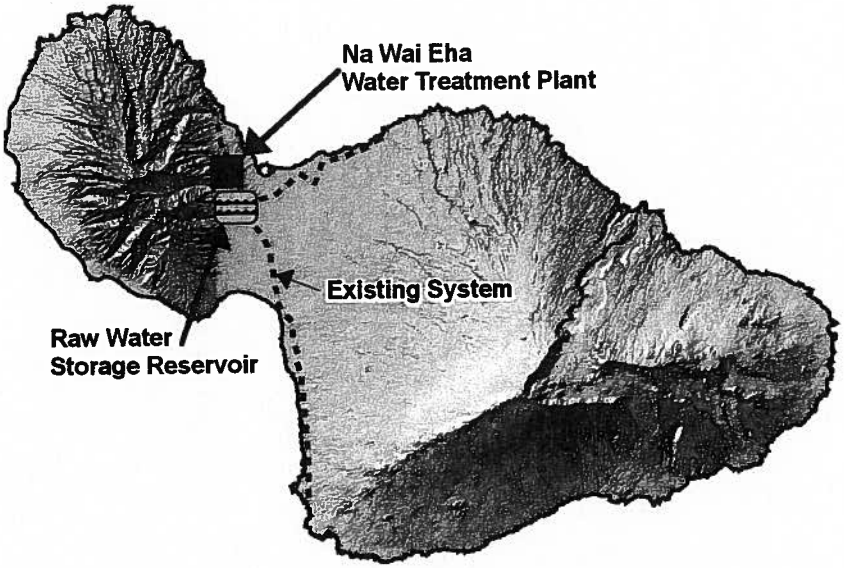
Alternate Eastward Basal Groundwater Strategies
"High" Energy Price Scenario: $125/bbl 2008 Equiv. Electric Power Costs Escalated at 1.0 % (Real) per Year

Basal Groundwater strategy in the comparisons of the Final Candidate Strategies in the following section of this report.

The chart above shows the same strategies as the previous chart, except that higher energy costs are assumed. The electrical costs assumed in the analyses shown on this chart are the high energy cost scenario. These costs reflect crude oil prices of $125 per barrel in 2008 ($0.34 per KWH marginal cost in the high power consumption block for large customer MECO Schedule P tariff) assumed to excalate at 1% per year in real terms (1% higher than general inflation).[16]

The higher electrical power costs shown on this chart make the cost advantages of the lower elevation wells more pronounced. The 1000-ft. Haiku wellfield strategy shows more economy compared to the higher elevation 1500-ft. Haiku wellfield strategy. The Waikamoi wellfield strategy with 600 ft. elevation wells is less expensive than the 1500-ft. Haiku wellfield due to the increased magnitude of energy costs savings from the lower well elevations. The Haiku wellfield at 1000-ft. elevations remains the most economical strategy assuming the higher energy costs.

16. The marginal power costs included in the variable costs do not include customer charge and demand charge components of electricity bill. These components of electrical costs are included in fixed operating costs.



C. Na Wai Eha Surface Water Treatment

Summary

This strategy features one or more water treatment plants using surface water from the areas of the Na Wai Eha streams. These four streams flow eastward from Mauna Kahalawai (the West Maui Mountains): Waikapu, Iao, Waiehu and Waihee streams.

Several alternate implementations of this strategy were examined including several treatment plant locations, operational configurations and storage reservoir alternatives. These alternatives were examined to consider alternate scenarios regarding possible water source agreements, financing options, source water costs, future energy prices and study period assumptions.

All of the implementations of this strategy include a "basic" Demand-Side Management program that is designed to attain 15% of the water efficiency technical potential in a period of five years.[17]

This strategy is perhaps one of the least expensive alternatives but is not viable until a long-term source of water is confirmed and the price of the source water is determined. These uncertainties may not be resolved for several years. This strategy would use water for municipal uses that would otherwise be available for agricultural and landscape irrigation uses.

Treatment Plant and Reservoir System Alternatives

There are several possible implementations of water treatment using water from the Na Wai Eha streams. These are discussed below.

Treatment Plant Location

Two water treatment plant locations were considered.

Waiale Water Treatment Plant: One alternative is the water treatment plant proposed by Alexander and Baldwin (A&B) at the site of its existing Waiale raw water reservoir. Design engineering for this water treatment plant is essentially complete and contract negotiations with the County have been ongoing. This alternative would use water from the Waihee Ditch systems.

17. The DSM program included in each of the Final Candidate Strategies is described in a separate section on this subject and in Appendix A.

Waihee Water Treatment Plant: A second alternative location that was analyzed is a generic unspecified site on the Waihee Ditch system north and "upstream" of the urbanized Wailuku area. There is no specific current proposal for a water treatment plant at this location. This site was considered in light of several features. It would reduce some potential water contamination issues associated with the Waiale WTP, which would use water transported in open ditches further through more populated areas. Analysis of this site also measures the economic advantages of using a higher elevation site, which would require less energy to pump water to the Central system hydraulic gradient pressure.[18]

Because the Waiale WTP is essentially fully engineered and is characterized in substantial detail, it is used as the basis for characterizing the construction and operation costs for water plants in the Na Wai Eha area. In order to focus on the merits of the two alternate sites, assumptions regarding the type, size and engineering of the water treatment plants was kept the same for both sites. Only parameters that differed due to the siting of the water treatment plants were distinguished in the analysis.[19]

Any comparisons between the Waiale WTP site and any possible Waihee WTP site should recognize that there is a specific Waiale WTP proposal that has been fully designed and is in the process of contract negotiations with the County. An environmental impact statement for the Waiale WTP was prepared and released but has now been withdrawn for possible amendment. The Waihee site considered in the WUDP analysis is an unspecified hypothetical site.

A Lowrie Ditch Water Treatment Plant is considered in the Eastward Basal Groundwater Well Development strategy. As characterized in that strategy, the WTP would be used to treat water produced by wells in the Waikamoi aquifer transported to the Central District via the EMI Lowrie Ditch. One alternative scenario that was examined but is not further characterized in this report is using water from the Lowrie Ditch from existing stream diversion sources as a source of raw water for a WTP for the Central District. The costs of this option are greater than a WTP located at the Waiale site, would require a reservoir to provide reliable capacity and would use water for which there is no agreement with EMI.

Economic analysis of alternate locations is presented later in this section.

Assurance of Long-Term Availability of Source Water

The County of Maui does not currently control the surface water from the Na Wai Eha streams. The primary diversions and ditch systems in the Na Wai Eha area are co-owned and controlled by the Wailuku Water Company (WWC) and HC&S.

In order to build and operate a water treatment plant for reliable potable water service to the DWS system, some guaranteed assurance of a long-term supply of source water is necessary. There are several ways the County could possibly assure a long-term supply of water but none are certain:

- The County could possibly negotiate a long-term water supply agreement with WWC and/or HC&S.

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18. It is recommended that a WTP at the Waiale site should consider productive use of the energy from dropping water from the Waihee ditch elevation to the WTP either directly or to produce electric power.

19. In the previous Candidate Strategies Chapter analyses, the costs and operating parameters of the Waihee water treatment plant option were characterized based on engineering feasibility and economic studies for a water treatment plant at a site at Reservoir 37, performed for C. Brewer & Co. Water Master Plan Report performed by Mecalf & Eddy. The size and configuration of the "Brewer" water treatment plant were different than what is being considered for the Waiale WTP. For analysis using the Brewer plant size and configuration see the Candidate Strategies Chapter.

- The County could possibly acquire title to the Na Wai Eha diversion and transmission appurtenances from WWC and/or HC&S by negotiated purchase or by eminent domain.[20]
- The County could seek and possibly obtain an allocation of water for its proposed municipal use from the CWRM in the process of the recent establishment of the Na Wai Eha area as a Surface Water Management Area. Note that an allocation from the CWRM would also be necessary in conjunction with either of the two cases above.[21]

The means and terms of assurance of a long-term source of water from the Na Wai Eha streams affect several aspects of this candidate resource strategy. These include the cost of source water, the reliability of the water treatment plant and the need for and costs associated with building raw water storage reservoir capacity. This is discussed further below.

Source Water Cost

The cost of source water for the Na Wai Eha water treatment plant options is a major factor in the cost-effectiveness of this strategy to meet future DWS potable water needs. A number of scenarios were examined with a range of alternate water costs. Most of the scenarios evaluated in the Final Candidate Strategy analyses assume that water would be provided at a fixed or escalating price, presumably according to a water source agreement and/or a tariff established by the Hawaii Public Utilities Commission. The cost of source water is a dominant but uncertain factor. For example, at a price of $0.30 per thousand gallons of source water, the Na Wai Eha water treatment strategies are among the least expensive strategies. At the price of $0.90 per thousand gallons (the price WWC proposes in its application for a *certificate of public convenience and necessity* with the Public Utilities Commission), the same water treatment strategies are among the more expensive strategies. Charts showing a comparison of total system costs assuming different raw water source costs are presented later in this section.

For the scenarios which assume substantial investments by the County for large raw water storage reservoirs, the unit cost of source water is presumed to be zero. These scenarios include instead the extensive capital costs to provide storage and transmission to create a reliable water source for water treatment facilities utilizing water available in high stream flow conditions (giving base flow preference to instream uses according to instream flow standards and preference to existing agricultural diversions).

Base Steam Flow Operation vs Raw Water Reservoir Storage

The means and circumstances of assuring a long-term reliable source of water supply will affect the reliability, treatment system operation protocols and the need for long-term raw water storage. If priority uninterrupted access to sufficient base flow from the ditch system is assured, a water treatment plant could provide reliable capacity for the DWS system without additional raw water storage. Without such reliable access, either sufficient raw water storage would have to be built or the water treatment facility would not provide reliable capacity to the DWS system.

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20. The County previously budgeted $7 million towards acquisition of the Na Wai Eha diversions and initiated the initial steps of a process to acquire the diversions by eminent domain. This appropriation has expired. Depending upon resolution of water prices by the Public Utilities Commission, acquisition of the Na Wai Eha diversion and transmission by the County, whether by negotiated purchase or by powers of eminent domain, could reduce long-term costs of this strategy.

21. An allocation of water from the CWRM for County municipal use is identified here as one method to assure a long-term supply of water for a water treatment plant. A CWRM allocation would also be necessary in conjunction with either of the two other methods cited. Unless there is an allocation of water by the CWRM for treatment for municipal use, neither acquisition of title to the diversion appurtenances nor a long-term water agreement would assure a reliable long-term supply of water. Water available for agricultural and municipal uses may also be affected by amended interim instream flow standards or the establishment of instream flow standards.

Reliable priority access to the ditch system base flow would depend on a conjunction of several as-yet uncertain conditions. First, either by acquisition of ownership of appurtenances or by long-term water source agreement, the DWS would have to gain uncontested priority control of sufficient ditch base flow to provide a reliable supply of water to the water treatment plant. Second, there would have to be sufficient base flow in the ditch system after any amended interim instream flow standards (or permanent instream flow standards) are established by the CWRM. Third, the DWS would have to obtain a sufficient allocation of water from the Na Wai Eha streams from the CWRM for the intended municipal uses of the treated water. None of these conditions have been established with certainty, and some may not be established for several years.[22]

Unless priority access to sufficient ditch system base flow is provided, raw water storage capacity would be necessary to enable a water treatment plant to provide reliable potable water supply for the DWS system. Building new reservoir capacity, however, is expensive.

The necessary reservoir capacity for a WTP with an average output of 9 MGD (the size of the proposed Waiale WTP) would depend upon several factors, primarily the amount of water and the flow profile of water available to the WTP system. Necessary reservoir capacity would vary between zero and over one billion gallons, depending upon available source water supply availability characteristics. Recent cost estimates for a new lined reservoir in the Central Maui area are about $0.11 per gallon, or about $110 million for a one-billion-gallon reservoir.

Several analyses were performed to determine the necessary reservoir size for alternate source water availability assumptions. Costs of these strategy alternatives were determined and compared. See discussion in the Economic Analysis section below.

Reservoir System Design and Operation Objectives

Several of the surface water treatment strategy alternatives incorporate a raw water storage reservoir. For these alternatives the design and operation objectives of the reservoir system must be considered. A reservoir and treatment plant system could be designed and operated to provide several types of benefits for the DWS water system.

Design and Operation for Maximum Reliable System Capacity

A reservoir system could be designed and operated to optimize the amount of reliable capacity provided to the DWS water system. The operation of the system would prioritize maintaining substantial reservoir levels to ensure adequate water supply during potential extended durations of low stream flows. A primary benefit of operating a reservoir to maximize reliable capacity would be deferral of other capital improvements that would otherwise be necessary to provide equivalent reliable capacity.

Design for Reducing Groundwater Withdrawals

An alternative objective in Central District surface water system design and operation would be maximization of treated water use to reduce groundwater withdrawals. The operation of the system would maximize production of treated water whenever water is available in the reservoir. A benefit of this operational protocol would be maximizing the reduction of groundwater withdrawals. If the variable costs of providing treated water are less than the costs of pumping groundwater sources, this operational protocol would reduce system operation costs. The variable costs

22. On June 10, 2010, the CWRM issued a "decision and order" in a contested case proceeding that considered, among other matters, a petition to amend the IIFS for the Na Wai Eha streams. The decision and order establishes amended IIFS for the Waihee and Waiehu streams that would affect the amount of allowed diversions from these streams and thus would limit the amount of base flow source water that ultimately might become available for a municipal WTP as considered in this strategy. The decision and order is currently under appeal.

of providing treated water would depend primarily upon the cost of source water for the water treatment plant.

Maximizing reservoir capacity is consistent with furthering either of the operation objectives identified above. The cost-effectiveness of providing ample reservoir storage, however, depends on different factors in each case. Several alternate reservoir operating protocols were examined in the analysis of the economics of Na Wai Eha raw water storage options.

Project Financing Alternatives

There are several alternatives by which water treatment plants and associated reservoirs and transmission improvements could be owned and financed:

Project Design, Construction, Ownership and Operation -- DWS vs Developer

A water treatment plant (and/or reservoir) could be constructed, owned and/or operated either by the DWS or by a project developer. Some combinations are possible. For example, according to the proposal under discussion for the Waiale WTP, the project would be designed and constructed by A&B. Upon completion of the WTP, ownership would be transferred to the DWS and the plant would be operated by the DWS.

It is presumed that, generally, a private project developer could construct a water treatment plant in less time than the County. In the specific case of the A&B proposed Waiale WTP, initial steps are already in process. Design for the proposed plant is essentially complete, an environmental impact statement has been prepared[23] and contractual terms have been discussed with the County.

A water treatment plant could be owned and operated by the plant developer or transferred to a third party or the County. If the plant would not be operated by the County, the water produced by the plant either would be sold to the County or would be distributed to users by an independently developed water transmission and distribution system[24].

Project Capitalization

A water treatment plant could be financed by several methods. The County could provide all necessary financing. Financing could be provided by a project developer. Financing could be shared. Some of the financing (or project funds outright) could be provided by state or federal sources.

The method of financing affects costs to the County and DWS customers. Clearly any financing or project funds provided by the state or federal government could reduce costs to the County and DWS customers. Financing by project developers may reduce or may increase costs to the County and DWS customers depending upon the terms of contractual agreements. This is discussed further below.

Policy and Feasibility Considerations

Water Allocation Issues

There are two general water allocation issues regarding use of water from the Na Wai Eha streams for treatment for potable DWS use. First, two proceedings that will allocate water from these streams are currently underway by the CWRM. Second, use of water from these streams would decrease the amount of water that would otherwise be available for agricultural and other uses. These issues are discussed briefly below:

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23. The environmental impact statement has been withdrawn, pending possible amendments.

24. In order for a non-county entity to sell water directly to "general public" customers it would have to become a public utility regulated by the Hawaii Public Utilities Commission.

CWRM ALLOCATIONS OF NA WAI EHA STREAM WATER

Two proceedings by the CWRM will formally determine allocations of water to Kuleana, instream, agricultural and municipal uses:

- Petition for Amendment of Interim Instream Flow Standards: On June 10, 2010, a decision and order was issued in a contested case before the CWRM establishing amended interim instream flow standards for the Waihee and Waiehu streams. The decision and order has been appealed to the Hawaii Supreme Court.
- Designation as a Surface Water Management Area: The Na Wai Eha streams have been designated as a surface water management area by the CWRM. This designation initiated a process that includes a one-year period of time for existing users to file claims with the CWRM followed by a process to allocate water to existing and new uses. A final decision and order from CWRM designating water for a new water treatment plant (as contemplated by the strategy outlined in this section) would certainly not be made in 2010 and would more likely be made in 2011 or later.[25] It is possible that any decision by the CWRM would be appealed to the Hawaii Supreme Court.

In its decision and order regarding interim instream flow standards the CWRM determined allocations of water for Kuleana and instream uses versus the amount of water that is allowed to be diverted from the streams for off-stream uses. In its decisions in the designation of the surface water management area and in ongoing decisions as an authority overseeing the surface water management area, the CWRM will determine allocations of water diverted from the streams to competing off-stream users as well as ongoing allocations for Kuleana and instream uses.

In the CWRM's determination of surface water management area allocations, water from the streams that is currently used by the DWS for treatment at the Iao Water Treatment Plant would be considered an existing use and would therefore be given some initial priority over new uses. Water for a new water treatment plant, however, would be considered a new use and would initially be subordinate to reasonable and beneficial existing uses. DWS municipal use would likely be considered a reasonable and beneficial use and, to the extent water would be used by DWS to serve domestic uses, could be considered a public trust use. In this latter respect, DWS municipal use may ultimately be given some priority in allocations by the CWRM.

In considering this strategy the uncertainty and timing of expected allocations should be considered. There is not currently a guaranteed long-term source of water for a new water treatment plant using water from the Na Wai Eha streams. CWRM determinations regarding allocations of water will not be finalized for several years.

AGRICULTURAL, LANDSCAPE AND GOLF COURSE IRRIGATION VERSUS MUNICIPAL USE OF STREAM WATER

Water diverted from the Na Wai Eha streams is currently used for agricultural, landscape and golf course irrigation uses (off-stream irrigation uses) with some existing use by the DWS for treatment for potable municipal uses. The Na Wai Eha water treatment strategy outlined in this section would increase the amount of water from the streams for DWS municipal uses. This strategy would therefore decrease the amount of surface water ultimately available for off-stream irrigation uses after in-stream and kuleana uses are provided for.[26] In this respect, this strategy

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25. This time line is an estimate by HDA and presumes that there will be a contested case hearing.

26. Several versions of the Na Wai Eha water treatment strategy consider using large raw water storage reservoirs to capture water during high stream flow events. This approach would decrease the impacts of using additional water from the streams on other uses. If the new treatment plant is to provide reliable potable supply, however, there will be some water taken from the streams that would otherwise be available for other uses unless the amount of additional treated water is small or unless the new raw water reservoir capacity substantially exceeds one billion gallons.

is different from the other Final Candidate Strategies which would provide new potable water supplies without substantially decreasing the amount of water available for other uses.[27]

The variations of this strategy that incorporate large raw water storage to capture high stage stream flows for municipal uses would substantially mitigate the impacts on existing agricultural uses.

As a matter of policy, the impacts of this strategy on the amount of water available for other uses should be considered in weighing its merits against other strategies.

Capitalization, Credits and Entitlements

Generally speaking, there are two distinguishable instruments of property created in contracts for developer financed water source projects.

SOURCE CREDITS

First is a "source credit," which is a "fiscal" credit good towards payment of the source component of the system development fee which is required to obtain a new water meter account with the DWS. Depending upon the terms of the applicable contract, source credits may or may not be tradable to other parties and may or may not expire at a determined date. Source credits could be denominated either in terms of a specified number of water meters (or meter equivalents) or in terms of a specified amount of dollars towards payment of system development fees.

ENTITLEMENTS

The second instrument created in contracts for source development is an "entitlement" to obtain water meters from the DWS upon demand and to obtain certification by the DWS director that the developer has provided or shown that there is a water source consistent with requirements of the County Code. Depending upon the terms of the applicable contract, any entitlements may pertain to specific land developments identified in the contract, may or may not be tradable and may or may not expire at a determined date.

Entitlements may be calculated or conjoined with source credits in the language of the contract terms but are nevertheless a distinguishable instrument of property and a distinguishable policy consideration. Source credits are a financial instrument good towards payment of a future source development fee. Entitlements are an obligation by the DWS to provide a DWS water meter (and/or a "verification" of availability of water source) upon demand of the holder at some future date.

The source credits and entitlements created in source development contracts are both real DWS liabilities. Although these liabilities are not documented in DWS standard accounting reports, they are necessary to consider in the economic assessment of the candidate resource strategies. The disposition of source credits is necessary to consider in the calculation of DWS capital costs, depreciation and debt service. Entitlements are important to consider in determining applicability of the resource capacity and water production to meet projected system water demands.

In the analyses presented in this report it is presumed that the capacity and production capability of a resource financed by a source developer by contract will be available to meet projected DWS system water demands. It is also presumed that capitalization of the water treatment

27. To some extent any use of water could be argued to affect other uses. Groundwater withdrawals, for example, can affect down-gradient surface and groundwater availability and freshwater flow to the ocean.

plants would be financed by the DWS. If the water treatment plants are financed by a source developer by contract with the DWS, it is probable that a different stream of costs would result.

From the perspective of the County, the DWS and its customers, the costs or benefits of private developer project financing depend upon specific contract terms, particularly the terms that specify how the source credits are to be denominated. Source credits are credits towards payment for the source component of DWS system development fees. Source credits are most often denominated in terms of a specified number of water meters (or 5/8" water meter equivalents) or a specified number of gallons per day credit towards land development requirements. These means of denomination are also typically applied to contractual water entitlements.

As an alternate approach, source credits could be denominated as a specified number of dollars credit towards system development fees charged for new water meters. This would have two advantages for the DWS. First, it would ensure that, if source development fees increase, the value of the source credits (like dollars) would not appreciate at the expense of other new DWS customers. Second, if source credits are tied to the costs of development of new sources, this would remove the incentive for source developers to develop only the cheapest sources and would remove the disincentive for source developers to provide sources desired by the DWS that might be more expensive, on a capacity unit basis, in terms of capital costs.

From a policy standpoint, it is important to keep in mind that when a project developer "pays" for all or some portion of a project and receives source credits towards system development fees, the developer is really only providing financing for the project, not funding the project. The potential benefit to the DWS and its customers is the savings that accrue from having to borrow less money to build the project. This benefit is offset by the decreased stream of revenue from system development fees when source credits would otherwise be redeemed. The extent to which project financing ultimately is a benefit or a cost to DWS customers depends upon a number of factors including the rate at which the source credits are used, how the source credits are denominated and whether system development fees increase in the meanwhile.

Several scenarios regarding alternate project capitalization arrangements were analyzed to determine the relative costs and benefits to the County and DWS customers. For a project that is financed half by a project developer and half by the DWS, the County (and DWS customers) would save about 13% compared to full DWS financing, assuming that the cost of the DWS system development fees does not increase.[28] If the DWS system source development fees increase significantly, developer financing could be more expensive to the County and its customers than full DWS financing.

Developer financing of projects clearly has some advantages to the County. First, with developer financing the County does not have to budget and finance all or some portion of the project. Second, to the extent that payment (or provision of source credits) for a project is contingent upon project completion and/or successful testing, a developer assumes potentially substantial project risks that otherwise would be assumed by the County.

The relative costs and benefits of developer versus DWS financing may differ substantially from project to project due to several additional factors. One factor is the fact that the project costs are not necessarily a direct function of project production capacity whereas the source credits are typically denominated in terms of project production capacity. In other words, the value of a source credit to the developer (and the equivalent liability to the DWS) is not directly related to the project cost. Another factor is that the value of the project to the DWS system is not always

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28. The specific amount of relative savings would depend on several factors. This analysis assumes that the DWS cost of debt obligations is 6% per annum, source credits would be denominated as a specified number of meters (meter equivalents), the cost of source development fees would remain constant, and that the source credits would be used at the same rate as general development growth in the overall DWS Central District.

directly related to the project production capacity or its capital cost. For example, a source that is expensive to operate is not as valuable to the DWS as a source with equivalent capacity that is economical to operate.

Reservoir Land Use and Land Acquisition

Construction of a large storage reservoir would require a substantial parcel of land. It is most economical to site a reservoir at an optimum location along the hydraulic gradient of the water source and transmission conduit. Availability of land for optimal reservoir siting is challenging in the area of the Waihee ditch system upstream of the Wailuku urbanized area.

Construction of a large storage reservoir in this area would require careful review of environmental impacts and impacts on cultural resources.

Non-Point Source Pollution in Developed and Urbanized Areas

The Waiale reservoir WTP location would use water transported in open ditches through some developed and urbanized areas. Some of the runoff from these areas enters the ditch system. The lower Spreckels Ditch runs through more urbanized areas than the higher elevation Waihee Ditch. Some system improvements may be required to limit these components of non-point source pollution by preventing runoff from entering the ditches and/or limiting the source water used by the WTP to water from the Waihee Ditch. Locating the WTP at a location upstream of the developed and urbanized areas would mitigate this issue.

Environmental Impacts

Construction of a water treatment plant could have associated environmental impacts depending upon the location.

Economic Analysis

The economic analysis of the Na Wai Eha water treatment strategies was done in several iterative rounds. Analysis of various water treatment plant scenarios is documented in the *Candidate Strategies* chapter. An initial round of analyses of the Final Candidate Strategies was presented to the Water Advisory Committee in January of 2008. This round of analyses included more thorough formulation of resource strategies, including comparison of water treatment plant location and source water pricing. A second round of analyses was presented to the Water Advisory Committee in June of 2008. This round of analyses included several refinements to the economic analysis model, including a longer fifty-year economic study period, incorporation of updated higher electrical energy costs and refined resource cost estimates. The analyses presented in this plan update include several further refinements. All of the Final Candidate Strategies incorporate updated and normalized assumptions regarding resources added in the later years of the planning period. Results assuming a range of possible energy price scenarios are presented.

In addition to the iterative rounds of analysis described above, the analyses in this plan update were reviewed to consider information developed and events occurring after the draft Central District Final Candidate Strategies Report was transmitted to the BWS for public hearing and recommendations. In particular, these recent developments include (1) the decision and order issued by the CWRM on June 10, 2010 amending the IIFS for the Waihee and Waiehu Streams and (2) the publication by USGS of a study of the effects of surface water diversions on the Na Wai Eha streams. Pertinent comments are noted in the text of this section.

Economic analysis of the final resource strategies was performed using an integrated resource analysis model that was configured for the Central District system. The results of the economic analyses are presented in charts that show the net present value of total DWS Central District system costs over a fifty-year study period. The charts show the net present value of several

cost categories for each of the strategies, including variable operating costs, fixed operating costs, capital costs, DSM program costs and total costs.

Five charts are shown on the following pages that show:

- Total costs for the fifty-year study period for alternate WTP locations and source water costs (Low Energy Price Scenario)
- Differential costs for the same strategies in the first chart (Low Energy Price Scenario)
- Differential costs for the same strategies in the first chart (High Energy Price Scenario)
- Differential costs for the same strategies with higher capital costs assumed for the Waihee WTP (Low Energy Price Scenario)
- Differential costs for the same strategies with higher capital costs assumed for the Waihee WTP (High Energy Price Scenario)

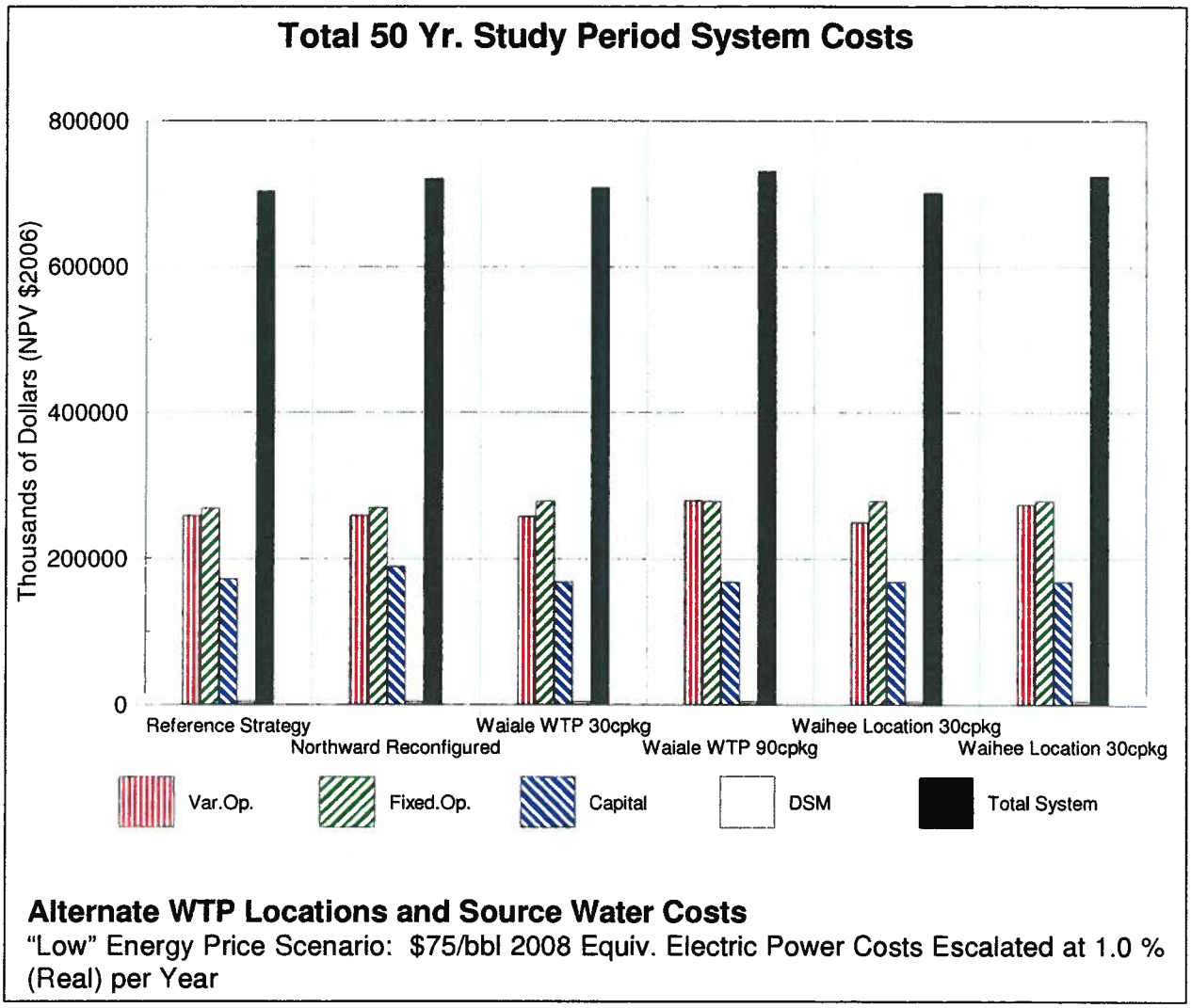
The first chart shows the total costs for the DWS Central District system for the fifty-year study period. Later charts show the same data presented as differences for each cost category for each strategy compared to a reference strategy. This format focuses on the differences between the strategies and makes differences easier to see. It is important to remember, however, that the costs represent total DWS system costs, not only the costs of the featured resources in each strategy.

The two strategies presented at the left of each chart are identical in all of the charts presented. The first strategy at the far left is the "Reference Strategy". This strategy provides the "zero point" for all of the charts that present costs as differences from the reference strategy. The second strategy from the left is the "Northward Reconfigured" basal well development strategy. This strategy is one of the Final Candidate Strategies and is provided in all of the charts as a standard basis of comparison and to indicate a reference for the magnitude of costs portrayed.[29]

Two charts are presented for each set of strategies that represent alternate energy cost scenarios. During the time in 2008 that the Final Candidate Strategies were analyzed and presented to the Water Advisory Committee, the cost of electrical power changed dramatically as crude oil prices increased from about $60 per barrel to $140 per barrel and then decreased again to about $60 per barrel. Energy costs are a significant component of the total costs of the DWS system. In order to consider the uncertainty regarding future energy costs, a "low" energy cost scenario (starting at $75 per barrel) and a high energy cost scenario (starting at $125 per barrel) are presented for each set of candidate strategies. In each scenario energy costs are assumed to increase at a rate 1% higher than the rate of general inflation.[30]

29. This is convenient since the scale of charts varies considerably depending on which strategies are included in each chart.

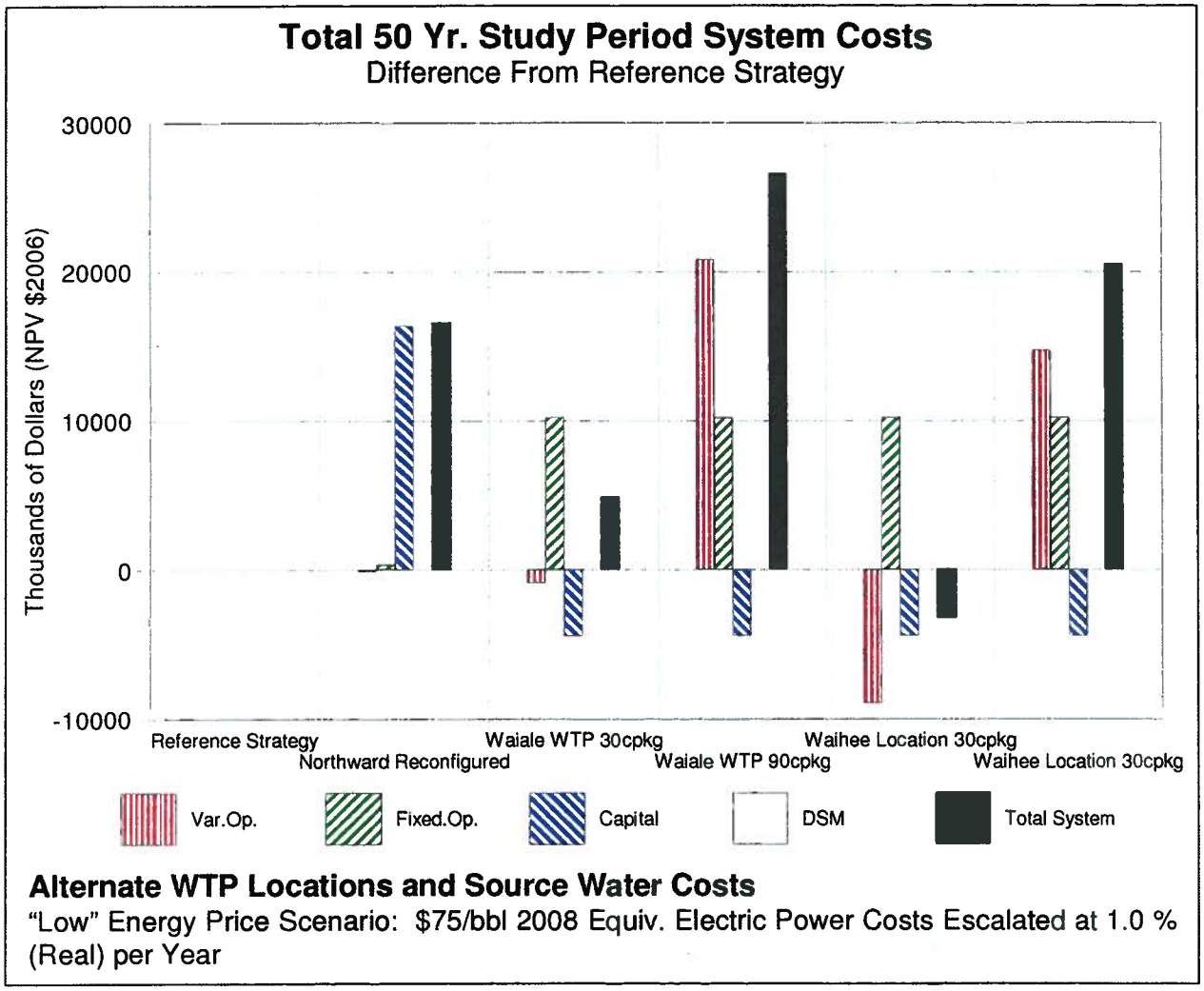
30. In addition to the analyses presented in this report several alternate assumptions regarding future energy prices were examined.



Alternate WTP Locations and Source Water Costs

The chart above shows the net present value costs for the DWS Central District system over a fifty-year study period (2005 - 2055). Variable operating, fixed operating and capital costs are significant components of total costs. The costs of the DSM conservation programs included in each of the strategies is a small component of total costs.

The differences between the costs of the strategies is discernible but is more clearly seen in the following chart that shows the same data presented as differences with respect to the Reference Strategy shown at the far left.



The chart above shows the same data as the previous chart except all costs are portrayed as differences from the Reference Strategy costs at the far left. The "Northward Reconfigured" strategy is provided as a reference. Four strategies are presented for comparison at the right side of the chart. The primary differences between the costs of these strategies are the variable costs, which include primarily the power costs and costs of purchasing raw source water for the WTP plants.

The two strategies in the center show the Waiale WTP strategy, assuming raw water source costs at $0.30 and $0.90 per thousand gallons (kgal) respectively. The energy costs of the WTP strategy are lower than the Northward basal well strategy but the additional raw water costs at $0.30 per kgal make the total variable operating costs comparable to the Northward basal well strategy. At this assumed cost of source water the Waiale WTP strategy is less expensive than the Northward basal well strategy.

At $0.90 per kgal for raw source water, however, the variable costs of the Waiale WTP strategy are substantially higher over the life of the study period. At this assumed cost of source water the overall cost of the Waiale WTP strategy is higher than the Northward basal well strategy.

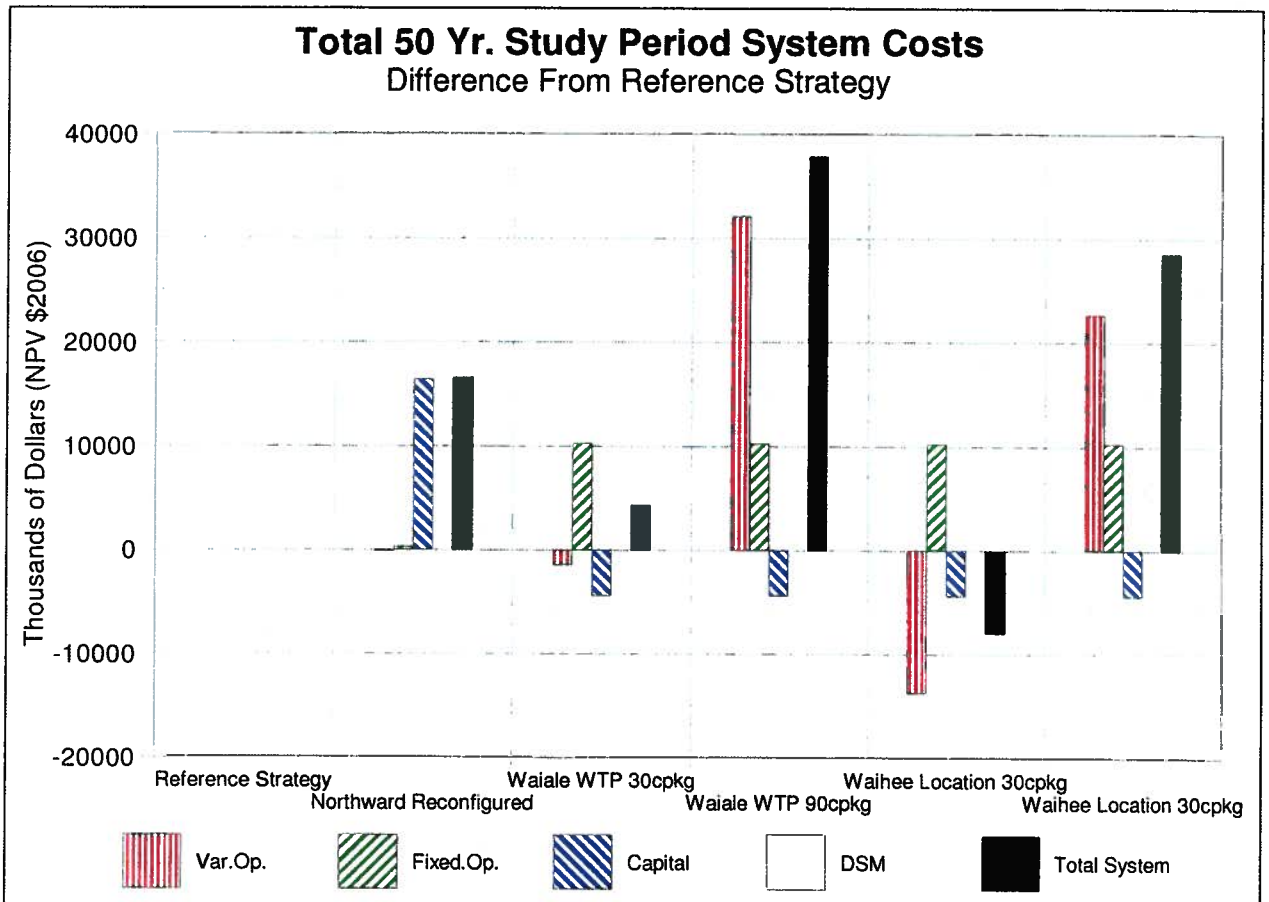
The two strategies shown at the right of the chart show the costs of the same WTP design and configuration located at a higher elevation upstream of the developed and urbanized areas of Wailuku. This location would provide for gravity flow into the Central District system and would not require pumping treated water up to the hydraulic gradient of the Central District system as required at the Waiale location. The operating and capital costs are assumed here to be equal to the Waiale WTP, but the difference in operating costs is apparent over the fifty-year planning

period. The variable costs and the resulting total costs are lower at the Waihee location. The recent implementation of amended instream flow standards on the Waihee Stream and CWRM allocations of offstream water uses may make implementation of a WTP at the Waihee location unfeasible without construction of a water storage reservoir. The costs of a reservoir are not included in the strategy characterized here.

All of the WTP strategies have higher fixed operating costs than the Northward Expansion strategy due to the higher costs of operation of treatment plants compared to groundwater wells. The capital costs of the WTP strategies are substantially lower due to the high capital costs associated with the water transmission improvements necessary in the Northward basal well strategy.

The electrical power costs included in the variable costs in this chart are the "low" energy cost scenario. These costs reflect crude oil prices of $75 per barrel in 2008 ($0.24 per KWH marginal cost in the high power consumption block for large customer MECO Schedule P tariff) assumed to escalate at 1% per year in real terms (1% higher than general inflation).[31]

All of the WTP strategies depicted here treat the capital costs of WTP construction as DWS costs financed by the County. Alternate assumptions regarding project financing were examined and are discussed in the preceding text in this section.

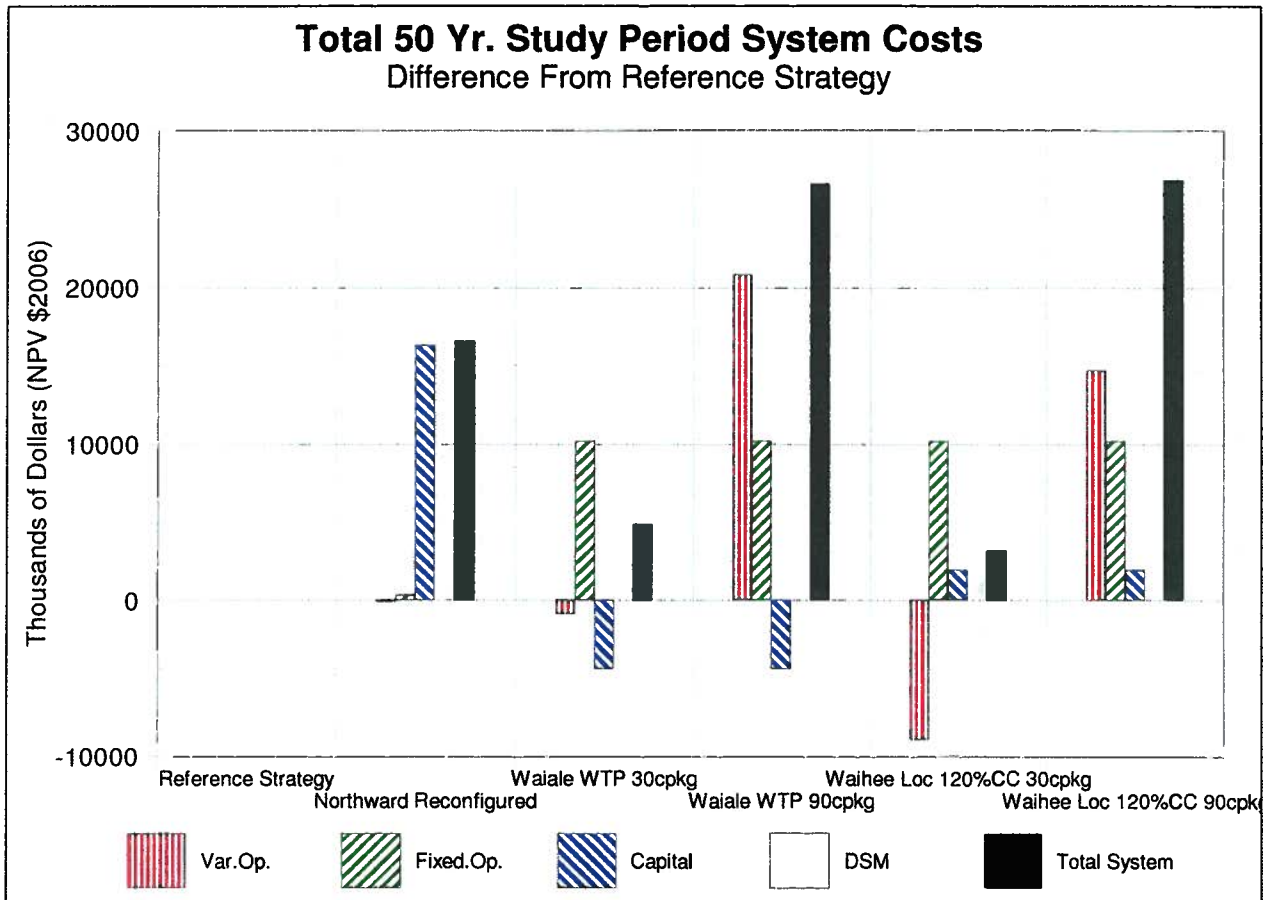


The chart above shows the same strategies and assumptions, except that higher energy costs

31. The marginal power costs included in variable costs do not include customer charge and demand charge components of electricity bills. These components are included in fixed operation costs.

are assumed. The electrical power costs included in the variable costs in this chart are the "high" energy cost scenario. These costs reflect crude oil prices of $125 per barrel in 2008 ($0.34 per KWH marginal cost in the high power consumption block for large customer MECO Schedule P tariff) assumed to escalate at 1% per year in real terms (1% higher than general inflation).[32]

In the high energy price scenario the variable costs are a higher proportion of total costs, but the relative ranking of these particular strategies does not change. Since the WTP options are more energy efficient than the Northward basal wells, the WTP strategies look more cost-effective compared to the Northward basal well strategy when higher energy costs are assumed.



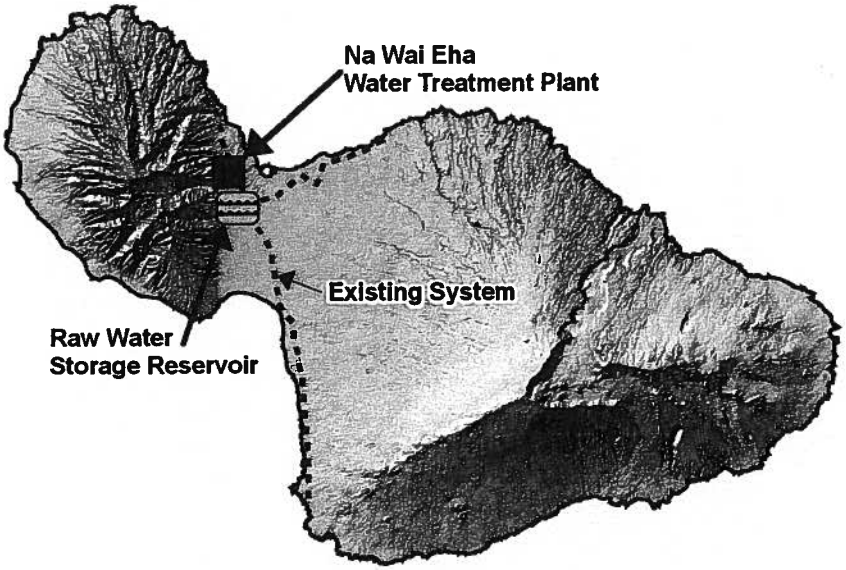
Alternate WTP Locations and Source Water Costs w Alt. Capital Costs
"Low" Energy Price Scenario: $75/bbl 2008 Equiv. Electric Power Costs Escalated at 1.0 % (Real) per Year

The chart above shows the same strategies as the immediately preceding charts, except that higher capital costs (+20%) are shown for the Waihee WTP. Since the Waihee WTP would be more remote and might have to be built on a site that is not ideally graded, the construction costs could exceed the estimated costs for the Waiale WTP. This analysis examines the extent to which increased construction costs would offset the long-term efficiency advantages of the higher-elevation Waihee location.

32. The marginal power costs included in variable costs do not include customer charge and demand charge components of electricity bills. These components are included in fixed operation costs.

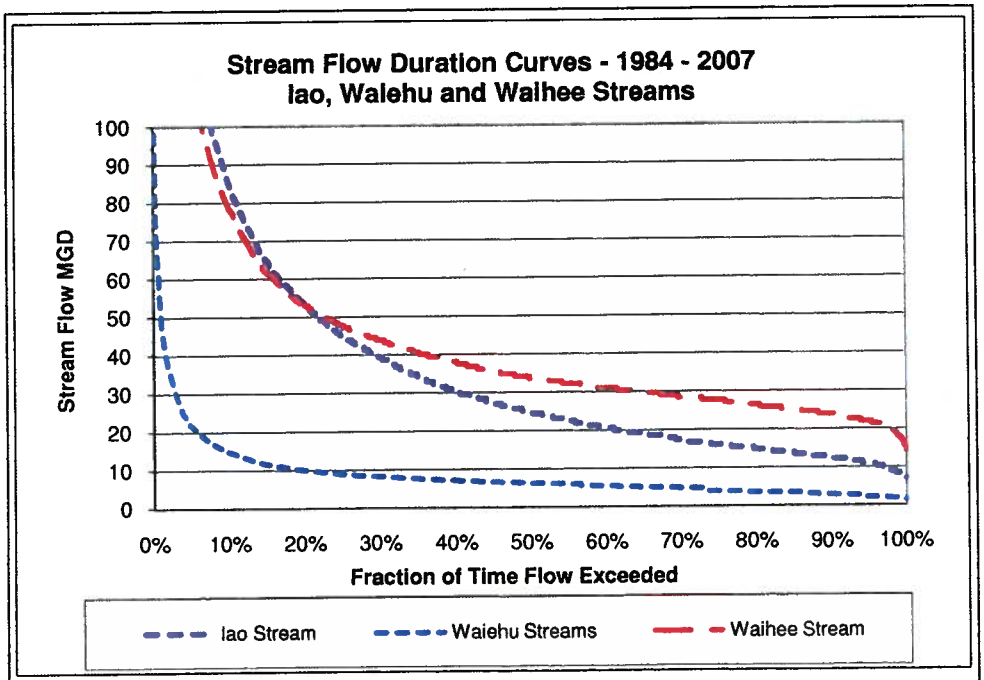
The chart above shows that for the low energy cost scenario, the Waihee location is still more cost-effective than the Waiale WTP location if construction costs would turn out to be 20% more expensive than the Waiale location. As noted above, the implementation of recent amended instream flow standards on the Waihee Stream and pending CWRM allocations of offstream water uses may make implementation of a WTP at the Waihee location unfeasible without construction of a raw water storage reservoir. The costs of a reservoir are not included in the strategy characterized here. Depending upon pending determinations by the CWRM regarding allocations of offstream water to existing and new uses, it is possible that a raw water storage reservoir may also be necessary in conjunction with a WTP as proposed at the Waiale site. In either case. the analysis presented here demonstrates the economic value of locating a WTP on a hydraulic gradient that would avoid the need to pump treated water back up to system transmission pressure.

One recommendation included in the Recommended Central District Plan section below is that any WTP located at the Waiale site should consider implementation of inline hydroelectric power generation or direct use of water pressure associated with dropping source water from higher elevations. Either of these measures could capture at least part of the economic advantages shown in the analysis described above.



Analysis of Reservoir System to Capture High Stage Stream Flows

As described above, one method to use Na Wai Eha stream water for municipal uses that would minimize impacts on existing instream and offstream irrigation uses would be to capture high stage stream flows in a large raw water storage reservoir for treatment for potable municipal use. In order to characterize this strategy, the streamflow characteristics of the Iao, Waiehu and Waihee streams were analyzed, assumptions were specified regarding allocation of water to instream and offstream uses, a mass flow reservoir analysis was performed and the resulting system characterization was analyzed in the integrated resource analysis model.



High Stage Stream Flow Storage Analysis -- Flow Duration Curves for Iao Waiehu and Waihee Streams

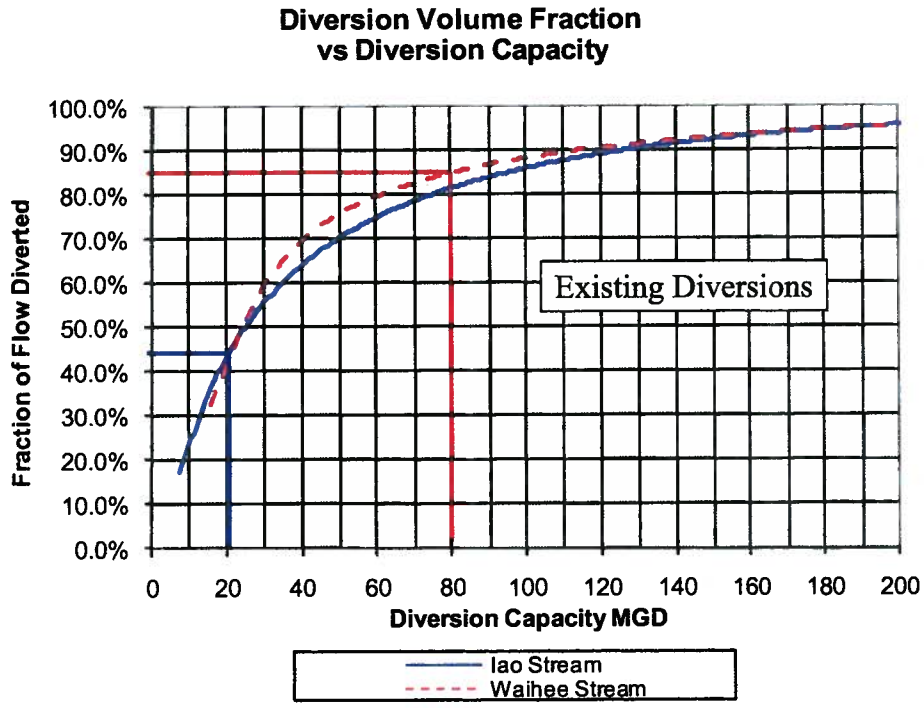
The chart above shows flow duration curves for the Iao, Waiehu and Waihee streams. The flow duration curves show the percentage of time (indicated on the horizontal axis) that stream flows exceed the daily stream flow volume (indicated on the vertical axis).

The maximum recorded flows for the Iao and Waihee streams for the 1984 - 2007 period of record are 1099 MGD and 750 MGD respectively. Daily flows larger than 200 MGD are infrequent and are not shown on this flow duration chart.

For the Iao Stream minimum daily flow for the period of record is 7.1 MGD (period of 29 days), mean flow is 41.1 MGD and median flow is 25.2 MGD.

For the Waihee Stream the minimum daily flow is 14.2 MGD (period of 6 days), mean flow is 47.4 MGD and median flow is 33.6 MGD.

Flow measurements for the Waiehu Streams are not available for the period of record but were recently estimated and reported by USGS. Total Waiehu Stream flows estimated for the period of record are: minimum daily flow 1.8 MGD; median daily flow 6.4 MGD.

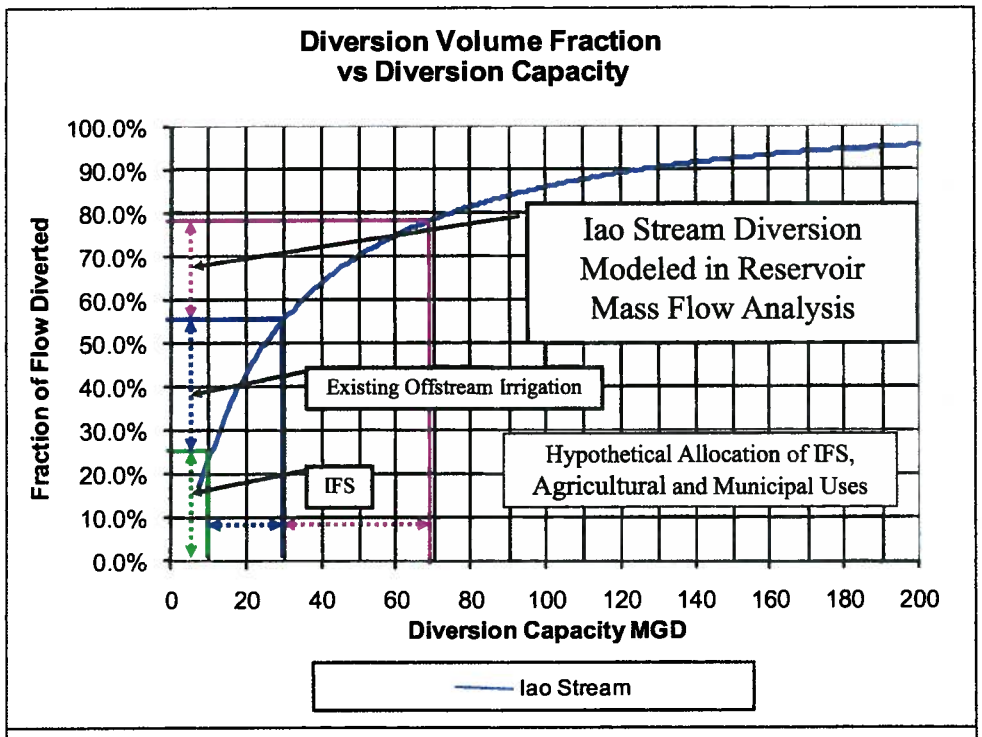


High Stage Stream Flow Storage Analysis -- Capacity and Fractions of Flow Diverted for Existing Diversions on Iao and Waihee Streams

The chart above is based on the same stream flow data as the previous chart. On this chart stream flows are expressed as the fraction of stream flow volume over the period of record (vertical axis) that occurs when stream flow is less than the stream flow rates indicated on the horizontal axis. This chart shows the fraction of total stream flow that would be diverted by diversion structures that take all stream flow from minimum flows up to the diversion capacity. This is characteristic of the existing diversion structures on the Iao and Waihee streams.

The Iao stream diversion currently diverts base stream flow from the stream to a control weir that, according to WWC estimates, diverts 20 MGD for offstream uses and returns the remainder to the stream, downstream of the diversions structure. As shown on the chart, this results in about 44% of the stream flow volume diverted to offstream uses.

The existing diversions of the Waihee Stream have a capacity of approximately 80 MGD and divert approximately 85% of the stream flow volume.



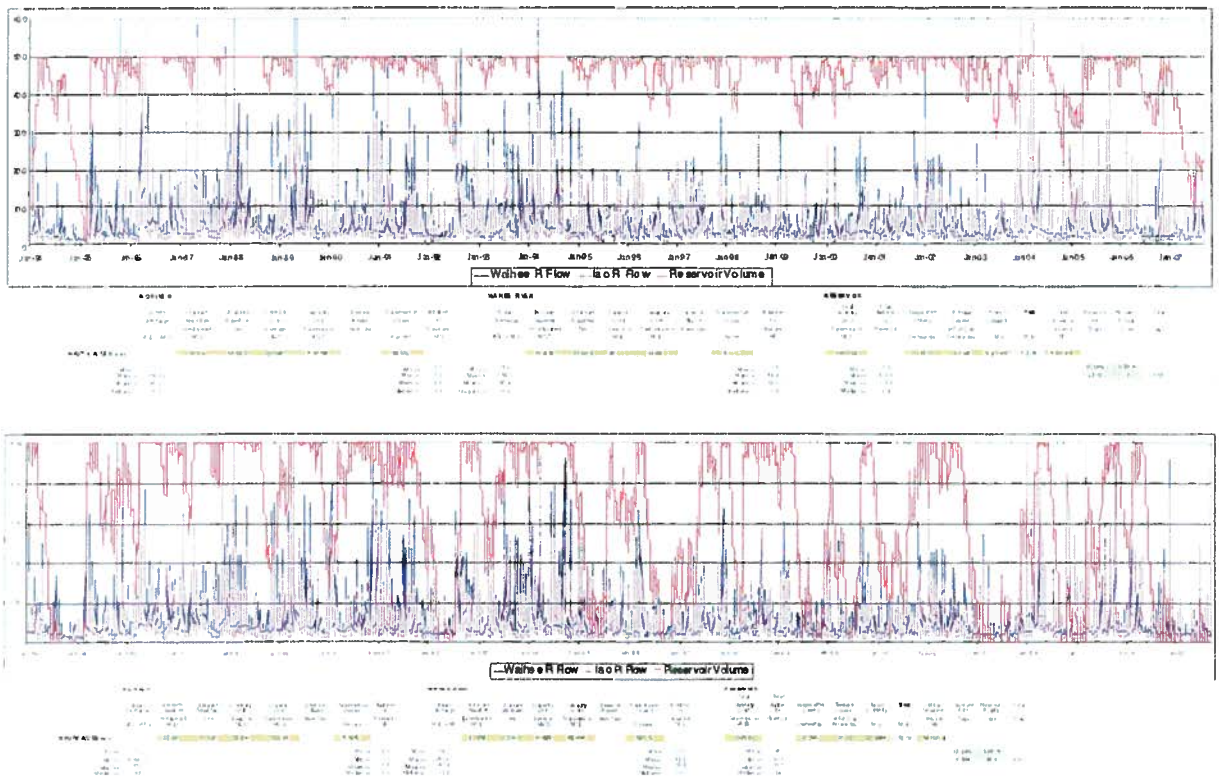
High Stage Stream Flow Storage Analysis -- Hypothetical Allocations of Stream Flow Used in Reservoir Mass Flow Analysis

In order to make a meaningful analysis of optimum reservoir size or economics, it is necessary to use specific assumptions regarding how much water will be available as source for the reservoir and how the reservoir system will be operated. The chart above shows a hypothetical allocation of Iao Stream water for purposes of analysis of a reservoir storage system considered in this section of the report. A ten MGD instream flow standard is assumed[33]. This would result in approximately 25% of the volume of the stream water to remain in the stream undiverted.

The next 20 MGD of streamflow above the instream flow standard would be diverted to the existing offstream irrigation uses (agriculture, landscape and golf course irrigation). This would be about 30% of the stream flow volume. This allocation would allow the same capacity (20 MGD) to be diverted but would amount to less total water volume (30% rather than the current 45%) for existing offstream irrigation uses.

The next 40 MGD of streamflow, equal to about 22% of the Iao Stream volume, would be diverted through the existing ditch system (with some capacity improvements) to a large storage reservoir for treatment for potable municipal use. Note that only Iao Stream water flows are depicted in this illustration.

33. The CWRM recently amended the IIFS for the Waihee and Waiehu streams. The IIFS for the Iao Stream was not amended in CWRM's recent decision. The current ongoing standard for the Iao Stream allows diversion of all stream water up to the capacity of the existing diversions (which is one subject of the current appeals of the CWRM decision).



High Stage Stream Flow Storage Analysis -- Mass Flow Reservoir Reliable Yield Analysis -- Daily Iao and Waihee Streamflows and Calculated Reservoir Volume

The charts above depict a sample of the mass flow reservoir analyses that were performed to determine the reliable yield of different sizes of raw water storage reservoirs under a spectrum of assumptions regarding instream flow standards, offstream water uses and water management priorities. The charts show daily streamflows and calculated reservoir levels from 1984 through 2007.[34]

The mass flow analyses consider the daily streamflows[35], instream flow minimums, diversion and transmission capacities and losses, offstream irrigation demand, contributions to irrigation needs from precipitation, resulting flows to the storage reservoir, evaporation losses and reliable productive system yield.[36]

34. The charts are not legible in detail here printed at letter size but can be viewed or printed in more detail from the PDF version of this report.

35. The mass flow analyses are based on historical stream flows for the Iao and Waihee streams. No specific consideration is made regarding trends in drought severity or frequency or anticipated climate change. The analyses could be revised based on specific assumptions regarding future stream flows. Waiehu streams' contributions were not considered in the analysis since estimates of daily streamflows for these streams were initially not available for the period of record.

36. The yield is the amount of water assumed to be withdrawn from the reservoir for useful purposes, in this case for treatment to produce potable municipal water supply.

Reservoir Mass Flow Analysis
Iao Stream

Instream Flow Base 10MGD
20 MGD Agricultural Diversion Capacity After IFS
40 MGD Diversion to Reservoir After IFS and Ag. Diversion

Reservoir Empty Days			
	MGD Yield		
MG Reservoir Capacity	3	6	9
30	26.0%	42.6%	51.5%
60	14.2%	31.8%	43.1%
100	8.5%	23.8%	36.4%
200	2.8%	15.2%	28.1%
300	1.8%	11.5%	23.6%
400	1.4%	8.9%	20.7%
500	1.0%	6.9%	18.6%
800	0.0%	3.6%	14.8%
1000	0.0%	2.5%	12.9%

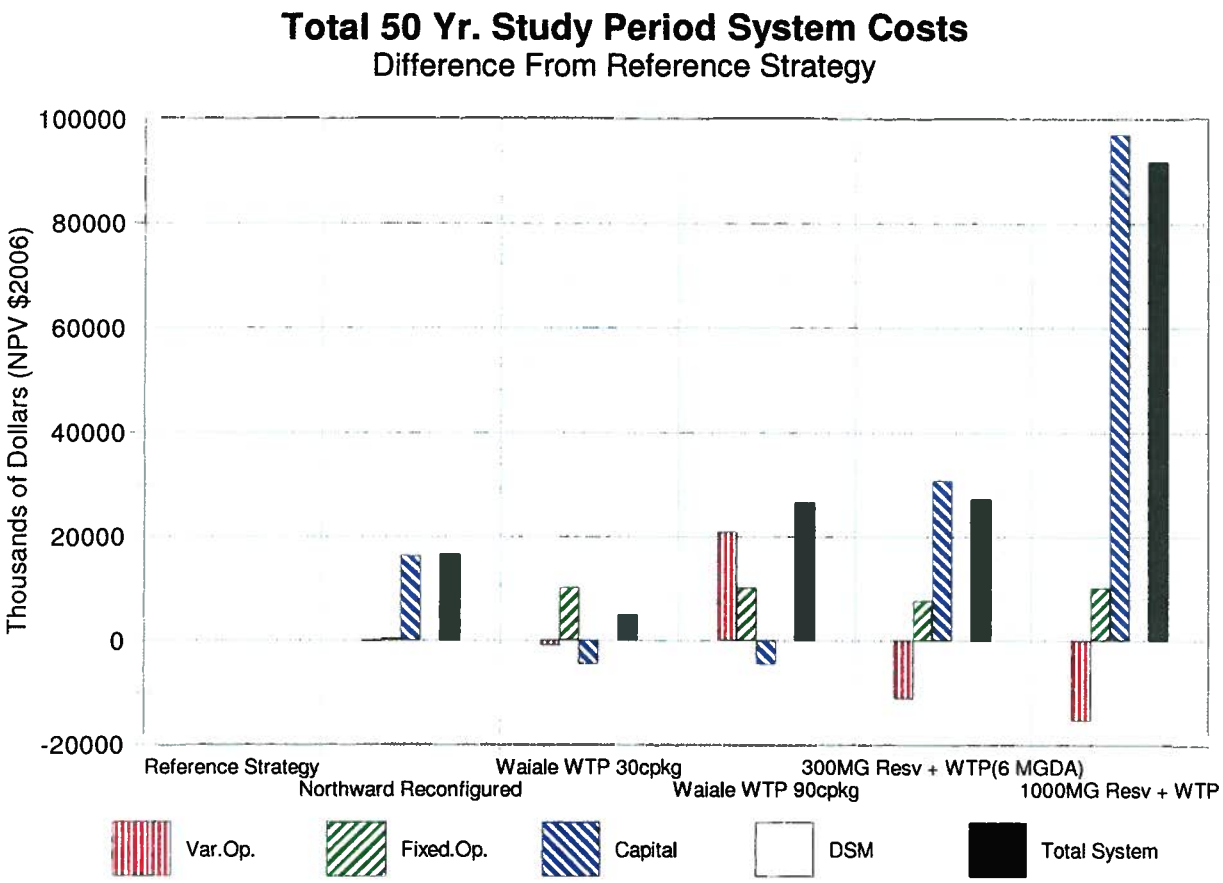
High Stage Stream Flow Storage Analysis -- Reservoir System Yield Reliability Results

The chart above shows the results of a series of mass flow reservoir analyses showing the percentage of days a storage reservoir would be empty assuming a range of reservoir capacities and average yields. In addition to the flows from diversions from high stage stream flows as described above, the results shown in the chart above include contribution to the reservoir from diverted flows that are normally used for existing offstream irrigation uses on days that precipitation is high enough that no diverted water would be necessary for irrigation purposes.

For the Central District system a raw water storage reservoir would have to be empty a small percentage of the time to provide reliable potable water supplies. As shown in the chart, a one-billion-gallon reservoir would be empty 13% of the time with a 9 MGD average withdrawal for water treatment according to the assumptions outlined above. Larger reservoir capacities would provide diminishing additional reliable system yields.[37] Other methods to increase reliable system reliable yield would be more cost-effective than extensive increases to reservoir size, such as reductions in ditch transmission losses or reduction in offstream irrigation water requirements through efficiency measures.

37. Note that adding an additional 200 MG of reservoir capacity between 800 MG and 1000 MG capacity changes the number of days the reservoir would be empty by less than 2%.

For purposes of further economic analysis, it is assumed that a 9 MGD reliable yield can be maintained with a one-billion-gallon reservoir and a 6 MGD reliable yield with a 300 MG reservoir. These assumptions are subject to several future uncertainties including the ultimate implementation of IIFS on the Na Wai Eha streams and pending CWRM allocations of offstream water to various competing uses.



Alternate WTP Strategies w Raw Water Storage Reservoir Strategies
Na Wai Eha Water Treatment Strategies Including Raw Water Storage Reservoir Strategies -- Low Energy Cost Scenario = $75/bbl Crude Oil Price Equiv Escalated at 1% (Real) per Year

The center two strategies shown in the chart above depict the costs of the Waiale WTP strategies assuming a full 9 MGD commitment of ditch base flow. These are the same analyses and results shown in the previous charts except for the difference in the vertical scale of the chart.

The right two strategies on the chart are the WTP strategies that use storage reservoirs to capture high stage stream flows from the Iao and Waihee streams as source water. These strategies assume the allocations of stream water previously discussed. Costs for raw water are assumed to be zero in the storage reservoir strategies depicted.[38]

The 300MG reservoir was determined to provide sufficient storage to provide 6 MGD "semi-reliable" yield. This strategy is characterized with a 9 MGD capacity WTP assumed to produce up to 6 MGD average output. Since this WTP produces less water than the other WTP strategies

38. In the analyses depicted here it is presumed that, if the County incurs the costs of the reservoirs, it would not have to pay volumetric fees for source water. Other assumptions have also been analyzed.

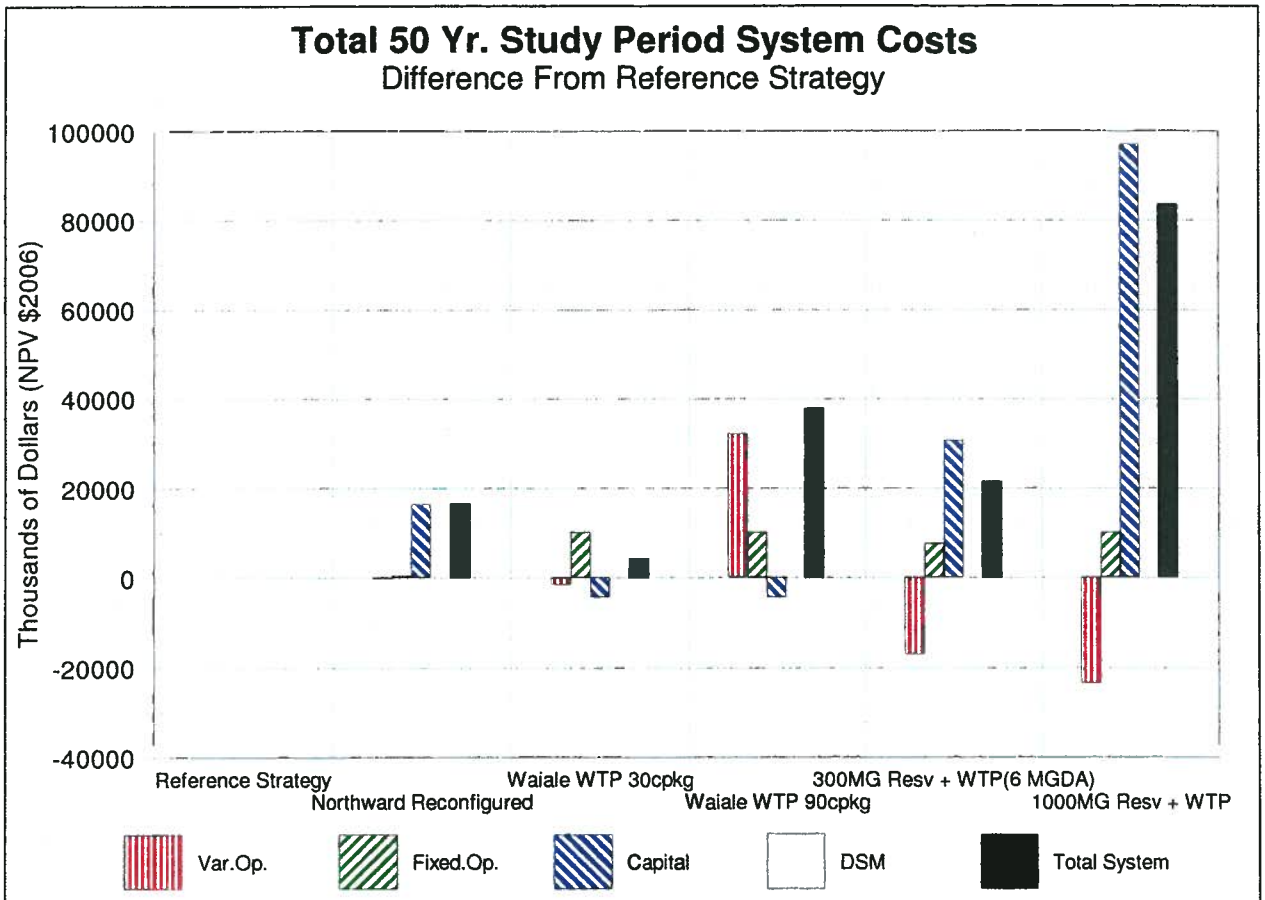
depicted, other following resources are assumed to be brought online sooner than in the other strategies.

The 1000MG reservoir was determined to provide sufficient storage to provide 9 MGD "semi-reliable" yield (assuming the specific hypothetical stream water allocations). This strategy is characterized with a 9 MGD average capacity WTP, identical to the Waiale WTP featured in the strategies that assume an allocation of 9 MGD guaranteed base flow from the ditch system.

The strategies that incorporate raw water storage reservoirs have substantially higher capital costs but lower variable operating costs (since no volumetric water charges are assumed). Based on the assumed stream water allocations used to characterize these strategies, the strategy that features the smaller 300 MG reservoir and 6 MGD average output WTP is more economically feasible. The additional costs of providing sufficient storage reservoir capacity to provide sufficient reliable yield for the larger 9 MGD average output WTP make that strategy substantially more expensive. Different assumptions regarding the allocation of Na Wai Eha stream water to instream and various offstream uses would have different economic results but the diminishing returns in reliable yield that result from increasing storage reservoir size beyond 300 MGD are difficult to justify on purely economical grounds.

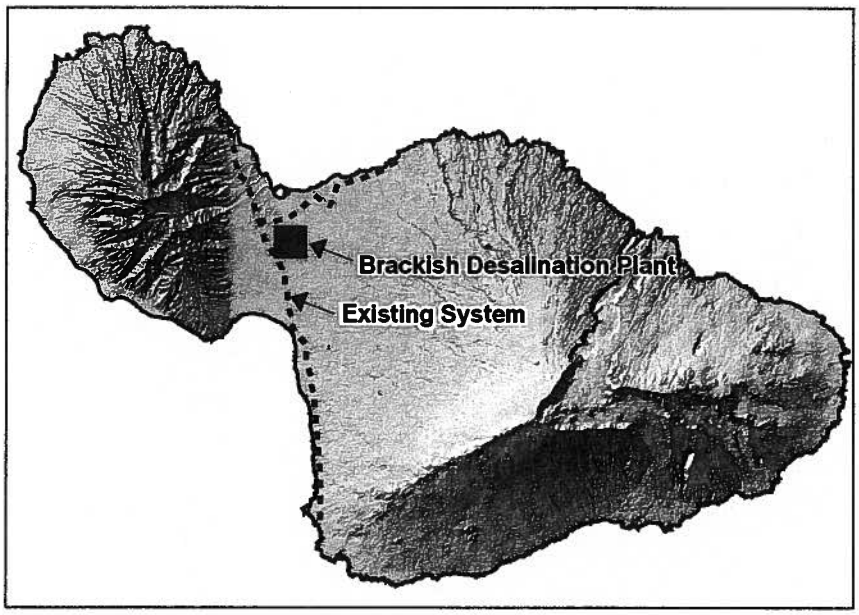
Note that the two strategies in the center that feature the Waiale WTP supplied by water from the ditch system without a reservoir would reduce the amount of water available for offstream irrigation uses. The two strategies at the right that incorporate raw water storage reservoirs would substantially reduce but would not entirely eliminate impacts on offstream irrigation water availability.

Note that all of the analyses described above are based on several hypothetical assumptions regarding the allocation of stream water to instream, offstream irrigation and reservoir system uses. These hypothetical assumptions are necessary to conduct meaningful reservoir system economic analyses. Different assumptions regarding water allocation or reservoir system operation protocols would be expected to yield different results. These analyses described above could be revised to reflect specific determinations regarding stream water allocations when these are determined.



Alternate WTP Strategies w Raw Water Storage Reservoir Strategies
Na Wai Eha Water Treatment Strategies Including Raw Water Storage Reservoir Strategies -- High Energy Cost Scenario = $125/bbl Crude Oil Price Equiv Escalated at 1% (Real) per Year

The chart above shows the same strategies as the previous chart except that high scenario energy costs are assumed.



D. Desalination of Brackish Groundwater

Summary

This strategy features construction and operation of a water treatment plant to desalinate brackish groundwater to potable standards. The characteristics of the desalination plant were derived from a recent study performed for the County of Maui.[39]

All of the implementations of this strategy include a "basic" Demand-Side Management program that is designed to attain 15% of the water efficiency technical potential in a period of five years.[40]

This strategy is one of the most expensive strategies due to the combination of capital and operation costs. Water produced by desalination of brackish water is the most expensive alternative in terms of operation costs.

Project Design Scenarios

The configuration of a desalination plant was examined in the *Candidate Strategies* chapter. The configuration of the plant in the final strategies analysis is the four-train configuration that was optimized in the previous analysis. The characteristics of this project are reported in detail in Appendix B.

Policy and Feasibility Considerations

Desalination of water is particularly energy-intensive. For this reason extensive water desalination represents a commitment to energy consumption and its corollary considerations: needs for energy generation resources, impacts on greenhouse gas emissions and energy price volatility.

Desalination also requires disposal of brackish water. Removal of salt from source brackish water increases the salinity of desalination plant effluent. Concern regarding disposal of brack-

39. *Central-South Maui Desalination Feasibility Study*, Brown & Caldwell

40. The DSM program included in each of the Final Candidate Strategies is described in a separate section on this subject and in Appendix A.

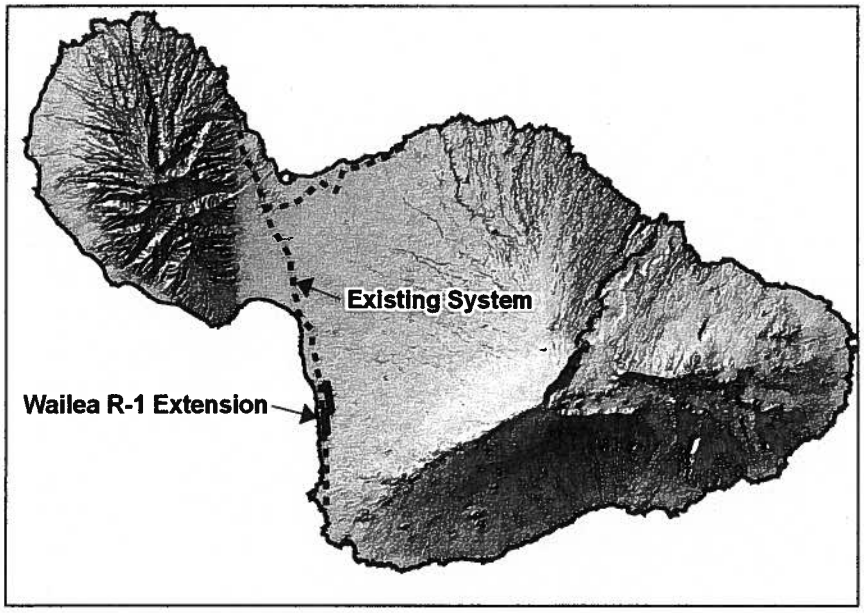
ish effluent is not as serious as similar concerns regarding the desalination of seawater which results in a much more concentrated effluent.

Brackish source water in the Central Maui area could contain contaminants that may pose public acceptance concerns.

Economic Analysis

The economics of brackish water desalination were addressed in the *Candidate Strategies* chapter and its supporting analyses. It was determined in those analyses that brackish water desalination was clearly preferable to seawater desalination for economic reasons. In addition it was determined that for reasonable additional capital costs, a treatment plant with multiple independent parallel filter trains would provide cost-effective benefits by increasing the effective reliability of the plant.

In the analysis of the Final Candidate Strategies in this report, the desalination strategy is characterized identically to the characterization in the *Candidate Strategy* chapter except that several alternate scenarios regarding future energy costs are considered. The economic analysis of this strategy is presented and discussed in the *Comparison of Final Candidate Strategies* section below.



E. Extensive Conservation and Wastewater Recycling

Summary

This strategy features meeting new water needs by increasing recycled water use and implementing water conservation measures to capture three times as much conservation potential as the programs in the other Final Candidate Strategies. This strategy characterizes maximizing the efficient use of water.

This strategy includes building new non-potable water transmission infrastructure to provide water from the existing Kihei Wastewater Treatment Plant (WWTP) to the South Maui area where water could be used to displace existing potable water now used for outdoor irrigation purposes.

This strategy is not the least expensive strategy but has several positive attributes regarding meeting the WUDP planning objectives and may play an important role as a contingency strategy if the viability of other strategies is not verified for an extended period of time.

Project Design Scenarios

There are two principal components to this strategy. One component is increased use of recycled wastewater to displace existing and future potable water use. The second component is more aggressive DSM water conservation programs than what are assumed in the other Final Candidate Strategies. Several scenarios were considered to analyze the maximization and optimization of both of these components.

Wastewater Recycling Options

Several possible water recycling scenarios were examined and described in the Central District Final Candidate Strategies Report transmitted to the BWS for public hearings and recommendations:

- R-1 water transmission and distribution extension from the Kihei Wastewater Treatment Plant (WWTP) to the South Kihei and Wailea areas:
    - Designed with sufficient laterals to displace 3.0 MGD of potable water use.

    - Capital costs estimated at approximately $50 million.
- R-1 water transmission extension from the Kihei WWTP to the Wailea area:
    - Designed to reach large-consumption properties to displace 1.5 MGD of potable water use.
    - Capital costs estimated at approximately $20 million.
- Upgrading the Kahului WWTP from R-2 to R-1 capability and transmission and distribution extension to the Kahului area:
    - This scenario was determined to be infeasible for economic and logistical reasons.

It was initially determined that the 1.5 MGD Wailea transmission extension option was more cost-effective than the substantially more expensive 3.0 MGD option or upgrading the Kahului WWTP. The 1.5 MGD potable displacement Kihei WWTP option was the scenario examined as a strategy in the Central District Final Candidate Strategies Report transmitted to the BWS for public hearings and recommendations. One recommendation of that report was that a study should be performed to (1) verify the amount of potable water in the Wailea area that could be displaced with R-1 water, (2) verify total project costs and Kihei WWTP long-term production capability and (3) investigate costs and feasibility of alternative strategies to deliver treated wastewater to displace potable use.

The Department of Environmental Management (DEM) published a South Maui R-1 Recycled Water Verification Study dated December 28, 2009. In that study several additional R-1 recycling options were identified that extend transmission infrastructure for the Kihei WWTP including several existing and planned projects. The following projects identified in the DEM study (beyond the existing and planned projects) were analyzed and included in this plan update:

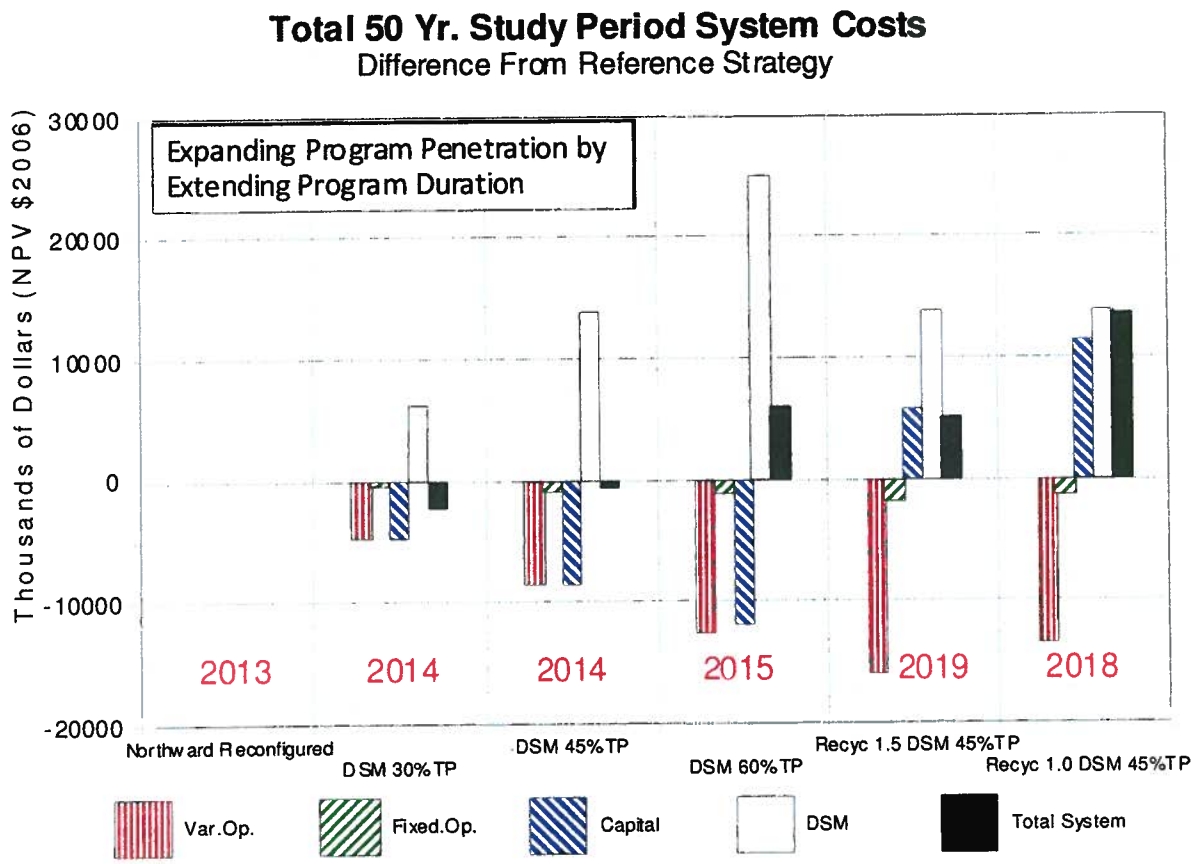
- Option 1: Waipulani Street / South Kihei Road
- Option 3: Liloa Drive / Halekuai Street
- Option 5b: North Kihei / North South Collector Road

The discussion and analysis of the Wailea Transmission option is presented below as it was included in the Central District Final Candidate Strategies Report transmitted to the BWS for public comment and recommendations. Supplemental discussion and analysis of the options identified in the subsequent DEM study are presented in a supplement at the end of this section.

Water Conservation Program Options

Several possible water conservation program scenarios were examined. In previous analyses the economics of different intensities of conservation program implementation was examined. Conservation programs can be designed to reach increasing proportions of conservation technical potential by providing more extensive program delivery mechanisms and by targeting progressively more expensive potential water saving fixtures, appliances and irrigation system improvements. Conservation programs can also be designed either to attain water savings at less cost to the utility by implementing programs at a slower pace or, alternatively, by accelerating the program water savings by more intensive and more expensive methods.

A series of alternative conservation program implementation scenarios was examined in each of the rounds of analyses of the Final Candidate Strategies. In the most recent round of analyses several implementation scenarios were examined with respect to several assumptions regarding future energy prices. The programs designed to reach 45% of conservation technical potential in ten years that were assumed in the previous rounds of analyses were retained in this Final Candidate Strategy presented in this report.



DSM and Wastewater Recylcing Scenarios
Comparison of Alternate DSM Penetration Scenarios and Wastewater Recycling Options with Corresponding Dates for the Next Required Discretionary New Supply Resource Addition -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

It should be noted that the first steps recommended to implement any of the conservation program scenarios are similar. Unless there is an urgent crisis regarding sufficient water supplies it is prudent and economical to be diligent but careful and methodical about establishing an aggressive DSM implementation capability in the DWS. The intensity of program implementation can be adjusted as experience with program implementation is attained and as future uncertain water needs and supply option situations continue to develop.

Policy and Feasibility Considerations

Both water conservation and wastewater recycling were consistently viewed as favorable options in discussions with the Water Advisory Committee. These options promote responsible use of water and promote the objective of sustainability.

Economic Analysis

The chart above compares the net present values of the costs for the DWS Central District system for the fifty-year study period (2005 - 2055). All costs are shown as differences compared to the Northward Basal Groundwater strategy (Northward strategy) depicted at the far left. The Northward strategy includes the same DSM programs assumed in all of the other final candidate resource strategies designed to attain 15% of the DSM "technical potential" in a period of five years[41]. The next three strategies depicted in the center of the chart show increasing intensities of DSM implementation to attain 30%, 45% and 60% of the technical potential (T.P.) in seven,

ten and twelve years respectively. All of the programs are assumed to begin in calendar year 2010.

The costs of the DSM programs (in excess of the Northward strategy DSM costs) are shown. These are offset by lower variable operating costs (due primarily to reductions in energy costs that result from smaller water production requirements) and lower capital costs (that result from deferral of new supply resources). The 30% and 45% T.P. options are the most cost-effective. The increasing program implementation and DSM measure costs of the 60% T.P option are not offset by corresponding variable and capital costs.

The "Extensive Conservation and Wastewater Recycling" Final Candidate Strategy is the second strategy from the right on the chart above. This strategy features the 45% T.P. DSM and 1.5 MGD Kihei WWTP R-1 transmission extension resources. Assuming the "low" energy cost scenario this strategy is more expensive than the Northward strategy. This strategy is compared to the other Final Candidate Strategies in the next section of this report. If only 1.0 MGD of potable water would be displaced by the R-1 transmission line, this strategy would be substantially less cost-effective.

Shown just above the horizontal axis labels of the chart are the date that new "discretionary" supply resources would be needed to maintain reliable water supply for the Central District system.[42] The sequence and dates for all resources in each strategy shown in the chart are shown on the table on the following page. Without any DSM programs, the next discretionary supply resource addition would be needed in 2012. With the DSM programs assumed in all of the other Final Candidate Strategies in this report (designed to attain 15% technical potential), the next discretionary supply resource would be needed in 2013. More aggressive DSM program implementation to attain 30%, 45% and 60% of the technical potential defers the need for the next needed resource until 2014, 2014 and 2015 respectively. In conjunction with a DSM program designed to attain 45% technical potential, the Kihei 1.5 MGD WWTP R-1 transmission extension strategy further defers the need for the next supply resource until 2019.[43] If this strategy only defers 1.0 MGD of potable water otherwise supplied by DWS, the next needed resource would be deferred until 2018.

Aside from any economic costs and benefits, these strategies represent viable options to meet mid-term (2012 - 2019) water demands if other strategies are delayed or are not feasible.

The following table indicates the source data for the chart above. The sequence and dates for new resource additions are shown for each of the strategies. The date of the next required discretionary new supply resource in each strategy is highlighted.

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41. See discussion of the characterization and analysis of Central District DSM end uses, technical potential and DSM program analysis in Appendix A of this report.

42. The next "discretionary" resource is the first resource needed beyond the committed and near-term resources that are assumed to be implemented in all strategies.

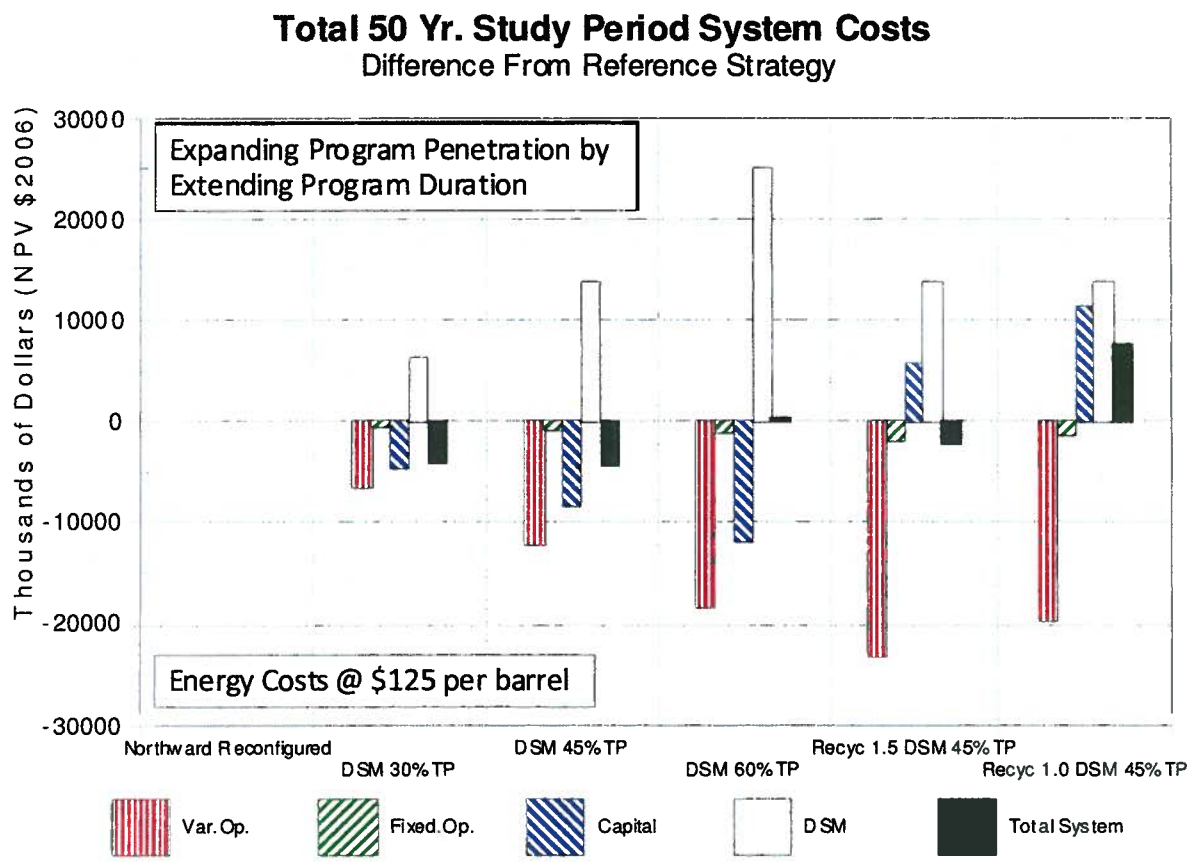
43. The capacity of the R-1 transmission line extension would substantially exceed 1.5 MGD. The strategy assumes that the amount of recycled water supplied by the line would displace 1.5 MGD of potable water supplied by the DWS system that is or would otherwise be used for irrigation uses.

Central District Final Candidate Strategies

"Low" Energy Price Scenario: $75/bbl 2008 Equiv. Electric Power Costs Escalated at 1.0% (Real) Per Year

System:	Central System	Central System	Central System	Central System	Central System	Central System
Strategy Name	**Northward (DSM 15% TP)**	**DSM 30%TP**	**DSM 45%TP**	**DSM 60%TP**	**Recyc 1.5 DSM 45%TP**	**Northward w No DSM**
Description	Multiple 350GPM Wells					
Demand Projection	Base Case	Base Case	Base Case	Base Case	Base Case	Base Case
Demand Proj.Source	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7
Notes:						
Var.Op.Esc.Rate	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	741,826	741,826	741,826	741,826	741,826	741,826
Cap.Shortfall 2006-30 MGD-Yrs.	19.244	19.249	19.286	19.215	19.206	19.268
Cap.Shortfall 2007-30 MGD-Yrs.	11.792	11.797	11.834	11.764	11.754	11.817
Cap.Shortfall 2008-30 MGD-Yrs.	4.365	4.370	4.408	4.336	4.327	4.389
Difference from Base Plan	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**
25 Year Planning Period Costs:						
Variable Operation Cost NPV	0	-3,149	-5,582	-7,907	-9,897	3,537
Fixed Operation Cost NPV	0	-322	-526	-719	-1,197	301
Capital Cost NPV	0	-4,215	-5,994	-8,266	894	3,858
DSM Program Cost	0	6,195	13,802	25,104	13,802	-4,314
Total System Cost NPV	0	-1,491	1,700	8,212	3,602	3,382
50 Year Study Period Costs:						
Variable Operation Cost NPV	0	-4,537	-8,513	-12,591	-15,941	4,792
Fixed Operation Cost NPV	0	-424	-749	-1,065	-1,823	393
Capital Cost NPV	0	-4,581	-8,397	-11,901	5,801	4,258
Total System Cost NPV	0	-2,112	-593	6,068	5,104	4,413
25 Year Planning Period Rate Impacts:						
Avg. Annual DWS Rate Increase	3.60%	3.67%	3.67%	3.72%	3.79%	3.61%
Levelized Unit Cost ($/kgal)	$3.659	$3.652	$3.658	$3.657	$3.673	$3.656

Resource Addition Sequence:												
	DSM DTD Indr 15TP	2010	DSM DTD Ind 30%	2010	DSM DTD Ind 45%	2010	DSM DTD Ind 60%	2010	DSM DTD Ind 45%	2010	No DSM	20
	DSM DTD Outdr 15TP	2010	DSM DTD Out 30%	2010	DSM DTD Out 45%	2010	DSM DTD Out 60%	2010	DSM DTD Out 45%	2010	No DSM	20
	Kupaa Well	2008	Kupaa Well	2008	Maui Lani Wells	2008	Kupaa Well	2008	Kupaa Well	2008	Kupaa Well	20
	Maui Lani Wells	2008	Maui Lani Wells	2008	Kupaa Well	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	20
	Generic Backup 1	2009	Generic Backup 1	2009	Waikapu South 1	2009	Generic Backup 1	2009	Generic Backup 1	2009	Generic Backup 1	20
	Iao Tank Site Well	2009	Iao Tank Site Well	2009	Generic Backup 1	2009	Iao Tank Site Well	2009	Iao Tank Site Well	2009	Iao Tank Site Well	20
	Waikapu South 1	2009	Waikapu South 1	2009	Iao Tank Site Well	2009	Waikapu South 1	2009	Waikapu South 1	2009	Waikapu South 1	20
	Waikapu Tank Well	2009	Waikapu Tank Well	2009	Waikapu Tank Well	2009	Waikapu Tank Well	2009	Waikapu Tank Well	2009	Waikapu Tank Well	20
	Waikapu South 2	2011	Waikapu South 2	2011	Waikapu South 2	2011	Waikapu South 2	2011	Waikapu South 2	2011	Waikapu South 2	20
	Maluhia (2)	2013	Maluhia (2)	2014	Maluhia (2)	2014	Maluhia (2)	2015	Kihei Recyc 1.5MGD	2014	Maluhia (2)	20
	Generic Backup 1	2014	Wailena (2)	2015	Generic Backup 1	2016	Generic Backup 1	2016	Maluhia (2)	2019	Generic Backup 1	20
	Generic Backup 1	2016	Generic Backup 1	2016	Wailena (2)	2018	Wailena (2)	2018	Wailena (2)	2020	Generic Backup 1	20
	Wailena (2)	2016	Generic Backup 1	2018	Waipili (2)	2019	Waipili (2)	2020	Generic Backup 1	2021	Wailena (2)	20
	Waipili (2)	2018	Waipili (2)	2019	Kahakuloa (4)	2020	Kahakuloa (4)	2021	Waipili (2)	2021	Waipili (2)	20
	Kahakuloa (4)	2019	Kahakuloa (4)	2020	Generic Backup 1	2021	Generic Backup 1	2022	Kahakuloa (4)	2023	Kahakuloa (4)	20
	Generic Backup 1	2020	Generic Backup 1	2021	Generic Backup 1	2022	Generic Backup 1	2024	Generic Backup 1	2024	Generic Backup 1	20
	Waihali (2)	2021	Generic Backup 1	2023	Generic Backup 1	2024	Waihali (2)	2024	Waihali (2)	2025	Waihali (2)	20
	Po'elua (2)	2022	Waihali (2)	2023	Waihali (2)	2024	Po'elua (2)	2025	Po'elua (2)	2026	Po'elua (2)	20
	Generic Backup 1	2024	Po'elua (2)	2025	Po'elua (2)	2025	Supplemental Wells	2027	Supplemental Wells	2027	Generic Backup 1	20
	Supplemental Wells	2025	Supplemental Wells	2026	Supplemental Wells	2027	Generic Backup 1	2028	Supplemental Wells	2029	Supplemental Wells	20
	Supplemental Wells	2027	Supplemental Wells	2027	Supplemental Wells	2028	Supplemental Wells	2029			Supplemental Wells	20
	Supplemental Wells	2028	Supplemental Wells	2029	Supplemental Wells	2030	Supplemental Wells	2030			Supplemental Wells	20
	Supplemental Wells	2029	Supplemental Wells	2030							Supplemental Wells	20



DSM and Wastewater Recylcing Scenarios

Comparison of Alternate DSM Penetration Scenarios and Wastewater Recycling Options -- "High" Energy Cost Scenario = $125/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows the same options as the previous chart except that the high energy cost scenario is assumed. Assuming higher energy prices, the more intensive 60% T.P. DSM program implementation is more cost-effective than the less aggressive options. The "Extensive Conservation and Wastewater Recycling" Final Candidate Strategy also becomes more cost-effective and costs less than the Northward strategy.

SUPPLEMENTAL ANALYSIS OF DEM R-1 RECYCLED WATER OPTIONS

Subsequent to the transmission of the Central District Final Candidate Strategies Report to the BWS for public hearings and recommendations, the Department of Environmental Management (DEM) published a South Maui R-1 Recycled Water Verification Study dated December 28, 2009 (DEM Verification Study). In that study several alternate R-1 recycling options were identified that would expand the transmission infrastructure for the Kihei WWTP.

The DEM Verification Study examines the Kihei WWTP available R-1 recycled water capacity and identifies the costs and the volume of displaced potable and non-potable water for each of several alternative projects. Each of these projects was reviewed and three of the most promising projects (beyond the existing and currently planned R-1 expansion projects) were selected for supplemental analysis as part of this Plan Update. These projects were analyzed both individually and combined into two phases:

PHASE 1:

- Option 1: Waipulani Street / South Kihei Road

  This line extension would serve nine properties and would displace 200,000 GPD of potable and 47,000 GPD of non-potable water at a cost of $1,215,000.

- Option 3: Liloa Drive / Halekuai Street

  This line extension would serve two properties, including future irrigation needs of the Kihei High School, displacing 245,000 GPD of potable water at a cost of $1,135,350. Timing would depend upon timing of the high school construction.

PHASE 2:

- Option 5b: North Kihei / North-South Collector Road

  This extension would serve at least three properties displacing 553,000 GPD of potable water at a cost of $6,300,000 (including $3,800,000 line extension cost identified in the DEM Verification Study plus $2,500,000 for an addition of a one-million gallon storage tank). Timing and feasibility would be subject to the rights-of-way and construction of the North-South Collector Road.

Policy and Feasibility Considerations

KIHEI WWTP R-1 PRODUCTION CAPACITY

The capacity of the Kihei WWTP to provide additional R-1 water was examined in the DEM Verification Study. Based on that analysis and assuming some reasonable future increases in wastewater inflows resulting from expected growth in the Kihei area, the Kihei WWTP will have sufficient capacity to provide R-1 water for the three projects identified above.

ALLOCATION OF COSTS AND REVENUES BETWEEN DEM AND DWS

The economic analysis presented below demonstrates that the capital and operating costs of the three projects considered in this Plan Update (born by DEM) are cost-effective in terms of the resulting savings in DWS capital and operating costs over the life of the projects. The analysis considers economics from an overall County perspective but does not differentiate or specifically allocate costs or revenues between the two agencies.

DEM will need sufficient revenues to fund the construction and operate and maintain the projects. Currently, the costs of producing and distributing R-1 water are not covered by DEM's R-1 water sales revenues. R-1 water production and distribution costs are subsidized by DEM's revenues from rates charged for general wastewater service. Future R-1 water sales revenues resulting from new R-1 line extension projects will not cover the incremental costs of the projects.

Since the displacement of potable water demand that would result from the R-1 line extensions would provide substantial benefits for DWS customers (in terms of lower potable system capital and operating costs), it may be appropriate to fund all or some portion of the costs of the new R-1 line extension projects with revenues collected by DWS for potable water service. This would be a rate design issue that would address the allocation of DEM R-1 water service capital and operating costs to DWS customers, DEM R-1 water service customers and DEM wastewater service customers. A reasonable allocation of revenues is certainly feasible but is a matter that will need to be explicitly addressed and ultimately approved by the Council in setting annual DEM and DWS service rates.

SUFFICIENT CAPITAL AND OPERATING ACCOUNTS AND BUDGETS

As discussed above, DEM will need sufficient revenues to construct and operate its R-1 water production and distribution system. Sufficient revenues can be provided by reasonable rate design. In addition, DEM will need sufficient capital and operating budgets on an ongoing basis.

Depending upon the source of any revenues from DWS, any pertinent restrictions on fund accounts and applicable standard accounting practices, it may be necessary to establish new accounts for capital and operating funds for these projects.

WATER SERVICE RELIABILITY STANDARDS AND PROTOCOLS

R-1 water service does not need to be as reliable as potable water service (which must meet demanding health and safety needs). R-1 water service does need to be sufficiently reliable to meet irrigation needs. It would be reasonable to establish some standards to express the level of service reliability expected and relied upon for R-1 water system planning and operation.

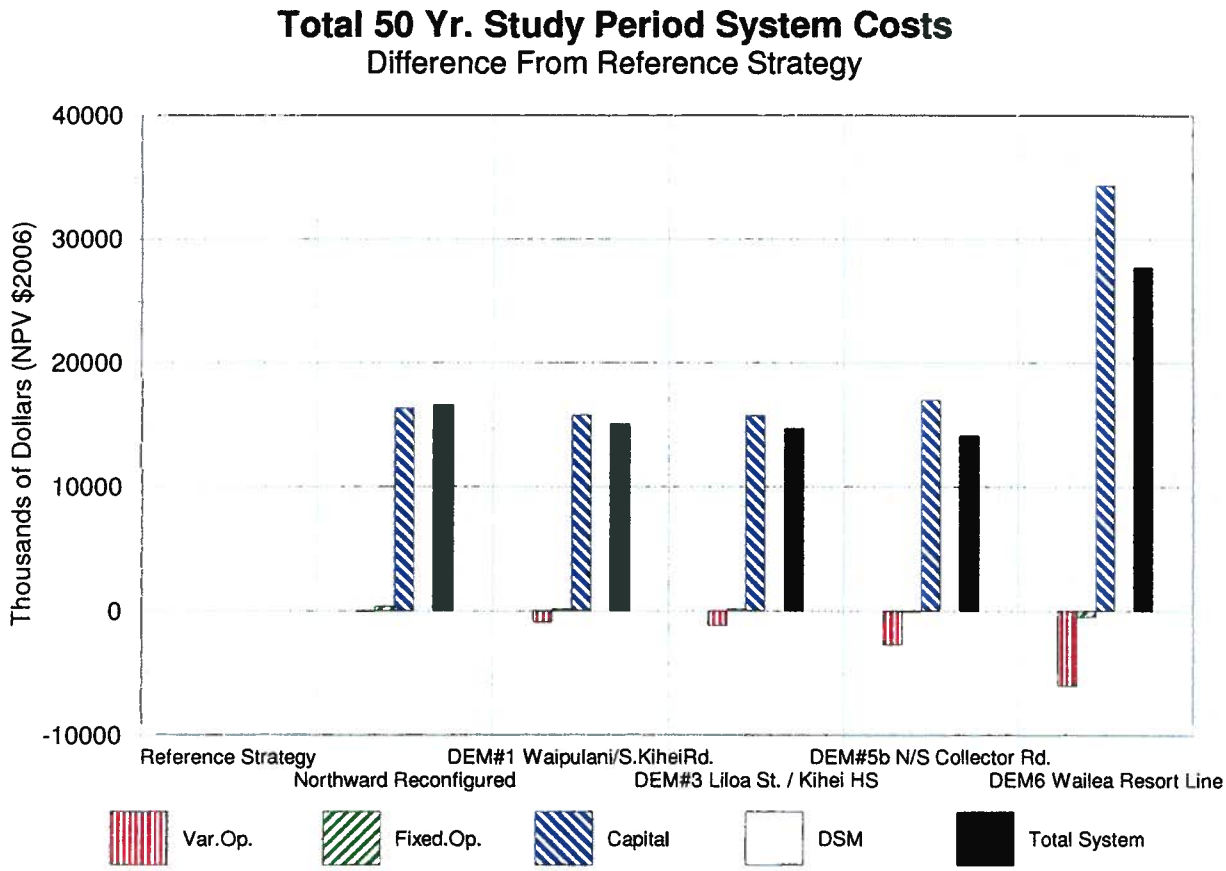
In the event that the R-1 water production capability of the Kihei WWTP is interrupted for any extended period of time, it may be feasible to provide backup water to the DEM R-1 distribution system from the DWS potable water system on an as-available basis. In addition to R-1 service reliability standards as discussed above, this would require protocols for provision of backup water from the DWS system to (1) ensure that DWS potable water system service reliability would not be degraded and (2) allocate revenues and costs.

Economic Analysis

Each of the three selected projects identified in the DEM Verification Study was examined individually and in phases using the integrated capacity expansion and production cost model for the Central District system. Several charts are presented below that present the results of several of the analyses.

The economic analyses support the following determinations:

- The three selected new projects characterized in the DEM Verification Study provide comparable benefits at less cost than the Wailea transmission project previously analyzed and presented in the Central District Final Candidate Strategies Report transmitted to the BWS for public hearing and recommendations.
- Each of the three selected projects are cost-effective individually, in combination with one another and in combination with the various DSM conservation scenarios.
- Implementing all three of the DEM projects in conjunction with the DSM programs assumed in all of the Final Candidate Strategies could defer the need for the next major source addition for the Central District system until 2016 or, in conjunction with the more aggressive DSM penetration scenario, until 2018.
- The three DEM projects are "least cost" options: Incorporation of the three DEM projects in any of the Final Candidate Strategies would reduce the costs of the strategies.



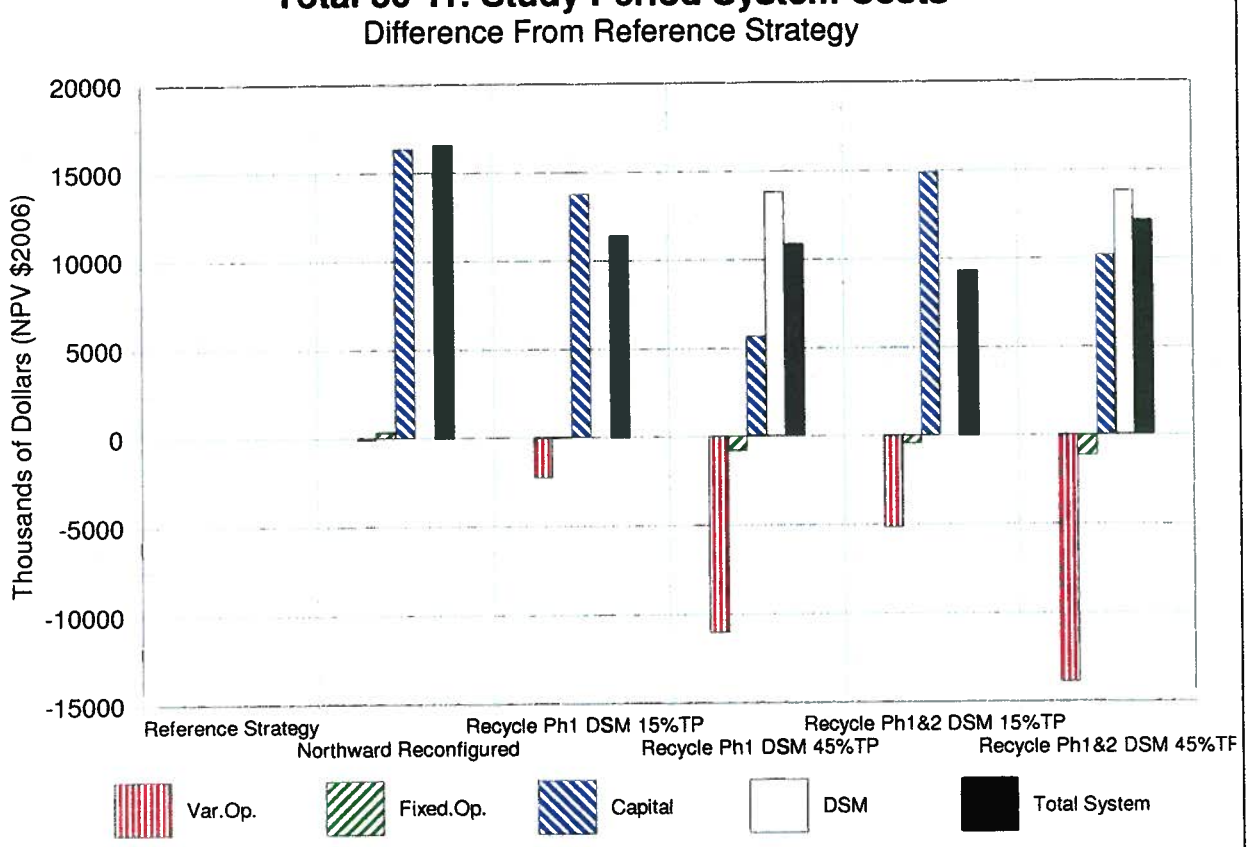
DEM R-1 Wastewater Recycling Options

Comparison of Individual DEM Verification Study Wastewater Recycling Options As Incremental Additions to the Northward Reconfigured Strategy -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above is presented in the same format as the charts shown in previous sections of this Plan Update. Each strategy is compared with the Reference Strategy in the leftmost column. The Northward Reconfigured strategy serves as the basis for comparing each of the DEM R-1 water recycling options.

The chart shows that when any of the three DEM projects are included as resources implemented prior to any new major resources in the Northward Reconfigured strategy, the fifty-year study period costs of operating the Central District system are reduced. The Wailea resort transmission line (characterized in the analyses presented earlier in this section) increases long-term operation costs of the system.

The chart above shows results for the "low" energy cost scenario. Results for the "high" energy cost scenario are similar but with more cost savings for each of the R-1 expansion strategies.

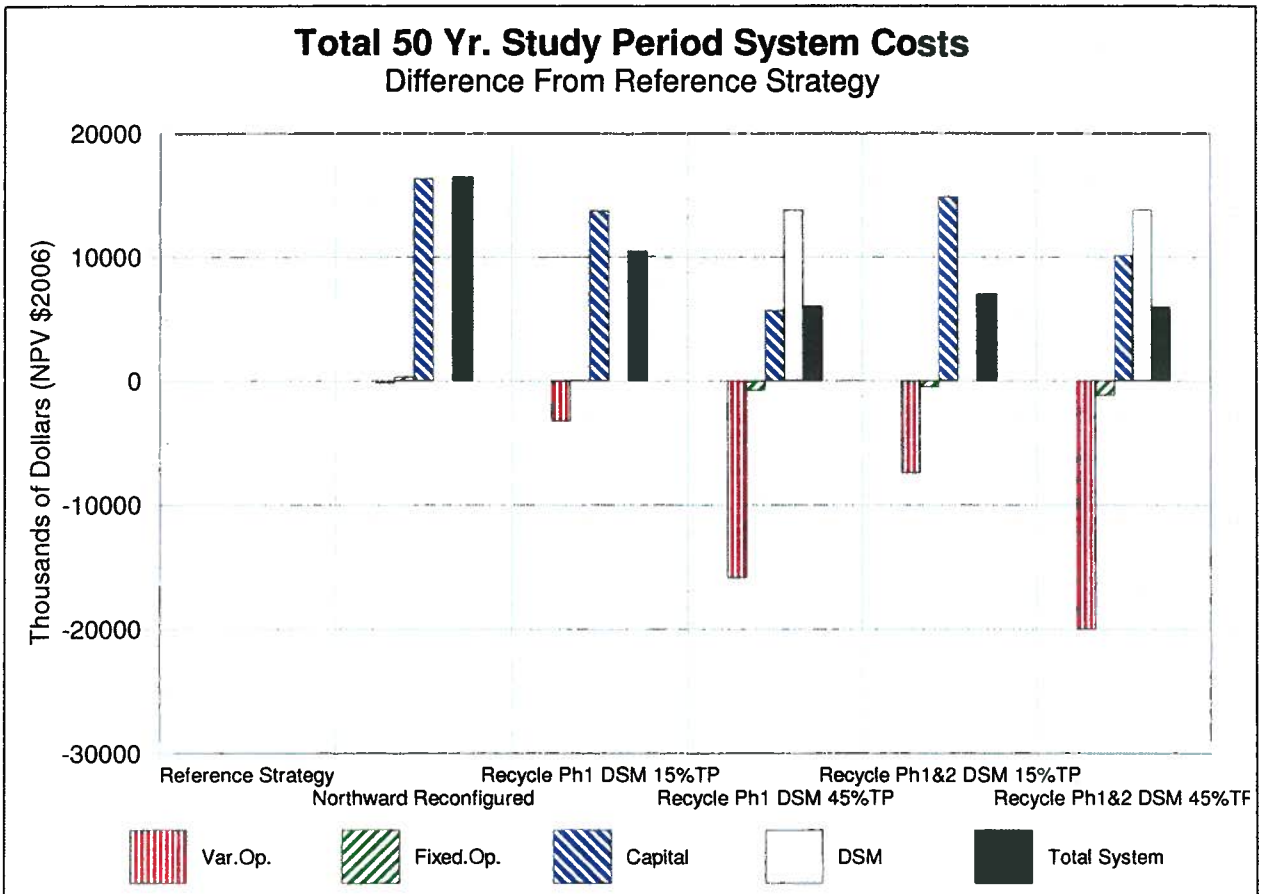


DEM R-1 Wastewater Recycling Options and DSM Penetration Scenarios
Comparison of Combinations of Phase 1 and Phases 1+2 DEM Verification Study Wastewater Recycling Options and Alternate DSM Implementation Scenarios As Incremental Additions to the Northward Reconfigured Strategy -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows an evaluation of implementing the following options, assuming the "low" energy cost scenario:

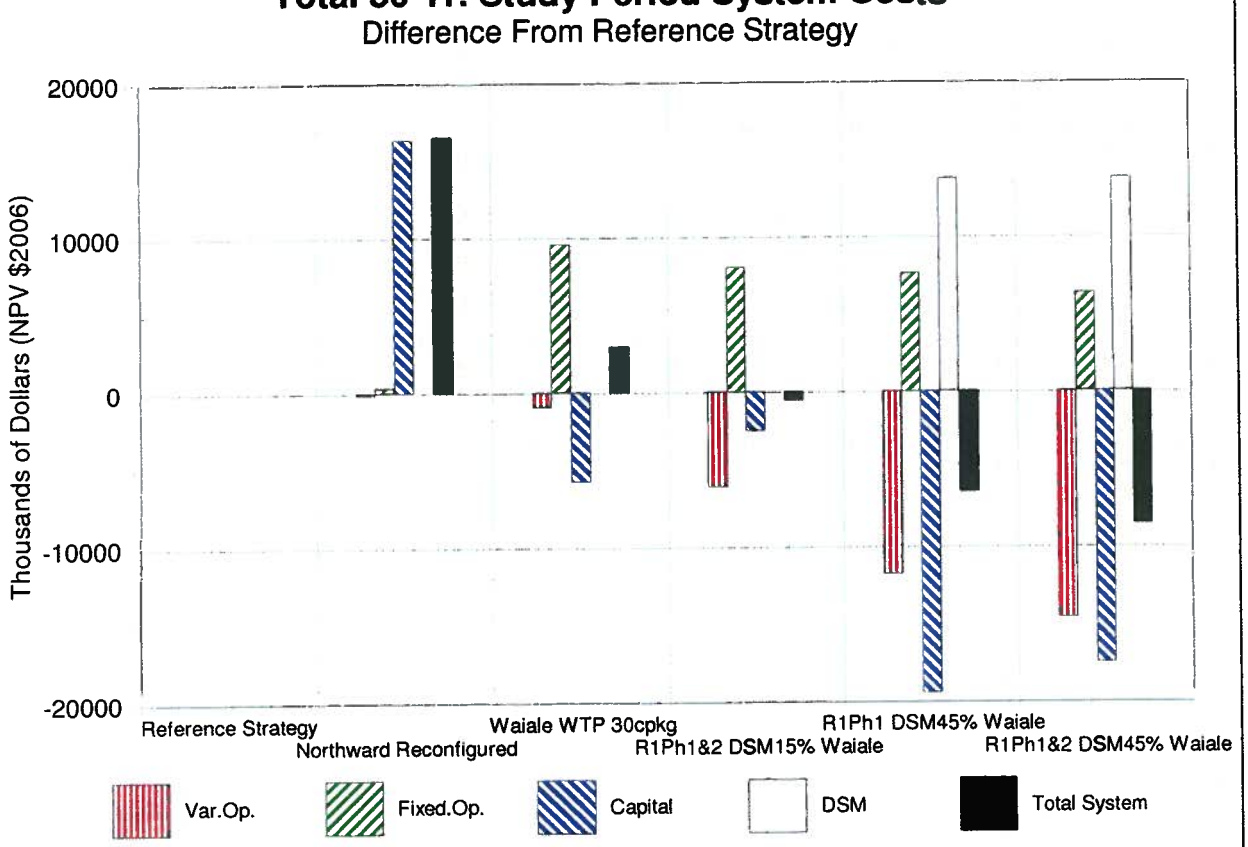
- DEM R-1 Phase 1 only with the lower DSM penetration scenario
- DEM R-1 Phase 1 only with the higher DSM penetration scenario
- DEM R-1 Phases 1 and 2 with the lower DSM penetration scenario
- DEM R-1 Phases 1 and 2 with the higher DSM penetration scenario

Each of these combinations reduces the fifty-year study period costs of operating the DWS Central District system.



DEM R-1 Wastewater Recycling Options And DSM Penetration Scenarios
Comparison of Combinations of Phase 1 and Phases 1+2 DEM Verification Study Wastewater Recycling Options and Alternate DSM Implementation Scenarios As Incremental Additions to the Northward Reconfigured Strategy -- "High" Energy Cost Scenario = $125/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows the same resources as the previous chart, assuming the "high" energy cost scenario. Under this energy cost scenario the cost savings are greater for each of the R-1 expansion and DSM penetration combinations.



DEM R-1 Wastewater Recycling Options And DSM Penetration Scenarios
Comparison of Alternate DSM Penetration Scenarios and Wastewater Recycling Options As Incremental Initial Additions to the Waiale WTP Strategy -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above examines the cost-effectiveness of implementing several combinations of the R-1 expansion projects and DSM penetration scenarios as a precursor to implementing the Waiale WTP strategy. Implementing the DSM programs and the R-1 expansion options would defer the need for the next major source addition (beyond those currently in progress and planned) for several years. This could provide time to determine whether a long-term source and reasonable price of water will be available to make the Waiale WTP strategy feasible.

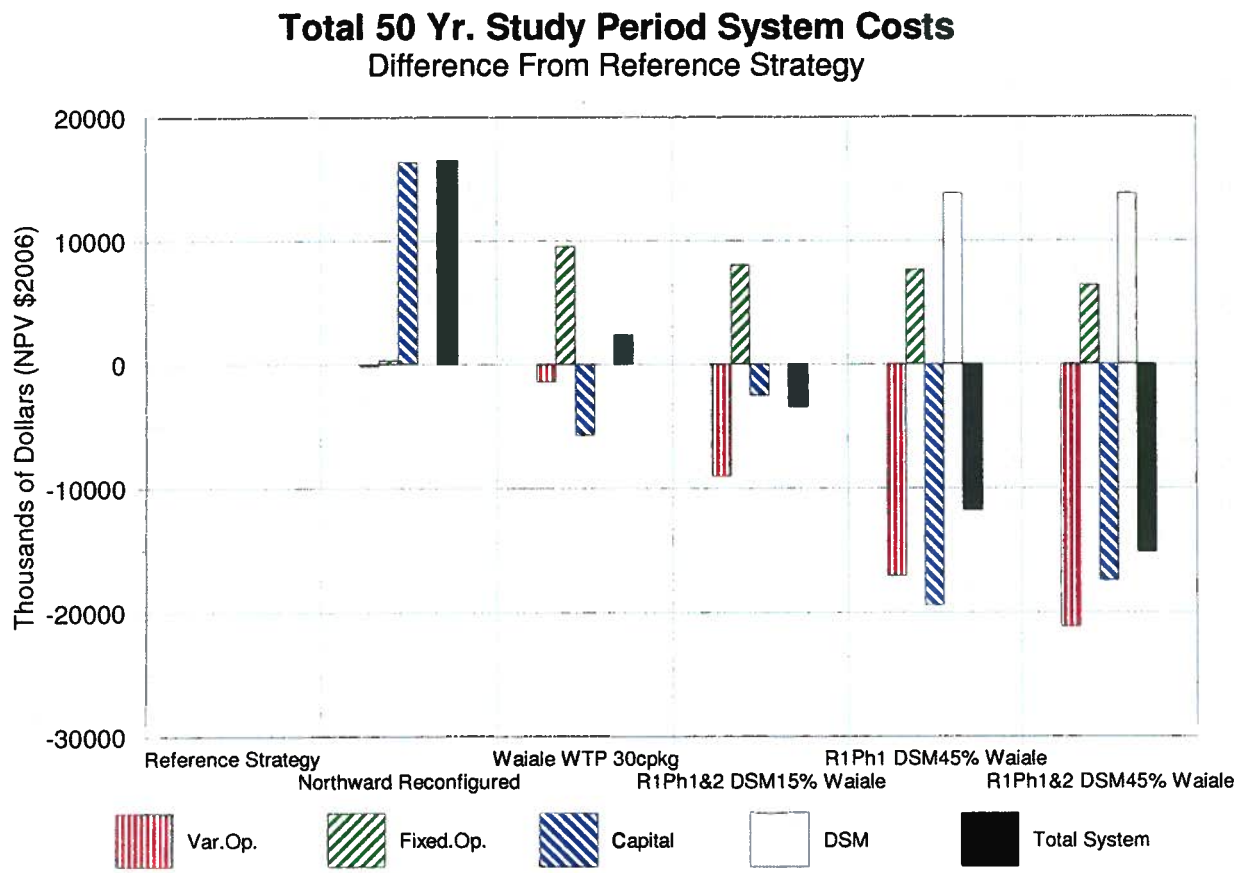
In all strategies examined, the price of the raw source water for the Waiale WTP is assumed to be $0.30 per kgal. The "low" energy cost scenario is assumed.

As shown in the right center column of the chart, implementing DEM R-1 Phases 1 and 2 with the lower DSM penetration scenario would reduce study period system costs.

As shown in the second column from the right, implementing only DEM R-1 Phase 1 but with the higher DSM penetration scenario would reduce system costs more substantially.

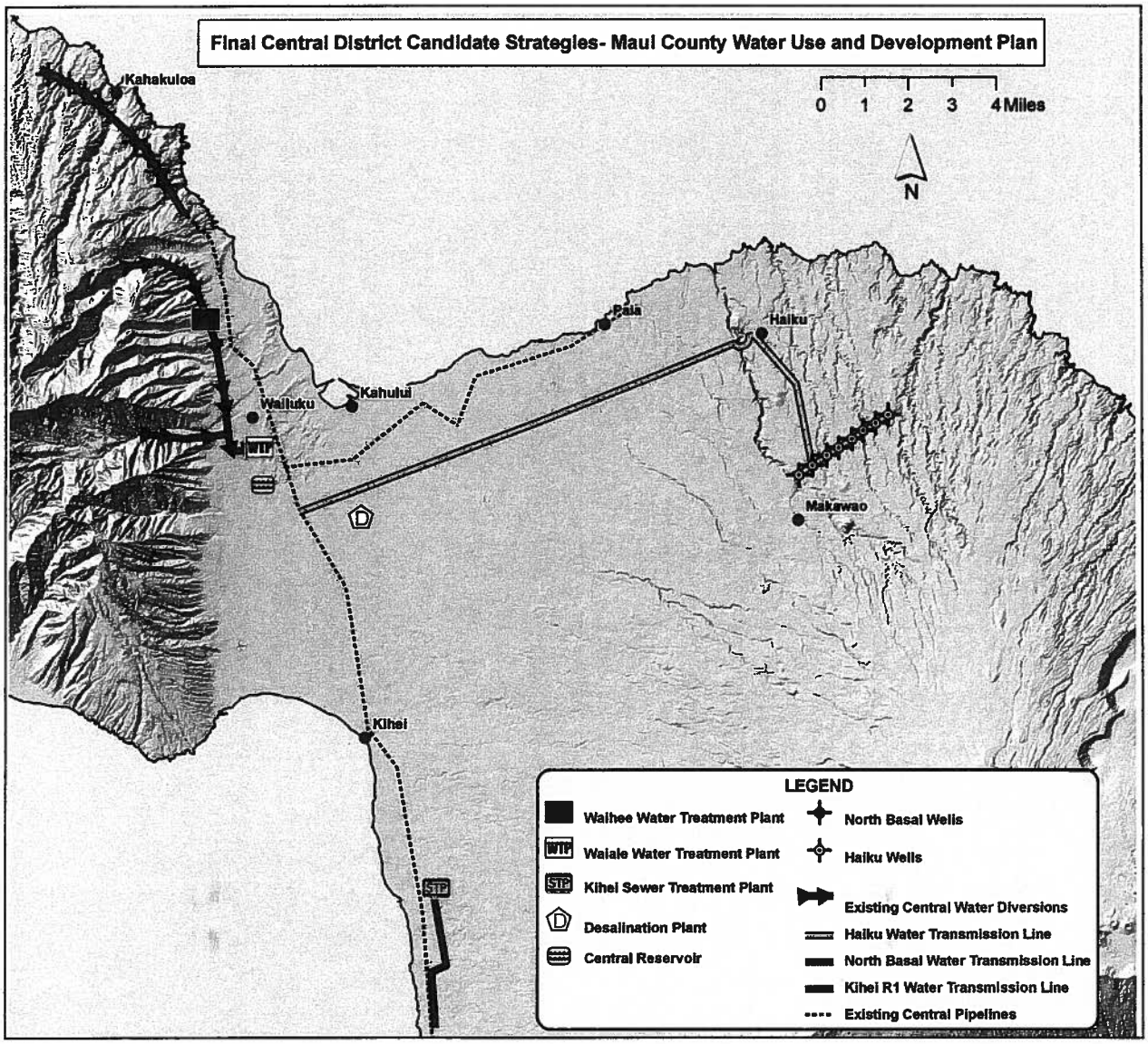
As shown in the rightmost column, implementing both DEM R-1 phases with the higher DSM penetration scenario is the most cost-effective.

In all cases, the DSM and R-1 expansion projects reduce both variable costs (by reducing the amount of DWS potable water produced) and capital costs (by deferring the date of installation of the Waiale WTP and other source improvements).



DEM R-1 Wastewater Recycling Options and DSM Penetration Scenarios
Comparison of Alternate DSM Penetration Scenarios and Wastewater Recycling Options As Incremental Initial Additions to the Waiale WTP Strategy -- "High" Energy Cost Scenario = $125/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows the same options as the previous chart, except that the high energy cost scenario is assumed. The results of the analyses are similar, except that the magnitude of savings from the DSM and R-1 expansion projects is substantially greater.



Comparison of Final Candidate Strategies

The CWRM Framework provides for an Integrated Resource Planning (IRP) process that begins by identifying planning objectives and making an assessment of future water needs. Various resources and strategies to meet these objectives are identified, characterized and analyzed. The selection of the best strategies is based on the extent to which they meet the planning objectives identified at the beginning and during the course of the IRP process. In this section the Final Candidate Strategies are evaluated with respect to the planning objectives identified for the Central District.

Planning Objectives and Attributes Matrix

A difficult task in long range planning is presenting a large volume of information about complex issues regarding several alternatives in a way that is, at the same time, comprehensive, meaningful and comprehendible. It is a challenge to consider and present all necessary factors that need to be considered without creating confusing complexity. Indeed, this is one of the reasons that IRP incorporates the identification and application of planning objectives. This approach

ensures that a wide spectrum of factors will be considered and encourages a methodical examination of the merits of the candidate strategies.

Early in the Central District public process, a matrix was developed to consider how each of an extensive list of resource options might affect each of the planning objectives.[44] This served as a tool to elicit comments regarding each of the resources that was considered. A similar matrix format was used in the evaluation of the candidate strategies with each "cell" of the matrix colored to indicate positive impacts, caution and potential negative impacts (green, yellow and red, respectively). In preparing this report the Candidate Strategies matrix was developed in more detail for the Final Candidate Strategies by providing a short text description of impacts in each applicable cell.

The objective of using a matrix approach is ultimately to present enough information to make meaningful decisions by "getting everything on the same page." The problem with this approach is that, even though the information provided in each cell is a very brief synopsis, the size of the matrix tends to get big and/or the type size tends to get small. The matrix is a helpful tool but is difficult to present "all-on-one-page" in the letter-size format of this report. The matrix is presented in six sections on the following pages. A one-page version of the matrix is also provided in scalable format, which can be examined or printed in larger scale in the electronic PDF version of this report but will be illegible in the hard copy of the report.

This matrix is provided for viewing or printing from the scalable electronic PDF format of this report and may not be legible printed at letter size.

44. Samples of the earlier matrix format are provided in the Resource Options Chapter of the Central District WUDP, August 24, 2005.

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES		Sufficient Water Supply			
	Viability	Municipal	DHHL	Agriculture	Cost
	Establish Viable Plans	Adequate Volume of Water for Municpal Uses	Adequate Volume of Water for DHHL Uses	Adequate Volume of Water for Agricultural Uses	Minimize Cost of Water Supply
CANDIDATE STRATEGIES					
NORTHWARD BASAL WELL DEVELOPMENT	- The goundwater hydrology of this area is relatively untested. Sustainable production output of new wells is uncertain.	+ Strategy provides sufficient water to meet projected demand	+ Strategy provides sufficient water to meet projected demand		- High capital costs associated with necessary transmission system extension Moderately hhigh operation costs
HAIKU AQUIFER BASAL WELL DEVELOPMENT	- Strategy would likely have organized opposition by East aquifer residents - High project capital costs	+ Strategy provides sufficient water to meet projected demand	+ Strategy provides sufficient water to meet projected demand		- High project capital and operating costs
EXTENSIVE CONSERVATION AND RECYCLING	+ Strategy is feasible provided that the DSM and Recycled R1 Transmission projects are funded.	+ Strategy provides sufficient water to meet projected demand	+ Strategy provides sufficient water to meet projected demand		+ Extensive DSM implementation and the R1 recycled water projects reduce long term total system costs
NA WAI EHA SURFACE WATER TREATMENT	- Long term availablility of source water needs to be assured. This depends on the outcome of several CWRM proceedings currently underway and finalization of contractual terms. - Cost of source water needs to be determined. Strategy economics depends on and is sensitive to the Cost of source water from WWC.	+ Strategy provides sufficient water to meet projected demand	+ Strategy provides sufficient water to meet projected demand	- Use of Na Wai Eha surface water for treatment for DWS municipal use would reduce amount of water available for agricultural and other offstream irrigation uses.	- Cost of source water is very uncertain and significantly affects economics of strategy
NA WAI EHA SURFACE WATER TREATMENT WITH LARGE RAW WATER STORAGE RESERVOIR	- Long term availablility of source water needs to be assured. This depends on the outcome of several CWRM proceedings currently underway and finalization of contractual terms. - High capital costs to build large raw water storage reservoir	+ Strategy provides sufficient water to meet projected demand	+ Strategy provides sufficient water to meet projected demand	- Development of large raw water storage reservoir would reduce impacts on amount of water available for offstream use but, unless reservoir capacity is very large there will be remaining impacts on agricultural use.	- High capital costs for sufficient reservoir capacity to provide reliable potable supply without reducing amount of water for agricultural use
BRACKISH WATER DESALINATION		+ Strategy provides sufficient water to meet projected demand	+ Strategy provides sufficient water to meet projected demand		- High operation cost and energy use

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES	Efficiency	Environment	Equity	Sustainability	Quality
	Maximize the Efficiency of Water Use	Minimize Environmental Impacts	Manage Water Equitably	Maintain Sustainable Resources	Maximize Water Quality
CANDIDATE STRATEGIES					
NORTHWARD BASAL WELL DEVELOPMENT	- Moderately high energy use	- Construction impacts: wells, transmission pipe, roads, power lines		- Moderately high energy use	
HAIKU AQUIFER BASAL WELL DEVELOPMENT	- Moderately high energy use	- Construction impacts: wells, transmission pipe, roads, power lines	- Export of water for use outside of source aquifer area	- Moderately high energy use	
EXTENSIVE CONSERVATION AND RECYCLING	+ Reduces water source use + Reduces energy consumption	+ Reduces water source use + Reduces energy consumption - Construction impacts: Transmission line + Reduces injection well use		+ Prioritizes sustainability + Reduces water source use + Reduces energy consumption	
NA WAI EHA SURFACE WATER TREATMENT		- Construction impacts: water treatment plant, minor ancillaries	- Export of water for use outside of source aquifer area		- Water quality issues associated with surface water - Open ditch sources through urban areas
NA WAI EHA SURFACE WATER TREATMENT WITH LARGE RAW WATER STORAGE RESERVOIR		- Construction impacts: water treatment plant, minor ancillaries - Reservoir construction impacts	- Export of water for use outside of source aquifer area		- Water quality issues associated with surface water - Open ditch sources through urban areas
BRACKISH WATER DESALINATION	- High energy use	- Construction impacts: water treatment plant, minor ancillaries - Brackish water disposal		- High energy use	

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES	Reliability	Streams	Resources	Culture	Conformity
	Maximize Reliability of Water Service	Protect and Restore Streams	Protect Water Resources	Protect Cultural Resources	Maintain Consistency with General and Community Plans
CANDIDATE STRATEGIES					
NORTHWARD BASAL WELL DEVELOPMENT	+ Strategy meets analysis design reliability / capacity expansion criteria		+ Assumes withdrawals within sustainable yields		
HAIKU AQUIFER BASAL WELL DEVELOPMENT	+ Strategy meets analysis design reliability / capacity expansion criteria	- Impacts on streams is an issue in prior litigation	+ Assumes withdrawals within sustainable yields		- Export of water for use outside of source aquifer area
EXTENSIVE CONSERVATION AND RECYCLING	+ Strategy meets analysis design reliability / capacity expansion criteria + Provides short and mid-term reliability benefits		+ Assumes withdrawals within sustainable yields + Reduces water source use		
NA WAI EHA SURFACE WATER TREATMENT	+ Strategy meets analysis design reliability / capacity expansion criteria	- Additional use of stream water for municipal purposes would increase competition for stream water allocations	+ Assumes withdrawals within sustainable yields		
NA WAI EHA SURFACE WATER TREATMENT WITH LARGE RAW WATER STORAGE RESERVOIR	+ Strategy meets analysis design reliability / capacity expansion criteria	+ Additional raw water storage capacity would minimize competion for stream water allocations	+ Assumes withdrawals within sustainable yields		
BRACKISH WATER DESALINATION	+ Strategy meets analysis design reliability / capacity expansion criteria		+ Assumes withdrawals within sustainable yields + Reduces potable water source use		

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES		Sufficient Water Supply			
	Viability	Municipal	DHHL	Agriculture	Cost
	Establish Viable Plans	Adequate Volume of Water for Municipal Uses	Adequate Volume of Water for DHHL Uses	Adequate Volume of Water for Agricultural Uses	Minimize Cost of Water Supply
COMPONENTS IN ALL STRATEGIES					
COMMITTED RESOURCE OPTIONS		+ These resources are necessary to provide sufficient production and capacity	+ These resources are necessary to provide sufficient production and capacity		
NEAR TERM RESOURCE OPTIONS	- Some uncertainty regarding timely implementation of Waikapu South #2 Well assumed to be online in integration analyses	+ These resources are necessary to provide sufficient production and capacity	+ These resources are necessary to provide sufficient production and capacity		
DEMAND SIDE MANAGEMENT PROGRAMS	+ Can be implemented immediately without permitting barriers	+ Provides short and mid-term benefit to meet water demands	+ Provides short and mid-term benefit to meet water demands	+ Provides short and mid-term benefit to meet water demands	+ Reduces system costs + Reduces customer costs - Upward pressure on unit rates
INDEPENDENT STRATEGY COMPONENTS					
SUPPLY SIDE LEAK REDUCTION		- Provides short and mid-term benefit to meet water demands	- Provides short and mid-term benefit to meet water demands		+ Reduces system costs + Reduces customer costs
ENERGY PRODUCTION AND EFFICIENCY					+ Reduces system costs + Reduces customer costs
STREAM RESTORATION MEASURES	+ County WUDP can make recommendations and state policy but authority rests with CWRM			+ Provides water for kuleana and subsistance agriculture - Reduces water supply for Central Maui large agriculture	
WATERSHED PROTECTION AND RESTORATION		+ Increases useable surface and groundwater aquifer sources	+ Increases useable surface and groundwater aquifer sources	+ Increases useable surface and groundwater aquifer sources	- Programs cost money
WELL DEVELOPMENT POLICIES AND REGULATIONS	+ Clear policies promote contract approvals	+ Clear policies encourage investment and promote contract approvals	+ Clear policies encourage investment and promote contract approvals		
WELLHEAD PROTECTION ORDINANCE					
LANDSCAPE ORDINANCE		- Limits water use for landscape irrigation + Increases availability for other uses	- Limits water use in times of drought	+ Increases water availability in times of drought	
DROUGHT WATER USE RESTRICTIONS		- Limits water use in times of drought	- Limits water use in times of drought	+ Increases water availability in times of drought	+ Allows maintenance of reliable water supply at reasonable cost
WATER RATE DESIGN AND PRICING POLICIES		+ Marginal pricing encourages conservation	+ Marginal pricing encourages conservation	+ Agricultural water rates are subsidized	

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES	Efficiency	Environment	Equity	Sustainability	Quality
	Maximize the Efficiency of Water Use	Minimize Environmental Impacts	Manage Water Equitably	Maintain Sustainable Resources	Maximize Water Quality
COMPONENTS IN ALL STRATEGIES					
COMMITTED RESOURCE OPTIONS		- Construction impacts: wells, transmission pipe, roads, power lines			
NEAR TERM RESOURCE OPTIONS		- Construction impacts: wells, transmission pipe, roads, power lines			
DEMAND SIDE MANAGEMENT PROGRAMS	+ Reduces water source use + Reduces energy consumption	+ Reduces water source use + Reduces energy consumption	- All customers pay for program participant benefits	+ Reduces water source use + Reduces energy consumption	
INDEPENDENT STRATEGY COMPONENTS					
SUPPLY SIDE LEAK REDUCTION	+ Prioritizes efficiency + Reduces water source use + Reduces energy consumption	+ Reduces water source use + Reduces energy consumption		+ Reduces water source use + Reduces energy consumption	
ENERGY PRODUCTION AND EFFICIENCY	+ Reduces energy consumption	+ Reduces energy consumption		+ Reduces energy consumption	
STREAM RESTORATION MEASURES		+ Promotes health stream, estuary and reef environment		+ Promotes aquifer recharge + Promotes sustainable kuleana subsistence	+ Promotes water quality for kuleana agricultural uses
WATERSHED PROTECTION AND RESTORATION		+ Improves forest and stream environmental quality		+ Increases useable surface and groundwater aquifer sources	+ Increases quality of stream water
WELL DEVELOPMENT POLICIES AND REGULATIONS		+ Allows planning & siting of new resources considering environmental quality	+ Promotes clear standards for allocation of water supply		+ Allows planning & siting of new resources considering water quality
WELLHEAD PROTECTION ORDINANCE		+ Promotes environmentally sensitive practices in wellhead protection zones	- Could affect existing land uses		+ Protects well sources from contamination from land uses
LANDSCAPE ORDINANCE	+ Promotes efficient use of water resources		+ Promotes allocation of water to public trust and beneficial uses - Impacts on existing landscape irrigation users	+ Promotes use of sustainable plantings	
DROUGHT WATER USE RESTRICTIONS	+ Reduces use of expensive resources in times of drought				
WATER RATE DESIGN AND PRICING POLICIES	+ Marginal pricing encourages conservation		- High volume users subsidize low volume users - Municipal users subsidize agricultural users	+ Marginal pricing encourages conservation	

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES	Reliability	Streams	Resources	Culture	Conformity
	Maximize Reliability of Water Service	Protect and Restore Streams	Protect Water Resources	Protect Cultural Resources	Maintain Consistency with General a Community Plans
COMPONENTS IN ALL STRATEGIES					
COMMITTED RESOURCE OPTIONS	+ These resources are necessary to provide sufficient production and capacity				
NEAR TERM RESOURCE OPTIONS	+ These resources are necessary to provide sufficient production and capacity				
DEMAND SIDE MANAGEMENT PROGRAMS	+ Provides short and mid-term system reliability benefits	+ Reduces source water use	+ Reduces source water use		+ Consistent with state and county policies and plans
INDEPENDENT STRATEGY COMPONENTS					
SUPPLY SIDE LEAK REDUCTION	+ Provides short and mid-term system reliability benefits	+ Reduces source water use	+ Reduces source water use		
ENERGY PRODUCTION AND EFFICIENCY					
STREAM RESTORATION MEASURES		+ Prioritizes & promotes healthy streams	+ Increases capture of precipitation and aquifer recharge	+ Promotes healthy streams and provides water for kuleana agriculture	
WATERSHED PROTECTION AND RESTORATION		+ Promotes healthy streams	+ Increases capture of precipitation and aquifer recharge	+ Promotes healthy streams and provides water for kuleana agriculture	
WELL DEVELOPMENT POLICIES AND REGULATIONS	+ Allows planning & siting of new resources considering system integration issues		+ Allows planning & siting of new resources considering protection of water resources	+ Allows planning & siting of new resources considering protection of cultural resources	+ Allows planning & siting of new resources considering general and community plans
WELLHEAD PROTECTION ORDINANCE			+ Protects well sources from contamination from land uses		
LANDSCAPE ORDINANCE		+ Reduces source water use	+ Reduces source water use		
DROUGHT WATER USE RESTRICTIONS	+ Increases drought period system reliability	+ Reduces source water use when sources have lowest yields	+ Reduces source water use when sources have lowest yields		
WATER RATE DESIGN AND PRICING POLICIES	+ Provides short and mid-term system reliability benefits				

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES	Planning Objectives														
		Sufficient Water Supply													
	Viability	Municipal	DHHL	Agriculture	Cost	Efficiency	Environment	Equity	Sustainability	Quality	Reliability	Streams	Resources	Culture	Conformity
	Establish Viable Plans	Adequate Volume of Water for Municipal Uses	Adequate Volume of Water for DHHL Uses	Adequate Volume of Water for Agricultural Uses	Minimize Cost of Water Supply	Maximize the Efficiency of Water Use	Minimize Environmental Impacts	Manage Water Equitably	Maintain Sustainable Resources	Maximize Water Quality	Maximize Reliability of Water Service	Protect and Restore Streams	Protect Water Resources	Protect Cultural Resources	Maintain Consistency with General and Community Plans
CANDIDATE STRATEGIES															
NORTHWARD BASAL WELL DEVELOPMENT	The groundwater hydrology of this area is relatively unstudied. Sustainable production output of new wells is uncertain.	• Strategy provides sufficient water to meet projected demand	• Strategy provides sufficient water to meet projected demand		• High capital costs associated with necessary transmission system extension/Moderately high operation costs	• Moderate/high energy use	• Construction impacts: wells, transmission pipe, roads, power lines		• Moderate/high energy use		• Strategy meets analysis design reliability / capacity expansion criteria		• Assures withdrawals within sustainable yields		
HANUI AQUIFER BASAL WELL DEVELOPMENT	• Strategy would likely have organized opposition by East Maui water users/High project capital costs	• Strategy provides sufficient water to meet projected demand	• Strategy provides sufficient water to meet projected demand		• High project capital and operating costs	• Moderate/high energy use	• Construction impacts: wells, transmission pipe, roads, power lines	• Export of water for use outside of source aquifer area	• Moderate/high energy use		• Strategy meets analysis design reliability / capacity expansion criteria	• Impacts on streams or air noise in prior litigation	• Assures withdrawals within sustainable yields		• Export of water for use outside of source aquifer area
EXTENSIVE CONSERVATION AND RECYCLING	• Strategy is feasible provided that the DDM and Recycled PI Transmission projects are funded	• Strategy provides sufficient water to meet projected demand	• Strategy provides sufficient water to meet projected demand		• Extensive DDM implementation and the PI recycled water projects reduce long term total system costs	• Reduces water source use • Reduces energy consumption	• Reduces water source use • Reduces energy consumption • Construction impacts: transmission line • Reduces injection well use		• Maximizes sustainability • Reduces water source use • Reduces energy consumption		• Strategy meets analysis design reliability / capacity expansion criteria • Provides novel and non-traditional benefits		• Assures withdrawals within sustainable yields • Reduces water source use		
NA WAI EHA SURFACE WATER TREATMENT	Long term availability of source water needs to be assured. This depends on the outcome of several CWRM proceedings currently underway and resolution of contested cases. Cost of source water needs to be definite and sensitive to the Cost of source water transmission.	• Strategy provides sufficient water to meet projected demand	• Strategy provides sufficient water to meet projected demand	Use of Na Wai Eha surface water for treatment for DHHL potential and would reduce amount of water available for agricultural and other off-stream irrigation uses	Cost of source water is very uncertain and significantly affects outcomes of strategy		Construction impacts: water treatment plant, water transmission	Export of water for use outside of source aquifer area		Water quality deficiencies associated with surface water • Open ditch sources through urban areas	• Strategy meets analysis design reliability / capacity expansion criteria	• Additional use of stream water for municipal purposes would increase competition for stream water diversions	• Reduces withdrawals within sustainable yields		
NA WAI EHA SURFACE WATER TREATMENT WITH LARGE RAW WATER STORAGE RESERVOIR	Long term availability of source water needs to be assured. This depends on the outcome of several CWRM proceedings currently underway and resolution of contested cases. High capital costs to build large raw water storage reservoir	• Strategy provides sufficient water to meet projected demand	• Strategy provides sufficient water to meet projected demand	Dewatering of large raw water storage reservoir would reduce impacts on amount of water available for agricultural use but, unless reservoir capacity is very large there will be adverse impacts on agricultural use.	High capital costs for sufficient reservoir capacity to provide reliable potable supply without reducing amount of water for agricultural use		Construction impacts: water treatment plant, other facilities • Reservoir construction impacts	Export of water for use outside of source aquifer area		Water quality issues associated with surface water • Open ditch sources through urban areas	• Strategy meets analysis design reliability / capacity expansion criteria	• Additional raw water storage capacity would facilitate competition for stream water diversions	• Assures withdrawals within sustainable yields		
BRACKISH WATER DESALINATION		• Strategy provides sufficient water to meet projected demand	• Strategy provides sufficient water to meet projected demand		High operation cost and energy use	High energy use	• Construction impacts: water treatment plant, wind turbines • Brackish water disposal		High energy use		• Strategy meets analysis design reliability / capacity expansion criteria		• Assures withdrawals within sustainable yields • Reduces potable water source use		

CENTRAL DISTRICT FINAL CANDIDATE STRATEGIES ATTAINMENT OF PLANNING OBJECTIVES	Planning Objectives														
		Sufficient Water Supply													
	Viability	Municipal	DHHL	Agriculture	Cost	Efficiency	Environment	Equity	Sustainability	Quality	Reliability	Streams	Resources	Culture	Conformity
	Establish Viable Plans	Adequate Volume of Water for Municipal Uses	Adequate Volume of Water for DHHL Uses	Adequate Volume of Water for Agricultural Uses	Minimize Cost of Water Supply	Maximize the Efficiency of Water Use	Minimize Environmental Impacts	Manage Water Equitably	Maintain Sustainable Resources	Maximize Water Quality	Maximize Reliability of Water Service	Protect and Restore Streams	Protect Water Resources	Protect Cultural Resources	Maintain Consistency with General and Community Plans
COMPONENTS IN ALL STRATEGIES															
COMMITTED RESOURCE OPTIONS		• These resources are necessary to provide sufficient production and capacity	• These resources are necessary to provide sufficient production and capacity				Construction impacts: wells, transmission pipe, roads, power lines				• These resources are necessary to provide sufficient production and capacity				
NEAR TERM RESOURCE OPTIONS	Some uncertainty regarding timely implementation of Waikapu Stream aid that connected to be online in integration analyses	• These resources are necessary to provide sufficient production and capacity	• These resources are necessary to provide sufficient production and capacity				• Construction impacts: wells, transmission pipe, roads, power lines				• These resources are necessary to provide sufficient production and capacity				
DEMAND SIDE MANAGEMENT PROGRAMS	• Can be implemented immediately without permitting barriers	• Provides short and mid-term benefit to meet water demands	• Provides short and mid-term benefit to meet water demands	• Provides short and mid-term benefit to meet water demands	• Reduces system costs • Reduces customer costs • Upward pressure on unit rates	• Reduces water source use • Reduces energy consumption	• Reduces water source use • Reduces energy consumption	• Agriculture jobs for program participant benefits	• Reduces water source use • Reduces energy consumption		• Provides short and mid-term system reliability benefits	• Reduces source water use	• Reduces source water use		• Consistent with state and county policies and plans
INDEPENDENT STRATEGY COMPONENTS															
SUPPLY SIDE LEAK REDUCTION		• Provides short and mid-term benefit to meet water demands	• Provides short and mid-term benefit to meet water demands		• Reduces system costs • Reduces customer costs	• Provides efficiency • Reduces water source use • Reduces energy consumption	• Reduces water source use • Reduces energy consumption		• Reduces water source use • Reduces energy consumption		• Provides short and mid-term system reliability benefits	• Reduces source water use	• Reduces source water use		
ENERGY PRODUCTION AND EFFICIENCY					• Reduces system costs • Reduces customer costs	• Reduces energy consumption	• Reduces energy consumption		• Reduces energy consumption						
STREAM RESTORATION MEASURES	• County WUDP can make recommendations and state policy for authority rests with County			• Provides water for aquaculture and a diversion agriculture • Reduces water supply for Central Maui large agriculture			• Promotes health stream, estuary and reef ecosystems		• Promotes aquifer recharge • Promotes sustainable fishpond subsistence	• Promotes water quality for fishpond agricultural uses		• Promotes & promotes healthy streams	• Increases capture of precipitation and aquifer recharge	• Promotes healthy streams and provides water for fishpond agriculture	
WATERSHED PROTECTION AND RESTORATION		• Increases sustainable surface and groundwater aquifer solutions	• Increases sustainable surface and groundwater aquifer solutions	• Increases sustainable surface and groundwater aquifer solutions	• Programs cost money		• Improves forest and stream environmental quality		• Increases sustainable surface and groundwater aquifer solutions	• Improves quality of stream water		• Promotes healthy streams	• Increases capture of precipitation and aquifer recharge	• Promotes healthy streams and provides water for fishpond agriculture	
WELL DEVELOPMENT POLICIES AND REGULATIONS	• Clear policies promote contract approvals	• Clear policies encourage investment and promote contract approvals	• Clear policies encourage investment and promote contract approvals				• Allows planning & siting of new resources considering environmental quality	• Promotes clear standards for allocation of water supply		• Allows planning & siting of new resources considering water quality	• Allows planning & siting of new resources considering system integration issues		• Allows planning & siting of new resources considering protection of water resources	• Allows planning & siting of new resources considering protection of cultural resources	• Allows planning & siting of new resources considering general and community plans
WELLHEAD PROTECTION ORDINANCE							• Promotes environmentally sensitive practices in wellhead protection zones	• Could affect existing land uses		• Protects well sources from contamination from land uses			• Protects well sources from contamination from land uses		
LANDSCAPE ORDINANCE		• Limits water use for landscape irrigation • Increases availability for other uses	• Limits water use in times of drought	• Increases water availability in times of drought		• Promotes efficient use of water resources		• Promotes allocation of water to parks, trees and residential uses • Impacts on existing landscape irrigation uses	• Promotes use of sustainable plantings			• Reduces source water use	• Reduces source water use		
DROUGHT WATER USE RESTRICTIONS		• Limits water use in times of drought	• Limits water use in times of drought	• Increases water availability in times of drought	• Allows maintenance of reliable water supply at reasonable cost	• Reduces use of expensive resources in times of drought					• Increases drought period system reliability	• Reduces source water use when surface sources have lowest yields	• Reduces source water use when surface sources have lowest yields		
WATER RATE DESIGN AND PRICING POLICIES		• Marginal pricing encourages conservation	• Marginal pricing encourages conservation	• Agricultural water uses are subsidized		• Marginal pricing encourages conservation		• High volume users subsidize low volume users • Municipal users subsidize agricultural users	• Marginal pricing encourages conservation		• Provides short and mid-term system reliability benefits				

This chart is not legible printed at letter size but can be viewed or printed from electronic PDF file format.

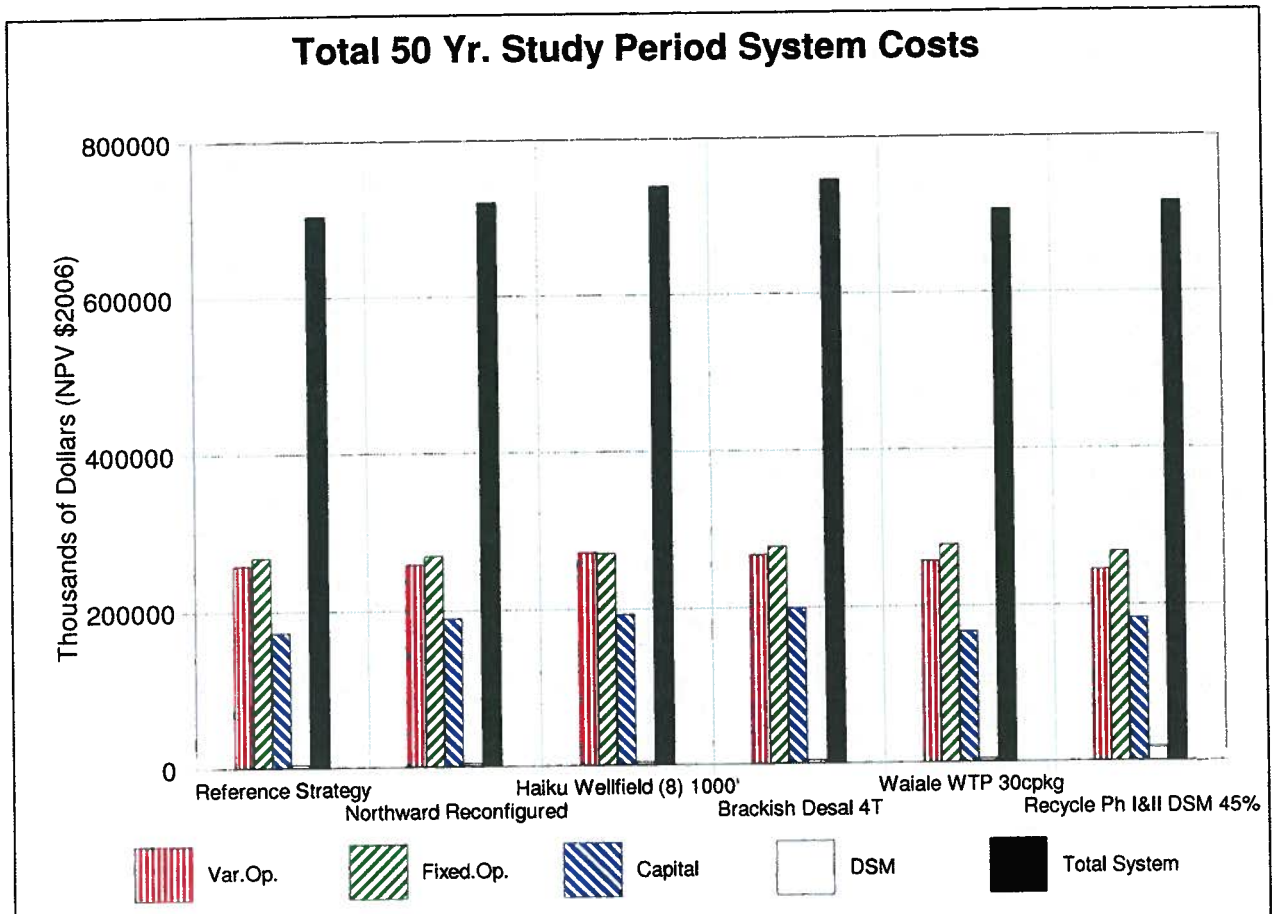


Figure 39
Central District Final Candidate Strategies -- Net Present Value of Fifty-Year Study Period Costs -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

Economic Analysis of the Final Candidate Strategies

The chart above shows the net present values for the DWS Central District system over a fifty-year study period (2005 - 2055) for each of the Final Candidate Strategies. Variable operating, fixed operating and capital costs are all substantial components of total costs in all strategies. The cost of the DSM (conservation) programs included in each of the strategies is a small component of costs.

A table on the following page shows the data presented in this chart along with information about water rate impacts and the dates that each resource in each strategy is determined to be necessary and assumed to be put into service. The shaded cells in the table indicate, for each strategy, the identity and date of the first "discretionary" resource required beyond the committed resource options included in all of the strategies and after the DEM R1 wastewater recycling transmission extension projects.

The differences between the cost components of the strategies is discernible in the chart above but is more clearly seen in the next chart, that shows the same data presented as differences with respect to the Reference Strategy shown at the far left.

Central District Final Candidate Strategies

Low Energy Price Scenario: $75/bbl 2008 Equiv. Electric Power Costs Escalated at 1.0% (Real) Per Year

System	Central System	Central System	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Northward Reconfigured**	**Haiku Wellfield (8) 1000'**	**Brackish Desal 4T**	**Waiale WTP 30cpkg**	**Recycle Ph I&II DSM 45%**
Description	N.Waihee.Kahak123.Supp	Multiple 350GPM Wells	1000' Wellhead Elevation			
Demand Projection	Base Case	Base Case	Base Case	Base Case	Base Case	Base Case
Demand Proj.Source	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7
Notes:						
Var.Op.Esc.Rate	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	741,826	741,826	741,826	741,826	741,826	741,826
Cap.Shortfall 2006-30 MGD-Yrs	19,293	19,244	19,425	19,440	19,650	19,199
Cap.Shortfall 2007-30 MGD-Yrs	11,842	11,792	11,973	11,988	12,198	11,748
Cap.Shortfall 2008-30 MGD-Yrs.	4,414	4,365	4,546	4,561	4,771	4,320
Net Present Value Costs	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**
25 Year Planning Period Costs:						
Variable Operation Cost NPV	164,405	164,339	169,993	170,065	164,157	155,569
Fixed Operation Cost NPV	173,204	173,301	174,897	177,949	178,800	172,298
Capital Cost NPV	113,278	121,967	133,356	125,246	109,301	115,718
DSM Program Cost	4,314	4,314	4,314	4,314	4,314	18,116
Total System Cost NPV	455,201	463,921	482,560	477,574	456,573	461,700
50 Year Study Period Costs:						
Variable Operation Cost NPV	257,960	257,837	271,096	266,081	257,059	244,065
Fixed Operation Cost NPV	268,126	268,470	270,388	277,040	277,709	266,970
Capital Cost NPV	172,601	188,939	192,641	198,010	166,858	182,732
Total System Cost NPV	703,717	720,275	739,155	746,160	706,655	715,863
25 Year Planning Period Rate Impacts:						
Avg. Annual DWS Rate Increase	3.49%	3.60%	3.75%	3.85%	3.31%	3.69%
Levelized Unit Cost ($/kgal)	$3,589	$3,659	$3,807	$3,767	$3,600	$3,626
Resource Addition Sequence:	DSMDTD Indoor 2010	DSMDTD Indoor 2010	DSMDTD Indoor 2010	DSMDTD Indoor 2010	DSMDTD Indoor 2010	DSMDTD Ind 45% 2010
	DSMDTD Outdoor 2010	DSMDTD Outdoor 2010	DSMDTD Outdoor 2010	DSMDTD Outdoor 2010	DSMDTD Outdoor 2010	DSMDTD Out 45% 2010
	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008
	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008
	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009
	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009
	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009
	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009
	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011
	Maluhia Well 2013	Maluhia (2) 2013	Haiku Wellfield (8) 2014	Brackish Desal 4Tm 2013	Waiale T.P.w30cpkg 2014	DEM1 Waipulani 2012
	Waiolai Well 2015	Generic Backup 1 2014	Generic Backup 1 2025	Generic Backup 1 2018	Generic Backup 1 2023	DEM3 Lilioa KHS 2012
	Generic Backup 1 2016	Generic Backup 1 2016	Generic Backup 1 2027	Generic Backup 1 2019	Generic Backup 1 2025	DEM5b NSCollRd. 2013
	Wailena Well 2018	Wailena (2) 2016	Generic Backup 1 2028	Generic Backup 1 2021	Generic Backup 1 2026	Maluhia (2) 2018
	Kahakuloa Ph1 2019	Waipili (2) 2018	Supplemental Wells 2029	Maluhia (2) 2021	Maluhia (2) 2028	Wailena (2) 2019
	Kahakuloa Ph2 2021	Kahakuloa (4) 2019		Wailena (2) 2022	Wailena (2) 2029	Waipili (2) 2020
	Kahakuloa Ph3 2022	Generic Backup 1 2020		Waipili (2) 2023	Supplemental Wells 2029	Generic Backup 1 2021
	Supplemental Wells 2024	Waihali (2) 2021		Kahakuloa (4) 2024		Kahakuloa (4) 2022
	Supplemental Wells 2026	Po'elua (2) 2022		Generic Backup 1 2025		Generic Backup 1 2023
	Supplemental Wells 2028	Generic Backup 1 2024		Waihali (2) 2027		Waihali (2) 2024
	Supplemental Wells 2030	Supplemental Wells 2025		Po'elua (2) 2028		Po'elua (2) 2025
		Supplemental Wells 2027		Supplemental Wells 2029		Generic Backup 1 2026
		Supplemental Wells 2028				Supplemental Wells 2028
		Supplemental Wells 2029				Supplemental Wells 2029
						Supplemental Wells 2030

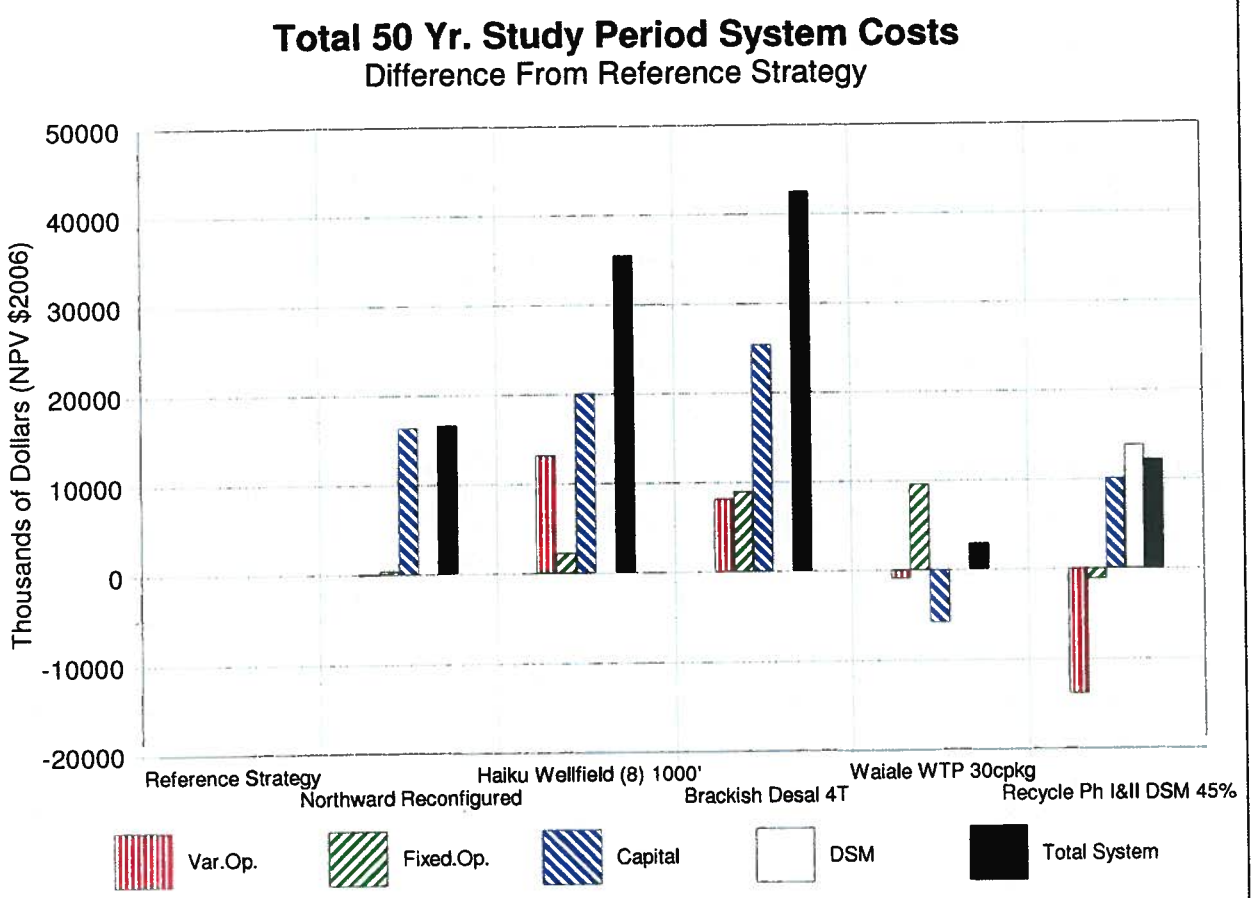


Figure 41
Central District Final Candidate Strategies -- Net Present Value of Fifty-Year Study Period Costs -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows the same data as the previous chart, except all costs are portrayed as differences from the Reference Strategy costs at the far left. The Reference Strategy is not a viable strategy and is included as a consistent reference for the charts presented in this report and the previous *Candidate Strategies* chapter. The five Final Candidate Strategies are presented to the right of the Reference Strategy for comparison to one another.

The cost data presented in this chart reflect the "low" energy price scenario of $75/bbl equivalent electric energy costs, escalated through the planning period at an annual compound rate 1% above the rate of general inflation.

The least expensive strategy shown on this chart is the Waiale WTP strategy shown assuming (1) a commitment of sufficient base steam flow to provide adequate reliable source water to provide reliable potable water service without a raw water storage reservoir and (2) a raw water price for source water of 30 cents per thousand gallons. As discussed in the Na Wai Eha Surface Water Treatment strategy section earlier in this report, neither of these assumptions is certain.

The second least expensive strategy shown on this chart, labeled "Recycle Ph.I&II DSM 45%" and shown in the rightmost column, is the "Extensive Conservation and Wastewater Recycling"

strategy. Several versions of this strategy were characterized in analyses presented in an earlier section of this plan update. The most cost-effective version of the strategy is depicted here, which includes both phases of the DEM R1 recycled water transmission extension projects, along with a portfolio of conservation programs designed to capture 45% of the conservation "technical potential" (three times the 15% target penetration of the conservation programs included in the other strategies shown). The conservation measures and the recycling projects included in this strategy delay the date of the next necessary resource addition (beyond the committed and planned resource additions) until the year 2018.[45]

The third least expensive strategy shown is the Northward Reconfigured strategy. This is the most recently reconfigured version of the Northward Basal Groundwater strategy described earlier in this study. The strategy depicted here is a series of incremental installations of transmission pipe, wells, storage tanks and booster pumps starting with transmission to a well on the north side of Makamakaole gulch in the north half of the Waihee aquifer and continuing in stages past the Kahakuloa Valley into the Kahakuloa aquifer.

The Haiku Wellfield strategy depicted here is the least expensive of the Eastward Basal Groundwater strategies considered and described previously in section "B. Eastward Basal Groundwater." This strategy includes a series of eight wells at approximately 1000 ft. elevation in the Haiku aquifer on the Hana side of Maliko Gulch and a transmission line to the Central District system. This strategy has relatively high energy costs associated with pumping water to the 1000 foot elevation resulting in total 50-year NPV costs about $19 million higher than the Northward Reconfigured strategy. The costs depicted for this strategy may be "optimistically" low in several respects. It is possible that it would be necessary to drill wells at a higher elevation in order to avoid agricultural groundwater contaminants. This would increase variable (pumping) costs. It is also possible that some of the wells drilled in this area would not be good productive wells, which would increase capital costs.[46]

The most expensive strategy depicted in this chart is the Brackish Desalination strategy. This strategy has high capital costs associated with building the desalination plant and high unit variable operating costs. The total variable operating costs over the 50-year planning period are shown lower than the Haiku Wellfield strategy depicted. The units costs for the desalinated water are higher than the unit costs of pumping water from the Haiku Wellfield, but the amount of water produced by the desalination plant over the planning period is smaller. This is due to (1) the size of the desalination plant in comparison to the output of the eight Haiku wells and (2) the fact that, due to the high costs of the desalinated water, the desalination plant is assumed to operate as little as possible by the integration analysis model.

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45. In this strategy, as in all of the strategies depicted in this chart, the first resources added after the committed and planned resources (that are included in all of the strategies) are the featured resources that characterize the strategy. When additional resources are needed beyond the resources that characterize each strategy, the resources from the "Northward Reconfigured" strategy are added sequentially when and to the extent necessary.to maintain sufficient production capability and system capacity..

46. Some of the incremental costs required to comply with the EMPLAN Consent Decree (described in an earlier section) are not explicitly included in the characterization of this strategy. These costs are difficult to quantify precisely but would represent a small fraction of the costs assumed in the contingency cost allowance included in the characterization of this strategy.

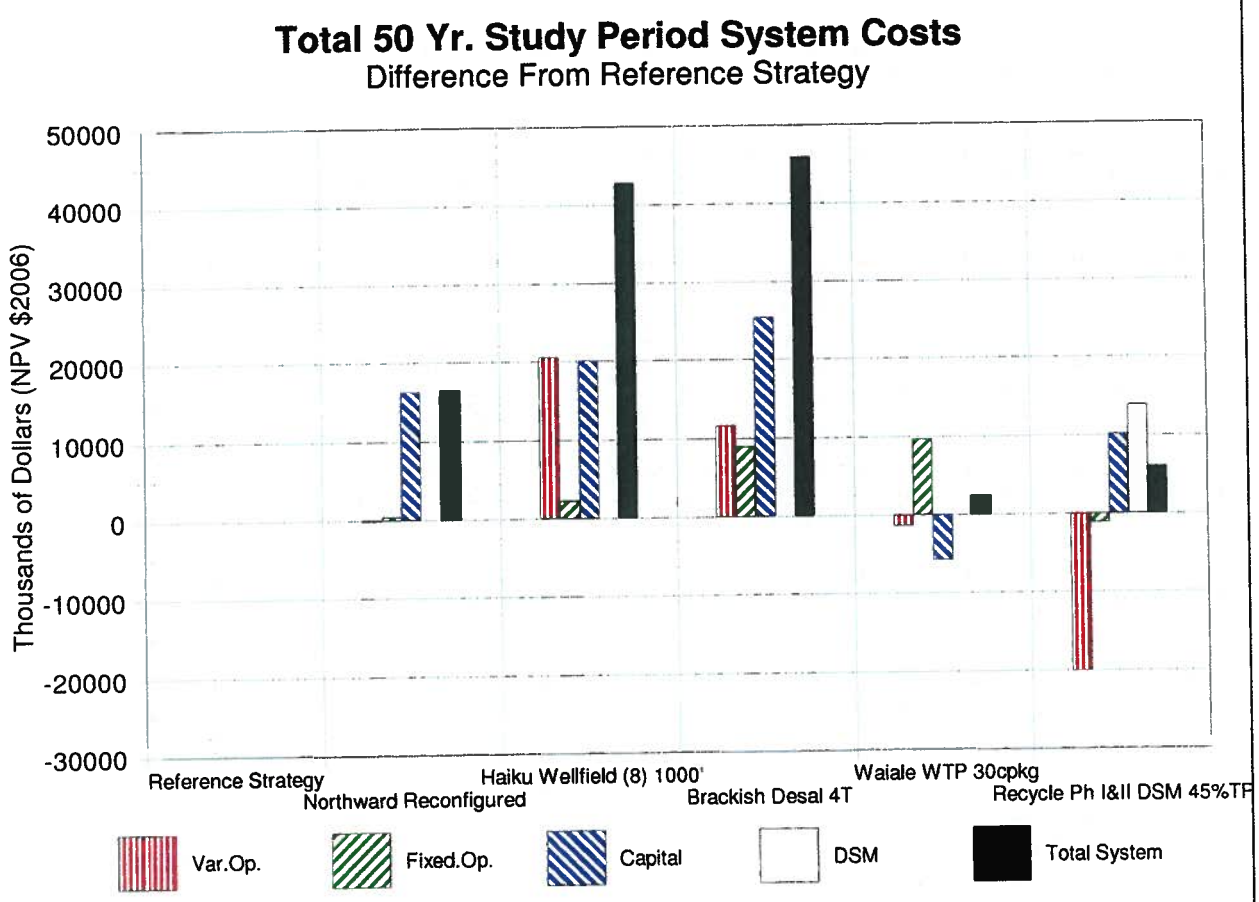

Figure 42
Central District Final Candidate Strategies -- Net Present Value of Fifty-Year Study Period Costs -- "High" Energy Cost Scenario = $125/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows the same strategies as the previous chart, except that the high energy price scenario is assumed with $125/bbl equivalent electric energy costs.

Assuming the higher energy costs the ranking of the economics of the strategies is similar except that the additional energy cost savings of the Extensive Conservation and Wastewater Recycling strategy make it less expensive than the Northward Basal Groundwater strategy.

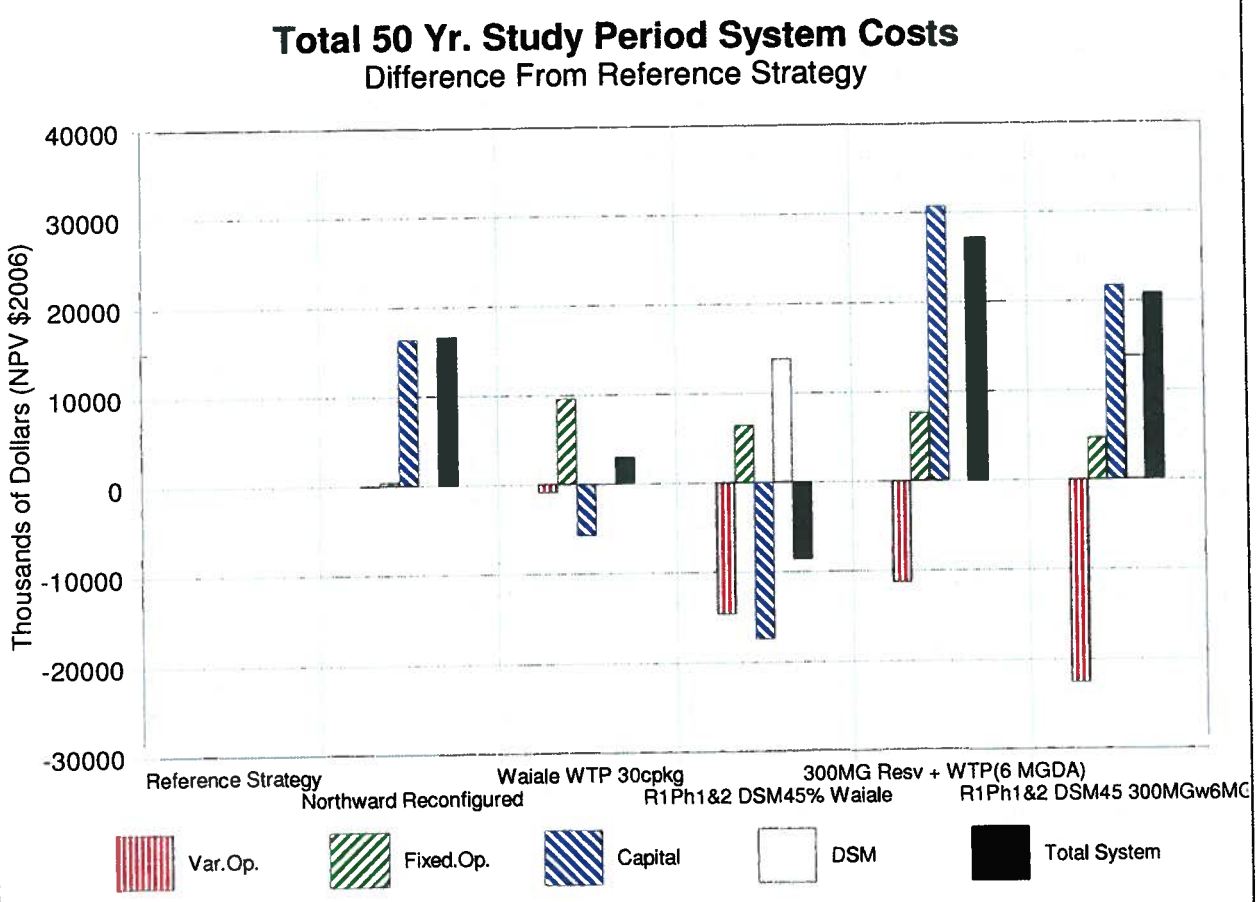

Figure 43
Central District Final Candidate Strategies with Alternate Assumptions -- "Low" Energy Cost Scenario = $75/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows several Na Wai Eha water treatment strategies in addition to the Waiale WTP strategy shown previously. All of the strategies shown in this chart assume the "low" energy price scenario.

The left center column shows the same Waiale WTP strategy depicted in the previous chart.

The right center column shows a strategy combining the Waiale WTP and Extensive Conservation and Wastewater Recycling strategies. In this strategy the DEM R1 transmission extension projects and the extensive conservation program portfolio defer the need for the Waiale WTP until the year 2018. This is the least expensive strategy analyzed but would only be feasible if sufficient base flow for the Waiale WTP could ultimately be secured at a reasonable price without the need for a raw water storage reservoir.

The second column from the right shows the 300 MG raw water storage reservoir strategy described earlier in this report. This strategy includes a 300 MG reservoir operated to capture high stage stream flows from the Iao Stream and incorporates a 9 MGD WTP (providing 6 MGD average output). As previously described, this strategy assumes the establishment of instream flow standards for the Na Wai Eha streams and provides approximately the existing amount of diversion capacity for existing offstream irrigation uses.[47] This strategy is more expensive than

the Waiale WTP strategy depicted in the previous two charts but provides more closely the same amount of water as the other strategies.[48]

The rightmost strategy depicted in the chart above shows a combination of the same 300MG reservoir and WTP strategy shown in the previous column, along with the Extensive Conservation and Wastewater Recycling strategy. In this strategy the DEM R1 recycled wastewater transmission extension projects and the extensive conservation program portfolio defer the need for the 300MG reservoir and WTP until the year 2018.

As shown in the analyses depicted in the chart above, adding the DEM R1 recycled wastewater transmission projects prior to implementing either of the Na Wai Eha WTP projects lowers the long-term economic costs for the DWS Central District system. Analyses (not depicted here) performed on all of the Final Candidate Strategies show that the DEM projects are cost-effective additions in all cases examined.

The table on the following page shows the results of the analyses shown in the chart above in tabular format along with additional statistics for each strategy. The shaded cells in the table indicate, for each strategy, the identity and date of the first "discretionary" resource required beyond the committed resource options, including in all of the strategies and after the DEM R1 wastewater recycling transmission extension projects.

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47. The existing amount of diversion capacity is assumed, but this results in less water volume diverted for offstream irrigation uses due to the assumption that instream flow standards are implemented. See discussion in earlier section of this report.

48. As explained in the Na Wai Eha Surface Water Treatment strategy section of this report, the Waiale and Waihee WTP strategies that assume allocation of sufficient stream base flow to provide reliable source water result in less water available for other offstream irrigation uses than the other strategies.

Central District Final Candidate Strategies

Low Energy Price Scenario: $75/bbl 2008 Equiv. Electric Power Costs Escalated at 1.0% (Real) Per Year

System	Central System	Central System	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Northward Reconfigured**	**Waiale WTP 30cpkg**	**R1Ph1&2 DSM45% Waiale**	**300MG Resv + WTP(6 MGDA)**	**R1Ph1&2 DSM45 300MGw6MGDA**
Description	N.Waihee,Kahakl23,Supp	Multiple 350GPM Wells				
Demand Projection	Base Case	Base Case	Base Case	Base Case	Base Case	Base Case
Demand Proj Source	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7	HDA 2006 Update v31.7
Notes:						
Var.Op.Esc.Rate	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	741,826	741,826	741,826	741,826	741,826	741,826
Cap.Shortfall 2006-30 MGD-Yrs.	19,293	19,244	19,650	19,107	19,284	19,226
Cap.Shortfall 2007-30 MGD-Yrs.	11,842	11,792	12,198	11,658	11,832	11,774
Cap.Shortfall 2008-30 MGD-Yrs.	4,414	4,365	4,771	4,228	4,405	4,347
Net Present Value Costs	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**	**$K NPV 2006**
25 Year Planning Period Costs:						
Variable Operation Cost NPV	164,405	164,339	164,157	155,405	158,414	152,153
Fixed Operation Cost NPV	173,204	173,301	178,800	176,372	177,769	175,261
Capital Cost NPV	113,278	121,967	109,301	106,841	134,741	122,505
DSM Program Cost	4,314	4,314	4,314	18,116	4,314	18,116
Total System Cost NPV	455,201	463,921	456,573	458,534	475,239	468,034
50 Year Study Period Costs:						
Variable Operation Cost NPV	257,960	257,837	257,059	243,372	246,719	235,325
Fixed Operation Cost NPV	268,126	268,470	277,709	274,527	275,796	272,805
Capital Cost NPV	172,601	188,939	166,858	155,142	203,333	194,350
Total System Cost NPV	703,717	720,275	706,655	695,138	730,878	724,577
25 Year Planning Period Rate Impacts:						
Avg. Annual DWS Rate Increase	3.49%	3.60%	3.31%	3.40%	3.72%	3.59%
Levelized Unit Cost ($/kgal)	$3,589	$3,659	$3,600	$3,584	$3,749	$3,678
Resource Addition Sequence:	DSMDTD Indoor 2010	DSMDTD Indoor 2010	DSMDTD Indoor 2010	DSMDTD Ind 45% 2010	DSMDTD Indoor 2010	DSMDTD Ind 45% 2010
	DSMDTD Outdoor 2010	DSMDTD Outdoor 2010	DSMDTD Outdoor 2010	DSMDTD Out 45% 2010	DSMDTD Outdoor 2010	DSMDTD Out 45% 2010
	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008	Kupaa Well 2008
	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008	Maui Lani Wells 2008
	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009	Generic Backup 1 2009
	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009	Iao Tank Site Well 2009
	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009	Waikapu South 1 2009
	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009	Waikapu Tank Well 2009
	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011	Waikapu South 2 2011
	Maluhia Well 2013	Maluhia (2) 2013	Waiale T.P.w30cpkg 2014	DEM1 Waipulani 2012	300MG Resv WTP 2013	DEM1 Waipulani 2014
	Waiolai Well 2015	Generic Backup 1 2014	Generic Backup 1 2023	DEM3 Lilioa KHS 2012	Generic Backup 1 2020	DEM3 Lilioa KHS 2015
	Generic Backup 1 2016	Generic Backup 1 2016	Generic Backup 1 2025	DEM5b NSCollRd. 2013	Generic Backup 1 2021	DEM5b NSCollRd. 2016
	Wailena Well 2018	Wailena (2) 2016	Generic Backup 1 2026	Waiale T.P.w30cpkg 2018	Maluhia (2) 2023	300MG Resv WTP 2018
	Kahakuloa Ph1 2019	Waipili (2) 2018	Maluhia (2) 2028	Generic Backup 1 2027	Generic Backup 1 2024	Generic Backup 1 2024
	Kahakuloa Ph2 2021	Kahakuloa (4) 2019	Wailena (2) 2029	Generic Backup 1 2029	Wailena (2) 2024	Generic Backup 1 2025
	Kahakuloa Ph3 2022	Generic Backup 1 2020	Supplemental Wells 2029	Generic Backup 1 2030	Waipili (2) 2026	Maluhia (2) 2027
	Supplemental Wells 2024	Waihali (2) 2021			Supplemental Wells 2027	Wailena (2) 2028
	Supplemental Wells 2026	Po'eiua (2) 2022			Generic Backup 1 2028	Waipili (2) 2028
	Supplemental Wells 2028	Generic Backup 1 2024			Supplemental Wells 2030	Supplemental Wells 2029
	Supplemental Wells 2030	Supplemental Wells 2025				Supplemental Wells 2030
		Supplemental Wells 2027				
		Supplemental Wells 2028				
		Supplemental Wells 2029				

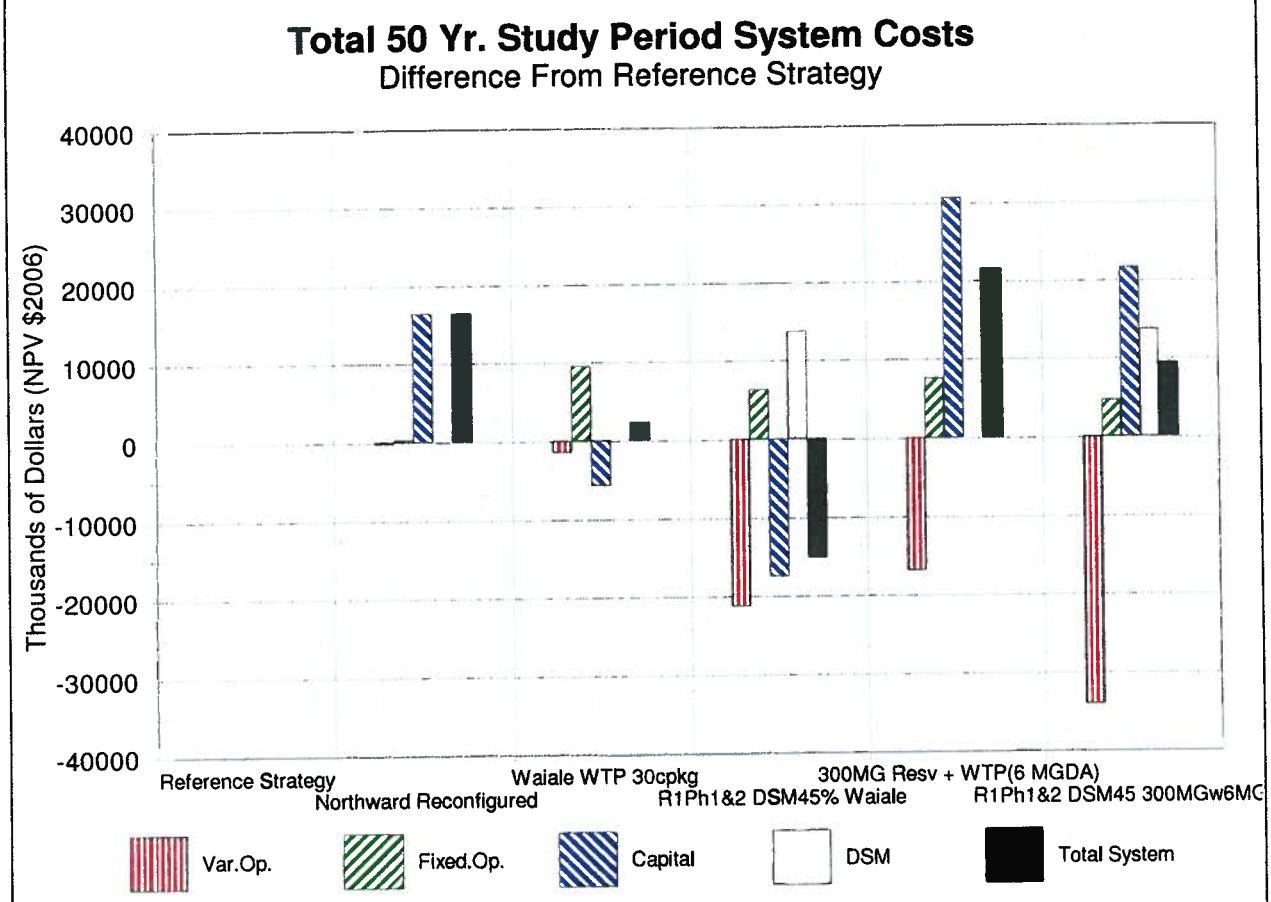

Figure 44
Central District Final Candidate Strategies With Alternate Assumptions -- "High" Energy Cost Scenario = $125/bbl 2008 Equiv Electrical Energy Costs Escalated at 1% (Real) per Year

The chart above shows the same strategies as the previous chart, except that the high energy price scenario is assumed. In the high energy cost scenario the combination of the 300MG reservoir with WTP and DEM R1 wastewater recycling transmission with extensive conservation is less expensive than the Northward Reconfigured strategy.

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Comparison of the Merits of the Final Candidate Strategies

The merits of the Final Candidate Strategies can be assessed using the Planning Objective and Attributes Matrix and consideration of the economic analyses described above. The recommendations provided in the following *Recommended Central District Plan* section are based on consideration of the merits of the Final Candidate Strategies with respect to each of the planning objectives identified in the Central District WUDP process.

Uncertainty and Contingency Planning

There are substantial uncertainties regarding several factors that are important to consider in determining recommended water resource plans. Some factors, such as future energy prices and the rate of future growth in water demand, are particularly uncertain at this time of pronounced economic upheaval. Some uncertainties have been examined to some extent by testing alternate scenarios in the integrated economic analyses presented in this report. Some remaining uncertainties are addressed by a "contingency planning" approach identifying specific measures to address uncertainties and maintain optimal planning flexibility.

Uncertainty Regarding the Viability of Strategies

The viability of several of the Final Candidate Strategies is uncertain to some extent.

- The Na Wai Eha Surface Water Treatment strategies are possibly the most economical options, but all are contingent upon pending resolution of long-term water availability and price. Both the outcomes of these determinations and the dates that the determinations will be made remain uncertain.
- The Northward Basal Groundwater strategy is uncertain regarding the expected yields of wells in this relatively "unexplored" area. The efficacy of basal wells in this area must be verified before large capital expenditures are committed to develop the necessary water transmission improvements.

The Recommended Central District Plan outlined below discusses and addresses each of these uncertainties.

Timing of Need for the Next Discretionary Resource

Because the viability of some of the preferred strategies is uncertain and depends on determinations that will not be known for several years, it is necessary to plan for contingencies. A principal question, for example, is whether or not it is possible to wait for decisions regarding the long-term availability and price of Na Wai Eha surface water for treatment for DWS municipal use. Is it possible to wait for the water allocation and pricing decisions that must be made by the CWRM and the Public Utilities Commission? Are other, possibly more expensive, contingency options warranted to preserve the option to implement this possible strategy? At what point would it become necessary to abandon this strategy (or other preferred strategies) and opt instead for more expensive options that would preclude this strategy, such as major capital investment in transmission and development of new basal wells in the Haiku aquifer? All of these questions require consideration of the degree of urgency to implement new long-term supply resources (beyond those that are committed and expected in the near term) and what immediate measures are necessary to preserve flexibility to implement valuable options and, at the same time, economically maintain reliable water services.

The need date for the next "discretionary" resource addition is calculated by the integrated capacity expansion and production costing model used in the analysis of the Final Candidate Strategies.[49] For the Central District system, assuming timely implementation of the committed and near-term supply resource options and assuming the base case projection of future water consumption, the next discretionary resource is required in the year 2012. With budgeting and implementation of the basic portfolio of DSM (conservation) programs assumed in each of the Final Candidate Strategies, the next discretionary resource addition would be required in the year 2013. As described below, these need dates incorporate some prudent margins that are appropriate for economic analysis and long range planning purposes but may be somewhat con-

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49. The "next discretionary resource" is the next resource in the candidate strategy beyond the committed and near-term resource additions assumed in all of the strategies.

servative in determining dates that resources are absolutely needed for contingency planning purposes.

The modeling analyses of the Final Candidate Strategies incorporate specific assumptions regarding future water demand and the available production capability of the existing Central DWS water system. These assumptions were made carefully to provide a uniform and reasonable basis for economic analysis and long range planning determinations. As described below, the assumptions include some conservative margins:

- The capacity expansion criteria used to determine the need dates for new supply resources in order to maintain sufficient reliable capacity are not as rigorous as the State of Hawaii Water System Standards but are nevertheless somewhat conservative considering the specific characteristics of the Central District system.
- The analyses assume that the existing and planned Committed and expected Short-Term resources in the Iao aquifer system will withdraw 16 MGD (12-month moving average) from basal groundwater sources. The DWS is currently permitted to withdraw 18.45 MGD from these sources. An additional 0.613 MGD withdrawal permit for Kehalani (Shaft 33) could also ultimately serve projected water demands for the Central District.
- The analyses assume that 4.0 MGD would be withdrawn from the existing and planned committed wells in the south half of the Waihee aquifer. Only in the Northward Basal Groundwater strategy with transmission to the north side of the Waihee aquifer is additional water withdrawal assumed from the Waihee aquifer. Recently actual withdrawals from the south side of the aquifer have averaged 5.7 MGD (twelve-month moving average) without any observable increase in chlorides. The 4 MGD withdrawal assumption is prudent for long range planning purposes, but it is reasonable to rely on higher levels of pumping as needed for several years with close monitoring of chlorides.
- The analyses assume production from the Iao Tunnel (which is not included in the Iao aquifer groundwater permitting or sustainable yield limitations) of 1.4 MGD. Sustained production of 2.0 MGD is possible from this existing resource.
- The analyses assume projections of water production requirements that are consistent with the Maui County General Plan Update demographic projections and the WUDP projections of water demand that are derived from these demographic projections. The WUDP projections of water demand predicted a decrease in water demand in the year 2008 as a result of increases in water prices in conjunction with the DWS inverted block rate structure. Actual water consumption in 2008 decreased substantially more than predicted, due, at least in part, to lower average visitor census resulting from national and global economic recession. 2008 consumption was over 1 MGD lower than assumed in the Final Candidate Strategy analyses.

Based on these factors, it is possible that the next discretionary resource may not be required on the Central District system for several years beyond what is determined in the modeling analyses for the Central District. For example, the following assumptions would lead to later discretionary resource need dates:

- Iao aquifer withdrawals with existing and committed resources at 19 MGD (additional 2.16 MGD)
- Waihee aquifer withdrawals (south side) with existing and committed resources at 5.5 MGD (additional 1.5 MGD)
- Iao Tunnel production at 2.0 MGD (additional 0.6 MGD)
-

- Water consumption at 1.0 MGD less than projected (using 2008 as base year for predicted increases)

These assumptions combined would provide 4.26 MGD more water production capability than assumed in the modeling analyses and 1 MGD less water production requirements. At a base case projected average system growth rate of approximately 0.6 MGD per year, this additional assumed production capability and lower consumption projection would result in a substantial delay in the need date for the next discretionary resource.

It might be reasonable to incorporate some of these less conservative production capability assumptions in the base case assumptions of the resource plans. It would not be prudent, however, to base plans on a conjunction of all of these less conservative assumptions since there is some uncertainty associated with each assumption and because plans do need to incorporate some conservative margins to account for inevitable delays in implementing planned resource additions. The analyses presume, for example, that the committed and planned near-term resource options will be implemented as scheduled. Although there is a fairly high degree of confidence in the likelihood these resources will be installed, there is nevertheless some uncertainty.[50]

Uncertainty Regarding Energy Prices

Electrical energy costs are the single largest expense of the DWS. The DWS is the single largest customer of the Maui Electric Company. Future electrical prices are an important determinant in the economic analysis comparing the merits of the Final Candidate Strategies.

The year 2008 saw the most volatile world energy prices in history. In the first half of the year world oil prices doubled. In the second half of the year they fell to one third of the peak price. This volatility can be seen in the electrical energy price assumptions incorporated in the concurrent WUDP economic analyses. The analyses of the Final Candidate Strategies was revised to incorporate electrical energy prices at approximately their peak and then revised again as prices fell. This report presents a comparative analysis of the Final Candidate Strategies with respect to a range of prices. This range is wide (equivalent to a range of $75 per barrel to $125 per barrel) but certainly does not bound the range of possible future energy prices. Future energy prices remain substantially and inevitably uncertain.

Energy price uncertainty and volatility affects long range planning decisions and DWS finances. From a planning standpoint, uncertainty regarding future energy prices is addressed by considering the results of the economic analyses of the Final Candidate Strategies assuming different future energy price scenarios. The impacts of energy price volatility on DWS finances could be addressed by rate designs that adjust rates according to energy prices.

Uncertainty Regarding Project Construction Costs

The estimates of project construction costs in the Final Candidate Strategy analyses were derived from several sources. Historical and recent actual and contractual project costs were examined. Estimates were also obtained from a Maui contractor for a range of possible major capital projects. Despite best efforts, however, the estimates of project costs remain substantially uncertain.

Construction costs on Maui for several recent years have been particularly high compared to historical costs due, at least in part, to high demand for limited construction industry services. More

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50. The specific assumption that two DWS wells will be developed in the near term in the Waikapu aquifer is very uncertain but in conjunction with several other wells in this aquifer that are drilled and in the process of being drilled, it is likely (but still not certain) that the full sustainable yield of this aquifer will be developed to serve municipal needs in the near term.

recently project construction costs have softened as demand for construction industry services wanes with economic recession.

The Final Candidate Strategies were compared under a range of capital cost assumptions to determine the extent to which future construction costs might change the comparative economics of the strategies. Although the magnitude of assumed capital costs changes the costs of the strategies, this factor does not change the comparative outcome of the analyses extensively, primarily due to the fact that all of the strategies incur substantial capital costs.

A more important consideration regarding the uncertainty of project construction costs is maintaining some flexibility in timing major projects to coincide with the availability of lower construction costs. To the extent the DWS can maintain several alternate resource development options and/or stay ahead of urgent needs for immediate project implementation, the DWS can potentially minimize capital costs by obtaining more competitive bids from competing contractors.

Capital Costs and Uncertainty in Future Water Demand

One specific factor that should be considered is the risk associated with strategies, such as the Eastward Basal Groundwater strategy, that require very large up-front lump-sum capital expenditures that cannot be implemented in phases as demand develops.[51] Some caution is advised regarding commitments to major capital projects at a time of possibly extended economic recession unless the objective (and associated provision of capital funding) is to promote economic stimulus.

In the analyses presented in this report, all of the strategies are evaluated assuming the consistent growth in water demand associated with the trends assumed in the County's land use planning analyses. It is assumed in the land use planning analyses that planned land development will result in persistent long-term growth in water demand. This is not a certain assumption. It is possible that water demand will not increase at projected rates, or indeed at all, in the next several years due to customer response to higher water prices and economic recession. In a worst-case perspective, rate increases resulting from large capital projects could further induce reductions in water demand, resulting in further needs for rate increases.

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51. Unlike some of the final candidate resource strategies that can be implemented in phases, the Eastward Basal Groundwater strategy would require a substantial capital investment in water transmission improvements before any water would be produced for the Central District system.

Central DWS District Plan

The recommended Central District Plan attempts to address the planning objectives derived from comments by the Central District Water Advisory Committee. The plan consists of several components:

- Department of Water Supply actions to provide water needs for its customers
  - Conservation and water recycling programs to reduce water production requirements
  - New sources of water supply
  - Regulations and rate designs to promote responsible use of water
- Programs to protect the County's aquifers, watersheds and streams
- Discussion of priorities and policies regarding water use and allocation

The recommended Central District Plan is outlined below:

Short-Term Resources

- ACQUIRE COMMITTED AND NEAR-TERM SUPPLY RESOURCES: One clear finding from the analyses supporting the examination of the candidate and Final Candidate Strategies is that the committed and near-term new supply resources are necessary to install as soon as possible to provide reliable water service for the Central District:
  - Maui Lani Wells
  - Kupaa Well
  - Shaft 33 Replacement Wells (Including Iao Tank and Waikapu Tank wells)
  - Waikapu South Wells 1 and 2

With these resources in place the DWS Central District System will have sufficient capacity and water production capability to meet projected water demands at least through the year 2012.[52]

- OPTIMIZE PRODUCTION FROM EXISTING RESOURCES.
  - Optimize pumping distribution for Iao aquifer wells.
  - Pump Waihee aquifer wells at safe rates up to aquifer sustainable yields.
  - Optimize Iao Tunnel production within legal constraints.
- CONTINUE AND ACCELERATE LEAK DETECTION AND REPAIR PROGRAM.
  - Provide additional budget, staff and equipment to accelerate leak detection and repair for all DWS systems.

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52. Currently the DWS Central District system has sufficient water production capability to provide water for existing needs but is deficient with respect to its system design criteria (State of Hawaii, Water System Standards, 2002). Applying the modified system design criteria used in the WUDP analyses, the installation of the committed and near-term resources identified here would provide sufficient capacity and water production capability to make the Central District system sufficient until 2012 at the rate of growth in consumption forecast in the WUDP base case projections.

The need dates for new resources cited in this Recommended Central District Plan are consistent with the results of the supporting system modeling analyses and include several conservative assumptions to provide planning margins appropriate for economic analysis and long range planning purposes. This is discussed in detail in the preceding section titled "Uncertainties and Contingency Planning"

- EXPLORE DEMAND RESPONSE OPTIONS -- Demand response options are measures that can be implemented quickly during periods of restricted water availability or in response to water supply system disruptions. In order for these options to be effective, protocols and authorities need to be established in advance of the need for demand response measures. Options include:
  - Landscape irrigation scheduling restrictions
  - Monitoring and enforcement of waste prohibitions
  - End-use restrictions (on pavement cleaning / watering, automobile washing, dust control with potable water and other discretionary uses of water)

Long-Term Resources

In previous sections of this report several final resource strategies were examined that posed alternative approaches to providing new water supply for the DWS. The recommended strategy recognizes that there is substantial uncertainty regarding the feasibility, costs and timing of the availability of some of the final resource strategies.

Discussion:

- The use of Na Wai Eha stream water for treatment to serve DWS municipal needs is possibly the most cost-effective strategy, but there are uncertainties regarding the feasibility and timing of availability of this strategy.
  - There is a specific project proposal for a treatment plant at the Waiale Reservoir site. The engineering and design for this project are nearly complete, an EIS has been prepared and withdrawn for amendment, and contract negotiations are in progress between the developer and the County.
  - There is currently no long-term assurance of available source water for a treatment plant. Any assured source of water will have to wait for the final outcome of several allocation proceedings by the CWRM.
  - The price of the source water is uncertain. The cost-effectiveness of this strategy depends upon an economical source of raw water supply.
- The costs and efficacy of developing new basal groundwater wells to the north of the existing extent of the Central District system (into the north half of the Waihee aquifer and the Kahakuloa aquifer) are uncertain.
  - Hydrology and expected well production output need to be verified before expensive transmission system costs are incurred.
  - Transmission system construction cost estimates are currently particularly high but may decrease in the next several years as the demand for construction services is expected to decrease.
- Developing water transmission lines to the Haiku aquifer would be more expensive than other options. Developing transmission to the Honopou or Waikamoi aquifers would be prohibitively expensive.
- Desalination of brackish water would be more expensive than other options. As desalination technologies continue to develop, costs may decrease.
- Water conservation programs would be economical and could delay the date by which new water supply resources are needed. The basic water conservation programs included in the final resource strategy analyses would cost approximately $4.3 million over a five year period and would reduce capital and operating costs by about $9.4

million.[53] If started in 2010, the basic conservation programs could defer the need for new supply resources (beyond the committed and near-term resources identified above) from 2012 to 2013.[54] More intensive implementation of conservation programs could defer the need for new supply resources by an additional one or two years. Customer response to higher water prices may also delay the need for new resources.

- Providing additional transmission for R-1 recycled water from the Kihei Wastewater Treatment Plant could displace enough potable water use to further delay the need for the next new supply resource to the year 2018 or 2019.[55]

Recommendations:

Based on these considerations the following plan components are recommended regarding acquisition of new potable water supply sources for the Central District:

- MONITOR NA WAI EHA SURFACE WATER PROCEEDINGS -- Monitor the progress of proceedings regarding water from the Na Wai Eha streams:
  - CWRM actions and related appeals regarding amending interim instream flow standards for the Na Wai Eha streams -- allocating water between instream and kuleana uses versus offstream uses.
  - CWRM actions regarding the designation of the Na Wai Eha surface water management area and allocations of water between all water users.
  - PUC actions regarding the terms of a Certificate of Public Convenience and Necessity for Wailuku Water Company (WWC) and associated tariffs specifying the price of water sold by WWC to users.
  - County of Maui actions regarding condemnation of WWC diversion structure appurtenances by powers of eminent domain.
- PROCEED WITH WAIALE WTP NEGOTIATIONS AND APPROVALS TO THE EXTENT POSSIBLE, PENDING DETERMINATION OF ASSURANCE OF LONG TERM WATER AVAILABILITY AND PRICE -- Negotiations would need to determine:
  - Construction of a WTP financed by A&B or by the DWS or by a partnering agreement.
  - Assurance of a long-term reliable base flow supply of water for the WTP, including:
    - obtaining water allocations from the CWRM.
    - obtaining contractual or other means of legal assurance of uncontested use of source water for the WTP.
  - Assurance that any price or delivery charges for raw water sources with be reasonable over the term of operation of the WTP.
  - Resolution of policies and contract terms regarding terms of ownership, denomination of source credits and entitlements to water, water meters or land develop-

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53. The basic conservation programs included in each of the Final Candidate Strategies are budgeted at approximately $ 1 million per year for a period of five years. The net present value (npv) of these costs is $ 4.3 million. As a result of the impacts of the programs, DWS capital costs would be reduced by $ 4.2 million (npv) and the operating costs would be reduced by $ 5.2 million (assuming the low energy price scenario).

54. See footnote number 52.

55. See footnote number 52.

ment approvals.

- Implementation of inline hydroelectric power generation or direct use of water pressure associated with dropping source water from higher elevations.

- CONSIDER ALTERNATE WTP SITES AND RAW WATER STORAGE RESERVOIR CONFIGURATIONS.
  - As a contingency option, review existing studies and conduct further siting feasibility investigations regarding possible WTP locations and raw water storage reservoir configurations. The factors listed above regarding Waiale WTP negotiations should be taken into consideration.
- IMPLEMENT NEW WATER CONSERVATION MEASURES:
  - Immediately take steps to begin implementation of water conservation programs designed to attain at least 15% of the technical conservation potential for the Central District within five years. As specified below, a conservation program specialist should be retained by the DWS to determine and assist the DWS to implement a portfolio of DSM programs, including the following elements:
    - Residential / commercial audit and direct installation program for indoor and landscape irrigation users
    - Education and publicity program to encourage water conservation and promote program participation
    - Direct installation of efficient fixtures at customer premises including toilet, showerhead and sink faucet flow restrictors
    - Audit of existing irrigation system equipment and practices and specific resulting recommendations to customer to improve efficiency
    - Direct installation of targeted high-payback fixtures in commercial premises
    - High-efficiency fixture rebates
    - High-efficiency washing machines
    - High-efficiency toilets and waterless urinals
    - Hotel awards program
    - Building manager user group and services
    - Agricultural user group and services
  - Budget for initial implementation of programs.
  - Provide additional DWS staff positions and training to support indoor and outdoor conservation audit procedures, DSM contract management and program tracking and evaluation functions.
  - Retain expert assistance to assist the DWS to consider a balance of mandatory provisions, direct install programs or incentive programs, determine optimal DSM program designs, solicit and procure DSM program implementation contracts, conduct necessary market research and publicity outreach, establish a portfolio of conservation programs for the DWS systems and implement accountable program tracking and evaluation procedures.
  - Establish and facilitate an agricultural water user group and a building facilities manager group to discuss and promote water efficiency measures.

- Based on experience with program implementation and based on continuing needs to defer the need for new supply resources, consider more aggressive DSM programs.

- EXPAND RECYCLING OF R-1 WASTEWATER PLANT EFFLUENT.
  - Initiate actions to implement additional transmission of R-1 recycled water from the Kihei WWTP to services in the South Maui area to, among other benefits, displace potable water currently used for landscape irrigation. In conjunction with the conservation programs recommended above, this option could defer the need for other new supply resources until 2018 or 2019 should other resources fail to become economically available in the next few years.
  - Establish policies, protocols and accounts, as necessary, to:
    - Provide project financing and establish sufficient capital and operation budgets for the DWS and DEM.
    - Fairly allocate costs to rates paid by DEM and DWS customers.
    - Determine reasonable reliability standards and backup provisions for recycled water service.
- MONITOR FEASIBILITY AND PRESERVE OTHER LONG TERM OPTIONS. Continue to monitor costs and feasibility of other resource strategy options.
  - Verify the hydrology of the North Waihee aquifer to determine the feasibility of the Northward Basal Groundwater strategy by supporting further study or drilling one or more test wells north of Makamakaole Gultch.
  - Monitor construction costs for water transmission and storage reservoir projects to determine the ongoing economic feasibility of the Northward and Eastward Basal Groundwater strategies.

Regulatory Mechanisms

- MAINTAIN AND/OR EXTEND INVERTED-BLOCK AND PROGRESSIVE RATE DESIGNS. The existing DWS inverted block rate design is progressive in the respect that it provides aggressive price signals in the higher consumption blocks that encourage conservation, and also provides lifeline rates for low volume consumers.
  - Consider increasing the rate block price differential and/or providing an additional higher cost block.
  - Ensure that all costs necessary to provide water services are included in rates.
- REVIEW SYSTEM EXPANSION FINANCING POLICIES AND/OR ESTABLISH SUFFICIENT SYSTEM DEVELOPMENT FEES. The County should establish sufficient and appropriate System Development Fees that are consistent with the fiscal purposes and policies of the DWS. The source and transmission components of the current fees are not sufficient to pay for commensurate new source and transmission improvements. As an alternative the County should consider revising its system development financing policies to provide debt financing for system expansion improvements where necessary.
- ESTABLISH WATER SOURCE DEVELOPMENT CONTRACT STANDARDS. The Maui County Code provides that approvals of new subdivisions require prior verification by the Water Director of a long-term reliable source of water. In areas where the DWS does not currently have sufficient water capacity or production capability, potential land developers have a strong incentive to develop new potable water sources in

order to obtain required verification. Few developers want to operate water sources or commit to providing perpetual water services. In most cases developers prefer to transfer ownership of a new water source to the DWS in trade for verification of water availability, entitlements to obtain water meters and/or source credits towards payment of DWS System Development Fees.

From the perspective of potential source developers as well as for the interests of the County, there is a need for clear policies and standards regarding water source contracts. Clear standards would provide fairness, encourage reasonable financial investments in new sources and ensure that new sources are safe, properly sited and contribute to the system planning and operation objectives of the DWS.

- Establish clear and uniform standards for determining source credits.
  - Source credits should be denominated in dollars towards the cost of system development fees at the time the source credits are redeemed (rather than in terms of capacity or meter equivalents).
  - Terms and transferability of source credits should be clearly established.
- Establish clear and uniform standards for determining entitlements, reservations and verifications of water availability.
- Establish standards for well (or other source) location, requiring consideration of:
  - Source / wellhead protection to ensure long-term water quality
  - Source elevation and impacts on water system operation costs
  - Proximity to existing water system transmission lines
  - Need to boost water to elevation of land developments
- Establish standards for integration of new sources with the DWS system considering:
  - Need and role of new source in DWS long range system plans
  - Functional / operational role of the new water source
  - Variable and fixed operation costs
  - Storage and disinfection contact requirements
  - Design of new sources to DWS construction / engineering standards

- ESTABLISH CLEAR, MEANINGFUL CRITERIA FOR DETERMINING AVAILABILITY OF WATER AND NEED FOR NEW SYSTEM SUPPLY RESOURCES. The DWS needs to have a clear method to determine whether there are sufficient water resources and sufficient infrastructure to supply new water demands. This is necessary for several reasons including (1) the need to determine verifications of sufficient water source for new subdivisions, (2) the timing of need for new source development and capital improvements in order to maintain reliable water service and (3) implementing water allocation policies.
  - Commission a study/project to develop reasonable and useful system reliability standards, system capacity expansion criteria and methods to determine and express the status of water availability for new water services.

Resource Protection and Restoration

Actions, programs and measures to protect and restore cultural, watershed and groundwater resources are essential components of Maui's WUDP. These include:

Watershed protection and restoration

Healthy forests and soil in our watershed areas are essential to maintain the healthy streams and ground water aquifers that are the source of our water supplies. These resources need protection and, in some places, substantial restoration. Healthy forests invite and capture precipitation, retain water to replenish aquifers, maintain base flow in streams, prevent soil erosion and flooding and maintain stream water quality.

- SUPPORT WATERSHED PARTNERSHIP AGREEMENTS.
- SUPPORT REFORESTATION PROGRAMS.

Wellhead protection

- IMPLEMENT A WELLHEAD / AQUIFER PROTECTION ORDINANCE FOR EACH ISLAND.

Stream restoration

Healthy streams are essential to support Hawai'i's unique stream fauna, support riparian uses and provide sufficient cool water necessary for growing taro. Existing diversions from streams provide water for agricultural and municipal uses.

- SUPPORT APPROPRIATE AMENDMENT OF INTERIM AND OR PERMANENT INSTREAM FLOW STANDARDS BY THE CWRM.
- SUPPORT PROGRAMS TO PROTECT AND RESTORE STREAMS.
- CONSIDER IMPACTS ON RELIANCE ON WATER FROM STREAMS IN COUNTY LAND USE DETERMINATIONS.

Protection of Cultural Resources

- SUPPORT STREAM RESTORATION MEASURES.
- CONSULT WITH THE BURIAL COUNCIL AND THE LOCAL KULEANA REPRESENTATIVES FOR FINDINGS AND RECOMMENDATIONS REGARDING DWS PROPOSED ACTIONS RELEVANT TO CULTURAL RESOURCES.
- ABIDE BY THE STATE WATER CODE (INCLUDING IN PARTICULAR HRS174C-101: NATIVE HAWAIIAN WATER RIGHTS) AND OTHER APPLICABLE LAWS PROTECTING TRADITIONAL AND CUSTOMARY PRACTICES AND THE RIGHTS AND INTERESTS OF KULEANA WATER USERS.

Energy Efficiency and Energy Production

Energy costs are the single largest expense of the DWS. The DWS is the largest aggregate customer of Maui Electric Company (MECO). Opportunities to use energy more efficiently, manage the timing of electrical loads with MECO and generate electrical energy can all benefit the County and DWS customers.

Efficient use of energy by the DWS will reduce costs to the County and DWS customers and reduce the impacts associated with electrical power production. Cost-effective energy efficiency measures are consistent with all of the WUDP planning objectives.

Managing the timing of electrical energy use (load management) can be a valuable resource to MECO. The DWS can benefit by existing MECO load management incentives and by negotiating benefits resulting from future power management protocols with MECO.

The DWS has several opportunities to produce renewable energy for its own use that would reduce system costs. Renewable energy production opportunities are site specific due to the nature and availability of renewable energy sources and proximity to the DWS system electrical

loads. Several specific opportunities for potential wind and hydroelectric generation have been identified for the Upcountry District. Opportunities for the Central District will depend on the location of future resource development.

- ESTABLISH DWS ENERGY RESOURCE COORDINATOR POSITION.
  - Establish a full time staff position to monitor, investigate and implement energy efficiency programs, load management measures and energy generation opportunities .
- IDENTIFY AND IMPLEMENT ENERGY EFFICIENCY OPPORTUNITIES.
  - Participate in Public Benefit Fee Administrator energy efficiency programs and MECO load management programs.
  - Invest in high efficiency equipment wherever cost-effective.
  - Monitor and optimize energy consumption of motor loads.
    - Establish and monitor baseline efficiency metrics for pumping loads.
    - Measure and monitor actual operational motor loads for energy diagnostics and optimization of equipment replacement.
  - Establish system operation protocols that consider energy efficiency.
    - Tabulate marginal operation costs for all system resources.
    - Determine operational protocols to minimize energy costs without compromising system functionality.
  - Optimize power factor correction on all large motor loads.
    - Balance three-phase circuits.
    - Determine and install optimum power factor correction capacitance for each large motor load.
- IDENTIFY AND IMPLEMENT LOAD MANAGEMENT OPPORTUNITIES.
  - Review and, as appropriate, amend MECO rate rider contracts.
    - Balance MECO rate incentives versus system operation functionality.
  - Monitor and negotiate load management opportunities, especially electrical system transient management services.
    - Monitor MECO system needs and proposed measures to incorporate increased wind generation on the Maui electrical grid.
    - Develop DWS load management protocols that are valuable to the MECO system.
    - Negotiate for shared system and economic benefits for load management services provided by DWS to MECO.
- IDENTIFY AND IMPLEMENT ENERGY GENERATION OPPORTUNITIES.
  - Monitor ongoing opportunities for cost-effective energy generation to serve DWS electrical loads.

Water Allocation Policies

This section of this plan update is incorporated solely to provide an expository discussion of possible water allocation policies. As this matter is discussed in various public forums more concrete recommendations may be offered. The discussion in this section may be used in

consideration of actions pursuant to the Maui County Code Chapter 2.90A -- *Regulation of Permits and Water Use.*

The State Water Code (HRS Chapter 174c) clearly provides that each county shall adopt a WUDP by ordinance **"... setting forth the allocation of water to land use in that county..."**[56] Apart from this unequivocal directive, however, the Water Code is silent and provides no further guidance regarding water allocations in the county WUDPs. The Water Code does not identify how the allocations should be made or what purposes they are intended to serve. The Water Code does not identify any context or venue in which the allocations should be applied, nor does it explicitly provide any authority to implement or enforce water allocations.[57]

There have been discussions in several venues regarding allocations of water in the WUDP, but there is no consensus regarding how the allocations should be expressed or how they should be applied. There are diverse opinions on this matter.

In order to provide a starting point for further detailed discussion regarding the "allocation of water to land use" in the WUDP, several clarifications and approaches are outlined below:

Venues and Purposes for Allocations

Water allocation in the WUDP can serve several purposes, either as guidelines or as rules.

- Water allocation policies established in the WUDP can serve as ***guidelines:***
  - To the CWRM regarding amendments to interim instream flow standards (IIFS) and establishing instream flow standards (IFS).
    - These CWRM standards determine allocation of water to instream versus offsteam uses.
  - To the CWRM regarding allocation of water to competing uses and users in water management areas.[58]
    - Permits for water use issued by the CWRM in surface water management areas explicitly allocate water between instream uses and offstream uses as well as between competing offstream users.
    - Permits for water use issued by the CWRM in groundwater management areas explicitly allocate water, within aquifer sustainable yields, to competing ground water uses and users.
  - To the DWS in making decisions within its discretionary authority.
  - To state and county agencies, including the Maui County Council, in determining rules, ordinances, policies and plans, including the General, Island and Community Plans.
- Water allocation policies in the WUDP can potentially serve as **rules** regarding determinations within the authority of the Maui County Council, including:

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56. HRS 174C-31(a)(2)

57. The County certainly may have authority to allocate water provided by the DWS to DWS customers but this authority does not derive from the Code's language regarding the Hawaii Water Plan or the County Water Use and Development Plans. There is a distinction between "users" in the context of the Code and DWS customers. In the context of the Code the DWS is a "user" but the DWS customers are not users. The DWS serves many customers

58. In the context of allocation of water by the CWRM, the DWS is a "user" but individual DWS customers are not "users" by way of receiving water from the DWS. These allocations are made in accordance with the provisions of the State Water Code, HRS Chapter 174C. Allocations of water between existing and potential DWS customers are determined by the County in accordance with DWS policies and county ordinances and rules.

- Rules regarding actions by the DWS, including:
  - Issuance of water meters
  - Issuance of reservations for water meters
  - Certification by DWS Director of availability of reliable source of water supply necessary for subdivision approvals
  - Approval of contracts with water source developers
  - Development of DWS supply and transmission resources
  - Restrictions on certain water uses during drought or temporary system deviance
- Rules regarding actions by County agencies, including:
  - Planning Commission
  - Department of Public Works
  - Planning Department permitting and/or subdivision approvals
  - Board of Variance and Appeals actions
- Rules with respect to the actions listed above regarding set asides or reservations for specific priority uses, possibly including:
  - Affordable housing projects
  - Kuleana or public trust domestic uses
  - Hospitals or other municipal emergency or public service uses
  - Department of Hawaiian Homelands (DHHL) projects
  - General or specific agricultural uses

Hierarchy of Priorities

A general hierarchy could be outlined to establish water use priorities. Outlined below is one example of a hierarchy of priorities of water use derived from existing law and practical considerations:

- Public Emergency Uses (Temporary)
  - Fire control
- Public Trust Uses
  - Instream uses
  - Kuleana kalo, subsistence agriculture and domestic uses
- Reasonable / Beneficial Uses
  - Essential municipal public service uses (hospitals)
  - DHHL domestic uses
  - Domestic uses
  - DHHL agricultural uses
  - Agricultural uses
  - Government uses (offices)
  - Hotel / Commercial / Industrial uses
  - Non-essential municipal public service uses (parks)

- Landscape irrigation uses
- Non-reasonable / Non-beneficial Uses
  - Excessive or purposeless commercial uses
  - Wasteful or excessive landscape irrigation uses
  - Waste

Set-Asides

Amounts of water could be set aside for specific users or uses. For example, it could be determined that a specific amount of water or a percentage of available water would be set aside for DHHL projects, for affordable housing, for agriculture, or other projects determined by the Council. Implementation of a set-aside policy requires quantification of the total amount of water available and the amounts already committed to existing and "entitled" uses. This approach requires several determinations and presents several challenges. It would be necessary to:

- Determine what categories of water users or uses would have water set aside.
- Determine what amounts of water would be set aside for each beneficiary category of users or uses.
- Determine whether the set-asides would be applied to the County as a whole, to each island or to specific areas, districts or systems.
- Establish a clear and concise method of determining, on an ongoing basis, how much total water is available to be allocated. It would have to be determined whether the set-asides would allocate portions of:
  - Potential sources (aquifer sustainable yields or stream flows)
  - Existing developed infrastructure (existing wells, treatment plants, transmission and storage)
  - Planned infrastructure
- Determine, if set-asides are made against planned infrastructure, at what threshold in the development of a water source it would be considered "available":
  - source construction contract
  - feasibility study
  - inclusion in the CIP
  - inclusion in the WUDP
- Establish a clear and concise method of determining, on an ongoing basis, how much of the total available water is already committed. This could include any of several categories of use:
  - use by existing customers with meters
  - average historical consumption basis
  - expected continued increase in use per meter (as lots with meters are improved and "built out")
  - anticipated use by projects and subdivisions that have some level of implicit or explicit entitlement or reservation
  - verification of long-term water source by the DWS director
  - water meter reservation
  - land use approvals

- water promised or committed by source development contracts
- water promised or committed by contract with DWS (letters or memoranda of understanding)

o Determine at what stage of which process the set aside allocations would be determined and at what stage the determinations of net availability would be applied:

- in General, Island or Community Plan land use designation process.
- in the WUDP.
- as a set-aside allocation ordinance.
- at time of subdivision verification of water source availability by DWS director.
- at time of reservation or issuance of water meter.

Allocations of Specific Water Sources to Land Use

Specific water sources could be allocated to specific land uses or categories of land uses.[59] For example, the output of a specific well or production tunnel could be allocated to municipal potable use. Raw water from a specific diversion or reservoir could be allocated to agricultural uses in a specific area. Specific allocations of water for instream uses could be identified.

Statements of Allocation Policies

The County could express its allocation of water to land use by stating policies that would apply generally or to specific circumstances. Some examples are provided, including statements of policy that have been suggested in the WUDP public process:

- Maintain mauka to makai flow in Maui's streams.
- Return all water to the streams.
- Give priority to riparian, kuleana and instream uses.
- Give priority to DHHL uses.
- Use ground water for potable uses and surface water for non-potable uses.
- Provide for the needs of existing users before allowing new uses (land development).
- Give priority to residents' needs over visitor industry needs.

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59. It is recognized that the County may not have explicit authority to directly allocate water from some specific sources. In these cases the allocations would serve as policy statements.

Appendix A - Analysis of Demand Side Management (Conservation) Program Portfolios

Demand Side Management (Conservation) Programs

"Demand-side management" (DSM) is a utility industry term of art that describes actions that can be taken by a utility to affect how the utility's commodity is used by its customers. Originally applied to the electric utilities and applied now also to gas and water utilities, DSM options have proven to be valuable "resources" to meet utility planning objectives.

DSM resource options are usually programs undertaken by a utility to encourage the use of efficient appliances or practices by its customers or to encourage customers to shift their time of use. DSM programs often use incentives such as monetary rebates to encourage purchase of efficient appliances. More intensive DSM programs include direct installation of new efficient fixtures by the utility (or a contractor paid by the utility) at customers' premises.

DSM programs are evaluated based on a comparison of the costs of implementing the programs with the costs the utility and its customers would otherwise incur to develop and operate new supply resources.

DSM programs are included in all of the final candidate strategies.

The analysis of DSM programs for the Central District strategies was conducted in several steps:

- Characterization and Evaluation of Individual DSM Measures
- Preliminary Analysis of Candidate DSM Programs
- Characterization of Water End Uses by District
- Estimate of DSM Technical Potential
- Estimate and Analysis of DSM Economic Potential
- Analysis of Magnitude and Pacing of DSM Programs
- Independent Expert Review of DSM Analysis and Program Design
- Specific DSM Program Design and Contracting

Each of these steps is described below:

Characterization and Evaluation of Individual DSM Measures

Analysis of an inclusive list of possible DSM measures is presented in the *Resource Options* chapter. In this analysis, each DSM measure was characterized in terms of the fixture costs, installation costs, program administration costs and average expected water savings. The costs and benefits of each measure were characterized in terms of the levelized life cycle costs per thousand gallons of water saved. This analysis does not explicitly consider the operational benefits of the DSM measures in the specific context of the water system or possible future resource strategies.

Preliminary Analysis of Candidate DSM Programs

Analysis of several candidate DSM programs was presented in the *Candidate Strategies* chapter. The purpose of these analyses was to determine, generally, whether DSM programs could be an effective and cost effective means to meet Central District water needs. In these analyses several example portfolios of DSM programs were examined in the specific context of the Central District system using the integrated capacity expansion and production cost analysis model for each of several candidate resource strategies.

The candidate DSM portfolios in these analyses include a toilet retrofit rebate program, a commercial urinal retrofit program, an irrigation efficiency program and a xeriscaping program. Labor assumed in characterizing the portfolio of programs includes four full time staff. The annual budget for the portfolio of programs includes $261,000 of rebates, $240,000 incremental administration costs and presumes $150,000 of costs borne by program participants. The portfolio impacts are estimated to reduce metered consumption by 88,000 gallons per day for each year of program implementation. The life of the measures is assumed to be fifteen years.

For purposes of sensitivity analysis several other portfolios were examined including a portfolio with twice the assumed penetration and a portfolio with higher administrative costs.

As documented in the *Candidate Resource Strategies* chapter, the DSM programs examined in this analysis proved to be effective and cost effective in the context of the candidate strategies. Based on these results more detailed characterization and analyses were conducted.

Characterization of Water End-Uses by District

The analyses described above characterize the economic benefits of several DSM programs but do not determine the amount of water savings that would ultimately be possible. The magnitude of potential water savings was determined in three progressive steps: end-use analysis, estimation of technical potential and estimation of economic potential.

End-use analysis determines how much water is used for different ultimate purposes. For the Central district the amount of water use was determined for each class of customers. For domestic uses the amount of water use was estimated for each of several end-use categories. A summary of the results of this analysis is portrayed in the tables below.

DWS CY2006 Consumption (MGD)			
	Wailuku Kahului CPD	Kihei Makena CPD	Central District
Agriculture	0.1	0.3	0.4
Commercial	1.4	0.9	2.4
Industrial	0.7	0.4	1.0
Domestic Indoor	3.8	3.4	7.2
Outdoor (Non-Ag)	3.3	7.5	10.8
Total	9.3	12.5	21.8

CY2006 Domestic Indoor Consumption (MGD)			
	Wailuku Kahului CPD	Kihei Makena CPD	Central District
Toilets	0.9	0.8	1.8
Showers	0.8	0.7	1.4
Baths	0.3	0.3	0.6
Faucets	1.0	0.9	1.9
Dishwashers	0.1	0.1	0.1
Clothes Washers	0.7	0.7	1.5
Total	3.9	3.5	7.2

Estimate of DSM Technical Potential

The DSM technical potential is the amount of water that could be saved using efficient fixtures and practices. For the purposes of this analysis the technical potential is defined as the amount of water that would be saved if all fixtures in the District were converted to fixtures meeting the current effective code efficiency standards.[60] The results of the quantification or the technical potential for various domestic end uses for the Central District is presented in the table below.

DSM Technical Potential (MGD)			
	Wailuku Kahului CPD	Kihei Makena CPD	Central District
Toilets	0.6	0.5	1.0
Showers	0.4	0.2	0.6
Baths	0.0	0.0	0.0
Faucets	0.3	0.2	0.6
Dishwashers	0.0	0.0	0.1
Clothes Washers	0.3	0.3	0.6
Total Indoor	1.6	1.2	2.9
Outdoor Irrigation	1.1	2.6	3.8
Total	2.7	3.9	6.7

The estimate of technical potential includes an assessment of the vintage of existing water fixtures determined from Maui County Tax Division records. The consumption of existing fixtures was estimated from fixture vintage based on the date of the last building permit for each TMK.

If all fixtures in the Central District were upgraded to the efficiency standards in current codes indoor water use would be reduced by approximately 2.9 MGD. This equals about 40% of indoor domestic consumption and equals about 13% of total Central District DWS system 2006 metered consumption.

Domestic outdoor use is primarily irrigation of plants. The technical potential estimate is based on an estimate of 35% reduction of outdoor irrigation use that would result from eliminating all over-watering of plants and eliminating waste due to poorly designed and/or maintained irrigation systems. This estimate is based on industry literature and discussion with local irrigation system industry personnel. 35% of 2006 estimated domestic outdoor irrigation use equals 3.8 MGD.

The total technical potential of indoor and outdoor measures is estimated to be 6.7 MGD, which equals about 30% of Central District 2006 total metered consumption. For practical purposes it is important to note that the estimates of technical potential assume upgrading ALL fixtures to current code standards and improving ALL irrigation to optimum practices. Assessments of realizable economic potential are determined by further analysis as described below.

Estimate and Analysis of DSM Economic Potential

Estimates and characterization of the practical, economic potential of implementing DSM programs was made in several stages. Initially, the economics of several DSM programs was examined in the analysis of the candidate strategies as described above. Based on the end-use analyses and the estimates of technical potential, the economics of a portfolio of more refined

60. Technical potential is sometimes defined as the amount of savings that would result from implementation of the most efficient fixtures and technologies available. The application used in the analyses reported here are, in this respect, somewhat conservative. For example, installation of dual-flush toilets that consume about 1.0 gallons per flush (gpf) are being considered. The technical potential estimates assume that 100% of all fixtures would be 1.6 gpf fixtures in compliance with existing codes.

and specific DSM programs were examined to explore the optimum magnitude and pacing of program implementation. This is described in the section below. After these analyses were conducted, a nationally recognized water conservation program expert was retained to visit Maui, review the assumptions, programs and analysis methods used and to recommend a specific portfolio of DSM programs for Maui's water systems.

Analysis of Magnitude and Pacing of DSM Programs

DSM programs can be implemented with differing degrees of intensity. Modest rebate programs can be expected to result in modest amounts of program participation and modest reductions in water use. With additional expenditures on DSM programs, providing higher incentives or direct installation of fixtures, higher amounts of program participation and water savings can be expected... but at a higher cost per unit of savings. Depending upon the circumstances and needs of the water system, higher expenditures on DMS programs may be more effective and more cost effective... but only to a point of diminishing returns.

In order to determine the optimum magnitude and pacing of DSM programs, several analyses were conducted using the integrated capacity expansion and production cost model for the Central District. A portfolio of DSM programs was characterized and applied in differing degrees of magnitude and pacing to compare the resulting effectiveness and cost effectiveness in the context of each of several final candidate strategies. The results of several analyses are provided below.

The portfolio of programs used in this analysis includes both indoor and outdoor measures. The indoor measures include direct installation of efficient toilets, showerheads and sink fixture flow restrictors for domestic units. The outdoor measures include direct installation of evapo-transpiration (ET) weather manager controls on automated irrigation systems and repair, replacement and adjustment of in-ground irrigation systems. The assumed program costs include the costs of installing and maintaining several weather stations to provide data to the ET controllers via automated telephone communication.

The differing intensities of program magnitude and pacing were analyzed based on an initial base program portfolio designed to attain 15% of the DSM technical potential in a period of five years. Differing intensities of DSM program implementation were analyzed as multiples of the base program with corresponding associated costs and impacts.

The base indoor program portfolio, including direct retrofit of domestic toilets, showerheads and sink faucet restrictors results in a reduction of water use of 89,000 gallons per day for each year of program implementation at a total cost (customer and utility cost) of $458,000 per year.[61] The outdoor program portfolio, including installation of ET controls and associated weather stations and repair and adjustment of existing irrigation systems would reduce water consumption by 111,000 gallons per day for each year of program implementation at a total cost of $507,000 per year. Combined, the indoor and outdoor portfolios would result in attaining 15% of the DSM technical potential after five years of implementation. This means that the programs would result in 15% of the possible savings that would result if ALL fixtures were upgraded to current code standards and ALL domestic irrigation equipment and practices were optimum.

The basic indoor program, for example, would reduce water consumption by 89,000 gallons per day for each year of program implementation. This would result in a reduction of water consumption of 445,000 gallons per day after five years of program implementation. This is equal to 15% of the 2.9 MGD indoor DSM technical potential for the Central District.

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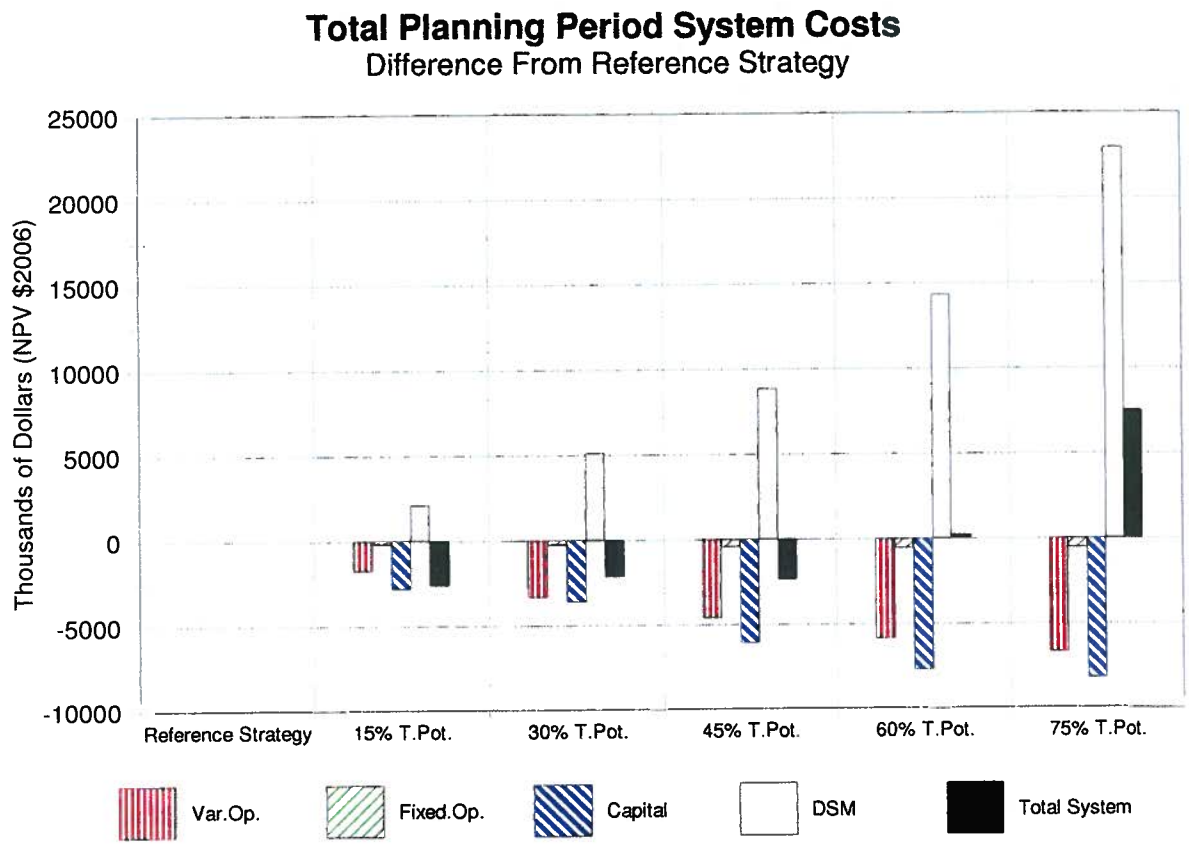
61. Note that, although the estimated reduction in water use for this indoor program (89,000 gpd/yr) is close to the reduction estimated for the combined indoor and outdoor program portfolio in a previous stage of analysis reported above (88,000 gpd/yr), these are separate programs with different components and different underlying assumptions.

The basic outdoor program would reduce water consumption by 111,000 gallons per day for each year of program implementation. This would result in a reduction of water consumption of 555,000 gallons per day after five years of program implementation. This is equal to 15% of the estimated 3.8 MGD domestic outdoor irrigation technical potential for the Central District.

Together, the basic indoor and outdoor program portfolio would reduce water consumption by 200,000 gallons per day for each year of program implementation, resulting in 1 MGD of reduction after five years of program implementation. This equals 15% of the 6.7 MGD total domestic DSM technical potential for the Central District.

Alternate magnitudes and pacing of DSM program implementation were analyzed, assuming program intensities that would attain 30%, 45%, 60% and 75% of technical potential. Increasing the intensity of program implementation would require higher costs per unit of savings due to the need to use higher incentives, more expenditure on publicity and advertising and increasingly expensive measures in the portfolio of DSM programs. For example, to attain higher percentages of the technical potential, it would be necessary to include substantial installation of more expensive measures such as high-efficiency clothes washers and dishwashers.



Central District Reference Strategy with Alternate Levels of Indoor DSM Program Penetration with Progressively Extended Program Duration

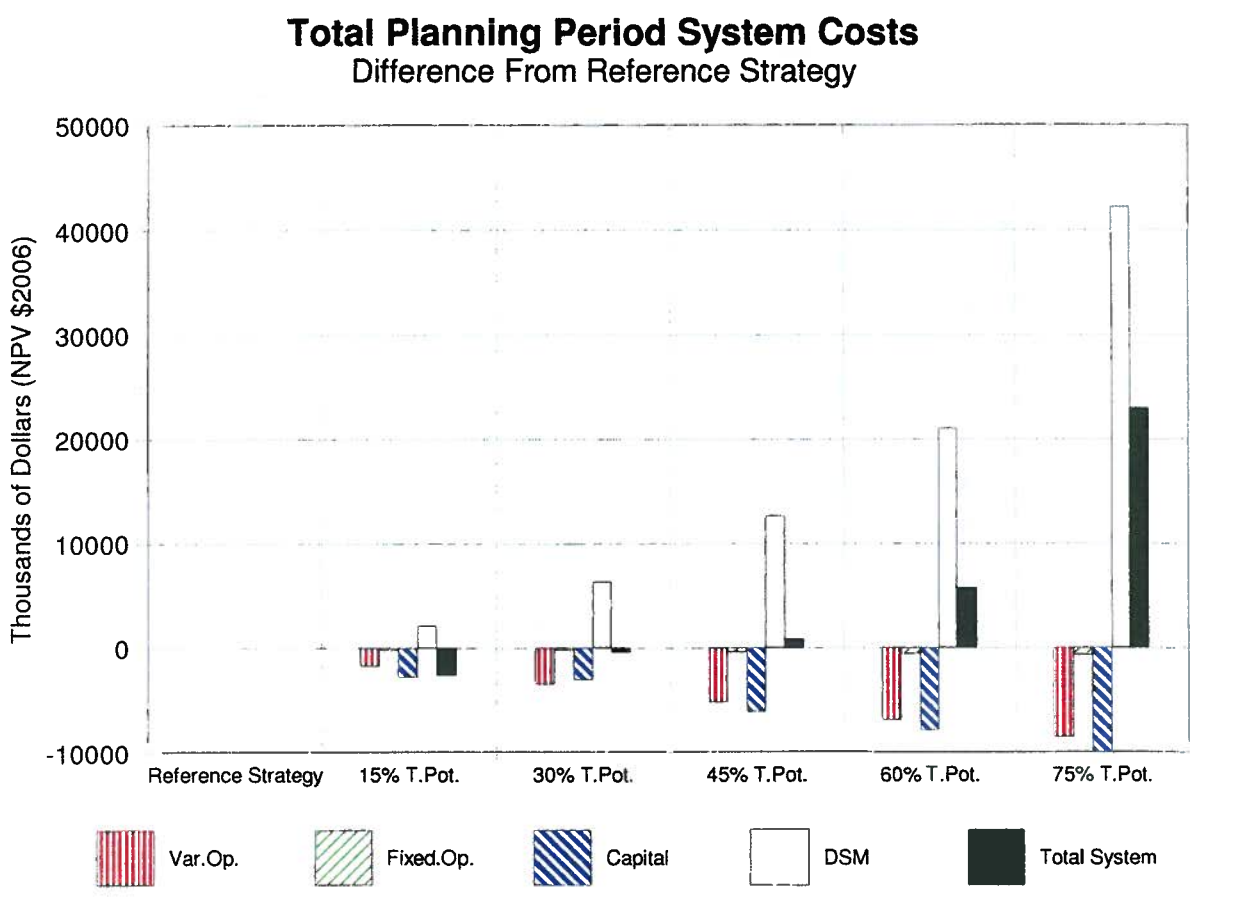
Analysis of alternate levels of indoor DSM program penetration with progressively extended program duration.

The table above shows the DSM costs and resulting planning period cost impacts of implementing an indoor DSM program with increasing duration and an increasing portfolio of measures. The base program attains 15% of the DSM technical potential in five years. Alternate levels of

implementation attain 30%, 45%, 60% and 75% of the DSM technical potential in seven, ten, twelve and fifteen years respectively. The longer duration programs include progressively higher levels of incentives, more expensive delivery mechanisms and more expensive measures in later years to achieve higher levels of program participation.

This analysis demonstrates that increasing the duration and intensity of program implementation yields diminishing returns. This is expected since it is necessary to employ more expensive program delivery mechanisms and to target more expensive water saving measures in order to achieve higher proportions of DSM technical potential. In this analysis, a ten-year program to attain 45% DSM technical potential is cost effective, but a twelve-year program to attain 60% DSM technical potential is not.

Several other analyses were performed using alternate assumptions and using different candidate strategies as the reference plan.



Central District Reference Strategy with Alternate Levels of Indoor DSM Program Penetration Using Accelerated Program Pacing to Attain Water Savings Within Five Years

Analysis of alternate levels of indoor DSM program penetration using accelerated program pacing to attain water savings within five years.

The chart above shows the DSM costs and resulting planning period cost impacts of implementing an indoor DSM program with increasing "pacing" and an increasing portfolio of measures. The base program attains 15% of the DSM technical potential in five years and is identical to the base program in the analysis presented on the previous page. Alternate levels of program imple-

mentation attain 30%, 45%, 60% and 75% of the DSM technical potential in five years using progressively higher levels of incentives and more expensive measures to achieve a higher rate of program implementation.

As shown with the analysis presented on the previous page, increasing the intensity of program implementation yields diminishing returns. Increasing the pace of program implementation as shown here is a more expensive way to achieve higher portions of DSM technical potential than by increasing program duration. This is because more expensive program delivery mechanisms are necessary in order to increase the pace of the programs. It is also less feasible to optimize program cost-effectiveness by capturing as much of the less expensive program opportunities in the early years of program implementation. In this analysis, it is not cost effective to achieve more than 30% of the DSM technical potential in a five-year period. Depending upon the specific characteristics and immediate needs of the water system, it may be more cost effective to accelerate the pacing of DSM programs in some circumstances.

Several analyses were performed to test the cost-effectiveness of several DSM program portfolios under alternate assumptions. The indoor and outdoor programs were tested and shown to be cost-effective individually and conjunctively. The DSM programs were also tested in conjunction with all of the final candidate strategies. In all cases, the basic DSM program portfolio of indoor and outdoor programs, designed to attain 15% of technical potential, was cost-effective.

The analyses shown above reflect electrical energy costs associated with world oil prices at approximately $75 per barrel consistent with the "low" energy price scenarios presented in the final candidate strategies report. During the year 2008, in which the final candidate strategies were examined, energy prices increased dramatically to over $140 per barrel and, by the end of the year fell again to under $40 per barrel. Several analyses of the DSM programs were performed assuming a range of energy prices. In the "high" energy price scenarios (equivalent to $125 per barrel crude oil price), the DSM programs, as expected, were determined to be more cost effective than in the lower price scenarios.

Independent Expert Review of DSM Analysis and Program Design

In order to verify the reasonableness of the characterization and analysis of DSM programs, a nationally renowned expert was retained. Amy Vickers, the author of an authoritative text on water conservation, Water Use and Conservation, was retained to visit Maui and provide a critical review of the DSM program analyses and provide a recommended portfolio of DSM programs appropriate for Maui's systems. The review included a spectrum of site visits to agricultural, commercial and domestic properties across the island, a technical review of the methods used in the analyses described above, meetings with DWS staff and a Powerpoint presentation of findings to the County Council Water Resources Committee.

Ms. Vickers approved of the analytical methods used but recommended some different DSM program designs and delivery mechanisms than were assumed in the analyses. After careful review it was determined that the programs used in the analyses are sufficient to conservatively demonstrate the value and cost effectiveness of a portfolio of DSM programs[62] but that a different portfolio of programs should be considered for implementation for Maui's systems. In particular, Ms. Vickers recommended against basing the outdoor DSM programs primarily upon the installation of ET irrigation system controls . Ms. Vickers recommended the following portfolio of DSM programs:

- Residential / Commercial audit and direct installation program for indoor and landscape irrigation users

62. The DSM program portfolio recommended by Ms. Vickers was determined to cost less and result in at least as much reduction in water usage as the program portfolio included in the prior analyses. The findings of the prior analyses, that the portfolio of DSM programs would be cost-effective, is therefor likely to be "conservative."

- Education and publicity program to encourage water conservation and promote program participation
- Direct installation of efficient fixtures at customer premises including toilet, showerhead and sink faucet flow restrictors
- Audit of existing irrigation system equipment and practices and specific resulting recommendations to customer to improve efficiency
- Direct installation of targeted high-payback fixtures in commercial premises
- High-efficiency fixture rebates
- High-efficiency washing machines
- High-efficiency toilets and waterless urinals
- Hotel awards program
- Building manager user group and services
- Agricultural user group and services

Specific DSM Program Design and Contracting

The analyses described above conclude that a portfolio of DSM programs would be beneficial and cost-effective for the Central District system. As recommended in the Central District Final Candidate Strategies Report, the next step towards implementing a DSM program for the DWS would be to obtain proposals and bids from companies that implement water utility DSM programs. This will provide more specific cost and impact estimates that can be used in further economic analysis.

Appendix B - Characterization of Central District Specific Resource Options

This appendix describes the specific new resource options that are or could be available for implementation for the DWS Central District water system. These options are the specific "ingredients" of the resource strategies considered for the Central system included in the Final Candidate Strategies Report.

As explained in the Final Candidate Strategies Report, there were several rounds of supporting analyses and, for some resources, several alternate assumptions were applied to test alternate scenarios. In some cases assumptions used in the Final Candidate Strategies Report may differ from the information documented in this appendix. In these cases the assumptions are noted in the Final Candidate Strategies Report. For example, the variable costs documented in this appendix reflect a "high" energy cost scenario assuming electrical energy prices in spring of 2008, when crude oil prices were approximately $125 per barrel. The analyses in the Final Candidate Strategies Report use several alternate variable cost assumptions for other scenarios in addition to the costs reported in this appendix.

Several additional specific resource options, as well as information regarding assumptions used in earlier analyses, are documented in the Central District Candidate Strategies Preliminary Draft (September 12, 2006).

The specific resource options are divided into several categories described below:

- **Committed Resource Options** - options that are in the process of being implemented but are not yet in service
- **Short Term Resource Options** - options that could mitigate immediate capacity reserve shortfalls
- **Long Term Resource Options** - alternative options that would form the fundamental basis of the resource strategies and would address the identified planning objectives over the time frame of the planning period
- **General Resource Options** - ancillary options and options that are not mutually exclusive (can be implemented in conjunction with most other combinations of options)

Committed Resource Options

Committed resource options are new projects that are in the process of being implemented but are not yet in service.

Option (Committed): Kupaa Well

The Kupaa well is located north of Waihee River at a elevation of 410 feet. This well will draw from the Waihee basal groundwater aquifer. Development of the Kupaa well includes well drilling and development, a new transmission line to the Kanoa well field and a 500 thousand gallon storage tank. The well is scheduled for completion to serve water to the DWS Central system starting in 2010.

The sustainable yield of the Waihee aquifer is currently set at 8 MGD. It is recommended, however, that the half of the Waihee aquifer south of Makamakaole gulch be pumped at only about half the 8 MGD sustainable yield of the entire Waihee aquifer. Because the Kupaa well is located in the south half of the Waihee aquifer, which is already developed and producing at its recommended yield at about 4 MGD, the well will not contribute substantial additional new sustained water source capability to the DWS system. The well will allow better distribution of

pumping and will provide needed pumping reserve capacity to meet the engineering design reliability criteria for the DWS Central system. In the near term, with careful monitoring of chlorides, operation of this well with total withdrawals from the southern half of the Waihee aquifer in excess of 4 MGD is presumed as a reasonable short-term contingency option.

The Kupaa well is the last of several wells currently planned to be developed by the DWS in the south half of the Waihee basal groundwater aquifer.

Information regarding the characteristics and costs of this well is provided in the tables at the end of this section describing committed resource options.

Option (Committed): Waikapu Tank Site Well

The Waikapu Tank Site Well is located next to the DWS Waikapu storage tank at an elevation of 670 feet. This well will draw from the Iao basal groundwater aquifer. Development of the well includes primarily well drilling and development. The well is scheduled to begin delivering water to the DWS system in 2010.

Since this well draws from the Iao basal groundwater aquifer, which is already developed and producing at up to its recommended sustainable yield, it will not contribute additional new sustained water source capability to the DWS system. The well will allow better distribution of pumping within the Iao aquifer and will provide needed reserve capacity to meet the engineering reliability criteria for the DWS Central system.

Information regarding the characteristics and costs of this well is provided in the tables at the end of this section describing committed resource options.

Option (Committed): Iao Tank Site Well

The Iao Tank Site Well is located in Wailuku next to the DWS Iao storage tank at an elevation of 506 feet. This well will draw from the Iao basal groundwater aquifer. Development of the well includes primarily well drilling and development. The well is scheduled to begin delivering water to the DWS system in 2010.

Since this well draws from the Iao basal groundwater aquifer, which is already developed and producing at up to its recommended sustainable yield, it will not contribute additional new sustained water source capability to the DWS system. The well will allow better distribution of pumping within the Iao aquifer and will provide needed reserve capacity to meet the engineering reliability criteria for the DWS Central system.

Information regarding the characteristics and costs of this well is provided in the tables at the end of this section describing committed resource options.

Option (Committed): Maui Lani Wells

The Maui Lani wells are three new basal groundwater wells located in Wailuku/Kahului at an altitude of about 220 feet. These wells will draw from the Kahului basal groundwater aquifer. The wells are being developed by Alexander & Baldwin and will be turned over to the DWS upon completion.

The sustainable contribution of these wells is limited to about 1 MGD due to the limited sustainable yield of the Kahului aquifer.

Information regarding the characteristics and costs of this well is provided in the tables at the end of this section describing committed resource options.

Tables Characterizing Committed Resource Options

The following tables provide more detailed information regarding each of the committed resource options for the Central system.

The installed capacity is the nominal twenty-four-hour-per-day pumping capability of the installed

pumps and motors. Actual capacity will depend upon the specific characteristics of the well and pump equipment and will ultimately be determined by flow testing.

The criteria capacity is the amount of source capability that is credited to the DWS system reserve capacity to meet the engineering reliability criteria for the DWS Central system. For most wells this is two-thirds of the installed capacity.

The effective sustainable capacity is the amount of additional new water source capability that is provided by the source. In some cases, where the well is located in an aquifer that is already developed at or near its sustainable yield, the effective sustainable capacity may be limited or zero.

Costs are expressed in year 2004 dollars. In deriving the costs, the assumed annual rate of capital and fixed cost escalation is 3.0%. The annual rate of fuel cost escalation is 4.0%. The assumed annual cost of capital is 6.0%.

Capital costs are stated as one time expenses.

Fixed operating costs are expressed as annual expenses.

Variable operating costs are expressed as costs per thousand gallons of water production.

Pumping efficiency is based on the average pumping efficiency of existing DWS wells.

Electrical costs are Spring 2008 MECO rates de-escalated to year 2004 dollars.

For options with zero effective sustained capacity an error (ERR) value is posted for entries expressing costs in units per thousand gallons of effective capacity.

Well - Waikapu Tank (Committed)

New DWS Well at Existing Tank Site

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Waikapu Tank
Aquifer	Iao

				Derivation
Earliest Online Date		**2008**		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity			1.344	2/3 Installed Capacity
Effective Sustainable Capacity				No Incremental effective capacity from Iao Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design		$74,230	ERR	DWS Information
Drilling		$543,765	ERR	DWS Information
Transmission			ERR	
Development		$782,621	ERR	DWS Information
Storage Improvements			ERR	
Engineering Costs		$898,700	ERR	DWS Information
Contingencies			ERR	
Total Plant Cost		$2,299,316	ERR	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date			Contingency
	-1	$782,621	34.0%	Development, Storage
	-2	$543,765	23.6%	Transmission, Drilling
	-3	$972,930	42.3%	Design, Engineering
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.062	
		Total	Per MGD	
Total Capitalized Cost		**$2,441,761**	ERR	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor			ERR	
Apportioned Operating Labor		$6,873	ERR	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor			ERR	
Fixed Operating Costs				
Electrical Demand		$24,535		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials			ERR	
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		**$31,408**		
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		670		
Variable O&M				
Electrical Energy			$0.974	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			**$0.979**	

Well - Iao Tank (Committed)

New DWS Well at Existing Tank Site

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Iao Tank
Aquifer	Iao

				Derivation
Earliest Online Date		2008		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity			1.344	2/3 Installed Capacity
Effective Sustainable Capacity				No Incremental effective capacity from Iao Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design		$56,405		DWS Information
Drilling		$395,680		DWS Information
Transmission				
Development		$1,200,000		DWS Information
Storage Improvements				
Engineering Costs		$150,000		DWS Information
Contingencies				
Total Plant Cost		$1,802,085		
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date			Contingency
	-1	$1,200,000	66.6%	Development, Storage
	-2	$395,680	22.0%	Transmission, Drilling
	-3	$206,405	11.5%	Exploration, Land, Engineering
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.043	
		Total	Per MGD	
Total Capitalized Cost		$1,878,987		
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873		Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$18,530		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		$25,402		
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		506		
Variable O&M				
Electrical Energy			$0.735	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			$0.741	

Well - Kupaa (Committed)

New DWS Well at New Site

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Waihee
Aquifer	Waihee (South)

				Derivation
Earliest Online Date		2008		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity			1.344	2/3 Installed Capacity
Effective Sustainable Capacity				No incremental effective capacity from South Waihee Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design		$76,750		DWS Information
Drilling		$290,000		DWS Information
Transmission		$1,700,000		
Development		$1,000,000		DWS Information
Storage Improvements		$1,200,000		DWS Information
Engineering Costs				Included in other contracts
Contingencies				
Total Plant Cost		$4,266,750		
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date			Contingency
	-1	$2,200,000	51.6%	Development, Storage
	-2	$1,990,000	46.6%	Transmission, Drilling
	-3	$76,750	1.6%	Exploration, Land, Engineering
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.044	
		Total	Per MGD	
Total Capitalized Cost		$4,455,342		
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873		Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$15,014		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		$21,887		
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		410		
Variable O&M				
Electrical Energy			$0.596	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			$0.601	

Wells - Maui Lani (Committed)

(3) New Developer Wells at Maui Lani Site
Turnkey transfer to DWS

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Operation costs by HDA.

Type	Basal Wells
System	Central
Source	Groundwater
Location	Maui Lani Subdivision
Aquifer	Kahului

				Derivation
Earliest Online Date		2008		
Capacity (MGD)				
Installed Capacity			2.160	(3) 500 GPM Wells
Criteria Capacity			1.440	2/3 Installed Capacity
Effective Sustainable Capacity			1.000	Limited by Kahului Aquifer Sustainable Yield
Capital Costs ($2004)		Total	Per MGD	
Total Plant Cost		$4,000,000	$4,000,000	DWS Information
Contingencies				
Total Plant Cost		$4,000,000	$4,000,000	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$4,000,000	100.0%	Estimated Developer Cost
	-1			
	-2			
	-3			
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.000	
		Total	Per MGD	
Total Capitalized Cost		$4,000,000	$4,000,000	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873	$6,873	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$8,632	$8,632	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		$15,504	$15,504	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		220		
Variable O&M				
Electrical Energy			$0.320	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			$0.325	

Short-Term Resource Options

Short-term resource options are projects that could serve to meet immediate capacity reserve shortfalls. These options are characterized by the ability to meet water demands or system capacity requirements in the next two to three years.

Option (Short-Term): Waikapu South Wells

Two wells are being planned for the Waikapu aquifer above Waikapu town at an elevation of about 750 feet. Development of these wells would include well drilling and development and minor transmission improvements.

Negotiations are underway for easements and rights-of-way. These wells would draw from the Waikapu basal groundwater aquifer. The earliest these wells could provide water to the DWS system is 2009.

The sustainable contribution of these wells as a new source of water is limited to the 2 MGD sustainable yield of the Waikapu aquifer. These wells would provide needed reserve capacity to meet the engineering reliability criteria for the DWS Central system.

It is not certain that these wells can be developed by the DWS. It is possible that several other candidate wells in this area may be developed by private entities. Whether these wells or other private wells are developed, it is presumed in the analyses supporting the Final Candidate Strategies Report that the 2 MGD sustainable yield of the Waikapu aquifer will be developed to serve water demand in the Central District area.

Information regarding the characteristics and costs of these wells is provided in the following tables.

Option (Short-Term): Backup Well at Existing Well Site

This is a generic resource option consisting of a new well drilled in near enough proximity to an existing well to rely on an existing storage tank to provide disinfection contact time and to minimize transmission and connection costs. The well would provide additional well pumping capacity, equipment redundancy and improved distribution of well pumping. The well would not provide additional annual system production capacity if it is located in an aquifer already limited by fully developed sustainable yield.

Option (Short-Term): Shaft 33 Replacement Well

It is expected that the existing plantation-era Shaft 33 well will be retired when one or more replacement wells are developed. Since any wells to replace Shaft 33 would presume retirement of Shaft 33, this resource option would not provide any additional system pumping capacity, redundancy or annual system production capability. Since it is expected that several smaller wells would replace the large Shaft 33 well, this would provide improved distribution of pumping within the Iao aquifer.

Well - Waikapu South #1

New DWS Well at New Site
1400 GPM

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial

Type	Basal Well
System	Central
Source	Groundwater
Location	Waikapu
Aquifer	Waikapu

				Derivation
Earliest Online Date		**2009**		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity			1.344	2/3 Installed Capacity
Effective Sustainable Capacity			1.344	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$250,000	$186,012	
Drilling		$424,500	$315,848	$566 per foot per Kupaa
Transmission		$425,000	$316,220	1312 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$744,048	
Storage Improvements				
Engineering Costs		$150,000	$111,607	
Contingencies		$1,124,750	$836,868	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$3,374,250	$2,510,603	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,124,750	33.3%	Contingency
	-1	$1,849,500	54.8%	Development, Storage, Transmission, Drilling
	-2	$400,000	11.9%	Exploration, Land, Engineering
	-3			
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.023	
		Total	Per MGD	
Total Capitalized Cost		**$3,451,759**	$2,568,273	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873	$5,114	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$27,465	$20,435	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		**$34,337**	$25,549	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M				
Electrical Energy			$1.090	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			**$1.095**	

Well - Waikapu South #2

New DWS Well at New Site
1400 GPM

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial

Type	Basal Well
System	Central
Source	Groundwater
Location	Waikapu
Aquifer	Waikapu

				Derivation
Earliest Online Date		2010		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity			1.344	2/3 Installed Capacity
Effective Sustainable Capacity			0.656	Balance of Aquifer S.Yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$50,000	$76,220	
Drilling		$424,500	$647,104	$566 per foot per Kupaa
Transmission		$136,000	$207,317	1312 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$1,524,390	
Storage Improvements				
Engineering Costs		$50,000	$76,220	
Contingencies		$830,250	$1,265,625	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$2,490,750	$3,796,875	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$830,250	33.3%	Contingency
	-1	$1,560,500	62.7%	Development, Storage, Transmission, Drilling
	-2	$100,000	4.0%	Exploration, Land, Engineering
	-3			
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.021	
		Total	Per MGD	
Total Capitalized Cost		$2,542,112	$3,875,170	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873	$10,476	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$27,465		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		$34,337		
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M				
Electrical Energy			$1.090	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			$1.095	

Backup Well - Existing Well Site

New DWS Well at Existing Site

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Generic Existing Well Site
Aquifer	Generic

				Derivation
Earliest Online Date		2008		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity			1.344	2/3 Installed Capacity
Effective Sustainable Capacity				No incremental effective capacity from Iao Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design		$60,000		DWS Information
Drilling		$400,000		DWS Information
Transmission				
Development		$1,000,000		DWS Information
Storage Improvements				
Engineering Costs		$150,000		DWS Information
Contingencies		$322,000		20% Contingency Allowance
Total Plant Cost		$1,932,000		
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$322,000	16.7%	Contingency
	-1	$1,000,000	51.8%	Development, Storage
	-2	$400,000	20.7%	Transmission, Drilling
	-3	$210,000	10.9%	Exploration, Land, Engineering
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.037	
		Total	Per MGD	
Total Capitalized Cost		$2,003,656		
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873		Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$18,530		5 Kwh/Kgal/Klt lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		$25,402		
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		506		
Variable O&M				
Electrical Energy			$0.735	5 Kwh/Kgal/klt lift efficiency * $.34 per Kwh June 2008 energy cost * klt lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			$0.741	

Well - Replacement for Shaft 33

New Developer Well at New Site

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	South of Iao Tank
Aquifer	Iao

				Derivation
Earliest Online Date		2008		
Capacity (MGD)				
Installed Capacity			2.016	1400 GPM
Criteria Capacity				2/3 Installed Capacity
Effective Sustainable Capacity				No incremental effective capacity from Iao Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design				
Drilling				
Transmission				
Development		$2,000,000		
Storage Improvements				
Engineering Costs				
Contingencies				
Total Plant Cost		$2,000,000		
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date			Contingency
	-1	$2,000,000	100.0%	Gross Well Development Costs
	-2			
	-3			
	-4			
	-5			
	-6			
	-7			
	-8			
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.029	
		Total	Per MGD	
Total Capitalized Cost		$2,058,252		
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor				
Apportioned Operating Labor		$6,873		Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor				
Fixed Operating Costs				
Electrical Demand		$18,310		5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials				
Maintenance Expenses				
Amort. of Capitalized Rebuild Costs				
Total Fixed Op. Costs		$25,182		
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		500		
Variable O&M				
Electrical Energy			$0.727	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses				
Total Variable Op. Costs			$0.732	

Long-Term Resource Options

Long-term resource options form the fundamental basis of the resource strategies that address the identified planning objectives over the time frame of the planning period. The long-term resource options tend to be mutually exclusive or need to be strategically sequenced and thus form the defining basis for the various alternative resource strategies.

Ground Water Production Options

Option (Long-Term): North Waihee Aquifer Wells

The south half of the Waihee aquifer is currently developed and utilized at the limits of the recommendation that only half of the 8 MGD sustainable yield of the Waihee aquifer should be used from wells south of Makamakaole gulch. New wells in the north half of the Waihee aquifer would allow sustained pumping from the aquifer up to 7.2 MGD (90% of the sustainable yield).

Development of wells in the north half of the Waihee aquifer would require substantial transmission improvements.

The North Waihee aquifer wells have been re-characterized based on updated information about hydrology and expected well yield in the north half of the Waihee aquifer and the Kahakuloa aquifer. These wells were characterized in earlier analyses as a series of three new wells in the north half of the Waihee aquifer. The updated configuration includes twice as many, much smaller wells than the initial characterization and assumes costs that have been updated with more recent information. The revised configuration is more expensive due to higher estimated project costs and lower expected production capability.

This option is characterized by the phased development of six wells in three phases. These phases are referred to in the information tables below as the Maluhia, Wailena and Waipili wells, respectively. The first phase (Maluhia) would require both water and electric power transmission improvements across Makamakaole gulch. The second phase (Wailena) would also require substantial transmission improvements. The third phase (Waipili) would require transmission improvements as well as a 0.5 MG storage tank.

This option is characterized as a project with transmission capability sized to accommodate the new wells in the north half of the Waihee aquifer. Installing transmission to this area could potentially facilitate development of wells further north in the adjoining Kahakuloa aquifer. This extended option is characterized as a separate option described below.

Information regarding the characteristics and costs of each of the wells is provided in the tables at the end of this section describing long term resource options. See in particular the tables for the Maluhia, Waiolai and Wailena wells.

Option (Long-Term): Kahakuloa Aquifer Wells

The Kahakuloa basal groundwater aquifer is north and adjoining the Waihee aquifer. This aquifer has a sustainable yield of 8 MGD. Development of wells in the Kahakuloa aquifer would require substantial water and electric power transmission improvements to connect with the existing DWS Central system. This option is characterized as an extension and sequel to the development of the North Waihee Aquifer Wells option described above.

The Kahakuloa Aquifer wells have been re-characterized based on updated information about hydrology and expected well yield in the north half of the Waihee aquifer and the Kahakuloa aquifer. These wells were characterized in earlier analyses as a series of five new wells in three phases in the Kahakuloa aquifer. The updated configuration includes eight, much smaller wells and assumes costs that have been updated with more recent information. The revised configuration is more expensive due to higher estimated project costs and lower expected production capability.

This option is characterized as the development of eight wells in three phases.

The first phase (Kahakuloa) would include four wells north of the Kahakuloa valley and includes power and water transmission and a 0.5 MG storage tank. It is not contemplated that wells would be developed within the Kahakuloa valley. The first phase costs also include the incremental costs to upgrade the size of the necessary water transmission improvements that would have to be installed originally for the Maluhia, Wailena and Waipili wells from 24" to 30" pipe.

The second phase (Waihali) includes two wells with associated power and water transmission.

The third phase (Poelua) includes four wells, power and water transmission, a 0.5 MG storage tank and a booster station.

Information regarding the characteristics and costs of each of the phases is provided in the tables at the end of this section describing long term resource options.

Option (Long-Term): Haiku Aquifer Wells

The Haiku basal groundwater aquifer lies to the east of the Kahului and Paia aquifers. The sustainable yield of the Haiku aquifer is currently established at 31 MGD. Production of water from the Haiku aquifer would require development of substantial transmission improvements to carry water to the major transmission network of the central district system. Because of potential contamination of the aquifer at lower elevations, two higher-elevation scenarios were examined (1000-foot elevation and 1500-foot elevation).

Costs for the characterization of this resource option were derived from several previous engineering studies identifying transmission requirements with transmission and well drilling, and development costs updated based on recent DWS experience.

Information regarding the characteristics and costs of this option is provided in the tables at the end of this section describing long term resource options.

Option (Long-Term): Honopou Aquifer Wells

The Honopou basal groundwater aquifer lies to the east of the Haiku aquifer with a sustainable yield currently established at 29 MGD. Production of water for the DWS Central District system from this aquifer would require substantial water transmission and electric power transmission improvements. Because this aquifer is not contaminated at lower elevations, the elevation of the wells could be in the range of as low as 500 to 600 feet. This option could be implemented as an extension and sequel to development of the Haiku Aquifer resource option or as an independent option. It is characterized here as an alternative to development of the Haiku aquifer wells to determine whether the long range cost savings of developing wells at lower elevation (600 feet rather than 1000 or 1500 feet for the Haiku aquifer) justify the additional costs of longer transmission distances.

Two scenarios are characterized with the development of 8 and 12 wells respectively.

Information regarding the characteristics and costs of this option is provided in the tables at the end of this section describing long term resource options.

Option (Long-Term): Waikamoi Aquifer Wells

Substantial concerns from residents in the Honopou area were expressed at several meetings of the Central District Water Advisory Committee. As a result of these concerns an additional wellfield configuration was developed bypassing the Honopou aquifer and extending transmission to the Waikamoi aquifer (see option below).

This option requires additional transmission beyond the Honopou aquifer. The scenario is characterized as a series of twenty smaller wells with a combined installed capacity of 10 MGD and a 1.0 MG storage tank.

Information regarding the characteristics and costs of this option is provided in the tables at the end of this section describing long term resource options.

Option (Long-Term): Waikamoi Aquifer Wells with Ditch Transmission

In response to a suggestion made by a member of the Central District Water Advisory Committee, an additional analysis was conducted to determine the economics of using the Lowrie ditch to transport water to the Central Maui area rather than an expensive transmission line. In this scenario water from the wells would be pumped into the Lowrie ditch at approximately 600 foot elevation. Water would be taken from the ditch downstream eliminating a substantial length of new transmission pipe but requiring construction and operation of a water treatment plant to bring the water to potable standards.

Information regarding the characteristics and costs of this option is provided in the tables at the end of this section describing long term resource options.

The Lowrie ditch is privately owned by HC&S and currently used for the transportation of irrigation water. Utilization of the ditch for transportation of water for public municipal purposes would require an agreement with HC&S.

Option (Long-Term): Brackish Water and Seawater Desalination

A study of the cost and feasibility of desalination of brackish water and seawater was recently completed by Brown & Caldwell for the DWS. The costs and characteristics of a 5 MGD (nominal) desalination facility were derived from the study.

Three variations of this potential resource option were characterized. A brackish desalination and a seawater desalination facility were characterized as described in the Brown & Caldwell study. In addition a variation of the brackish desalination facility was developed, assuming four parallel trains of membranes rather than two parallel trains as described in the study. Using four rather than two parallel trains increases the reliability of the facility and increases the credit the facility would provide towards the DWS reserve capacity reliability standards. Additional costs to configure the facility with four parallel trains were estimated.

Information regarding the characteristics and costs of this option is provided in the tables at the end of this section describing long term resource options.

Tables Characterizing Long-Term Ground Water Production Options

Tables characterizing the long term ground water production resource options are provided below. A brief description of some of the terms used in the tables is provided on pages 2-3.

Wells - Maluhia (2)

(2) New DWS Wells at New Site
500GPM
w/Transmission from Kupaa

Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.

Type	Basal Well
System	Central
Source	Groundwater
Location	North Waihee
Aquifer	Waihee (North)

				Derivation
Earliest Online Date		**2010**		
Capacity (MGD)				
Installed Capacity			1.440	(2) 500 GPM
Criteria Capacity			0.960	2/3 Installed Capacity
Effective Sustainable Capacity			0.672	Effective capacity reduced based on expected sustainable yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$500,000	$744,048	
Drilling		$849,000	$1,263,393	$566 per foot per Kupaa
Transmission		$7,016,680	$10,441,488	9482 feet 30"DI at $675 per foot based on 2007 Construction estimate plus $65 per foot ancillary, SCADA, road
Development		$1,500,000	$2,232,143	(2) 500 GPM Wells @ 750,000
Storage Improvements				
Engineering Costs		$200,000	$297,619	
Contingencies		$2,013,136	$2,995,738	20% Contingency
Total Plant Cost		$12,078,816	$17,974,429	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,013,136	16.7%	Contingency
	-1	$1,500,000	12.4%	Development, Storage
	-2	$7,865,680	65.1%	Transmission, Drilling
	-3	$700,000	5.8%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.047	
		Total	Per MGD	
Total Capitalized Cost		**$12,650,337**	$18,824,906	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$6,873	$10,227	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$19,618	$29,193	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$26,490**	$39,420	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M			$0.000	
Electrical Energy			$1.090	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.095**	

Wells - Wailena (2)

(2) New DWS Wells at New Site
500GPM
w/Transmission from Kupaa
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.

Type	Basal Well
System	Central
Source	Groundwater
Location	North Waihee
Aquifer	Waihee (North)

				Derivation
Earliest Online Date		**2011**		
Capacity (MGD)				
Installed Capacity			**1.440**	(2) 500 GPM
Criteria Capacity			**0.960**	2/3 Installed Capacity
Effective Sustainable Capacity			**0.672**	Effective capacity reduced based on expected sustainable yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$500,000	$744,048	
Drilling		$905,600	$1,347,619	$566 per foot per Kupaa
Transmission		$4,248,340	$6,321,935	5741 feet 30"DI at $675 per foot based on 2007 Construction estimate plus $65 per foot ancillary, SCADA, road
Development		$1,500,000	$2,232,143	(2) 500 GPM Wells @ 750,000
Storage Improvements				
Engineering Costs		$200,000	$297,619	
Contingencies		$1,470,788	$2,188,673	20% Contingency
Total Plant Cost		$8,824,728	$13,132,036	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,470,788	16.7%	Contingency
	-1	$1,500,000	17.0%	Development, Storage
	-2	$5,153,940	58.4%	Transmission, Drilling
	-3	$700,000	7.9%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.047	
		Total	Per MGD	
Total Capitalized Cost		**$9,235,983**	$13,744,022	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$6,873	$10,227	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$20,926	$31,139	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$27,798**	$41,366	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.163	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.168**	

Wells - Waipili (2)

(2) New DWS Wells at New Site
500GPM
w/Transmission from Wailena Wells
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.

				Derivation
Type		Basal Well		
System		Central		
Source		Groundwater		
Location		North Waihee		
Aquifer		Waihee (North)		
Earliest Online Date		**2013**		
Capacity (MGD)				
Installed Capacity			1.440	(2) 500 GPM
Criteria Capacity			0.960	2/3 Installed Capacity
Effective Sustainable Capacity			0.672	Effective capacity reduced based on expected sustainable yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$500,000	$744,048	
Drilling		$905,600	$1,347,619	$566 per foot per Kupaa
Transmission		$2,220,000	$3,303,571	3000 feet 30"DI at $675 per foot based on 2007 Construction estimate plus $65 per foot ancillary, SCADA, road
Development		$1,500,000	$2,232,143	(2) 500 GPM Wells @ 750,000
Storage Improvements		$1,200,000	$1,785,714	Based on Kupaa Cost
Engineering Costs		$200,000	$297,619	
Contingencies		$1,305,120	$1,942,143	20% Contingency
Total Plant Cost		$7,830,720	$11,652,857	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,305,120	16.7%	Contingency
	-1	$2,700,000	34.5%	Development, Storage
	-2	$3,125,600	39.9%	Transmission, Drilling
	-3	$700,000	8.9%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.042	
		Total	Per MGD	
Total Capitalized Cost		**$8,157,050**	$12,138,467	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$6,873	$10,227	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$20,926	$31,139	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*Installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$27,798**	$41,366	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.163	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.168**	

Wells - Kahakuloa (4)

Four New DWS Wells at New Sites
500 GPM each
w/Transmission from Waipili Wells
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.

Type	Basal Well
System	Central
Source	Groundwater
Location	Kahakuloa
Aquifer	Kahakuloa

				Derivation
Earliest Online Date		2014		
Capacity (MGD)				
Installed Capacity			2.880	(4) 500 GPM
Criteria Capacity			1.920	2/3 Installed Capacity
Effective Sustainable Capacity			1.344	Effective capacity reduced based on expected sustainable yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$1,000,000	$744,048	
Drilling		$1,811,200	$1,347,619	$566 per foot per Kupaa
Transmission		$5,180,000	$3,854,167	7000 feet 30"DI at $675 per foot based on 2007 Construction estimate plus $65 per foot ancillary, SCADA, road
Development		$3,000,000	$2,232,143	(4) Wells @ $750K
Storage Improvements		$1,200,000	$892,857	
Engineering Costs		$250,000	$186,012	
Contingencies		$2,488,240	$1,851,369	20% Contingency
Total Plant Cost		$14,929,440	$11,108,214	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,488,240	16.0%	Contingency
	-1	$4,200,000	26.9%	Development, Storage
	-2	$6,991,200	44.8%	Transmission, Drilling
	-3	$1,250,000	8.0%	Exploration, Land, Engineering
	-4	$175,313	1.1%	Waiolai to Wailena incremental transmission costs
	-5	$185,938	1.2%	Maluhia to Waiolai incremental transmission costs
	-6	$307,062	2.0%	Kupaa to Maluhia incremental transmission costs
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.048	
		Total	Per MGD	
Total Capitalized Cost		$15,652,772	$11,646,408	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$13,745	$10,227	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$41,851	$31,139	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		$55,596	$41,366	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.163	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			$1.168	

Wells - Waihali (2)

Two New DWS Wells at New Site
500 GPM
w/Transmission from Kahakaloa Wells
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.

Type		Basal Well		
System		Central		
Source		Groundwater		
Location		Kahakuloa		
Aquifer		Kahakuloa		
Earliest Online Date		**2015**		**Derivation**
Capacity (MGD)				
Installed Capacity			1.440	(2) 500GPM
Criteria Capacity			0.960	2/3 Installed Capacity
Effective Sustainable Capacity			0.672	Effective capacity reduced based on expected sustainable yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$500,000	$744,048	
Drilling		$905,600	$1,347,619	$566 per foot per Kupaa
Transmission		$2,070,000	$3,080,357	3000 feet 24"DI at $625 per foot based on 2007 Construction estimate plus $65 per foot ancillary. SCADA, road
Development		$1,500,000	$2,232,143	(2) Wells @ $750K
Storage Improvements				
Engineering Costs		$200,000	$297,619	
Contingencies		$1,035,120	$1,540,357	20% Contingency
Total Plant Cost		$6,210,720	$9,242,143	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,035,120	16.7%	Contingency
	-1	$1,500,000	24.2%	Development, Storage
	-2	$2,975,600	47.9%	Transmission, Drilling
	-3	$700,000	11.3%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.045	
		Total	Per MGD	
Total Capitalized Cost		**$6,493,233**	$9,662,550	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$6,873	$10,227	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$20,926	$31,139	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$27,798**	$41,366	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.163	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.168**	

Wells - Po'elua (4)

Four New DWS Wells at New Sites
500 GPM each
w/Transmission from Waihali Wells
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.

Type	Basal Well
System	Central
Source	Groundwater
Location	Kahakuloa
Aquifer	Kahakuloa

				Derivation
Earliest Online Date		**2016**		
Capacity (MGD)				
Installed Capacity			**2.880**	(4) 500 GPM
Criteria Capacity			**1.920**	2/3 Installed Capacity
Effective Sustainable Capacity			**1.344**	Effective capacity reduced based on expected sustainable yield
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$1,000,000	$744,048	
Drilling		$1,811,200	$1,347,619	$566 per foot per Kupaa
Transmission		$3,450,000	$2,566,964	5000 feet 24"DI at $625 per foot based on 2007 Construction estimate plus $65 per foot ancillary, SCADA, road
Development		$3,500,000	$2,604,167	(4) Wells + Includes booster station
Storage Improvements		$1,200,000	$892,857	
Engineering Costs		$300,000	$223,214	
Contingencies		$2,252,240	$1,675,774	20% Contingency
Total Plant Cost		$13,513,440	$10,054,643	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,252,240	16.7%	Contingency
	-1	$4,700,000	34.8%	Development, Storage
	-2	$5,261,200	38.9%	Transmission, Drilling
	-3	$1,300,000	9.6%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.042	
		Total	Per MGD	
Total Capitalized Cost		**$14,078,207**	$10,474,856	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$13,745	$10,227	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$41,851	$31,139	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$55,596**	$41,366	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.163	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.168**	

Wellfield - Haiku Aquifer (1500')

(8) New DWS Wells In Haiku Aquifer @ 1500' el.
w/Transmission to Central System

Derivation:
Prospective engineering and capital cost estimates by HDA based on prior engineering studies and recent DWS unit cost information.
Operation costs by HDA.

Type		Basal Wells		
System		Central		
Source		Groundwater		
Location		Haiku		
Aquifer		Haiku		
Earliest Online Date		**2014**		**Derivation**
Capacity (MGD)				
Installed Capacity			16.128	(8) wells @1400 GPM
Criteria Capacity			10.752	2/3 Installed Capacity
Effective Sustainable Capacity			10.752	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$2,000,000	$186,012	
Drilling		$6,792,000	$631,696	$566 per foot per Kupaa
Transmission		$44,298,347	$4,120,010	Based on LS 2007 Construction estimate $46.906M + Ancillary $1.5M 70,000 ft. 36" line + 4000 ft 12" line Deescalated to $2004
Development		$8,000,000	$744,048	
Storage Improvements		$2,400,000	$223,214	(1) 1MG Tank
Engineering Costs		$400,000	$37,202	Includes EIS
Contingencies		$12,778,069	$1,188,437	20% Contingency
Total Plant Cost		$76,668,417	$7,130,619	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$12,778,069	16.7%	Contingency
	-1	$10,400,000	13.6%	Development, Storage
	-2	$51,090,347	66.6%	Transmission, Drilling
	-3	$2,400,000	3.1%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.046	
		Total	Per MGD	
Total Capitalized Cost		**$80,206,684**	$7,459,699	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$54,060	$5,028	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$439,438	$40,870	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$493,498**	$45,898	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1500		
Variable O&M			$0.000	
Electrical Energy			$2.180	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$2.185**	

Wellfield - Haiku Aquifer (1000')

(8) New DWS Wells In Haiku Aquifer @ 1000' el.
w/Transmission to Central System

Derivation:
Prospective engineering and capital cost estimates by HDA based on prior engineering studies and recent DWS unit cost information.
Operation costs by HDA.

Type	Basal Wells
System	Central
Source	Groundwater
Location	Haiku
Aquifer	Haiku

				Derivation
Earliest Online Date		**2014**		
Capacity (MGD)				
Installed Capacity			**16.128**	(8) wells @1400 GPM
Criteria Capacity			**10.752**	2/3 Installed Capacity
Effective Sustainable Capacity			**10.752**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$2,000,000	$186,012	
Drilling		$4,528,000	$421,131	$566 per foot per Kupaa
Transmission		$44,298,347	$4,120,010	Based on LS 2007 Construction estimate $46.906M + Ancillary $1.5M 70,000 ft. 36" line + 4000 ft 12" line Deescalated to $2004
Development		$8,000,000	$744,048	
Storage Improvements		$2,400,000	$223,214	(1) 1MG Tank
Engineering Costs		$400,000	$37,202	Includes EIS
Contingencies		$12,325,269	$1,146,323	20% Contingency
Total Plant Cost		$73,951,617	$6,877,941	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$12,325,269	16.7%	Contingency
	-1	$10,400,000	14.1%	Development, Storage
	-2	$48,626,347	66.0%	Transmission, Drilling
	-3	$2,400,000	3.2%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.046	
		Total	Per MGD	
Total Capitalized Cost		**$77,356,080**	$7,194,576	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$54,060	$5,028	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$292,958	$27,247	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$347,018**	$32,275	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1000		
Variable O&M			$0.000	
Electrical Energy			$1.453	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.459**	

Wellfield - Waikamoi Aquifer Redesign

(20) New DWS Wells In Waikamoi Aquifer
w/Transmission to Central System

Derivation:
Prospective engineering and capital cost estimates by HDA based on prior engineering studies and recent DWS unit cost information.
Operation costs by HDA.

Type	Basal Wells
System	Central
Source	Groundwater
Location	Waikamoi
Aquifer	Waikamoi

				Derivation
Earliest Online Date		**2014**		
Capacity (MGD)				
Installed Capacity			**10.000**	(20) wells @350 GPM
Criteria Capacity			**6.667**	2/3 Installed Capacity
Effective Sustainable Capacity			**6.667**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$4,000,000	$600,000	(20) Well sites
Drilling		$7,924,000	$1,188,600	$566 per foot per Kupaa
Transmission		$75,070,901	$11,260,635	Based on LS 2007 Construction estimate $70.612M + Ancillary, roads, SCADA $2.8M 113,000 ft. 36" line + 2000 ft 12" line Deescalated to $2004 Plus 20,000ft extension 24" line @ $557plf
Development		$15,000,000	$2,250,000	(20) Wells @ $750,000
Storage Improvements		$2,400,000	$360,000	(1) 1MG Tank
Engineering Costs		$400,000	$60,000	Includes EIS
Contingencies		$20,958,980	$3,143,847	20% Contingency
Total Plant Cost		$125,753,881	$18,863,082	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$20,958,980	16.7%	Contingency
	-1	$17,400,000	13.8%	Development, Storage
	-2	$82,994,901	66.0%	Transmission, Drilling
	-3	$4,400,000	3.5%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.046	
		Total	Per MGD	
Total Capitalized Cost		**$131,561,512**	$19,734,227	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$54,060	$8,109	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$127,152	$19,073	5 Kwh/Kgal/Klt lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$181,212**	$27,182	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		700		600' well lift + 100' dynamic transmission head
Variable O&M			$0.000	
Electrical Energy			$1.017	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.023**	

Wellfield - Waikamoi w Ditch Transmission and WTP

(20) New DWS Wells In Honopou Aquifer
w/Ditch Transmission to Central Maui

Derivation:
Prospective engineering and capital cost estimates by HDA based on prior engineering studies and recent DWS unit cost information.

Type	Basal Wells
System	Central
Source	Groundwater
Location	Waikamoi
Aquifer	Waikamoi

				Derivation
Earliest Online Date		**2014**		
Capacity (MGD)				
Installed Capacity			**9.000**	(20) wells @350 GPM Minus 10% Ditch Losses
Criteria Capacity			**6.000**	2/3 Installed Capacity
Effective Sustainable Capacity			**6.000**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$4,000,000	$666,667	(20) Well sites
Drilling		$6,792,000	$1,132,000	$566 per foot per Kupaa
Transmission		$26,469,557	$4,411,593	Based on breakdown from LS 2007 Construction estimate: (20)12" laterals and valves $1.520M 45,000 ft.36"line @ $557plf + Itemized transmission pipeline costs = $27.124M Ancillary, roads, SCADA $2.8M De-escalated to $2004
Development		$15,000,000	$2,500,000	(20) Wells @ $750,000
Treatment Plant		$27,454,000	$4,575,667	$30M $2007 de-escalated to $2004 (per Waiale WTP cost)
Engineering Costs		$400,000	$66,667	Includes EIS
Contingencies		$16,023,111	$2,670,519	20% Contingency
Total Plant Cost		$96,138,669	$16,023,111	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$16,023,111	16.7%	Contingency
	-1	$42,454,000	44.2%	Development, Storage
	-2	$33,261,557	34.6%	Transmission, Drilling
	-3	$4,400,000	4.6%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.037	
		Total	Per MGD	
Total Capitalized Cost		**$99,736,749**	$16,622,792	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$54,060	$9,010	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Treatment Plant Operating		$638,239	$106,373	Per Waiale WTP cost
Fixed Operating Costs		$0	$0	
Electrical Demand		$98,089	$16,348	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*Installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$790,388**	$131,731	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		600		600' well lift
Treatment Electrical Energy			$0.438	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Pumping Electrical Energy			$0.872	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Treatment Chem/Materials			$0.228	Chemicals and amortized membrane filter replacement
Water Delivery Fee			$0.060	
Total Variable Op. Costs			**$1.598**	

Brackish Desalination - 2 Train

Brackish Water Desalination Plant per Brown & Caldwell

Derivation:
Per Brown & Caldwell Final Report March 2006
Deration of Effective Output per HDA

Type	Brackish Desal
System	Central
Source	Groundwater
Location	Puunene
Aquifer	Kahului

				Derivation
Earliest Online Date		**2010**		
Capacity (MGD)				
Installed Capacity			**5.000**	Two parallel trains
Criteria Capacity			**2.500**	One train out of service
Effective Sustainable Capacity			**4.250**	85% of installed capacity
Capital Costs ($2004)		Total	Per MGD	
Site, Design, EA, Management		$4,430,201	$1,042,400	B&C 2006 estimate de-escalated to $2004
Source Wells, Distribution, Storage		$4,147,422	$975,864	B&C 2006 estimate de-escalated to $2004
Desalination Plant Cost		$11,311,151	$2,661,447	B&C 2006 estimate de-escalated to $2004
Concentrate Disposal Facilities		$1,696,673	$399,217	B&C 2006 estimate de-escalated to $2004
Contingencies		$10,792,723	$2,539,464	50% Contingency
Total Plant Cost		$32,378,169	$7,618,393	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$10,792,723	33.3%	Contingency
	-1	$17,155,246	53.0%	Construction
	-2	$0	0.0%	
	-3	$4,430,201	13.7%	Site, Design, EA, Management
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.028	
		Total	Per MGD	
Total Capitalized Cost		**$33,276,326**	$7,829,724	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$235,649	$55,447	B&C 2006 estimate de-escalated to $2004
Apportioned Operating Labor		$0	$0	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,965	$24,462	Derived sys demand cost factor * electrical energy cost * installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$75,408	$17,743	B&C 2006 estimate de-escalated to $2004
Amort. of Capitalized Rebuild Costs		$93,317	$21,957	B&C 2006 estimate de-escalated to $2004
Total Fixed Op. Costs		**$508,338**	$119,609	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1145		Desal Plant Equiv. Electrical Efficiency Factor
Raw Water Cost			$0.000	
Electrical Energy			$1.663	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.139	B&C 2006 estimate de-escalated to $2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.802**	

Brackish Desalination - 4 Train

Brackish Water Desalination Plant per Brown & Caldwell

Derivation:
Per Brown & Caldwell Final Report March 2006
Deration of Effective Output per HDA
Assumed Split to 4 Parallel Train per HDA

Type	Brackish Desal
System	Central
Source	Groundwater
Location	Puunene
Aquifer	Kahului

				Derivation
Earliest Online Date		2010		
Capacity (MGD)				
Installed Capacity			5.000	Four parallel trains
Criteria Capacity			3.750	One train out of service
Effective Sustainable Capacity			4.250	85% of installed capacity
Capital Costs ($2004)		Total	Per MGD	
Site, Design, EA, Management		$4,430,201	$1,042,400	B&C 2006 estimate de-escalated to $2004
Source Wells, Distribution, Storage		$4,147,422	$975,864	B&C 2006 estimate de-escalated to $2004
Desalination Plant Cost		$12,442,266	$2,927,592	B&C 2006 estimate de-escalated to $2004 + 10% per HDA (split trains)
Concentrate Disposal Facilities		$1,696,673	$399,217	B&C 2006 estimate de-escalated to $2004
Contingencies		$11,358,281	$2,672,537	50% Contingency
Total Plant Cost		$34,074,842	$8,017,610	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$11,358,281	33.3%	Contingency
	-1	$18,286,361	53.7%	Construction
	-2	$0	0.0%	
	-3	$4,430,201	13.0%	Site, Design, EA, Management
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.027	
		Total	Per MGD	
Total Capitalized Cost		$35,005,944	$8,236,693	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$235,649	$55,447	B&C 2006 estimate de-escalated to $2004
Apportioned Operating Labor		$0	$0	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,965	$24,462	Derived sys demand cost factor * electrical energy cost * installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$75,408	$17,743	B&C 2006 estimate de-escalated to $2004
Amort. of Capitalized Rebuild Costs		$93,317	$21,957	B&C 2006 estimate de-escalated to $2004
Total Fixed Op. Costs		$508,338	$119,609	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1145		Desal Plant Equiv. Electrical Efficiency Factor
Raw Water Cost			$0.000	
Electrical Energy			$1.663	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.139	B&C 2006 estimate de-escalated to $2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			$1.802	

Seawater Desalination - 2 Train

Brackish Water Desalination Plant per Brown & Caldwell

Derivation:
Per Brown & Caldwell Final Report March 2006
Deration of Effective Output per HDA

Type		Brackish Desal		
System		Central		
Source		Seawater		
Location		Puunene		
Aquifer		Seawater		
Earliest Online Date		**2010**		**Derivation**
Capacity (MGD)				
Installed Capacity			**5.000**	Two parallel trains
Criteria Capacity			**2.500**	One train out of service
Effective Sustainable Capacity			**4.250**	85% of installed capacity
Capital Costs ($2004)		Total	Per MGD	
Site, Design, EA, Management		$13,761,900	$3,238,094	B&C 2006 estimate de-escalated to $2004
Source Wells, Distribution, Storage		$6,315,393	$1,485,975	B&C 2006 estimate de-escalated to $2004
Desalination Plant Cost		$45,600,000	$10,729,412	B&C 2006 estimate de-escalated to $2004
Concentrate Disposal Facilities		$3,520,000	$828,235	B&C 2006 estimate de-escalated to $2004
Contingencies		$34,598,646	$8,140,858	50% Contingency
Total Plant Cost		$103,795,939	$24,422,574	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$34,598,646	33.3%	Contingency
	-1	$55,435,393	53.4%	Construction
	-2	$0	0.0%	
	-3	$13,761,900	13.3%	Site, Design, EA, Management
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.027	
		Total	Per MGD	
Total Capitalized Cost		**$106,648,423**	$25,093,747	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$235,649	$55,447	B&C 2006 estimate de-escalated to $2004
Apportioned Operating Labor		$0	$0	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$340,223	$80,052	Derived sys demand cost factor * electrical energy cost * Installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$329,909	$77,626	B&C 2006 estimate de-escalated to $2004
Amort. of Capitalized Rebuild Costs		$471,298	$110,894	B&C 2006 estimate de-escalated to $2004
Total Fixed Op. Costs		**$1,377,078**	$324,018	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		3746		Desal Plant Equiv. Electrical Efficiency Factor
Raw Water Cost			$0.000	
Electrical Energy			$5.444	5 Kwh/Kgal/kft lift efficiency * $.34 per Kwh June 2008 energy cost * kft lift / VarOpCost EscRate ^ (2008-2004) => eq:$125/bbl crude $2008
Chemicals/Materials			$0.287	B&C 2006 estimate de-escalated to $2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$5.730**	

Surface Water Treatment Options

Option (Long-Term): Waiale Water Treatment Plant

Construction design for the Waiale surface water treatment plant using water collected by existing diversions from the Na Wa Eha streams is currently more than 90% complete. This project design is sponsored by Alexander & Baldwin (A&B).

The water treatment plan would be a membrane filtration facility with three trains of 4.5 MGD (nominal) filters. The facility would have an installed capacity of 13.5 MGD and an expected average capacity of 9 MGD.

No contractual agreements between A&B and the DWS have been finalized but several cost and water sharing arrangements have been discussed. Several cost and water sharing configurations were analyzed. Costs reported in this appendix show the total estimated capital costs of the treatment plant.

One substantial uncertainty regarding the economics of this resource option is the cost of the raw water charged by A&B and the Wailuku Water Company (WWC). Estimates of the costs that would be charged by these entities to the DWS for operation of the facility range from a total of $0.30 per thousand gallons of raw water to $0.90 per thousand gallons. Costs are reported in this appendix for three raw water cost scenarios ($0.30, $0.60 and $0.90 per thousand gallons).

Information regarding the characteristics and costs of this option is provided in the tables at the end of this section describing long term resource options.

Option (Long-Term): Waihee Water Treatment Plant

A water treatment plant similar to the Waiale facility discussed above to be developed by the WWC is being considered for the longer term. This option is characterized with a range of water costs similar to the Waiale facility.

There is no specific current proposal for a water treatment plant at this location. This site was considered in light of several features. It would reduce some potential water contamination issues associated with the Waiale WTP, which would use water transported in open ditches further through more populated areas. Analysis of this site also measures the economic advantages of using a higher elevation site, which would require less energy to pump water to the Central system hydraulic gradient pressure.

Information regarding the characteristics and costs of this option based on preliminary studies and characterizations is provided in the tables at the end of this section describing long term resource options.

Option (Long-Term): Iao Stream "Flash" Water Storage

One resource option suggested for consideration at a DWS WUDP Water Advisory Committee meeting was use of water from the Iao Stream during high water stages for storage and later treatment and use as a source for the DWS Central District system. The existing Waiale reservoir was suggested as a storage reservoir for this option. This option also characterizes the costs of providing reasonably reliable water production capability for the DWS system if sufficient baseflow is not allocated for a water treatment plant on a long term basis to serve municipal water needs.

The characteristics of the source, reservoir and water treatment plant system are based on a mass flow analysis (described in the Central District Final Candidate Strategies Report). Several reservoir size and source water allocation and availability scenarios were examined. Two scenarios are documented in this appendix that are included as final candidate strategies in the report. One strategy assumes a 1000 MG reservoir with the same water treatment plant configuration as characterized in the Waiale WTP option. A second strategy assumes a smaller 300

MG reservoir, lower overall reliability and a smaller WTP configuration.

Information regarding the characteristics and costs of this option based on preliminary studies and characterizations is provided in the tables at the end of this section describing long term resource options.

Tables Characterizing Long Term Surface Water Treatment Options

Tables characterizing the long term surface water treatment resource options are provided below. A brief description of some of the terms used in the tables is provided on pages 2-3.

Waiale WTP @30cpkal

Surface Water Treatment Plant at Waiale Reservoir
Construction by A&B

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Kahului
Aquifer	Iao & Waihee Surface

				Derivation
Earliest Online Date		**2009**		
Capacity (MGD)				
Installed Capacity			**13.500**	Three 3MGD parallel units
Criteria Capacity			**9.000**	One unit out of service
Effective Sustainable Capacity			**9.000**	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Contingencies		$5,490,800	$610,089	20% Contingency
Total Plant Cost (		$32,944,800	$3,660,533	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,490,800	16.7%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	83.3%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.049	
		Total	Per MGD	
Total Capitalized Cost		**$34,567,352**	$3,840,817	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$63,267	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,258	$11,473	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$672,658**	$74,740	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.300	
Electrical Energy			$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.140**	

Waiale WTP @60cpkal

Surface Water Treatment Plant at Waiale Reservoir
Construction by A&B

Derivation:
Per DWS

Type	Surface Water Treatment		
System	Central		
Source	Surface Water		
Location	Kahului		
Aquifer	Iao & Waihee Surface		
Earliest Online Date	**2009**		**Derivation**
Capacity (MGD)			
Installed Capacity		13.500	Three 3MGD parallel units
Criteria Capacity		9.000	One unit out of service
Effective Sustainable Capacity		9.000	2/3 Installed Capacity
Capital Costs ($2002)	Total	Per MGD	
Project Cost	$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Contingencies	$5,490,800	$610,089	20% Contingency
Total Plant Cost (	$32,944,800	$3,660,533	

Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,490,800	16.7%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	83.3%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	

Const. Per. Esc. Rate (Nom.)	3.00%	
AFUDC Interest Rate (Nom.)	6.00%	
AFUDC Factor		1.049
	Total	Per MGD
Total Capitalized Cost	**$34,567,352**	$3,840,817
Fixed Operating Costs ($2002)	Per Year	Per Y/MGD
Dedicated Operating Labor	$0	$0
Apportioned Operating Labor	$569,400	$63,267
Maintenance Labor	$0	$0
Fixed Operating Costs	$0	$0
Electrical Demand	$103,258	$11,473
Chemicals/Materials	$0	$0
Maintenance Expenses	$0	$0
Amort. of Capitalized Rebuild Costs	$0	$0
Total Fixed Op. Costs	**$672,658**	$74,740

Variable Operating Costs ($2002)		Per KGal	
Vertical Lift	0		
Raw Water Cost		$0.600	
Electrical Energy		$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials		$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses		$0.000	
Total Variable Op. Costs		**$1.440**	

Waiale WTP @90cpkal

Surface Water Treatment Plant at Waiale Reservoir
Construction by A&B

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Kahului
Aquifer	Iao & Waihee Surface

				Derivation
Earliest Online Date		**2009**		
Capacity (MGD)				
Installed Capacity			**13.500**	Three 3MGD parallel units
Criteria Capacity			**9.000**	One unit out of service
Effective Sustainable Capacity			**9.000**	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Contingencies		$5,490,800	$610,089	20% Contingency
Total Plant Cost (		$32,944,800	$3,660,533	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,490,800	16.7%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	83.3%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.049	
		Total	Per MGD	
Total Capitalized Cost		**$34,567,352**	$3,840,817	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$63,267	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,258	$11,473	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$672,658**	$74,740	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.900	
Electrical Energy			$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.740**	

Waihee Location WTP @30cpkal

Surface Water Treatment Plant at Waiale Reservoir
Specs per Waiale WTP

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Kahului
Aquifer	Iao & Waihee Surface

				Derivation
Earliest Online Date		2009		
Capacity (MGD)				
Installed Capacity			13.500	Three 3MGD parallel units
Criteria Capacity			9.000	One unit out of service
Effective Sustainable Capacity			9.000	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Contingencies		$5,490,800	$610,089	20% Contingency
Total Plant Cost (		$32,944,800	$3,660,533	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,490,800	16.7%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	83.3%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.049	
		Total	Per MGD	
Total Capitalized Cost		$34,567,352	$3,840,817	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$63,267	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$73,896	$8,211	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		$643,296	$71,477	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.300	
Electrical Energy			$0.438	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			$0.966	

Waihee Location WTP @60cpkal

Surface Water Treatment Plant at Waiale Reservoir
Specs per Waiale WTP

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Kahului
Aquifer	Iao & Waihee Surface

				Derivation
Earliest Online Date		2009		
Capacity (MGD)				
Installed Capacity			13.500	Three 3MGD parallel units
Criteria Capacity			9.000	One unit out of service
Effective Sustainable Capacity			9.000	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Contingencies		$5,490,800	$610,089	20% Contingency
Total Plant Cost (		$32,944,800	$3,660,533	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,490,800	16.7%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	83.3%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.049	
		Total	Per MGD	
Total Capitalized Cost		$34,567,352	$3,840,817	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$63,267	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,258	$11,473	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		$672,658	$74,740	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.600	
Electrical Energy			$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			$1.440	

Waihee Location WTP @90cpkal

Surface Water Treatment Plant at Waiale Reservoir
Specs per Waiale WTP

Derivation:
Per DWS

Type		Surface Water Treatment		
System		Central		
Source		Surface Water		
Location		Kahului		
Aquifer		Iao & Waihee Surface		
Earliest Online Date		**2009**		**Derivation**
Capacity (MGD)				
Installed Capacity			13.500	Three 3MGD parallel units
Criteria Capacity			9.000	One unit out of service
Effective Sustainable Capacity			9.000	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Contingencies		$5,490,800	$610,089	20% Contingency
Total Plant Cost (		$32,944,800	$3,660,533	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,490,800	16.7%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	83.3%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.049	
		Total	Per MGD	
Total Capitalized Cost		$34,567,352	$3,840,817	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$63,267	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,258	$11,473	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		$672,658	$74,740	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.900	
Electrical Energy			$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			$1.740	

300 MG Reservoir and WTP

300 MG Reservoir w Reconfigured Iao Diversion w 10 MGD IFS
w 6MGD Reliable Yield

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Kahului
Aquifer	Iao & Waihee Surface

				Derivation
Earliest Online Date		**2009**		
Capacity (MGD)				
Installed Capacity			9.000	Three 3MGD parallel units
Criteria Capacity			6.000	One unit out of service
Effective Sustainable Capacity			6.000	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
WTP Project Cost		$21,048,258	$3,508,043	$23M $2007 de-escalated to $2004
Reservoir Cost		$29,851,921	$4,975,320	$32.620M $2007 de-escalated to $2004
Ditch Trans Improvements		$2,000,000	$333,333	
Contingencies		$10,580,036	$1,763,339	20% Contingency
Total Plant Cost (		$63,480,215	$10,580,036	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$10,580,036	33.5%	Contingency
	-1	$0	0.0%	
	-2	$21,048,258	66.5%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.039	
		Total	Per MGD	
Total Capitalized Cost		**$65,976,947**	$10,996,158	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$438,438	$73,073	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$68,839	$11,473	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$507,277**	$84,546	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.000	
Electrical Energy			$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.840**	

1000 MG Reservoir and WTP

1000 MG Reservoir w Reconfigured Iao Diversion w 10 MGD
IFS

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Kahului
Aquifer	Iao & Waihee Surface

				Derivation
Earliest Online Date		**2009**		
Capacity (MGD)				
Installed Capacity			13.500	Three 3MGD parallel units
Criteria Capacity			9.000	One unit out of service
Effective Sustainable Capacity			9.000	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
WTP Project Cost		$27,454,000	$3,050,444	$30M $2007 de-escalated to $2004
Reservoir Cost		$99,506,098	$11,056,233	$108.733M $2007 de-escalated to $2004
Ditch Trans Improvements		$2,000,000	$222,222	
Contingencies		$25,792,020	$2,865,780	20% Contingency
Total Plant Cost (		$154,752,118	$17,194,680	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$25,792,020	48.4%	Contingency
	-1	$0	0.0%	
	-2	$27,454,000	51.6%	Total Plant Cost
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.030	
		Total	Per MGD	
Total Capitalized Cost		**$159,467,839**	$17,718,649	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$63,267	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$103,258	$11,473	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$672,658**	$74,740	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.000	
Electrical Energy			$0.612	Electric cost from similar DWS membrane filtration plants consistent with Brewer Waihee WTP study = $0.302 / kgal Plus cost to boost to DWS system pressure at 100' additional head = $0.12 / kgal Escalated by 45% to reflect June 2008 $0.34/KWH electricity prices de-escalated to $2004
Chemicals/Materials			$0.228	Chemicals and amortized membrane filter replacement
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.840**	

Water Reclamation / Recycling Options

This option consists of building a new non-potable water transmission line from the existing Kihei Wastewater Treatment Plant (WWTP) to the Wailea area, where water could be used to displace existing potable water now used for outdoor irrigation purposes. The viability of this strategy needs to be verified by further study to determine the long term capacity of the Kihei WWTP to produce R-1 recycled water and the amount of potable water in the Wailea area that could be displaced by making R-1 water available.

Three scenarios are characterized assuming different amounts of potable water that could be displaced (1.5, 1.0 and 0.5 MGD).

DEM Kihei R-1 So.Trans. 1.5MGD Displaced Potable

24,000' Line South of Kikei WWTP

Derivation:
Connect existing Kihei WWTP R-1 system with 1.5 MGD of displaceable potable irrigation water

Type	0
0	0
Source	0
Location	0
Aquifer	0

				Derivation
Earliest Online Date		2012		
Capacity (MGD)				
Installed Capacity			1.500	
Max. Day Capacity			3.000	
Effective Sustainable Capacity			1.500	
Capital Costs ($2004)		Total	Per MGD	
Basic Plant Cost				Uses existing R-1 capacity of Kikei WTP
Distribution / Metering		$970,874	$647,249	(25) connection distribution and meter installations @ $40k $2007
Transmission Improvements		$14,454,663	$9,636,442	24,300 feet 18" Transmission Line w/valves, connections, installed @ $650 pl $2007 De-escalated to $2004
Treatment Improvements				Uses existing R-1 capacity of Kikei WTP
Storage Improvements		$4,575,708	$3,050,472	(2) 1.0 MGD Storage Tanks @ $2.50/gal. $2007 De-escalated to $2004
Engineering Costs		$485,437	$323,625	
Contingencies		$4,097,336	$2,731,558	20% Contingency
Total Plant Cost		$24,584,018	$16,389,345	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,068,210	20.6%	
	-1	$19,030,371	77.4%	
	-2	$485,437	2.0%	
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.024	
		Total	Per MGD	
Total Capitalized Cost		$25,166,990	$16,777,993	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$0	$0	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$0	$0	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		$0	$0	
Variable Operating Costs ($2004)			Per KGal	
Operating Labor		0		
Maintenance Labor			$0.000	
Electrical Energy			$0.331	FY04 Reuse Elec Cost $123,110 for 536,003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	FY04 Expenses $9,674 for 536,003 Kgal
Total Variable Op. Costs			$0.398	

DEM Kihei R-1 So.Trans. 1.0MGD Displaced Potable

24,000' Line South of Kikei WWTP

Derivation:
Connect existing Kihei WWTP R-1 system with 1.5 MGD of displaceable potable irrigation water

Type	0	
0	0	
Source	0	
Location	0	
Aquifer	0	

				Derivation
Earliest Online Date		**2012**		
Capacity (MGD)				
Installed Capacity			**1.000**	
Max. Day Capacity			**2.000**	
Effective Sustainable Capacity			**1.000**	
Capital Costs ($2004)		Total	Per MGD	
Basic Plant Cost				Uses existing R-1 capacity of Kikei WTP
Distribution / Metering		$970,874	$970,874	(25) connection distribution and meter installations @ $40k $2007
Transmission Improvements		$14,454,663	$14,454,663	24,300 feet 18" Transmission Line w/valves, connections, installed @ $650 plf $2007 De-escalated to $2004
Treatment Improvements				Uses existing R-1 capacity of Kikei WTP
Storage Improvements		$4,575,708	$4,575,708	(2) 1.0 MGD Storage Tanks @ $2.50/gal. $2007 De-escalated to $2004
Engineering Costs		$485,437	$485,437	
Contingencies		$4,097,336	$4,097,336	20% Contingency
Total Plant Cost		$24,584,018	$24,584,018	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,068,210	20.6%	
	-1	$19,030,371	77.4%	
	-2	$485,437	2.0%	
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.024	
		Total	Per MGD	
Total Capitalized Cost		**$25,166,990**	$25,166,990	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$0	$0	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$0	$0	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$0**	$0	
Variable Operating Costs ($2004)			Per KGal	
Operating Labor		0		
Maintenance Labor			$0.000	
Electrical Energy			$0.331	FY04 Reuse Elec Cost $123,110 for 536,003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	FY04 Expenses $9,674 for 536,003 Kgal
Total Variable Op. Costs			**$0.398**	

DEM Kihei R-1 So.Trans. 0.75MGD Displaced Potable

24,000' Line South of Kikei WWTP

Derivation:
Connect existing Kihei WWTP R-1 system with 1.5 MGD of displaceable potable irrigation water

Type	0
0	0
Source	0
Location	0
Aquifer	0

				Derivation
Earliest Online Date		**2012**		
Capacity (MGD)				
Installed Capacity			**0.750**	
Max. Day Capacity			**1.500**	
Effective Sustainable Capacity			**0.750**	
Capital Costs ($2004)		Total	Per MGD	
Basic Plant Cost				Uses existing R-1 capacity of Kikei WTP
Distribution / Metering		$970,874	$1,294,498	(25) connection distribution and meter installations @ $40k $2007
Transmission Improvements		$14,454,663	$19,272,883	24,300 feet 16" Transmission Line w/valves, connections, installed @ $650 plf $2007 De-escalated to $2004
Treatment Improvements				Uses existing R-1 capacity of Kikei WTP
Storage Improvements		$4,575,708	$6,100,944	(2) 1.0 MGD Storage Tanks @ $2.50/gal. $2007 De-escalated to $2004
Engineering Costs		$485,437	$647,249	
Contingencies		$4,097,336	$5,463,115	20% Contingency
Total Plant Cost		$24,584,018	$32,778,690	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$5,068,210	20.6%	
	-1	$19,030,371	77.4%	
	-2	$485,437	2.0%	
	-3	$0	0.0%	
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.024	
		Total	Per MGD	
Total Capitalized Cost		**$25,166,990**	$33,555,987	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$0	$0	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$0	$0	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$0**	$0	
Variable Operating Costs ($2004)			Per KGal	
Operating Labor		0		
Maintenance Labor			$0.000	
Electrical Energy			$0.331	FY04 Reuse Elec Cost $123,110 for 536.003 Kgal Increased by 45% to reflect $2008 $0.34/KWH de-escalated to $2004
Chemicals/Materials			$0.050	FY04 UV Bulbs and Muriatic Acid
Maintenance Expenses			$0.017	FY04 Expenses $9,674 for 536.003 Kgal
Total Variable Op. Costs			**$0.398**	

WE HEREBY CERTIFY that the foregoing BILL NO. 92 (2010), Draft 1

1. Passed FINAL READING at the meeting of the Council of the County of Maui, State of Hawaii, held on the 17th day of December, 2010, by the following vote:

Dennis A. MATEO Chair	Michael J. MOLINA Vice-Chair	Gladys C. BAISA	Jo Anne JOHNSON	Solomon P. KAHO'OHALAHALA	William J. MEDEIROS	Wayne K. NISHIKI	Joseph PONTANILLA	Michael P. VICTORINO
Aye	Aye	Excused	Excused	Aye	Aye	Aye	Aye	Aye

2. Was transmitted to the Mayor of the County of Maui, State of Hawaii, on the 27th day of December, 2010.

DATED AT WAILUKU, MAUI, HAWAII, this 27th day of December, 2010.

DENNIS A. MATEO, CHAIR
Council of the County of Maui

JEFFREY T. KUWADA, COUNTY CLERK
County of Maui

RECEIVED
2010 DEC 27 PM 1:47
OFFICE OF THE MAYOR

THE FOREGOING BILL IS HEREBY APPROVED THIS 27th DAY OF ~~DECEMBER~~, 2010.

CHARMAINE TAVARES, MAYOR
County of Maui

I HEREBY CERTIFY that upon approval of the foregoing BILL by the Mayor of the County of Maui, the said BILL was designated as ORDINANCE NO. 3804 of the County of Maui, State of Hawaii.

JEFFREY T. KUWADA, COUNTY CLERK
County of Maui

Passed First Reading on December 3, 2010.
Effective date of Ordinance December 27, 2010.

I HEREBY CERTIFY that the foregoing is a true and correct copy of Ordinance No. 3804, the original of which is on file in the Office of the County Clerk, County of Maui, State of Hawaii.

Dated at Wailuku, Hawaii, on

County Clerk, County of Maui

COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII

´Iao Ground Water Management Area High-Level Source Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihe´e, Waiehu, ´Iao & Waikapu Streams Contested Case Hearing	Case No. CCH-MA06-1 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that on this date a true and correct copy of the foregoing document was duly served upon the following individuals by U.S. mail, postage prepaid, to their last known addresses as follows:

David Schulmeister, Esq.
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1000 Bishop St., Suite 1200
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Earthjustice
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Attorneys for Hui O Na Wai Eha

DATED: Wailuku, Maui, Hawaii, January 3, 2014.

PATRICK K. WONG
Corporation Counsel
JENNIFER M.P.E. OANA
Deputy Corporation Counsel

Attorneys for COUNTY OF MAUI
DEPARTMENT OF WATER SUPPLY

By _____
JENNIFER M.P.E. OANA
Deputy Corporation Counsel