



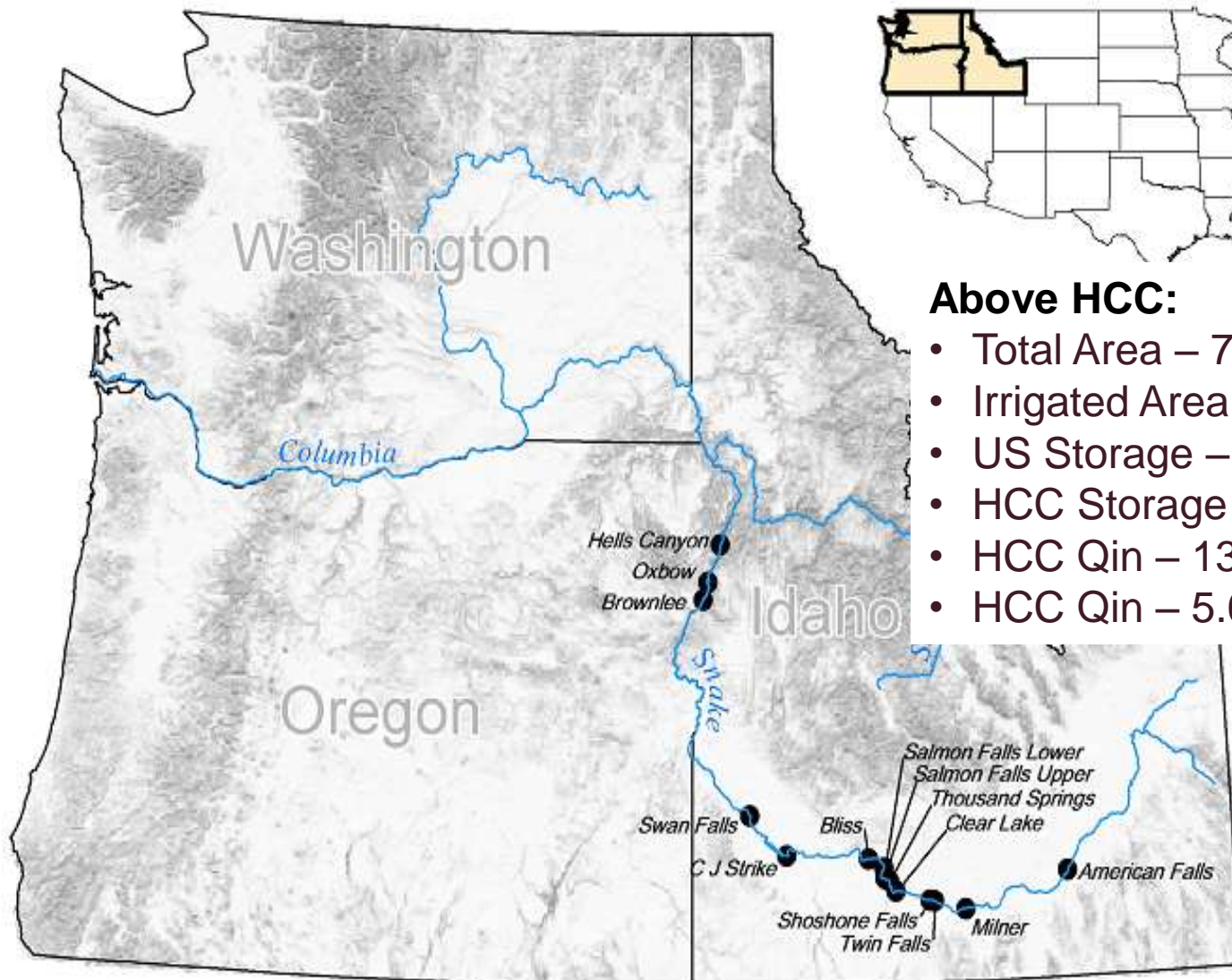
# Sediment in Hells Canyon

Shaun Parkinson, Ph.D, PE

## Why Did IPC Study Sediment?

- FERC relicensing was the motivating factor
- Initially sediment was not on the table....
- Specific sediment issues would be addressed in resource evaluations (fisheries, recreation, etc.)
- During study plan development, issues related to sediment expanded and sediment became a separate ‘topic’
- Most of the interest was/is downstream of HCD

# Study Area



## Above HCC:

- Total Area – 73,300 mi<sup>2</sup>
- Irrigated Area – 6,400 mi<sup>2</sup>
- US Storage – 9.4 MAF
- HCC Storage (active) – 1 MAF
- HCC Qin – 13.8 MAF Annual
- HCC Qin – 5.6 MAF A-J

# Hells Canyon Reach

- Approximately 100 miles of un-impounded river
- North Americas deepest gorge
- Wild & Scenic sections
- Hells Canyon National Recreation Area
- 7 aquatic species of concern, 5 T&E species



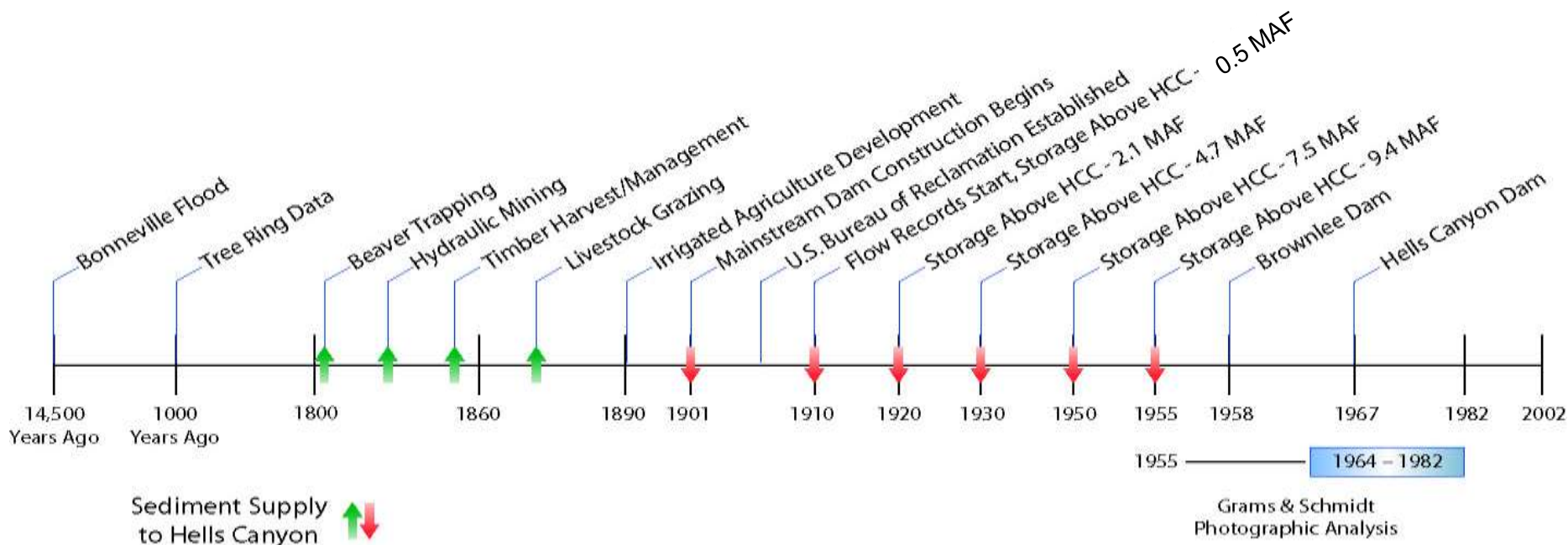
# Hells Canyon Sediment Issues

- Sandbars – recreation, aesthetics, rearing habitat
- Terraces – cultural resources, recreation
- Gravels – spawning, invertebrates
- Fine sediments – predation, shoreline vegetation, spawning

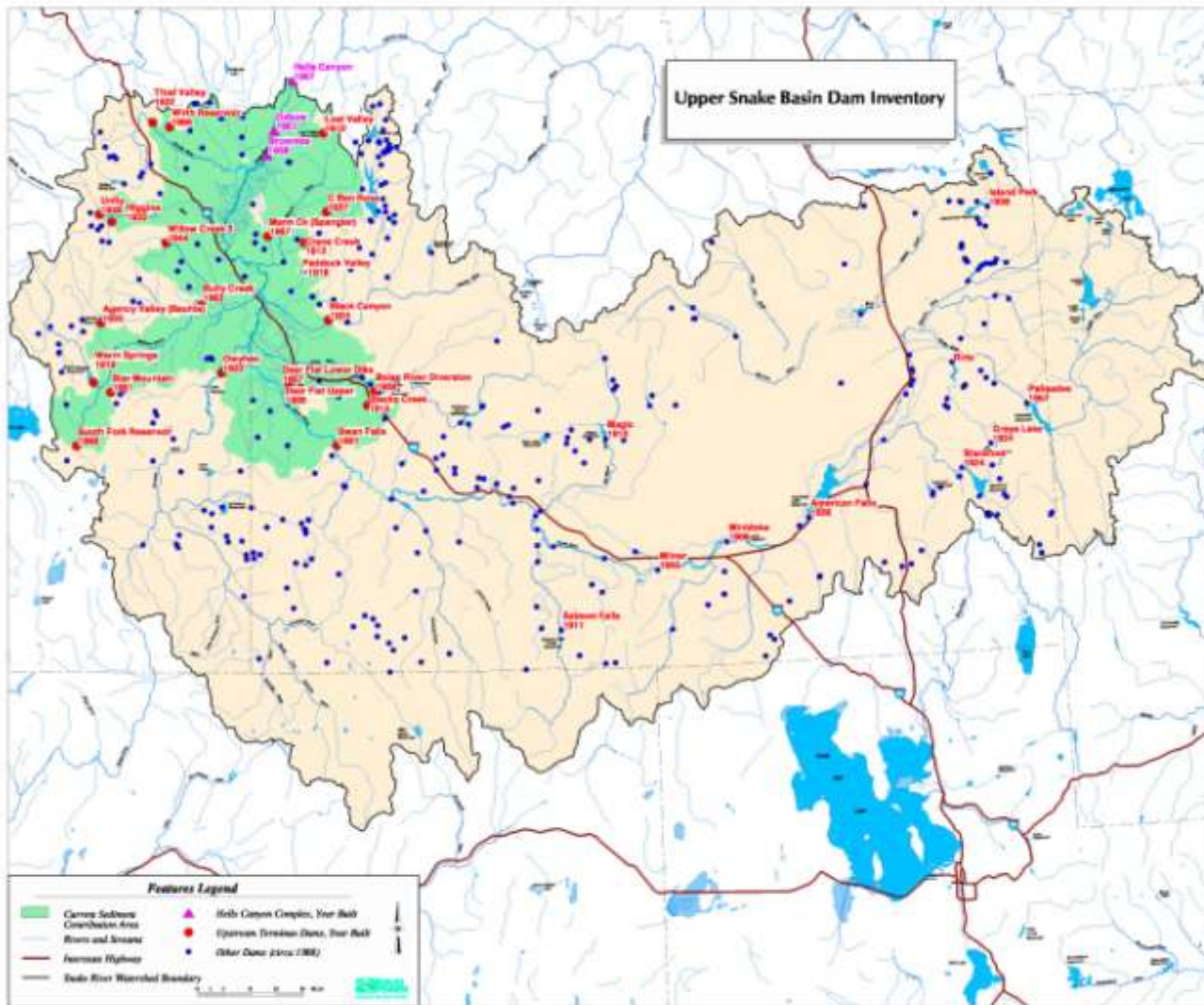
No specific criteria or standards for (lack of) sediment or fluvial features

# Sediment and Water Supply

## Anthropogenic Impacts in the Snake River Basin

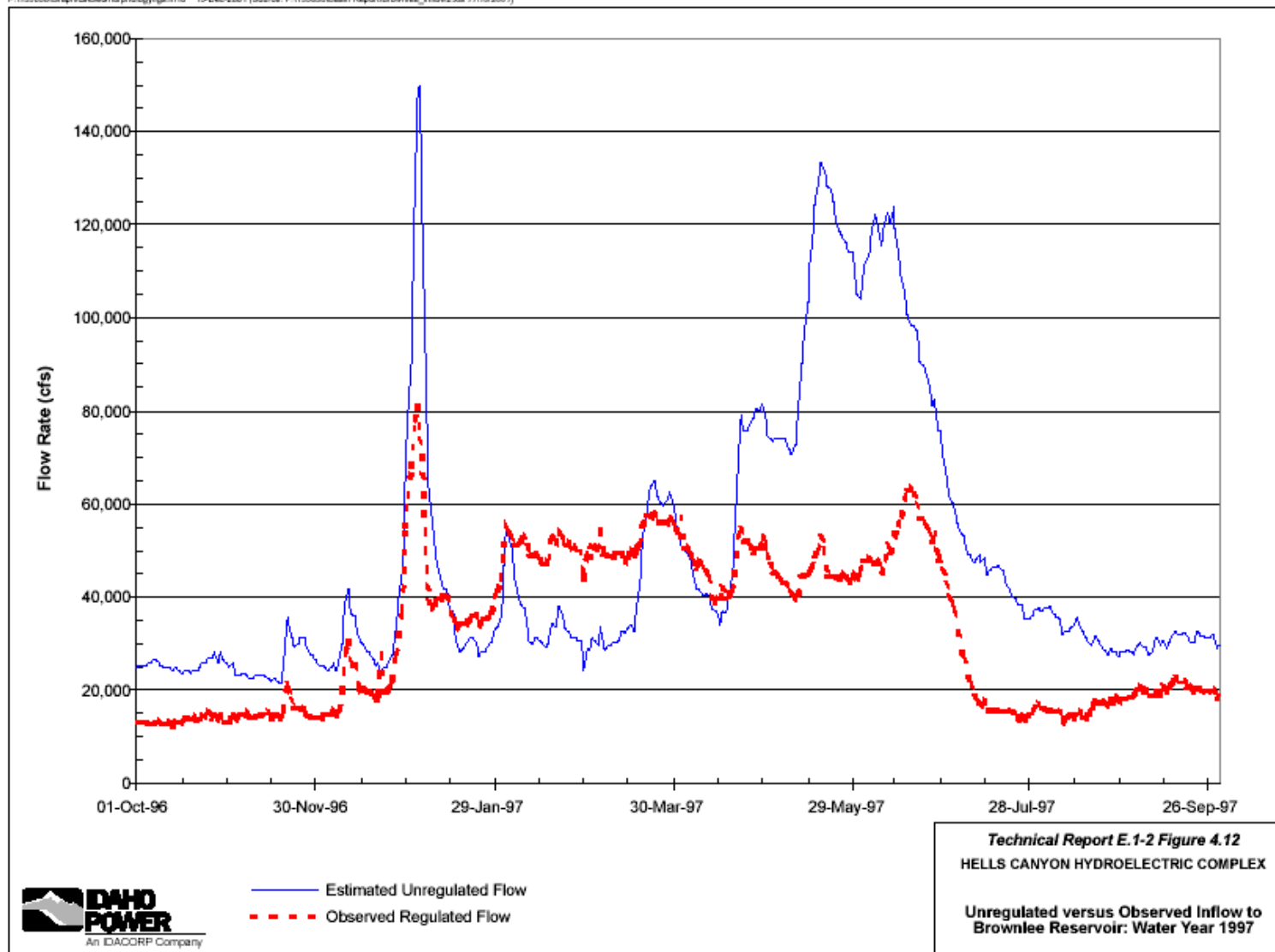


# Dam Inventory - 1958



# Hydrology - 1997

P:\155638\Graphical\Geomorphology\figs\fr10 15-Dec-2001 [Source: P:\155638\Basin Reports\Brownlee\_inflow2.xls 11/15/2001]



# Initial Reach-Scale Efforts

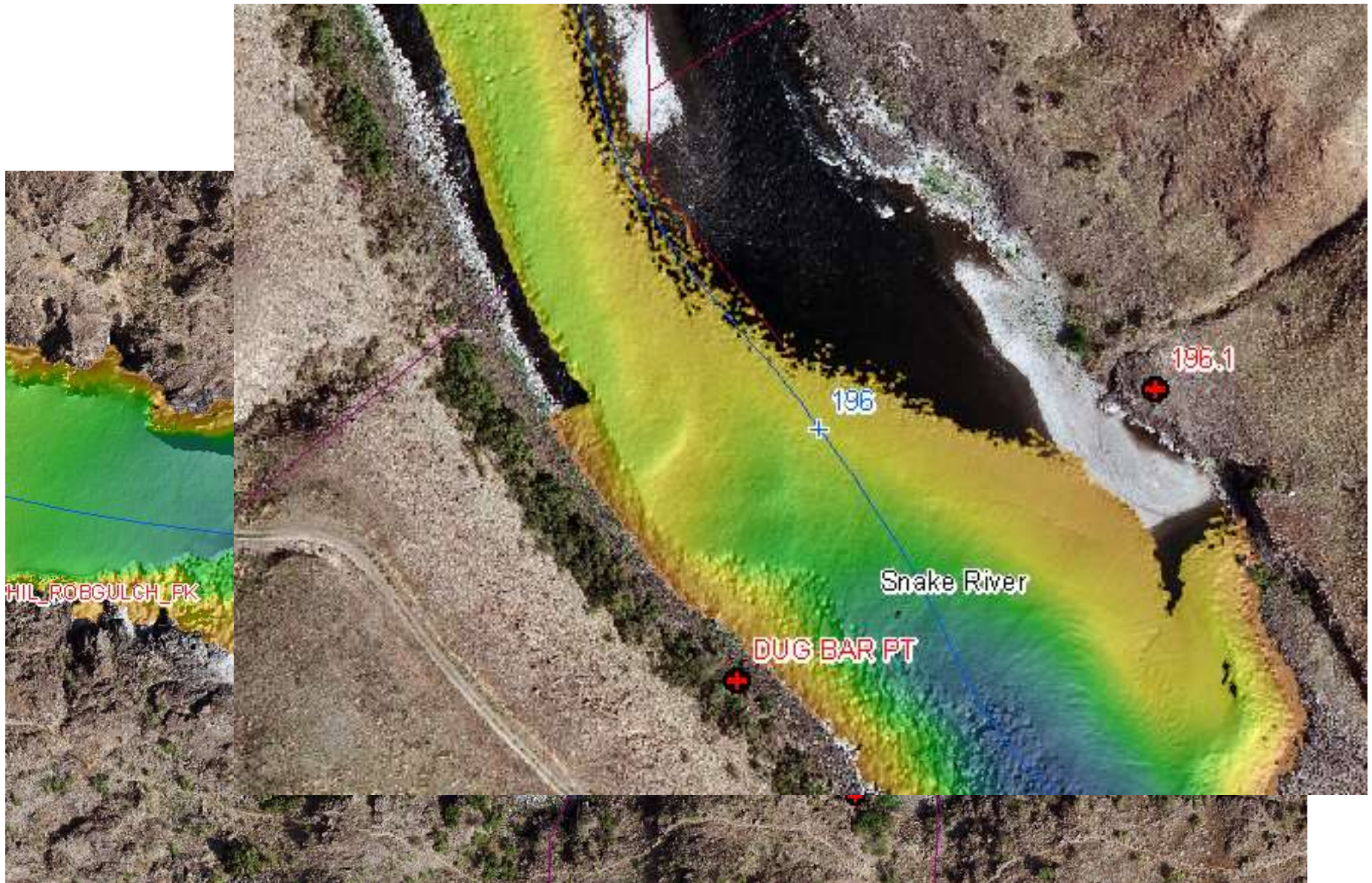
## Large-scale mapping

- River and reservoir bathymetry
- LiDAR & Photogrametry mapping

## What was source of sediments for sediment features?

- Sediment sampling
  - Bed material
  - Reservoir sediment sampling
- XRD to identify source (provenance) of sediments.

# Multi-Beam Bathymetry



# Reservoir Sampling

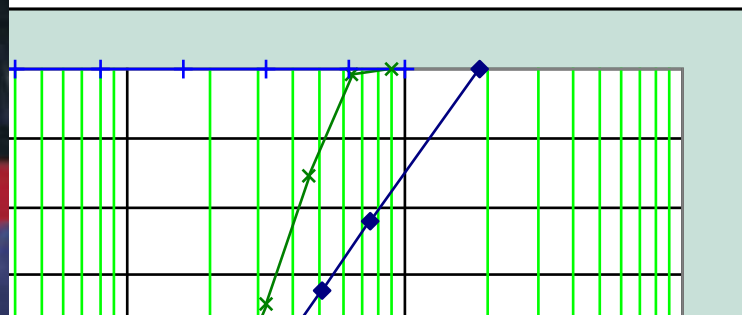
Core Sampling  
12/13/98



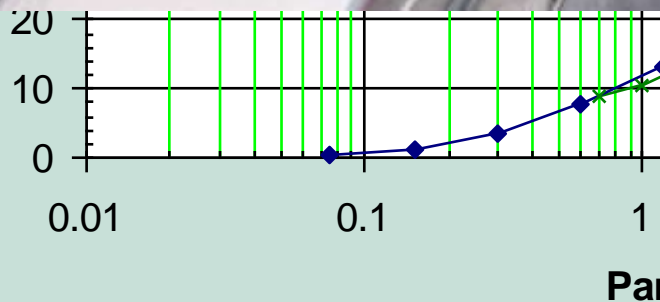
Recording Core Sample  
12/13/98

# Sediment Characteristics

Brownlee Sediments

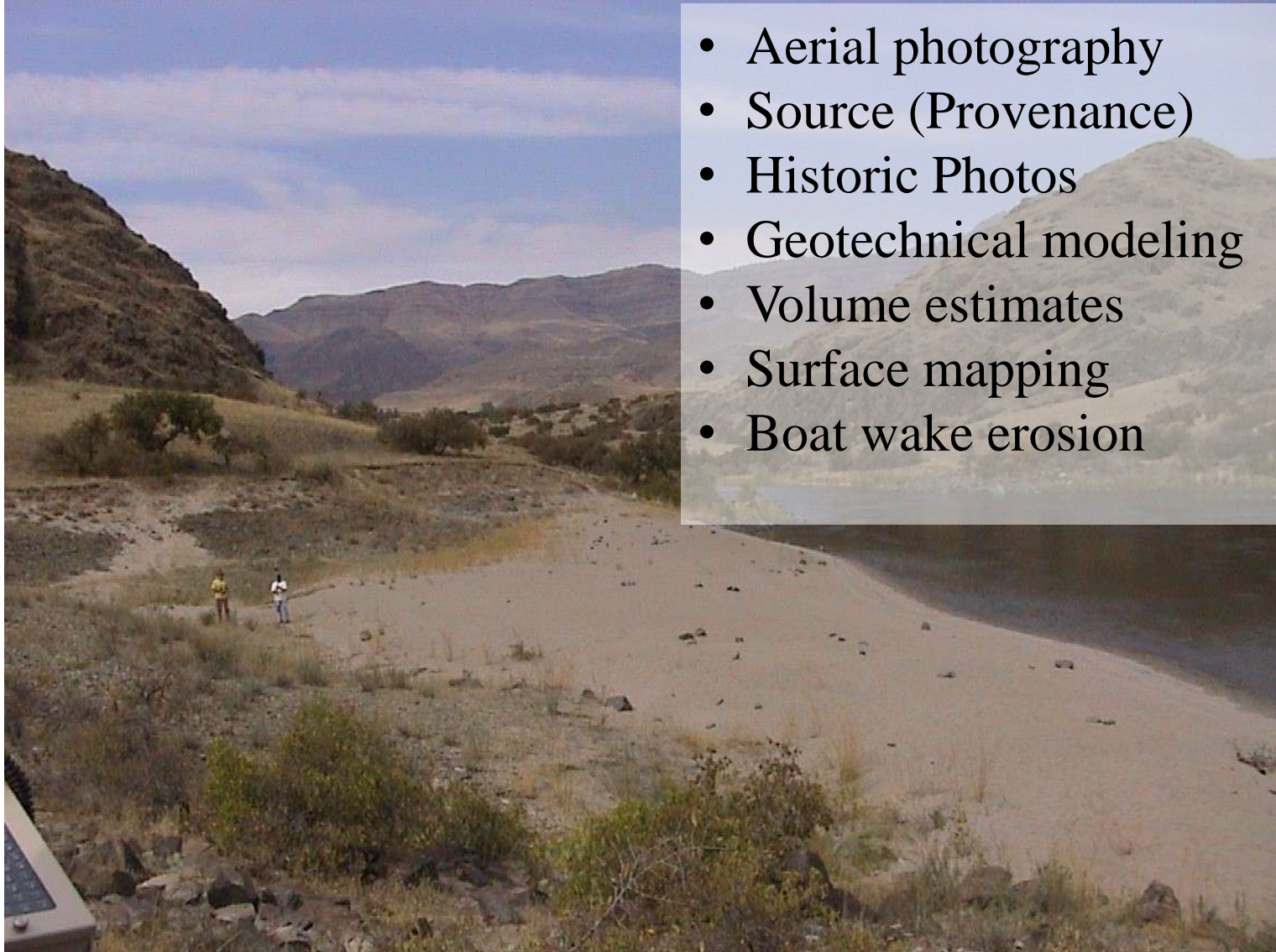


Hells Canyon Bed Material, RM 224



—x— Bed Material above HCC —+— Sediment

# Sandbars

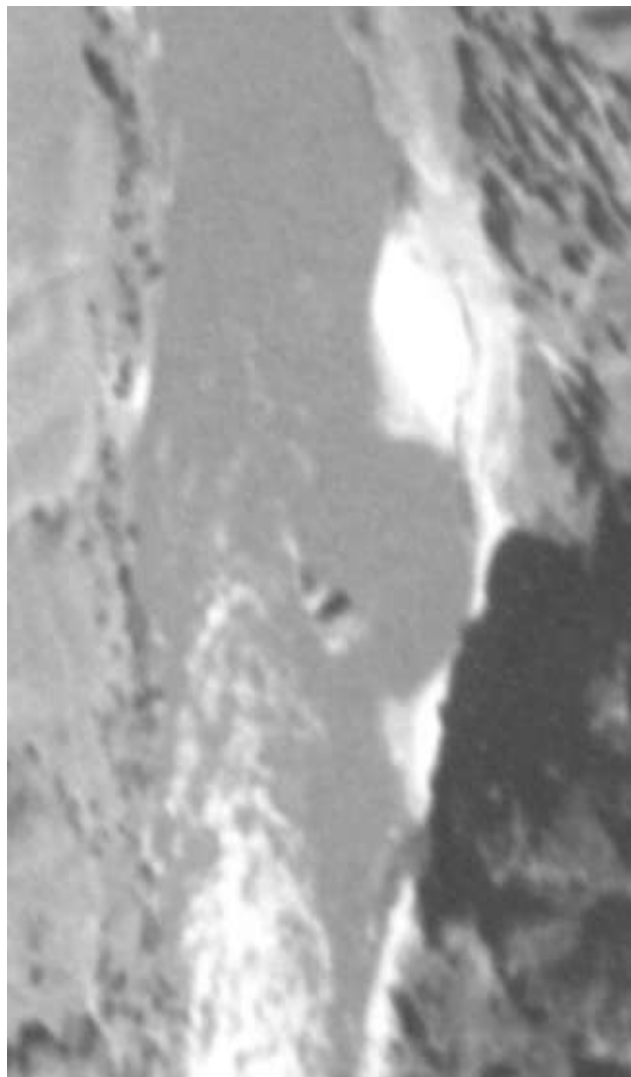


- Aerial photography
- Source (Provenance)
- Historic Photos
- Geotechnical modeling
- Volume estimates
- Surface mapping
- Boat wake erosion

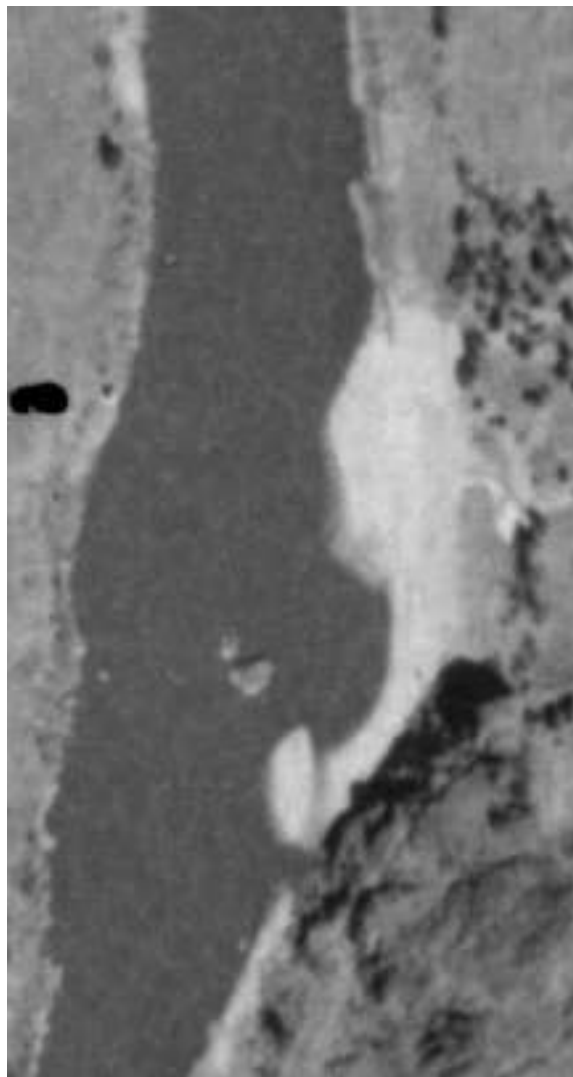
# Aerial Photography

## Pine Bar

1946 (13,500 cfs)



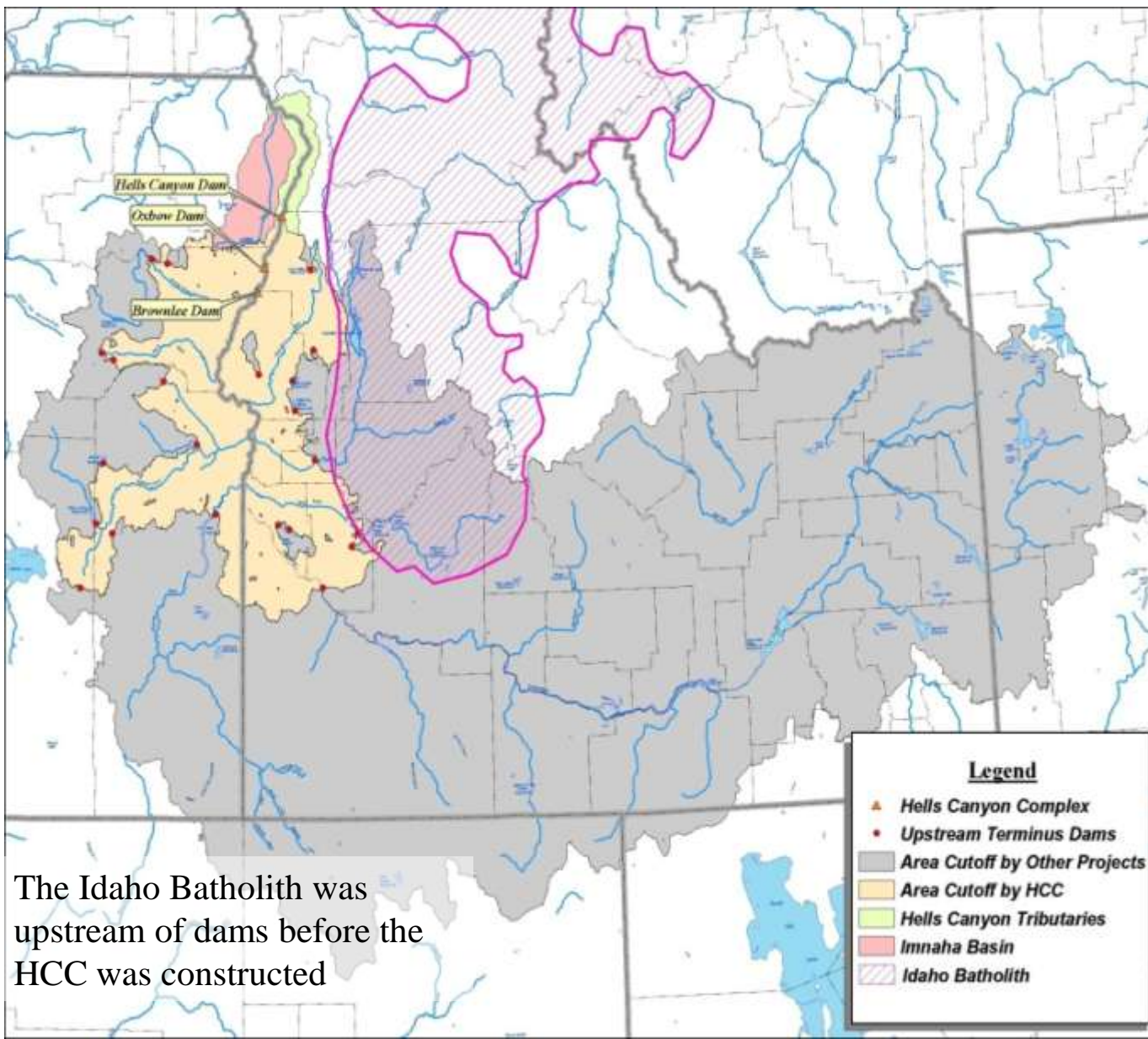
1949 (10,700 cfs)



1964 (11,300 cfs)



# Sediment Provenance

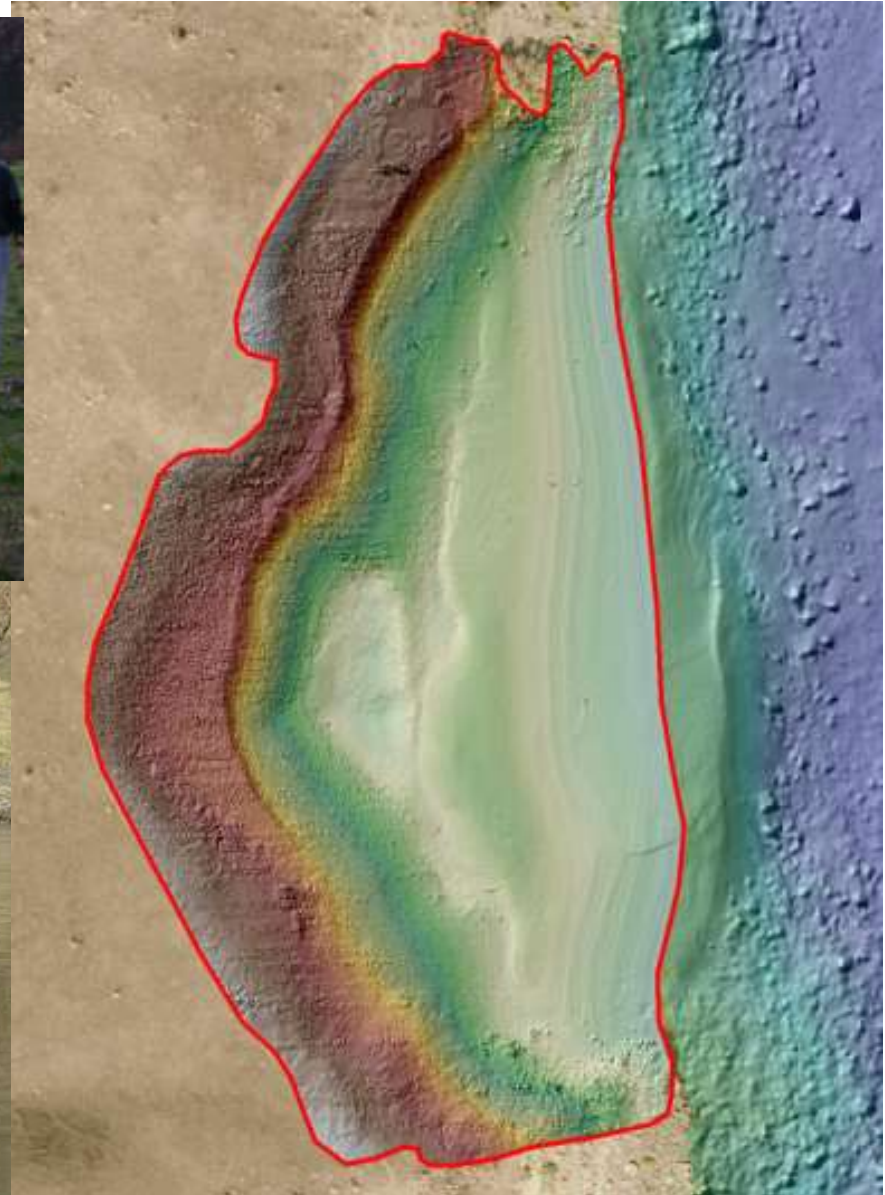


The Idaho Batholith was upstream of dams before the HCC was constructed

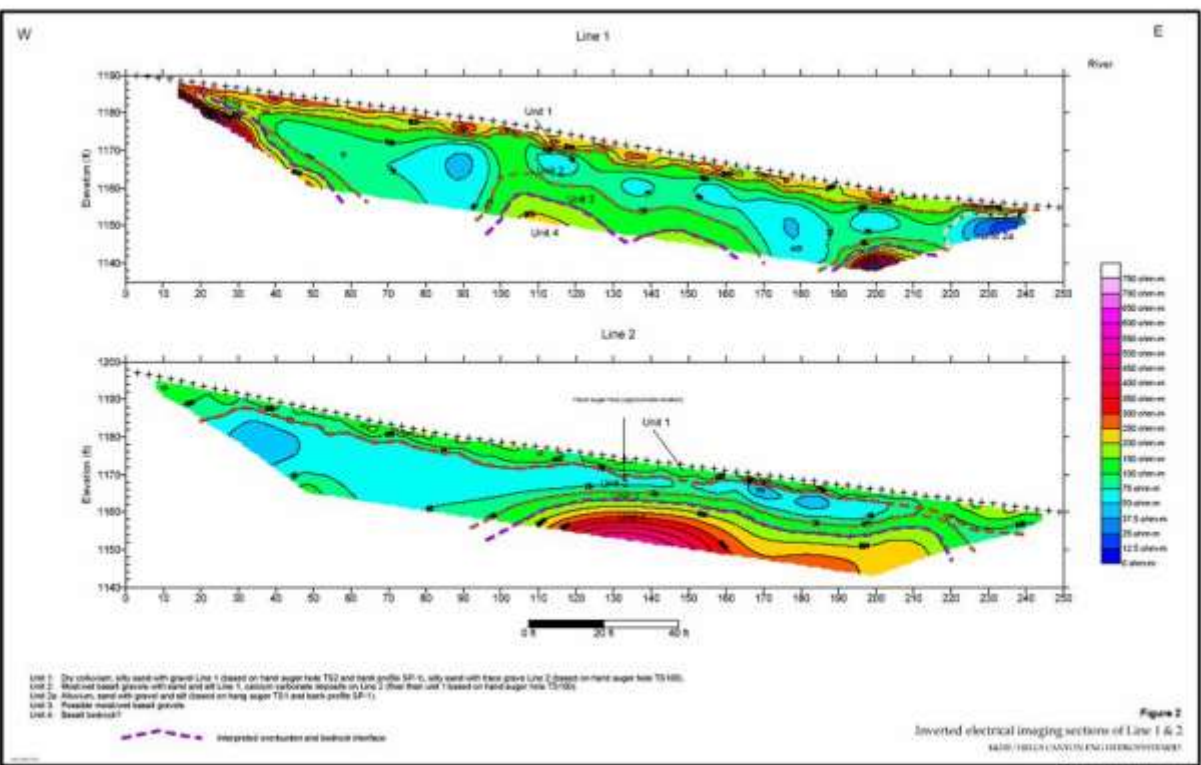
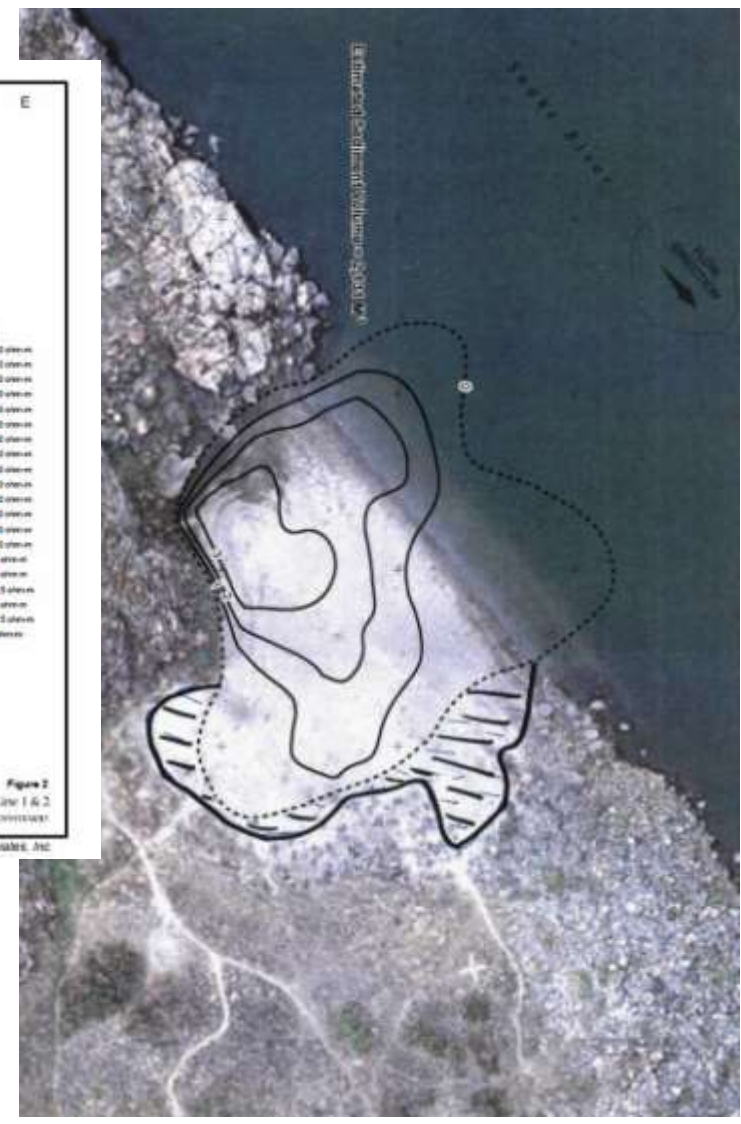
**Legend**

- ▲ Hells Canyon Complex
- Upstream Terminus Dams
- Area Cutoff by Other Projects
- Area Cutoff by HCC
- Hells Canyon Tributaries
- Imnaha Basin
- ▨ Idaho Batholith

# Surface Mapping



# Bar Volume - Geophysics



# Boat Erosion Studies



- ADV
- OBS
- Wave Gages

# Spawning Gravels

- Substrate Mapping
- Surface Mapping
- Source (Provenance)
- Scour chains
- Quality (freeze cores)
- Hydraulic modeling



# Substrate Quality

Specifically interested in:

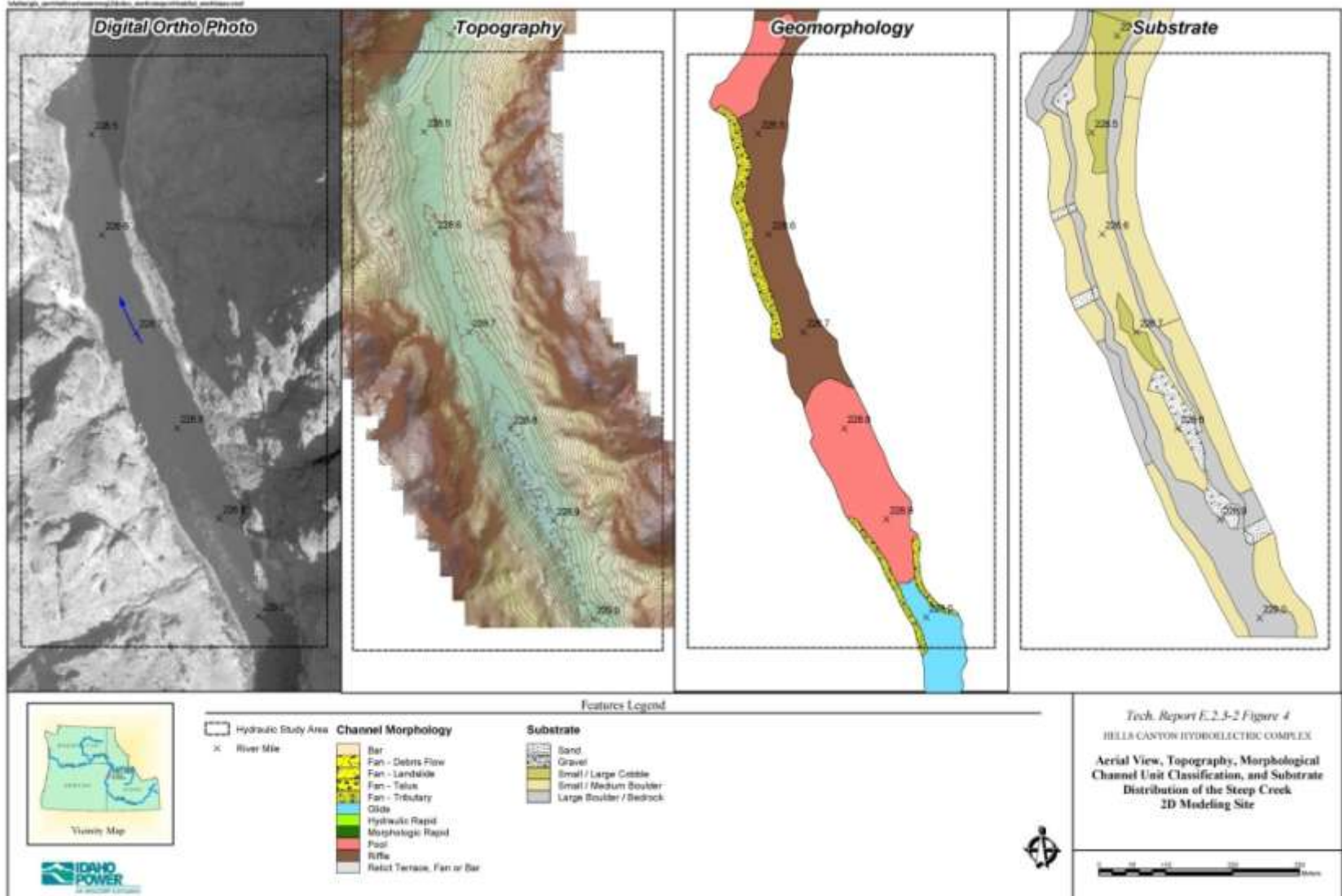
- Water quality
- Hyporheic velocity
- Grain size distribution

Data collection:

- Piezometers
- Freeze-core sampling
- Bulk sediment sampling

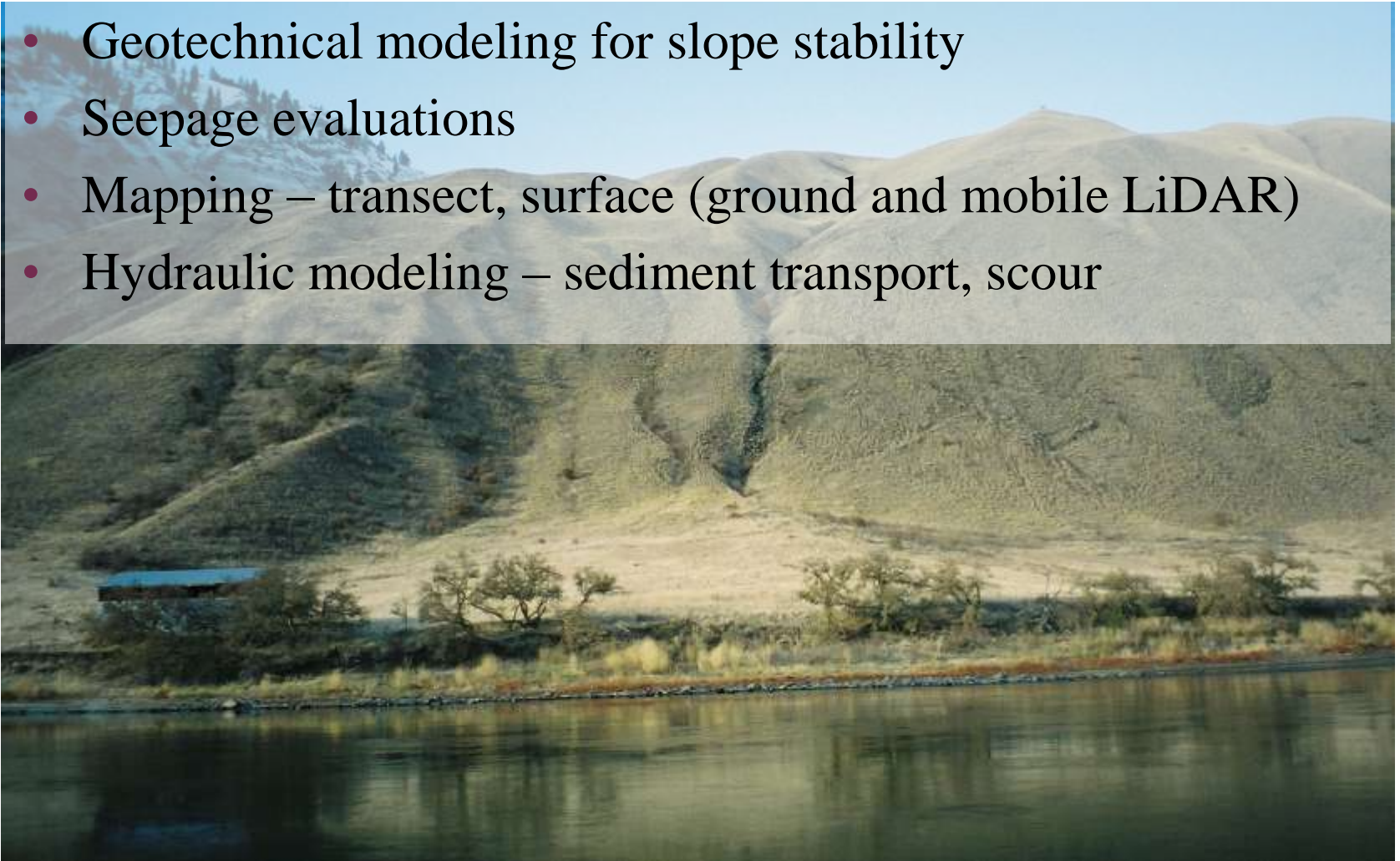


# Mapping



# Terraces

- Geotechnical modeling for slope stability
- Seepage evaluations
- Mapping – transect, surface (ground and mobile LiDAR)
- Hydraulic modeling – sediment transport, scour



# Hydrogeology:

## Hydraulic Conductivity

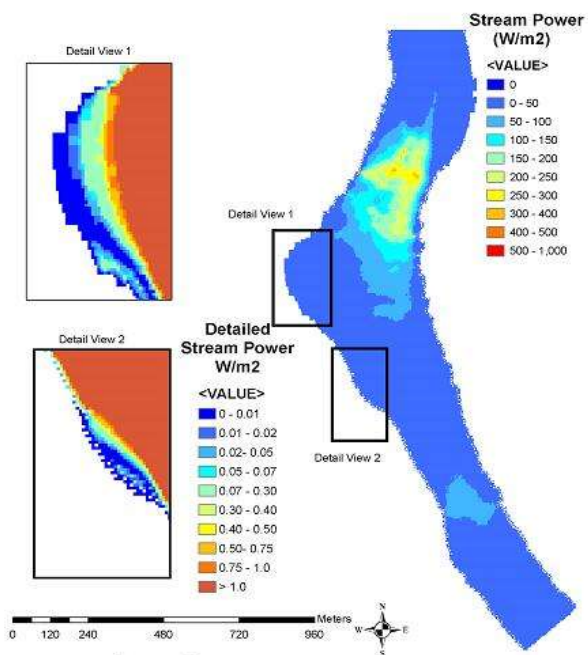



- Insitu Hydraulic Conductivity
- Guelph Permeameter

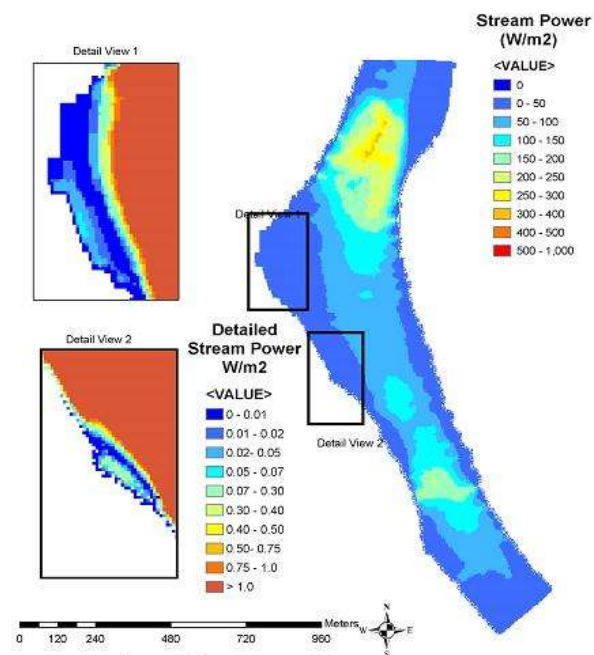
ERI Line	Section	Location	Depth (in)	k (cm/s)
ER#1	294	TS2b	15	2.7E-04
ER#1	294	TS2a	64	1.6E-03
ER#2	295	TS100	19	2.7E-03
ER#2	295	TS100	77	6.0E-04


# Modeling - Tin Shed

## Sediment Transport: Stream Power



 Stream Power Resulting from 708 cms (from WEST database) *figure 12*  
Idaho Power Company Engineering and Hydrosystems Inc  
Hells Canyon: Tin Shed Bank Erosion Study



 Stream Power Resulting from 1416 cms (from WEST database) *figure 13*  
Idaho Power Company Engineering and Hydrosystems Inc  
Hells Canyon: Tin Shed Bank Erosion Study

# Sediment Related Mitigation

- Stabilization of cultural sites
- Monitoring of spawning gravels
  - Substrate mapping
  - Volumetric changes of spawning gravel
  - Erosion or deposition of gravels (ex. scour chains)
  - Gravel quality
  - Redd monitoring
- Monitor bar and terrace areas and river substrate
- Provide a fund to USFS for restoration and maintenance of sandbars (restore 10 acres, maintain 14 acres)
- Stabilization of Farewell Bend Park
- Purchase habitat to mitigate for shoreline erosion
- Monitor shoreline erosion – river and reservoir

## Information I wish I'd had....

- Bathymetry and Topography – reservoirs and river
- Aerial photography predating project
- Sediment transport data
- Survey control
- Tributary flows

**Questions?**