Maui County Water Use and Development Plan

Candidate Strategies

Central District Preliminary Draft

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Carl Freedman
Haiku Design & Analysis
4234 Hana Hwy.
Haiku, Maui, HI. 96708

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Table of Contents

I. Introduction

This chapter (Candidate Strategies Chapter) is one component of a comprehensive update of the Maui County Water Use & Development Plan (WUDP). The purpose of this chapter is to present and explain the derivation and analysis of various resource "strategies" identified for the Maui Department of Water Supply (DWS) Central District. Each strategy is a combination of resource options sequenced to meet the forecasted water needs and planning objectives for the DWS Central District for a twenty-five year planning period (2006 - 2030).

As explained in previous chapters, the resource options included in the candidate strategies are inclusively defined to include any measures, programs, activities, policies or improvements that could further the planning objectives identified for the WUDP. A broad spectrum of resource options was initially identified and characterized in generic terms in a foregoing Resource Options Chapter. In this chapter specific resource options for the DWS Central District are identified and characterized in substantial detail.

The specific resource options identified in this chapter are analyzed using an integration model that simulates the operation of the existing DWS Central District water system, determines the timing of resource addition needs and calculates the production costs, fixed costs and capital costs of the existing system and resource additions. The economics of individual resource options and various combinations of resource options are examined to determine a set of candidate strategies. The characteristics of these strategies are examined to determine the extent to which the strategies achieve the planning objectives identified for the WUDP.

It is expected that the DWS will select several of the candidate strategies or specify modified or additional strategies to serve as "final" strategies that will undergo more rigorous analysis and development of detail. The determination of the final strategies will be based on a review of the analyses and characterization of the candidate strategies, comments by the Central Disrtict Water Advisory Committee (WAC), the Maui Board of Water Supply (BWS), the Maui County Council (Council) and the Hawaii Commission on Water Resource Management (CWRM). The final strategies will be optimized and analyzed to determine the selection of the Central District portion of the Maui WUDP.

This preliminary draft of the Resource Options chapter is intended for the purpose of review by the DWS, the Central District WAC, the Maui BWS, the Maui Council and the CWRM. It is expected that the scope and content of the this chapter may change based on comments and recommendations by the DWS and the Central District WAC prior to or after presentation the other reviewing agencies.

II. Analysis and Screening Process

The process used to identify, characterize and analyze the specific resource options and candidate strategies for the DWS Central District is described below. Specific resources options were characterized and then analyzed individually and in combinations in the context of the operation of the DWS Central District system. Several candidate strategies were developed, evaluated and presented for comparison.

The analysis and screening process is described briefly below and in more detail in each of the following sections.

Characterization of Specific Resource Options

Several specific resource options are identified for the DWS Central District system. The resource options are classified as:

- **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 exclusive and can be implemented in conjunction with most other combinations of options.

The characteristics of each of these resource options are identified in substantial detail to provide for meaningful analysis in the water system integration model.

Integrated Analysis of Candidate Strategies

The analysis of the specific resource options and candidate strategies was conducted in several stages:

- **Determination of a Reference Strategy**: A base case combination and 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.

Assessment of Attainment of Objectives

The candidate strategies need to be evaluated in light of the degree to which they meet the multiple planning objectives identified for the WUDP. An evaluation matrix was developed showing the candidate strategies and strategy components and each of the WUDP planning objectives. This matrix is offered for comment and for examination of the merits of the candidate strategies.

Selection of Final Candidate Strategies

It is expected that the DWS will select several of the candidate strategies or specify modified or additional strategies to serve as "final" strategies that will undergo more rigorous analysis and development of detail. The determination of the final strategies will be based on a review of the analyses and characterization of the candidate strategies, comments by the Central District Water Advisory Committee (WAC), the Maui Board of Water Supply (BWS), the Maui County Council (Council) and the Hawaii Commission on Water Resource Management (CWRM). The final strategies will be optimized and analyzed to determine the selection of the Central District portion of the Maui WUDP.

III. Characterization of Specific Resource Options

This section 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. 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 2007.

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.

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 2007.

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 2007.

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 and 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 rate of capital and fixed cost escalation is 3.0%. The rate of fuel cost escalation is 4.0%. The assumed 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 2006 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 - 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)

	Year			Derivation
Earliest Online Date		**2007**		
Capacity (MGD)				
Installed Capacity			**2.016**	1400 GPM
Criteria Capacity			**1.344**	2/3 Installed Capacity
Effective Sustainable Capacity			**0.000**	No incremental effective capacity from South Waihee Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design		$76,750	ERR	DWS Information
Drilling		$290,000	ERR	DWS Information
Transmission		$1,700,000	ERR	
Development		$1,000,000	ERR	DWS Information
		$1,200,000	ERR	DWS Information
			ERR	Included in other contracts
Contingencies			ERR	
Total Plant Cost		$4,266,750	ERR	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$0	0.0%	Contingency
	-1	$2,200,000	51.6%	Development, Storage
	-2	$1,990,000	46.6%	Transmission, Drilling
	-3	$76,750	1.8%	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			1.044	
		Total	Per MGD	
Total Capitalized Cost		**$4,455,342**	ERR	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	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		$0	ERR	
Fixed Operating Costs		$0	$0	
Electrical Demand		$13,410	ERR	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	ERR	
Maintenance Expenses		$0	ERR	
Amort. of Capitalized Rebuild Costs		$0	ERR	
Total Fixed Op. Costs		**$20,283**	ERR	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		410		
Variable O&M			$0.000	
Electrical Energy			$0.532	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.538**	

Well - Waikapu Tank (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	Waikapu Tank
Aquifer	Iao

				Derivation
Earliest Online Date		**2007**		
Capacity (MGD)				
Installed Capacity			**2.016**	1400 GPM
Criteria Capacity			**1.344**	2/3 Installed Capacity
Effective Sustainable Capacity			**0.000**	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
			ERR	
		$898,700	ERR	DWS Information
Contingencies			ERR	
Total Plant Cost		$2,299,316	ERR	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$0	0.0%	Contingency
	-1	$782,621	34.0%	Development, Storage
	-2	$543,765	23.6%	Transmission, Drilling
	-3	$972,930	42.3%	Design, 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			1.062	
		Total	Per MGD	
Total Capitalized Cost		**$2,441,761**	ERR	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	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		$0	ERR	
Fixed Operating Costs		$0	$0	
Electrical Demand		$21,914	ERR	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	ERR	
Maintenance Expenses		$0	ERR	
Amort. of Capitalized Rebuild Costs		$0	ERR	
Total Fixed Op. Costs		**$28,787**	ERR	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		670		
Variable O&M			$0.000	
Electrical Energy			$0.870	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.875**	

Well - Iao Tank (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	Iao Tank
Aquifer	Iao

				Derivation
Earliest Online Date		**2007**		
Capacity (MGD)				
Installed Capacity			**2.016**	1400 GPM
Criteria Capacity			**1.344**	2/3 Installed Capacity
Effective Sustainable Capacity			**0.000**	No incremental effective capacity from Iao Aquifer
Capital Costs ($2004)		Total	Per MGD	
Design		$56,405	ERR	DWS Information
Drilling		$395,680	ERR	DWS Information
Transmission			ERR	
Development		$1,200,000	ERR	DWS Information
			ERR	
		$150,000	ERR	DWS Information
Contingencies			ERR	
Total Plant Cost		$1,802,085	ERR	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$0	0.0%	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	$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			1.043	
		Total	Per MGD	
Total Capitalized Cost		**$1,878,987**	ERR	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	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		$0	ERR	
Fixed Operating Costs		$0	$0	
Electrical Demand		$16,550	ERR	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	ERR	
Maintenance Expenses		$0	ERR	
Amort. of Capitalized Rebuild Costs		$0	ERR	
Total Fixed Op. Costs		**$23,423**	ERR	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		506		
Variable O&M			$0.000	
Electrical Energy			$0.657	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.662**	

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

Earliest Online Date		**2008**		**Derivation**
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
0			$0	
0			$0	
0			$0	
			$0	
			$0	
Contingencies			$0	
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	$0	0.0%	
	-2	$0	0.0%	
	-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			1.000	
		Total	Per MGD	
Total Capitalized Cost		**$4,000,000**	$4,000,000	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$7,710	$7,710	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		**$14,582**	$14,582	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		220		
Variable O&M			$0.000	
Electrical Energy			$0.286	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.291**	

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 2008.

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.

Information regarding the characteristics and costs of these wells is provided in the following tables.

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
contingency allowance.
Operation costs by HDA.

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	
			$0	
		$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	$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			1.023	
		Total	Per MGD	
Total Capitalized Cost		**$3,451,759**	$2,568,273	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$24,531	$18,252	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		**$31,403**	$23,365	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M			$0.000	
Electrical Energy			$0.973	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.979**	

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
contingency allowance.
Operation costs by HDA.

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	
			$0	
		$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	$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			1.021	
		Total	Per MGD	
Total Capitalized Cost		**$2,542,112**	$3,875,170	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$24,531	$37,394	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		**$31,403**	$47,871	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M			$0.000	
Electrical Energy			$0.973	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.979**	

Option (Short Term): Hamakuapoko Wells

The Hamakuapoko wells are two existing wells east of Paia near Maliko gulch at elevations of 702 and 781 feet. These wells pump from the Haiku basal groundwater aquifer. Each well has an installed pump capacity of 500 gallons per minute (720,000 gallons per day).

These wells were originally drilled as part of the East Maui Water Development Plan (EMPLAN) to serve the Central DWS system. The EMPLAN project was contested in court and based on a settlement agreement, further development of wells is stopped pending fulfillment of the settlement terms. The existing Hamakuapoko wells are now connected to the Upcountry DWS system and provide a backup source of water during upcountry drought conditions.

Because detectable amounts of DBCP are found in the water from these wells a granulated activated carbon (GAC) filtration system has been installed at the site of the upper well to bring the water into compliance with federal and state water quality standards. Nitrates in the well water are at about half of the allowable federal and state limits. Nitrates are not removed by the GAC filtration system. The costs of installing and operating the GAC treatment system for thirty years are paid by defendants in a settlement of a separate court action. After thirty years (2029) the costs of operating the GAC system will become the responsibility of the DWS.

Transmission improvements are currently underway to connect the output of the GAC treatment system to the Upper Paia tank which is part of the Central DWS system. Providing water to this tank would supply the Paia / Kuau area services with water from the Hamakuapoko wells and displace all or some portion of the current supply to this area from the existing Central system sources. The Paia / Kuau area currently consumes uses about 0.5 MGD of water production. An existing check valve at the Spreckelsville booster station would prevent water from these wells from flowing towards Kahului unless modifications were made. Without modification the maximum contribution to the Central system from the Hamakuapoko wells would be the 0.5 MGD production requirements of the Paia /Kuau area.

Both the DBCP and nitrate content of the Hamakuapoko well water is a substantial concern to Maui residents. The Council of the County of Maui has passed a resolution (advisory) and is considering an ordinance (mandatory) that would to prevent using the Hamakuapoko wells for potable use on the Central system.

The ultimate fate of the use of the Hamakuapoko wells is uncertain. The initial and preliminary characterization of the use of these wells is the DWS characterization that half of the capacity of the wells would serve upcountry drought reserve needs and half would serve Central system needs. This characterization is used not as any presumption regarding what should happen or is likely to happen regarding the disposition of the wells but simply as a means to conduct meaningful economic analysis. In the analysis of resource strategies several alternate characterizations are tested.

Option (Short Term): Hamakuapoko Wells Water Trading Agreement

One option that has been considered is using the Hamakuapoko wells to pump water to the EMI irrigation system in trade for water from the Wailoa ditch in trade for water from the Kamole water treatment plant. Two versions of this option were characterized by the DWS and presented at several public meetings. One version would have the wells pump water to an EMI reservoir at an elevation of 890 feet. The other version would have the wells pump the water to the EMI Hamakua ditch (downstream from the Wailoa ditch) at an elevation of 1110 feet. In either case the concept would be to use the wells only for non-potable uses and provide potable needs with treated surface water from the Kamole water treatment plant.

Several improvements would be necessary to allow water from the Kamole water treatment plant to serve the Paia /Kuau area. This option would require agreement with EMI.

There are several considerations and limitations regarding this option. One consideration is whether there would be concerns by the Department of Health regarding use of upcountry surface water system with the Central water system (which is also a surface water system for purposes of health regulations due to the operation of the Iao water treatment plant). Another consideration is the limitations of the capacity of the Kamole water treatment plant. The Kamole facility does not have excess capacity to serve the Central system during times of drought (high water demand and low Wailoa ditch flow) on the Upcountry system. This would limit the use of this option to times of ample Upcountry water supply.

Option (Short Term): Kamole Emergency Capacity Agreement

This option would use output from the Kamole water treatment plant to serve the DWS Central system. This is similar to the Hamakuapoko Well Water Trading Agreement option described immediately above except that it would be contingent upon specifically defined emergency circumstances on the DWS Central system such as the temporary loss of the use of one or more large well pumps.

Reserve source capacity is the principal driving need for the timing of new source additions for the Central system. Options that can provide reserve source capacity can reduce or defer the need to develop more expensive reserve capacity to provide reliable service in emergency conditions. Under normal conditions no water would be used from the Upcountry system. In times when emergency backup supply is necessary water would be used from the Kamole water treatment plant if it is available. Water used from the Wailoa ditch would be replaced by the DWS by pumping from the Hamakuapoko wells to the Hamakua ditch at a time when EMI needs the water for irrigation purposes.

In order to implement this option several improvements would be necessary to allow water from the Kamole water treatment plant to flow to the Central system. This option would require agreement with EMI.

Option (Short Term): Emergency Night-Only Landscape Irrigation Restriction

The reserve capacity needs of the DWS Central system are the driving factor in the timing of new source capacity. Options that can meet the reserve capacity criteria of the Central system can reduce or defer the need to develop more expensive reserve capacity to provide reliable service in emergency conditions.

The need for reserve capacity on the DWS Central system is determined by the requirement that the system should be able to meet its peak daily maximum source flow requirements using two thirds of its source production capability with the largest single production source out of service. One way to meet this requirement would be to reduce the peak daily maximum flow requirement. One way to do this would be to use water for irrigation at night instead of during the daytime when peak flow levels occur. Irrigation timers are available that would enable implementation of this approach.

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 Waihee aquifer would allow 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.

This option is characterized by the phased development of three wells. These are referred to in the information tables below as the Maluhia, Waiolai and Wailena wells respectively. The first phase (Maluhia) would require both water and electric power transmission improvements across Makamakaole gulch. The second phase (Waiolai) would also require substantial transmission improvements. The third phase would require transmission improvements as well as a 0.5 MG storage tank and a booster station.

This option is characterized as a project with transmission capability sized to accommodate the three 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.

This option is characterized as the development of five wells in three phases.

The first phase would include two wells and includes power and water transmission and a 0.5 MG storage tank. 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, Waiolai and Wailena wells from 24" to 30" pipe.

The second phase includes one well with associated power and water transmission.

The third phase includes two 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. See in particular the tables for the Kahakuloa #1, #2 and #3 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 it is presumed that wells would be located at approximately 1000 feet 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 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): Generic Perched Wells

Wells that pump from “perched” aquifers with heads substantially higher than sea level require less electrical power than pumping water from the basal water lens near sea level. Since the costs of pumping water over the life of a well are substantial, perched well sources are valuable. Perched aquifers are, however, difficult to find and can be limited in sustainable production capacity.

Although specific sites are not presently known for perched aquifers in the Central District area, several sites have been suggested for exploration. In order to determine the value of perched well resources they are included as a specific resource option for analysis for the DWS Central

District system.

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. Cost estimates for perched water resources are necessarily speculative since the locations are not known and hence the difficulty and costs of access and required water and power transmission improvements are difficult to estimate with certainty.

Option (Long Term): Existing High Level Production Tunnels

Two existing production tunnels produce a sum of approximately five to six MGD at an elevation of 1625 and 1650 feet on the Waihee River. The output of the tunnels currently flows into the river. The flow from the tunnels has apparently not been measured in many years. Access is difficult.

These tunnels present a very challenging (and possibly unfeasible) but potentially valuable resource. Since the water is considered a groundwater and not a surface source it would not require treatment (other than disinfection). Since the water is available at a high elevation it would not require pumping and could provide a substantial source of hydroelectric energy. The electrical energy generated from 5 MGD of water dropping from 1600 feet could be used directly by the DWS to power the pumps in the Waihee vicinity which pump water from basal aquifers to the Central Maui tank at about 500 foot elevation.

Despite the substantial challenges that development of this potential resource would present, it is included as a specific resource option for the DWS Central District. Two scenarios are characterized, one with and one without hydroelectric generation. Both would require installing a pipeline from the tunnels down to the existing DWS transmission network. The hydroelectric option would incorporate two or more pelton hydroelectric generation stations and associated electric power transmission. Although the costs to install the required pipelines and improvements would be substantial, so is the value of the groundwater and energy potentially provided.

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. Substantial budgets are allowed for the extensive capital improvements necessary under challenging conditions, including allowances for installation of transmission pipeline by helicopter access.

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 at page 7.

Well - Maluhia

New DWS Well at New Site
1400 GPM
w/Transmission from Kupaa
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	North Waihee
Aquifer	Waihee (North)

	Year			Derivation
Earliest Online Date		**2010**		
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		$3,070,625	$2,284,691	9482 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$744,048	
			$0	
		$150,000	$111,607	
Contingencies		$2,447,563	$1,821,103	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$7,342,688	$5,463,309	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,447,563	33.3%	Contingency
	-1	$1,000,000	13.6%	Development, Storage
	-2	$3,495,125	47.6%	Transmission, Drilling
	-3	$400,000	5.4%	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		**$7,614,358**	$5,665,445	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$24,531	$18,252	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		**$31,403**	$23,365	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M			$0.000	
Electrical Energy			$0.973	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.979**	

Well - Waiolai

New DWS Well at New Site
1400 GPM
w/Transmission from Maluhia Well
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	North Waihee
Aquifer	Waihee (North)

				Derivation
Earliest Online Date		**2011**		
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		$452,800	$336,905	$566 per foot per Kupaa
Transmission		$1,859,375	$1,383,464	5741 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$744,048	
			$0	
		$150,000	$111,607	
Contingencies		$1,856,088	$1,381,017	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$5,568,263	$4,143,052	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,856,088	33.3%	Contingency
	-1	$1,000,000	18.0%	Development, Storage
	-2	$2,312,175	41.5%	Transmission, Drilling
	-3	$400,000	7.2%	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			1.036	
		Total	Per MGD	
Total Capitalized Cost		**$5,770,019**	$4,293,169	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$26,166	$19,469	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		**$33,039**	$24,582	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.038	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.044**	

Well - Wailena

New DWS Well at New Site
1400 GPM
w/Transmission from Waiolai Well
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	North Waihee
Aquifer	Waihee (North)

Earliest Online Date		**2013**		**Derivation**
Capacity (MGD)				
Installed Capacity			**2.016**	1400 GPM
Criteria Capacity			**1.344**	2/3 Installed Capacity
Effective Sustainable Capacity			**0.512**	Balance of N.Waihee Aquifer S.Y.
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$250,000	$488,281	
Drilling		$452,800	$884,375	$566 per foot per Kupaa
Transmission		$1,753,125	$3,424,072	5413 feet at $340 per foot based on Kupaa Transmision costs
Development		$2,000,000	$3,906,250	Includes boost station
		$1,200,000	$2,343,750	Based on Kupaa Cost
		$150,000	$292,969	
Contingencies		$2,902,963	$5,669,849	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$8,708,888	$17,009,546	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,902,963	33.3%	Contingency
	-1	$3,200,000	36.7%	Development, Storage
	-2	$2,205,925	25.3%	Transmission, Drilling
	-3	$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			1.030	
		Total	Per MGD	
Total Capitalized Cost		**$8,968,443**	$17,516,489	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$6,873	$13,423	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		$26,166	$51,106	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		**$33,039**	$64,529	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.038	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.044**	

Wells - Kahakuloa #1

Two New DWS Wells at New Site
1400 GPM each
w/Transmission from Wailena Well
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Kahakuloa
Aquifer	Kahakuloa

				Derivation
Earliest Online Date		2014		
Capacity (MGD)				
Installed Capacity			4.032	1400 GPM
Criteria Capacity			2.688	2/3 Installed Capacity
Effective Sustainable Capacity			2.688	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$250,000	$93,006	
Drilling		$905,600	$336,905	$566 per foot per Kupaa
Transmission		$2,091,952	$778,256	5000 feet at $340 per foot based on Kupaa Transmision costs Incremental costs to upgrad Maluhia, Waiolai and Wailena Transmission from 24" to 30" @ 15% cost increase.
Development		$1,500,000	$558,036	
		$1,200,000	$446,429	
		$150,000	$55,804	
Contingencies		$3,048,776	$1,134,217	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$9,146,329	$3,402,652	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$3,048,776	31.1%	Contingency
	-1	$2,700,000	27.5%	Development, Storage
	-2	$2,997,552	30.5%	Transmission, Drilling
	-3	$400,000	4.1%	Exploration, Land, Engineering
	-4	$175,313	1.8%	Waiolai to Wailena incremental transmission costs
	-5	$185,938	1.9%	Maluhia to Waiolai incremental transmission costs
	-6	$307,062	3.1%	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			1.041	
		Total	Per MGD	
Total Capitalized Cost		**$9,518,661**	$3,541,169	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$13,745	$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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$52,332	$19,469	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		**$66,077**	$24,582	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.038	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.044**	

Wells - Kahakuloa #2

One New DWS Well at New Site
1400 GPM
w/Transmission from Kahakaloa #1 Wells
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Kahakuloa
Aquifer	Kahakuloa

				Derivation
Earliest Online Date		**2015**		
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		$452,800	$336,905	$566 per foot per Kupaa
Transmission		$1,020,000	$758,929	3000 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$744,048	
			$0	
		$150,000	$111,607	
Contingencies		$1,436,400	$1,068,750	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$4,309,200	$3,206,250	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,436,400	33.3%	Contingency
	-1	$1,000,000	23.2%	Development, Storage
	-2	$1,472,800	34.2%	Transmission, Drilling
	-3	$400,000	9.3%	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			1.035	
		Total	Per MGD	
Total Capitalized Cost		**$4,461,349**	$3,319,456	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$26,166	$19,469	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		**$33,039**	$24,582	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.038	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.044**	

Wells - Kahakuloa #3

Two New DWS Wells at New Site
1400 GPM each
w/Transmission from Kahakaloa #2 Wells
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	Kahakuloa
Aquifer	Kahakuloa

	Year			Derivation
Earliest Online Date		**2016**		
Capacity (MGD)				
Installed Capacity			**4.032**	1400 GPM
Criteria Capacity			**2.688**	2/3 Installed Capacity
Effective Sustainable Capacity			**2.688**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$250,000	$93,006	
Drilling		$905,600	$336,905	$566 per foot per Kupaa
Transmission		$1,700,000	$632,440	5000 feet at $340 per foot based on Kupaa Transmision costs
Development		$2,500,000	$930,060	Includes booster station
		$1,200,000	$446,429	
		$150,000	$55,804	
Contingencies		$3,352,800	$1,247,321	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$10,058,400	$3,741,964	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$3,352,800	33.3%	Contingency
	-1	$3,700,000	36.8%	Development, Storage
	-2	$2,605,600	25.9%	Transmission, Drilling
	-3	$400,000	4.0%	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			1.030	
		Total	Per MGD	
Total Capitalized Cost		**$10,356,139**	$3,852,730	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$13,745	$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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$52,332	$19,469	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		**$66,077**	$24,582	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		800		
Variable O&M			$0.000	
Electrical Energy			$1.038	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.044**	

Wellfield - Haiku Aquifer

(8) New DWS Wells In Haiku 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	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		$41,400,000	$3,850,446	70,000 ft. 30" line @ $576plf 4000 ft 12" line @ $270plf
Development		$8,000,000	$744,048	
		$2,400,000	$223,214	(1) 1MG Tank
		$400,000	$37,202	Includes EIS
Contingencies		$29,364,000	$2,731,027	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$88,092,000	$8,193,080	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$29,364,000	33.3%	Contingency
	-1	$10,400,000	11.8%	Development, Storage
	-2	$45,928,000	52.1%	Transmission, Drilling
	-3	$2,400,000	2.7%	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		**$91,325,169**	$8,493,784	
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		$261,661	$24,336	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		**$315,721**	$29,364	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1000		
Variable O&M			$0.000	
Electrical Energy			$1.298	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.303**	

Wellfield - Honopou Aquifer

(8) New DWS Wells In Honopou 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	Honopou
Aquifer	Honopou

	Year			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		$2,716,800	$252,679	$566 per foot per Kupaa
Transmission		$56,376,000	$5,243,304	70,000 ft. 30" line @ $576plf 26,000 ft. 30" line @ $576plf 4,000 ft 12" line @ $270plf
Development		$8,000,000	$744,048	
		$2,400,000	$223,214	(1) 1MG Tank
		$400,000	$37,202	Includes EIS
Contingencies		$35,946,400	$3,343,229	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$107,839,200	$10,029,688	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$35,946,400	33.3%	Contingency
	-1	$10,400,000	9.6%	Development, Storage
	-2	$59,092,800	54.8%	Transmission, Drilling
	-3	$2,400,000	2.2%	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			1.037	
		Total	Per MGD	
Total Capitalized Cost		**$111,850,418**	$10,402,755	
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		$156,996	$14,602	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		**$211,056**	$19,629	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		600		
Variable O&M			$0.000	
Electrical Energy			$0.779	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.784**	

Wellfield - Honopou Aquifer

(12) New DWS Wells In Honopou 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	Honopou
Aquifer	Honopou

	Year			Derivation
Earliest Online Date		**2014**		
Capacity (MGD)				
Installed Capacity			**24.192**	(8) wells @1400 GPM
Criteria Capacity			**16.128**	2/3 Installed Capacity
Effective Sustainable Capacity			**16.128**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$3,000,000	$186,012	
Drilling		$4,075,200	$252,679	$566 per foot per Kupaa
Transmission		$59,076,000	$3,662,946	70,000 ft. 30" line @ $576plf 26,000 ft. 30" line @ $576plf 6,000 ft 12" line @ $270plf 4000 ft. 24" line @ $540plf
Development		$12,000,000	$744,048	
		$2,400,000	$148,810	(1) 1MG Tank
		$450,000	$27,902	Includes EIS
Contingencies		$40,500,600	$2,511,198	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$121,501,800	$7,533,594	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$40,500,600	33.3%	Contingency
	-1	$14,400,000	11.9%	Development, Storage
	-2	$63,151,200	52.0%	Transmission, Drilling
	-3	$3,450,000	2.8%	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			1.037	
		Total	Per MGD	
Total Capitalized Cost		**$125,963,823**	$7,810,257	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$54,060	$3,352	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		$235,495	$14,602	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		**$289,555**	$17,954	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		600		
Variable O&M			$0.000	
Electrical Energy			$0.779	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.784**	

Well - Generic Perched Source

New DWS Well at New Site
1400 GPM
w/Transmission
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Perched Well
System	Central
Source	Perched Aquifer
Location	Generic
Aquifer	Generic

				Derivation
Earliest Online Date		**2010**		
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		$500,000	$372,024	
Drilling		$150,000	$111,607	$1000 per foot * 150 ft depth
Transmission		$1,700,000	$1,264,881	5000 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$744,048	
			$0	
		$150,000	$111,607	
Contingencies		$1,750,000	$1,302,083	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$5,250,000	$3,906,250	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$1,750,000	33.3%	Contingency
	-1	$1,000,000	19.0%	Development, Storage
	-2	$1,850,000	35.2%	Transmission, Drilling
	-3	$650,000	12.4%	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			1.038	
		Total	Per MGD	
Total Capitalized Cost		**$5,446,929**	$4,052,775	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
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		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$3,271	$2,434	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		**$10,143**	$7,547	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		100		
Variable O&M			$0.000	
Electrical Energy			$0.130	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.135**	

Production Tunnel Connection

Connection of Waihee Tunnels @ 1600 ft. elevation to DWS Central System

Derivation:
Prospective engineering and capital cost estimates by HDA

Type	Production Tunnel
System	Central
Source	Perched Aquifer
Location	Upper Waihee Stream
Aquifer	Waihee Surface

				Derivation
Earliest Online Date		**2011**		
Capacity (MGD)				
Installed Capacity			**5.900**	1400 GPM
Criteria Capacity			**3.933**	2/3 Installed Capacity
Effective Sustainable Capacity			**3.933**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$500,000	$127,119	
Site Improvements, Forebay		$1,000,000	$254,237	
Transmission		$20,800,000	$5,288,136	26,000 ft @ $800 per ft. 10", 12" and 16" line (w contingency = $1200 per ft.) Crew of six for one week @ $60/hr.+concrete&steel @ $2000+Helicopter@12hr.@$500/hr.+$6000pipe and fitting for 40 lineal feet => $710
Development		$2,500,000	$635,593	Includes UV disinvection
			$0	
		$500,000	$127,119	
Contingencies		$12,650,000	$3,216,102	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$37,950,000	$9,648,305	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$12,650,000	33.3%	Contingency
	-1	$2,500,000	6.6%	Development, Storage
	-2	$21,800,000	57.4%	Transmission, Site Improvements
	-3	$1,000,000	2.6%	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			1.038	
		Total	Per MGD	
Total Capitalized Cost		**$39,401,161**	$10,017,244	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$20,418	$5,191	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*3.993MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$0	$0	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		**$20,418**	$5,191	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.120	
Electrical Energy			$0.000	
Chemicals/Materials			$0.006	UV Disinfection cost per Iao Tunnel
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.126**	

Prod. Tunnel Connect. w Pelton Hydro

Connection of Waihee Tunnels @ 1600 ft. elevation to DWS Central System
Includes inline hydroelectric generation
Derivation:
Prospective engineering and capital cost estimates by HDA

Type	Production Tunnel
System	Central
Source	Perched Aquifer
Location	Upper Waihee Stream
Aquifer	Waihee Surface

				Derivation
Earliest Online Date		**2011**		
Capacity (MGD)				
Installed Capacity			**5.900**	1400 GPM
Criteria Capacity			**3.933**	2/3 Installed Capacity
Effective Sustainable Capacity			**5.310**	90% Capacity Factor
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$500,000	$94,162	
Site Improvements, Forebay		$1,000,000	$188,324	
Transmission		$20,800,000	$3,917,137	26,000 ft @ $800 per ft. 10", 12" and 16" line (w contingency = $1: per ft.) Crew of six for one week @ $60/hr.+concrete&steel @ $2000+Helicopter@12hr.@$500/hr.+$6000pipe and fitting for 40 lineal feet => $710
Development		$2,500,000	$470,810	Includes UV disinvection
		$5,000,000	$941,620	1.5MW@$2000/kW TPC + $2M transmission
		$500,000	$94,162	
Contingencies		$15,150,000	$2,853,107	50% Contingency based on DWS Engineering estimates that cost: would be much higher than $2002 basis
Total Plant Cost		$45,450,000	$8,559,322	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$15,150,000	33.3%	Contingency
	-1	$7,500,000	16.5%	Development, Inline Hydro, Power Transmission
	-2	$21,800,000	48.0%	Transmission, Site Improvements
	-3	$1,000,000	2.2%	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			1.035	
		Total	Per MGD	
Total Capitalized Cost		**$47,046,792**	$8,860,036	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$20,418	$3,845	Fixed labor derived from FY03 Central district costs from R.W.Bec Rate Study district cost analysis, apportioned by project volume.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		-$48,675	-$9,167	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		**-$28,257**	-$5,321	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.120	
Electrical Energy			-$0.660	5.9MGD@1400ft eff. head =>1.18MW @60% generation efficiency => 0.71MW
Chemicals/Materials			$0.006	UV Disinfection cost per Iao Tunnel
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**-$0.534**	

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
			$0	
			$0	
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		$92,858	$21,849	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		**$497,231**	$116,996	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1145		Desal Plant Equiv. Electrical Efficiency Factor
Raw Water Cost			$0.000	
Electrical Energy			$1.486	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.139	B&C 2006 estimate de-escalated to $2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.624**	

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 (spli
Concentrate Disposal Facilities		$1,696,673	$399,217	B&C 2006 estimate de-escalated to $2004
			$0	
			$0	
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		$92,858	$21,849	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		**$497,231**	$116,996	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		1145		Desal Plant Equiv. Electrical Efficiency Factor
Raw Water Cost			$0.000	
Electrical Energy			$1.486	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.139	B&C 2006 estimate de-escalated to $2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.624**	

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
			$0	
			$0	
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		$303,876	$71,500	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		**$1,340,731**	$315,466	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		3746		Desal Plant Equiv. Electrical Efficiency Factor
Raw Water Cost			$0.000	
Electrical Energy			$4.862	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.287	B&C 2006 estimate de-escalated to $2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$5.149**	

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 80% 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 3 MGD (nominal) filters. The facility would have an installed capacity of 9 MGD and an expected average capacity of 6 MGD.

No contractual agreements between A&B and the DWS have been finalized but several cost and water sharing arrangements have been discussed. One possible arrangement, posed here as a hypothetical example, could have A&B financing the construction of the facility and ultimately paying for two thirds of the capital costs with the DWS paying for one third. The operation of the facility would be turned over to the DWS upon completion of the facility. A&B would recoup its investment by holding source credits towards the DWS source development fees equal to one half of the average capacity of the treatment plant (3 MGD).

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 $0.12 per thousand gallons of raw water to $0.60 per thousand gallons.

This resource option is characterized in the analysis of candidate strategies in several ways including several possible cost and water sharing arrangements between A&B and the DWS and including several possible raw water costs for the source water from A&B and the WWC.

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.

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 Steam 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.

A preliminary (and rudimentary) mass flow analysis of the water storage requirements and resulting reliable average yield for this option determined that the Waiale reservoir would not provide sufficient storage capacity to provide sufficient average yield to justify the cost of a water treatment facility. The resource value of this potential option would, however, be captured to a significant degree and could be incorporated into the diversion facility design of the Waiale treatment plant option described above.

Option (Long Term): Interconnection with Upcountry Kamole Water Treatment Plant

One resource option suggested for consideration at a DWS WUDP Water Advisory Committee meeting was use of water from the Wailoa Ditch for treatment and distribution to the Central water system. This option would require expansion of the Kamole water treatment plant (which now exclusively serves the DWS Upcountry water systems) and increased withdrawal of water from the Wailoa Ditch.

Withdrawals from the Wailoa Ditch are currently limited by written agreement with A&B in terms of allowable diversion volumes that are dependent upon the ditch flow volume. Withdrawals are also limited to use for the Upcountry systems. The allowed volume of water for withdrawal from the Wailoa Ditch is also a limiting parameter for the amount of water that can be supplied by the Kamole treatment facility for the long term source needs of the DWS Upcountry System.

Notwithstanding the incumbent contractual limitations, the economics of this resource option were examined in terms of the costs to expand the Kamole water treatment plant and the limited value of the option to provide reliable reserve capacity to the Central system in drought conditions when ditch flows would be limited.

Costs to increase the capacity of the Kamole facility by 6 MGD were estimated by DWS staff at 15 to 20 million dollars. The contribution to Central system reserve capacity would be nil due the possibility of extended drought conditions that would limit the facility to capacity necessary for the DWS Upcountry system. The option would provide economical water production during conditions of ample ditch flow but would not provide reliable capacity that could defer or displace other source development investments for the Central system. As shown in the integration analyses of this option described later in this chapter this resource option would be more substantially more expensive than other available 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 at page 7.

Waiale WTP @12cpkal

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			**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	
Project Cost		$19,700,255	$3,283,376	$20.9M $2006 de-escalated to $2004
0			$0	
0			$0	
0			$0	
			$0	
			$0	
Contingencies		$3,940,051	$656,675	20% Contingency
Total Plant Cost (		$23,640,305	$3,940,051	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$3,940,051	16.7%	Contingency
	-1	$0	0.0%	
	-2	$19,700,255	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		**$24,804,605**	$4,134,101	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$569,400	$94,900	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$51,750	$8,625	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$621,150**	$103,525	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.120	
Electrical Energy			$0.460	
Chemicals/Materials			$0.000	
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.580**	

Waihee WTP @60cpkal

Surface Water Treatment Plant at Waihee Site
Construction by WWC

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Waihee
Aquifer	Waihee Surface

Earliest Online Date		**2015**		**Derivation**
Capacity (MGD)				
Installed Capacity			**6.000**	Three 2MGD parallel units
Criteria Capacity			**4.000**	One unit out of service
Effective Sustainable Capacity			**4.000**	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$13,790,178	$3,447,545	$14.63M $2006 de-escalated to $2004
0			$0	
0			$0	
0			$0	
			$0	
			$0	
Contingencies		$2,758,036	$689,509	20% Contingency
Total Plant Cost (		$16,548,214	$4,137,053	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,758,036	16.7%	Contingency
	-1	$0	0.0%	
	-2	$13,790,178	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		**$17,363,224**	$4,340,806	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$379,596	$94,899	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$34,500	$8,625	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$414,096**	$103,524	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.600	
Electrical Energy			$0.460	
Chemicals/Materials			$0.000	
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.060**	

Waihee WTP @12cpkal

Surface Water Treatment Plant at Waihee Site
Construction by WWC

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Waihee
Aquifer	Waihee Surface

Earliest Online Date		**2015**		**Derivation**
Capacity (MGD)				
Installed Capacity			**6.000**	Three 2MGD parallel units
Criteria Capacity			**4.000**	One unit out of service
Effective Sustainable Capacity			**4.000**	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$13,790,178	$3,447,545	$14.63M $2006 de-escalated to $2004
0			$0	
0			$0	
0			$0	
			$0	
			$0	
Contingencies		$2,758,036	$689,509	20% Contingency
Total Plant Cost (		$16,548,214	$4,137,053	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,758,036	16.7%	Contingency
	-1	$0	0.0%	
	-2	$13,790,178	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		**$17,363,224**	$4,340,806	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$379,596	$94,899	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$34,500	$8,625	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$414,096**	$103,524	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.120	
Electrical Energy			$0.460	
Chemicals/Materials			$0.000	
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.580**	

Waihee WTP @60cpkal

Surface Water Treatment Plant at Waihee Site
Construction by WWC

Derivation:
Per DWS

Type	Surface Water Treatment
System	Central
Source	Surface Water
Location	Waihee
Aquifer	Waihee Surface

				Derivation
Earliest Online Date		**2015**		
Capacity (MGD)				
Installed Capacity			**6.000**	Three 2MGD parallel units
Criteria Capacity			**4.000**	One unit out of service
Effective Sustainable Capacity			**4.000**	2/3 Installed Capacity
Capital Costs ($2002)		Total	Per MGD	
Project Cost		$13,790,178	$3,447,545	$14.63M $2006 de-escalated to $2004
0			$0	
0			$0	
0			$0	
			$0	
			$0	
Contingencies		$2,758,036	$689,509	20% Contingency
Total Plant Cost (		$16,548,214	$4,137,053	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,758,036	16.7%	Contingency
	-1	$0	0.0%	
	-2	$13,790,178	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		**$17,363,224**	$4,340,806	
Fixed Operating Costs ($2002)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$379,596	$94,899	
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$34,500	$8,625	
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$414,096**	$103,524	
Variable Operating Costs ($2002)			Per KGal	
Vertical Lift		0		
Raw Water Cost			$0.600	
Electrical Energy			$0.460	
Chemicals/Materials			$0.000	
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$1.060**	

General Resource Options

General resource options are those that can be implemented with most combinations of the other resource options. These include resource options that may be implemented along with most or all of the long term resource options. General resource options can address specific planning objectives.

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 very 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 shift their time of use. DSM programs often use monetary rebates to encourage purchase of efficient appliances. DSM programs are evaluated based a comparison of the costs of water savings with the costs the utility and its customers would have to incur to develop and operate new supply resources to supply an equivalent amount of water.

For purposes of analysis for the Central District system, a candidate DSM program portfolio was characterized based on the list and characterization of possible DSM measures presented in the Resource Options Chapter. The design and characterization of the candidate DSM portfolio preliminary and formulated for the purposes of the economic analysis of the candidate strategies. A more detailed portfolio of programs can be targeted, sized and optimized as part of the analyses of the final candidate strategies.

The candidate DSM portfolio includes a toilet retrofit rebate program, a commercial urinal retrofit program, an irrigation efficiency program and a xeriscaping program. Staffing for the portfolio of programs includes a program manager and three 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 born 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.

Supply Side Leak Reduction

The DWS examines its system for leaks in transmission and distribution pipes. Contractors are available to provide services to the DWS to conduct leak detection surveys using several techniques. Specific measures were not examined in this part of the analysis of candidate strategies. As the characteristics of specific measures, including expected costs and results are identified, economic analysis can be performed using the approach used in the analysis of the candidate resource strategies.

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 Public Works (DPW) is a purveyor of reclaimed "recycled" nonpotable water in the Central District areas. The DPW 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 DPW recycled water for non-potable uses if the property is adjacent to DPW R-1 distribution lines.

Some DPW 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 DPW 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.

The characterization and analysis of the costs and impacts on DWS potable water displacement for two specific DPW projects is described in a later section below at page 53.

Energy Production and 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 energy efficiency measures will be considered in the analysis of the Final Candidate Strategies Chapter.

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 is analyzed in this chapter. Other options, including wind generation, will be considered in the analysis of the Final Candidate Strategies Chapter.

Energy production and energy efficiency measures serve several of the WUDP planning objectives including: Cost, Efficiency, Environment, and Sustainability.

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 of Maui has allocated $7,000,000 in its 2007 fiscal year budget to purchase stream diversion structures with an objective of stream restoration for the Na Wa Eha streams.

Stream restoration measures affect several WUDP planning objectives including: Availability, Cost, Environment, Equity, Sustainability, Streams, Resources, Agriculture and Culture.

Watershed Protection and Restoration Measures

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 are discussed in detail in a separate chapter of the WUDP.

These measures serve several WUDP planning objectives including: Environment, Sustainability, Quality, Streams, 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.

These measures would serve several WUDP planning objectives including: Cost, Efficiency, Environment, Quality, and Resources.

Wellhead Protection Ordinance

A wellhead protection ordinance was presented to the WAC and is described in detail in a separate chapter of the WUDP.

A wellhead protection ordinance would serve several WUDP planning objectives including: Environment, Sustainability, Quality, and Resources.

Landscape Ordinance

A landscape ordinance has been drafted for consideration by the County of Maui. This ordinance is described in a separate chapter of the WUDP. The proposed ordinance would reduce future water needs by limiting landscape irrigation uses to reasonable alternatives. The impacts of the proposed landscape ordinance will be quantified in the consideration of the final candidate strategies.

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 use volume. Another way to implement drought water restrictions would be to limit the types of uses for which water could be used during drought conditions.

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 water. 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.

Several adjustments are being considered for DWS rate design that could increase or decrease the extent to which pricing policies could encourage efficient water use.

IV. Integrated Analysis of Candidate Strategies

Using an integration model the specific resource options and candidate strategies were analyzed in several steps:

- **Determination of a Reference Strategy**: A base case combination and 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 were analyzed individually in the total system context of the expansion and 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.

Each of these steps is described in more detail below:

Description of the Integration Model

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 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 system production costs
- 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

Description of the Summary Output Chart and Table Format

The results of the integration model analyses of individual specific resource options and candidate strategies are presented in a series of charts and tables. Each chart and table presents the results of four strategies (cases) for purposes of comparison. For all of the analyses of the individual specific resource strategies the first case in each chart is the same reference strategy.

The charts and tables are presented in two formats. The first format shows the total costs of each case for each cost category (variable costs, fixed costs, capital costs, DSM costs and total costs).

The second format shows the differences in costs for each case compared to the reference case. Since the total costs of the strategies are large in comparison to the differences between the costs of each strategy, it is useful to examine the differences between the strategies. The bar charts in this format show the costs for each cost category and total costs compared to the reference strategy. A bar going upward indicates costs more than the reference strategy. A bar going downward indicates costs less than the reference strategy. In this format the reference case shows zero cost differences since it is the basis for comparison.

In both formats the reference case is always in the first (leftmost) column.

For each chart a table is provided that shows the numerical values portrayed in the chart as well as several additional analysis assumptions and results.

In the summary charts and tables the costs for each component and the total costs are portrayed as “net present values” discounted to year 2006 dollars.

All costs in the charts and tables are total DWS Central District system planning period costs including existing resource and administration costs as well as the costs of all resource additions throughout the planning period.

The rate impacts of each strategy are shown in terms of average annual percentage rate increases and in terms of “levelized” planning period rates expressed in year 2006 dollars.

Determination of a Reference Strategy

A reference strategy was determined in order to serve as a basis for comparison for the analyses of individual resource options. The reference strategy selected was a series of basal wells extending north from the existing DWS Central District system to the north side of the Waihee groundwater aquifer and the Kahakuloa groundwater aquifer. This strategy was selected for several reasons.

- Development of wells in the north half of the Waihee aquifer is part of the existing DWS long range Capital Improvement Plan.
- The wells would be developed in a series of sequential phases that could be accelerated or deferred based on resource needs. This provides a good reference basis for economic analysis compared to options that are installed in large blocks of capacity.

Integrated Analysis of Individual Resource Options

Each of the principle resource options that substantially affects the demand or supply or production economics of the DWS Central District system was analyzed individually in the integrated context of the operation of the water system. In these analyses each resource option was added to the series of resources included in the reference strategy. The costs and characteristics of the operation of the DWS system both with and without the inclusion of each resource was compared to evaluate the merits of the individual resource options. The total system costs and characteristics of the reference case and resource option cases are portrayed in both tabular and graphic formats.

Note that the costs portrayed in this section are total system costs including the variable, fixed and capital costs of both the existing system and the resource additions over the twenty-five year planning period. The specific costs of the individual resource options are identified in the tables in the previous section of this chapter on the Characterization of Specific Resource Options. The costs portrayed in this section take into consideration the impacts of each resource addition in the context of other resources on the system.

Demand Side Management (Conservation) Options

Three DSM program portfolio options are compared with the reference strategy. These include a basic portfolio of DSM programs (DSM A), a portfolio designed to attain two times the program participation and impacts of the basic portfolio (DSM A x2) and a sensitivity scenario that is the basic portfolio of programs assuming a higher level of administrative costs. The DSM portfolios are described in more detail below.

DSM A

This candidate DSM portfolio includes a toilet retrofit rebate program, a commercial urinal retrofit program, an irrigation efficiency program and a xeriscaping program. Staffing for the portfolio of programs includes a program manager and three 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 born 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. The specific attributes of the measure impacts included in the programs are portrayed in the Resource Options Chapter.

DSM A (x2)

This DSM portfolio includes the same programs as the DSM A portfolio but includes a more aggressive budget designed to attain twice the program participation and impacts. The annual budget includes $535,000 of rebates, $340,000 incremental administration costs and $300,000 participant costs. Impacts are estimated to reduce metered consumption by 176,000 gallons per day per year of program implementation.

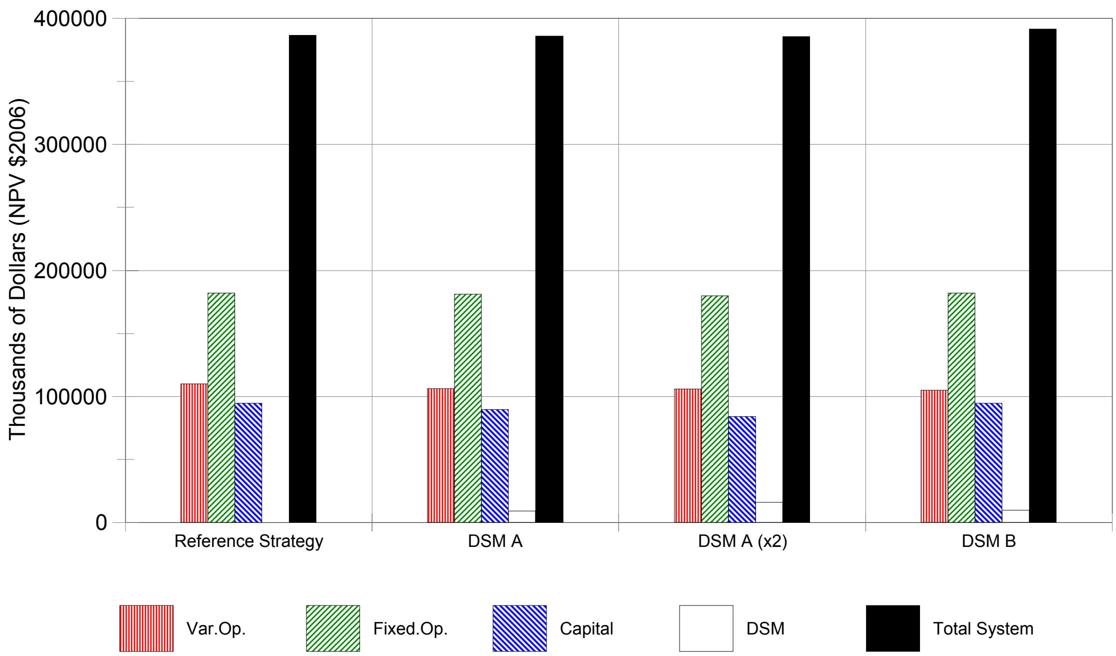
<u>DSM B</u>

This portfolio is identical to the DSM A portfolio except that the annual administrative costs are assumed to be $40,000 higher.

Each of the three DSM cases is evaluated in the context of the reference strategy. Each of the DSM portfolios is added as a resource along with the list of resources in the reference strategy. The timing of resource additions and the amount of water production is adjusted based on the impacts of the DSM portfolio. The impacts and costs of each strategy are portrayed and compared to the reference strategy.

Compared to the reference case the “DSM A” and “DSM A x2" portfolios are cost effective (i.e. they result in lower total system costs.) This is most easily seen on the chart and table showing the differences between each case and the reference case costs. Note, however, that the cost effectiveness of the programs is sensitive to administrative costs as demonstrated by the higher costs of the “DSM B” portfolio. As determined in later analyses, the DSM portfolios are sometimes more and sometimes less cost effective when applied to different candidate strategies than the reference strategy.

Total Planning Period System Costs

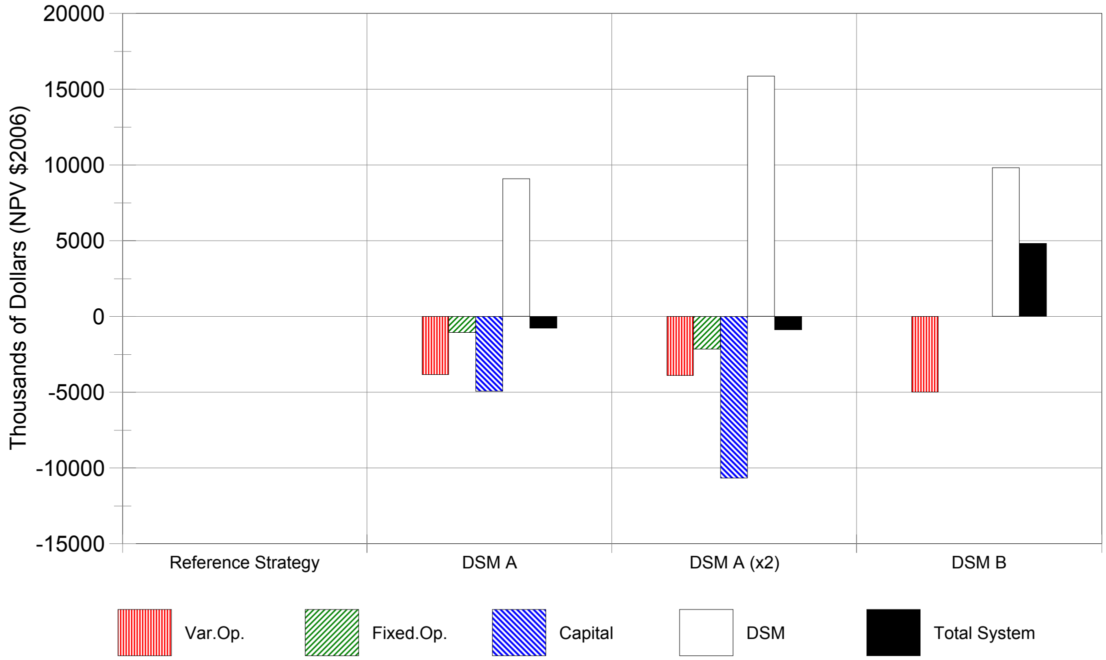


Comparison of Reference Strategy with Alt. DSM Portfolios
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**DSM A**	**DSM A (x2)**	**DSM B**
Description	N.Waihee,Kahak123,Waiale	Ref Strat with DSM Portfolio 15 Yr. Measure Life	Ref Strat with DSM Portfolio 15 Yr. Measure Life	Ref with DSM Portfolio Test Higher Admin Cost
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online prior to availab	All adds > avail date	All adds > avail date	All adds > avail date
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	12.951	12.251	12.951
Cap.Shortfall 2007-30 MGD-Yr	6.711	5.706	5.006	5.706
Cap.Shortfall 2008-30 MGD-Yr	3.431	2.558	1.990	2.558
Strategy Cost Summary	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	109,882	106,025	105,990	104,889
Fixed Operation Cost NPV	182,160	181,089	179,976	182,160
Capital Cost NPV	94,592	89,635	83,903	94,592
DSM Utility Cost	0	9,087	15,870	9,812
Total System Cost NPV	386,633	385,837	385,739	391,452
Variable Operation Cost NPV	0.000%	-3.510%	-3.542%	-4.544%
Fixed Operation Cost NPV	0.000%	-0.588%	-1.199%	0.000%
Capital Cost NPV	0.000%	-5.240%	-11.300%	0.000%
Total System Cost NPV	0.000%	-0.206%	-0.231%	1.246%
Avg. Annual DWS Rate Increas	3.70%	3.80%	4.15%	3.77%
Levelized Unit Cost ($/kgal)	$2.956	$2.948	$2.964	$2.986

Resource Addition Sequence:	Reference Strategy		DSM A		DSM A (x2)		DSM B	
	Existing Marginal	2006	DSM Portfolio A	2007	DSM Portfolio A X2	2007	Existing Marginal	2006
	Hamakuapoko Wells	2007	Existing Marginal	2006	Existing Marginal	2006	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Kupaa Well	2007	Kupaa Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Maui Lani Wells	2008	Maui Lani Wells	2008	Waikapu South 1&2	2009
	Maluhia Well	2010	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Maluhia Well	2010
	Waiolai Well	2011	Maluhia Well	2010	Maluhia Well	2010	Waiolai Well	2011
	Wailena Well	2012	Waiolai Well	2011	Waiolai Well	2012	Wailena Well	2012
	Kahakuloa Ph1	2013	Wailena Well	2013	Wailena Well	2015	Kahakuloa Ph1	2013
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2014	Kahakuloa Ph1	2016	Kahakuloa Ph2	2016
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2018	Kahakuloa Ph2	2020	Kahakuloa Ph3	2018
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2020	Kahakuloa Ph3	2022	Waiale T.P.w12cpkg	2022
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2024	Waiale T.P.w12cpkg	2026	Supplemental Wells	2029
					Supplemental Wells	9999		

Total Planning Period System Costs
Difference From Reference Strategy

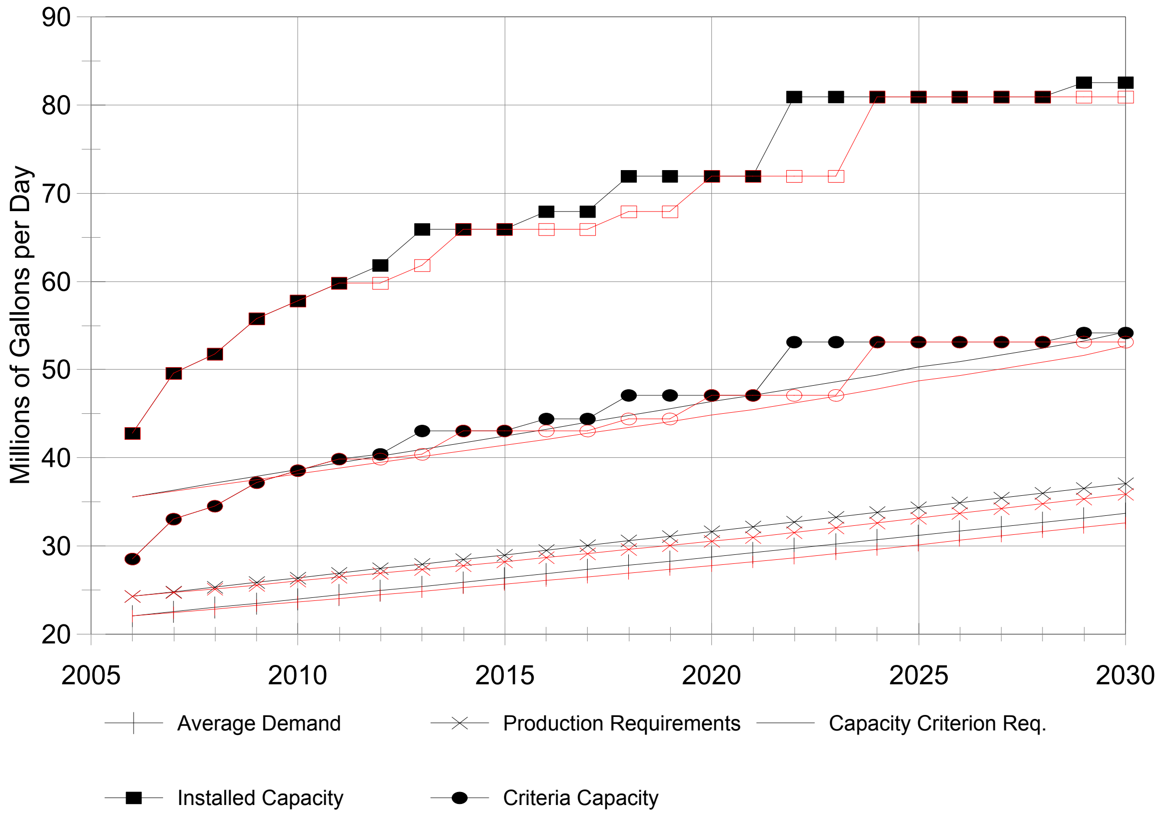


Comparison of Reference Strategy with Alt. DSM Portfolios
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**DSM A**	**DSM A (x2)**	**DSM B**
Description	N.Waihee,Kahak123,Waiale'	Ref Strat with DSM Portfolio 15 Yr. Measure Life	Ref Strat with DSM Portfolio 15 Yr. Measure Life	Ref with DSM Portfolio Test Higher Admin Cost
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online prior to availab	All adds > avail date	All adds > avail date	All adds > avail date
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	12.951	12.251	12.951
Cap.Shortfall 2007-30 MGD-Yr	6.711	5.706	5.006	5.706
Cap.Shortfall 2008-30 MGD-Yr	3.431	2.558	1.990	2.558
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-3,856	-3,892	-4,993
Fixed Operation Cost NPV	0	-1,070	-2,184	0
Capital Cost NPV	0	-4,957	-10,689	0
DSM Utility Cost	0	9,087	15,870	9,812
Total System Cost NPV	0	-797	-894	4,819
Variable Operation Cost NPV	0.000%	-3.510%	-3.542%	-4.544%
Fixed Operation Cost NPV	0.000%	-0.588%	-1.199%	0.000%
Capital Cost NPV	0.000%	-5.240%	-11.300%	0.000%
Total System Cost NPV	0.000%	-0.206%	-0.231%	1.246%
Avg. Annual DWS Rate Increas	3.70%	3.80%	4.15%	3.77%
Levelized Unit Cost ($/kgal)	$2.956	$2.948	$2.964	$2.986

Resource Addition Sequence:	Existing Marginal	2006	DSM Portfolio A	2007	DSM Portfolio A X2	2007	Existing Marginal	2006
	Hamakuapoko Wells	2007	Existing Marginal	2006	Existing Marginal	2006	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Kupaa Well	2007	Kupaa Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Maui Lani Wells	2008	Maui Lani Wells	2008	Waikapu South 1&2	2009
	Maluhia Well	2010	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Maluhia Well	2010
	Waiolai Well	2011	Maluhia Well	2010	Maluhia Well	2010	Waiolai Well	2011
	Wailena Well	2012	Waiolai Well	2011	Waiolai Well	2012	Wailena Well	2012
	Kahakuloa Ph1	2013	Wailena Well	2013	Wailena Well	2015	Kahakuloa Ph1	2013
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2014	Kahakuloa Ph1	2016	Kahakuloa Ph2	2016
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2018	Kahakuloa Ph2	2020	Kahakuloa Ph3	2018
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2020	Kahakuloa Ph3	2022	Waiale T.P.w12cpkg	2022
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2024	Waiale T.P.w12cpkg	2026	Supplemental Wells	2029
					Supplemental Wells	9999		

DWS System Requirements and Capacity



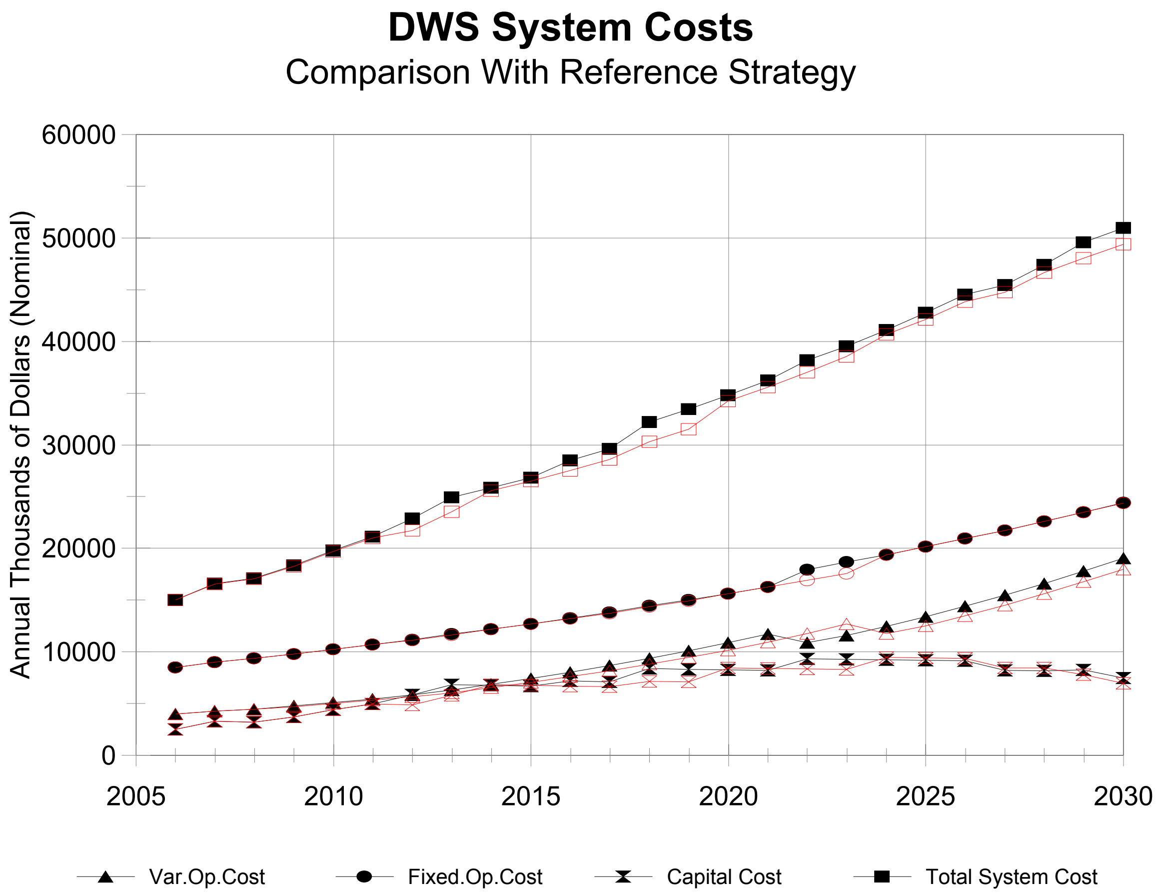
Comparison of Reference Strategy with Alt. DSM Portfolios

Reference Strategy: N. Waihee, Kahakuloa Wells

Solid Markers:	**Reference Strategy**	**N.Waihee,Kahak123,Waiale12**
Hollow Markers:	**DSM A**	**Ref Strat with DSM Portfolio**

The table above shows the annual changes in resource addition timing of the reference strategy that results from the implementation of the DSM A program portfolio. The solid markers show the installed capacity and criteria capacity for the reference strategy. The hollow markers show the capacities for the DSM A case. The DSM programs lower the average demand and production requirements for the system as well as the system reserve capacity criteria. The dates that new resources are needed to meet the system reserve capacity criteria are deferred. This results in savings in system capital costs and some fixed costs for the twenty-five year planning period. The annual cost streams are shown on the table on the following page.

Variable costs are lowered due to the reduced amounts of water that need to be produced.



Comparison of Reference Strategy with Alt. DSM Portfolios

Reference Strategy: N. Waihee, Kahakuloa Wells

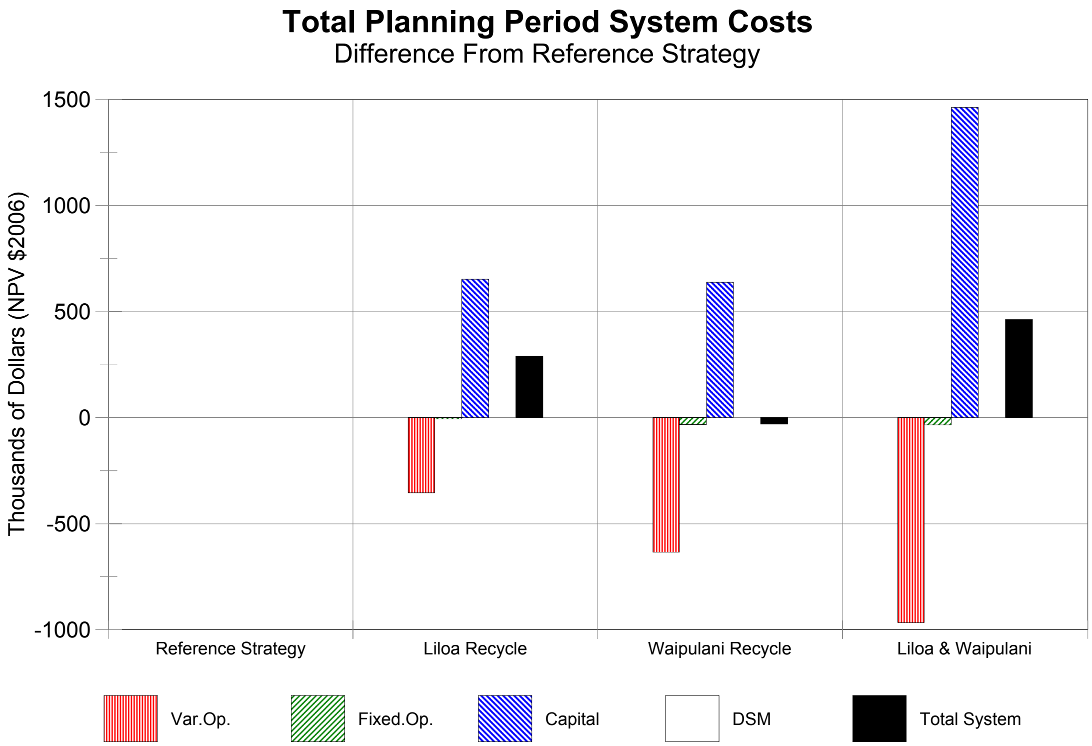
Solid Markers:	**Reference Strategy**	**N.Waihee,Kahak123,Waiale12**
Hollow Markers:	**DSM A**	**Ref Strat with DSM Portfolio**

Water Recycling Options

Two specific DPW projects were used to characterize the economics of extending recycled water distribution lines to provide displacement of DWS potable water production requirements. The costs and estimated potable water displacement impacts for the Liloa Street and Waipulani Street projects were provided by the DPW. These projects were analyzed individually and in combination making three cases that are compared to the reference strategy.

As shown in the following tables, as applied to the reference strategy, the Liloa project has capital costs that exceed the reductions in DWS water production costs (variable costs). For the Waipulani project, however, the reverse is true. In combination the capital costs exceed DWS production cost savings.

Although the combination of water recycling projects is not cost effective in this analysis it does prove to be cost effective in combination with the DSM program portfolios and other resources in some of the candidate strategies.



Comparison of Reference Strategy with Water Recycling Options

Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Liloa Recycle**	**Waipulani Recycle**	**Liloa & Waipulani**
Description	N.Waihee,Kahak123,Waiale'	R-1 Waterline Liloa St., Kihei	R-1 Waterline Waipulani St., Kihei	R-1 Waterline Both Projects
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date	2 wells online < avail date	2 wells online < avail date	2 wells online < avail date
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	13.687	13.515	13.374
Cap.Shortfall 2007-30 MGD-Yr	6.711	6.442	6.270	6.129
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.163	2.991	2.849
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-356	-634	-967
Fixed Operation Cost NPV	0	-7	-34	-34
Capital Cost NPV	0	652	637	1,463
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	289	-31	462
Variable Operation Cost NPV	0.000%	-0.324%	-0.577%	-0.880%
Fixed Operation Cost NPV	0.000%	-0.004%	-0.018%	-0.019%
Capital Cost NPV	0.000%	0.689%	0.674%	1.547%
Total System Cost NPV	0.000%	0.075%	-0.008%	0.120%
Avg. Annual DWS Rate Increase	3.70%	3.70%	3.70%	3.70%
Levelized Unit Cost ($/kgal)	$2.956	$2.958	$2.955	$2.959

Resource Addition Sequence:	Reference Strategy	Year	Liloa Recycle	Year	Waipulani Recycle	Year	Liloa & Waipulani	Year
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Recycle Liloa Dr.	2008	Recyle Waipulani St.	2008	Recycle Both	2008
	Maluhia Well	2010	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Waiolai Well	2011	Maluhia Well	2010	Maluhia Well	2010	Maluhia Well	2010
	Wailena Well	2012	Waiolai Well	2011	Waiolai Well	2011	Waiolai Well	2011
	Kahakuloa Ph1	2013	Wailena Well	2012	Wailena Well	2012	Wailena Well	2012
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2013	Kahakuloa Ph1	2013	Kahakuloa Ph1	2013
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2016	Kahakuloa Ph2	2017	Kahakuloa Ph2	2017
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2018	Kahakuloa Ph3	2018	Kahakuloa Ph3	2018
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2022	Waiale T.P.w12cpkg	2022	Waiale T.P.w12cpkg	2022
			Supplemental Wells	2030	Supplemental Wells	2030	Supplemental Wells	2030

Night Only Landscape Irrigation Water Restrictions

The amount and timing of new water supply resources for the DWS Central District system is determined by criteria for capacity reserves. In order to ensure reliable water supply the DWS must maintain sufficient installed capacity for the Central system to supply the maximum expected rate of water demand even if some of its supply resources are not in service. The capacity reserve standard requires that the DWS can meet its peak day demand (1.5 times average daily flow) with two thirds of its installed capacity with its largest single source out of service.

One approach to providing equivalent reliable capacity for the Central system would be to shift some of the water use from peak demand periods to off-peak periods. This approach is used extensively by electric utilities to reduce system and customer costs. For the DWS Central District one possible option would be to restrict landscape irrigation use to night time only. This would lower the peak day demand by shifting this component of water use to an off-peak period.

Restricting landscape irrigation to night use only would require installation of timers and/or sensors to automatic landscape irrigation systems. This option could be implemented without restricting daytime landscape irrigation by hand held hoses and would only apply to installed irrigation systems. Essentially this restriction would require that any installed landscape irrigation system would have to be controlled (manually or by timer) to operate only during certain off-peak hours.

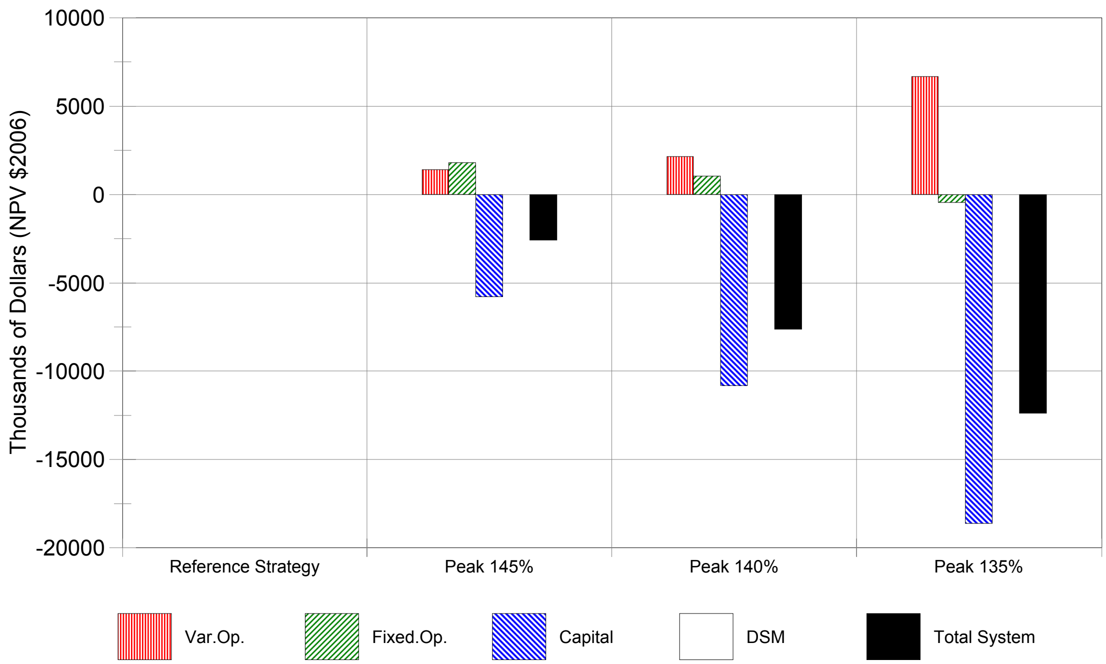
To evaluate the economics of this option the following program was assumed. Alternate provisions may be preferable.

- On-peak landscape irrigation using installed systems would be prohibited by ordinance.
- The assumed costs of the program would include funds for the DWS to supply irrigation system timers and/or light activated sensors to customers free of charge for an initial period of one year after initiation of the restrictions.
- Program costs would include funds for two inspectors to enforce the restrictions.
- The assumed impacts of the program were analyzed for three scenarios reducing Central District peak demand factors from 150% by 5%, 10% and 15% respectively.

The results of this analysis are shown in the following chart and table. All of the scenarios (5%, 10% and 15% peak factor reductions) are very cost effective due to substantial capital cost savings resulting from deferral of new supply resource timing. This option also reduces the near term capacity reserve shortfalls substantially. Note that the implementation of the restrictions increases the system planning period variable costs for each of the scenarios. This is due to deferral of new supply resources that results in the need to increase use of higher cost production sources in some years of the planning period.

The analyses of this option do not consider reductions in landscape irrigation water volume that are likely to occur as a result of the increased efficiency and reductions in evaporation from night time irrigation and from irrigation control and management generally. This restriction would reduce unregulated and careless water irrigation practices.

Total Planning Period System Costs
Difference From Reference Strategy



Comparison of Reference Strategy with Night Only Landscape Irr. Restrictions
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Peak 145%**	**Peak 140%**	**Peak 135%**
Description	N.Waihee,Kahak123,Waiale	Night Only Landscape Irr.	Night Only Landscape Irr.	Night Only Landscape Irr.
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date	Cost include enforcement Timer cost to DWS	Cost include enforcement Timer cost to DWS	Cost include enforcement Timer cost to DWS
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	9.681	6.261	3.868
Cap.Shortfall 2007-30 MGD-Yr	6.711	3.541	1.226	0.000
Cap.Shortfall 2008-30 MGD-Yr	3.431	1.390	0.204	0.000
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	1,413	2,141	6,687
Fixed Operation Cost NPV	0	1,808	1,048	-465
Capital Cost NPV	0	-5,802	-10,832	-18,623
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	-2,580	-7,643	-12,401
Variable Operation Cost NPV	0.000%	1.286%	1.948%	6.086%
Fixed Operation Cost NPV	0.000%	0.993%	0.575%	-0.255%
Capital Cost NPV	0.000%	-6.134%	-11.451%	-19.688%
Total System Cost NPV	0.000%	-0.667%	-1.977%	-3.207%
Avg. Annual DWS Rate Increas	3.70%	3.78%	3.82%	3.59%
Levelized Unit Cost ($/kgal)	$2.956	$2.936	$2.897	$2.861

Resource Addition Sequence:	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Night Only Lscp Ord.	2008	Night Only Lscp Ord.	2008	Night Only Lscp Ord.	2008
	Maluhia Well	2010	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Waiolai Well	2011	Maluhia Well	2010	Maluhia Well	2012	Maluhia Well	2014
	Wailena Well	2012	Waiolai Well	2012	Waiolai Well	2014	Waiolai Well	2016
	Kahakuloa Ph1	2013	Wailena Well	2014	Kahakuloa Ph1	2016	Kahakuloa Ph1	2018
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2015	Wailena Well	2016	Wailena Well	2018
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2018	Kahakuloa Ph2	2020	Kahakuloa Ph2	2022
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2020	Kahakuloa Ph3	2022	Kahakuloa Ph3	2024
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2024	Waiale T.P.w12cpkg	2025	Waiale T.P.w12cpkg	2028
			Supplemental Wells	9999	Supplemental Wells	9999	Supplemental Wells	9999

Waiale Water Treatment Plant Options

The Waiale water treatment plant options described in the preceding section on specific resource options (starting at page 36)were analyzed using the integration model. Three cases are compared with the reference strategy.

The first case models the Waiale treatment plant assuming raw water costs of $0.12 per thousand gallons and presumes that all of the capital costs of the plant would be born by the DWS. This case results in lower total system planning period costs than the reference strategy. The increased fixed operating costs are offset by decreased planning period capital costs and production (variable) costs.

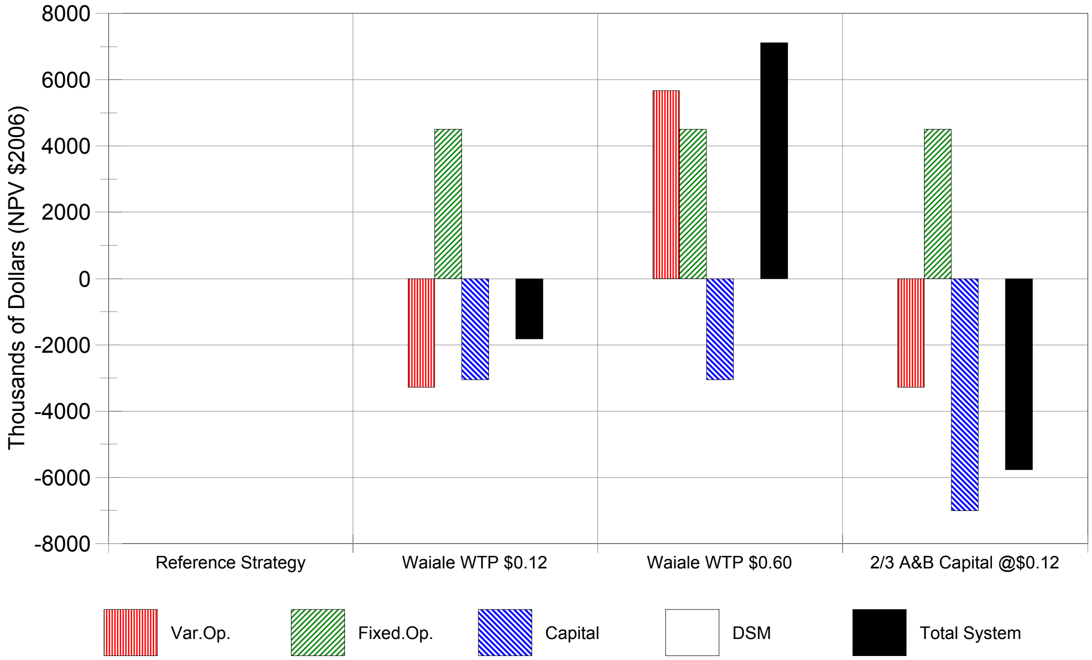
The second case models the plant assuming raw water costs of $0.69 per thousand gallons and also presumes that all of the capital costs of the plant would be born by the DWS. This case results in higher total system planning period costs than the reference strategy due primarily to higher system variable production costs.

The third case assumes the lower raw water costs of $0.12 per thousand gallons and accounts for financing of two thirds of the capital costs by A&B with half of the output of the plant accruing to A&B in credits towards source development fees. This case results in substantially lower total system planning period costs than the reference strategy.

Although construction design planning is more than 80% complete for the Waiale water treatment plant there are no contractual arrangements finalized between A&B and the County of Maui (that are known to the author at this time). Several possible financial arrangements and frameworks for water commitments and source development credits are possible and can be analyzed more rigorously as details become available.

No costs are identified for raw water storage reservoir capacity. Use of the existing Waiale reservoir is presumed. The need for additional storage reservoir capacity would depend in the long term on the agreements with A&B and WWC regarding DWS allotments of water from the diversions and ditch system that would supply the Waiale treatment plant. Required storage reservoir capacity would be a substantial potential cost that would depend fundamentally on the priority of access to water from the Na Wa Eha water diversion sources during low surface water flow conditions.

Total Planning Period System Costs
Difference From Reference Strategy



Comparison of Reference Strategy with Waiale Treatment Plant Options
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Waiale WTP $0.12**	**Waiale WTP $0.60**	**2/3 A&B Capital @$0.12**
Description	N.Waihee,Kahak123,Waiale	(3) 3MGD Units Parallel	(3) 3MGD Units Parallel	(3) 3MGD Units Parallel
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date	Raw water cost @ $0.12	Raw water cost @ $0.60	Raw water cost @ $0.12 DWS covers one third capita
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	13.834	13.834	13.834
Cap.Shortfall 2007-30 MGD-Yr	6.711	6.588	6.588	6.588
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.309	3.309	3.309
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-3,279	5,669	-3,279
Fixed Operation Cost NPV	0	4,508	4,508	4,508
Capital Cost NPV	0	-3,057	-3,057	-7,007
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	-1,828	7,120	-5,778
Variable Operation Cost NPV	0.000%	-2.984%	5.159%	-2.984%
Fixed Operation Cost NPV	0.000%	2.475%	2.475%	2.475%
Capital Cost NPV	0.000%	-3.232%	-3.232%	-7.408%
Total System Cost NPV	0.000%	-0.473%	1.842%	-1.494%
Avg. Annual DWS Rate Increas	3.70%	3.76%	3.96%	3.71%
Levelized Unit Cost ($/kgal)	$2.956	$2.942	$3.010	$2.912

Resource Addition Sequence:								
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Waiale T.P.w12cpkg	2010	Waiale T.P.w60cpkg	2010	Waiale T.P.w12cpkg	2010
	Waiolai Well	2011	Maluhia Well	2016	Maluhia Well	2016	Maluhia Well	2016
	Wailena Well	2012	Waiolai Well	2018	Waiolai Well	2018	Waiolai Well	2018
	Kahakuloa Ph1	2013	Wailena Well	2020	Wailena Well	2020	Wailena Well	2020
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2021	Kahakuloa Ph1	2021	Kahakuloa Ph1	2021
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2024	Kahakuloa Ph2	2024	Kahakuloa Ph2	2024
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2026	Kahakuloa Ph3	2026	Kahakuloa Ph3	2026
	Supplemental Wells	2029	Supplemental Wells	2029	Supplemental Wells	2029	Supplemental Wells	2029

Waihee Water Treatment Plant Options

The Waihee water treatment plant options described in the preceding section on specific resource options (starting at page 36) were analyzed using the integration model. Three cases are compared with the reference strategy. This analysis is identical in format and results as the preceding analysis of the Waiale water treatment plant. The analyses differ primarily in the size and configuration of the treatment plants. The Waiale treatment plant uses three parallel trains or 3 MGD filters whereas the Waihee treatment plant uses three parallel trains of 2 MGD filters.

The first case models the Waihee treatment plant assuming raw water costs of $0.12 per thousand gallons and presumes that all of the capital costs of the plant would be born by the DWS. This case results in lower total system planning period costs than the reference strategy. The increased fixed operating costs are offset by decreased planning period capital costs and production (variable) costs.

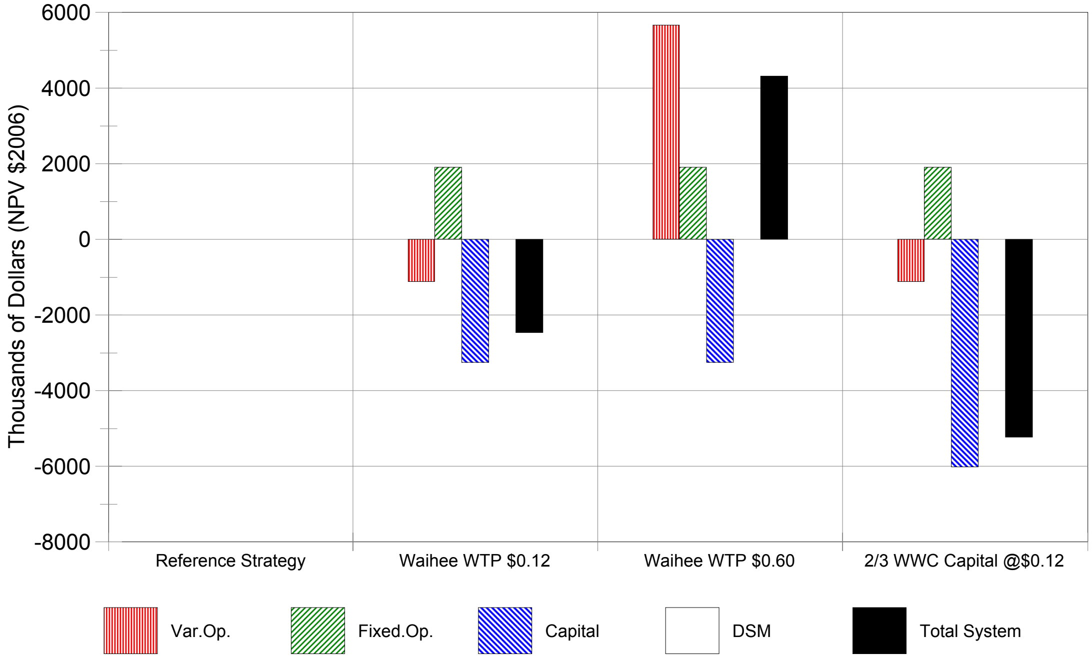
The second case models the plant assuming raw water costs of $0.60 per thousand gallons and also presumes that all of the capital costs of the plant would be born by the DWS. This case results in higher total system planning period costs than the reference strategy due primarily to higher system variable production costs.

The third case assumes the lower raw water costs of $0.12 per thousand gallons and accounts for financing of two thirds of the capital costs by WWC (or other sponsoring developers) with half of the output of the plant accruing in credits towards source development fees. This case results in substantially lower total system planning period costs than the reference strategy.

Several possible financial arrangements and frameworks for water commitments and source development credits are possible by contract between the sponsoring developer(s) and the DWS and can be analyzed more rigorously as details become available.

No costs are identified for raw water storage reservoir capacity. The need for storage reservoir capacity would depend in the long term on the agreements with A&B and WWC regarding DWS allotments of water from the diversions and ditch system that would supply the Waihee treatment plant. Required storage reservoir capacity would be a substantial potential cost that would depend fundamentally on the priority of access to water from the Na Wa Eha water diversion sources during low surface water flow conditions.

Total Planning Period System Costs
Difference From Reference Strategy



Comparison of Reference Strategy with Waihee Treatment Plant Options
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Waihee WTP $0.12**	**Waihee WTP $0.60**	**2/3 WWC Capital @$0.12**
Description	N.Waihee,Kahak123,Waiale	(3) 2MGD Units Parallel	(3) 2MGD Units Parallel	(3) 2MGD Units Parallel
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date	Raw water cost @ $0.12	Raw water cost @ $0.60	Raw water cost @ $0.12 DWS covers one third capita
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	13.835	13.835	13.835
Cap.Shortfall 2007-30 MGD-Yr	6.711	6.590	6.590	6.590
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.310	3.310	3.310
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-1,117	5,669	-1,117
Fixed Operation Cost NPV	0	1,909	1,909	1,909
Capital Cost NPV	0	-3,259	-3,259	-6,024
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	-2,466	4,319	-5,231
Variable Operation Cost NPV	0.000%	-1.016%	5.159%	-1.016%
Fixed Operation Cost NPV	0.000%	1.048%	1.048%	1.048%
Capital Cost NPV	0.000%	-3.445%	-3.445%	-6.368%
Total System Cost NPV	0.000%	-0.638%	1.117%	-1.353%
Avg. Annual DWS Rate Increas	3.70%	3.65%	3.79%	3.61%
Levelized Unit Cost ($/kgal)	$2.956	$2.937	$2.989	$2.916

Resource Addition Sequence:								
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Waihee T.P.w12cpkg	2010	Waihee T.P.w12cpkg	2010	Waihee T.P.w12cpkg	2010
	Waiolai Well	2011	Maluhia Well	2014	Maluhia Well	2014	Maluhia Well	2014
	Wailena Well	2012	Waiolai Well	2016	Waiolai Well	2016	Waiolai Well	2016
	Kahakuloa Ph1	2013	Wailena Well	2017	Wailena Well	2017	Wailena Well	2017
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2018	Kahakuloa Ph1	2018	Kahakuloa Ph1	2018
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2022	Kahakuloa Ph2	2022	Kahakuloa Ph2	2022
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2023	Kahakuloa Ph3	2023	Kahakuloa Ph3	2023
	Supplemental Wells	2029	Supplemental Wells	2027	Supplemental Wells	2027	Supplemental Wells	2027
			Supplemental Wells	2029	Supplemental Wells	2029	Supplemental Wells	2029

East Maui Aquifer Options

Three specific East Maui aquifer basal well development resource options were analyzed using the integration model and compared to the reference strategy. Each of these options was previously characterized in more detail in the preceding section of this chapter on specific resource options at page 18.

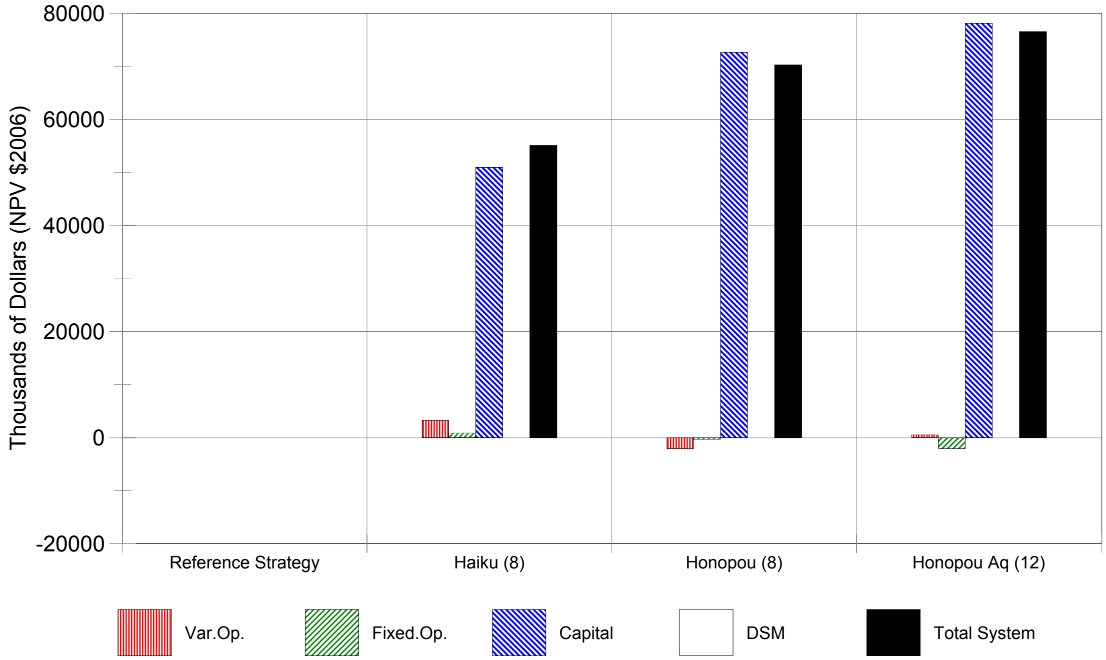
The first case examines the economics of developing eight basal wells at an elevation of 1000 feet in the Haiku groundwater aquifer.

The second case examines the development of eight basal wells at an elevation of 600 feet in the Honopou groundwater aquifer.

The third case examines the development of twelve basal wells at an elevation of 600 feet in the Honopou groundwater aquifer.

All of these resource options are substantially more expensive than the reference strategy due to high capital costs. The predominant portion of the capital costs are costs of the extensive required water transmission improvements. Several sensitivity analyses were performed to examine the economics assuming lower transmission installation costs and assumed amortization of transmission improvements over extended periods of time. In all cases, however, the capital costs of these options dominate the economics.

Total Planning Period System Costs
Difference From Reference Strategy



Comparison of Reference Strategy with East Maui Aquiter Strategies
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Haiku (8)**	**Honopou (8)**	**Honopou Aq (12)**
Description	N.Waihee,Kahak123,Waiale	8 Wells Haiku Aquifer	8 wells Honopou Aquifer	12 wells Honopou Aquifer
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date	Haiku wells online < avail da	H'pou wells online < avail da	H'pou wells online < avail da
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	14.470	13.802	13.826
Cap.Shortfall 2007-30 MGD-Yr	6.711	7.225	6.557	6.581
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.946	3.277	3.301
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	3,273	-2,124	494
Fixed Operation Cost NPV	0	873	-306	-2,047
Capital Cost NPV	0	50,979	72,674	78,094
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	55,126	70,244	76,541
Variable Operation Cost NPV	0.000%	2.979%	-1.933%	0.450%
Fixed Operation Cost NPV	0.000%	0.480%	-0.168%	-1.124%
Capital Cost NPV	0.000%	53.894%	76.829%	82.559%
Total System Cost NPV	0.000%	14.258%	18.168%	19.797%
Avg. Annual DWS Rate Increas	3.70%	4.51%	4.81%	4.76%
Levelized Unit Cost ($/kgal)	$2.956	$3.377	$3.493	$3.541

Resource Addition Sequence:

Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
Maluhia Well	2010	Haiku Wellfield (8)	2010	H'pou Wellfield (8)	2010	H'pou Wellfield (12)	2010
Waiolai Well	2011	Waiale T.P.w12cpkg	2024	Waiale T.P.w12cpkg	2023	Supplemental Wells	2030
Wailena Well	2012	Supplemental Wells	2030	Supplemental Wells	2030		
Kahakuloa Ph1	2013						
Kahakuloa Ph2	2016						
Kahakuloa Ph3	2018						
Waiale T.P.w12cpkg	2022						
Supplemental Wells	2029						

Desalination Options

Three desalination scenarios are examined using the integration model and compared with the reference strategy. Each of these options is described in more detail in the previous section on specific resource options at page 19.

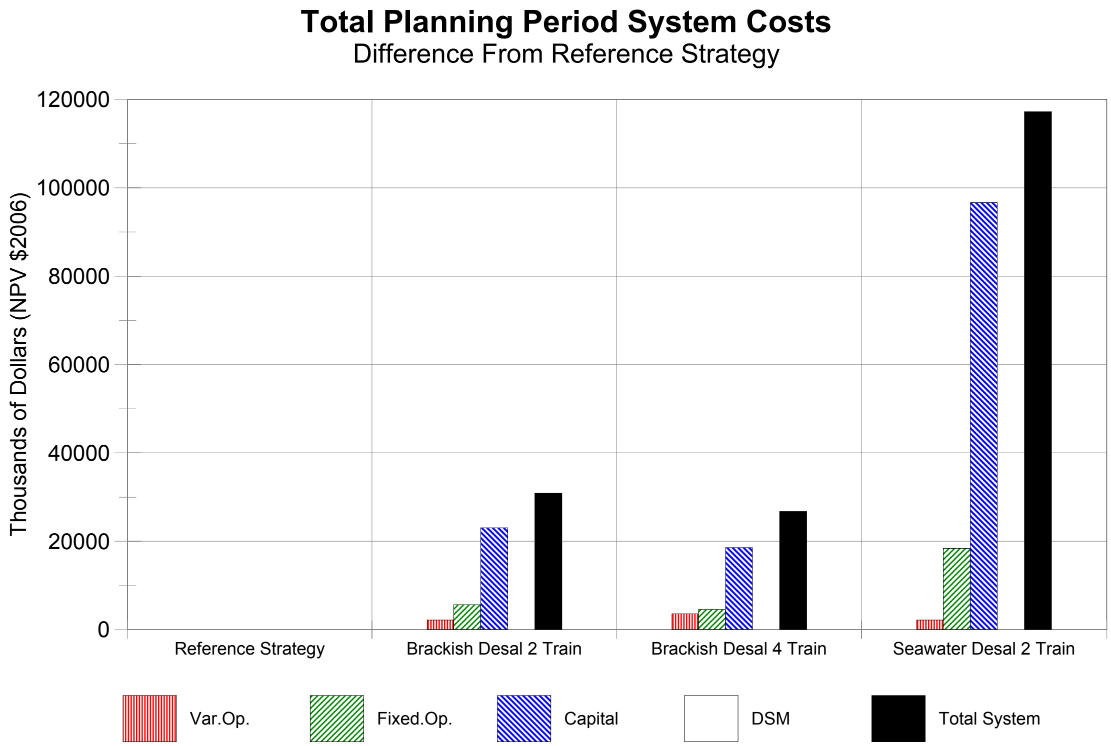
The first case examines the economics of a two train brackish water desalination facility as characterized by Brown & Caldwell in the recent desalination study prepared for the DWS.

The second case examines the economics of four train version of the previous case. Dividing the plant into four trains increases the reliability of the plant and increases the credit that the plant would be given towards the DWS Central District capacity reserve criteria. The modest additional capital costs of configuring this facility as a four train rather than a two train facility are more than offset by reduced system capital costs resulting from additional deferral of subsequent supply resource additions.

The third case examines the economics of the two train seawater desalination facility as characterized by Brown & Caldwell in the desalination study prepared for the DWS.

All of the desalination options are substantially more expensive than the reference strategy.

Note that the variable production costs of the desalination option cases are not appreciably higher than the reference strategy even though the variable costs of desalinated water are substantially higher than the reference strategy resources. This is because the integration model simulates operation of the water system in the most economical manner and avoids operation of the most expensive water sources unless required. In the analyses very little water is assumed to be produced by the desalination facilities because of the high variable production costs.



Comparison of Reference Strategy with Desalination Strategies

Reference Stategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Brackish Desal 2 Train**	**Brackish Desal 4 Train**	**Seawater Desal 2 Train**
Description	N.Waihee,Kahak123,Waiale	Ref w/ Desal << N.Waihee	Ref w/ Desal << N.Waihee	Ref w/ Desal << N.Waihee
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	13.726	13.787	13.726
Cap.Shortfall 2007-30 MGD-Yr	6.711	6.481	6.542	6.481
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.201	3.262	3.201
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	2,141	3,581	2,141
Fixed Operation Cost NPV	0	5,651	4,544	18,414
Capital Cost NPV	0	23,079	18,596	96,638
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	30,871	26,722	117,193
Variable Operation Cost NPV	0.000%	1.948%	3.259%	1.948%
Fixed Operation Cost NPV	0.000%	3.102%	2.495%	10.109%
Capital Cost NPV	0.000%	24.399%	19.659%	102.164%
Total System Cost NPV	0.000%	7.985%	6.911%	30.311%
Avg. Annual DWS Rate Increas	3.70%	4.23%	4.04%	5.52%
Levelized Unit Cost ($/kgal)	$2.956	$3.192	$3.160	$3.852

Resource Addition Sequence:	Reference Strategy		Brackish Desal 2 Train		Brackish Desal 4 Train		Seawater Desal 2 Train	
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Brackish Desal 2Trn	2010	Brackish Desal 2Trn	2010	Seawater Desal	2010
	Waiolai Well	2011	Maluhia Well	2012	Maluhia Well	2014	Maluhia Well	2012
	Wailena Well	2012	Waiolai Well	2014	Waiolai Well	2015	Waiolai Well	2014
	Kahakuloa Ph1	2013	Wailena Well	2015	Wailena Well	2017	Wailena Well	2015
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2016	Kahakuloa Ph1	2018	Kahakuloa Ph1	2016
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2020	Kahakuloa Ph2	2021	Kahakuloa Ph2	2020
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2021	Kahakuloa Ph3	2023	Kahakuloa Ph3	2021
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2025	Waiale T.P.w12cpkg	2027	Waiale T.P.w12cpkg	2025

Perched and High Altitude Source Options

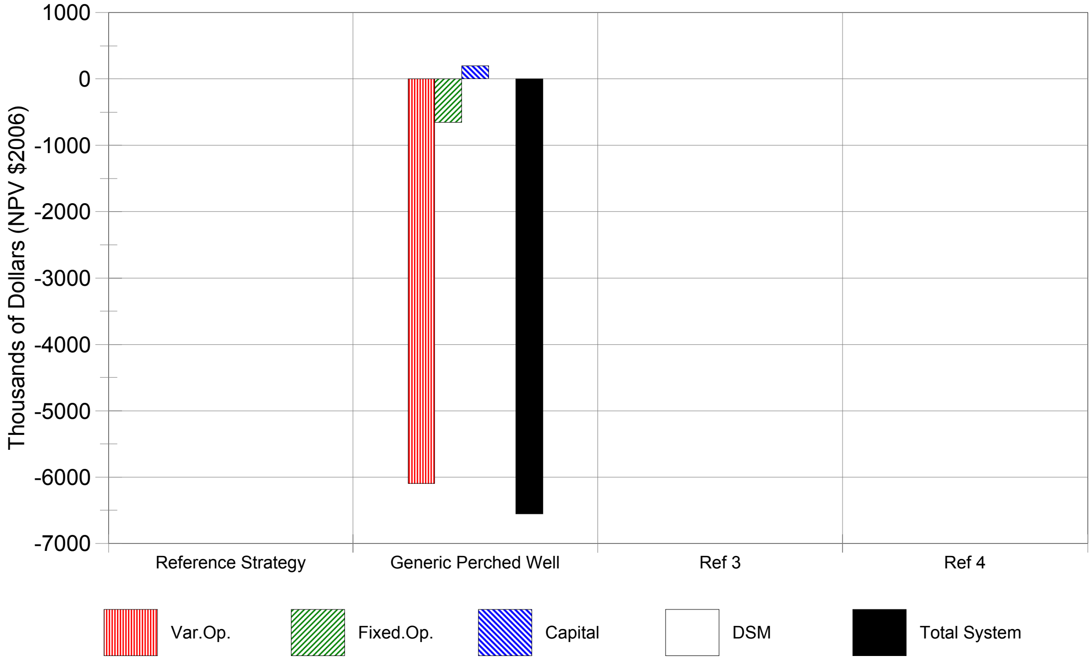
Wells that pump from “perched” aquifers with heads substantially higher than sea level require less electrical power than pumping water from the basal water lens near sea level. Since the costs of pumping water over the life of a well are substantial, perched well sources are valuable. Perched aquifers are, however, difficult to find and can be limited in sustainable production capacity.

Although specific sites are not presently known for perched aquifers in the Central District area, several sites have been suggested for exploration. In order to determine the value of perched well resources this option was analyzed using the integration model and compared with the costs of the resources in the reference strategy. Details regarding the characterization of the perched water option are provided in the text and table in the previous section of this chapter on specific resource options at page 18.

The first following chart and table shows a comparison of the reference strategy with and without a perched source well. Based on the assumptions regarding perched source capital and operation costs it is a very cost effective option. The cost assumptions are of necessity uncertain. Nevertheless the value of reduced planning period production costs of the perched water sources is clearly demonstrated to be substantial compared to the assumed capital costs.

Two options using existing high level production tunnel sources on the upper Waihee River are also examined. The two cases examines this groundwater source without and with hydroelectric energy production respectively. The configuration of these resource options is described in detail in the previous section on specific resource options at page 19.

Total Planning Period System Costs
Difference From Reference Strategy

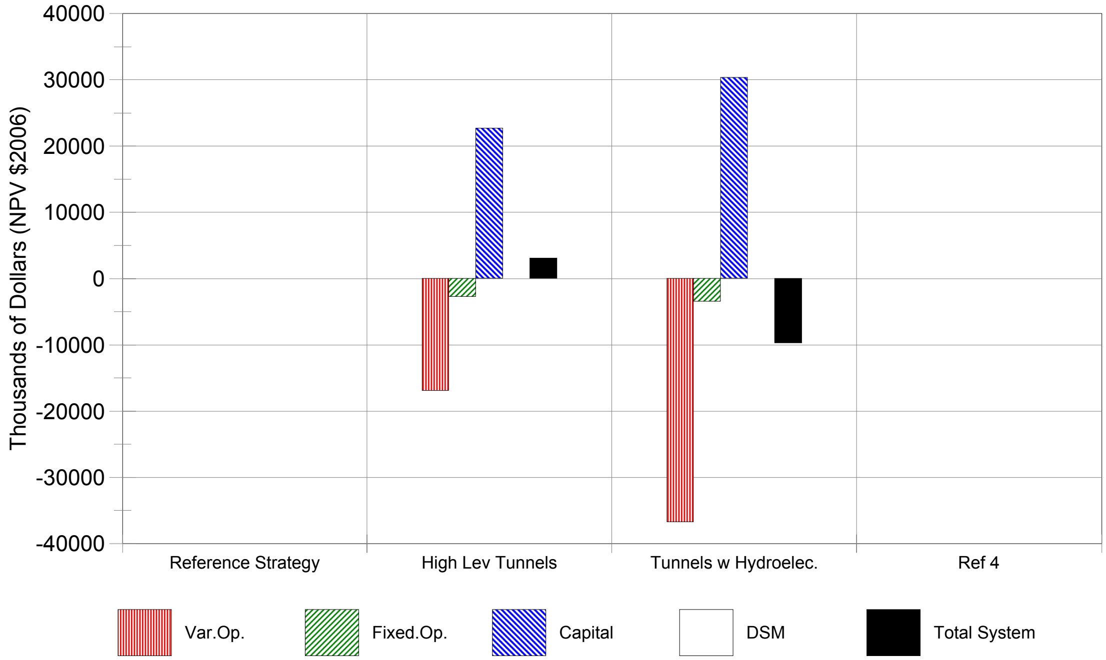


Comparison of Reference Strategy with Perched Water Resource Option
Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Generic Perched Well**	**Ref 3**	**Ref 4**
Description	N.Waihee,Kahak123,Waiale			
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	13.848	13.956	13.956
Cap.Shortfall 2007-30 MGD-Yr	6.711	6.603	6.711	6.711
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.323	3.431	3.431
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-6,096	0	0
Fixed Operation Cost NPV	0	-657	0	0
Capital Cost NPV	0	196	0	0
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	-6,556	0	0
Variable Operation Cost NPV	0.000%	-5.547%	0.000%	0.000%
Fixed Operation Cost NPV	0.000%	-0.361%	0.000%	0.000%
Capital Cost NPV	0.000%	0.208%	0.000%	0.000%
Total System Cost NPV	0.000%	-1.696%	0.000%	0.000%
Avg. Annual DWS Rate Increas	3.70%	3.69%	3.70%	3.70%
Levelized Unit Cost ($/kgal)	$2.956	$2.906	$2.956	$2.956

Resource Addition Sequence:								
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Gen. Perched Well	2010	Maluhia Well	2010	Maluhia Well	2010
	Waiolai Well	2011	Maluhia Well	2011	Waiolai Well	2011	Waiolai Well	2011
	Wailena Well	2012	Waiolai Well	2012	Wailena Well	2012	Wailena Well	2012
	Kahakuloa Ph1	2013	Wailena Well	2014	Kahakuloa Ph1	2013	Kahakuloa Ph1	2013
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2015	Kahakuloa Ph2	2016	Kahakuloa Ph2	2016
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2018	Kahakuloa Ph3	2018	Kahakuloa Ph3	2018
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2020	Waiale T.P.w12cpkg	2022	Waiale T.P.w12cpkg	2022
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2023	Supplemental Wells	2029	Supplemental Wells	2029

Total Planning Period System Costs
Difference From Reference Strategy



Comparison of Reference Strategy with High Level Production Tunnel Strategies
Reference Strategy: N.Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**High Lev Tunnels**	**Tunnels w Hydroelec.**	**Ref 4**
Description	N.Waihee,Kahak123,Waiale			
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	13.744	13.744	13.956
Cap.Shortfall 2007-30 MGD-Yr	6.711	6.498	6.498	6.711
Cap.Shortfall 2008-30 MGD-Yr	3.431	3.219	3.219	3.431
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-16,912	-36,687	0
Fixed Operation Cost NPV	0	-2,697	-3,434	0
Capital Cost NPV	0	22,720	30,386	0
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	3,111	-9,735	0
Variable Operation Cost NPV	0.000%	-15.391%	-33.388%	0.000%
Fixed Operation Cost NPV	0.000%	-1.481%	-1.885%	0.000%
Capital Cost NPV	0.000%	24.020%	32.123%	0.000%
Total System Cost NPV	0.000%	0.805%	-2.518%	0.000%
Avg. Annual DWS Rate Increas	3.70%	3.59%	3.36%	3.70%
Levelized Unit Cost ($/kgal)	$2.956	$2.979	$2.881	$2.956

Resource Addition Sequence:	Reference Strategy		High Lev Tunnels		Tunnels w Hydroelec.		Ref 4	
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	HLevProdTun	2010	HLevProdTun wHydro	2010	Maluhia Well	2010
	Waiolai Well	2011	Maluhia Well	2014	Maluhia Well	2014	Waiolai Well	2011
	Wailena Well	2012	Waiolai Well	2016	Waiolai Well	2016	Wailena Well	2012
	Kahakuloa Ph1	2013	Wailena Well	2017	Wailena Well	2017	Kahakuloa Ph1	2013
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2018	Kahakuloa Ph1	2018	Kahakuloa Ph2	2016
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2021	Kahakuloa Ph2	2021	Kahakuloa Ph3	2018
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2023	Kahakuloa Ph3	2023	Waiale T.P.w12cpkg	2022
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2027	Waiale T.P.w12cpkg	2027	Supplemental Wells	2029

Upcountry Surface Water and Interconnection

One possible long term resource strategy is interconnection of the DWS Upcountry and Central systems. The Upcountry system is primarily a surface water system with water sources at higher elevations that are subject to substantial variability depending on precipitation cycles. The Central system is primarily a groundwater system that pumps most of its water from sea level. Interconnection of these systems has been characterized as a complimentary option that could provide economical water to the Central system from the higher level upcountry sources when upcountry water is plentiful and could provide the upcountry system with a reliable groundwater source in periods of drought.

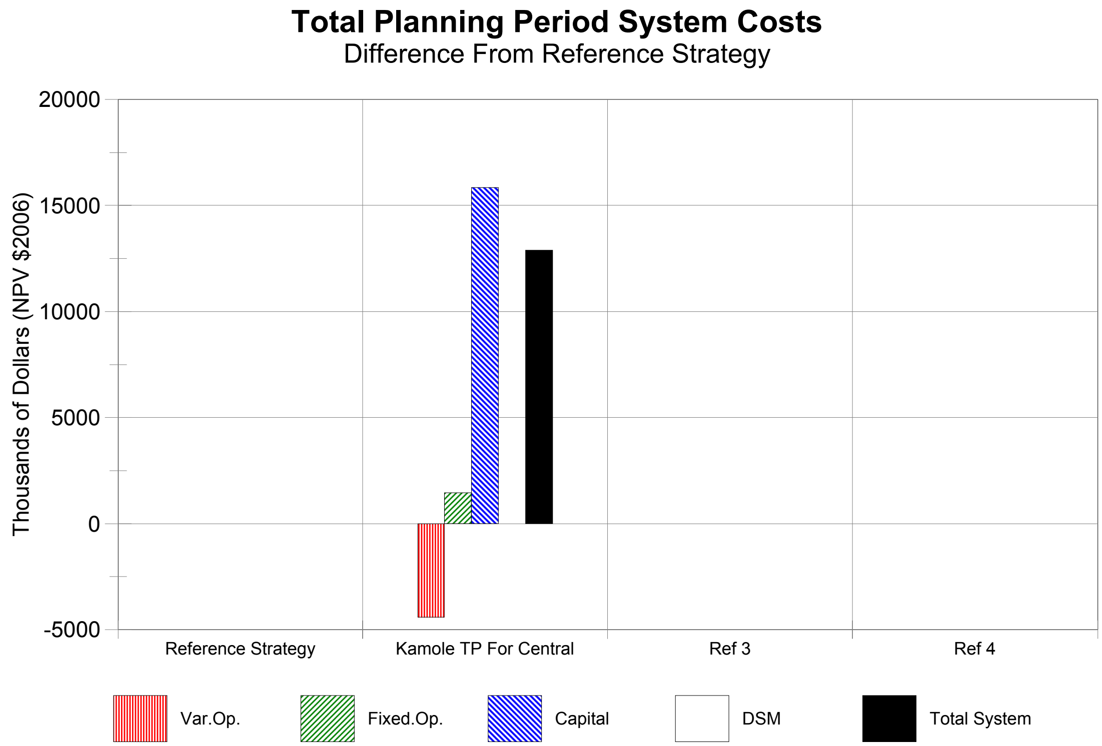
In practical application the presumed complimentary nature of these systems is difficult to exploit for several reasons that become very clear in attempts to characterize and analyze interconnection options in detail.

First, there is not sufficient excess groundwater capacity on the Central system to supply the upcountry system with a reliable source of water during drought conditions. Basal wells located in the upcountry area may be more economical sources of basal groundwater than Central system sources that are a substantial distance away.

Second, development of additional treatment capacity on the upcountry system to serve the Central system would not avoid or defer the need for redundant Central system capacity to serve the needs of the Central system when upcountry sources would not be available.

Third, water transmission costs are substantial for the distances required for high volume interconnection capacity.

One option that was examined using the integration model is expansion of the Kamole water treatment plant and interconnection with the Central system to provide an economical source of water when ample ditch flows were available upcountry. This option is discussed in more detail in the preceding discussion of specific resource options at page 37. This option assumes expansion of the Kamole treatment plant by 6 MGD for a cost of $15 million. Production of water available to the Central system was assumed for 50% of the time. No costs for transmission or interconnection were assumed. No deferral of Central system source additions was presumed. As shown on the following chart and table, even under these optimistic assumptions this option proves substantially more expensive than the reference strategy.



Comparison of Reference Strategy with Kamole TP Expansion as Central Source

Reference Strategy: N. Waihee, Kahakuloa Wells

System:	Central System	Central System	Central System	Central System
Strategy Name	**Reference Strategy**	**Kamole TP For Central**	**Ref 3**	**Ref 4**
Description	N.Waihee,Kahak123,Waiale			
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	13.956	12.226	13.956	13.956
Cap.Shortfall 2007-30 MGD-Yr	6.711	4.981	6.711	6.711
Cap.Shortfall 2008-30 MGD-Yr	3.431	2.201	3.431	3.431
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-4,422	0	0
Fixed Operation Cost NPV	0	1,460	0	0
Capital Cost NPV	0	15,858	0	0
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	12,896	0	0
Variable Operation Cost NPV	0.000%	-4.024%	0.000%	0.000%
Fixed Operation Cost NPV	0.000%	0.801%	0.000%	0.000%
Capital Cost NPV	0.000%	16.764%	0.000%	0.000%
Total System Cost NPV	0.000%	3.335%	0.000%	0.000%
Avg. Annual DWS Rate Increas	3.70%	3.84%	3.70%	3.70%
Levelized Unit Cost ($/kgal)	$2.956	$3.054	$2.956	$2.956

Resource Addition Sequence:	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Kamole Expansion	2010	Maluhia Well	2010	Maluhia Well	2010
	Waiolai Well	2011	Maluhia Well	2010	Waiolai Well	2011	Waiolai Well	2011
	Wailena Well	2012	Waiolai Well	2011	Wailena Well	2012	Wailena Well	2012
	Kahakuloa Ph1	2013	Wailena Well	2012	Kahakuloa Ph1	2013	Kahakuloa Ph1	2013
	Kahakuloa Ph2	2016	Kahakuloa Ph1	2013	Kahakuloa Ph2	2016	Kahakuloa Ph2	2016
	Kahakuloa Ph3	2018	Kahakuloa Ph2	2016	Kahakuloa Ph3	2018	Kahakuloa Ph3	2018
	Waiale T.P.w12cpkg	2022	Kahakuloa Ph3	2018	Waiale T.P.w12cpkg	2022	Waiale T.P.w12cpkg	2022
	Supplemental Wells	2029	Waiale T.P.w12cpkg	2022	Supplemental Wells	2029	Supplemental Wells	2029
			Supplemental Wells	2029				

Formulation and Preliminary Optimization of Candidate Strategies

Several candidate strategies were formulated. All of the candidate strategies include several committed and short term resource options in common. Several additional resource options were analyzed to determine whether they were part of an optimum combination of resources in the context of each individual candidate strategy. Several additional resource options are compatible with all of the candidate resource strategies and are evaluated separately on their own merits. The steps described above are described in more detail below.

Determination of the Candidate Strategies

Based on the foregoing analyses several primary long term resource options were identified as the fundamental basis for candidate strategies. These include four basal groundwater strategies, two surface water treatment strategies and one desalination strategy. In addition, several alternate Na Wa Eha surface water treatment strategies are examined.

- **Northward Basal Well Development**: A series of wells in the North half of the Waihee aquifer and the Kahakuloa aquifer.
- **Haiku Aquifer Basal Well Development**: A series of eight wells at approximately 1000 foot elevation.
- **Honopou Aquifer Basal Well Development (8 wells)**: A series of eight wells at approximately 600 foot elevation.
- **Honopou Aquifer Basal Well Development (12 wells)**: A series of twelve wells at approximately 600 foot elevation.
- **Na Wa Eha Surface Water Treatment**: A surface water treatment plant using water from the Waihee, Waiehu and Iao streams and the existing Waiale reservoir.
- **Kamole Expansion and Upcountry Interconnection**: Expansion of the Upcountry District Kamole water treatment plant and interconnection with the Central District system.
- **Brackish Water Desalination**: The least expensive brackish water desalination option.
- **Alternate Na Wa Eha Surface Water Treatment Options**: Alternate surface water treatment plant strategies using water from the Waihee, Waiehu and Iao streams.

Each of the primary long term resource options above provide a central basis for the formulation of a candidate strategy. Each of these candidate strategies includes the existing DWS Central District system resources as well as several committed and short term resource options.

Identification of Resource Options Included in All Candidate Strategies

The following committed and short term resource options are included in each of the candidate strategies:

- Committed Resource Options
    - Existing DWS Central System resources
    - Kupaa Well
    - Iao Tank Site Well

- Waikapu Tank Site Well
- Maui Lani Wells
- Short Term Resource Options
  - Hamakuapoko Wells
  - Wailuku South Wells #1 and #2

It is stressed here that the short term resource options included in the analysis of the candidate strategies are not committed or certain and depend upon developing circumstances. These resources were included uniformly in each of the candidate strategies to provide a consistent basis for comparative analysis.

Analysis of Resource Options Considered for Each Candidate Strategy

In addition to the resource options identified above several resource options were analyzed in the context of each individual candidate strategy to determine whether they are a complimentary option:

- A Portfolio of DSM programs
- Department of Public Works water recycling options
- A Night Only Landscape Irrigation Restriction Ordinance

The following findings were made based on a series of analyses of each of these resource options in the context of each of the candidate strategies:

- The basic DSM program portfolio is cost effective in each of the candidate strategies.
- A more aggressive DSM portfolio had greater gross benefits than the basic DSM portfolio but had approximately the same net benefits.
- The water recycling options were cost effective components of some strategies and were not cost effective for others. These options reduced capacity reserve shortfalls in all strategies.
- The night-only landscape irrigation restriction option was very cost effective in all candidate strategies.
- For the Haiku and Honopou aquifer basal well strategies, the DSM, water recycling and night only landscape irrigation restriction resource options were all necessary combined to meet system capacity reserve requirements until the 2014 earliest available dates for the Haiku and Honopou basal well development resource options.

The following initial determinations were made regarding these resource options:

- The basic DSM program portfolio was included in all of the candidate strategies.
- The water recycling options were included in all of the candidate strategies.
- The night only landscape irrigation restriction option was included only in the Haiku and Honopou basal well development strategies.

Identification of Resource Options to be Evaluated Independently

Finally, several resource options are presumed to be evaluated separately from the comparative evaluation of the candidate strategies. Each of the following resource options will be evaluated on its own merits for incorporation into any of the candidate resource strategies. These options are discussed in the previous section on general resource options starting at page 42:

- Supply Side Leak Reduction
- Energy Production and Efficiency Measures
- Streamflow Restoration Measures
- Watershed Protection and Restoration Measures
- Well Development Policies and Regulation
- Wellhead Protection Ordinance
- Landscape Ordinance
- Drought Water Use Restriction Options
- Water Rate Design and Pricing Policies

The resulting candidate strategies are analyzed and presented for comparison below.

Evaluation and Comparison of Candidate Strategies

The integration model was used to compare the candidate strategies. The results of the analyses are presented using charts and tables in the same format as the preceding analyses of the individual resource options.

The first set of charts and tables compares the Northward Basal Well Development strategy with basal well development strategies in the Haiku and Honopou aquifers.

Clearly the northward development strategy is more economical than the eastward well development strategies. The predominant factor in the high costs of the Haiku and Honopou aquifer strategies is the capital cost of the required transmission improvements. Even with sensitivity scenarios assuming transmission installation costs at half of the estimated costs and extending economic analysis life to fifty years for these options they prove more expensive than the northward basal well development scenario.

The second set of charts and tables compares the Northward Basal Well Development strategy with several surface water treatment strategies including strategies featuring the Waiale surface water treatment plant, expansion and interconnection of the Kamole water treatment plant and the least expensive desalination alternative.

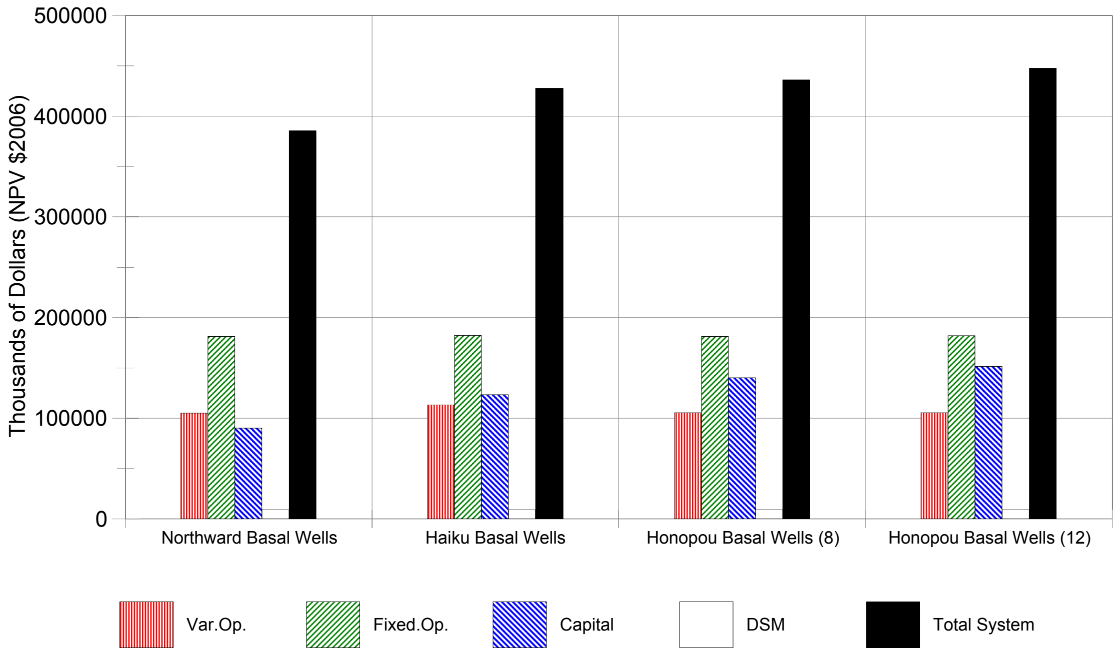
The Waiale surface treatment strategy proves comparable in cost to the northward basal well development plan. Because there are substantial uncertainties regarding the costs of both the northward basal well development strategy (costs of transmission) and Waiale surface treatment plant development (cost of raw water and financing alternatives) it is not possible to say which of these strategies may prove more economical. The costs and financial details of both options will be investigated in more detail in consideration of the final candidate strategies if these strategies are included.

The Kamole expansion and interconnection strategy is more expensive than the northward basal well development strategy because the savings that result from providing economical treated water during times of ample ditch flows do not compensate for the capital costs of the project. Because the Kamole plant would not be able to provide water for the Central District system during times of low ditch flows the plant expansion and interconnection would not avoid or defer any capital costs for providing capacity reserve for the Central District system. It should also be noted that no transmission or interconnection costs are included in the Kamole Expansion and Interconnect candidate strategy. Including these necessary costs would make this option less economical compared to the other options.

The desalination option is more expensive than the northward basal well development strategy due primarily to higher capital costs. The variable costs of the desalinated water produced would be substantial but are not directly accounted for in the analysis because the integration model avoids using the most expensive water sources unless necessary to meet water supply requirements.

The third set of charts and tables shows a comparison of different surface water treatment plant strategies using water from the Waihee, Waiehu and Iao streams. The northward basal well development strategy is compared with three surface water treatment cases. In the first case the Waiale surface water treatment plant is installed in 2010 followed by the other northward basal well development increments as necessary to meet capacity reserve requirements. In the second case the Waihee surface water treatment plant is assumed to be installed in 2010 instead of the Waiale treatment plant. Note that the timing of the installation of the Waihee facility in 2010 is probably not viable. This case is presented here for purposes of economic analysis. The third case includes a sequence of the two surface water treatment plants with the Waiale plant installed in 2010 and the Waihee plant installed when required in 2016 followed by the northward basal well development increments starting when required in 2024. Considering the amount of uncertainty in the cost estimates and financing details, the costs of these options are too close to each other to determine which is significantly the least or most economical.

Total Planning Period System Costs



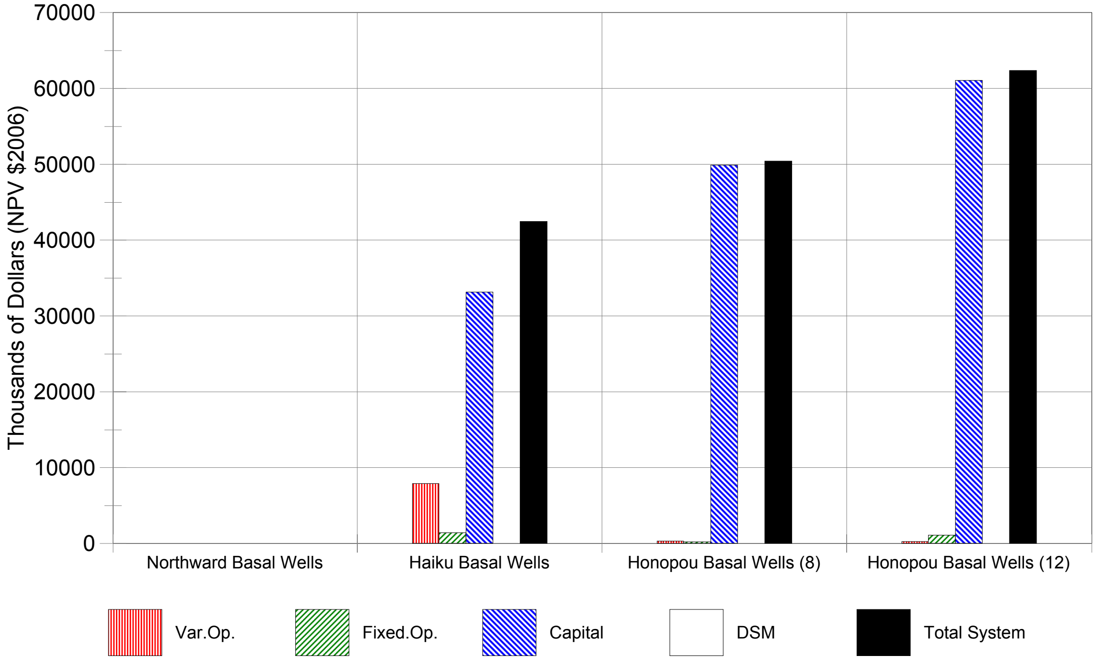
Comparison of Candidate Strategies - Basal Groundwater Strategies

Haiku and Honopou Aquifer Well Strategies Include Night Only Lanscape Irrigation Restriction

System:	Central System	Central System	Central System	Central System
Strategy Name	**Northward Basal Wells**	**Haiku Basal Wells**	**Honopou Basal Wells (8)**	**Honopou Basal Wells (12)**
Description	N.Waihee,Kahakuloa Wells DSM Port A and Recycle	8 Wells at 1000' Night Only Lanscape Ord.	8 Wells at 600' Night Only Lanscape Ord.	12 Wells at 600' Night Only Lanscape Ord.
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:				
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	12.631	6.119	6.119	6.026
Cap.Shortfall 2007-30 MGD-Yr	5.386	1.084	1.084	0.990
Cap.Shortfall 2008-30 MGD-Yr	2.238	0.185	0.185	0.091
Strategy Cost Summary	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	105,107	113,031	105,430	105,348
Fixed Operation Cost NPV	180,975	182,366	181,162	182,051
Capital Cost NPV	90,329	123,488	140,245	151,373
DSM Utility Cost	9,087	9,087	9,087	9,087
Total System Cost NPV	385,498	427,971	435,924	447,859
Variable Operation Cost NPV	0.000%	7.539%	0.308%	0.229%
Fixed Operation Cost NPV	0.000%	0.769%	0.103%	0.595%
Capital Cost NPV	0.000%	36.708%	55.260%	67.579%
Total System Cost NPV	0.000%	11.018%	13.081%	16.177%
Avg. Annual DWS Rate Increas	3.82%	4.57%	4.71%	5.00%
Levelized Unit Cost ($/kgal)	$2.945	$3.278	$3.340	$3.433

Resource Addition Sequence:	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Recycle Both	2008	Night Only Lscp Ord.	2008	Night Only Lscp Ord.	2008	Night Only Lscp Ord.	2008
	Waikapu South 1&2	2009	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008
	Maluhia Well	2010	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Waiolai Well	2012	Haiku Wellfield (8)	2014	H'pou Wellfield (8)	2014	H'pou Wellfield (12)	2014
	Wailena Well	2014	Supplemental Wells	2029	Supplemental Wells	2029		
	Kahakuloa Ph1	2015						
	Kahakuloa Ph2	2018						
	Kahakuloa Ph3	2020						
	Waiale T.P.w12cpkg	2024						

Total Planning Period System Costs
Difference From Reference Strategy

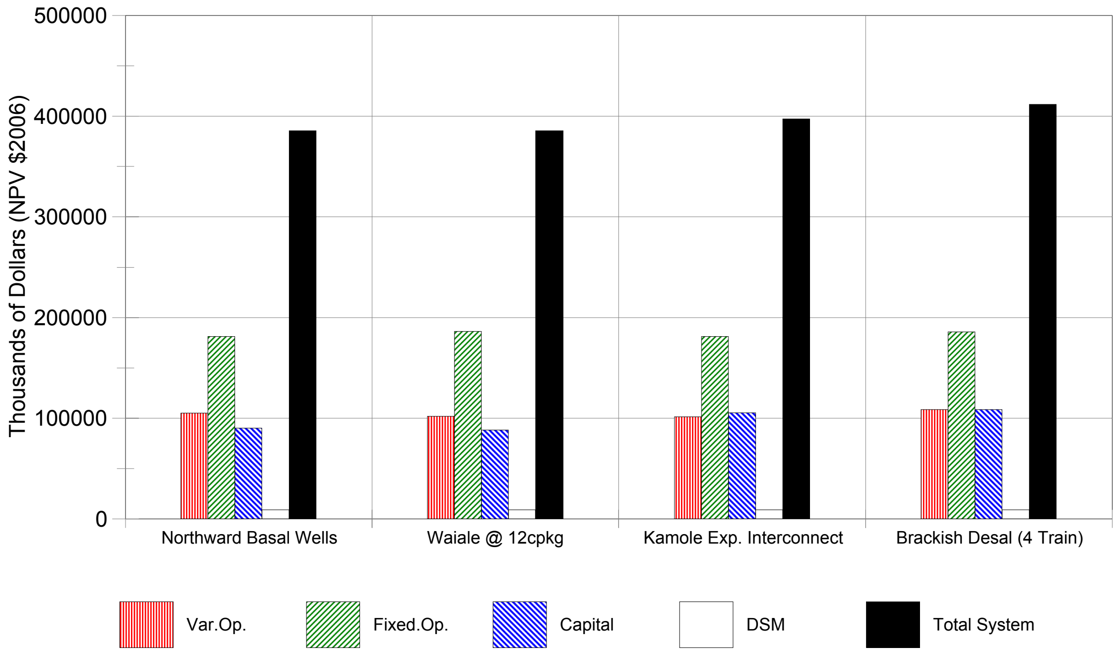


Comparison of Candidate Strategies - Basal Groundwater Strategies
Haiku and Honopou Aquifer Well Strategies Include Night Only Lanscape Irrigation Restriction

System:	Central System	Central System	Central System	Central System
Strategy Name	**Northward Basal Wells**	**Haiku Basal Wells**	**Honopou Basal Wells (8)**	**Honopou Basal Wells (12)**
Description	N.Waihee,Kahakuloa Wells DSM Port A and Recycle	8 Wells at 1000' Night Only Lanscape Ord.	8 Wells at 600' Night Only Lanscape Ord.	12 Wells at 600' Night Only Lanscape Ord.
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	12.631	6.119	6.119	6.026
Cap.Shortfall 2007-30 MGD-Yr	5.386	1.084	1.084	0.990
Cap.Shortfall 2008-30 MGD-Yr	2.238	0.185	0.185	0.091
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	7,924	323	241
Fixed Operation Cost NPV	0	1,391	187	1,076
Capital Cost NPV	0	33,158	49,916	61,044
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	42,474	50,426	62,361
Variable Operation Cost NPV	0.000%	7.539%	0.308%	0.229%
Fixed Operation Cost NPV	0.000%	0.769%	0.103%	0.595%
Capital Cost NPV	0.000%	36.708%	55.260%	67.579%
Total System Cost NPV	0.000%	11.018%	13.081%	16.177%
Avg. Annual DWS Rate Increas	3.82%	4.57%	4.71%	5.00%
Levelized Unit Cost ($/kgal)	$2.945	$3.278	$3.340	$3.433

Resource Addition Sequence:	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Recycle Both	2008	Night Only Lscp Ord.	2008	Night Only Lscp Ord.	2008	Night Only Lscp Ord.	2008
	Waikapu South 1&2	2009	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008
	Maluhia Well	2010	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Waiolai Well	2012	Haiku Wellfield (8)	2014	H'pou Wellfield (8)	2014	H'pou Wellfield (12)	2014
	Wailena Well	2014	Supplemental Wells	2029	Supplemental Wells	2029		
	Kahakuloa Ph1	2015						
	Kahakuloa Ph2	2018						
	Kahakuloa Ph3	2020						
	Waiale T.P.w12cpkg	2024						

Total Planning Period System Costs

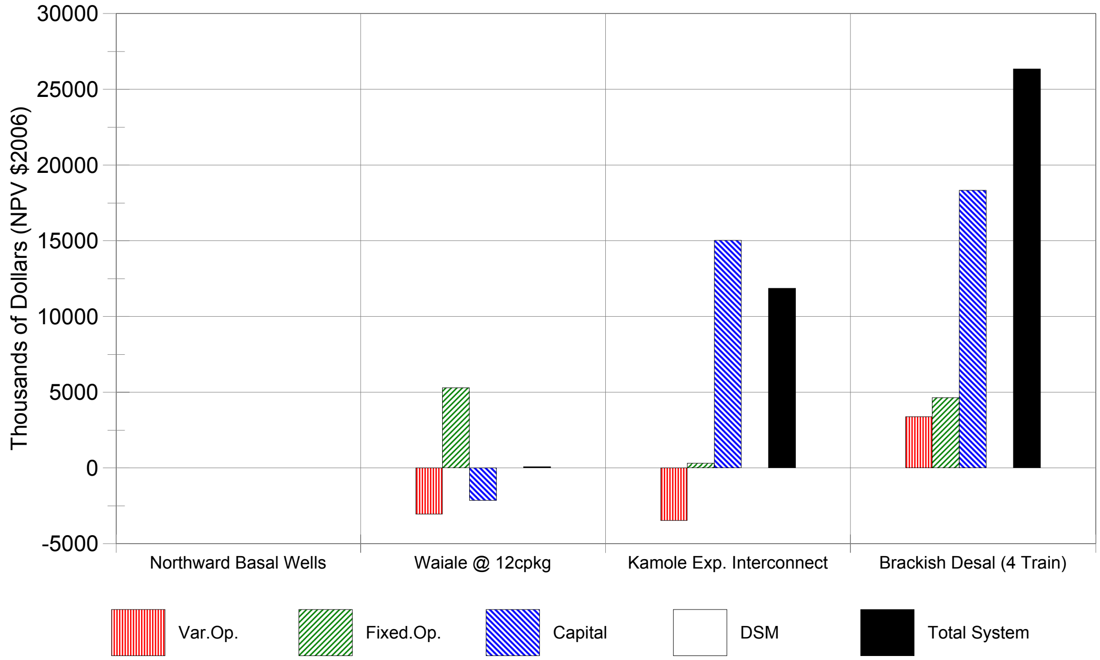


Comparison of Candidate Strategies - Treatment Plant Strategies
Northward Basal Well Strategy as Reference Plan

System:	Central System	Central System	Central System	Central System
Strategy Name	**Northward Basal Wells**	**Waiale @ 12cpkg**	**Kamole Exp. Interconnect**	**Brackish Desal (4 Train)**
Description	N.Waihee,Kahakuloa Wells DSM Port A and Recycle	DSM Port A and Recycle	DSM Port A and Recycle	DSM Port A and Recycle
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:				
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	12.631	12.473	12.631	12.467
Cap.Shortfall 2007-30 MGD-Yr	5.386	5.228	5.386	5.222
Cap.Shortfall 2008-30 MGD-Yr	2.238	2.080	2.238	2.074
Strategy Cost Summary	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	105,107	102,045	101,614	108,493
Fixed Operation Cost NPV	180,975	186,258	181,277	185,614
Capital Cost NPV	90,329	88,187	105,367	108,648
DSM Utility Cost	9,087	9,087	9,087	9,087
Total System Cost NPV	385,498	385,576	397,345	411,841
Variable Operation Cost NPV	0.000%	-2.913%	-3.324%	3.221%
Fixed Operation Cost NPV	0.000%	2.919%	0.167%	2.563%
Capital Cost NPV	0.000%	-2.372%	16.648%	20.280%
Total System Cost NPV	0.000%	0.020%	3.073%	6.834%
Avg. Annual DWS Rate Increas	3.82%	3.61%	3.98%	4.14%
Levelized Unit Cost ($/kgal)	$2.945	$2.946	$3.038	$3.152

Resource Addition Sequence:	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Waiale T.P.w12cpkg	2010	Kamole Expansion	2010	Brackish Desal 4Trn	2010
	Waiolai Well	2012	Maluhia Well	2019	Maluhia Well	2010	Maluhia Well	2015
	Wailena Well	2014	Waiolai Well	2020	Waiolai Well	2012	Waiolai Well	2017
	Kahakuloa Ph1	2015	Wailena Well	2022	Wailena Well	2014	Wailena Well	2019
	Kahakuloa Ph2	2018	Kahakuloa Ph1	2023	Kahakuloa Ph1	2015	Kahakuloa Ph1	2020
	Kahakuloa Ph3	2020	Kahakuloa Ph2	2027	Kahakuloa Ph2	2018	Kahakuloa Ph2	2024
	Waiale T.P.w12cpkg	2024	Kahakuloa Ph3	2028	Kahakuloa Ph3	2020	Kahakuloa Ph3	2025
			Waiale T.P.w12cpkg	2029	Waiale T.P.w12cpkg	2024	Waiale T.P.w12cpkg	2029

Total Planning Period System Costs
Difference From Reference Strategy

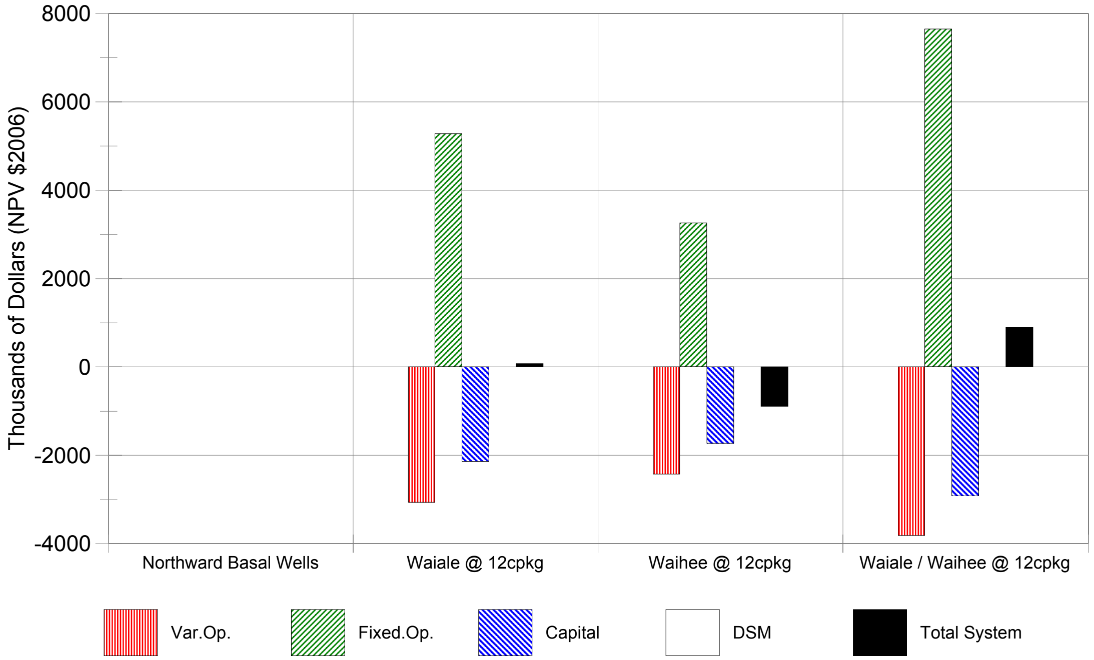


Comparison of Candidate Strategies - Treatment Plant Strategies
Northward Basal Well Strategy as Reference Plan

System:	Central System	Central System	Central System	Central System
Strategy Name	**Northward Basal Wells**	**Waiale @ 12cpkg**	**Kamole Exp. Interconnect**	**Brackish Desal (4 Train)**
Description	N.Waihee,Kahakuloa Wells DSM Port A and Recycle	DSM Port A and Recycle	DSM Port A and Recycle	DSM Port A and Recycle
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yr	12.631	12.473	12.631	12.467
Cap.Shortfall 2007-30 MGD-Yr	5.386	5.228	5.386	5.222
Cap.Shortfall 2008-30 MGD-Yr	2.238	2.080	2.238	2.074
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-3,062	-3,493	3,386
Fixed Operation Cost NPV	0	5,283	303	4,639
Capital Cost NPV	0	-2,143	15,038	18,319
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	78	11,847	26,343
Variable Operation Cost NPV	0.000%	-2.913%	-3.324%	3.221%
Fixed Operation Cost NPV	0.000%	2.919%	0.167%	2.563%
Capital Cost NPV	0.000%	-2.372%	16.648%	20.280%
Total System Cost NPV	0.000%	0.020%	3.073%	6.834%
Avg. Annual DWS Rate Increas	3.82%	3.61%	3.98%	4.14%
Levelized Unit Cost ($/kgal)	$2.945	$2.946	$3.038	$3.152

Resource Addition Sequence:								
	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Waiale T.P.w12cpkg	2010	Kamole Expansion	2010	Brackish Desal 4Trn	2010
	Waiolai Well	2012	Maluhia Well	2019	Maluhia Well	2010	Maluhia Well	2015
	Wailena Well	2014	Waiolai Well	2020	Waiolai Well	2012	Waiolai Well	2017
	Kahakuloa Ph1	2015	Wailena Well	2022	Wailena Well	2014	Wailena Well	2019
	Kahakuloa Ph2	2018	Kahakuloa Ph1	2023	Kahakuloa Ph1	2015	Kahakuloa Ph1	2020
	Kahakuloa Ph3	2020	Kahakuloa Ph2	2027	Kahakuloa Ph2	2018	Kahakuloa Ph2	2024
	Waiale T.P.w12cpkg	2024	Kahakuloa Ph3	2028	Kahakuloa Ph3	2020	Kahakuloa Ph3	2025
			Waiale T.P.w12cpkg	2029	Waiale T.P.w12cpkg	2024	Waiale T.P.w12cpkg	2029

Total Planning Period System Costs
Difference From Reference Strategy



Comparison of Candidate Strategies - Alternate Na Wa Eha TP Strategies
Northward Basal Well Strategy as Reference Plan

System:	Central System	Central System	Central System	Central System
Strategy Name	**Northward Basal Wells**	**Waiale @ 12cpkg**	**Waihee @ 12cpkg**	**Waiale / Waihee @ 12cpkg**
Description	N.Waihee,Kahakuloa Wells DSM Port A and Recycle	DSM Port A and Recycle	DSM Port A and Recycle Non-Viable Waihee Date	DSM Port A and Recycle
Demand Projection	Medium-High Case	Medium-High Case	Medium-High Case	Medium-High Case
Demand Proj.Source	HDA v22	HDA v22	HDA v22	HDA v22
Notes:	3 wells online < avail date			
Var.Op.Esc.Rate	4.00%	4.00%	4.00%	4.00%
Fix.Op.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Cap.Cost.Esc.Rate	3.00%	3.00%	3.00%	3.00%
Discount Rate	6.00%	6.00%	6.00%	6.00%
Cost of Capital	6.00%	6.00%	6.00%	6.00%
Unserved Demand kgal	0	0	0	0
Cap.Shortfall 2006-30 MGD-Yrs.	12.631	12.473	12.497	12.473
Cap.Shortfall 2007-30 MGD-Yrs.	5.386	5.228	5.252	5.228
Cap.Shortfall 2008-30 MGD-Yrs.	2.238	2.080	2.104	2.080
Difference from Base Plan	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**	**$M NPV 2006**
Variable Operation Cost NPV	0	-3,062	-2,433	-3,823
Fixed Operation Cost NPV	0	5,283	3,265	7,649
Capital Cost NPV	0	-2,143	-1,728	-2,923
DSM Utility Cost	0	0	0	0
Total System Cost NPV	0	78	-896	904
Variable Operation Cost NPV	0.000%	-2.913%	-2.314%	-3.637%
Fixed Operation Cost NPV	0.000%	2.919%	1.804%	4.227%
Capital Cost NPV	0.000%	-2.372%	-1.913%	-3.236%
Total System Cost NPV	0.000%	0.020%	-0.232%	0.234%
Avg. Annual DWS Rate Increase	3.82%	3.61%	3.77%	3.65%
Levelized Unit Cost ($/kgal)	$2.945	$2.946	$2.938	$2.953

Resource Addition Sequence:								
	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007	DSM Portfolio A	2007
	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006	Existing Marginal	2006
	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007	Hamakuapoko Wells	2007
	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007	Iao Tank Site Well	2007
	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007	Kupaa Well	2007
	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007	Waikapu Tank Well	2007
	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008	Maui Lani Wells	2008
	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008	Recycle Both	2008
	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009	Waikapu South 1&2	2009
	Maluhia Well	2010	Waiale T.P.w12cpkg	2010	Waihee T.P.w12cpkg	2010	Waiale T.P.w12cpkg	2010
	Waiolai Well	2012	Maluhia Well	2019	Maluhia Well	2016	Waihee T.P.w12cpkg	2019
	Wailena Well	2014	Waiolai Well	2020	Waiolai Well	2018	Maluhia Well	2024
	Kahakuloa Ph1	2015	Wailena Well	2022	Kahakuloa Ph1	2020	Waiolai Well	2026
	Kahakuloa Ph2	2018	Kahakuloa Ph1	2023	Wailena Well	2020	Kahakuloa Ph1	2028
	Kahakuloa Ph3	2020	Kahakuloa Ph2	2027	Kahakuloa Ph2	2024	Wailena Well	2028
	Waiale T.P.w12cpkg	2024	Kahakuloa Ph3	2028	Kahakuloa Ph3	2026		
			Waiale T.P.w12cpkg	2029	Waiale T.P.w12cpkg	2029		

V. Assessment of Attainment of Objectives

Much of the preceding analysis of the candidate strategies has focused on the costs and the ability of each strategy to provide reliable water delivery. The candidate strategies, however, need to be evaluated in the broader context of all of the WUDP planning objectives.

CENTRAL DISTRICT WUDP PLANNING OBJECTIVES:

Availability	Provide Adequate Volume of Water Supply
Cost	Minimize Cost of Water Supply
Efficiency	Maximize Efficiency of Water Use
Environment	Minimize Adverse Environmental Impacts
Equity	Manage Water Equitably
Sustainability	Maintain Sustainable Resources
Quality	Maximize Water Quality
Reliability	Maximize Reliability of Water Service
Streams	Protect and Restore Streams
Resources	Protect Water Resources
Culture	Protect Cultural Resources
DHHL	Provide For Department of Hawaiian Homelands Needs
Agriculture	Provide For Agricultural Needs
Conformity	Maintain Consistency with General and Community Plans
Viability	Establish Viable Plans

A matrix is provided below that provides a rudimentary indication of the impact on each of the planning objectives by each candidate strategy and some of the principal strategy components. The matrix is offered here as a tool for examining the candidate strategies and components in the broad context of multiple planning objectives.

CANDIDATE STRATEGIES	Availability	Cost	Efficiency	Environment	Equity	Sustainability	Quality	Reliability	Streams	Resources	Culture	DHHL	Agriculture	Conformity	Viability
	Planning Objectives														
	MGD Average	$ / kgal 20YR Lev.	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -
CANDIDATE STRATEGIES															
NORTHWARD BASAL WELL DEVELOPMENT	+	$2.95						+				+	+		?
HAIKU AQUIFER BASAL WELL DEVELOPMENT	+	$3.28						+				+	+	-	?
HONOPOU AQUIFER BASAL WELL DEVELOPMENT	+	$3.34						+				+	+	-	
NA WA EHA SURFACE WATER TREATMENT	+	$2.95			?		?	+				+	+		+
KAMOLE EXPANSION AND INTERCONNECTION	+	$3.04					?	+				+	+	-	?
BRACKISH WATER DESALINATION	+	$3.15						+				+	+		+
COMPONENTS IN ALL STRATEGIES															
COMMITTED RESOURCE OPTIONS	+							+							
NEAR TERM RESOURCE OPTIONS	+							+							?
HAMAKUAPOKO WELLS	+	+					? / -	+					+		? / -
DEMAND SIDE MANAGEMENT PROGRAMS	+	+	+					+							
DPW WATER RECYCLING PROJECTS	+		+					+							
NIGHT ONLY LANDSCAPE IRRIGATION RESTRICT	-	+	+					+							
COMPONENTS IN SOME STRATEGIES															
NIGHT ONLY LANDSCAPE IRRIGATION RESTRICT	-	+	+					+							
INDEPENDENT STRATEGY COMPONENTS															
SUPPLY SIDE LEAK REDUCTION	+	+	+												
ENERGY PRODUCTION AND EFFICIENCY MEASURE		+	+												
STREAM RESTORATION MEASURES		-		+		+	+		+	+	+		+ / -		
WATERSHED PROTECTION AND RESTORATION	+			+		+	+		+	+	+		+		
WELL DEVELOPMENT POLICIES AND REGULATIONS				+	+	+	+			+					
WELLHEAD PROTECTION ORDINANCE				+	?	+	+		+	+					
LANDSCAPE ORDINANCE	+	+	+					+	+	+					
DROUGHT WATER USE RESTRICTIONS	-												+ / -		
WATER RATE DESIGN AND PRICING POLICIES			+										+		

VI. Selection of Final Candidate Strategies

It is expected that the DWS will select several of the candidate strategies or specify modified or additional strategies to serve as “final” strategies that will undergo more rigorous analysis and development of detail. The determination of the final strategies will be based on a review of the analyses and characterization of the candidate strategies, comments by the Central District Water Advisory Committee (WAC), the Maui Board of Water Supply (BWS), the Maui County Council (Council) and the Hawaii Commission on Water Resource Management (CWRM). The final strategies will be optimized and analyzed to determine the selection of the Central District portion of the Maui WUDP.

This section of this chapter or a similarly titled section of the Final Candidate Strategies Chapter will describe the basis and selection of the final candidate plans.