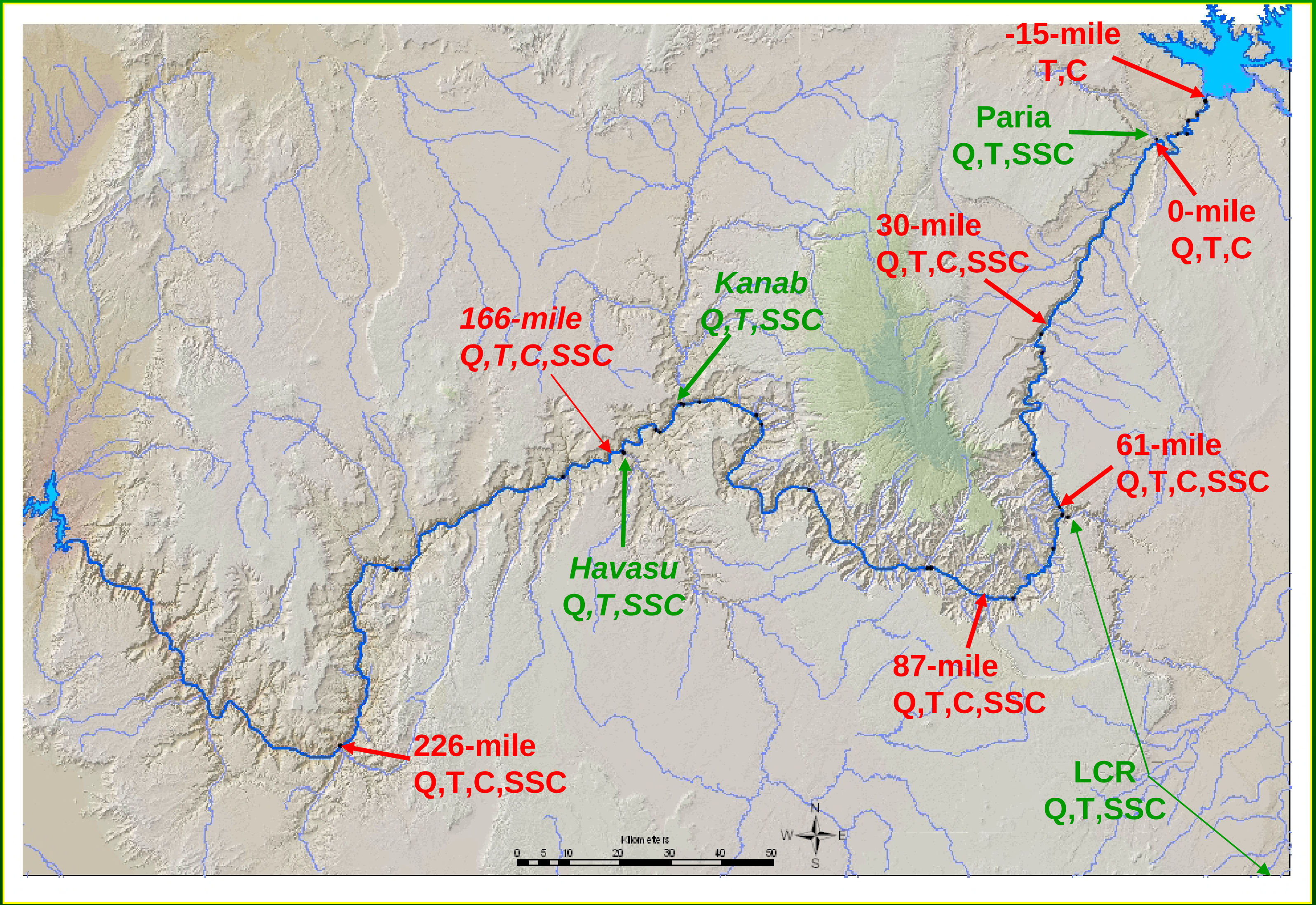
Core Monitoring Plan

Step-down Process for Evaluating the Core Monitoring Components of the Downstream Water Quality Project

Proposed Core Monitoring Plan for Downstream Water Quality



Step 1: AMWG Priority

Does the data directly or indirectly address an AMWG priority?

Priority 1: Why are the humpback chub not thriving, and what can we do about it? How many HBC are there and how are they doing?

Priority 2: Which cultural resources, including TCPs, are within the APE, which should we treat, and how do we best protect them? What are the status and trends of cultural resources and what are the agents of deterioration?

Priority 3: What is the best flow regime?

Priority 4: What is the impact of sediment loss and what should we do about it?

Priority 5: What will happen when we test or implement the TCD? How should it be operated? Are safeguards need for management?

- Directly addresses AMWG Priority 4
- Directly addresses AMWG Priority 5
- Indirectly addresses AMWG Priority 1
Physical habitat

- Indirectly addresses AMWG Priority 2
Aeolian transport/arroyos

- Indirectly addresses AMWG Priority 3
Flows affect sediment transport/water quality

Step 2: MOs and CMINs

Does the data directly or indirectly address an existing MO and specific CMIN?

MOs directly addressed

7.1 Attain water temperature ranges and seasonal variability in the mainstem necessary to maintain or attain desired levels of desirable biological resources.
7.2 Maintain water quality in the mainstem of the Colorado River Ecosystem.
7.3 Maintain suitable water quality in Glen Canyon Dam releases to meet downstream management objectives.
7.4 Maintain flow dynamics associated with power plant operations, BHBF and habitat maintenance flows.
8.1 Maintain or attain fine sediment abundance, grain-size, distribution in the main channel below 5,000 cfs.
8.2 Maintain or attain fine sediment abundance, grain-size, distribution within channel margins (not eddies) from 5,000 to 25,000 cfs.
8.3 Maintain or attain fine sediment abundance, grain-size, distribution within eddies below 5,000 cfs.
8.4 Maintain or attain fine sediment abundance, grain-size, distribution within eddies 5,000 to 25,000 cfs.
8.5 Maintain or attain fine sediment abundance, grain-size, and distribution on shorelines between 25,000 cfs and the uppermost effects of maximum dam releases.

CMINs addressed

1) Surface Water Measurements

7.4.1 Determine and track releases from Glen Canyon Dam under all operating conditions.

- Addressed directly through flow measurements at Lees Ferry

7.4.2 Determine and track flow releases from Glen Canyon Dam, particularly related to flow duration, upramp, and downramp conditions.

- Addressed directly through flow measurements at Lees Ferry

CMINs addressed

2) Sediment Transport Measurements

8.1.2 What are the monthly sand and silt/clay export volumes and grain-size characteristics, by reach, as measured at Lees Ferry, Lower Marble Canyon, Grand Canyon, and Diamond Creek Stations?

- Addressed directly through proposed monitoring at 61-mile, 87-mile and 226-mile. Nearly continuous monitoring is required to get monthly volumes.
- Do not propose sediment monitoring at Lees Ferry
- Propose additional stations at 30-mile and 166-mile

8.1.3 Track, as appropriate, the monthly sand and silt/clay input volumes and grain-size characteristics, by reach, as measured or estimated at the Paria and Little Colorado River stations, other major tributaries like Kanab and Havasu Creeks, and “lesser” tributaries.

- Addressed directly through proposed sampling on the Paria, LCR (Cameron and mouth), Kanab and Havasu Creeks.
- No proposed monitoring on “lesser” tributaries; this is still in the research phase.

CMINs addressed

3) Water Chemistry Measurements

7.1.1 Determine the water temperature dynamics in the main channel, tributaries (as appropriate), backwaters, and near-shore areas throughout the Colorado River ecosystem.

- Addressed directly through temperature monitoring at -15-mile, 0-mile, 30-mile, 61-mile, 87-mile, 166-mile and 226-mile, Paria, LCR, Kanab, Havasu
- Backwaters and near-shore areas not proposed for Core Monitoring – still assessing methodology and locations

7.1.2 Determine the seasonal and yearly trends in turbidity, water temperature, conductivity, DO, and pH, (decide below whether selenium is important) changes in the main channel throughout the Colorado River ecosystem.

- Water temperature and conductivity addressed directly at sites listed above.
- Turbidity, DO, pH, and selenium not included. Assessing existing turbidity, DO, and pH data; may become part of CM based on foodbase research findings.

7.1.3 What are the status and trends of water quality releases from Glen Canyon Dam?

- Addressed directly through monitoring (temperature and conductivity) at -15-mile.
- Other parameters (e.g. nutrients, organics) awaiting results of foodbase research.

Step 3: Compliance

Does the data satisfy a specific legal compliance requirement outside of GCPA and the NPS Organic Act (e.g. EIS/ROD, ESA, LOR, NHPA)?

Only flows at Lees Ferry for Compact, I think.

Step 4: Legacy

Does the data contribute to an historical record that is important to continue?

Lees Ferry flow since 1921; temperature since 1949 (some breaks)
Grand Canyon flow since 1922; temperature since 1940 (some breaks)

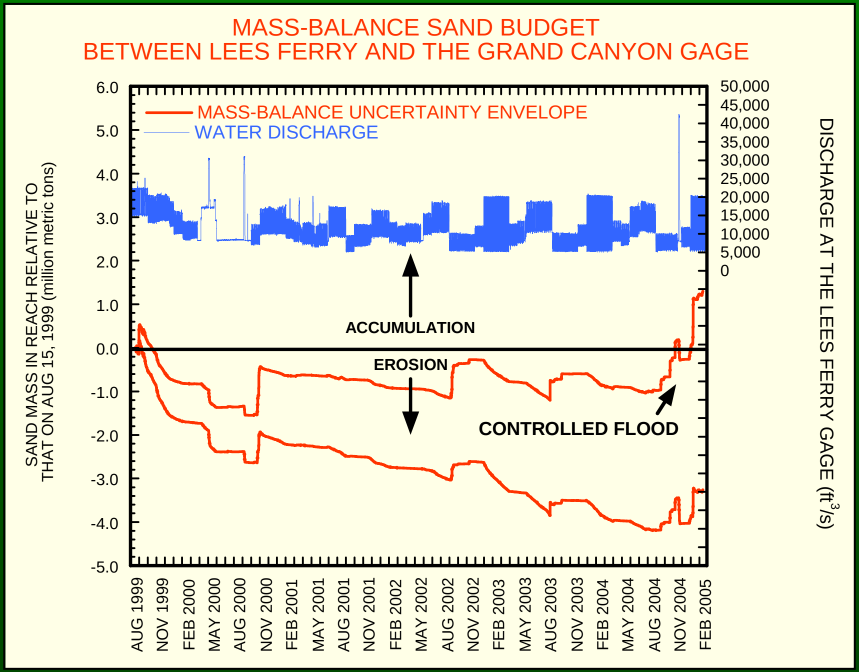
Sediment mass balance began in 1999

Breaking the sediment records has more consequences than breaking e.g. temperature records. A break in the sediment records means restarting the mass balance from zero.

Step 5: Data quality/availability

Is the accuracy and precision of the data known for proposed data collection, and if so, is the level of accuracy/precision adequate, inadequate, or more than adequate to meet the needs of the program? How will data be made available?

Temperature: ±0.15°C
Conductivity: ±0.5% of reading
±10% for mainstream sediment loads
±20-30 for tributary sediment loads



Eventually, all data will be available through the GCMRC Oracle database.

Step 6: Cost/benefit and risk assessment

What are the relative merits of collecting this data relative to other data collection?

Sediment and temperature are directly linked to habitat and ecosystem function. They are probably the WQ parameters most affected by GCD operations

These parameters either directly or indirectly relate to the top 5 AMWG priorities

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Step 7: Status of knowledge

What is the current status of knowledge about the resource that the data is intended to monitor?

Temperature: Colder and less variability than pre-dam; during low releases, more downstream warming occurs

Sediment: MLFF operations during minimum release years result in a negative mass balance. High flows move sediment to high elevations sandbars, but potentially at the expense of low elevation sand in eddies.

Step 8: Methodology

Does methodology exist that provides acceptable accuracy, precision, and frequency of data?

Temperature data collection methodology is standardized.

GCMRC has developed a unique system for providing the frequency of sediment data necessary to develop a continuous mass balance (see Melis et al. paper) for the Colorado River in Grand Canyon, an extremely difficult location to do this. Whether the uncertainty bounds are acceptable is up the managers; it would be very costly to reduce them.

Budget

$1,104,000 – Arizona WRD estimate to undertake all data collection

$200,000 – GCMRC salaries

Linkage to Modeling Efforts

Monitoring data is essential for continued development and validation of models, as well as for boundary conditions

Flow data → UNSTEADY: LF, Paria, LCR data needed for boundary conditions. Other sites useful for periodic testing of the model.

Sediment data → 1D/2D models under development by Wiele et al. Data essential for calibrating/validating models.

Temperature data → Upcoming development of mainstem and backwater models. Data essential for calibrating/validating models.

Well established models can reduce the need for monitoring. However, always need boundary conditions, and it's wise to maintain at least one within system station for periodic checking of the model calculations.