

**Sediment Production on Forest
Road Surfaces in California's
Redwood Region:
Results for HY2006 and HY2007**

Brian Barrett

California Department of Forestry and Fire Protection

David Tomberlin

National Marine Fisheries Service

Calif. Board of Forestry and Fire Protection-Monitoring Study Group Mtg.

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Research Questions

- How much erosion is occurring on forest road surfaces in the redwood region?
- How suitable is this study's approach for studying road surface erosion in our region?

Background

- Road erosion can pose problems
 - Fish
 - Water quality
 - Road function and maintenance
- Info for management
 - Role of road surface erosion in sediment budgets
 - Relative efficacy of different road treatments
 - Variability among road segments and over time for use in management model

Preview Results

- Total Sediment Production: $\sim 0-5 \text{ kg/m}^2/\text{yr}$
- On length basis: $\sim 0-22 \text{ kg/m/yr}$
- Share of fines generally 30% to 90%
- Highly variable among sites and over years
- Relationship to site characteristics unclear

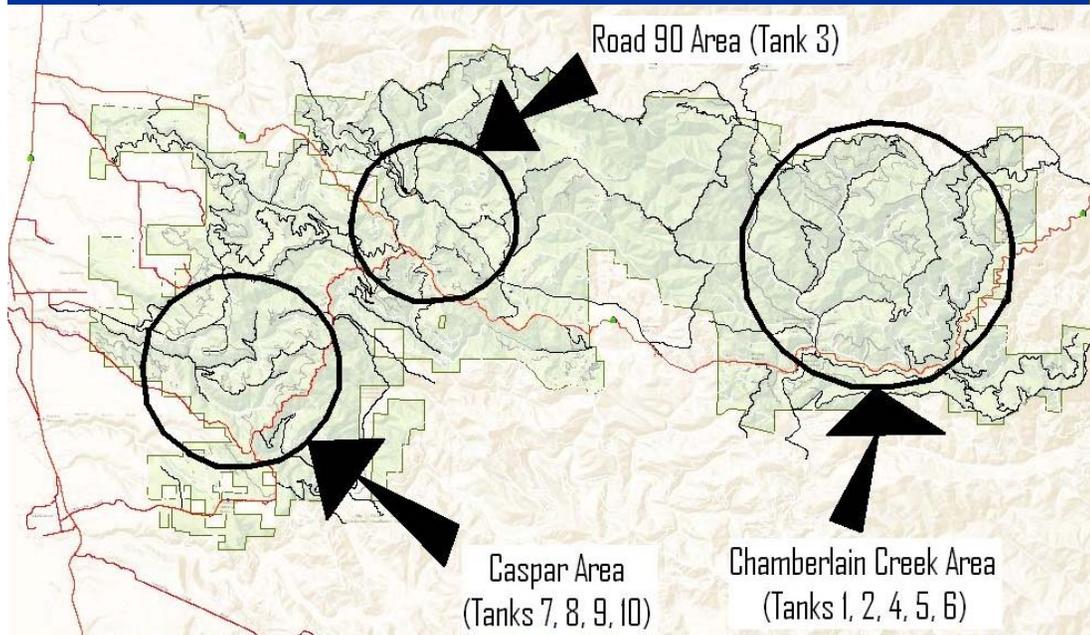
Method

- Measure runoff, coarse sediment, fine sediment
- 10 hydrologically isolated road segments
- Settling basins and tipping buckets
- Sensitivity analysis with respect to segment area and calibration parameters



Study Area

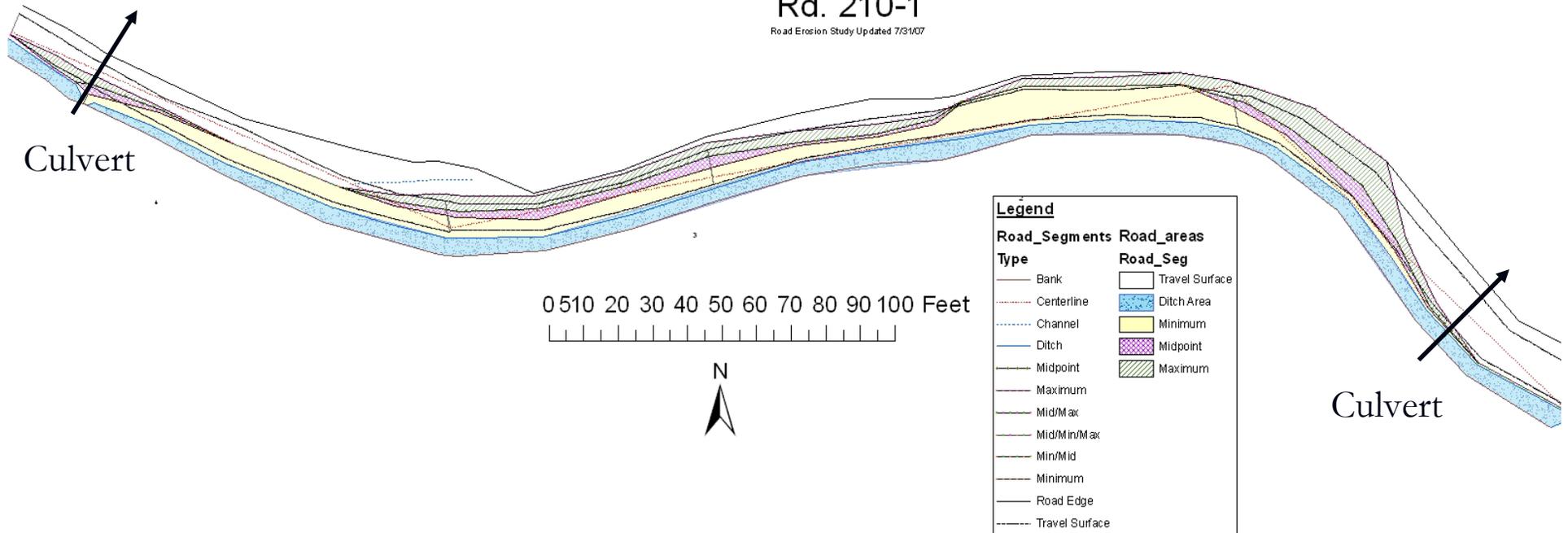
- Mediterranean climate
- Redwood/Douglas-fir forest
- High uplift rates
- Soils



Study Sites

Rd. 210-1

Road Erosion Study Updated 7/31/07



■ Selection constraints

- Working roads (as-is)
- Existing culverts
- Travel distances-clustering
- Placement on sideslope

■ Site configuration

- Hydrologically isolated
- Crowned roads
- Cutbank flow possible

Study Sites

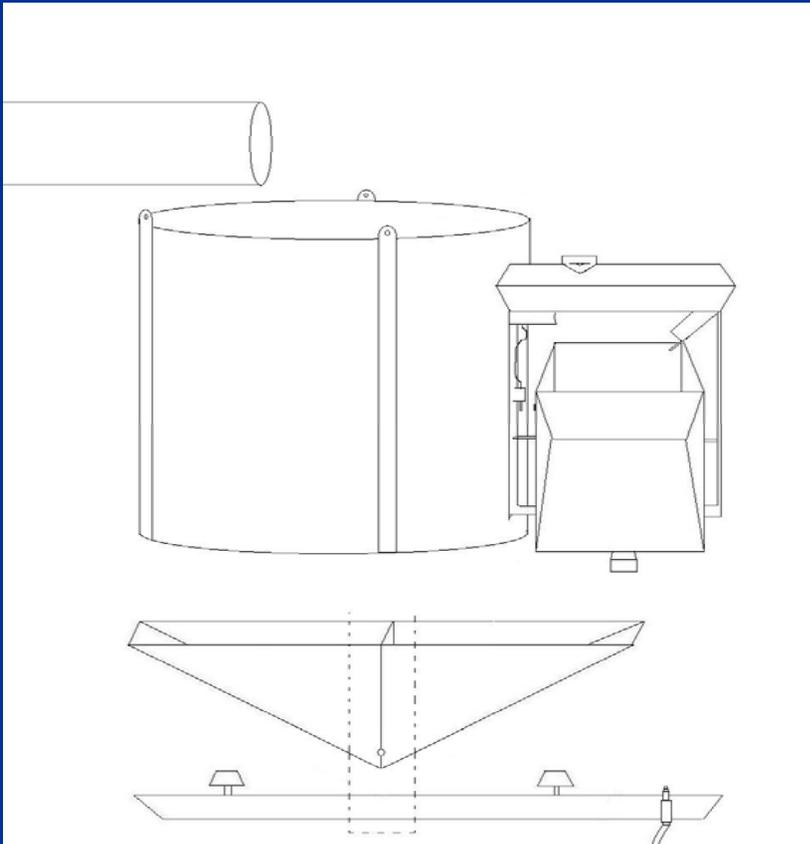
	Surface	Winter Traffic	Ditch (% vegetated)	Grade	Area (m ²)	Length (m)	Notes
Site 1 (Rd 1000-1)	Unrocked	Light	10%	6%	1031	207	Graded 2004
Site 2 (Rd 240-1a)	Unrocked	None	0%	4%	716	134	Graded 2005
Site 3 (Rd 90-1)	Unrocked	None	10%	6%	634	205	
Site 4 (Rd 210-2)	Unrocked	None	10%	6%	778	180	
Site 5 (Rd 210-1)	Unrocked	None	10%	7%	560	143	
Site 6 (Rd 240-1)	Unrocked	None	0%	9%	399	84	Light Grading 2004
Site 7 (Rd 600-4)	Rocked	Light	75%	4%	757	165	Graded 2006, Hidden Culvert
Site 8 (Rd 620-4)	Rocked	Light	30%	7%	452	95	Graded 2006
Site 9 (Rd 640-7)	Rocked	Light	30%	7%	723	185	
Site 10 (Rd 640-1)	Rocked	Light	20%	4%	573	198	

Study Sites



Instrument Design

- Black, Thomas A., and Charles H. Luce. 2007. *Measuring Water and Sediment Discharge from a Bordered Road Plot using a Settling Basin and Tipping Bucket*. USDA Forest Service Rocky Mountain Research Station, Boise, ID.



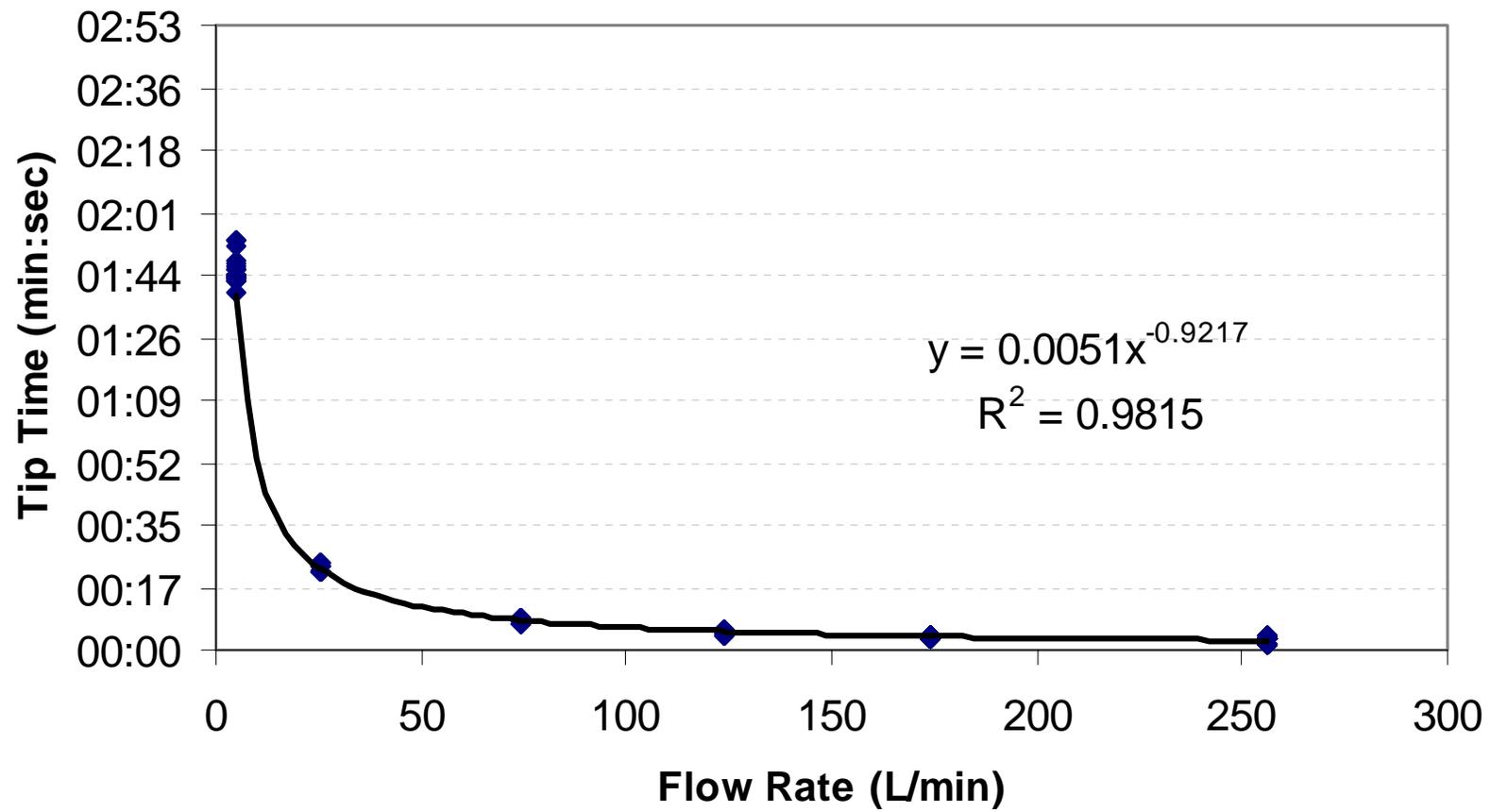
Instrument Manufacture



- Made at CALFIRE's Parlin Fork Conservation Camp
- Cost: c. \$1700 per instrument

Instrument Calibration

Calibration Curve for Tank 1, October 2006



Installation & Function



Data Collection

- Runoff:

HY06: 338 downloads

HY07: 183 downloads

- Total Suspended Solids (TSS)

HY06: 196 samples

HY07: 70 samples

- Coarse Sediment:

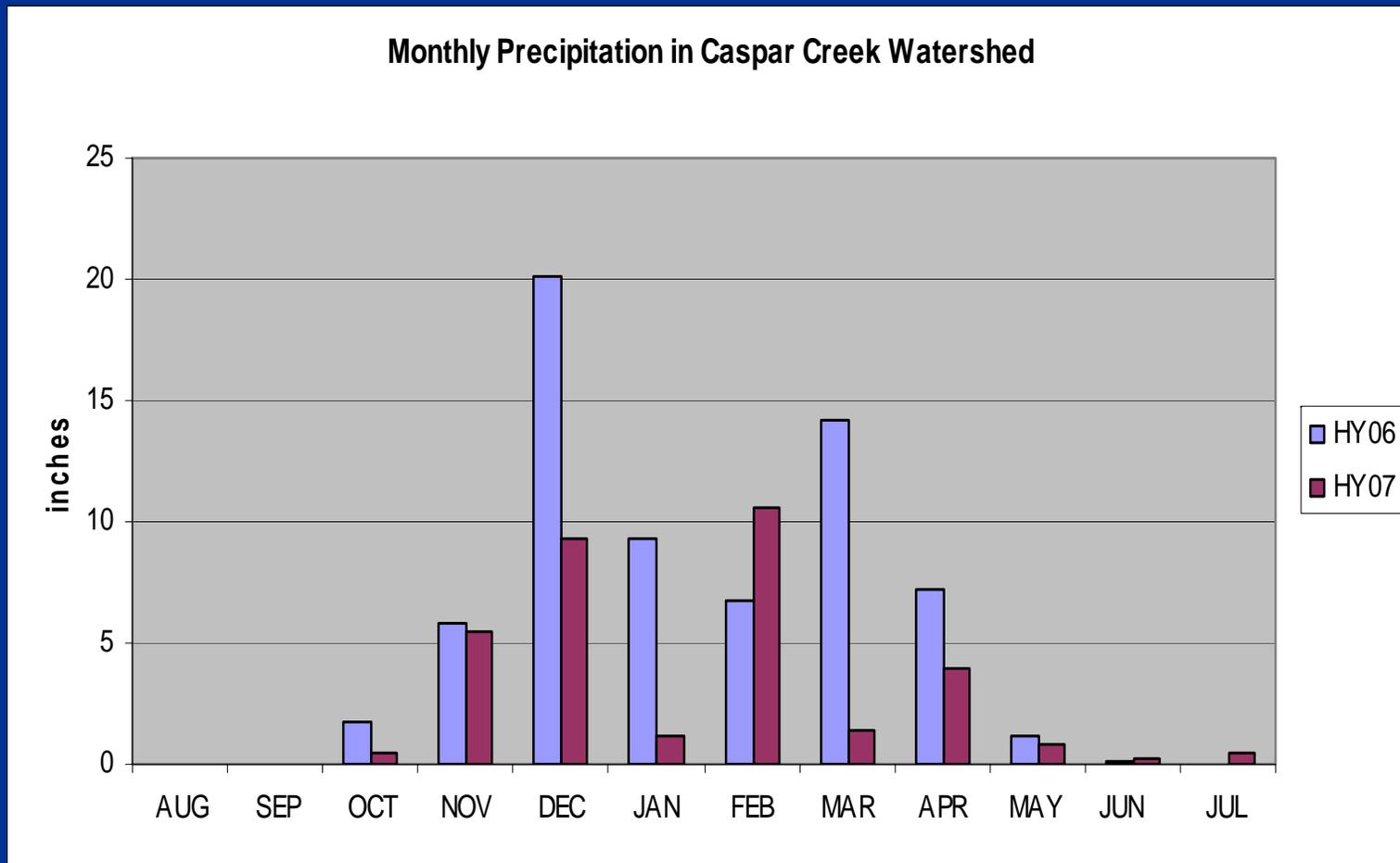
HY06: 15 weighings

HY07: 11 weighings



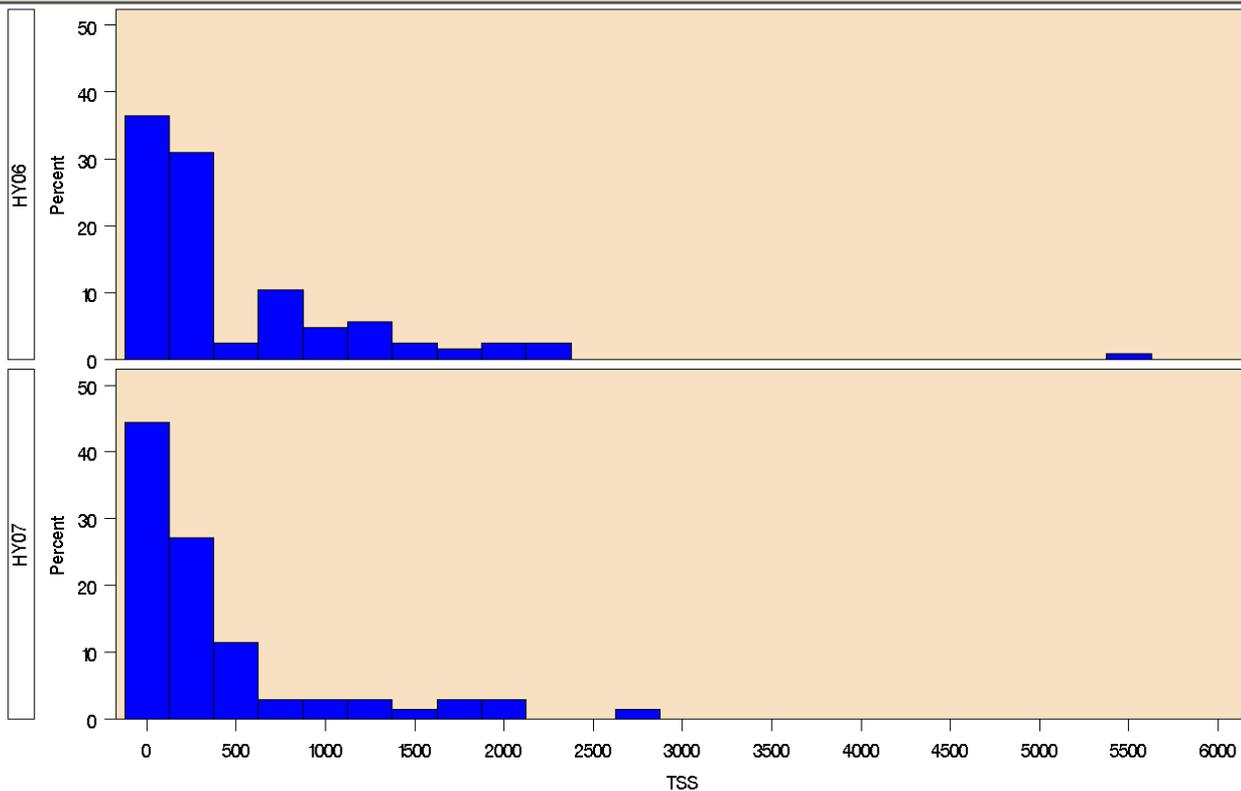
Precipitation

- $>2''$ daily precip: 6 in HY06, 2 in HY07
- % of avg precip: HY06 = 147%, HY07 = 74%



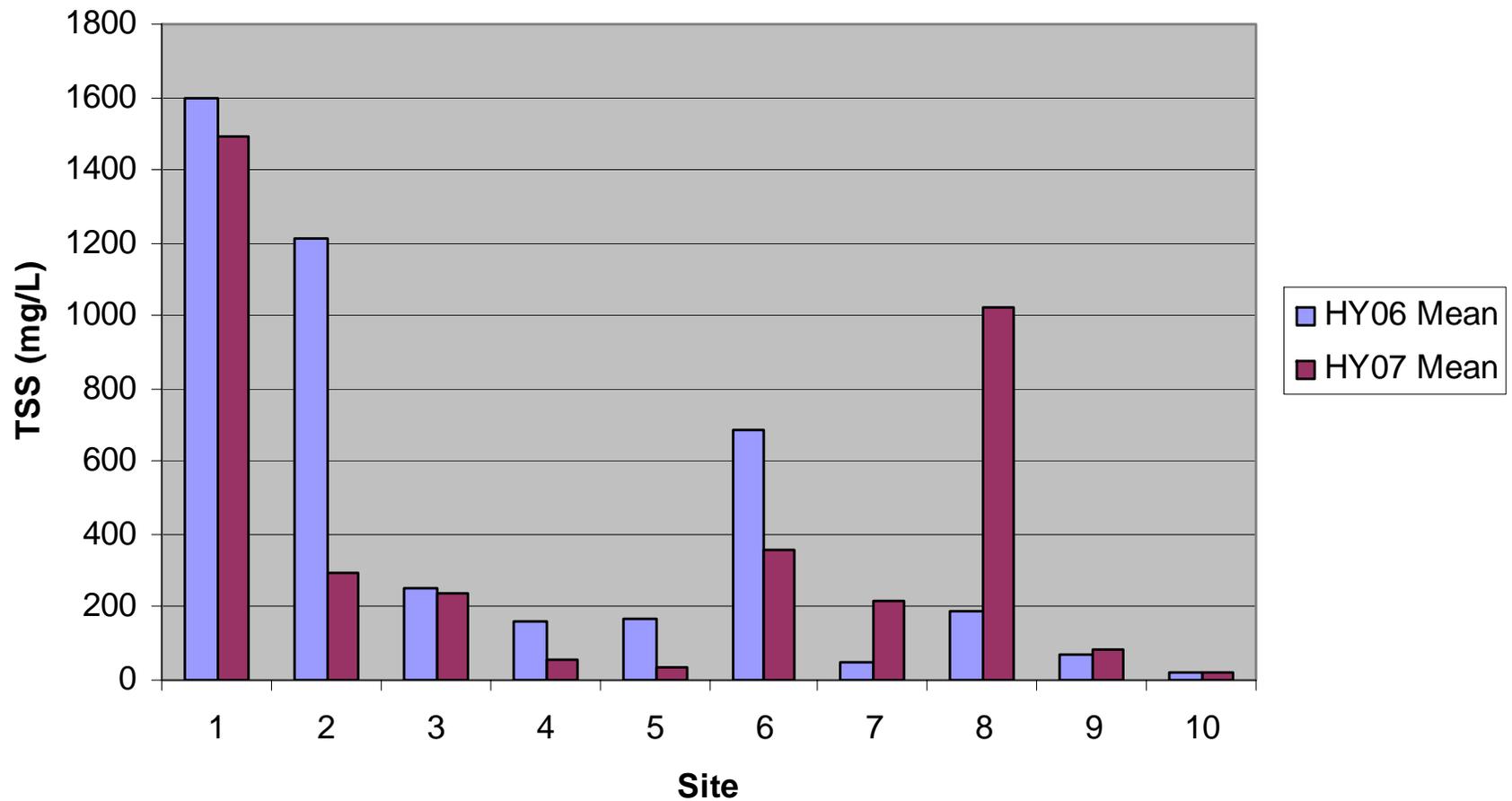
Total Suspended Solids (TSS) Results

	Precip (m)	Samples	Mean (mg/L)	Min (mg/L)	Max (mg/L)
HY0506	1.69	196	539	6	5400
HY0607	0.86	70	396	6	2800



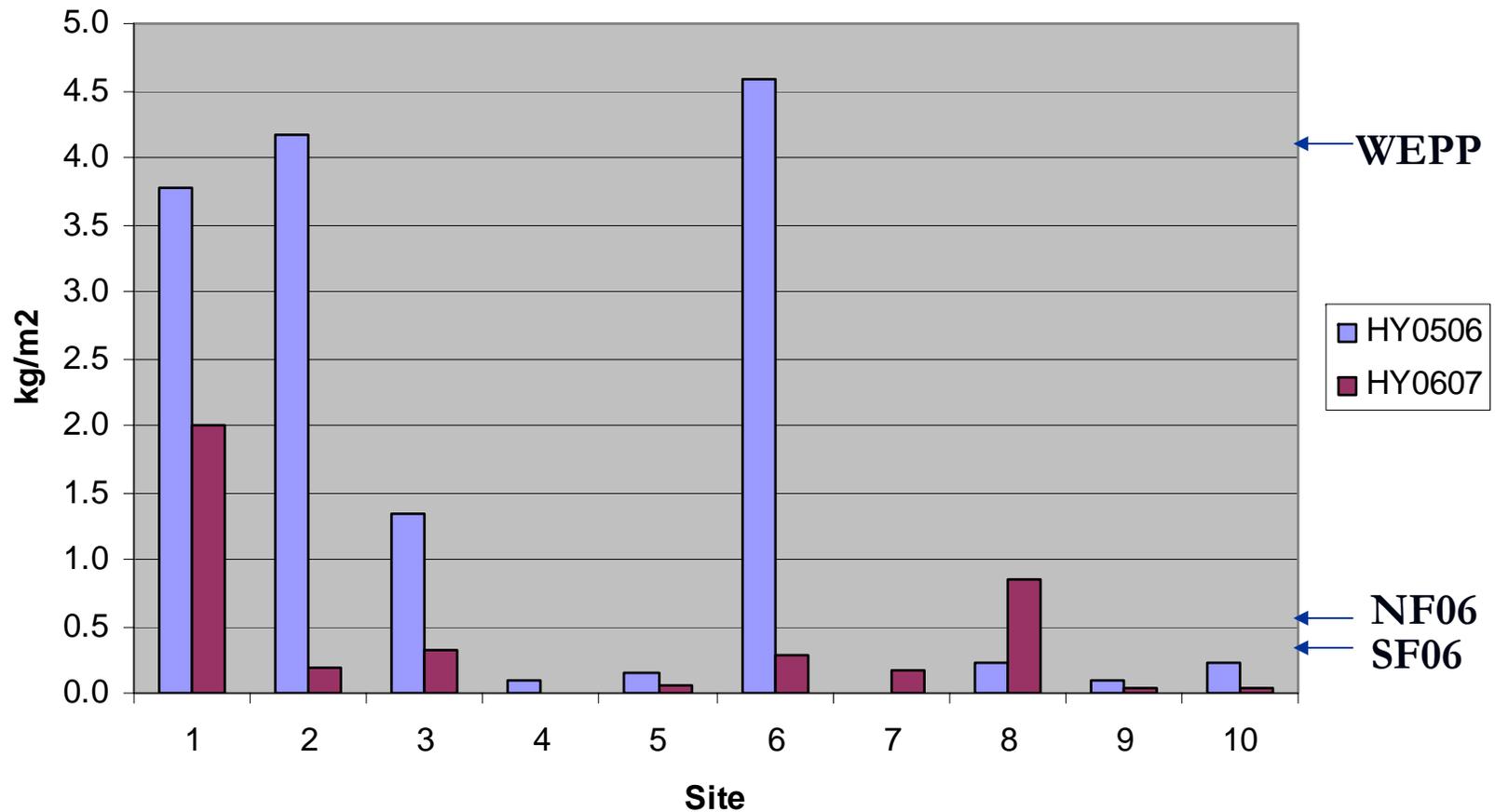
TSS Results

Mean TSS by Site and Year



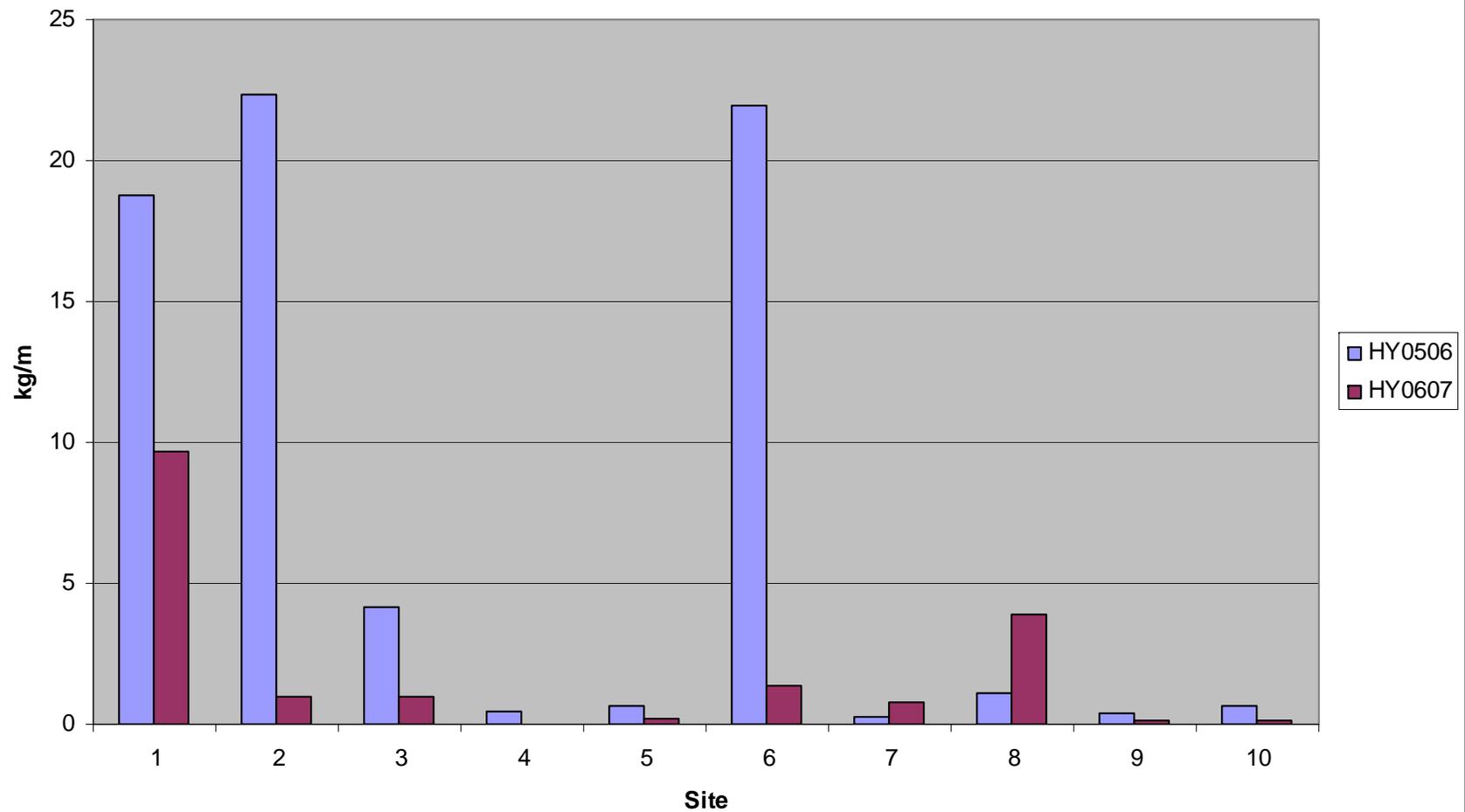
Results

Total Sediment Production Normalized by Area



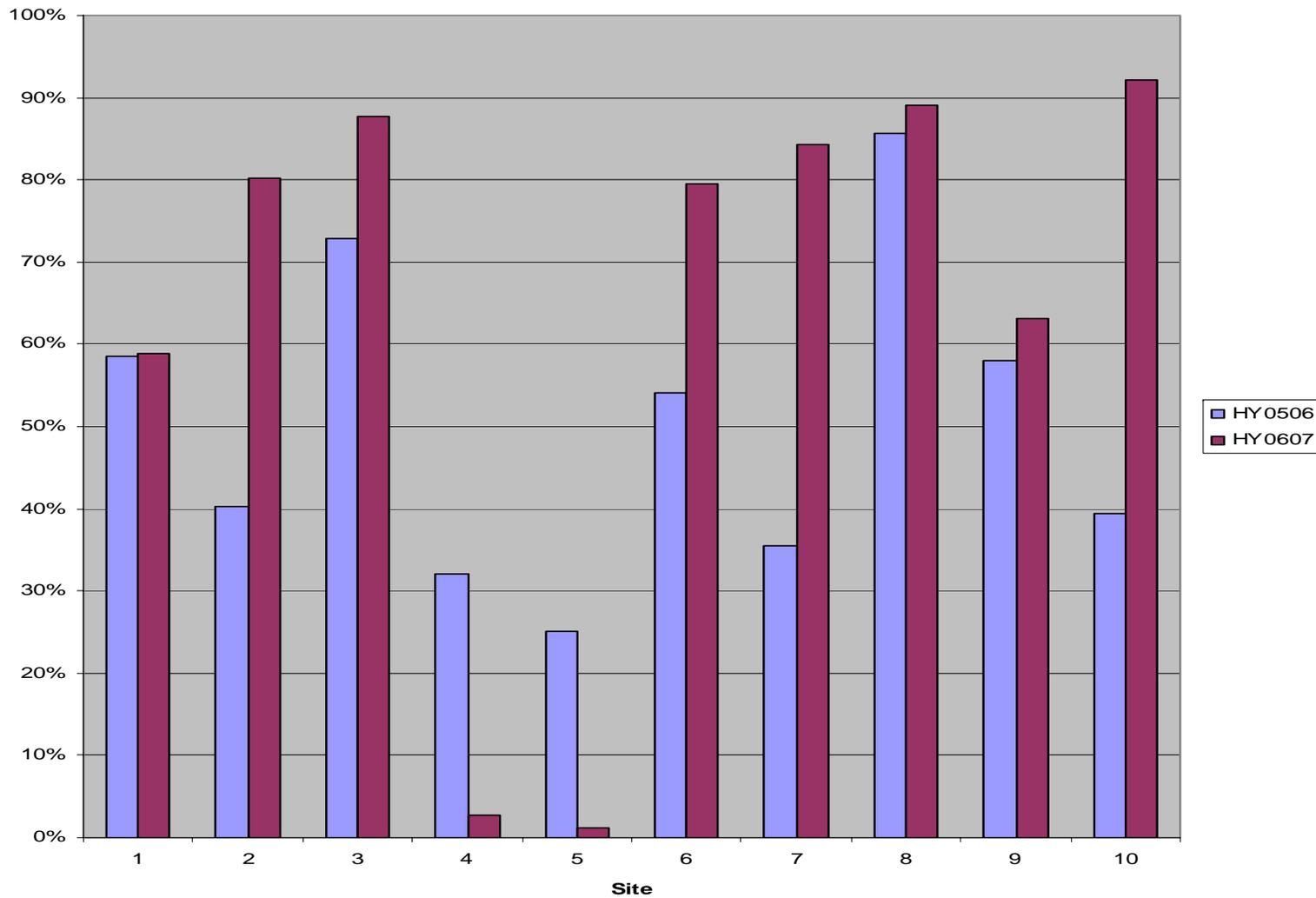
Results

Total Sediment Production Normalized by Segment Length



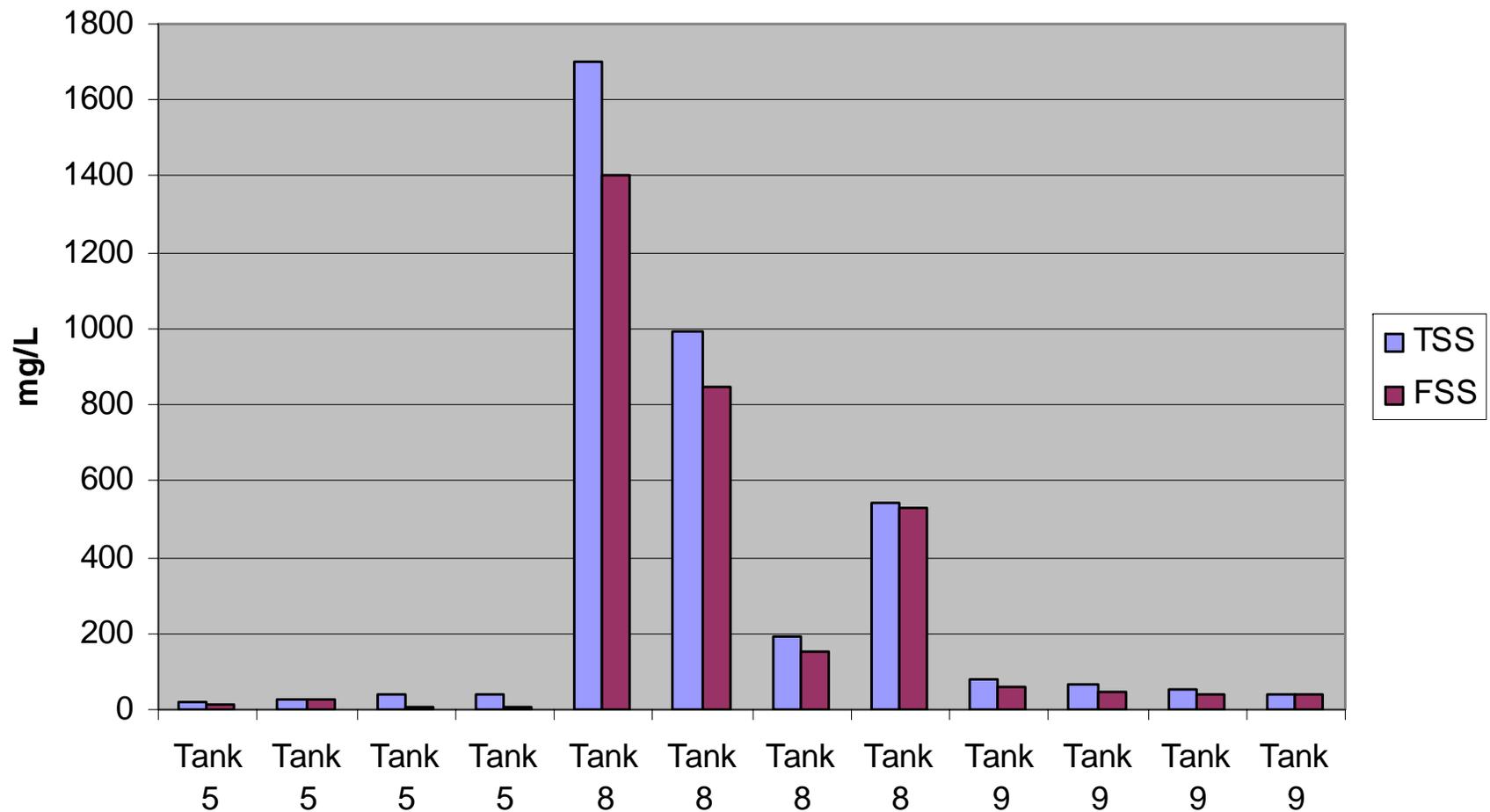
Results

Suspended Sediment as a Share of Total Sediment



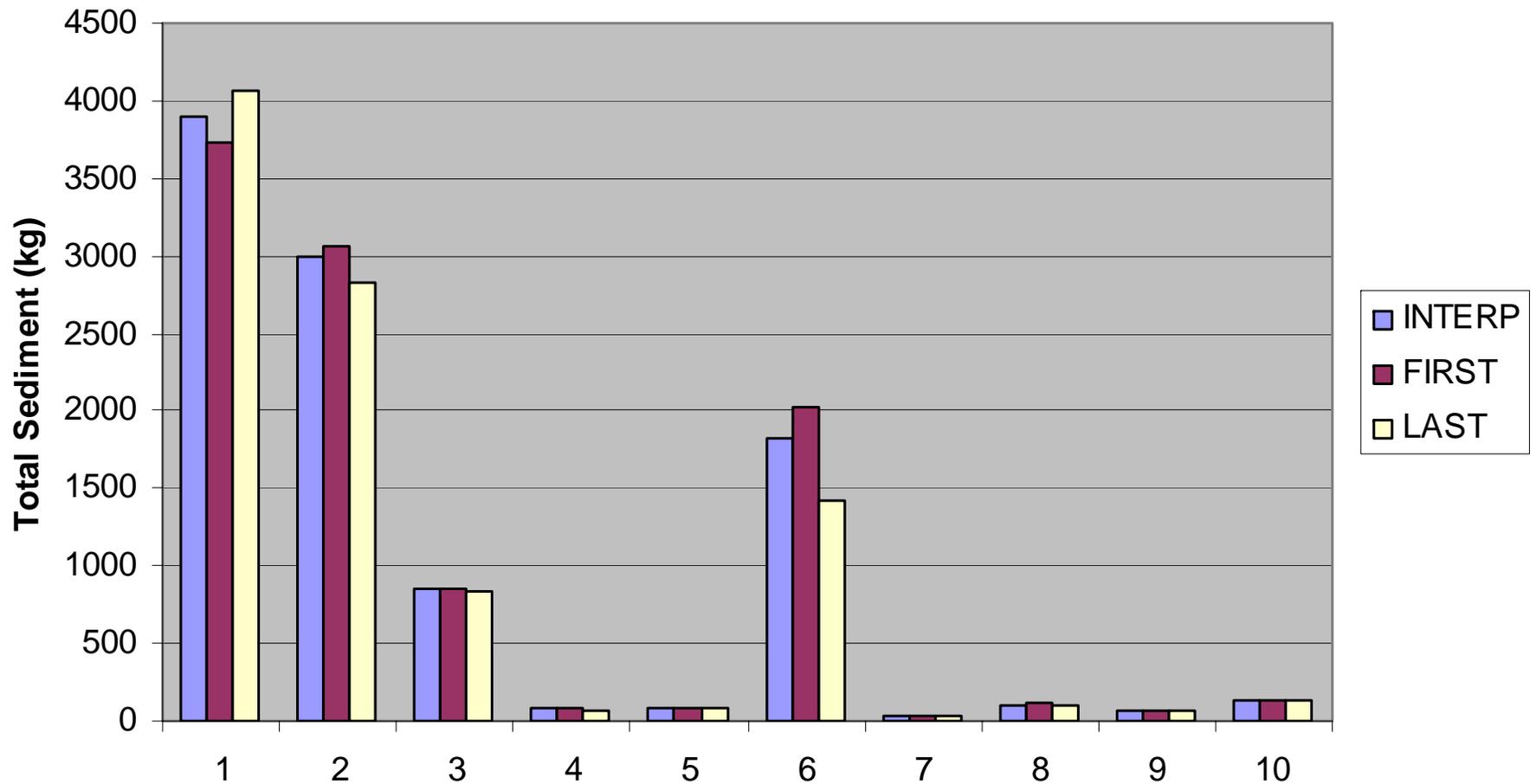
Results

Total and Fixed (Inorganic) Suspended Solids



Uncertainty

Sensitivity of Total Sediment Production Estimates to Intra-Seasonal Calibration Parameter Changes



Complications

- Equipment failure
- Segment length
- Filter size
- Hidden old culvert
- Vandalism
- Data loggers overfull
- Data files overwritten
- Time intensive and expensive



Conclusion

- Lots of variability over time, among sites
- Outstanding questions:
 - Connectivity
 - Factors contributing to sediment production
- Worth the time and expense?
 - Need comparison to other study methods
 - POMDP model to assess when monitoring is worthwhile

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