SUMMARY OF SAND-BAR DATA (1990-2001)

Hydrology – Has varied from "dry" to "wet" and back to "dry" Full UB Hydrologic Cycle!

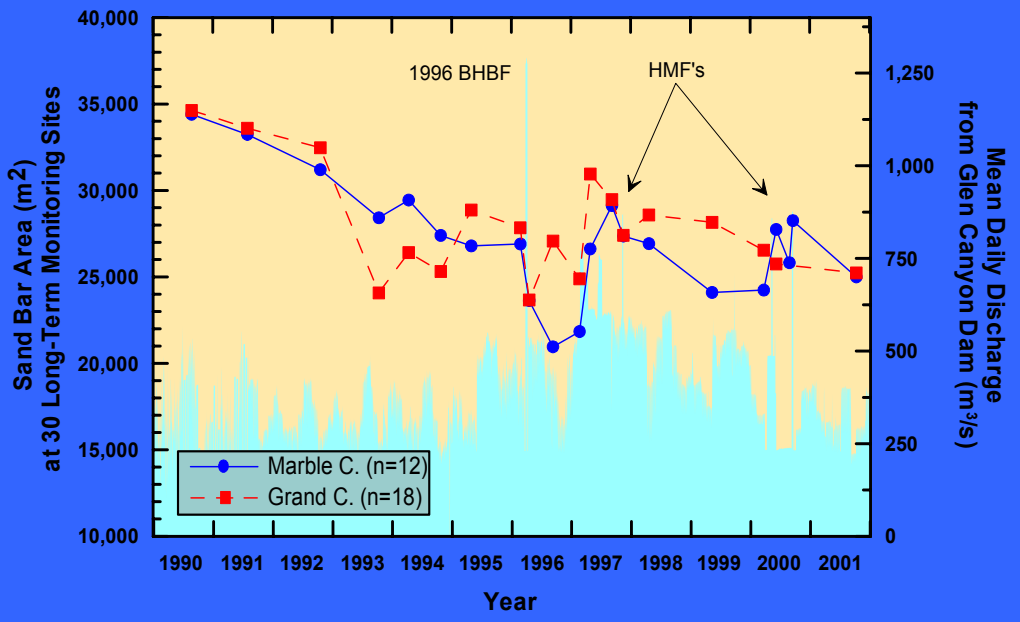
Bar Responses – Largest responses forced by most dramatic operations (BHBF Response)

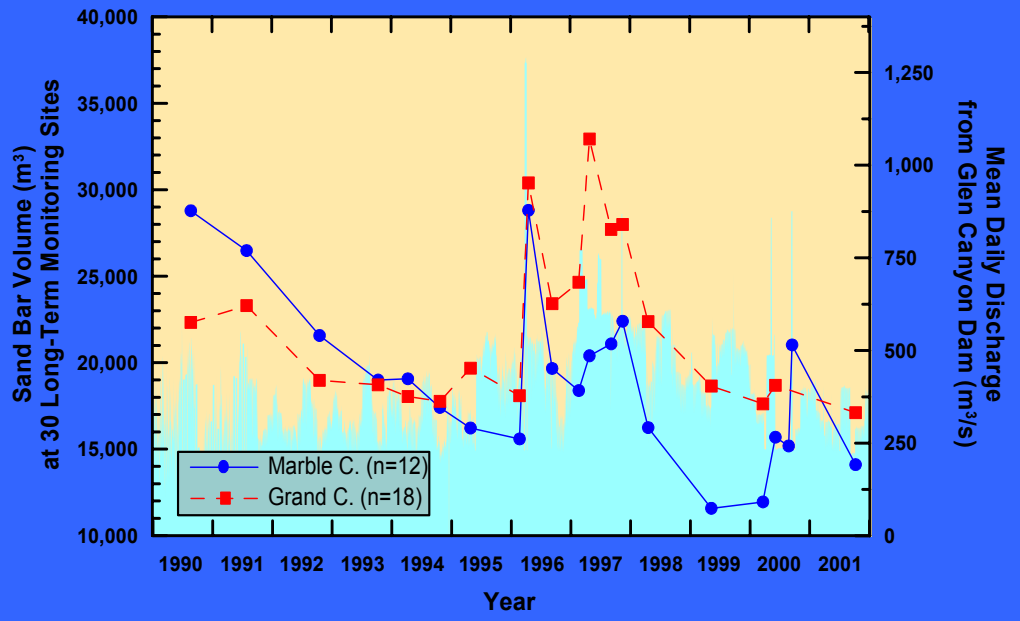
Long-Term Response – Decline in all areas of Marble Canyon, but less so at high-elevation in Grand Canyon

Cause & Effect – Limited sediment supply with median flow increase of 75%

TWG UPDATE - Sand Bar Areas and Volumes

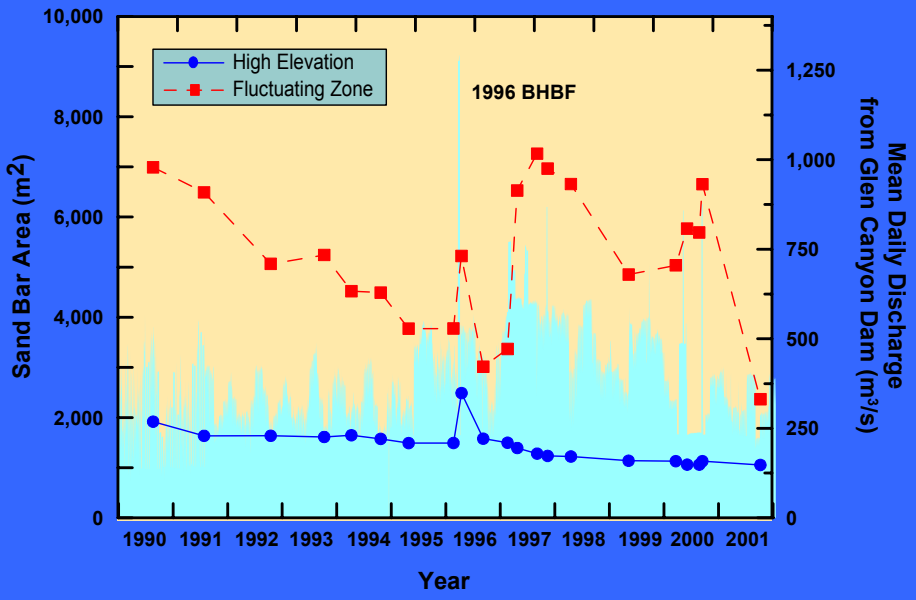
"System-Wide" In Fluctuating Zones of Eddies 1990-2001 (NAU Data)

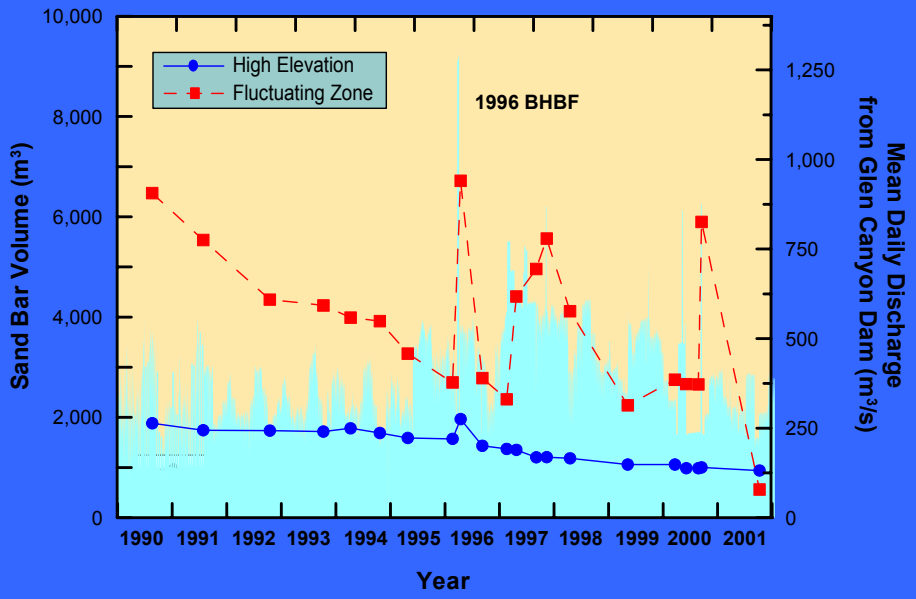




TWG UPDATE - Sand Bar Area and Volume

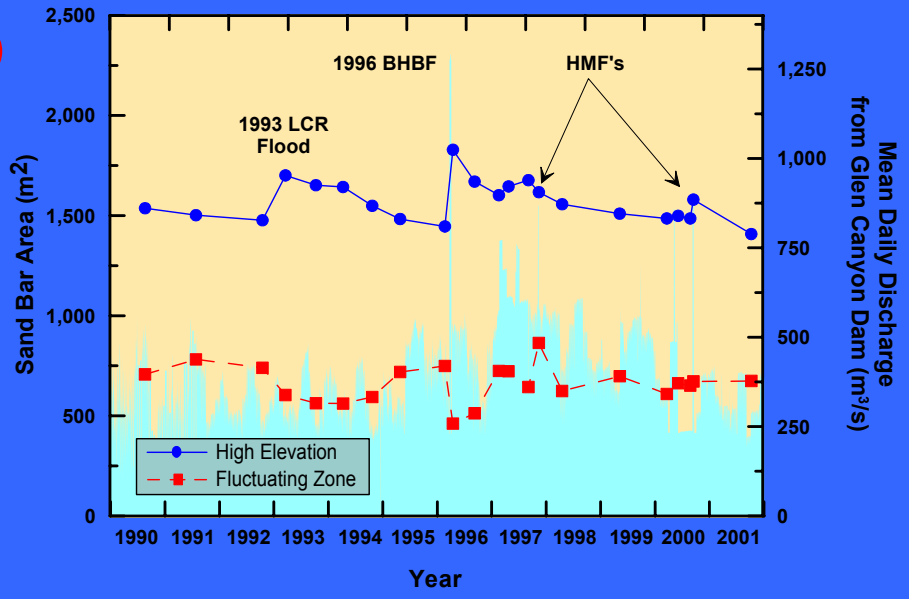
"Saddle Camp" 1990-2001 (NAU Data)

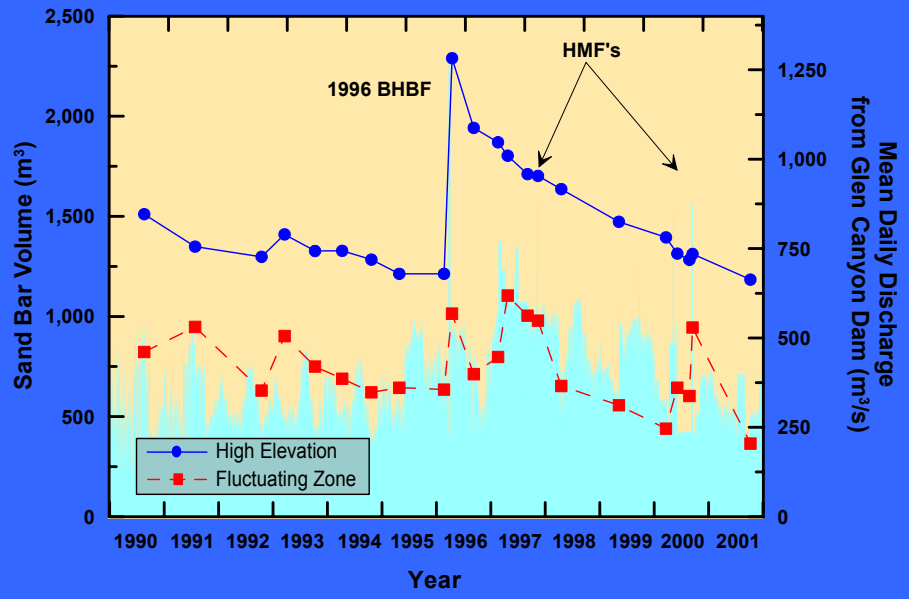




TWG UPDATE - Sand Bar Area and Volume

Grapevine Camp 1990-2001 (NAU Data)





DOWNSTREAM FROM NANKOWEAP

1890. The pre-dam river was lined with expansive sandbars. The banks were mostly barren of vegetation up to the old high-water line (Stanton).

1991. The sandbars have disappeared, leaving exposed cobble bars. Riparian vegetation has encroached on the formerly barren banks.

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THE CAMPING BEACH DOWNSTREAM FROM TAPEATS CREEK

1952 (Kent Frost). Everyone would want to camp here now.

1995. The beach reappeared briefly after the 1996 flood.

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CHANGES AT DEER CREEK FALLS

1923. Beach present, falls fans out (LaRue)

1940. Falls fans out wider, large beach present, rocks shifted (Goldwater)

1972. Riparian vegetation chokes channel mouth, no beach, new rocks (Turner)

2001. Tributary flooc scoured mouth of sar and most vegetation (Brownold)

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SUMMARY OF SAND BALANCE DATA (WY 1999-2001)

Basin Hydrology – Has varied from "dry" to "wet" and back to "dry" Full UB Hydrologic Cycle Under ROD!

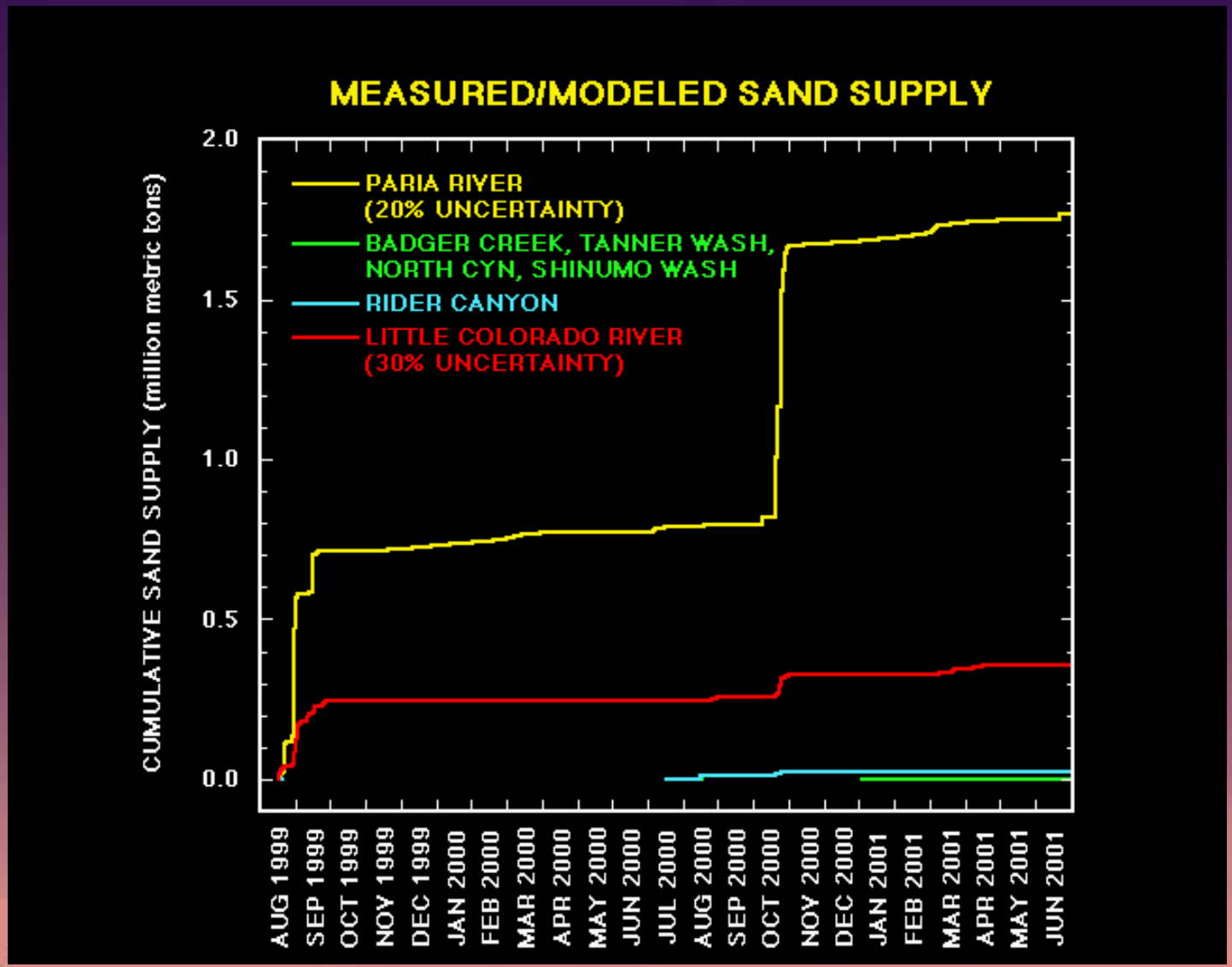
Paria Inputs – Sand equal to annual average (1.4 mil Mg)

Sand Supply – Largest responses forced by most dramatic operations (BHBF Response)

Long-Term Response – No evidence of channel accumulation throughout river system, but channel and eddy storage responds to mainstem hydrology

Cause & Effect – Declining sediment supply in system is caused by compressed flood frequency, limited supply and fine grain size of sand from downstream sources

Sand Inputs (1999 – 2001)



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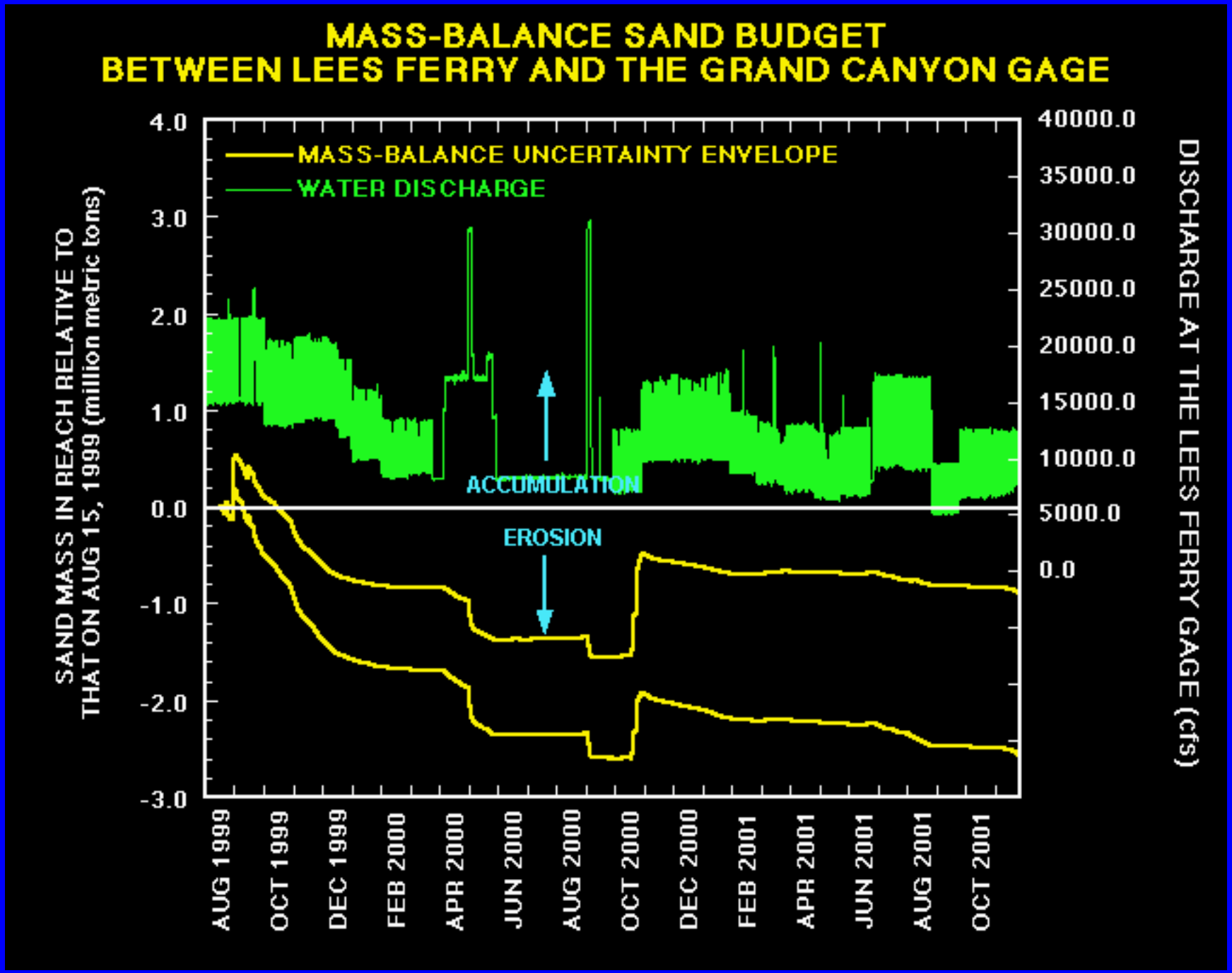

MASS-BALANCE SAND BUDGET
BETWEEN LEES FERRY AND THE GRAND CANYON GAGE
MASS-BALANCE UNCERTAINTY ENVELOPE
WATER DISCHARGE
ACCUMULATION
EROSION
SAND MASS IN REACH RELATIVE TO
THAT ON AUG 15, 1999 (million metric tons)
DISCHARGE AT THE LEES FERRY GAGE (cfs)
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
40000.0
35000.0
30000.0
25000.0
20000.0
15000.0
10000.0
5000.0
0.0
AUG 1999
OCT 1999
DEC 1999
FEB 2000
APR 2000
JUN 2000
AUG 2000
OCT 2000
DEC 2000
FEB 2001
APR 2001
JUN 2001
AUG 2001
OCT 2001

"TAKE-HOMES" ON SAND BALANCE DATA (1999-2001)

Basin Hydrology – Dry Now! Chance for Conservation and Restoration of Bars – *Let's Water the Canyon!*

Sand Inputs – Paria River Continues its Domination!

Sand Supply – Currently winnowed, last inputs Sept. '01 were below average for sand from all sources!

Long-Term Response – No evidence of channel-sand accumulation, but export reduced during below-average ROD operations in WY 2001-2002.

Cause & Effect – Declining sediment supply in system is caused by compressed flood frequency, limited supply and fine grain size of sand from downstream sources

Revisiting *BETA* Concept

What is it?

A New Sediment-Supply Monitoring Parameter…
(Concentration and Grain-Size in Suspension Used to Back-Calculate the Grain-Size of Sediment on the Bed)

What does it mean?

Quickly Tells How Enriched or Depleted the Bed Is…

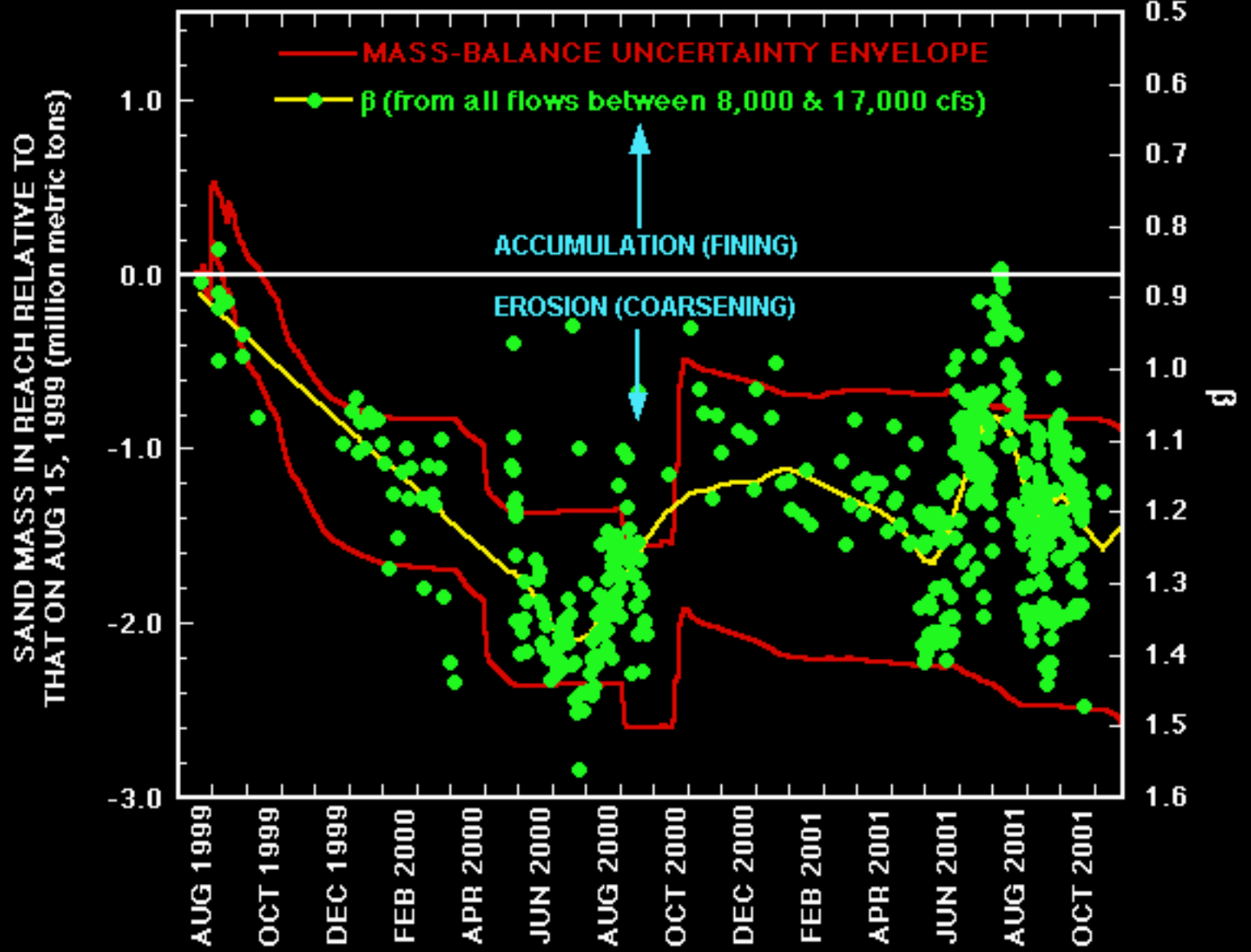
Who Cares about more sediment information?

It Could End Up Telling Us What We Need to Know For Less Cost and Effort in Real Time…

High-Flow Treatments and Spill Volumes?

How Long Before Channel-Bed Is "Cleaned" (Whether For Sand-Bar Restoration or for Cleaning Gravels)

COMPARISON OF LF TO GC "MASS-BALANCE" SAND BUDGET WITH "BETA" SAND BUDGET AT THE GRAND CANYON GAGE



SUMMARY OF *BETA* PLOT (1999-2001)

Sand Inputs – How significantly is the channel-bed enriched and over what period following tributary inputs?

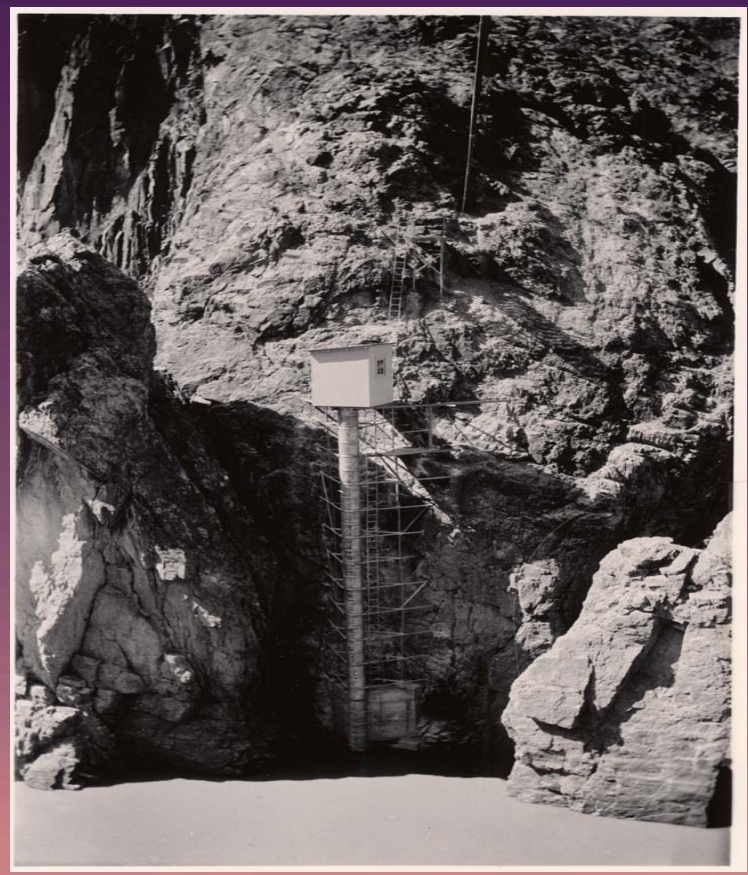
Sand Supply – When are we there? When are we not? When should we *Water the Canyon*?

Long-Term Monitoring – How does current level of enrichment or depletion of sand in channel compare relative to previous periods of pre- or post-dam enrichment conditions throughout a given reach?

Use w/ LISST Support – Should be able to support "Real Time" basis for evaluating sand-supply dynamics throughout the ecosystem's "active-transport" channel

Grand Canyon Gage (Built 1934)

- Extremely Reliable Flow Record
- Just US from SS Cross-Section
- Flow & Sediment Record (1925-2002)
- Well-Mixed Flow Zone (turbulent)
- Historically Significant Test Site for USGS Sediment Samplers
- Ideal Setting for LISST Deployment and Testing
- **GCMRC Intensive Sediment Monitoring Program Provides Abundant Verification Data for New Alternative Methods**



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Grand Canyon Gage
(2001 LISST Fixed-Depth Test Site)

- **24-Hour Test Duration** (over 1-Diurnal Cycle)
- **13 – Cableway (D-77)** Samples Obtained
- **720 – LISST-100B Samples** (averaging 16 measurements every 2-minutes)
- **Flow Range – 9,000 to 17,000 cfs (typical summer)**
- **Highly Mixed Cross Section w/ Mostly Quartz Sand**
- **Bedrock-Controlled Channel w/o Flood Plains**

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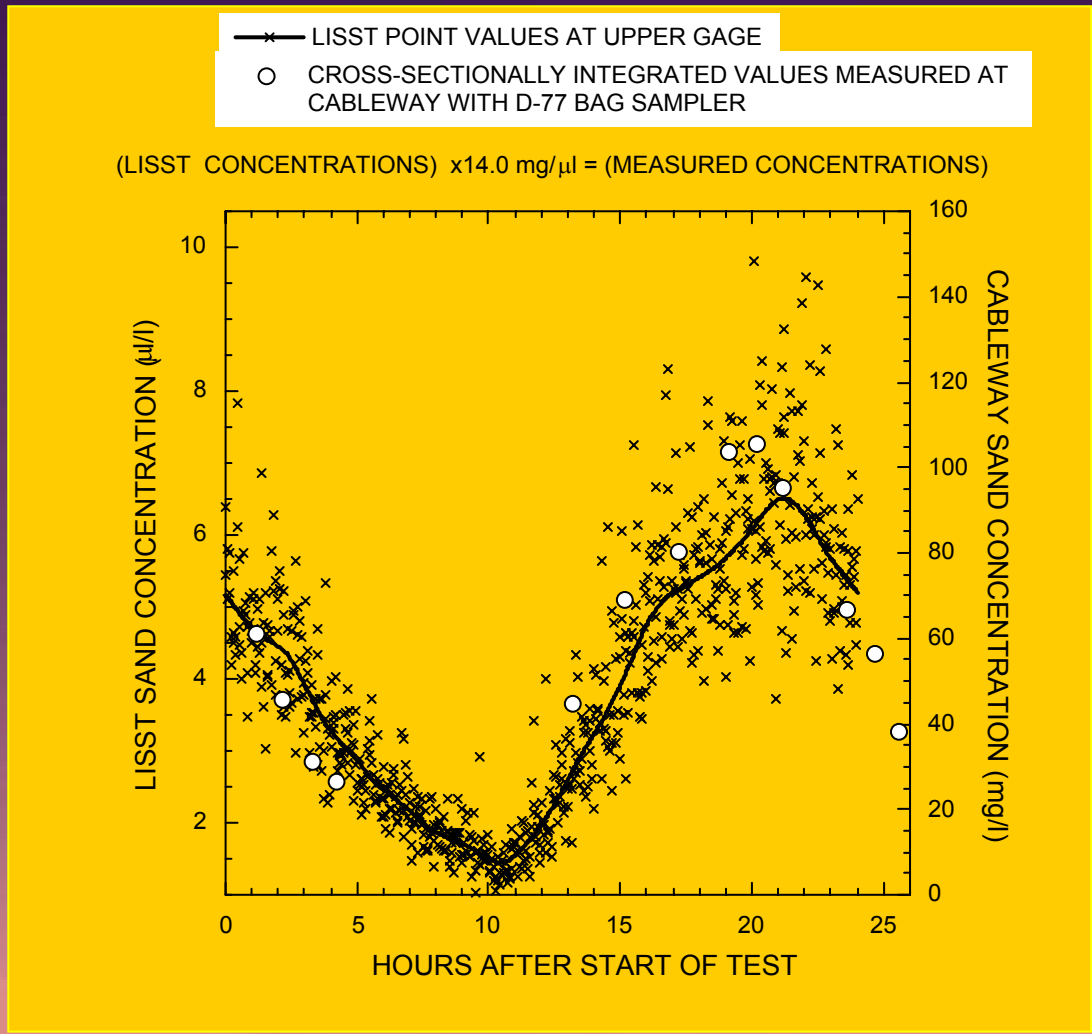
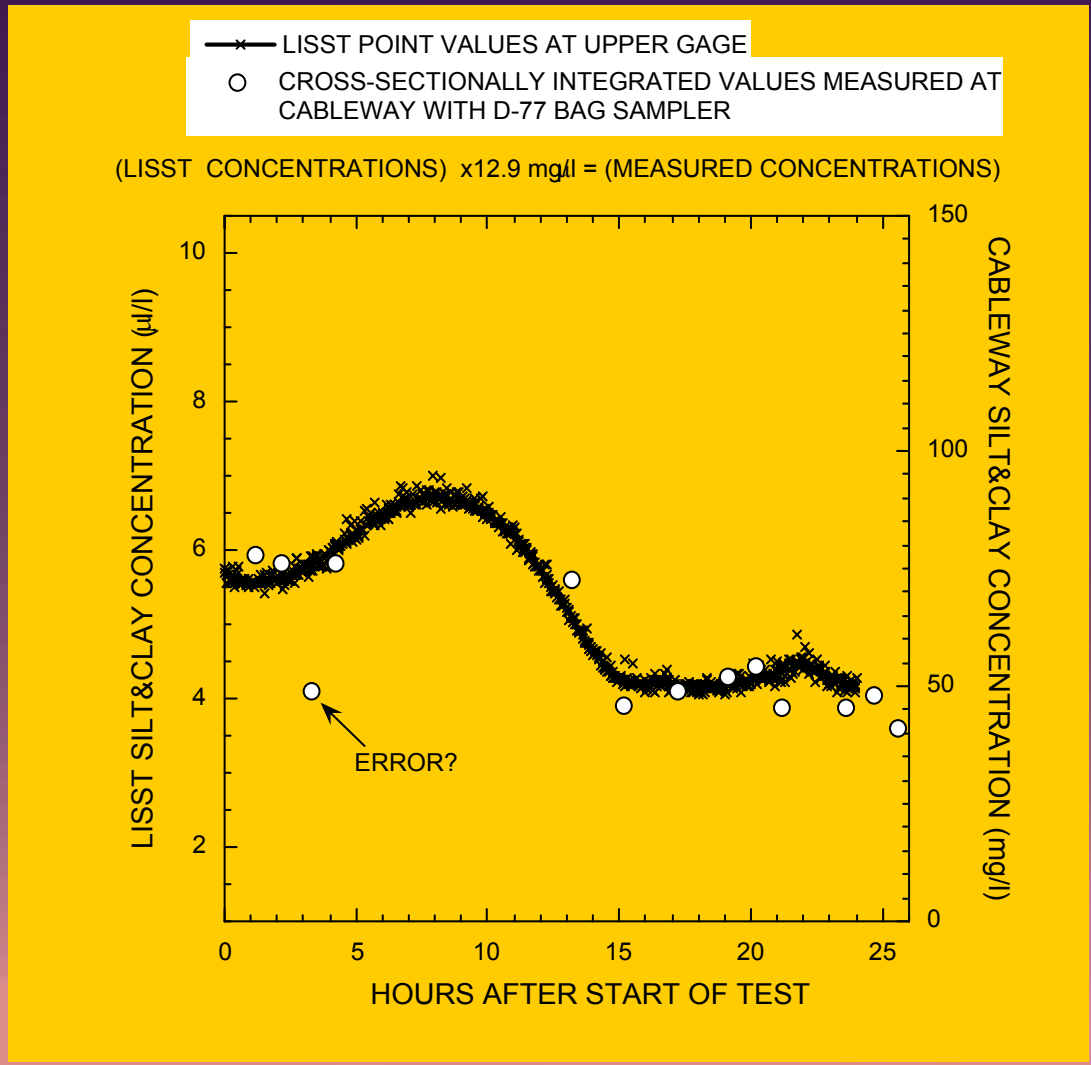
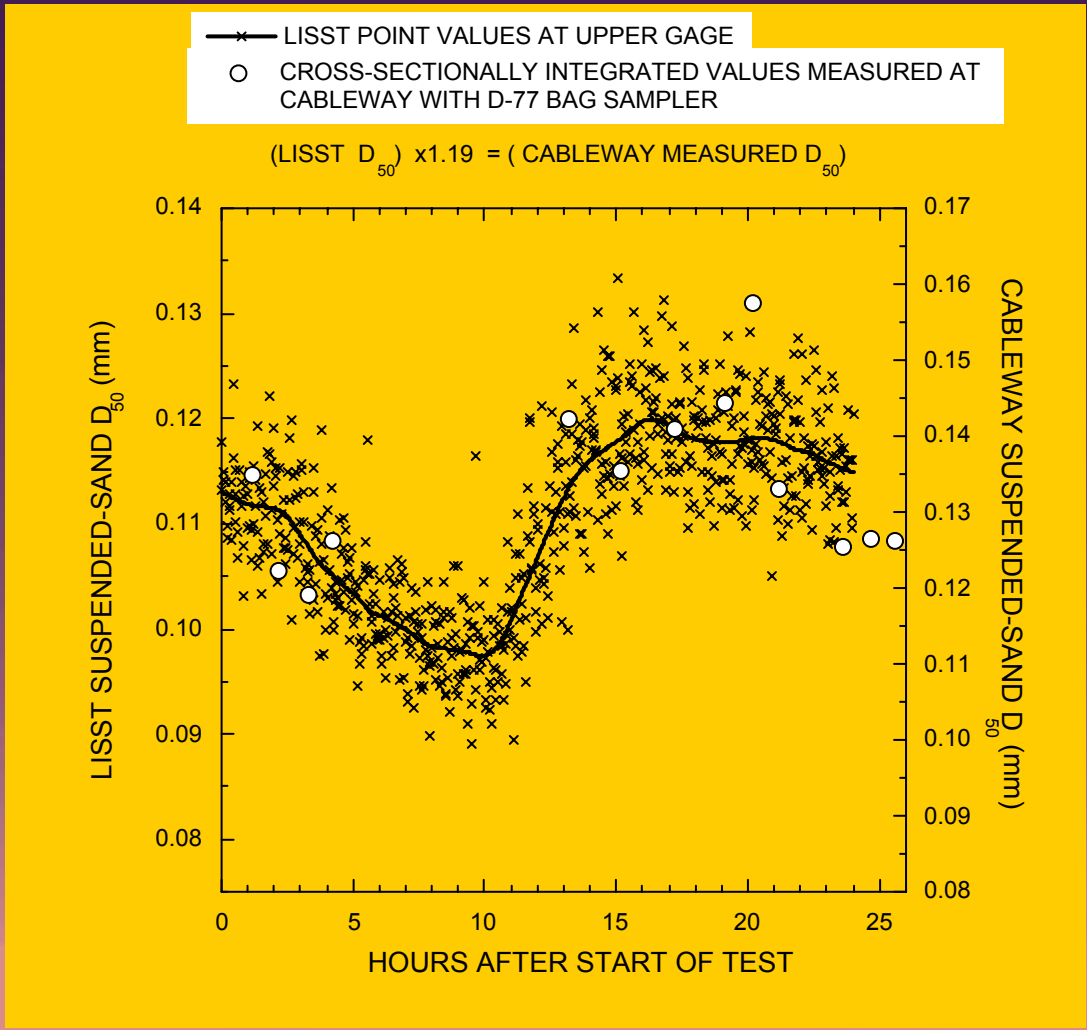
RESULTS - SAND CONCENTRATION



RESULTS - SILT & CLAY CONCENTRATION



RESULTS - MEDIAN GRAIN-SIZE OF SAND



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THANKS AGAIN FOR YOUR ATTENTION . . .

Pray for Rain!