The health of our waters is the principal measure of how we live on the land
Luna Leopold

FOUNDATIONS OF SEDIMENT MANAGEMENT

TRINITY RIVER RESTORATION PROGRAM

"The health of our waters is the principal measure of how we live on the land"
Luna Leopold

Presentation to TMC – September 2015

SEMINAL DOCUMENTS

- 1990-1997
  - Channel Maintenance Flow Studies
  - Associated Independent Studies
- 1999
  - Trinity River Flow Evaluation Study Final Report
- 2000
  - Trinity ROD Signed by Secretary Babbitt and Hoopa Valley Tribe
  - National Academy of Sciences publishes Trush, McBain and Leopold

Integrated Studies of Ecosystem Components

1985-1997

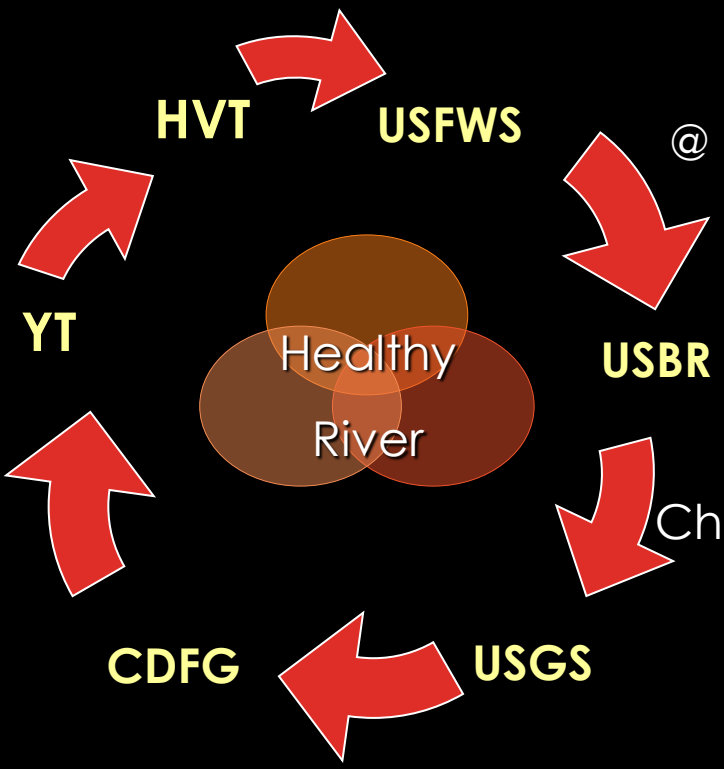
Salmonid

Microhabitat Studies

1988-1997

Habitat

@ Rehabilitation Sites



1977-1997

Flow-Temperature Studies

1993-1997

Chinook Production Model (SALMOD)

1990-1995

Sediment Transport Studies

1990-1997

Fluvial Geomorphology

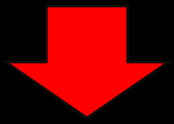
RESTORATION OF RIVER HEALTH

- A New Direction
  - *away from single species management*
  - *away from engineered habitat*
- **Developed "attributes of alluvial river integrity" from historical analysis, literature, and field observations.**
- **Used attributes to develop restoration objectives in the Flow Study.**
- **Health equates to capacity for self-renewal**

TRUSH, W. J., S. MCBAIN, AND L. LEOPOLD. 2000.

- Attributes of an alluvial river and their relation to water policy and management. Proceedings of the National Academy of Sciences of the United States of America. Vol. 97 No 22 pp 11959-11863.

- River Health as the Foundation of Restoration



- Fundamental Objective of TRRP

HEALTH EQUATES TO CAPACITY FOR SELF-RENEWAL

- Actions that promote self-renewal of the processes and physical habitats within the Trinity River are those to be taken
- Management of basic inputs Flows
  - Temperatures
  - Wood
  - Nutrients
  - Sediments

TRINITY RIVER RESTORATION STRATEGY

Premise: Native life (including salmonids) adapted to the unimpaired ecosystem and the habitats provided. If naturally produced salmonid populations are to be restored, habitats on which they depend must be restored.

Restoration Strategy: Integration of riverine processes and instream flow-dependent needs.

TRFES
HEALTHY RIVER ATTRIBUTES

Attribute 1 *The primary geomorphic and ecological unit of an alluvial river is the alternate bar sequence.*

Attribute 3 *The gravel-bed surface is frequently mobilized.*

Attribute 4 *The gravel-bed surface is periodically scoured and redeposited.*

Attribute 5 *Fine and coarse sediment supply from the watershed is balanced by river transport.*

ATTRIBUTE #1
SPATIALLY COMPLEX CHANNEL
APPENDIX H TRFES

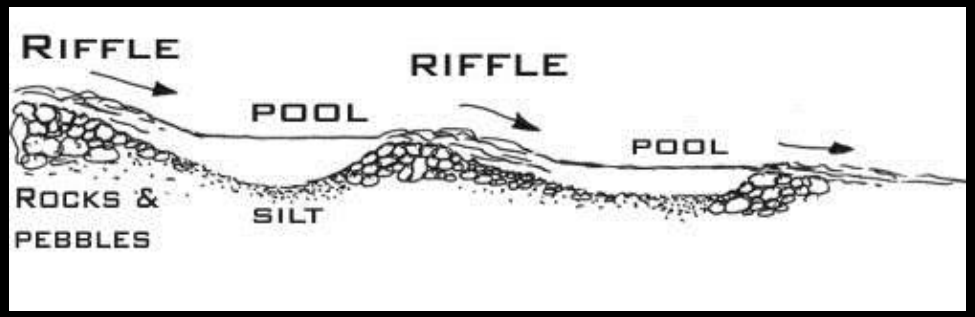
- **Desired Physical Responses**:
  - An alternate bar morphology extending upstream from the present alluvial transition zone near Indian Creek.
  - Development of a functional floodplain, now missing from the post-TRD channel morphology.

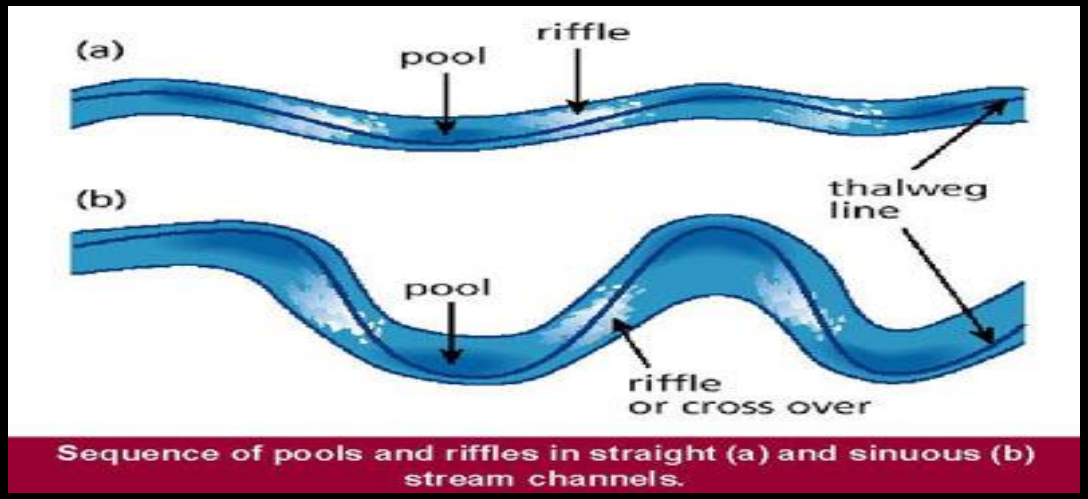
ATTRIBUTE #5
BALANCED SEDIMENT BUDGETS
APPENDIX H TRFES

- **Desired Physical Responses:**
- Maintain physical complexity by sustaining alternate bar morphology.
- Reduce storage of fine sediment in riparian berms.
- D84 tracer rocks should negotiate alternate bar sequences; i.e., larger particles from upstream riffles should not accumulate in downstream pools.
- Encourage slight degradation of bed elevation at tributary deltas.
- Increase pool depths.

IDEALIZED ALTERNATE BAR SEQUENCE

POOL-RIFFLE-POOL





Sequence of pools and riffles in straight (a) and sinuous (b) stream channels.

Active Bar at Meander Bend

Both flows and sediment supply must be sufficient to support active bars (self-renewal)

ACTIVE BAR COMPLEX

TRINITY IS NOT ALLUVIAL THROUGHOUT ITS LENGTH

- Some areas
  - Confined by Bedrock or Valley Walls
  - Edged by Mine Tailings
  - Crowded by Roads, Bridges and other structures

TRINITY RIVER ALLUVIAL REACH

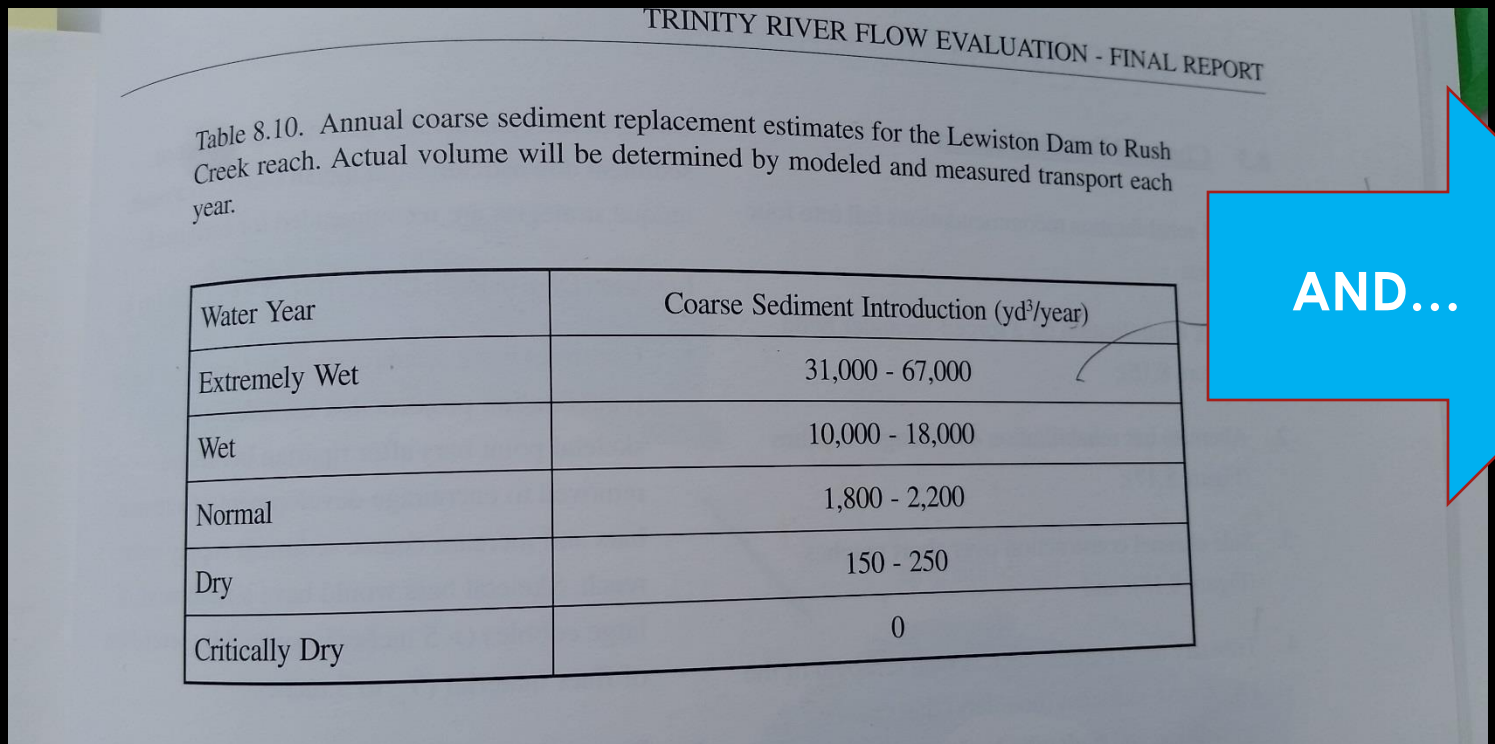
TRINITY RIVER ACTIVE GRAVEL BAR

TRFES COARSE SEDIMENT STRATEGY

- Both a short-term and a long-term strategy for coarse sediment introductions.
  - The short-term strategy rapidly (over a few years) replenishes coarse sediment storage in the reach at multiple sites in a manner scaled to flow regime.
  - The long-term strategy maintains storage by periodically introducing coarse sediment at a rate equal to transport.

TRFES Coarse Sediment Recommendations:

- (1) immediate placement of more than 16,000 cubic yards of properly graded coarse sediment (5 / 16 to 5 inches) between Lewiston Dam and Rush Creek to restore the spawning gravel deficit caused by the elimination of upstream coarse sediment supply by the TRD;
- (2) annual supplementation of coarse sediment to balance the coarse sediment supply along the Lewiston Dam to Rush Creek segment;



TRINITY RIVER FLOW EVALUATION - FINAL REPORT

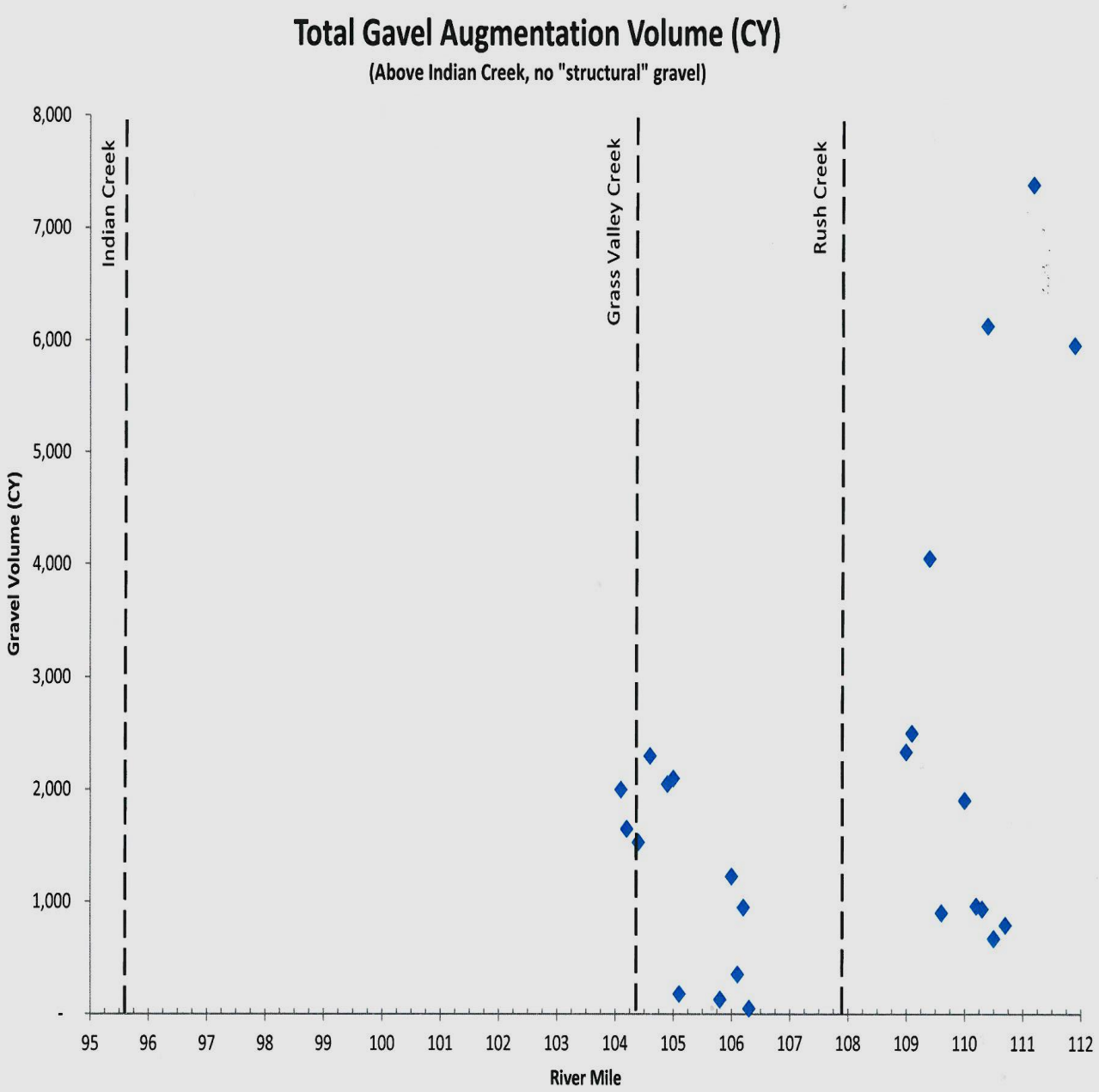
Table 8.10. Annual coarse sediment replacement estimates for the Lewiston Dam to Rush Creek reach. Actual volume will be determined by modeled and measured transport each year.

Water Year	Coarse Sediment Introduction (yd^3/year)
Extremely Wet	31,000 - 67,000
Wet	10,000 - 18,000
Normal	1,800 - 2,200
Dry	150 - 250
Critically Dry	0

ATTRIBUTE #4
BALANCED SEDIMENT BUDGETS

- **Desired Physical Responses:**
- Maintain physical complexity by sustaining alternate bar morphology.
- Reduce storage of fine sediment in riparian berms.
- D84 tracer rocks should negotiate alternate bar sequences; i.e., larger particles from upstream riffles should not accumulate in downstream pools.
- Encourage slight degradation of bed elevation at tributary deltas.
- Increase pool depths.

DISCUSSION


Total Gavel Augmentation Volume (CY)
(Above Indian Creek, no "structural" gravel)
Gravel Volume (CY)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Indian Creek
Grass Valley Creek
Rush Creek
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
River Mile