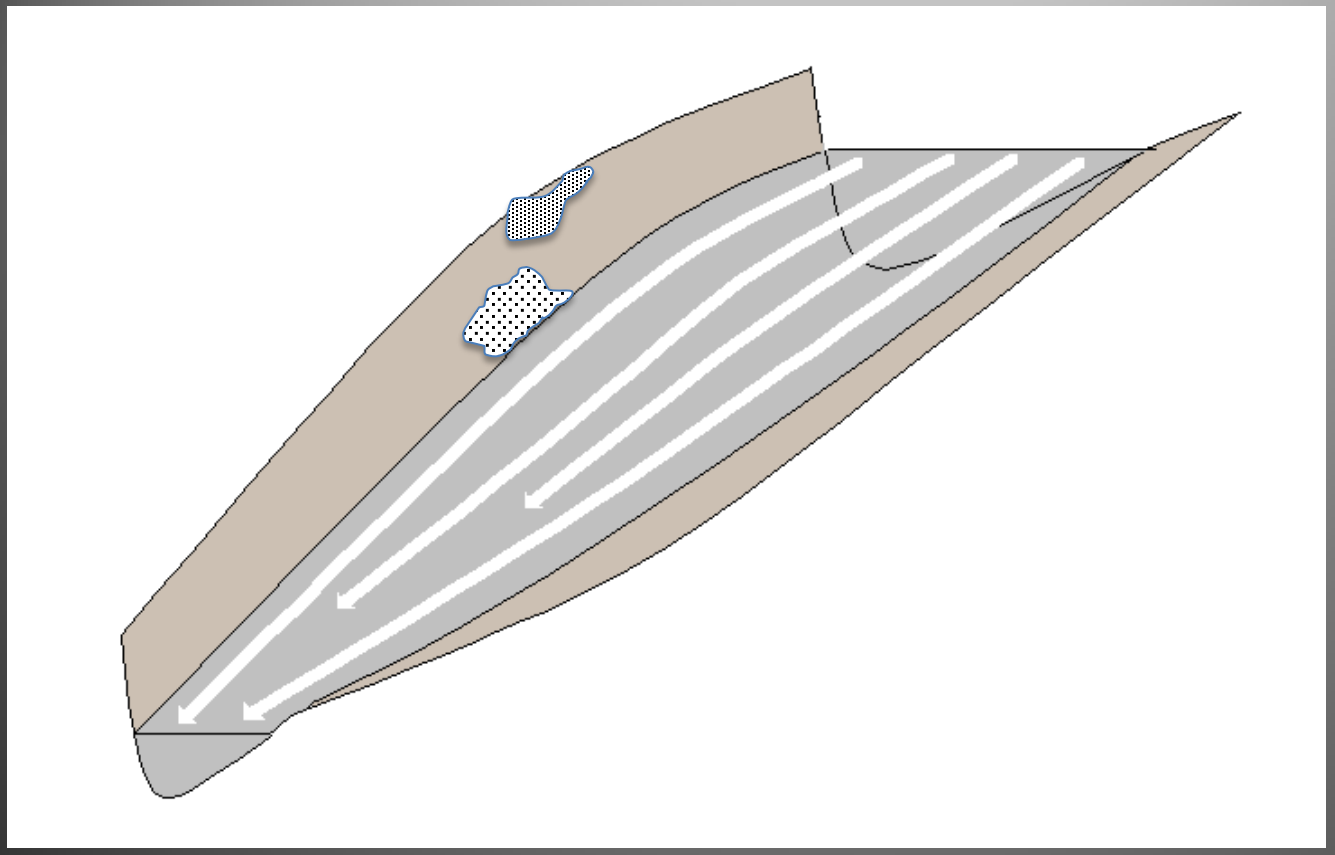
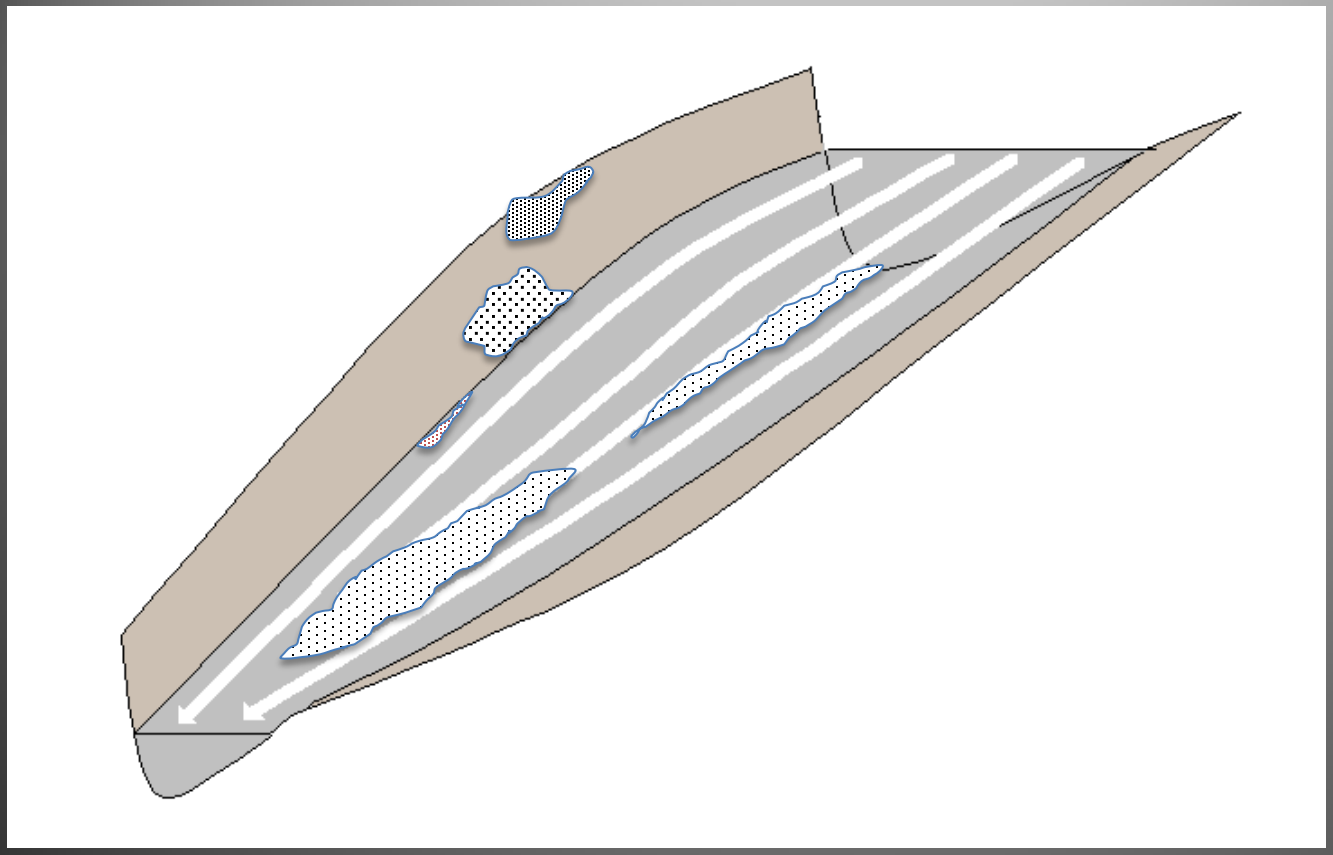


The physical system

Colorado River in Grand Canyon behaves like a pipe – a pipe with a very rough boundary

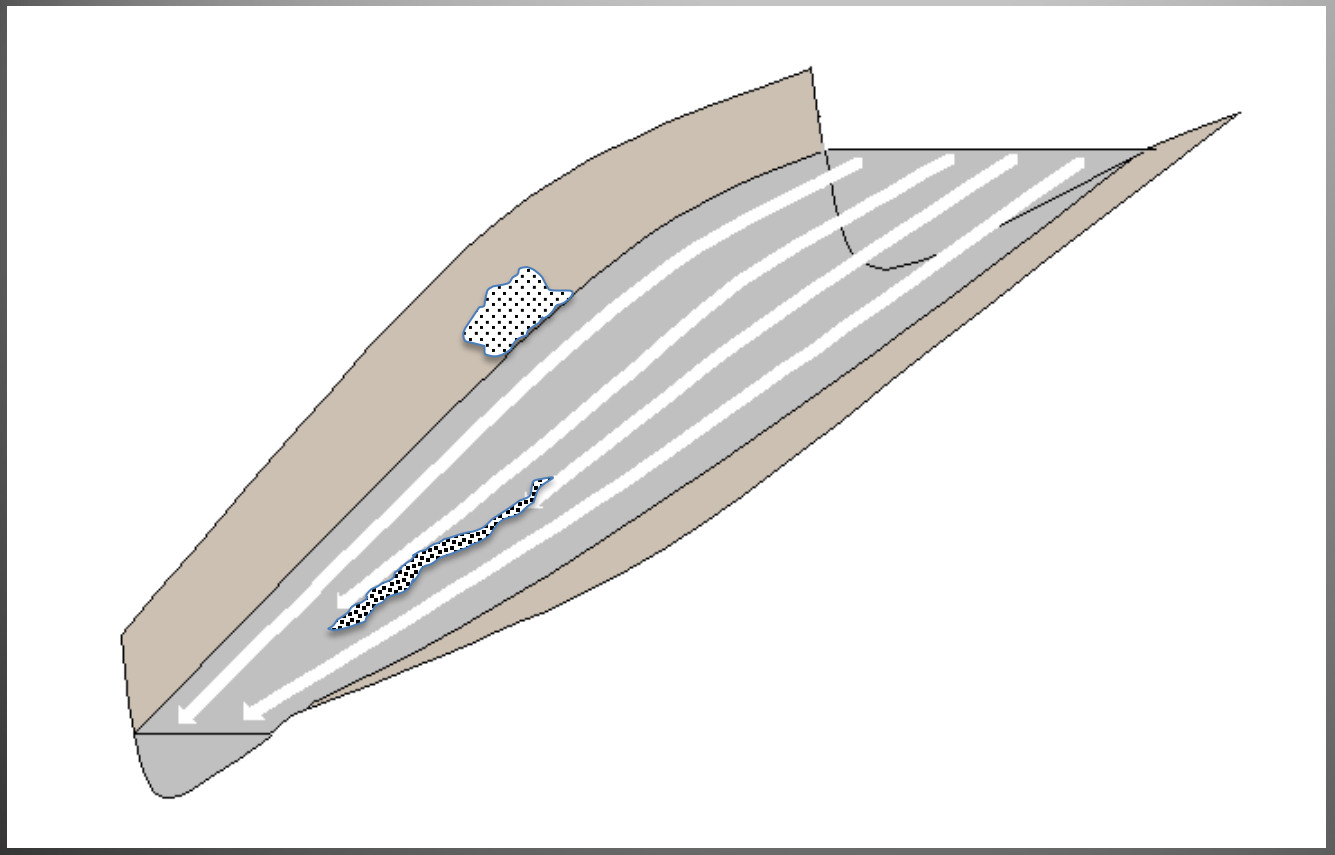
There are pockets of fine sediment, primarily sand, that occur in isolated pockets and as thin ribbons. Some of the very fine sand is blown by winds to higher elevation.

USGS



When fine sediment enters the river from tributaries (primarily the Paria River), the sand and mud is initially deposited on the channel bottom and at low elevation

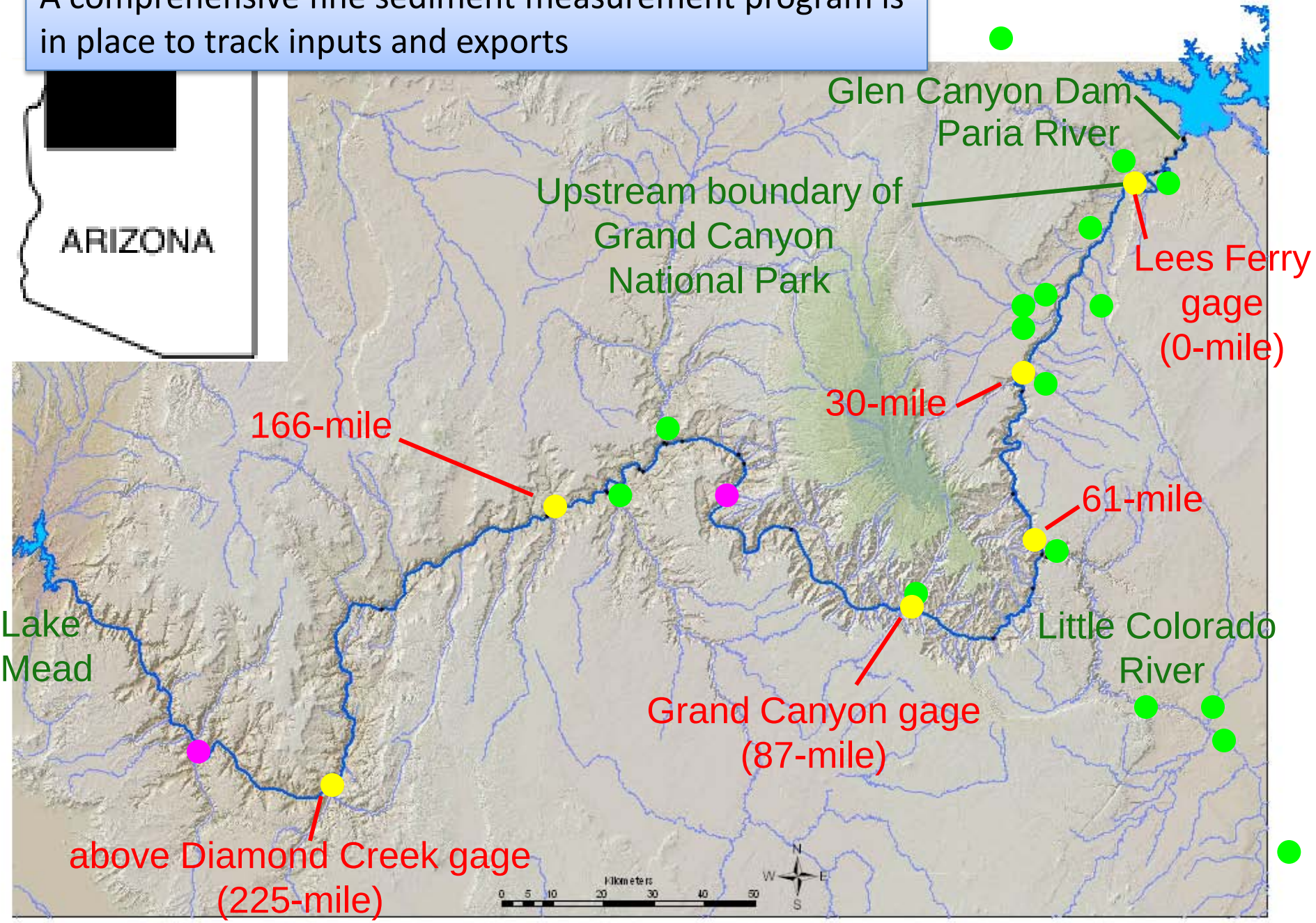
USGS



This sand and mud is quickly transported downstream. The mud is transported most quickly and the sand that remains on the bed becomes coarser.

USGS

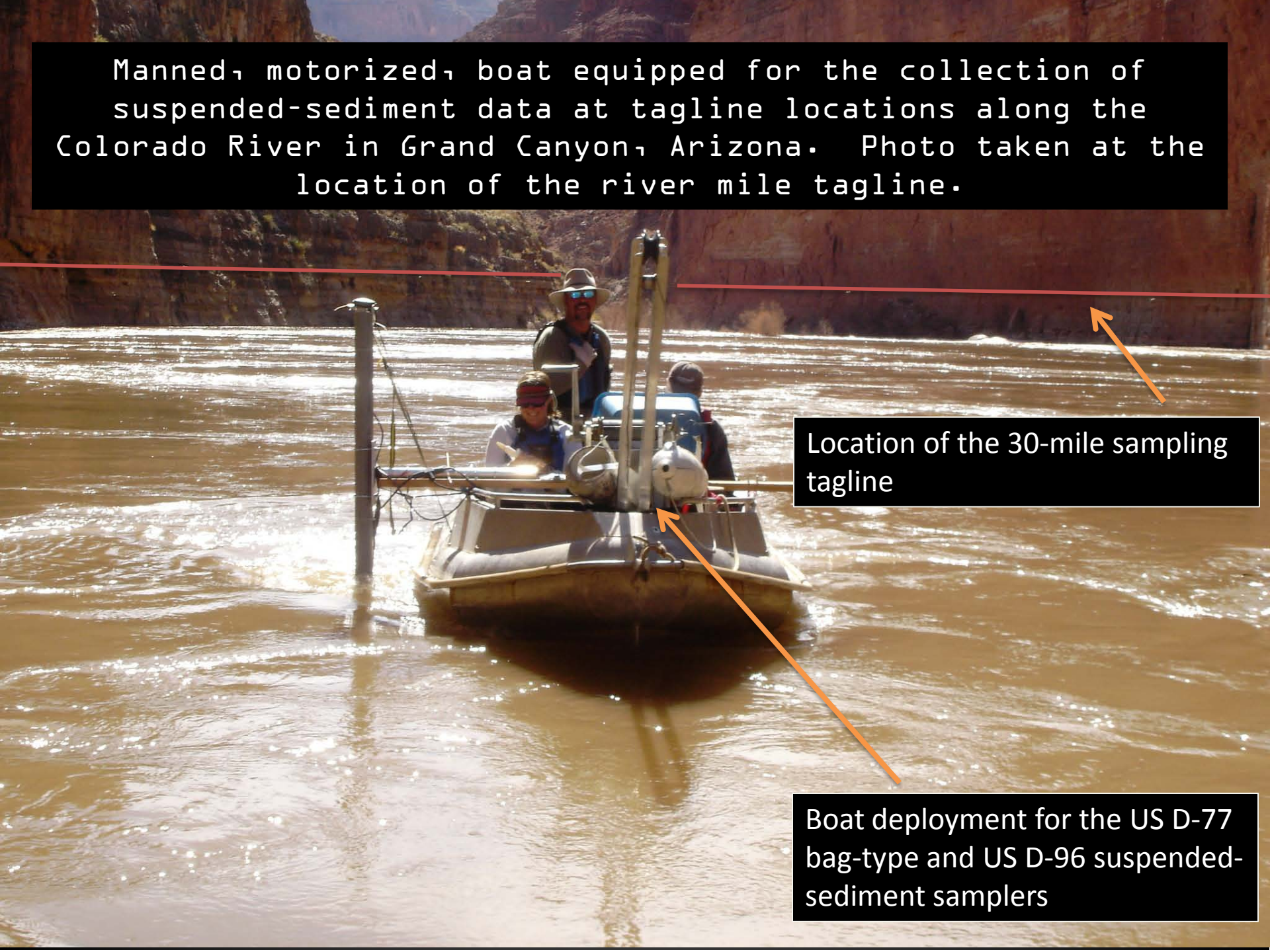
A comprehensive fine sediment measurement program is in place to track inputs and exports



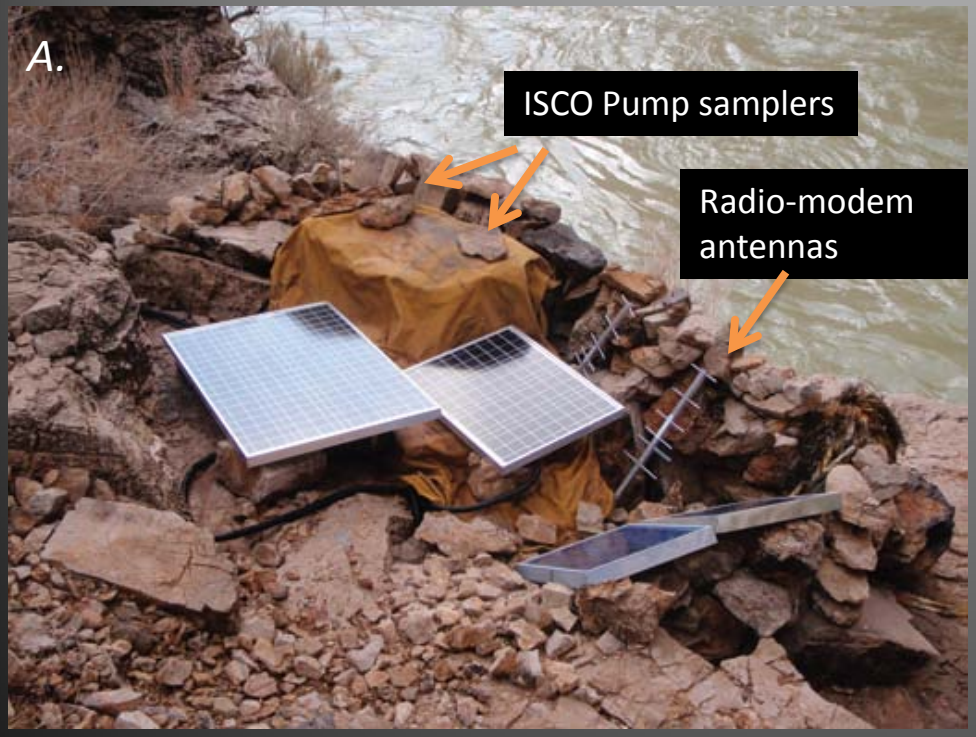
The focus of river management is on the fine sediment mass balance of Upper Marble Canyon

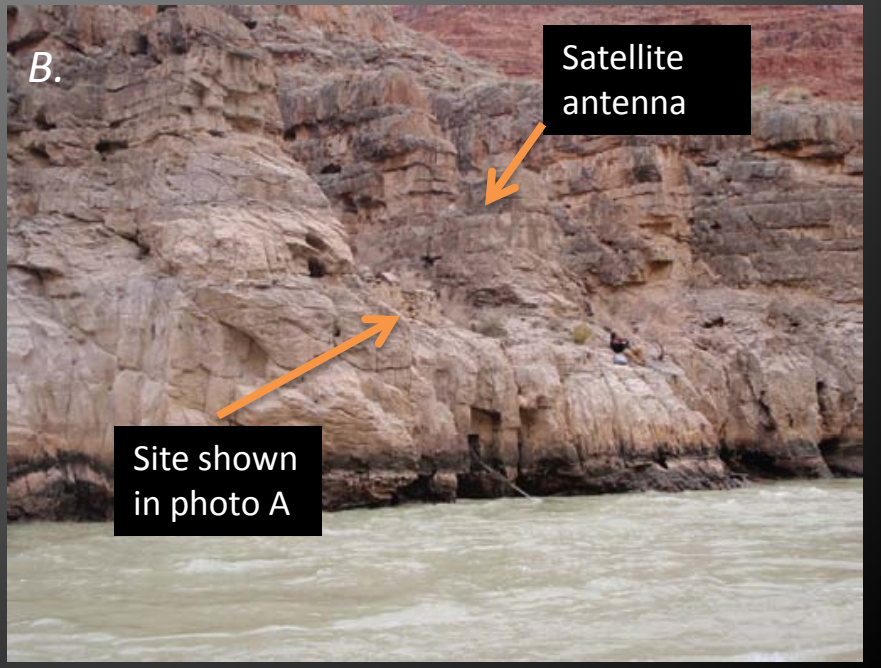
Glen Canyon Dam
Paria River
Upstream boundary of
Grand Canyon
National Park
Lees Ferry
gage
(0-mile)
30-mile
166-mile
61-mile
Lake
Mead
Little Colorado
River
Grand Canyon gage
(87-mile)
above Diamond Creek gage
(225-mile)
Kilometers
0 5 10 20 30 40 50
N
W
E
S


USGS AZ WSC sampling near the PARIA RIVER AT LEES FERRY, AZ gage during a flood on the Paria River
ISCO 6712 automatic pump sampler
US D-74 sampler suspended from fixed reel on bridge
INTAKE location for the ISCO 6712 pump sampler

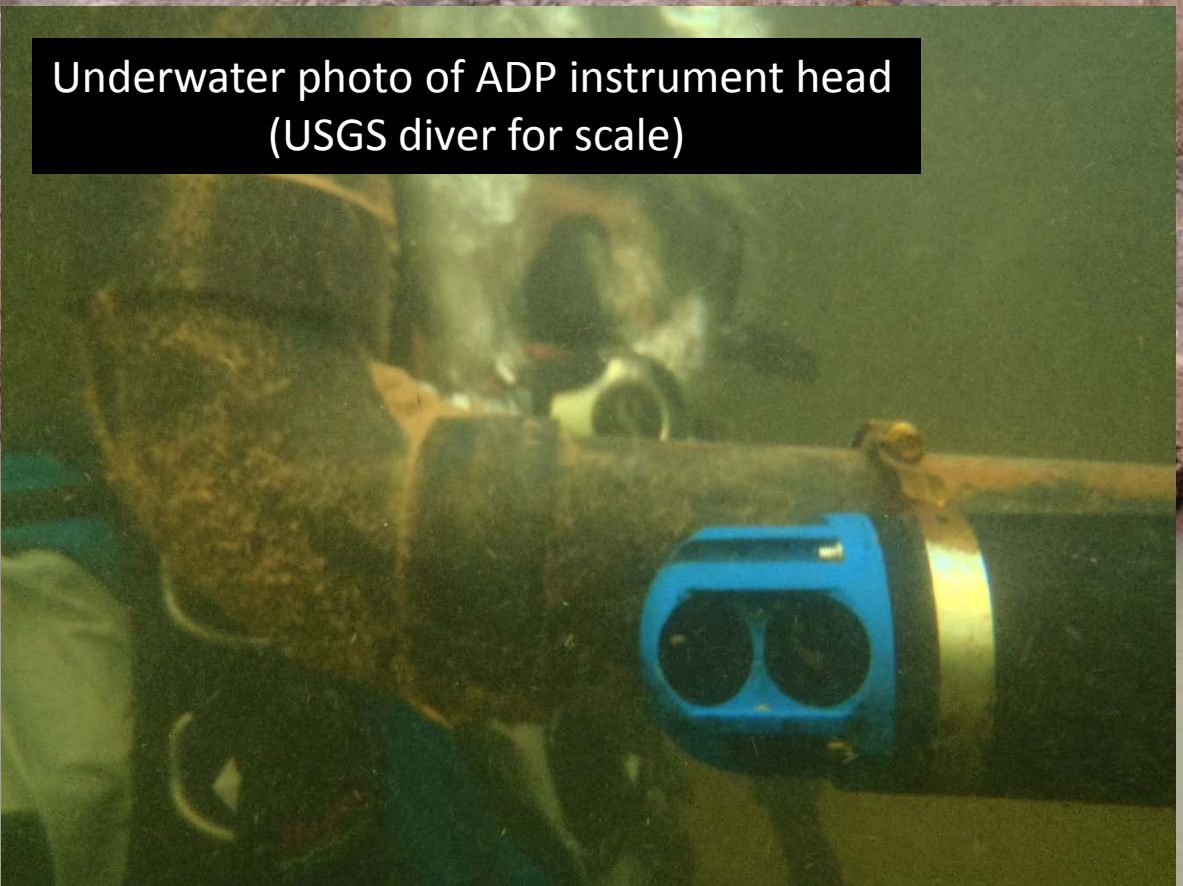

Manned, motorized, boat equipped for the collection of suspended-sediment data at tagline locations along the Colorado River in Grand Canyon, Arizona. Photo taken at the location of the river mile tagline.
Location of the 30-mile sampling tagline
Boat deployment for the US D-77 bag-type and US D-96 suspended-sediment samplers

Instrumentation and site appearance at the 30-mile sediment-transport station. *A*, configuration of instruments. The rock wall behind the instruments is used to camouflage the station. *B*, Site appearance from river level. View is downstream. Site is concealed behind the rock wall.





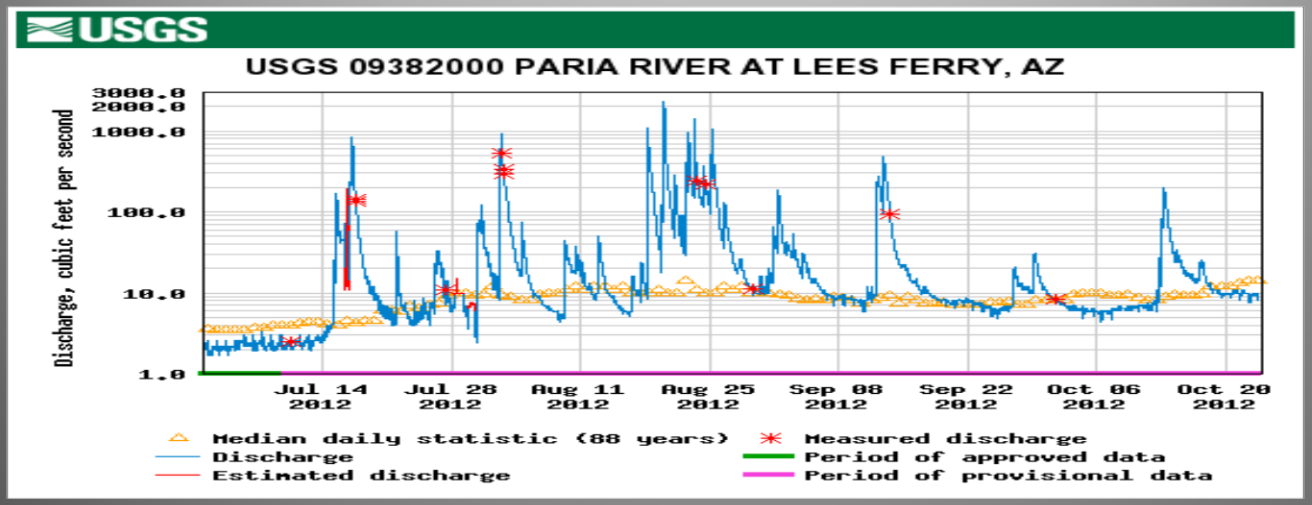
Mount for the 2-MHz Acoustic doppler Profiler (ADP) at the 30-mile sediment-monitoring station. Photograph shows the camouflaged mount and the radio modem antenna.



Underwater photo of ADP instrument head (USGS diver for scale)

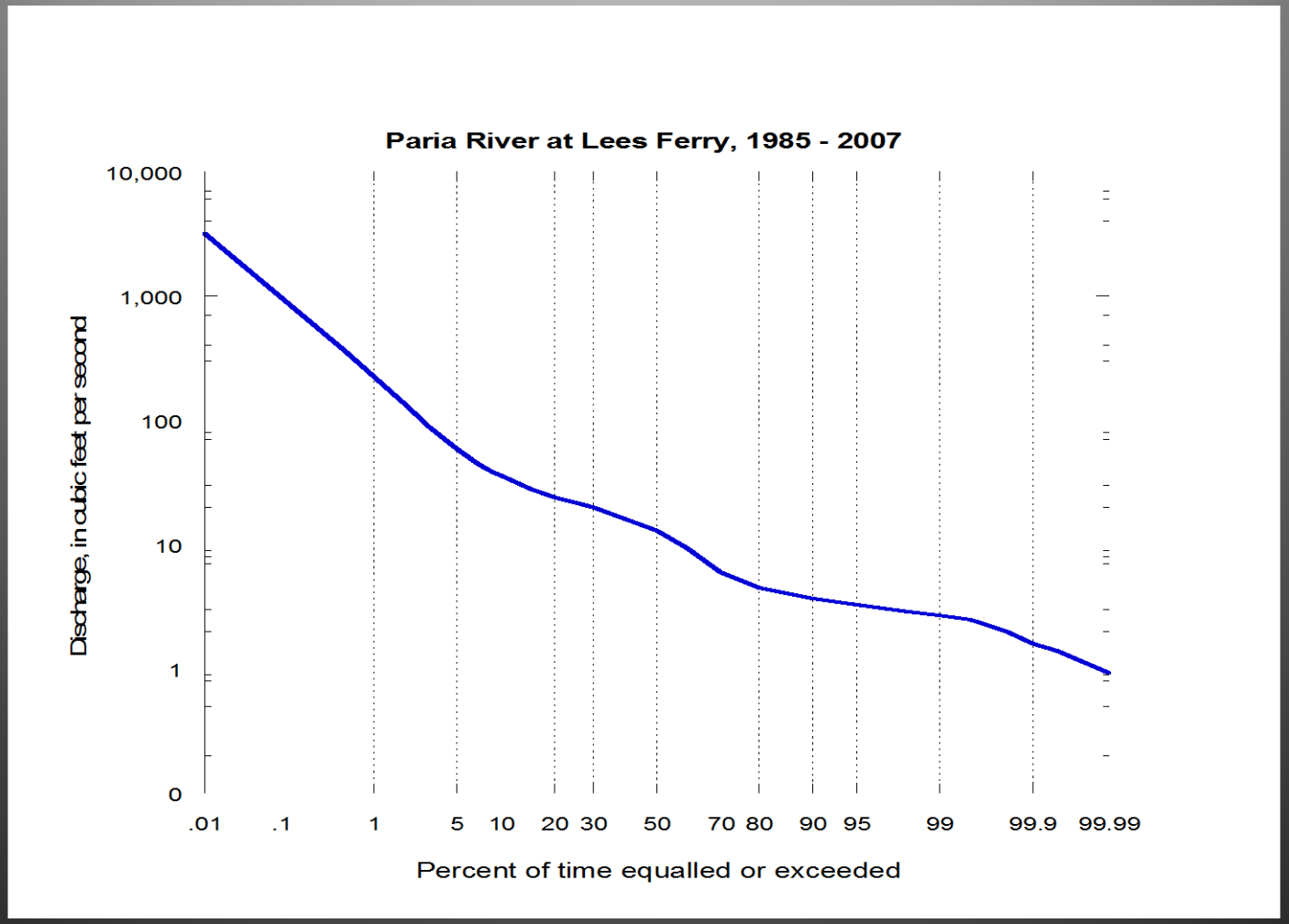
Radio-modem antenna

ADP mount

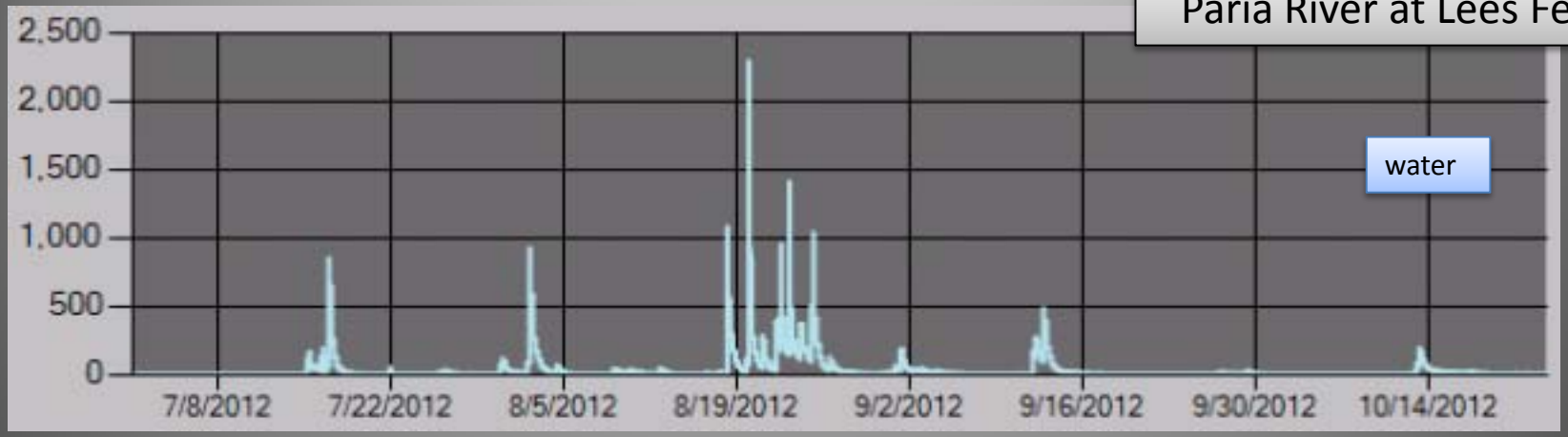


Measured discharge of the Paria River at Lees Ferry

July 1 to October 23, 2012

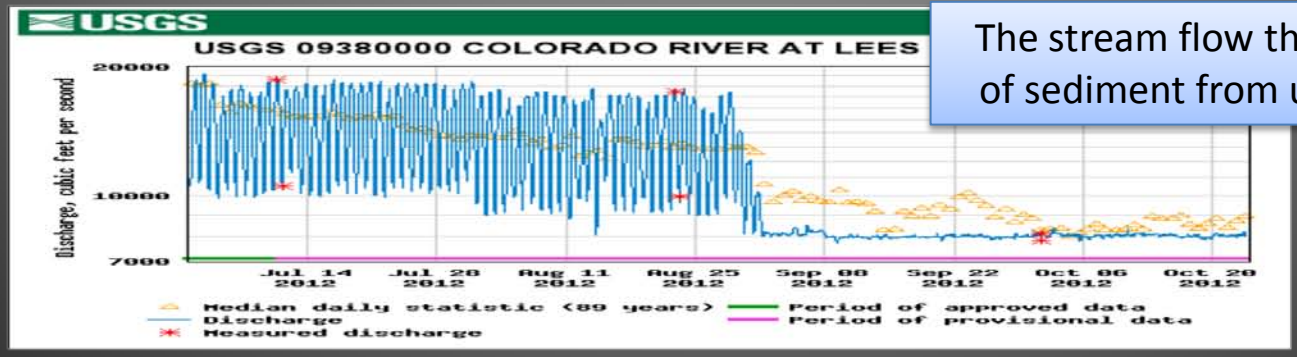

Paria River at Lees Ferry, 1985 - 2007
10,000
1,000
100
10
1
0
Discharge, in cubic feet per second
.01
.1
1
5
10
20
30
50
70
80
90
95
99
99.9
99.99
Percent of time equalled or exceeded

Paria River at Lees Ferry

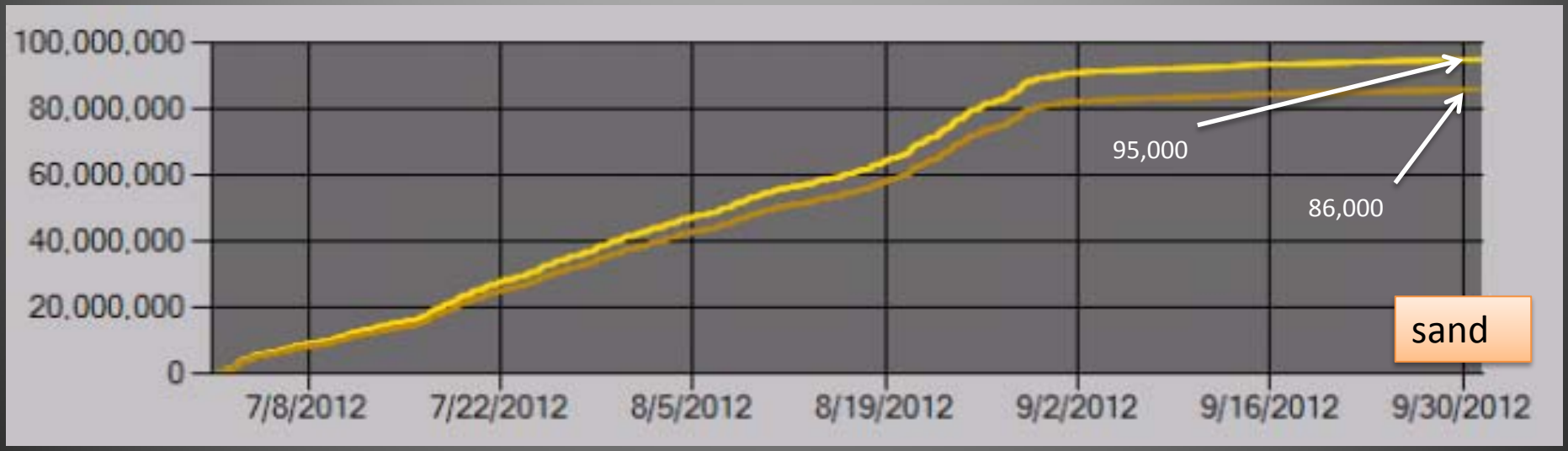


The stream flow that determines input of sediment

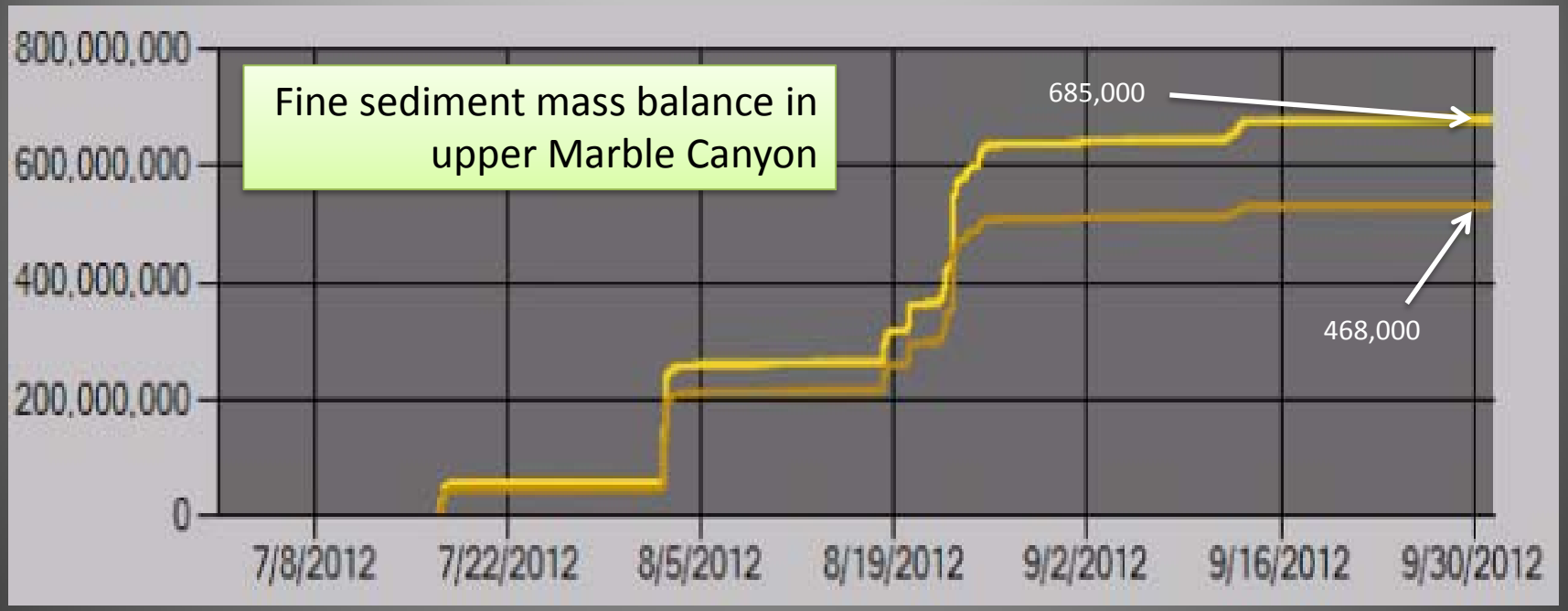
The stream flow that determines export of sediment from upper Marble Canyon

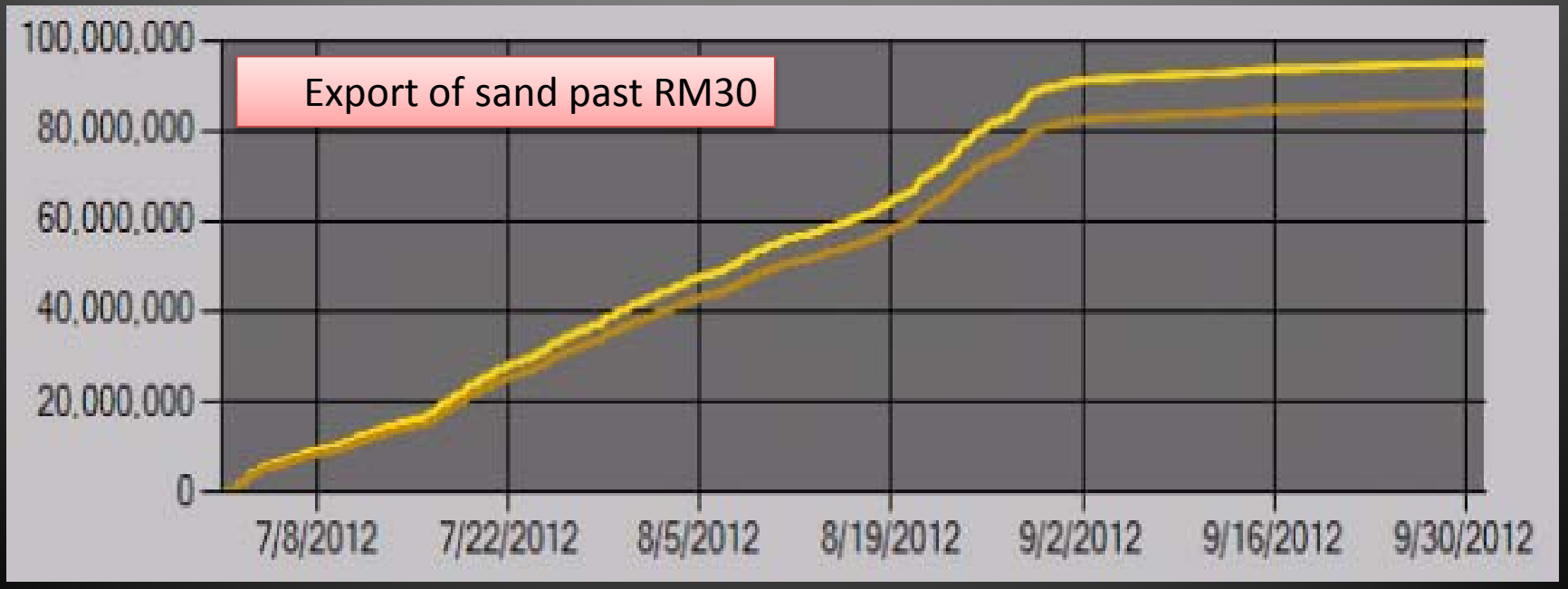



Sediment transport at RM30
20,000
15,000
10,000
5,000
0
7/8/2012
7/22/2012
8/5/2012
8/19/2012
9/2/2012
9/16/2012
9/30/2012

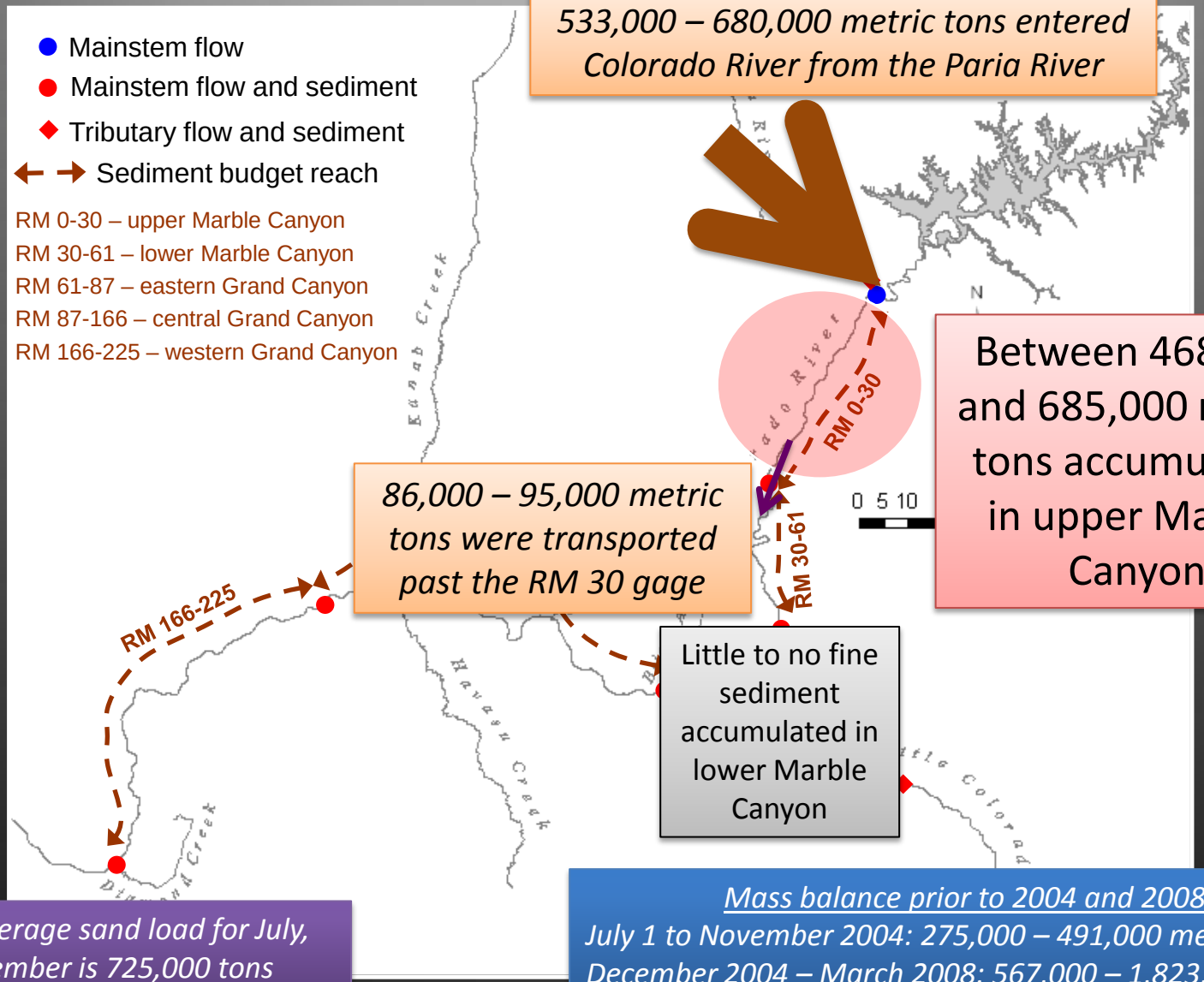

100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
95,000
86,000
sand
7/8/2012
7/22/2012
8/5/2012
8/19/2012
9/2/2012
9/16/2012
9/30/2012


1,200,000,000
1,000,000,000
800,000,000
600,000,000
400,000,000
200,000,000
0
silt and clay
7/8/2012
7/22/2012
8/5/2012
8/19/2012
9/2/2012
9/16/2012
9/30/2012


Fine sediment mass balance in upper Marble Canyon
685,000
468,000
800,000,000
600,000,000
400,000,000
200,000,000
0
7/8/2012
7/22/2012
8/5/2012
8/19/2012
9/2/2012
9/16/2012
9/30/2012


Export of sand past RM30
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
7/8/2012
7/22/2012
8/5/2012
8/19/2012
9/2/2012
9/16/2012
9/30/2012

Between July 1 and October 1 …



Long-term average sand load for July, August, September is 725,000 tons

Mass balance prior to 2004 and 2008 HFEs
July 1 to November 2004: 275,000 – 491,000 metric tons
December 2004 – March 2008: 567,000 – 1,823,000 metric tons

Recommended High Flow Experiment for November 2012

Peak flow to sustain high deposition rates and allow comparison with previous HFEs

Slow recession rate to improve deposition characteristics in eddies

Upramp rate is slower than 1996 and faster than 2004/2008. Efficiently uses water and does not unnecessarily stress measurement equipment downstream.

Efficient use of water

Recommended High Flow Experiment for November 2012

GCMRC Science Activities associated with HFE

October	02 - 19	I. Riparian vegetation	Pre-HFE riparian vegetation survey in Marble and Grand Canyons
October	02 - 19	A. Campsite/sandbar monitoring	NAU/USGS fall campsite/sandbar monitoring
October	mid-month	F. Rainbow trout early life stage study	Electrofishing survey of age-0 rainbow trout in Glen Canyon
October	15 - 19	F. Rainbow trout monitoring in Glen Canyon	AZGF electrofishing survey of adult rainbow trout and other nonnative fish in Glen Canyon
October	20-29	F. Rainbow trout natal origins	Rainbow trout tagging - effort to PIT tag 8,000-10,000 fish in Glen Canyon as part of an ongoing mark-recapture study
November	before 11/18	B. Sediment transport	Pre-HFE sampling of sediment transport at 60 mile, Grand Canyon (~87 mile), and National Canyon (167 mile)
November	before 11/18	F. Foodbase monitoring	Pre-HFE sampling of invetebrate drift, primary productivity, and benthos at Lees Ferry and Diamond Creek
November	18 - 24	B. Sediment transport	HFE sampling of sediment transport at 60 mile, Grand Canyon (~87 mile), and National Canyon (167 mile)
November	18 - 24	F. Foodbase monitoring	HFE sampling of invetebrate drift at Lees Ferry, RM61, and Diamond Creek
November	late Nov	B. Sediment transport	Post-HFE sampling of sediment transport at 60 mile, Grand Canyon (~87 mile), and National Canyon (167 mile)
November	late Nov	F. Foodbase monitoring	Post-HFE sampling of invetebrate drift, primary productivity, and benthos at Lees Ferry and Diamond Creek
December	3 - 7	H. Rainbow trout population management	Post-HFE electrofishing surveys and mark-recapture effort to monitor any fish response to HFE
Late Nov or early January	?	A. Sandbar and sediment storage dynamics	Post-HFE retrieval of memory cards from remote cameras for sandbar time series photos
December	?	F. Rainbow trout early life stage study	Rainbow trout redd counts in Glen Canyon
January	?	F. Rainbow trout natal origins/juvenile chub monitoring	Quarterly electrofishing surveys and mark-recapture effort to monitor rainbow trout abundance and movement/quarterly monitoring of juvenile humpback chub near the Little Colorado River confluence
January	?	F. Rainbow trout early life stage study	Rainbow trout redd counts in Glen Canyon