Recovery Planning Advisory Group (RPAG)

Agenda – Modeling Meeting

• Intro & Welcome
• Q&A from Meeting #1
• Key Questions
• Priority Pools – Shortage & Firming
• On-River – Shortage & Firming
• Modeling Tools
• Updated Modeling
  - Timing, Volume, Likelihood
  - Factors Influencing Recovery
• Next Meeting (May)
Schedule

• Background & Overview of 2014 Joint Recovery Plan to Present (Meeting 1)
• Updated Modeling (Meeting 2)
  - Risk tolerance
• Methods & Credit Distribution (Meeting 3)
  - Joint Recovery Plan and SUA
  - Stakeholder proposals
• Projected Recovery Costs (Meeting 4)
• Synthesis of information from previous meetings (Future meetings)
• Other Topics Important to Stakeholders
Key Questions

• How much recovery capacity is needed?

• When will recovery occur?
  – Instate recovery of AWBA Credits is triggered when reduction to the supply impacts the deliveries to CAP and on-River users for which the AWBA has a firming requirement.
  – Interstate recovery is triggered by requests from Nevada in shortage and non-shortage years.

Key Questions

• To address “How much & when?” we will go through three steps:
  1. Shortage impacts to deliveries
     – CAP & On-River
  2. Timing & magnitude of shortages
     – CRSS modeling
  3. Combined recovery results
     – Recovery modeling & risk tolerance
Shortage Impacts to Deliveries

CAP Priority Pools (current use)
CAP Priority Pools – ‘07 Guidelines

- **Indian Priority**
- **M&I Priority**
- **Other Excess**

**2007 Guideline Reductions to AZ**
- Ag Pool: 320,000
- NIA Priority: 480,000
- Firmed by AWBA

CAP Priority Pools – LBDCP

**LBDCP Reductions to AZ**
- 192,000
- Ag Pool: 512,000 (320k + 192k)
- NIA Priority: 592,000 (400k + 192k)
- Firmed by AWBA
Additional Considerations

- RPAG modeling does not assume changes in use behavior in response to shortages
- Changes demand management/conservation, and Long-term Storage Credit accrual could affect recovery volumes
Alternate Demand Assumptions

Impact of a Tier2 + DCP (512 kAF) reduction to CAP priority pools, based on current usage

Baseline

-5% Municipal Demand

-5% Municipal Demand & -40% in LTSCs

On-River Priority 4 (Current Use)

LBDCP
Reductions to AZ
(with corresponding reductions to on-River P4, based on ADWR Director’s 2006 AZ shortage sharing recommendation)

Acre Feet

On-River Priority 4 Diversion Entitlements for 512 kAF

Agricultural Use 59 KAF

M&I Use 36 KAF

192,000

512,000

592,000

640,000

720,000

2016 Use: 95,436 AF Diversion (59,210 AF CU)

Firmed by AWBA
On-River Priority 4 (2045 @ 100% M&I)

- **M&I Use**: 103 KAF
- **Firmed by AWBA**: 592,000

Reductions to AZ (with corresponding reductions to on-River P4, based on ADWR Director's 2006 AZ shortage sharing recommendation)

**Timing & Magnitude of Shortages**
Modeling Tools

RiverWare modeling software
- Water resource planning
- Operational decision-making
- System optimization
- Water accounting
- Water rights administration

Reclamation RiverWare models
1. Colorado River Simulation System (CRSS)
2. Mid-Term Operations Model (MTOM)
3. 24-Month Study Model

Modeling Tools

<table>
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<th>Attribute</th>
<th>24-Month Study</th>
<th>MTOM</th>
<th>CRSS</th>
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<td>Primary Use</td>
<td>Projections of current conditions</td>
<td>Risk-based operational planning and analysis</td>
<td>Long-term planning studies and risk analysis</td>
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<td>Probabilistic or Deterministic</td>
<td>Deterministic (single hydrologic trace)</td>
<td>Probabilistic (35 hydrologic traces)</td>
<td>Probabilistic (110 hydrologic traces)</td>
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<td>Simulated Reservoir Operations</td>
<td>Fixed operations</td>
<td>User-defined rule-based operations</td>
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<td>Time Horizon (Years)</td>
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<td>5</td>
<td>50+</td>
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<td>Upper Basin Inflow</td>
<td>Single-trace unregulated inflow forecast (CBRFC)</td>
<td>Multi-trace unregulated inflow forecast (CBRFC)</td>
<td>Natural inflow based on historical, paleo-, or climate driven hydrology</td>
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<td>Upper Basin Demands</td>
<td>Estimated in unregulated inflow forecast</td>
<td>Based on UCRC schedules</td>
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<tr>
<td>Lower Basin Demands</td>
<td>Based on LB demand schedules</td>
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Major Inputs to CRSS

- Full basin model from the headwaters of the mainstem and major tributaries, down to the Northerly International Boundary with Mexico
- Simulates the system on a monthly time step over decades to assess long-term system conditions
- Gives a range of potential future conditions
  - Reservoir levels
  - Releases
  - River flows
- Physical layout
  - Reservoirs: 12
  - Diversions: ~225
  - Natural inflow points: 29
- Model Components: 365 objects
  - Feature of basin (ex. Reservoir, Data, Reach)
- Outputs of Interest
  - Lake Mead elevation
  - Lake Powell elevation, inflow, release
  - Delivery reductions

CRSS Features
Modeling Assumptions for RPAG

- CRSS Model
  - October 2017 version
- Hydrology
  - 110 years (DNF; Observed Hydrology)
- Operational Rules
  - DCP, No Absolute Protect
- CAP full buildout by 2045
- On-River full conversion of P4 Ag to Muni by 2045

Combined Recovery Results
### AZ Shortage Volumes

#### Years

| Year | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|

#### Runs

The result of a single hydrologic "trace" run through CRSSS.
M&I Recovery Volumes

M&I Recovery

M&I Recovery Volumes
Sorted, Low-to-High, Each Year

2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044

140,000

Mean

50th

25th

10th
M&I Recovery Volumes
Sorted, Low-to-High, Each Year

Recovery Volumes

On River

NIA

M&I

Total
Recovery Volumes – Adjusted Scales

Recovery Volumes – Adjusted Scales
Recovery Volumes – On-River

Recovery Volumes – NIA
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**Recovery Volumes – Total In-State**

**Recovery Volumes – In-State**
Recovery Volumes – Total In-State

-5% Municipal Demand &
-40% in LTSC accrual

Nevada Recovery Volumes
Nevada Recovery Volumes

Conclusions

- LBDCP reduces the probability of critically low reservoir elevations, but the deeper defined reductions increase NIA and M&I recovery compared to the 2014 Joint Plan
- The volume and timing of recovery is uncertain, but can be evaluated probabilistically
- Using percentiles provides a way to evaluate risk and tradeoffs
Discussion

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Wrap Up

• Questions/Comments
• Next possible meeting dates:
  – May 8, 9, 22, 23
• Will send a Doodle Poll to confirm best availability
• Contact Jeff Inwood with questions or comments jinwood@azwater.gov