Maui County Water Use & Development Plan

Final Candidate Strategies Analysis Update

Water Advisory Committee
Upcountry District

February 13, 2008
ELEMENTS OF AN IRP PROCESS

Planning Objectives

Demand Forecast

Resource Assessment
  - Supply-side
  - Demand-side

Evaluation Criteria

Characterize Resource Options

Define Future Uncertainties and Potential Outcomes

Form Potential Resource Sequences
  Narrow

Test Sequences Against Evaluation Criteria
  Narrow

Form Resource Strategies

Probabilities of Outcomes

Evaluate Resource Strategies
  Narrow

Final Recommendations

Institutional Feasibility
Current Status of Final Strategies
Analysis Presentation

• Analysis is Ongoing. This is a Presentation of Consultant’s Work In Progress.
• Work has not been reviewed by DWS, BWS, Council or Public.
• Findings Subject to Change Based on Comments and Further Analysis.
• Review is Welcome.
Upcountry District
Final Candidate Strategies

• A. Expansion of Raw Water Storage
• B. Full Basal Groundwater Backup
• C. Limited Growth with Extensive Conservation Measures
• D. Expanded Kamole Water Treatment Plant Capacity and Volume
Options Included in All Strategies

• Committed / Near Term Options
  – Pookela Well
  – Olinda WTP Upgrade
  – Piiholo Well
  – Kamole WTP Upgrade

• Phase 6 and Phase 10 Booster Upgrades
Options Considered for Each Strategy

• Demand Side Management Portfolio
  – Included in All Strategies

• Standard for Maintaining Drought Period Service Reliability
  – Development of Upcountry District Capacity Expansion Reliability Criteria
  – Alternate Standards Explored to Determine Cost of Reliability Improvements
Independent Components

- Supply Side Leak Reduction Measures
- Production Energy Efficiency Measures
- Energy Production Options
- Stream Restoration Measures
- Watershed Protection and Restoration
Independent Components

- Well Development Policies and Regulation
- Wellhead Protection Ordinance
- Landscape Ordinance
- Drought Period Water Use Restrictions
- Water Rate Design and Pricing Policies
  - Altitude Based Tariff
  - Summer / Winter Rates
  - Drought Period Surcharge
**Well - Maluhia**

New DWS Well at New Site

1400 GPM

w/Transmission from Kupaa

**Operation costs by HDA.** contingency allowance. Exceptional expected escalation is accounted in substantial

**Capital Costs by HDA from DWS information using recent costs.**

### Derivation

<table>
<thead>
<tr>
<th>Basal Well</th>
<th>Central System</th>
<th>Groundwater Source</th>
<th>North Waihee Location</th>
<th>Aquifer</th>
</tr>
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<tr>
<td>Earliest Online Date</td>
<td>2010</td>
<td>1400 GPM</td>
<td>Transmission from Kupaa</td>
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</table>
| Capacity (MGD) | 2.016 | 2.016 | 3%
| Installed Capacity | 2.016 | 2.016 | 3%
| Criteria Capacity | 1.344 | 1.344 | 3%
| Effective Sustainable Capacity | 1.344 | 1.344 | 3%

### Capital Costs ($2004)

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Exploration, Land</td>
<td>$250,000</td>
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<tr>
<td>Drilling</td>
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<td>Transmission</td>
<td>$3,070,625</td>
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<td>Development</td>
<td>$1,000,000</td>
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<td>Contingencies</td>
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<td>Total Plant Cost</td>
<td>$7,342,688</td>
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<td>Normalized Per Y/MDG</td>
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### Expenditure Pattern

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<td>1</td>
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<tr>
<td>2</td>
<td>$3,495,125</td>
</tr>
<tr>
<td>3</td>
<td>$4,542,890</td>
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<tr>
<td>4</td>
<td>$0</td>
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<td>5</td>
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<td>7</td>
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<td>8</td>
<td>$0</td>
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### Fixed Operating Costs ($2004)

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<th>Type</th>
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<tr>
<td>Dedicated Operating Labor</td>
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<tr>
<td>Apportioned Operating Labor</td>
<td>$6,873</td>
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<td>Maintenance Labor</td>
<td>$0</td>
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<td>Fixed Operating Costs</td>
<td>$0</td>
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<tr>
<td>Electrical Demand</td>
<td>$24,531</td>
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<tr>
<td>Chemicals/Materials</td>
<td>$0</td>
</tr>
<tr>
<td>Maintenance Expenses</td>
<td>$0</td>
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<tr>
<td>Amort. of Capitalized Rebuild Costs</td>
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<td>Total Fixed Op. Costs</td>
<td>$23,365</td>
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### Variable Operating Costs ($2004)

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<td>Variable O&amp;M</td>
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<td>Electrical Energy</td>
<td>$0,973</td>
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<td>Maintenance Expenses</td>
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<td>Total Variable Op. Costs</td>
<td>$0,979</td>
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### Reference Strategy

#### Average Years

DW S System Costs
Comparison With Reference Strategy

Annual Thousands of Dollars (Nominal)

2005 2010 2015 2020 2025 2030

- Capital Cost
- Total System Cost
Comparison of Upcountry Candidate Strategies
Total Planning Period System Costs
Difference From Reference Strategy

Comparison of Upcountry Candidate Strategies

- Incremental Basal Wells
- 300MG Resv. L. Kula
- Up.Kula Reallocate Dev.
- Kamole +2 MGD Intake

Thousands of Dollars (NPV $2006)
## Planning Objectives

<table>
<thead>
<tr>
<th>Planning Objectives</th>
<th>Availability</th>
<th>Cost</th>
<th>Efficiency</th>
<th>Environment</th>
<th>Equity</th>
<th>Sustainability</th>
<th>Quality</th>
<th>Reliability</th>
<th>Streams</th>
<th>Resources</th>
<th>Culture</th>
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<th>Agriculture</th>
<th>Conformity</th>
<th>Viability</th>
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</table>

### Candidate Strategy Components

- **Expanded Stream Water Diversion**: + (+) + ? + +
- **Improved Collection System Efficiency**: + (+) + + + ?
- **Increased Surface Storage Reservoirs**: + (+) + + + ?
- **Haiku System Basal Well Development**: + (+) + + + ?
- **Makawao System Basal Well Development**: + (+) + + + ?
- **Demand Side Management Programs**: + + + + + + +
- **Awalau Treatment Plant**: + (+) + ? / -
- **Interconnection with Central System**: ? - - - + +

### Independent Strategy Components

- **Supply Side Leak Reduction**: + + +
- **Energy Production and Efficiency Measures**: + +
- **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**: + +
Demand Side Management Program Analysis

- What programs can the County implement to encourage customers to use energy efficiently?
- How effective will the programs be as a “resource” to meet future water needs?
- Are the programs cost effective?
Demand Side Management Program Analysis

• One Indoor DSM Program Currently Characterized for Upcountry District
• One Indoor and one Outdoor Program Characterized for the Central District
• Programs are Analyzed Using an Integrated Capacity Expansion and Production Cost Model
• Characterization is Prospective for Analysis
Demand Side Management Program Analysis

• Indoor DSM Program for the Upcountry District
  – Direct Installation Program for Residences
  – Installation of Low-Flow Toilets, Showerheads and Faucet Restrictors
  – Five Year Program Costs $162,000/Year and Reduces Consumption by 25,970 GPD/Year
  – Alternative Program Durations and Intensities Characterized and Analyzed
Expanding Program Penetration by Extending Program Duration
Total Planning Period System Costs
Difference From Reference Strategy

Expanding Program Penetration by Accelerating Program Intensity
Total Planning Period System Costs
Difference From Reference Strategy

Expanding Program Penetration by Extending Program Duration
Expanding Program Penetration by Accelerating Program Intensity
Demand Side Management Program Analysis

• Conclusions:
  – DSM programs can be an effective and cost-effective resource to meet future Upcountry District water needs.
  – Prospective characterization and analysis of programs are designs is necessary
Demand Side Management Program Analysis

• Conclusions:
  – DSM programs can be an effective and cost-effective resource to meet future Upcountry District water needs.
  – Review of program characterization and refinement of program designs is necessary
Demand Side Management Program Analysis

• DSM Program Design Consultant is Being Retained
  – Review of Existing Characterization of DSM Programs in Central and Upcountry Analysis
  – Recommend Additional Program Designs
    • Commercial Users
    • Agricultural Users
    • Outdoor Program for Upcountry
A. Expansion of Raw Water Storage

Addition of substantial additional raw water storage for the Upper Kula, Lower Kula and/or Makawao systems.
A. Expansion of Raw Water Storage Variations / Analysis Issues

• Reservoir Size – Target System Reliability
• Water System
  – Upper Kula, Lower Kula or Makawao Systems
• Reservoir Operation Objectives
  – Maximize Drought Reliability
  – Optimize Operation Economics
• Financing Alternatives
### Reservoir Mass Flow Analysis

#### Input Data

<table>
<thead>
<tr>
<th>Reservoir Capacity</th>
<th>Separate Waikamoi Collection</th>
<th>Original Waikamoi Collection</th>
<th>MG</th>
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<tbody>
<tr>
<td>Average Demand (Res. Output)</td>
<td>6.439</td>
<td>2.930</td>
<td>MGD</td>
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</table>

#### Max Stream Diversion

- **Honomanu**: 2.000 MGD
- **Haipuaena**: 2.000 MGD
- **Puohokamo E**: 2.000 MGD
- **Puohokamo M**: 2.000 MGD
- **Puohokamo W**: 2.000 MGD
- **Waikamoi**: 6.000 MGD
- **Waikamoi E**: 6.000 MGD

#### Max Collection Capacity

- 4.700 MGD
- 7.500 MGD

#### Reservoir Starting Volume

- 150 MG
- 25 MG

#### Output Data

<table>
<thead>
<tr>
<th>Average Streamflow</th>
<th>20.975</th>
<th>20.975</th>
<th>MGD</th>
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<tbody>
<tr>
<td>Average Input to Reservoir</td>
<td>6.600</td>
<td>5.117</td>
<td>MGD</td>
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<tr>
<td>Reservoir Full Days</td>
<td>76</td>
<td>805</td>
<td># Days</td>
</tr>
<tr>
<td>Reservoir Empty Days</td>
<td>0</td>
<td>0</td>
<td># Days</td>
</tr>
<tr>
<td>Reservoir Spill Days</td>
<td>76</td>
<td>805</td>
<td># Days</td>
</tr>
</tbody>
</table>

This analysis assumes no contribution from the Kailua stream(s)

Calculations are based on the Mink and Yuen spreadsheet columns A thru AM

Calculations consider constraints on total contribution to collection system

This calculation accounts for limit of 4.7 MGD on E.Puohokamo to Waikamoi Collection line.

Separate collection for Waikamoi streams appears to provide about 450,000 GPD additional yield

With no empty reservoir days

With all stream diversion limits at 2.0 MGD
Alternate Reservoir Sizes for the Lower Kula System

Total Planning Period System Costs
Difference From Reference Strategy

Thousands of Dollars (NPV $2006)

<table>
<thead>
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<tbody>
<tr>
<td>Ref Srat Basal Wells</td>
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<tr>
<td>100MG Resv. L.Kula</td>
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<tr>
<td>300MG Resv. L.Kula</td>
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<td></td>
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<tr>
<td>Reference Strategy</td>
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## Resource Additions

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<tr>
<th>Reference Strategy</th>
<th>100 MG Resv. L.Kula</th>
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<tr>
<td>Ph 10 Boost Add.</td>
<td>Ph 10 Boost Add.</td>
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<tr>
<td>Phase 6 Boost Add.</td>
<td>Phase 6 Boost Add.</td>
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<tr>
<td>Ph 10 Boost Add#2</td>
<td>Well 1300 ft Kokomo</td>
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<tr>
<td>Well 1600' (Mak)</td>
<td>100 MG Reservoir</td>
</tr>
<tr>
<td>Well 1600' (Mak)</td>
<td>Phase 6 #2 Boost Add.</td>
</tr>
<tr>
<td>Phase 6 #2 Boost Add.</td>
<td>Well 1600' (Mak)</td>
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<tr>
<td>Well 1300 ft Kokomo</td>
<td>Well 1600' (Mak)</td>
</tr>
<tr>
<td>Well 1600' (Mak)</td>
<td>Ph 10 Boost Add#2</td>
</tr>
<tr>
<td>Well Supp. (Mak)</td>
<td>Additional Well</td>
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<tr>
<td>Ph 10 3rd Upgrade</td>
<td>2029</td>
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<tr>
<td></td>
<td>2009</td>
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<td>2009</td>
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<td></td>
<td>2011</td>
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<td></td>
<td>2011</td>
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<td></td>
<td>2014</td>
</tr>
<tr>
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<td>2017</td>
</tr>
<tr>
<td></td>
<td>2022</td>
</tr>
<tr>
<td></td>
<td>2027</td>
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<td>2029</td>
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# Resource Additions

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<tr>
<th>300 MG Resv. L.Kula</th>
<th>500 MG Resv. L.Kula</th>
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<tbody>
<tr>
<td>Ph 10 Boost Add.</td>
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<td>2009</td>
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<td>Phase 6 Boost Add.</td>
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<td>2009</td>
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<td>2011</td>
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<td>2028</td>
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<tr>
<td>Well 1600' (Mak)</td>
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<tr>
<td>2027</td>
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</table>
Total Planning Period System Costs
Difference From Reference Strategy

Alternate Reservoir Sizes for the Lower Kula System
Alternate Reservoir Sizes for the Lower Kula System

Total Planning Period System Costs
Difference From Reference Strategy

Thousands of Dollars (NPV $2006)

- Ref Strat Basal Wells
- 100MG Resv. L.Kula
- 200MG Resv. L.Kula
- 300MG Resv. L.Kula

Total Planning Period System Costs
Difference From Reference Strategy

Alternate Reservoir Sizes for the Upper Kula System

Thousands of Dollars (NPV $2006)

- Ref Strat Basal Wells
- 100MG Resv Olinda
- 200 MG Resv. Olinda
- 300MG Resv. Olinda

Alternate Reservoir Sizes for the Makawao System

Total Planning Period System Costs
Difference From Reference Strategy

Thousands of Dollars (NPV $2006)

Ref Strat Basal Wells
100MG Resv. Kamole
200MG Resv. Kamole
300MG Resv. Kamole

Total Planning Period System Costs
Difference From Reference Strategy

100 MG Reservoir on Alternate Systems

Thousands of Dollars (NPV $2006)

Ref Strat Basal Wells
100MG Resv. Kamole
100MG Resv. L.Kula
100MG Resv Olinda

Total Planning Period System Costs
Difference From Reference Strategy

200 vs 200 vs 100+100 MG Reservoirs

Thousands of Dollars (NPV $2006)


Ref Strat Basal Wells | 200MG Resv. L.Kula | 200 MG Resv. Olinda | 100MG Up + 100MG Low

Total Planning Period System Costs

Difference From Reference Strategy

200 vs 200 vs 100+100 MG Reservoirs

Thousands of Dollars (NPV $2006)


Ref Strat Basal Wells | 200MG Resv. L.Kula | 200 MG Resv. Olinda | 100MG Up + 100MG Low
A. Expansion of Raw Water Storage Variations / Analysis Issues

- Reservoir Size – Target System Reliability
- Water System
  - Upper Kula, Lower Kula or Makawao Systems
- Reservoir Operation Objectives
  - Maximize Drought Reliability
  - Optimize Operation Economics
- Financing Alternatives
A. Expansion of Raw Water Storage Policy Issues

• Cost vs Reliability vs Sustainability
  – Budgeting for Project Capital Costs
  – Reservoir Management Objectives

• Agricultural vs Municipal Service Objectives
  – Protocols for Allocation in Drought Periods
  – Financing Alternatives

• Additional Use of Stream Water
B. Full Basal Groundwater Well Backup

Development of sufficient new basal wells to provide reliable water capacity in “worst case” drought conditions
B. Full Basal Well Backup Variations / Analysis Issues

• Well Locations (Elevations)
• Well Costs
• Hydrology – Expected Yield
• Additional Reservoir Alternatives
• Integration with Upcountry Systems
  – Baseline Surface Source Reliability
  – Reservoir Management Protocols
Total Planning Period System Costs
Difference From Reference Strategy

Thousands of Dollars (NPV $2006)

Basal Well Drought Backup Alternatives

Ref Strat Basal Wells  Full Basal Grdwtr. Backup  Basal Backup w/Kamole  Backup w/Kamole w/Ops

B. Full Basal Well Backup Policy Issues

- Cost vs Reliability vs Sustainability
- EMPLAN Consent Decree Compliance
- Non-DWS Well Development Issues
  - Well Siting – Wellhead Protection
  - Well Siting – Integration with DWS Systems
  - Capitalization, Source Credits, Entitlements
D. Expanded Kamole WTP Capacity and Volume

Improvements to storage, pretreatment and/or filter capacity to maximize Kamole WTP drought period capacity
D. Kamole WTP Improvements
Analysis Issues

• Determination and Analysis of Options
  – Scope of Possible Options
  – Project Costs
  – Resulting Drought Period Reliable Capacity

• Integration with Upcountry Systems
  – Additional Reservoir Alternatives
  – Reservoir Management Protocols
D. Kamole WTP Improvements Analysis

- Reservoir Options Examined
  - Wailoa Ditch Flow Analysis
  - Mass Flow Analysis of Resv. Reliable Yields
  - Cost/Benefit Analysis in Integration Model

- Kamole WTP Filter Upgrade is Already Planned

- Intake Capacity Improvements Evaluated
Total Planning Period System Costs
Difference From Reference Strategy

Thousands of Dollars (NPV $2006)

Imputed Value of Increased Kamole WTP Intake Capacity

Ref Strat Basal Wells    Kamole +1 MGD Intake    Kamole +2 MGD Intake    Kamole +3 MGD Intake

Alternate Reservoir Sizes for the Makawao System

Total Planning Period System Costs
Difference From Reference Strategy

Thousands of Dollars (NPV $2006)

Ref Strat Basal Wells
100MG Resv. Kamole
200MG Resv. Kamole
300MG Resv. Kamole

D. Kamole WTP Improvements
Analysis Conclusions

• There is substantial value to improving Kamole WTP drought period reliability.
  – Primary value is in displacing need for expensive but seldom used backup wells.

• Specific means to increase drought period reliability depend upon collaborative and negotiated details.
D. Kamole WTP Improvements
Policy Issues

• Cost vs Drought Condition Reliability
• Additional Use of Stream Water
• Agricultural vs Municipal Use of Drought Period Surface Water
C. Limited Growth with Extensive Conservation Measures

Restrictions on growth on Upper Kula system and targeted conservation to keep water demands within surface water system capacity
C. Limited Growth and Conservation Variations / Policy Issues

• Nature and Extent of Growth Restrictions
  – Restrict Number of New Services?
  – Restrict Subdivisions?
  – Restrict Increases in Water Consumption?
  – Restrict Agricultural and Municipal Uses?

• Implementation or Restrictions
  – Interface with Land Use Plans and Regulation

• DHHL Exemption from Restrictions
C. Limited Growth and Conservation Variations / Policy Issues

• Conservation Implementation Thresholds
  – Cost-effective Efficiency Measures
  – Subsidized Efficiency Measures
  – Use Restrictions

• Conservation Implementation Measures
  – Incentives
  – Mandates
Total Planning Period System Costs
Difference From Reference Strategy

Resource Value of Limiting and Reallocating Upper Kula System Area Development
Upcountry District
Final Candidate Strategies

• A. Expansion of Raw Water Storage
• B. Full Basal Groundwater Backup
• C. Limited Growth with Extensive Conservation Measures
• D. Expanded Kamole Water Treatment Plant Capacity and Volume
Comparison of Candidate Strategies

Total Planning Period System Costs

Thousands of Dollars (NPV $2006)

Incremental Basal Wells 100MG Resv. L. Kula 300MG Resv. L. Kula Up.Kula Reallocate Dev. Kamole +2 MGD Intake Basal Backup (w/Kamole)

Cost of Adding 200,000 GPD to Each Subsystem

$14/GPD to $19/GPD

Total Planning Period System Costs
Difference From Reference Strategy
Upcountry District
Final Candidate Strategies

• A. Expansion of Raw Water Storage
• B. Full Basal Groundwater Backup
• C. Limited Growth with Extensive Conservation Measures
• D. Expanded Kamole Water Treatment Plant Capacity and Volume
• E. ???
## Planning Objectives

<table>
<thead>
<tr>
<th>UP COUNTRY CANDIDATE STRATEGIES</th>
<th>Availability</th>
<th>Cost</th>
<th>Efficiency</th>
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<th>Quality</th>
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### CANDIDATE STRATEGIES

- Increased Raw Water Storage Reservoir
- Add Well and Booster Pump's Incremental
- Basal Wells for Full System Backup
- Limit and Reallocate Upper Kula Growth Improvement
- Improve Kamoile WTP Drought Reliability

### COMPONENTS IN ALL STRATEGIES

- Committed Resource Options
- Booster Pump Upgrades
- Demand Side Management Programs

### INDEPENDENT STRATEGY COMPONENTS

- Supply Side Leak Reduction
- Energy Production and Efficiency Measures
- 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
- WTP Water Quality Improvements
Comments Are Encouraged:

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Wailuku, HI 96793