RECLAMATION

Managing Water in the West

Using CRSS to Explore Shortage Studies on the Lower Colorado River

RiverWare User Group Meeting
Boulder, CO
March 2005

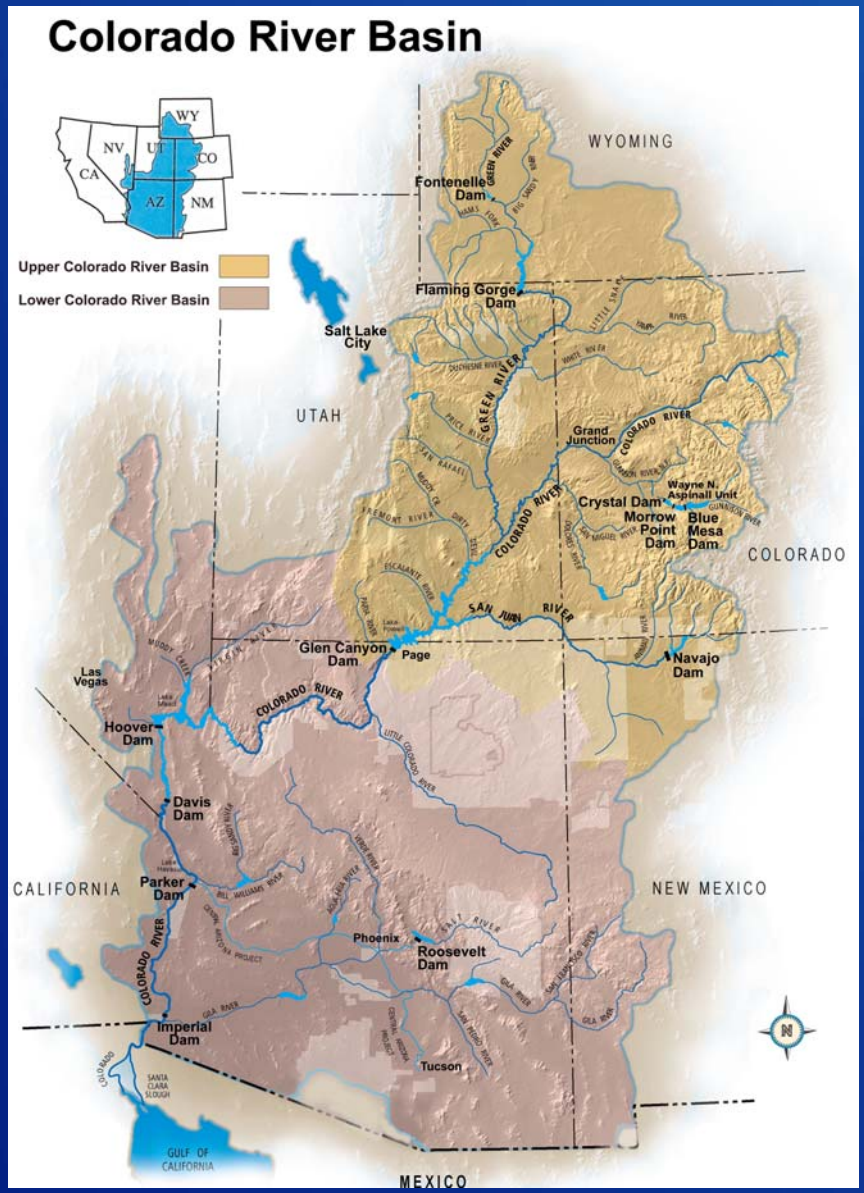
U.S. Department of the Interior
Bureau of Reclamation

AGENDA

- System Overview
- The Drought
- Modeling Objectives and Approach
- Modeling Assumptions
- Overview of Scenarios
- General Results

RECLAMATION

Colorado River Basin Overview



- Over 1,450 miles in length
- Basin makes up about 12% of total U.S. lands
- 60 MAF of total storage
- Average “natural” annual inflow of 15 MAF
- Irrigates 3 million acres
- Serves 30 million people
- Generates 10 billion KWh of electricity
- Provides more than 30 million visitor-days of recreation

RECLAMATION

Colorado River Basin Drought

- Worst drought in 100 years of recordkeeping
- Below average runoff every year, 2000-2004
  - 25% in 2002
- System is currently half full
  - Was over 90% full in 1999

RECLAMATION

Mid-Term Droughts - Colorado River
(Average 100 year natural flow 15.1 maf)

Years	Duration	Average Flow
1931-1935	5 years	11.4 maf
1953-1956	4 years	10.2 maf
1959-1964	6 years	11.4 maf
1988-1992	5 years	10.9 maf
2000-2004	5 years	9.9 maf *

* Estimated

RECLAMATION

Lake Powell at Hite Bay
Circa 1999

RECLAMATION

IIIc

Lake Powell at Hite Bay
March, 2003

RECLAMATION

IIIc

Lake Mead's Delta Area Circa 1999

RECLAMATION

Lake Mead's Delta Area
November, 2003

RECLAMATION

Colorado River Basin Storage
(as of February 17, 2005)

Current Storage	Percent Full	1000 Ac-Ft	Elev. (Ft)
Lake Powell	34%	8,333	3560.13
Lake Mead	59%	15,357	1139.67
Total System Storage	51% *	30,531	NA

*Total system storage was 32,317 kaf or 54% this time last year

RECLAMATION

What will it take to refill Lake Powell and Lake Mead?

- With average inflow and current demand projections, it would take Lake Powell decades to refill; Lake Mead would not re-fill
- The good news is that we “never get average” hydrology!
- It will take a ‘cycle’ of wet hydrology to refill Lake Powell and Lake Mead
- 1983-1984 hydrology would refill to 88 percent of capacity

2005 Lake Powell Inflow Scenarios *

Scenario	WY 2005	April – July
Minimum Probable	82 %	75 %
Most Probable	110 %	113 %
Maximum Probable	138 %	153 %

* Based on 2/15/05 forecast

RECLAMATION

Drought Mitigation Measures

- To date, there has never been a shortage in the Lower Basin
- There are currently no shortage guidelines
- At the request of the Secretary of the Interior, the seven Basin States are discussing potential short-term and long-term drought mitigation measures
  - Short-term measures include improved system efficiencies
  - Long-term measures may include ways to decrease demands
  - Basin states technical team is investigating various operational scenarios; Reclamation provides technical assistance
- Secretary announced in December 2004, that the Department will initiate a process to adopt shortage guidelines for the Lower Basin before the end of her term.

Modeling Objectives

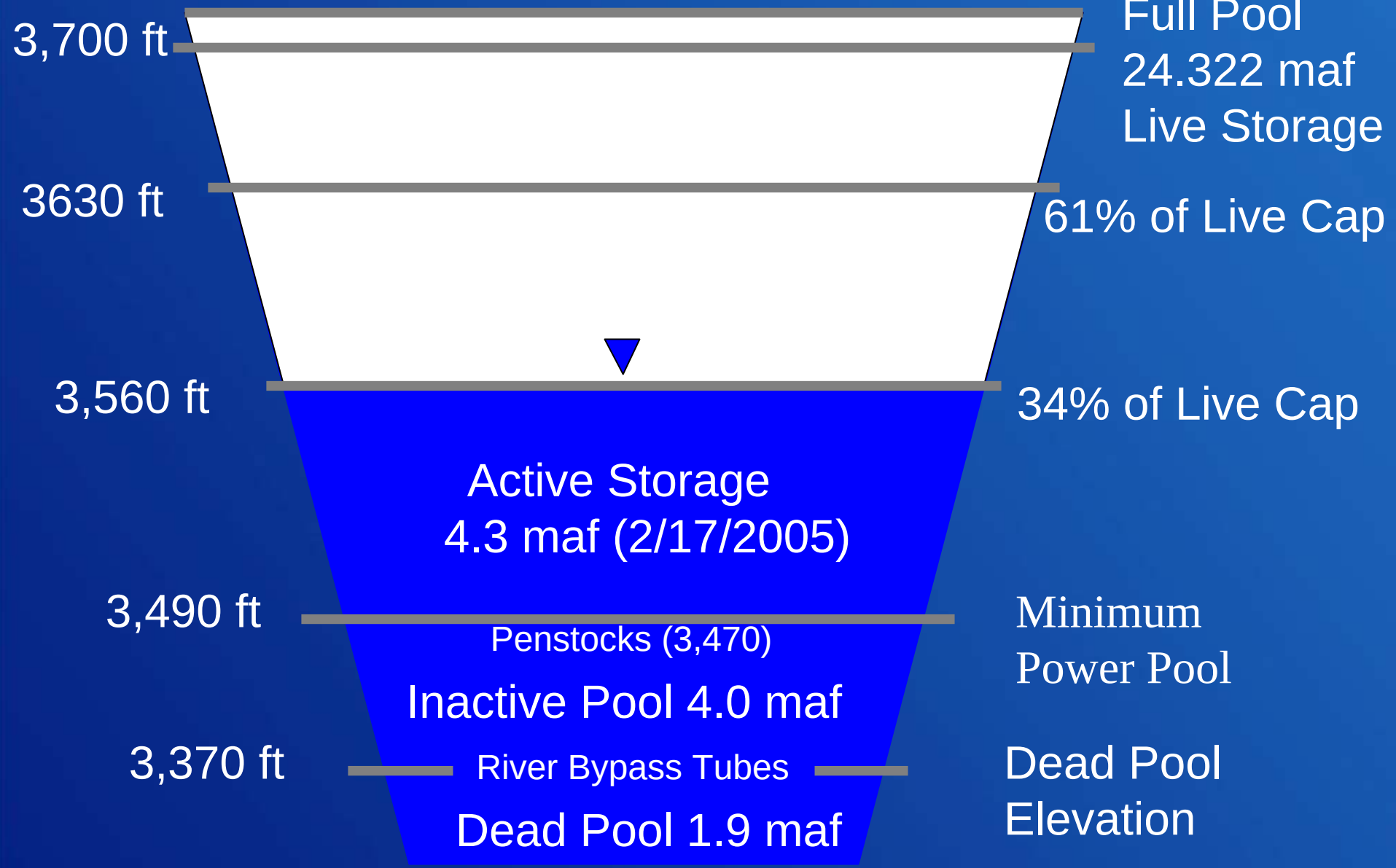
- Use CRSS to investigate the response of the system to:
  - a range of future inflows
  - a range of potential drought management options
  - focus is on protecting levels in Lake Powell and Lake Mead
- Determine the basis for future discussions with regard to:
  - the onset of possible shortages
  - the magnitude of possible shortages

How Might We Protect Specific Reservoir Elevations?

Develop rules in RiverWare to determine:

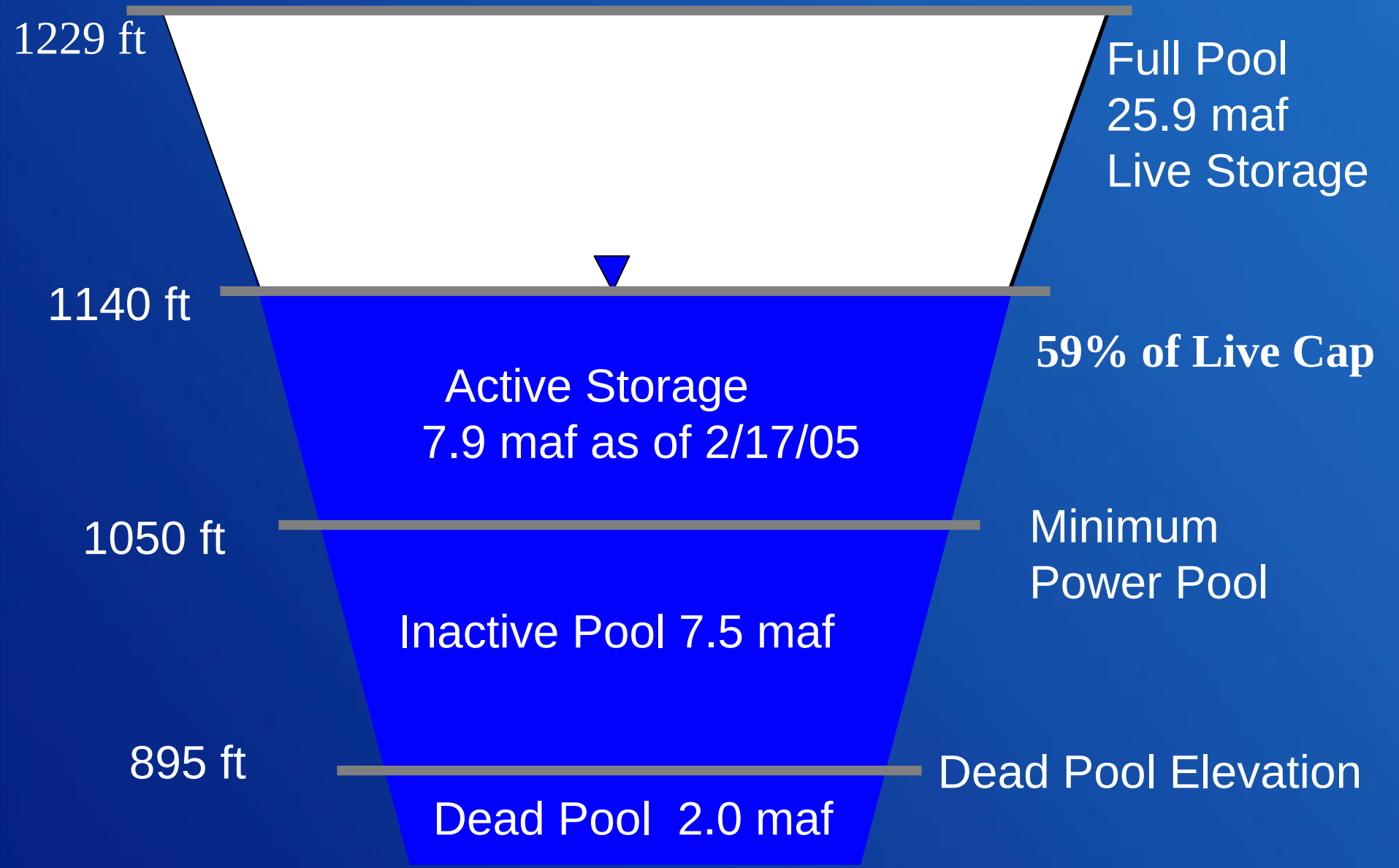
- when a reduction in release should occur to keep the reservoir above a specified elevation
- how much reduction in release is required to keep the reservoir above a specified elevation

Lake Powell Capacity



RECLAMATION

Lake Mead Capacity



RECLAMATION

Modeling Approach

- Initial reservoir conditions set to projected January 1, 2005 levels from May 2004 24-month Study
- Future hydrology generated from historical record of natural flows (1906 – 1995) using the Index Sequential Method (ISM)
- Model runs on a monthly time step from 2005 through 2076
- 90 simulations were generated
- Analysis through 2025

Modeling Approach - a note on ISM

- Con: no new sequences
- Surplus EIS modeling done in CY 2000
  - Absolute min at Lake Mead was not predicted
    - 1137.61 vs. 1130.01
    - Reason: sequence was not seen in historical record
- Moving toward stochastic hydrology
  - Currently two projects underway
    - Parametric approach
      - CSU (Salas/TSC)
    - Non-parametric approach
      - CU (Prairie/Balaji)

Modeling Assumptions
Common to All Scenarios

- “Worse case” assumes the 1953 – 1973 sequence is repeated in 2005 – 2025
- “Average case” assumes 1926 inflow is repeated each year in the future
- All historical sequences (90 possibilities) were also studied to project the probabilities of future events

Overview of 21 Scenarios Studied

- "Protect" Lake Mead
  - No protection (dead pool, 895 ft.)
  - Protect 1000 ft. (lower SNWA intake)
  - Protect 1050 ft. (upper SNWA intake and current minimum power pool)
- "Protect" Lake Powell
  - No protection (dead pool, 3370 ft.)
  - Protect 3490 ft. (minimum power pool)
- Implement "water savings" in the Lower Basin
  - Assume no savings
  - Assume savings of 100 kaf in 2006, 150 kaf in 2007, and 200 kaf in 2008 and beyond

Modeling Results

For the “Worse case,” with no protection of Lake Powell or Lake Mead:

- Lake Powell would not equalize in the period 2005-2025
- Lake Powell would be at “dead pool” in 2008 and would remain below elevation 3600 ft through 2025
- Lake Mead would decline throughout the period and be nearly at “dead pool” by 2025
- Shortages in the Lower Basin would first occur in 2014 and continue throughout the period

Modeling Results

For the “Worse case,” with protection of minimum power pool at both Lake Powell and Lake Mead:

- Lake Powell would not make minimum objective release in WY 2007 and 2008
- A shortage would first occur in the Lower Basin in 2007

Modeling Results

For the “Average Case,” with no protection of Lake Powell or Lake Mead:

- Lake Powell would begin equalization releases in WY 2009
- It would take decades for Lake Powell to re-fill
- Lake Mead would never re-fill but would stabilize near elevation 1110 feet

Modeling Results

For all hydrologic scenarios:

- With no protection at Lake Powell and Lake Mead, there is negligible chance of shortage in the first 5 years
- With protection of minimum power pool at both lakes, the chance increases to 10% in the first five years
- With no protection at Lake Powell and Lake Mead, there is 14% chance of shortage in the first 10 years; with protection of minimum power pool at both lakes, the chance increases to 51%
- Saving 200,000 acre-feet per year in the Lower Basin will delay the onset of shortage by 2 years and decrease the magnitude of the cumulative shortages significantly (approximately 30%)

Adoption of Specific Lower Basin Shortage Guidelines

- A longer term process
- Specific environmental compliance required
- Example: Interim Surplus Guidelines adopted in January, 2001
  - 20 months from initiation of NEPA process to the Record of Decision
- Estimated Shortage ROD signed May 2007

RECLAMATION


Questions?