Sustainable (?) Watershed Management Planning

City of Tucson
Water Plan 2000-2050
Define Goals

Resource and System Planning Goals

- Meet Projected Total Demand
- Utilize Renewable Resources
- Meet Water Quality Targets
- Achieve Sustainable Purposes
- Manage Costs and Rate Impacts
- Comply with Assured Water Supply

Planning Process

DEMAND
- Obtain Depiction of Current Water Use
- Develop Water Use Projections

SUPPLY
- Develop Water Supply Options
- Quantify Available Sources

Steps:
1. Conduct Scenario Planning Process
2. Evaluate Alternative Pathways and Identify Common Elements
3. Develop Recommended Plan
Innovative Planning Approach

One-Dimensional versus Scenario Planning

One-Dimensional Planning
- Outcomes
  - A
  - B
  - C
  - D

Scenario Planning
- Possible Futures
  - A
  - B
  - C
  - D

Background: Geography
Background: Geography

Historical Water Use

Beat the Peak Program
Value of Public Education

Projecting Demand

- Population
- Water use
  - per land use
    - Ag
    - Residential
    - Electric Power generation
    - Other commercial & industrial
  - per capita
    - Actual use by individuals
- Weather
Growth in Service Area

Demand Management

<table>
<thead>
<tr>
<th>Single-Family Residential GPCD*</th>
<th>Selected Western Cities</th>
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</thead>
<tbody>
<tr>
<td>95</td>
<td>Albuquerque, New Mexico</td>
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<tr>
<td>114</td>
<td>El Paso, Texas</td>
</tr>
<tr>
<td>120</td>
<td>Tucson, Arizona</td>
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<tr>
<td>123</td>
<td>Mesa, Arizona</td>
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<td>131</td>
<td>Glendale, Arizona</td>
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<tr>
<td>140</td>
<td>Tempe, Arizona</td>
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<tr>
<td>165</td>
<td>Phoenix, Arizona</td>
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<tr>
<td>169</td>
<td>Scottsdale, Arizona</td>
</tr>
<tr>
<td>230</td>
<td>Las Vegas, Nevada</td>
</tr>
<tr>
<td>286</td>
<td>Oro Valley, Arizona</td>
</tr>
<tr>
<td>242</td>
<td>Sacramento, California</td>
</tr>
<tr>
<td>261</td>
<td>Fresno, California</td>
</tr>
</tbody>
</table>

*Source: Data provided by utility representatives except for Las Vegas which was obtained from Western Resource Advocates (2003).

GPCD = gal/capita-day
## Available Water Resources

- **Groundwater**
  - Physically available
    - “Full depletion”: 18.5 million acre-feet
    - Sustainable model: 50-70,000 acre-ft/yr
  - GW Quality Concerns
    - Natural GW minerals
    - Impact of contaminants on overall availability and cost of water
    - Can limit use of existing production wells

## Available Water Resources

- Current projection indicate will pass “sustainable model” (50,000 acre-ft/yr) by around 2035
- Can use water from another district to replenish GW by 12,500 acre-ft/yr
  - Need to finalize agreement
  - Need to find appropriate storage location
Available Water Resources

Colorado River Water

336 miles of canals, tunnels & pumping plants

Available Water Resources

- State of Arizona has rights to 2.8 million acre-ft/yr
  - Yeah, right!
  - CA has been using part of AZ allocation for years
  - Currently AZ is using long-term banking facilities to store some of its “surplus”
Available Water Resources

Allocations in Tucson area (acre-ft/yr)

<table>
<thead>
<tr>
<th>Allocation Holder</th>
<th>Current Allocations</th>
<th>Pending Reallocations</th>
<th>Future Allocations</th>
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</thead>
<tbody>
<tr>
<td>City of Tucson</td>
<td>135,688</td>
<td>8,205</td>
<td>144,172</td>
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<tr>
<td>Community Water Company (Green Valley)</td>
<td>1,337</td>
<td>1,521</td>
<td>2,858</td>
</tr>
<tr>
<td>Flowing Wells Irrigation District</td>
<td>4,354</td>
<td>0</td>
<td>4,354</td>
</tr>
<tr>
<td>Green Valley Domestic Water Improvement District</td>
<td>1,000</td>
<td>0</td>
<td>1,000</td>
</tr>
<tr>
<td>San Xavier District (Tohono O’odham Nation)</td>
<td>27,000</td>
<td>23,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Schuit Toak District (Tohono O’odham Nation)</td>
<td>10,000</td>
<td>5,200</td>
<td>16,000</td>
</tr>
<tr>
<td>Tohono O’odham Nation</td>
<td>500</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>Town of Marana</td>
<td>47</td>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td>Metropolitan Domestic Water Improvement District</td>
<td>9,669</td>
<td>4,602</td>
<td>14,260</td>
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<tr>
<td>Town of Oro Valley</td>
<td>8,748</td>
<td>3,587</td>
<td>10,335</td>
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<tr>
<td>Spanish Trail Water Company</td>
<td>3,037</td>
<td>0</td>
<td>3,037</td>
</tr>
<tr>
<td>Arizona State Land Department</td>
<td>14,000</td>
<td>0</td>
<td>14,000</td>
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<tr>
<td>Vail Water Company</td>
<td>798</td>
<td>1,071</td>
<td>1,867</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>215,333</strong></td>
<td><strong>47,157</strong></td>
<td><strong>262,490</strong></td>
</tr>
</tbody>
</table>

Political Constraints

- Voters passed initiative in 1995 prohibiting direct use of Colorado River water
- Use only for recharge
  - 330 acres
  - 27 recover wells
  - Some surface water storage, blending
Storage & Recovery

Concerns with Colorado Water

- Tucson is at the end of the aqueduct...
- If temporarily off-line or drought, first to get hit
- Probability of shortage is 20-60% for a given year after 2020
  - Depends on weather & previous conditions
Wastewater Effluent

Effluent will grow with population
- About 121,000 acre-ft/yr by 2030
- About 128,000 acre-ft/yr by 2050
- Tucson gets about 50%

<table>
<thead>
<tr>
<th>Entity</th>
<th>Acre-Feet per Year</th>
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<tbody>
<tr>
<td>Tucson</td>
<td>32,739</td>
</tr>
<tr>
<td>Secretary of Interior</td>
<td>28,200</td>
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<tr>
<td>Pima County</td>
<td>3,886</td>
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<tr>
<td>Metropolitan Domestic Water Improvement District</td>
<td>3,074</td>
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<tr>
<td>Oro Valley</td>
<td>2,062</td>
</tr>
</tbody>
</table>
| TOTAL                                    | 68,061             

Wastewater Effluent

- AZ law does not allow direct use of treated effluent for potable water supply
- Can use indirectly through GW recharge and recovery
- Can also use it directly for non-potable uses
Wastewater Effluent

- Constructed wetlands for secondary treatment
- Recharge in basins after wetlands
- Class A reclaimed water

- 100 miles of transmission pipelines
- 600 customers (golf, parks, schools, industrial, some residential)
- 8% of total current demand
- Demand expected to increase from 10,900 to 20,200 acre-ft/yr by 2050

Demand vs. Supply
Water Delivery: Wellfields
Water Delivery: Pipelines

Water Delivery: Reclaimed
Water Delivery: Reclaimed

Water Delivery: Expansion

<table>
<thead>
<tr>
<th>Year</th>
<th>Projected Service Area (Population)</th>
<th>Water Demand (Acre-Feet)</th>
<th>Expansion Cost</th>
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<tr>
<td>2020</td>
<td>1.22 million</td>
<td>241,028</td>
<td>$500 million</td>
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<tr>
<td>2025</td>
<td>1.29 million</td>
<td>255,028</td>
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<tr>
<td></td>
<td>Total Estimated Cost</td>
<td></td>
<td>$550 million</td>
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Flexible Planning
### Flexible Planning

#### Common Plan Elements

- Acquire additional supplies
- Develop salinity mgmt program
- Encourage sewer connections
- Additional conservation programs
- Expand Public Outreach
- Pursue regional cooperation
- Reduce water losses in systems
Critical Decisions

What is an acceptable long-term minerals content?

- **DECISION #1 (2000)**
  - Mineral Content between 500 and 650 mg/L
    - No further action required.
  - Mineral Content of 450 mg/L
    - Implement Enhanced Treatment
      Tucson Water would need to install enhanced treatment trains at the Hayden-Udall Treatment Plant.
    - Implement Residuals Management
      Evaporation ponds would be constructed to dispose of the brine waste stream.
    - Implement Three-Points Well Field
      Construct new well field in the Three-Points area to provide additional ground water for blending.

Critical Decisions

Should Tucson expand recharge program?

- **DECISION #2 (2000)**
  - Expand Clearwater Recharge Program
    - Design, Construct & Operate SAVSARP Phase II
      - Expand SAVSARP capacity to 100,000 acre-feet per year of recharge with 80,000 acre-feet per year of recovery. This could provide additional recharge capacity for use by the Water Bank.
  - Implement Direct Treatment
    - Rehabilitate Hayden-Udall Treatment Plant
      - Directly-treat 50,000 acre-feet per year of Colorado River water and add to the blend.
  - Study Primary Disinfectants
    - The effectiveness and potential by-products of alternative disinfectants (e.g., UV, chlorine, ozone) should be studied.
Critical Decisions

Should effluent use be maximized?

DECISION #3
(2014)

Use Effluent Resource
Augment Recharge Program
Evaluate location to recharge effluent based on end use and other factors

Construct Effluent Pipeline
A pipeline to convey highly treated effluent to points of storage or reuse in Arava Valley or the Tucson basin should be constructed.

Continue Effluent Disposal
No further action required.

If effluent use is maximized, should it be stored or used as potable water supply?

DECISION #4
(2014)

Effluent to Augment Potable Supply
Initiate Effluent Enhanced Treatment
For effluent to be used to augment potable supply, it must undergo extensive treatment.

Initiate Effluent Residuals Management
Evaporation ponds would be constructed to dispose of the brine waste stream.

Effluent for Long Term Banking
No Further Action Required.
Costs...

<table>
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<tr>
<th>Family of Pathways</th>
<th>Pathway</th>
<th>Combined Costs (M$)</th>
<th>2020 ANNUAL PLAN (M$)</th>
<th>UNIT COST ($/1000 gallon)</th>
<th>Total Present Worth (M$)</th>
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<td></td>
<td>1</td>
<td>LA</td>
<td>$37.75</td>
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<td>XII-A</td>
<td>$37.75</td>
<td>$13.1500</td>
<td>$13.1500</td>
</tr>
</tbody>
</table>

*The 2020 Average Plan is only the water made available for use by implementing each pathway.
*The unit cost is based upon the estimated capital and O&M costs divided by the 2020 Average Flow for each pathway. The costs for every 100 gallons of new water supply fall into the above plan pathway.

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Final Plan (one pathway)
Final Plan (Pathway 10)

Timeline
### Key Points

- Planning for the future involves considering major uncertainties
- Flexible approach with clear “check points” better than rigid approach
- Focus on water supply may not result in a sustainable solution
- Reuse/recycle will be the wave of the future