Preparing for the Worst: Integrated Drought Planning for a SC Water Utility in the Age of Water Scarcity

Hope Walker, E.I.T.

October 15, 2008

South Carolina Water Resources Conference
AGENDA

- Background
- Safe Yield
- SJWD Drought Plan
- Conclusions
SJWD Water District

- Startex Jackson Wellford Duncan (SJWD)
- 20,000 taps (45,000 to 50,000 customers)
- Average daily demand ~ 6.5 mgd
- 1956 - Special Purpose District
- Previously purchased water
SJWD Sources

- **1976** – Construct Lake Cooley
- **1994** – Approval for North Tyger Reservoir
- **1997-1998** – WTP and Lake Lyman
- **2006** – North Tyger Reservoir utilized
Drought Planning

- Drought Response act of 2000
  - Water suppliers must implement ordinance
  - Consistent with State Plan

- Drought Phases
  - Incipient (Level 1)
  - Moderate (Level 2)
  - Severe (Level 3)
  - Extreme (Level 4)

- Conservation goals
Update previous plan
  - Last plan 2003
  - Expanded supply system

Scope
  - Update safe yield
  - Review and revise drought phase indicators
  - Devise reservoir optimization scheme
  - Revise Ordinance
AGENDA

- Background
- **Safe Yield**
- SJWD Drought Plan
- Conclusions
What is Safe Yield?

- Reliable reservoir withdrawal during drought
- Statistical value
- Requirements vary by State
- Compared to Average Day or Peak Month demands
- Reservoir simulation with constructed historical record
SJWD Drought Contingency Plan

Mass Balance

- PRECIPITATION
- EVAPORATION
- INFLOW
- SPILLWAY OVERFLOW
- DOWNSTREAM RELEASE
- WATER TREATMENT PLANT
- WITHDRAWAL
SJWD Reservoir Simulation

- 6% to 14% reduction (from previous estimates)
- 2002 and 2007 droughts are significant
- Droughts potentially becoming more frequent and intense
AGENDA

- Background
- Safe Yield
- **SJWD Drought Plan**
- Conclusions
Current Supply Management
Previous Triggers

<table>
<thead>
<tr>
<th>Stage [feet above MSL]</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
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<tbody>
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<td>Phase 1: Incipient Drought</td>
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<td>Phase 2: Moderate Drought</td>
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<td>Phase 3: Severe Drought</td>
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<td>Phase 4: Extreme Drought</td>
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</table>

- Average Simulated Stage at 14.1 mgd Withdrawal

<table>
<thead>
<tr>
<th>PHASE 0 (normal)</th>
<th>PHASE 1 (incipient)</th>
<th>PHASE 2 (moderate)</th>
<th>PHASE 3 (severe)</th>
<th>PHASE 4 (extreme)</th>
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</thead>
<tbody>
<tr>
<td>0%</td>
<td>0%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
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<tr>
<td>No Restrictions</td>
<td>No Restrictions</td>
<td>Voluntary Conservation</td>
<td>Voluntary Conservation</td>
<td>Mandatory Conservation</td>
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</table>
Reservoir Simulation

(previous triggers, withdrawal = safe yield)
Potential Drought Indicators

- Reservoir Level (storage remaining)
- Streamflow
- Precipitation

![Reservoir Levels](North Tyger Reservoir 9%, Lyman Lake 40%, Lake Cooley 51%)
Simulation Analysis

Lyman Usable Volume Remaining
Cumulative Precipitation (in)

Cooley Usable Volume Remaining
Normal Cumulative Precipitation (in)

Note: Drought stages shown are based Lyman Lake volume only and come from 2003 Drought Contingency Plan.
New Indicators and Triggers

- **PHASE 1**: Incipient Drought
  - Normal Pool
  - Precipitation:
    - Normal
    - PHASE 1 (Incipient)
    - PHASE 2 (Moderate)
    - PHASE 3 (Severe)
    - PHASE 4 (Extreme)

- **PHASE 2**: Moderate Drought
  - Precipitation:
    - PHASE 1 (Incipient)
    - PHASE 2 (Moderate)
    - PHASE 3 (Severe)
    - PHASE 4 (Extreme)

- **PHASE 3**: Severe Drought
  - Precipitation:
    - PHASE 1 (Incipient)
    - PHASE 2 (Moderate)
    - PHASE 3 (Severe)
    - PHASE 4 (Extreme)

- **PHASE 4**: Extreme Drought
  - Precipitation:
    - PHASE 1 (Incipient)
    - PHASE 2 (Moderate)
    - PHASE 3 (Severe)
    - PHASE 4 (Extreme)
Reservoir Operational Strategy

- **PHASE 0 (Normal Conditions)**: 15 mgd Lyman
- **PHASE 1 (Incipient Drought)**: 16.0 mgd Lyman
- **PHASE 2 (Moderate Drought)**: 13.5 mgd Lyman
- **PHASE 3 (Severe Drought)**: 13.2 mgd Lyman
- **PHASE 4 (Extreme Drought)**: 12.6 mgd Lyman

**Demand / Withdrawal**
- Normal Conditions
- Extreme Drought
- Severe Drought
- Moderate Drought
- Incipient Drought

- 25% Cooley Reduction
- 35% Cooley Reduction
- 50% Cooley Reduction
- 60% Cooley Reduction

**System Reductions**
- 15% Total System Reduction
- 20% Total System Reduction
- 25% Total System Reduction
Reservoir Simulation
(previous triggers, withdrawal = safe yield)
AGENDA

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Conclusions

- Droughts more frequent and severe
- Safe yield not set-in-stone
- Drought plans should be system specific
- Reservoir optimization provides value
Advantages of Integrated Drought Planning

- Confidence in yield estimates
- Effective increase in Safe Yield
  - (20% for SJWD)
- Confidence in reservoir operation
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