6-10-2011

SLIDES: Long-Term Augmentation of the Water Supply of the Colorado River System

Les Lampe

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Navigating the Future of the Colorado River

Natural Resources Law Center Summer Conference

Long-Term Augmentation of the Water Supply of the Colorado River System

Helping to provide a clear vision of water augmentation in the Colorado River Basin

Colorado River Water Consultants CH2MILL · BLACK & VEATCH

June 10, 2011
The States will move forward with a package of other actions that include… initiation of a study for long-term augmentation of Colorado River System water supplies.”
The Purpose of the Project

- Evaluate major options for augmenting the Colorado River supply:
  - Environmental
  - Costs
  - Overall feasibility

- Prepare summary report on result

“CRWC to provide the technical assessment of options ... the States will provide legal, administrative, or institutional considerations.”

Exhibit A, Scope of Services, Agreement to Provide Professional Services
Meetings with states provided information on options

- Wyoming
- Colorado
- California
- Lower Colorado Region – Reclamation
- Nevada
- New Mexico
- Arizona
- Utah
- Upper Colorado Region – Reclamation
Twelve long-term augmentation concepts were initially identified and ‘white papers’ prepared

- Brackish water desalination
- Coalbed methane produced water
- Conjunctive use
- Ocean water desalination
- Power Plants - Reduction of consumptive use
- Reservoir evaporation control

- River basin imports
- Stormwater storage
- Vegetation management
- Water imports using ocean routes
- Water reuse
- Weather modification
Locations of augmentation options
Technical Memoranda drafted on six options designated by Technical Committee

- Brackish Water Desalination
- Conjunctive Use
- Ocean Water Desalination
- River Basin Imports
- Stormwater Storage (Painted Rock Reservoir)
- Vegetation Management
Assumptions used for costs of options

- Discount Rate: 5.0%
- Inflation Rate: 5.0%
- Operations Labor Rate: $50/hour
- Cost of Power: $0.08/kwh
- Unit cost: = annual cost/annual yield ($/AF)
- Annual cost: = amortized capital cost + O&M
- Period of amortization: 30 years
Brackish Water Desalting

Quantity Evaluated: 4,000 – 50,000 AFY
Cost: $700 – $2,000/AF
Coalbed Methane Produced Water

Quantity Evaluated:
3,000 – 20,000 AFY

Cost: $900 – $4,600/AF
Conjunctive Use Concept
Conjunctive Use Concept

Quantity Evaluated:
8,000 – 40,000 AFY

Cost: $400 – $700/AF

Explanation

- Semitropic Water Storage District
- Chino Groundwater Basin
- Hayfield Groundwater Storage Project
- Phoenix Active Management Area
- Pinal Active Management Area
- Tucson Active Management Area
Ocean Water Desalination Process

EXISTING
OPEN OCEAN
INTAKE / OUTFALL
STRUCTURE

INTAKE
SCREENS

TO
RESIDUALS
HANDLING

TRANSFER
PUMPS

MF/UF
MEMBRANES

OCEAN INTAKE

PRETREATMENT SYSTEM

Chlorine
Polymer
Coagulant
Acid

Sodium
Bisulfite

Antiscalant

Acid

HIGH PRESSURE
PUMPS

FIRST PASS RO

SECOND PASS RO
( IF REQUIRED )

REVERSE OSMOSIS SYSTEM

HIGH PRESSURE
PUMPS

ENERGY
RECOVERY
SYSTEM

CHLORINE
AMMONIA

POST
TREATMENT

REJECT
PUMP
STATION

STORAGE
TANK

TO OCEAN
OUTFALL

REJECT

FINISHED
WATER
PUMP
STATION

DISTRIBUTION SYSTEM

RESIDUALS HANDLING

TO OCEAN
OUTFALL

REJECT

PUMP
STATION

FINISHED
WATER
PUMP
STATION

DISTRIBUTION SYSTEM

RESIDUALS HANDLING

TO OCEAN
OUTFALL

REJECT

PUMP
STATION

FINISHED
WATER
PUMP
STATION

DISTRIBUTION SYSTEM

RESIDUALS HANDLING

TO OCEAN
OUTFALL

REJECT

PUMP
STATION

FINISHED
WATER
PUMP
STATION

DISTRIBUTION SYSTEM

RESIDUALS HANDLING
Ocean Water Desalination Concept

Quantity Evaluated:
20,000 – 100,000 AFY

Cost: $1,100 – $1,800/AF

- Desalt ocean water by reverse osmosis to drinking water standards and integrate into supply system
# Power Plants – Reduction of Consumptive Use

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Plant Capacity (MW)</th>
<th>Consumptive Use (AFY)</th>
<th>Water Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navajo</td>
<td>2,409</td>
<td>27,366</td>
<td>Lake Powell</td>
</tr>
<tr>
<td>Jim Bridger</td>
<td>2,312</td>
<td>25,266</td>
<td>Green River</td>
</tr>
<tr>
<td>Four Corners</td>
<td>2,270</td>
<td>22,515</td>
<td>San Juan River</td>
</tr>
<tr>
<td>San Juan</td>
<td>1,848</td>
<td>19,981</td>
<td>San Juan River</td>
</tr>
<tr>
<td>Hunter</td>
<td>1,441</td>
<td>18,968</td>
<td>Cottonwood Creek</td>
</tr>
<tr>
<td>Huntington</td>
<td>996</td>
<td>12,307</td>
<td>Huntington Creek</td>
</tr>
<tr>
<td>Bonanza</td>
<td>500</td>
<td>7,964</td>
<td>Green River</td>
</tr>
<tr>
<td>Reid Gardner</td>
<td>612</td>
<td>7,500</td>
<td>Muddy River</td>
</tr>
<tr>
<td>Naughton</td>
<td>707</td>
<td>6,081</td>
<td>Hams Fork River</td>
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<tr>
<td>Hayden</td>
<td>465</td>
<td>2,896</td>
<td>Yampa River</td>
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<tr>
<td>Carbon</td>
<td>189</td>
<td>2,679</td>
<td>Price River</td>
</tr>
<tr>
<td>Craig</td>
<td>1,339</td>
<td>2,534</td>
<td>Yampa River</td>
</tr>
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<td>South Point Energy Center</td>
<td>708</td>
<td>1,955</td>
<td>Colorado River</td>
</tr>
<tr>
<td>Desert Basin Power</td>
<td>646</td>
<td>1,810</td>
<td>Central Arizona Project Canal Water</td>
</tr>
<tr>
<td>Nucla</td>
<td>114</td>
<td>1,520</td>
<td>San Miguel River</td>
</tr>
</tbody>
</table>
Power Plants – Reduction of Consumptive Use

Quantity Evaluated:
Up to 160,000 AFY

Cost: $1,000 – $4,000/AF
Reservoir Evaporation Control

Quantity Evaluated (chemical covers):
  Up to 270,000 AFY

Quantity Evaluated (preferential storage):
  Up to 90,000 AFY

Cost: $500 – $2,000/AF

Options

- Chemical covers
- Preferential upstream storage
River Basin Imports

Quantity Evaluated: 30,000 - 700,000 AFY

Cost: Needs more refinement
Transbasin Imports
Mississippi River Diversion

Quantity: 675,000 AFY
Cost: $1,370 / AF
Stormwater Storage

Quantity Evaluated:
Up to 100,000 AFY
(but unreliable)

Cost: $600+/AF

Painted Rock Control Tower, photo credit: USACE
Vegetation Management
Location 1: Lower Virgin River

Quantity Evaluated: 17,000 AFY
Cost: $100 /AF

Concept:
- Saltcedar removed by *spraying and burning*; ongoing revegetation and spraying as needed
Vegetation Management Location 2: Lower Colorado River

Quantity Evaluated: 154,000 AFY

Cost: $30 /AF

Concept:
- Saltcedar removed by *leaf beetles*; ongoing revegetation and spraying as needed
Water Imports Using Ocean Routes

Quantity Evaluated:
10,000 – 300,000 AFY

Cost: $1,400 – $4,000/AF

Options
- Undersea Aqueduct
- Tankers
- Towing Water Bags
- Towing Icebergs
Water Reuse

Quantity Evaluated:
20,000 – 800,000 AFY

Cost: $900 – $1,700/AF

Concept
- Reuse Colorado River-derived wastewater in large urban areas

Irrigation using reclaimed water
Weather Modification

Quantity Evaluated:
150,000 – 1,400,000 AFY

Cost:
$20 – $30/AF

Weather Modification Programs in Western U.S.
# Augmentation Quantities and Costs

<table>
<thead>
<tr>
<th>Method</th>
<th>Annual Yield Evaluated (Acre-Feet per Year)</th>
<th>Cost ($ per Acre-Foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brackish Water Desalination</td>
<td>4,000 – 50,000</td>
<td>$700 - $2,000</td>
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<td>Coalbed Methane Produced Water</td>
<td>3,000 – 20,000</td>
<td>$900 – $4,600</td>
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<tr>
<td>Conjunctive Use</td>
<td>8,000 – 40,000</td>
<td>$400 – $700</td>
</tr>
<tr>
<td>Ocean Water Desalination</td>
<td>20,000 – 100,000</td>
<td>$1,100 – $1,800</td>
</tr>
<tr>
<td>Power Plants - Reduce Consumptive Use</td>
<td>1,500 – 160,000</td>
<td>$1,000 – $4,000</td>
</tr>
<tr>
<td>Reservoir Evaporation Control</td>
<td>0 – 270,000</td>
<td>$500 – $2,000</td>
</tr>
<tr>
<td>River Basin Imports</td>
<td>30,000 – 700,000</td>
<td>Needs more refinement</td>
</tr>
<tr>
<td>Stormwater Storage</td>
<td>0 – 100,000</td>
<td>$600+</td>
</tr>
<tr>
<td>Vegetation Management</td>
<td>20,000 – 150,000</td>
<td>$30 – $100</td>
</tr>
<tr>
<td>Water Imports Using Ocean Routes</td>
<td>10,000 – 300,000</td>
<td>$1,400 – $4,000</td>
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<td>$900 – $1,700</td>
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<tr>
<td>Weather Modification</td>
<td>150,000 – 1,400,000</td>
<td>$20 – $30</td>
</tr>
</tbody>
</table>
Importance of Augmentation Projects to the Basin

“Implementation of projects to augment the long-term supply of the Colorado River is of utmost importance not only to the Basin States and the millions of people who live here, but to the nation as a whole.”

June 10, 2011 • 26
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