



Purpose and Need

The purpose and need for physical and biological monitoring of the Provo River Restoration Project can be put into three important categories:

1. To quantify baseline conditions of the restored and un-restored reaches and track change over time.
2. To acquire adequate data and analysis capabilities over time to adaptively maintain the riverine ecosystem in a desirable condition. Adaptive maintenance activities will likely be centered around flow recommendations and replenishing sediment supplies below Jordanelle Dam.
3. To use the "best available scientific knowledge" to assure the Mitigation Commission meets all fish, wildlife, and recreation mitigation commitments.

Holistic Ecological Considerations

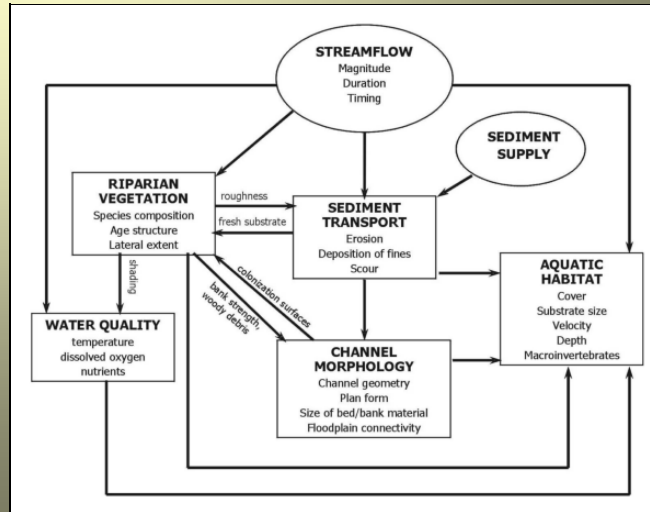


Diagram 1.1. Schematic illustration of major interactions among riverine resources and processes.

Monitoring Activities

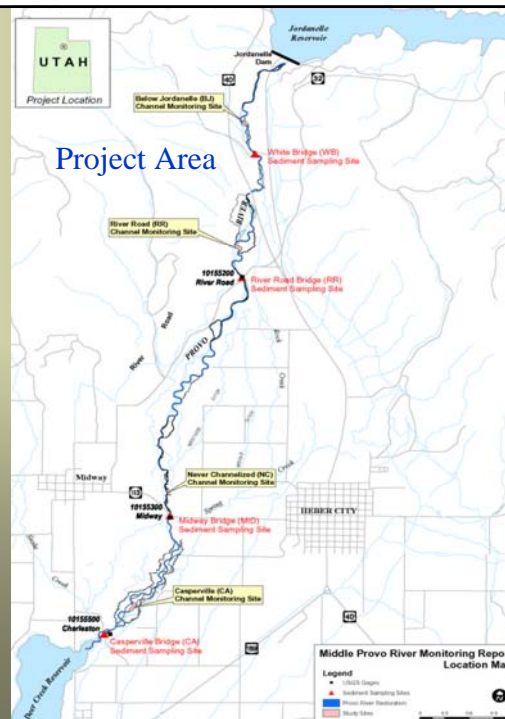
Establish Permanent Monitoring Sites

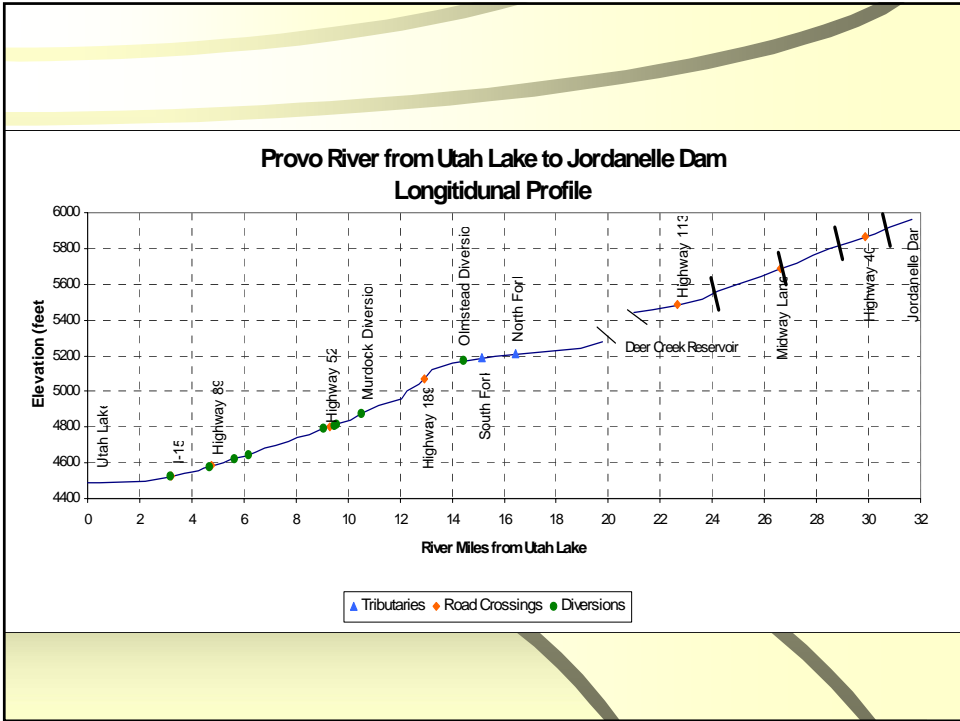
Survey Channel Cross Sections and Streambed Longitudinal Profiles

***Map Substrate and Measure Streambed Particle Size Distributions**

***Sample Suspended and Bedload Sediments**

Sample Benthic Macroinvertebrates









Analysis of Cross Section Data

1. Meander Migration (bank erosion, bar development)
2. Channel Geometry (width, depth, shape, incision)
3. Hydraulic Conditions (stage/discharge relationships, overbank flooding, single XS and HEC RAS)

Analysis of Longitudinal Profiles

1. Streambed Elevation (channel incision)
2. Habitat Complexity (riffle, run, pools)

Streambed Materials

1. **Substrate Patch Mapping**
2. Particle Size Distribution Sampling



Photo of riffle at BJ site (boot for scale): 40% cobble, 35% boulder, 25% large gravel



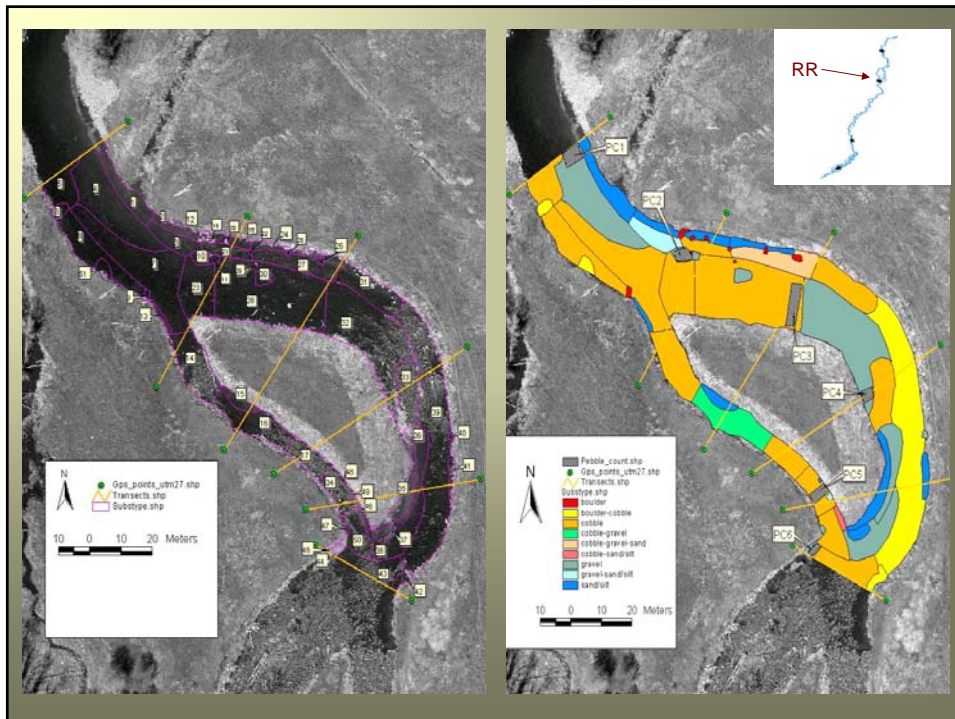
Photo of patch at BJ site (blue 152mm ruler for scale): 50% cobble, 25% medium gravel, 25% large gravel

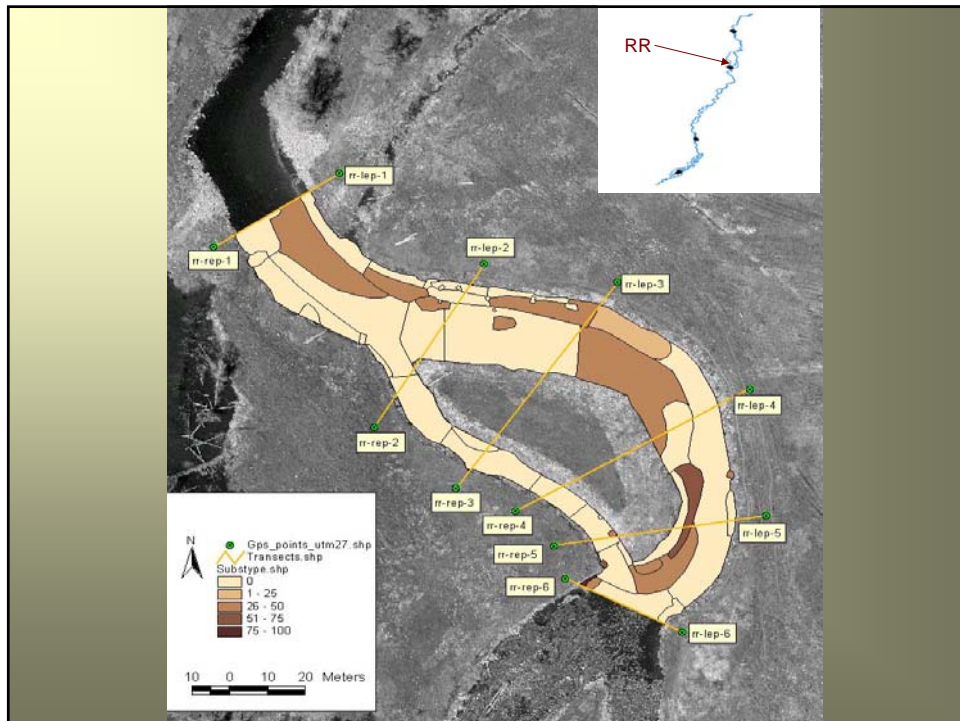
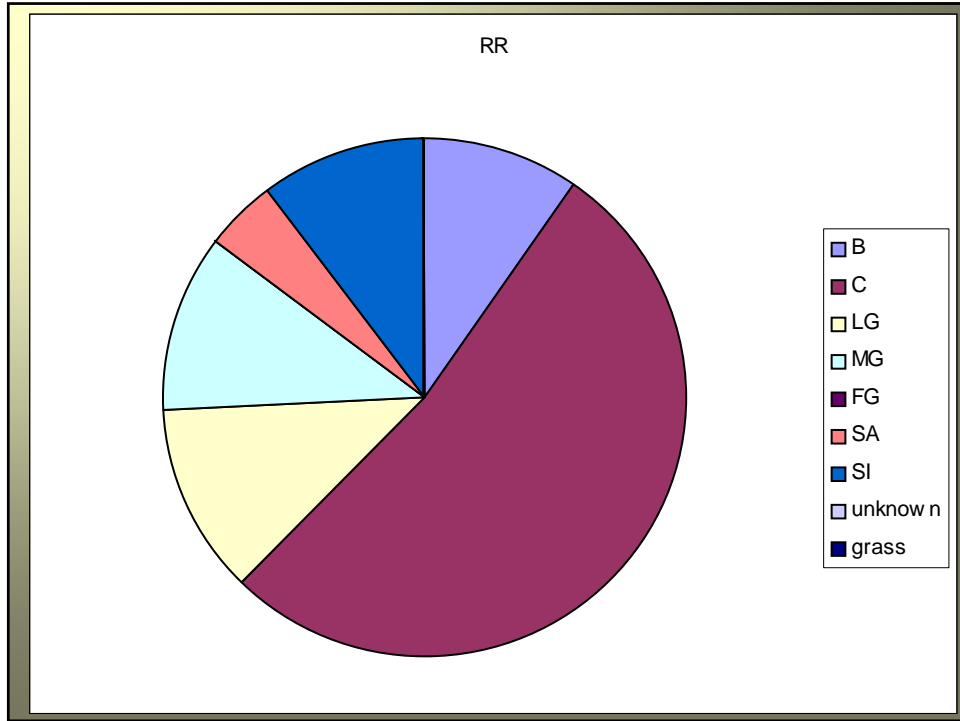


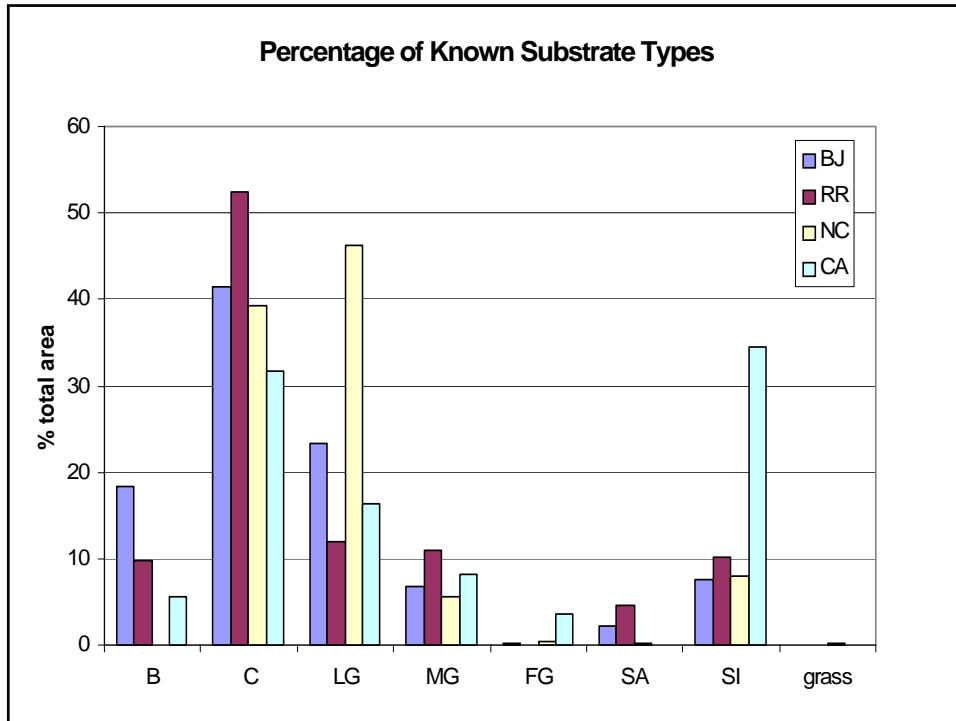
Photo of patch at NC site (blue 152mm ruler for scale): 50% cobble, 50% large gravel



Photo of patch at NC site near PC#1 (blue 152mm ruler for scale): 30% cobble, 35% large gravel, 35% medium gravel

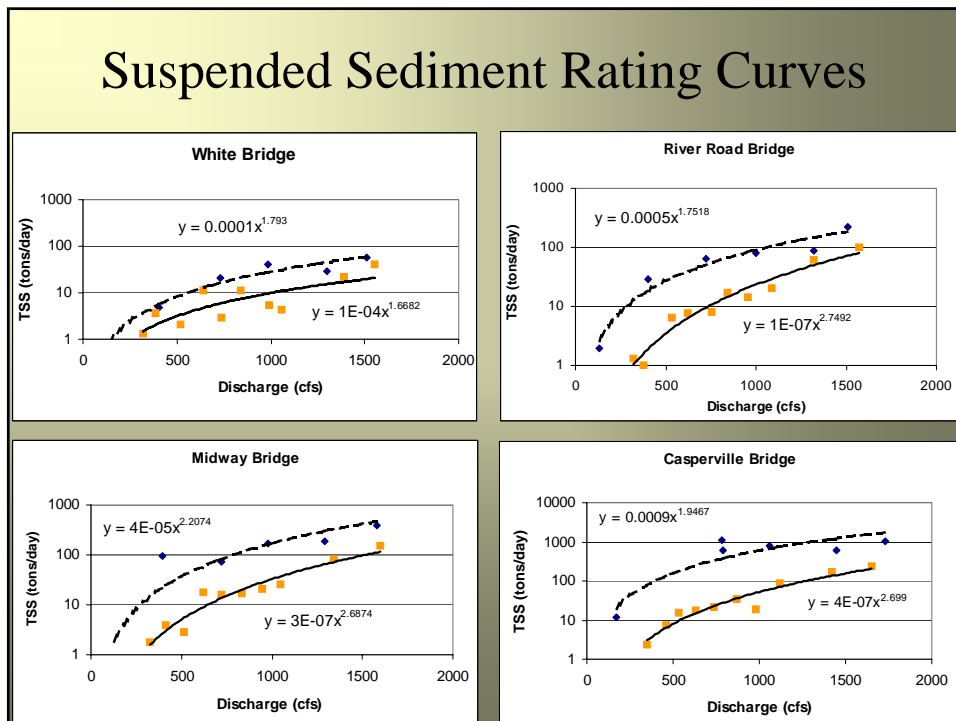
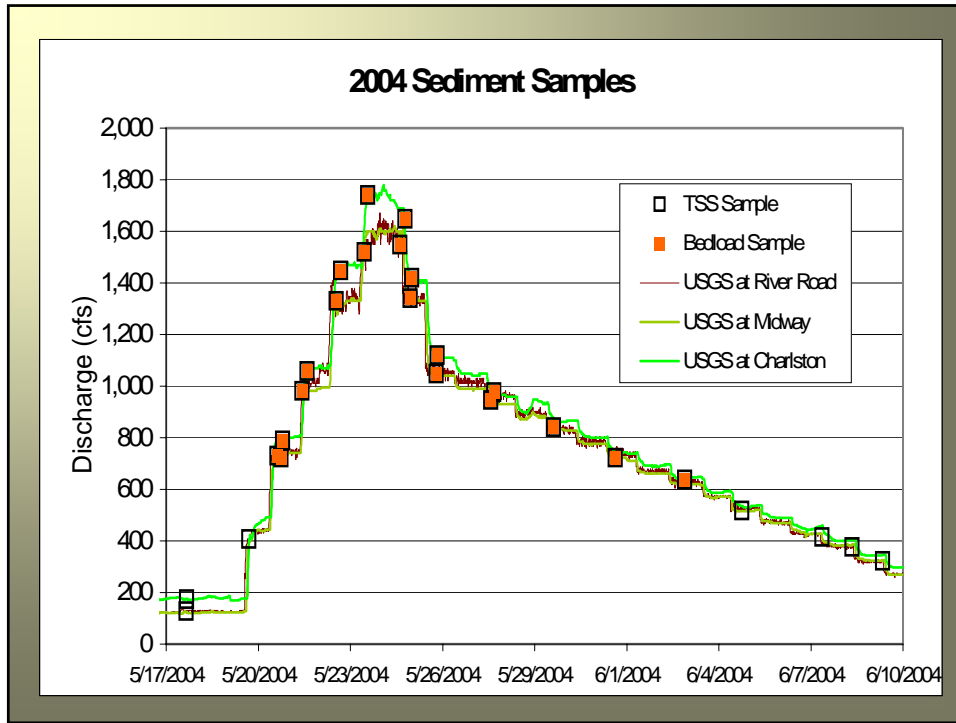




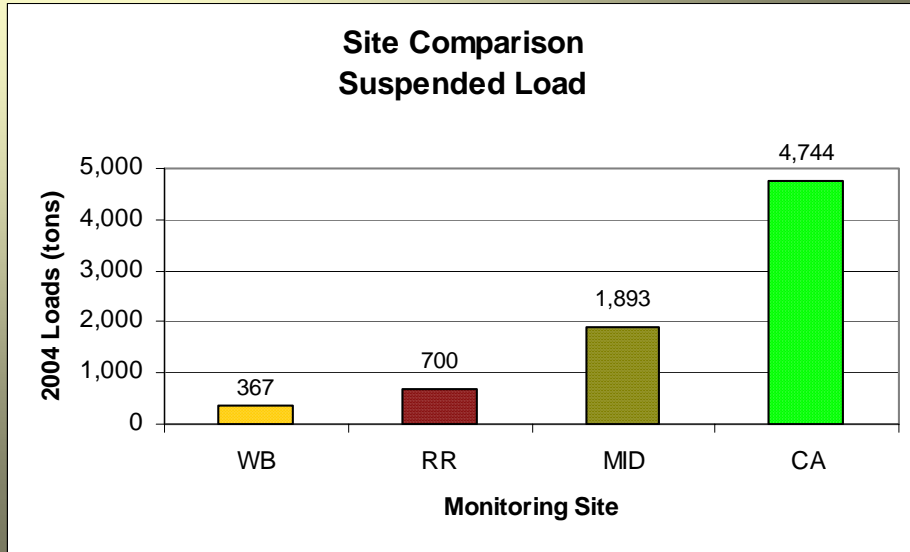


Sediment Transport

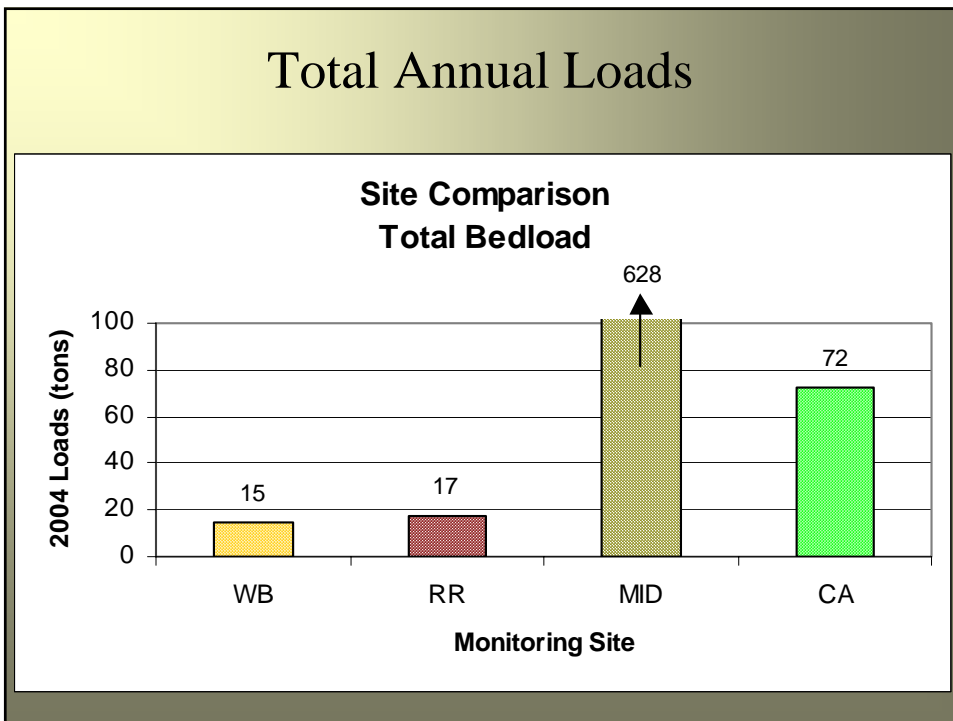
**Sediment samples collected
during spring runoff in
2002, 2003, and 2004**



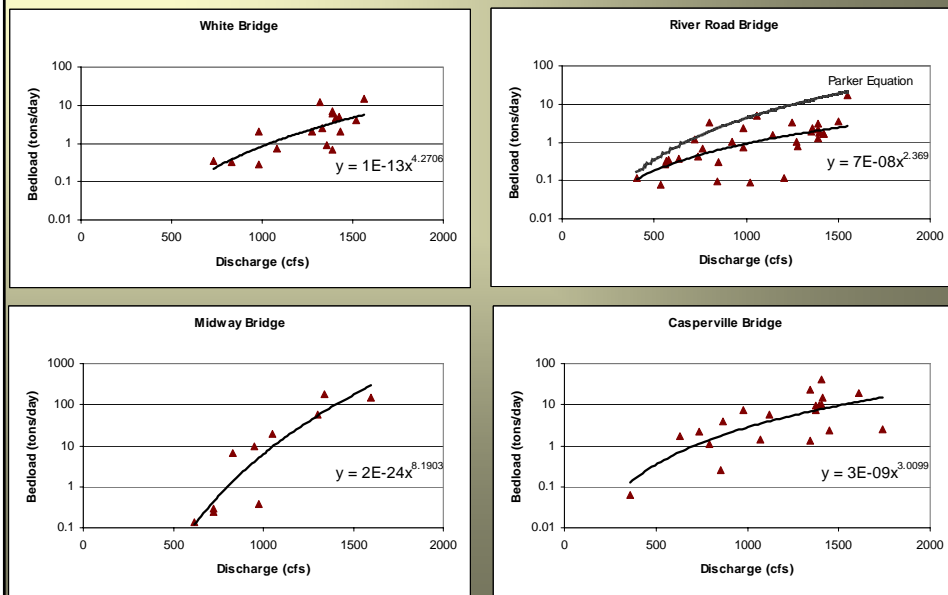
Total Annual Loads



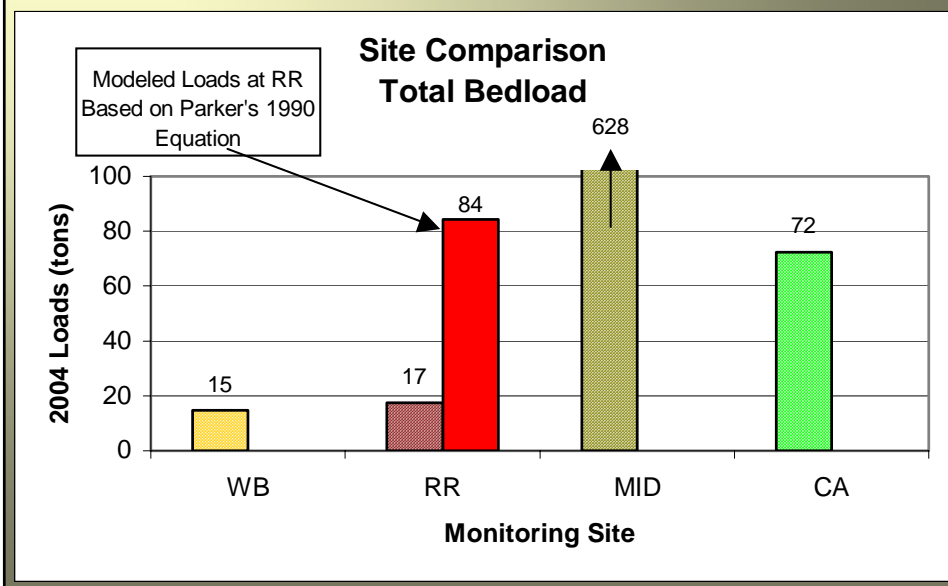
Total Annual Loads



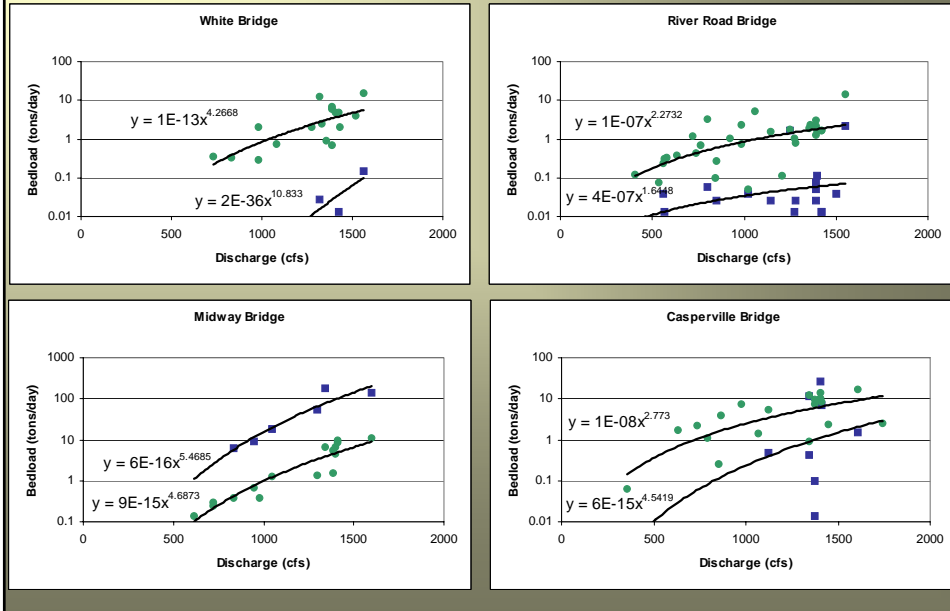
Bedload Rating Curves



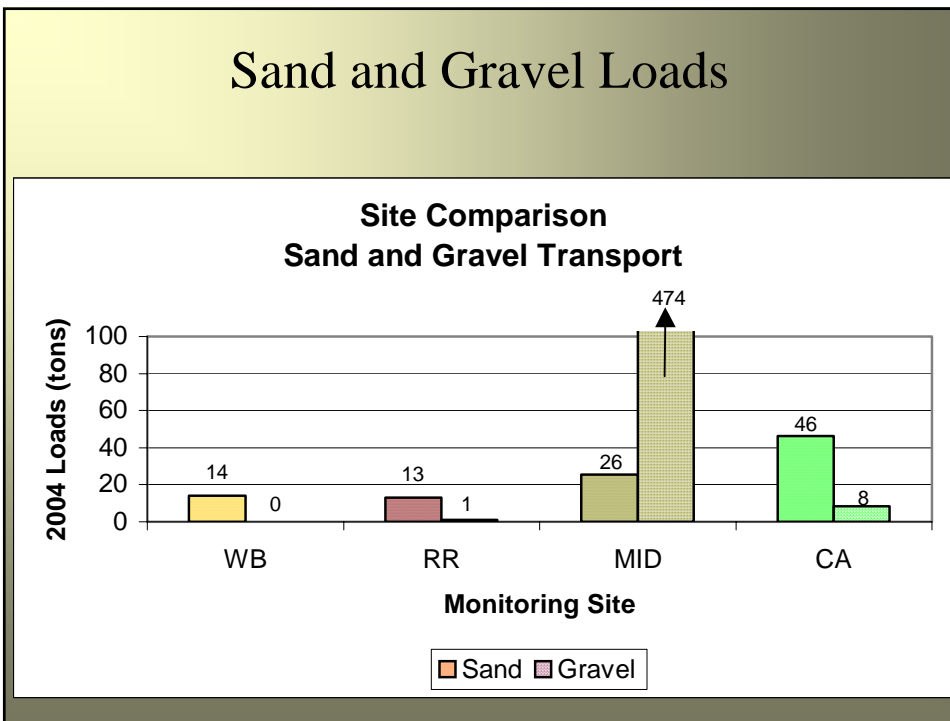
Total Annual Loads



Sand and Gravel Rating Curves



Sand and Gravel Loads



Sediment Transport Discussion and Recommendations

- The sediment transport results demonstrate the immediate need for channel maintenance activities (i.e., replenishing sediment supplies) below Jordanelle Dam.

Sediment Transport Discussion and Recommendations

- How much sediment should be replenished below Jordanelle Dam?
- Does more sediment need to be replenished above the never channelized reach?

The **first question** regarding “what to do?” is answered by defining, and maybe refining in the future:

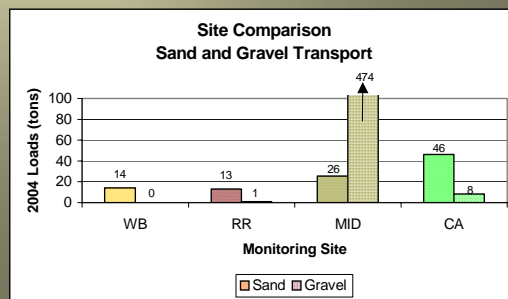
What transport rates and annual loads of gravel and sand resources would off-set deficits caused by Jordanelle Dam?

How much sand and gravel should be supplied on an annual basis below Jordanelle Dam?

- Bedload transport should average approximately 150 tons/year of sand and gravel based on 1997-2004 post-Jordanelle flow data.
- It is anticipated that this number could range annually between 50 and 400 tons depending on actual runoff conditions resulting from relatively “dry” and “wet” years.

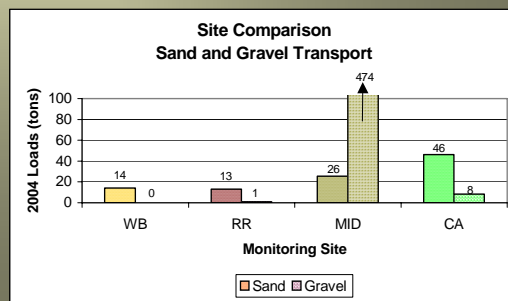
How much sand and gravel should be supplied on an annual basis below Jordanelle Dam?

- The replenishing sediment supplies during “dry years” should consist of half gravel (25 tons) and half sand (25 tons). Sand transport will be greater than gravel, especially if prolonged phase I transport occurs.



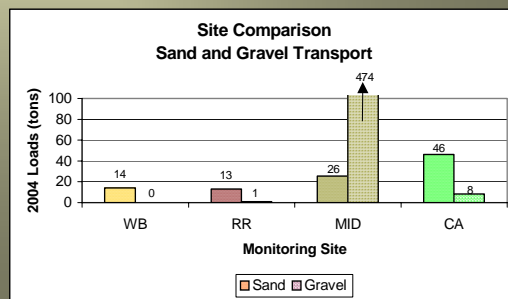
How much sand and gravel should be supplied on an annual basis below Jordanelle Dam?

- The replenishing sediment supplies during “average years” should consist of mostly gravel (100 tons) with some sand (50 tons). Gravel transport will be greater than sand, especially if phase II transport dominates.



How much sand and gravel should be supplied on an annual basis below Jordanelle Dam?

- The replenishing sediment supplies during “wet years” should consist of mostly gravel (300 tons) with some sand (100 tons). Phase II transport will dominate.



What does monitoring tell us about the design concepts?

What does monitoring tell us about the design concepts?

–Sediment transport in the reaches below Jordanelle Dam matches loads calculated during the design phase.

–We always knew that bedload supplies would need to be replenished on the order of approximately 200 tons/year.

What does monitoring tell us about the design concepts?

–However, we didn't expect the Never Channelized Reach to adjust so quickly and produce a wave of migrating gravel bars below Midway.



Functional Riverine Ecosystems

What Matters Most?

- Legal Protection
- Water Quality
- Space
- “Natural” Hydrology
- Continuity
- Connectivity
- Complexity
- Dynamics

