# 05 – 06 Experimental Update on Fine-Sediment TWG Meeting – February 3, 2005

- ✓ Review Paria River Sediment Trigger & Activity (WY's 2004-05)
- ✓ Preliminary Results of Sand-Bar Area and Volume Changes as Measured in the Long-Term Monitoring Sites Measured Repeatedly by the Northern Arizona University, Geology Department
- ✓ Preliminary Results of the Suspended-Sediment Mass Balance for Marble Canyon for July 2004 through January 2005, as Estimated by the USGS

Preliminary Data – Subject to Review and Revision 02/02/05

USGS

# Paria River Provides the Key Sand Inputs in the Post-Dam Era

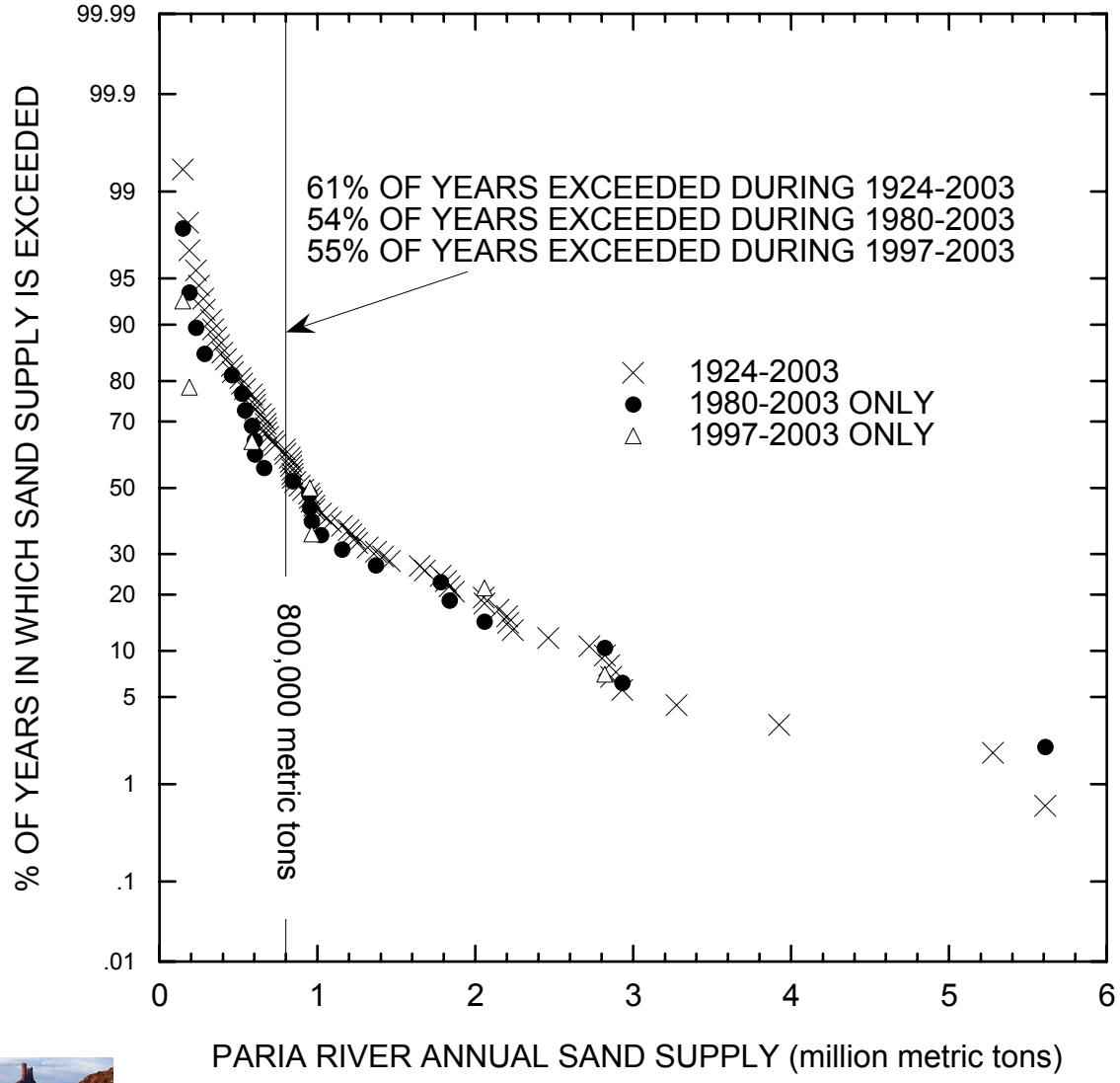



- Typically, inputs contain about 50% sand and 50% fines
- Concentrations as high as 1,000,000 mg/l (a world class muddy stream!)
- Average Annual Sand Input ~1.4 million metric tons
- Median Sand Grain Size ~ 115 μm (fine)
- Located 15 Miles Below Glen Canyon Dam
- Bars Structure Fish Habitats!

**Preliminary Data – Subject to Review and Revision 02/02/05**

# Basis for Experimental Design Relating to Paria River Sand Trigger

(Testing the concept of sand bar response under a relatively frequent sand enrichment condition of about 800,000 tons)

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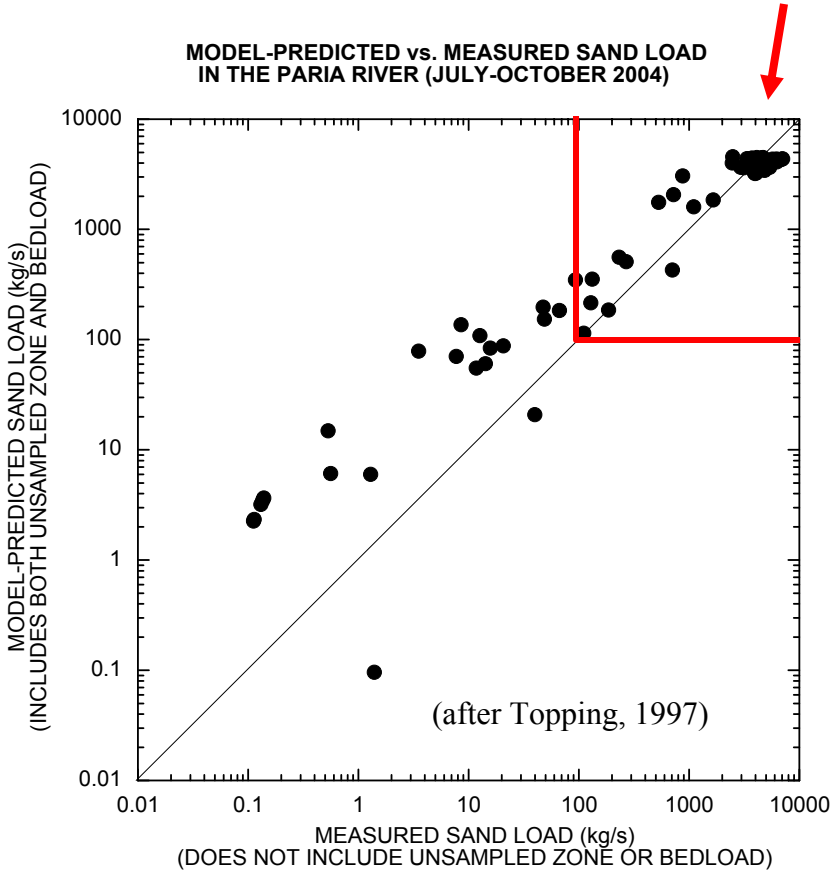
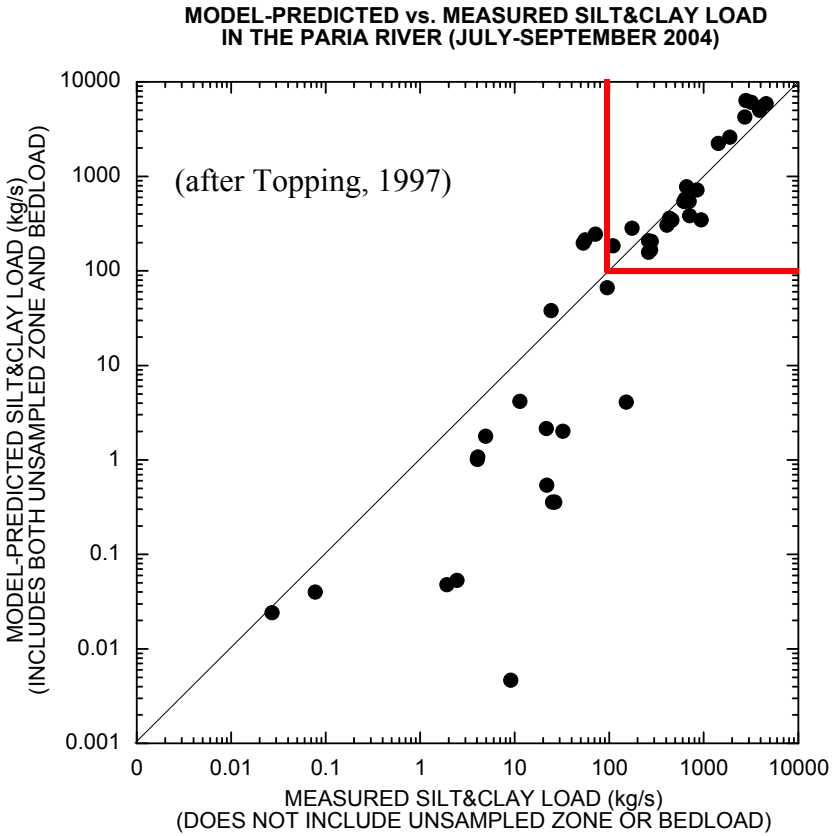
# Real-Time Estimation for Sand Inputs in Support of Experimental Triggering at Paria River

With Respect to Sand for events above 1,000 cfs, the model Works Extremely Well!




MEAN DIFFERENCE: MODEL IS 7% LOW RELATIVE TO MEASUREMENTS
INTEGRATED DIFFERENCE: MODEL IS 7% LOW RELATIVE TO MEASUREMENTS

n=93




MEAN DIFFERENCE: MODEL IS 36% HIGH RELATIVE TO MEASUREMENTS
INTEGRATED DIFFERENCE: MODEL IS 36% HIGH RELATIVE TO MEASUREMENTS

n=52

# SOP for Reporting on Paria River Sand Inputs

Monitor storm activity & runoff from 3 “real-time” gages

**Event Responses** – field crews make flow measurements & collect conventional SS samples (even if it’s cold, dark and rainy).

**Modeling Estimated Inputs** – the Arizona District (WRD) of USGS reports preliminary flow hydrograph and the Paria model predicts sand and fine-sediment loads and grain sizes

**Delivery of Preliminary Results** – the results are relayed through the GCMRC and the BuRec is notified and briefed (recently, this whole sequence has occurred in as little as 12 hours)

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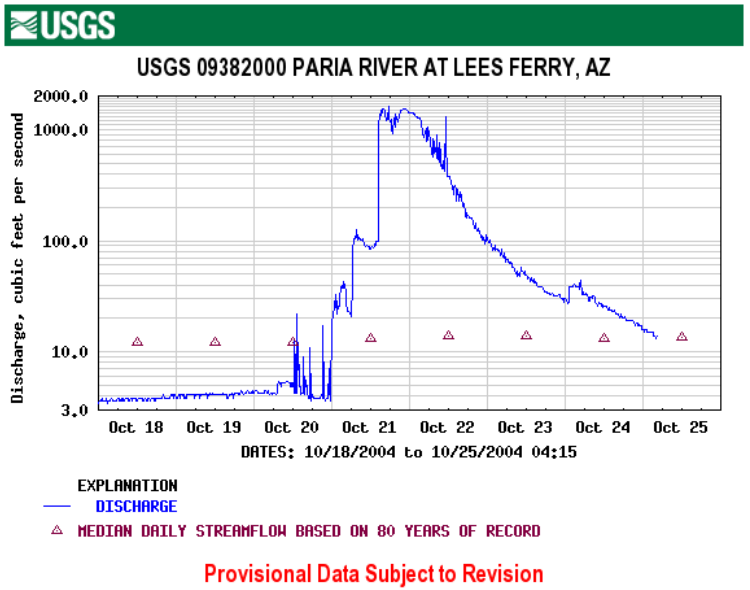
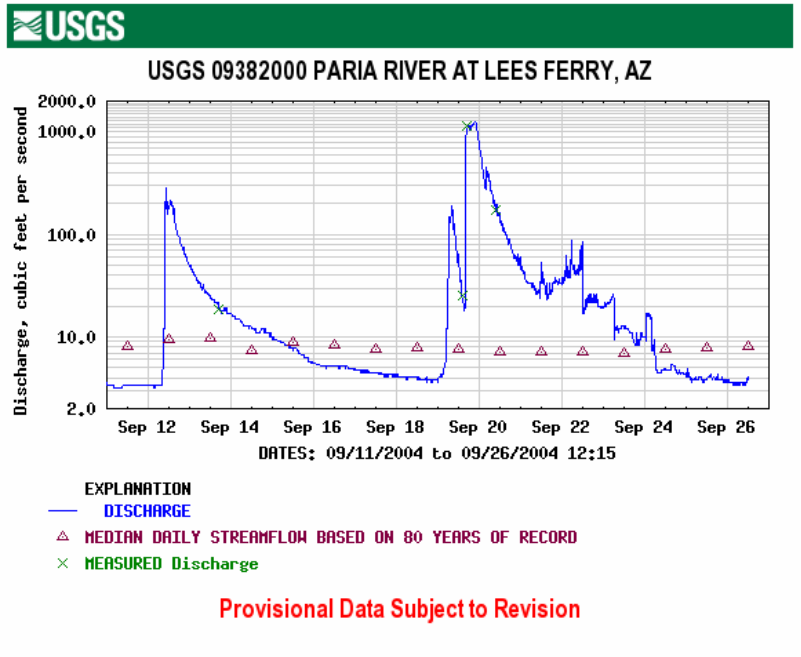
# Ex Post-Facto Evaluation of the 2004 Warm-Season Sand Inputs from Paria River

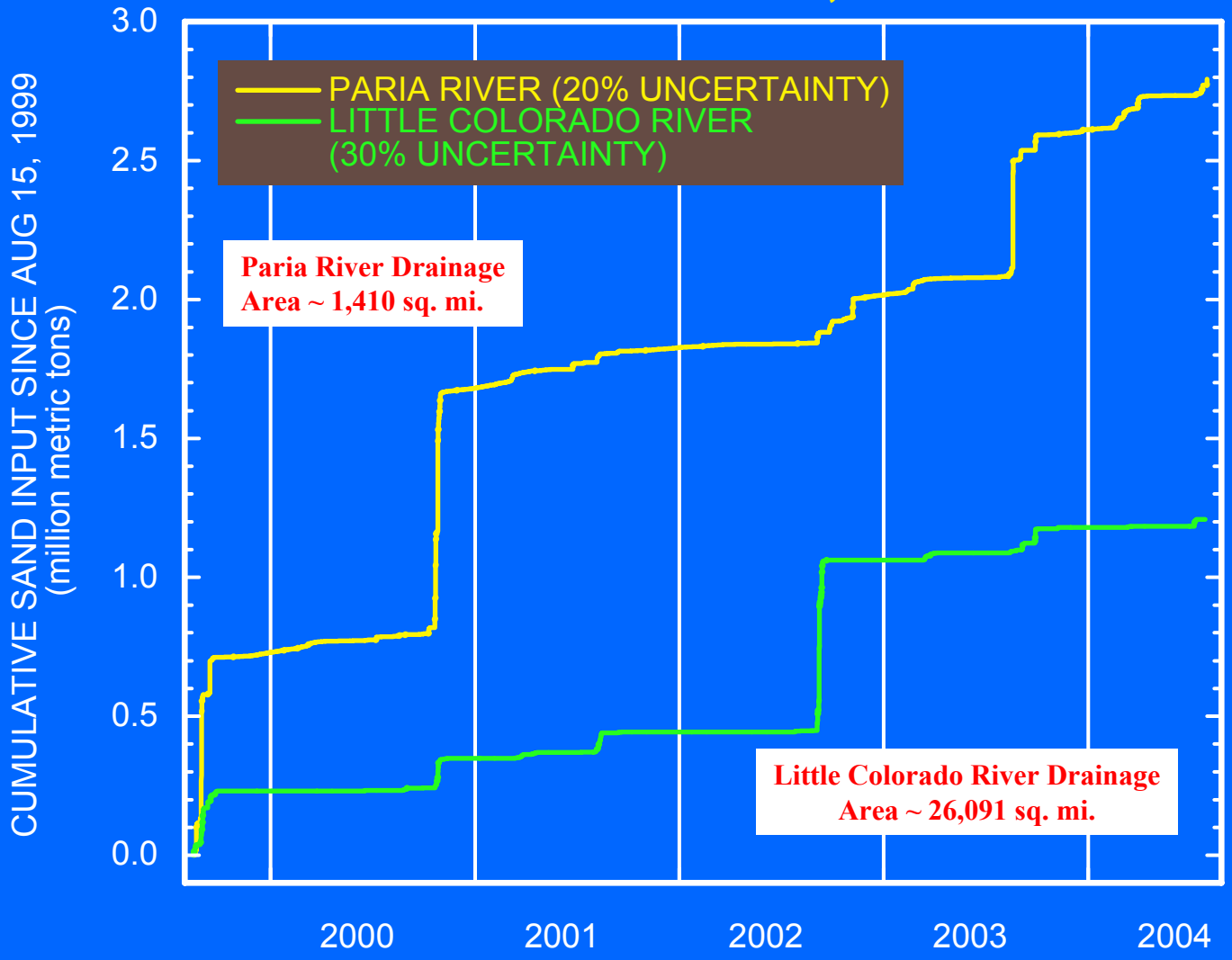
Warm-Season PPT started with Some Early "monsoon" activity, But Cumulative Rainfall was Scant Until after September 1st, when Dam Operations were Abruptly Reduced




Tropical Storms Came Late in the Warm Season with Largest Events Occurring in Late October and Early November – From an Experimental Perspective, Total Sand Inputs Were About Equal to the Long-Term Annual Median of About 800,000 metric tons.

# TRIBUTARY SAND INPUT BETWEEN THE LEES FERRY AND GRAND CANYON GAGES SINCE AUGUST 1, 1999

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# Results of Sep 2003 vs. Dec 2004 NAU Sand Bar Surveys

Of the 12 Sites in Marble Canyon Where Sand-Bar Surveys Have Been Repeated Annually Since 1990:

**Upper Marble Canyon Response** – Total Bar Area increased by 27% and Volume was increased by 55%.

**Lower Marble Canyon Response** – Total Bar Area was increased by only 2%, while Total Bar Volume increased by 15%.

**Contrasting Response** - Upper MC Bar Volume Response was Almost 4X Greater than in Lower MC

Preliminary Results – Subject to Review and Revision 02/02/05

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# NAU Sand Bar Surveys: 1996 vs. 2004

Of the Sites in Marble Canyon Where Sand-Bar Surveys Have Been Repeated Annually Since 1990:

**Upper Marble Canyon Response** - 2/3 of the sites in Upper Marble Canyon Were Larger with respect to Area and Volume after the 2004 Test than they were after the 1996 BHBF Experiment (in Dec 2004, the total area of Upper MC sites was back to 1990 level and there was 10% more sand volume!)

Lower Marble Canyon Response – Only 1/3 of the sites measured after the 2004 test were larger than they were following the 1996 BHBF Experiment (in Dec 2004, the total area was 23% less and the total volume was 4% less than that measured in 1990)

2004 Experimental Sand Mass Balance – of the approximately 800,000 metric tons input into Upper Marble Canyon in Jul-Nov 2004, approximately 200,000 metric tons were retained in the reach above river mile 30, following the Nov High-Flow Test (the only documented positive result in Upper Marble Canyon during a high-flow release since high-resolution mass-balance began in August 1999.)

**Preliminary Data – Subject to Review and Revision 02/02/05**

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# Update on Recent Fine-Sediment Inputs

**The Paria River peaked at 3,100 cfs on Jan 11, 2005**

**This was the largest peak since Oct 2000 and second largest since Sept 1998**

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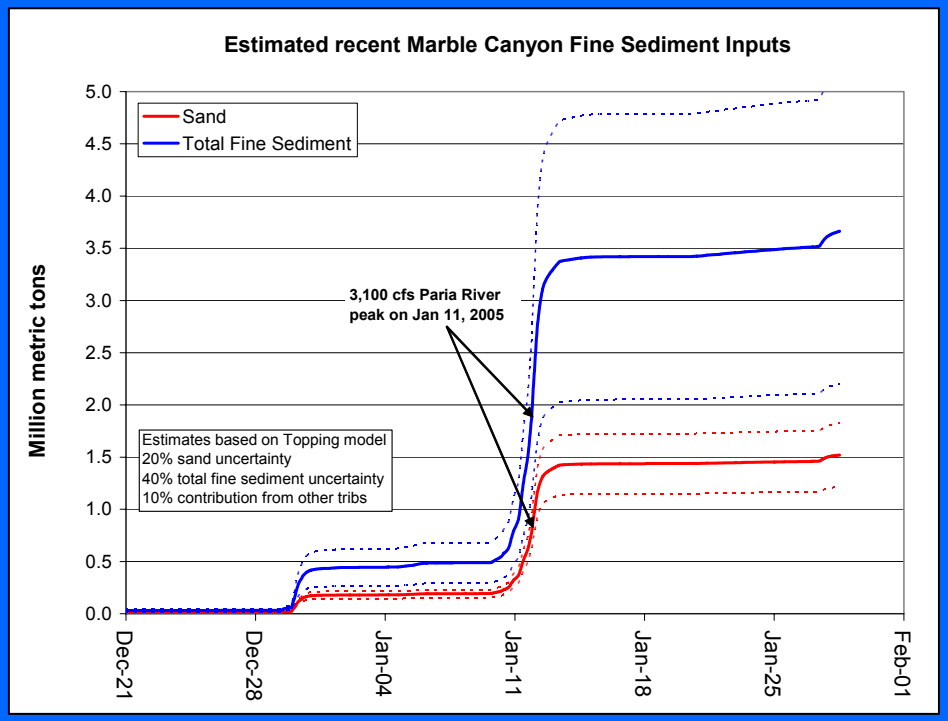


## Input Summary: Dec 1 – Jan 31

***Paria River + Marble tribs***

Sand: 1.2 – 1.8 Million metric tons (Mmt)

Total Fines: ~2.2 – 5.1 Mmt

***Little Colorado River***

Sand: 0.23 – 0.38 Mmt

Total Fines: perhaps 7x

**Export:** **0.2 – 0.5 Mmt sand past 30-mile since Jan 1, 2005**

**Retention:** **0.7 – 1.6 Mmt of sand retained above 30-mile in Marble Canyon**

**Export rate:** **Without further inputs, export is about 0.1 Mmt sand every two weeks under 5-20k flows (export is higher immediately following inputs).**

**Note: These numbers are preliminary and subject to change. In particular, the export numbers had to be estimated for the periods of highest export. Thus, processing of samples in the lab could significantly alter these numbers.**

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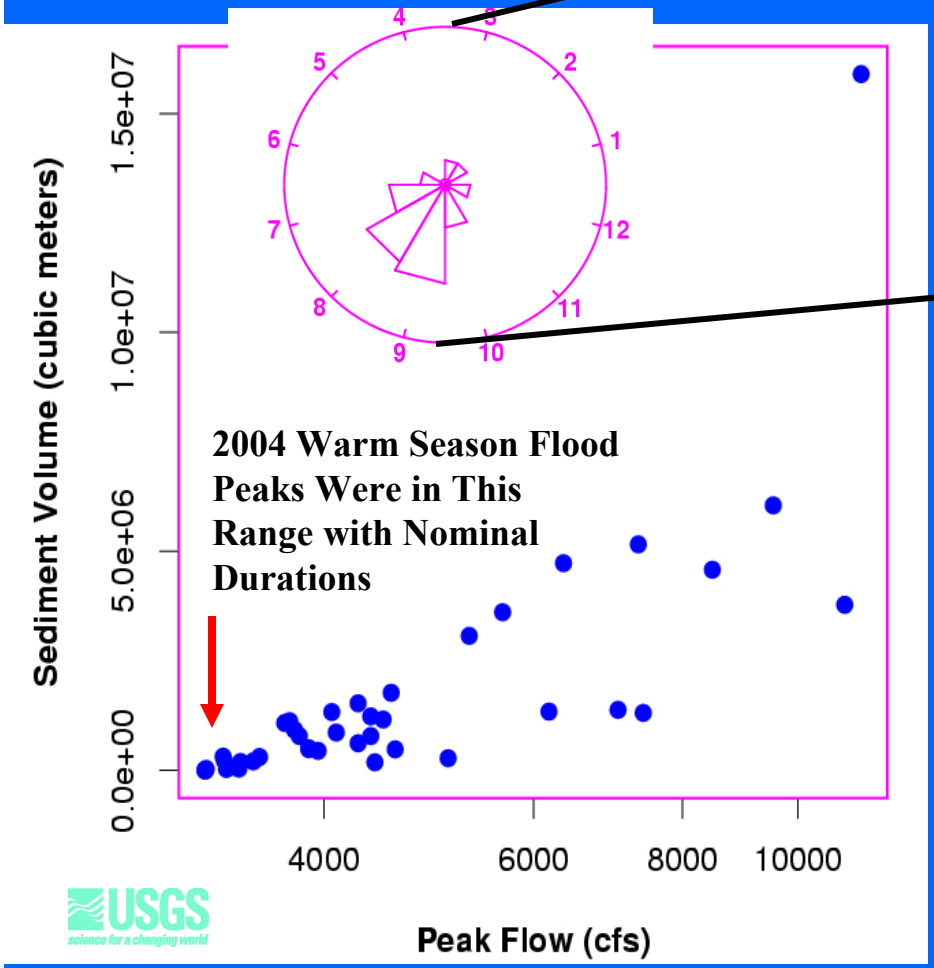
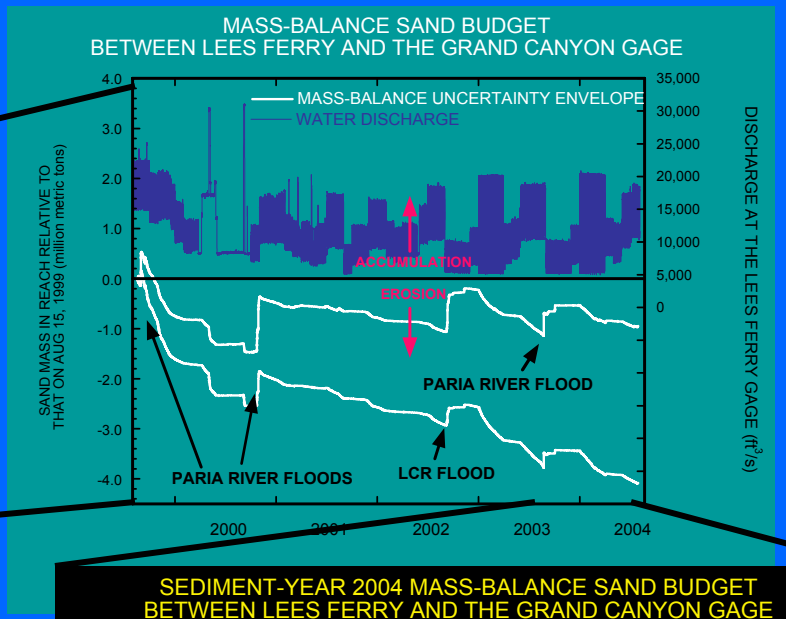
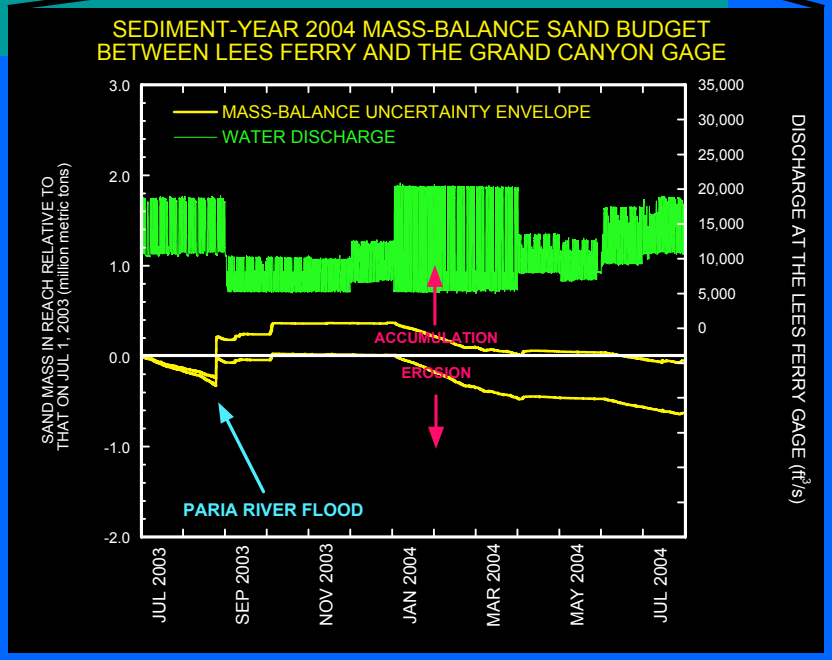
# Seasonal Timing of Paria River Sand Inputs into the Colorado River vs. Monthly-to-Diurnal Dam Operations (8.23 maf release year)

Export of Sand is Forced by seasonally "adjusting" Monthly Volumes in Minimum Release Years + Exp. Fluctuating Flows Designed to Disadvantage Non-Native Fish To Benefit Endangered Native Fish

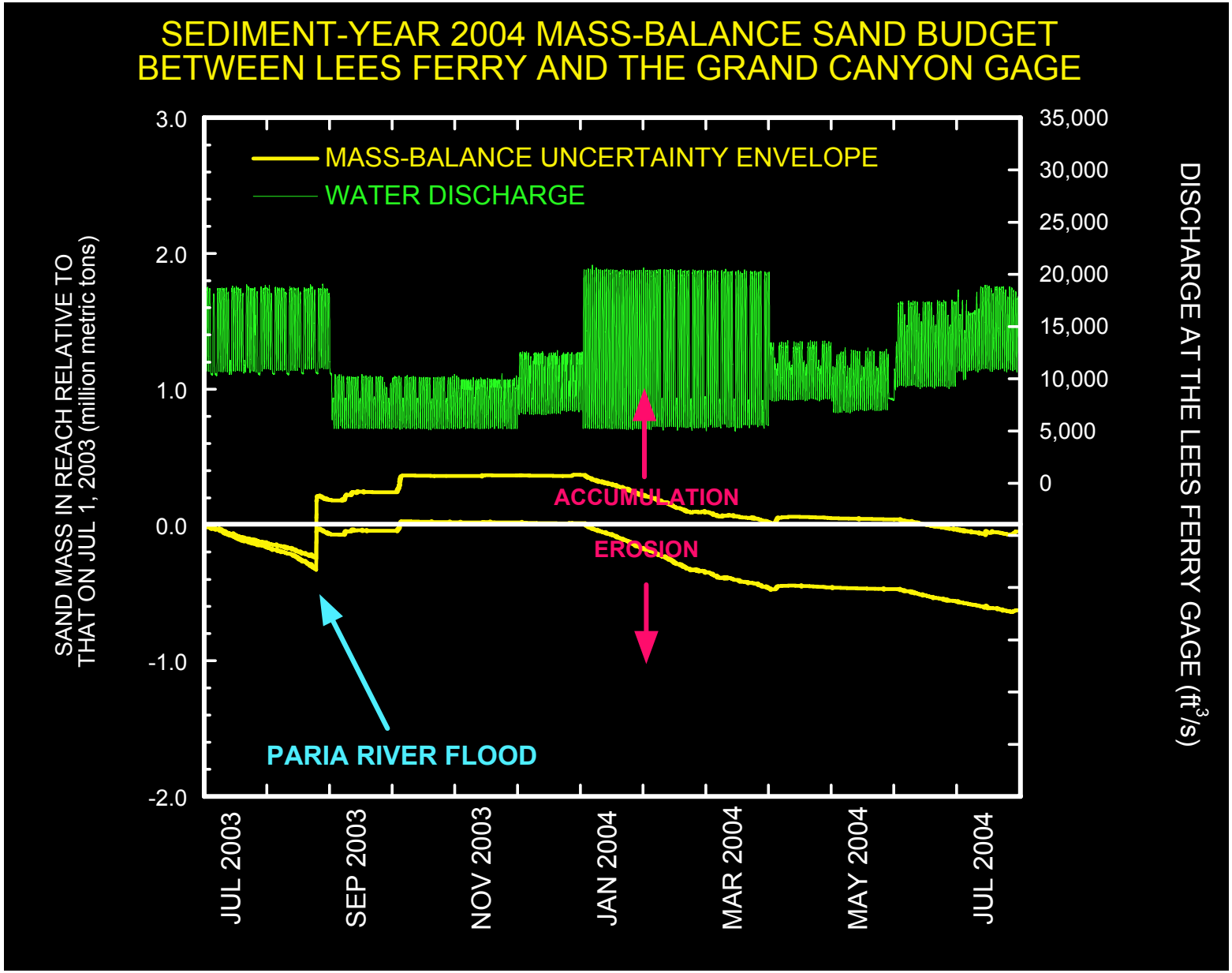



Preliminary Data – Subject to Review and Revision 02/02/05

## Under 2 Consecutive 8.23 MAF Release Water Years - What's Happening Here? A Test…

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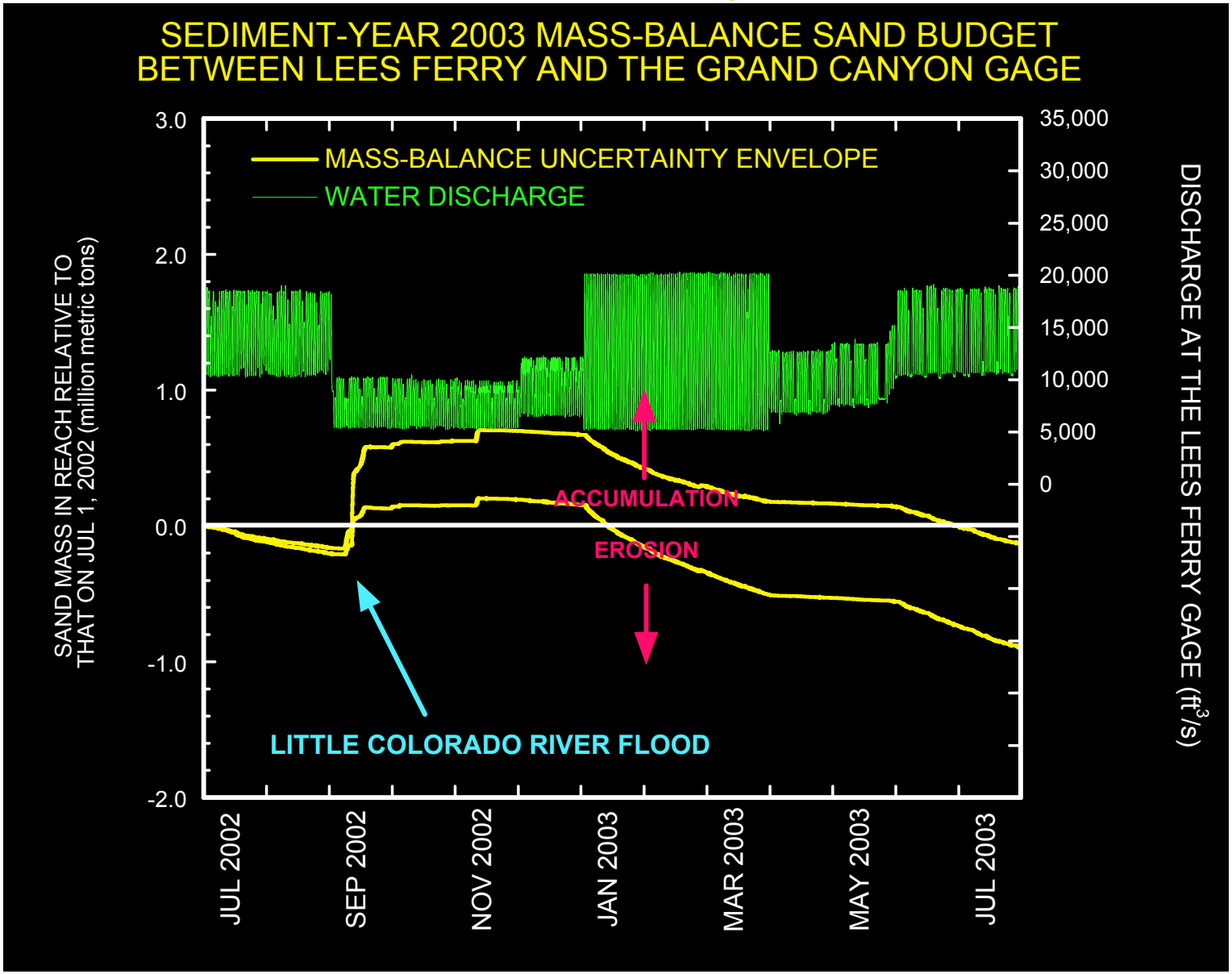
Preliminary Data – Review Slides from the 08/09/04 AMWG Meeting

# Under 2 Consecutive 8.23 MAF Release Water Years - What's Happening Here? Need to Further Assess the Pattern of Monthly Release Volumes

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**Preliminary Data – Review Slides from the 08/09/04 AMWG Meeting**

## SBSC's Grand Canyon Monitoring & Research Center

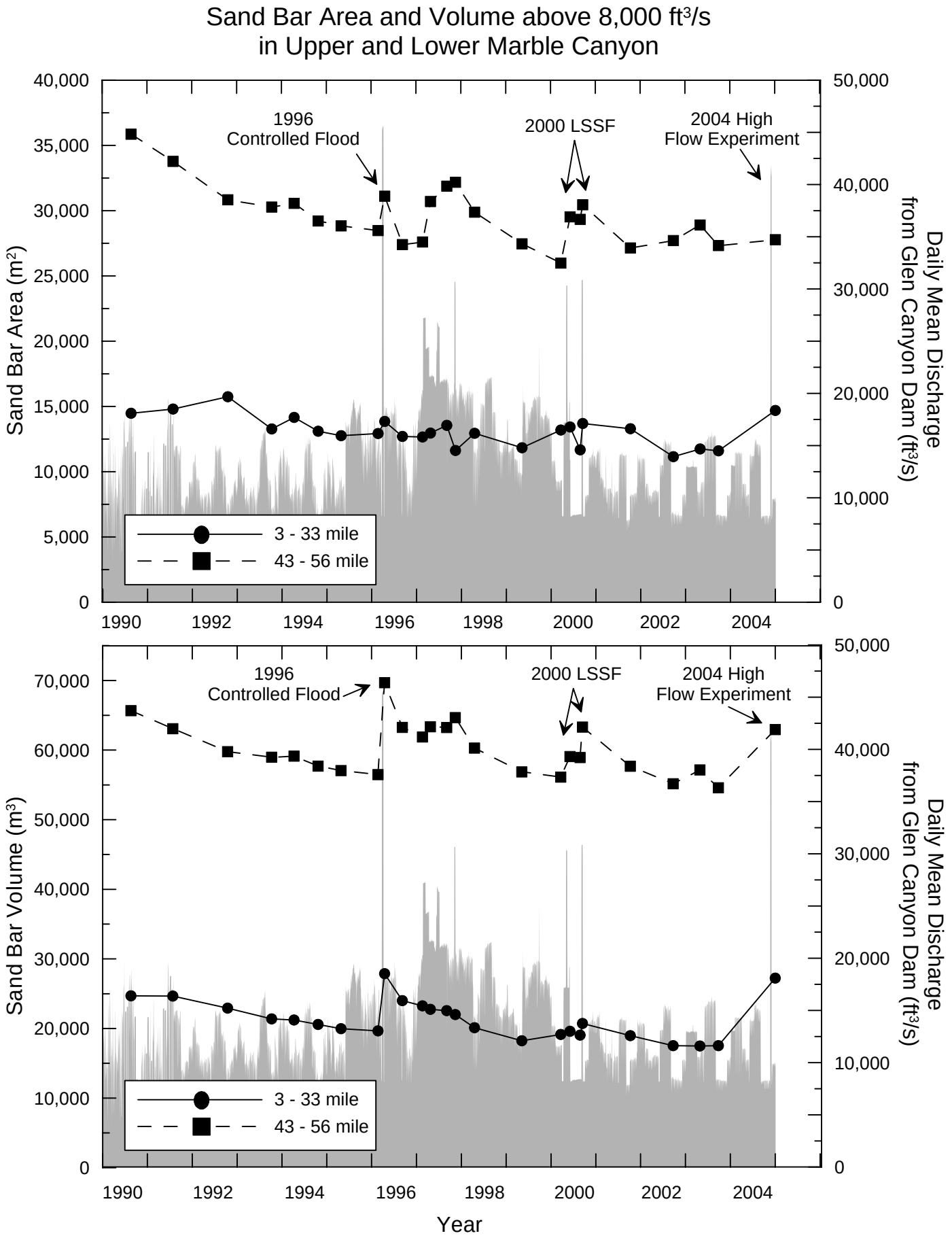
# Ongoing Considerations for Future Experimental Operations & Management

**Other Sediment Experimental Treatments for Consideration by TWG:**

- Discuss whether or not it is still desirable or useful to test Experimental High-Flow scenarios #2 or #3 (from 2002 EA) to further learning?

- Consider recommendations for testing even shorter-duration high-flow releases (30 hours or less) following significant fine-sediment enrichment from Paria or Little Colorado Rivers, perhaps preceded by a period of fluctuating flows of prescribed duration that would more evenly distribute new sand inputs through more of the test reach (presumably at the cost of losing more of the sub-sand sized material before the high flow release)?

- Consider recommendations for other alternative operational tests of the EIS strategy for accumulating multiple sand inputs over the course of more than 1 year that might result in a more robust sand supply to measure response against (within Record-of-Decision constraints)?


Sand Bar Area and Volume above 8,000 ft³/s
in Upper and Lower Marble Canyon
Sand Bar Area (m²)
Sand Bar Volume (m³)
Daily Mean Discharge
from Glen Canyon Dam (ft³/s)
1996
Controlled Flood
2000 LSSF
2004 High
Flow Experiment
3 - 33 mile
43 - 56 mile
Year