Coarse Sediment Augmentation on the Trinity River, CA

CALFED

7/13/04

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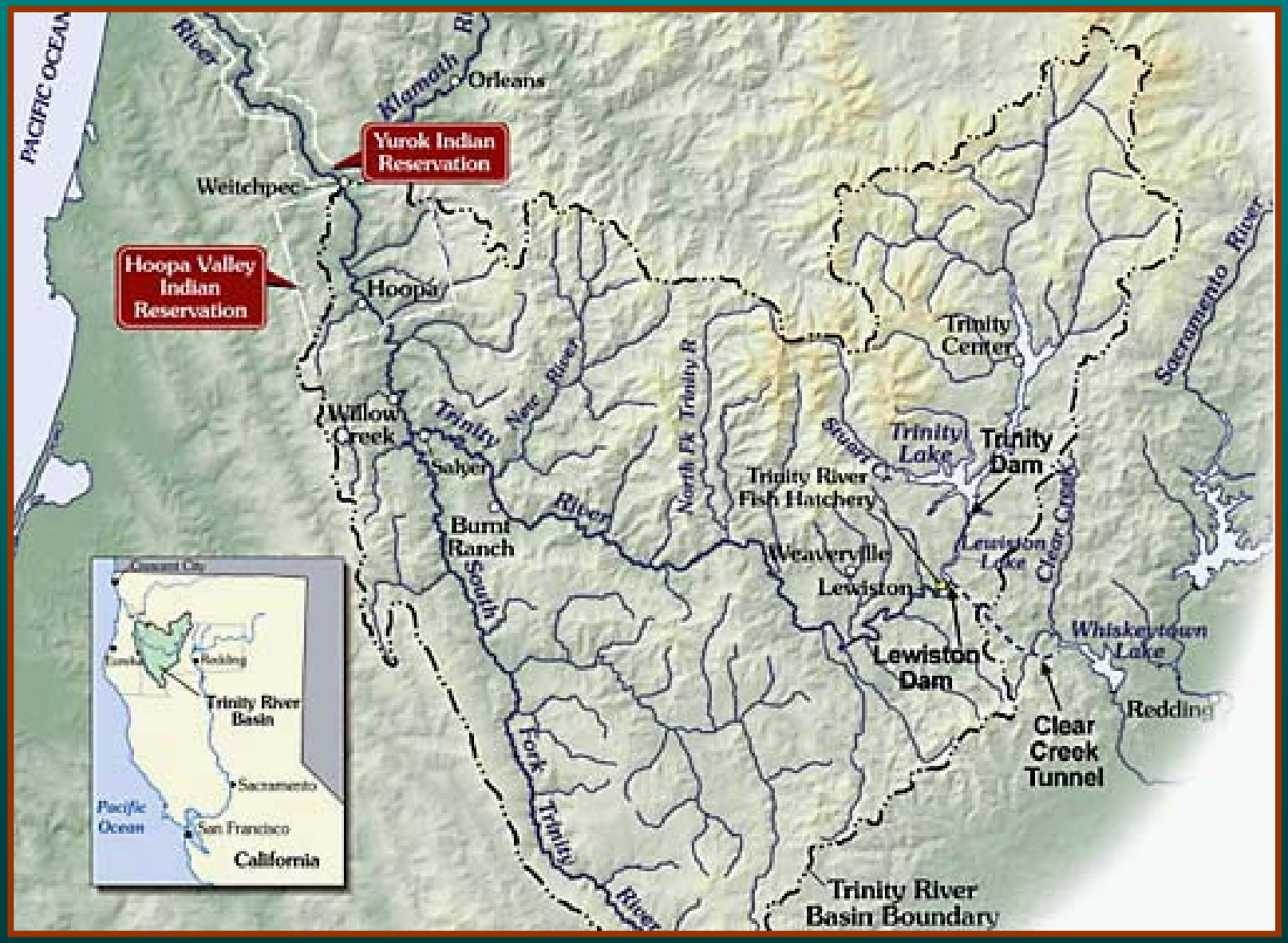
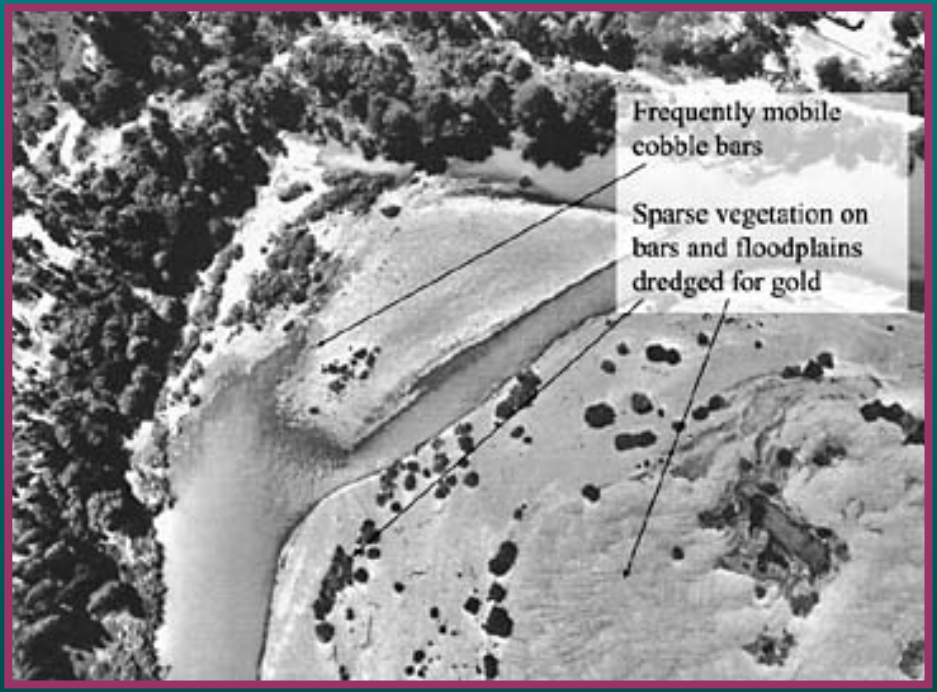
Outline

- TRRP overview
- Sediment management goals
- Coarse sediment management plan
- Monitoring and assessment
- Technical challenges

Trinity River Basin

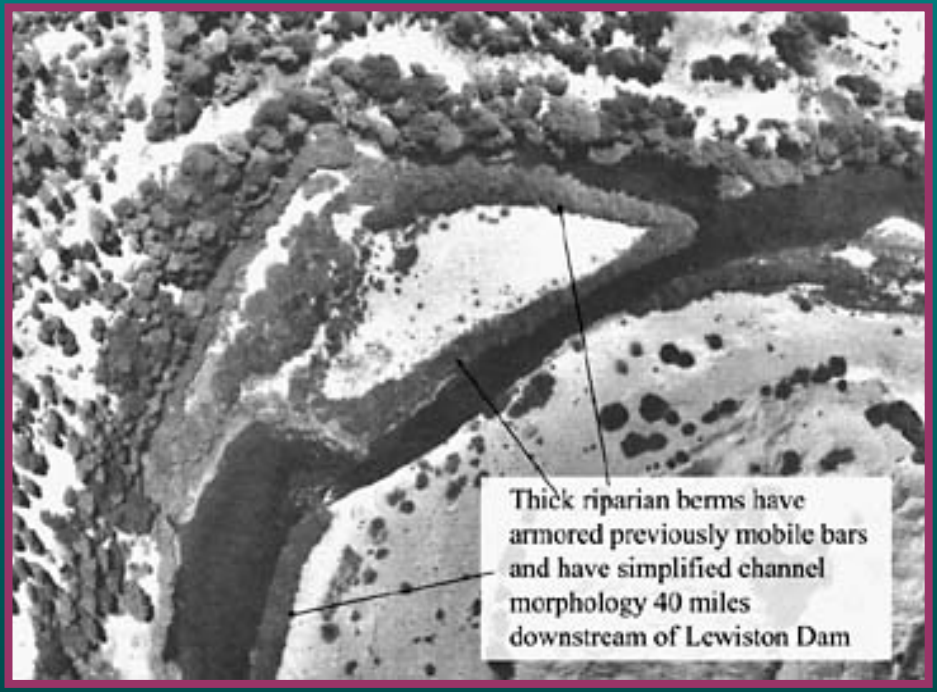


Riparian Encroachment



Pre-Dam

Gold Bar 1961

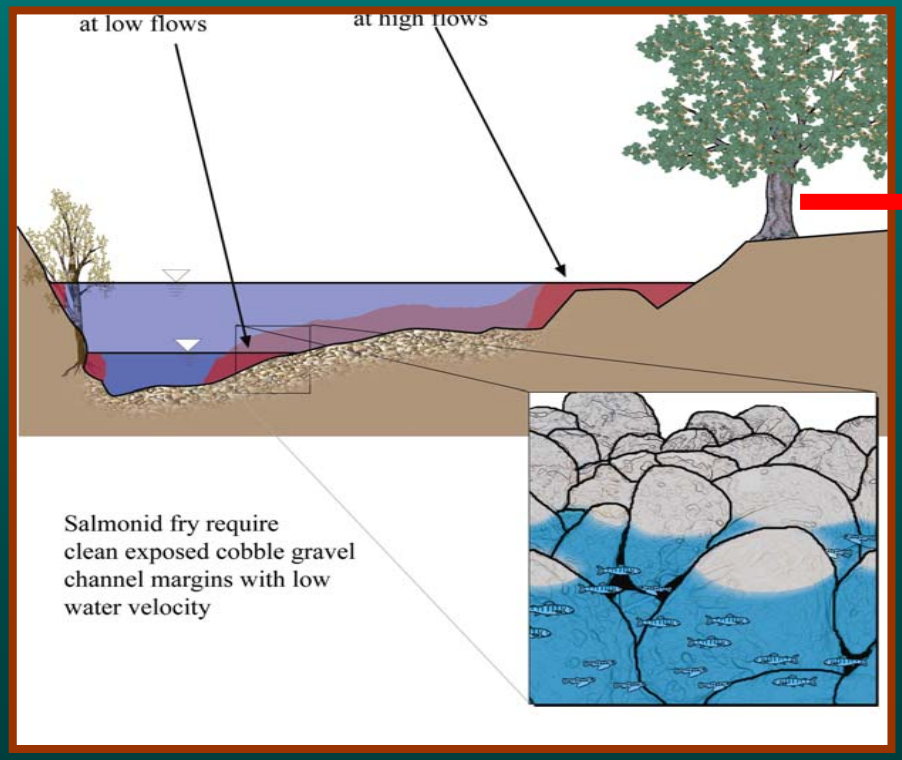


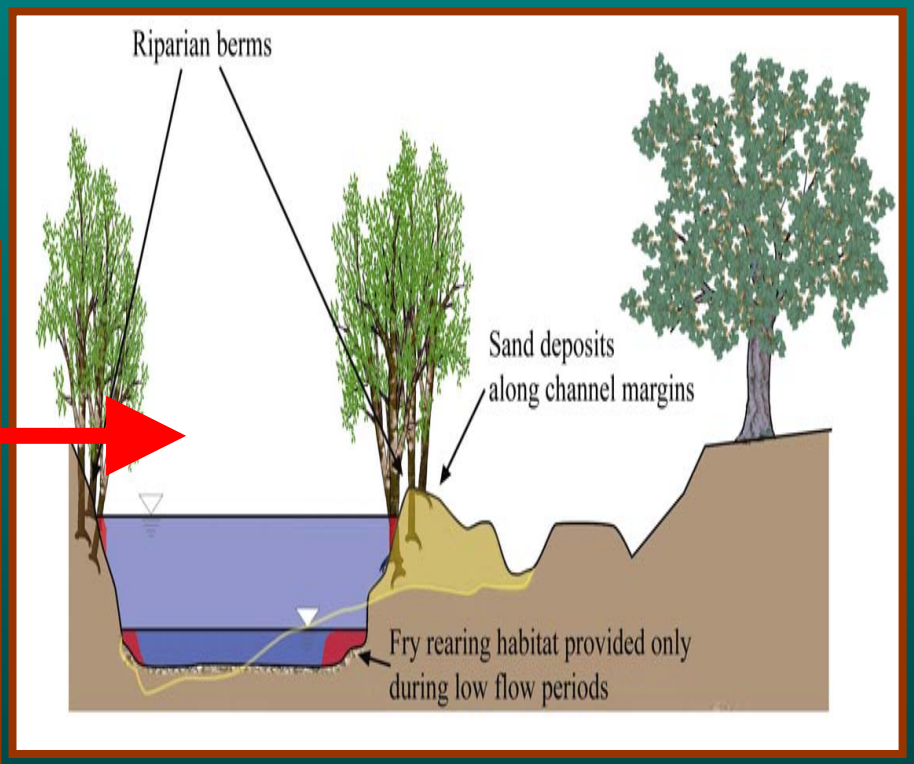
6 years

Post-Dam

Gold Bar 1970

Fish Habitat Reduction





Restoration Overview

Restore Natural Fluvial Processes → Increase and Maintain Spawning and **Rearing** Habitat → Recover Natural Salmonid Populations

Post Dam Population Declines

Chinook	67%
Coho	96%
Steelhead	53%

Habitat Goals

3X to 4X increase in rearing habitat

↓

Double Smolt production

Population Goals
(natural in-river spawners)

Chinook (Spring and Fall Run)	68,000
Coho	1,400
Steelhead	40,000

10 Attributes of Alluvial Rivers

1) Spatially complex morphology and habitat
2) Variable flow and temperature regime
3) Frequent mobilization of gravel bed
4) Period scour and redeposition of gravel bed
5) Balanced sediment budget (fine and coarse)
6) Periodic channel migration
7) Frequently inundated floodplain
8) Infrequent very large floods to re-organize channel and riparian vegetation
9) Self-sustaining and diverse riparian vegetation
10) River often connect with adjacent water table

Geomorphic Processes and Coarse Sediment Supply

(Source: McBain and Trush 2003)

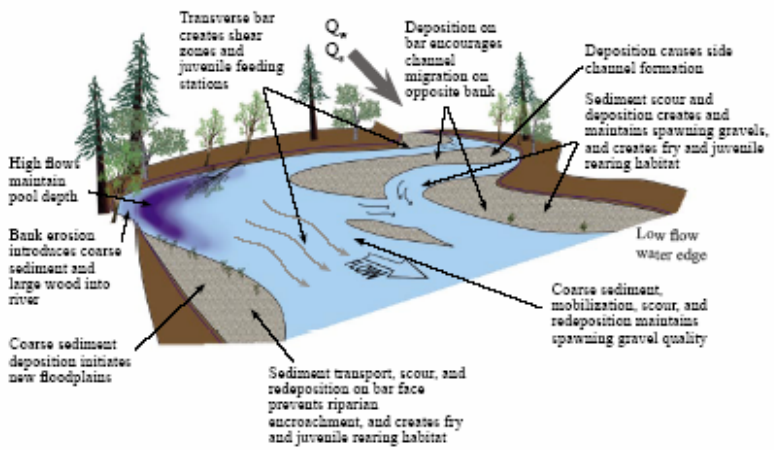
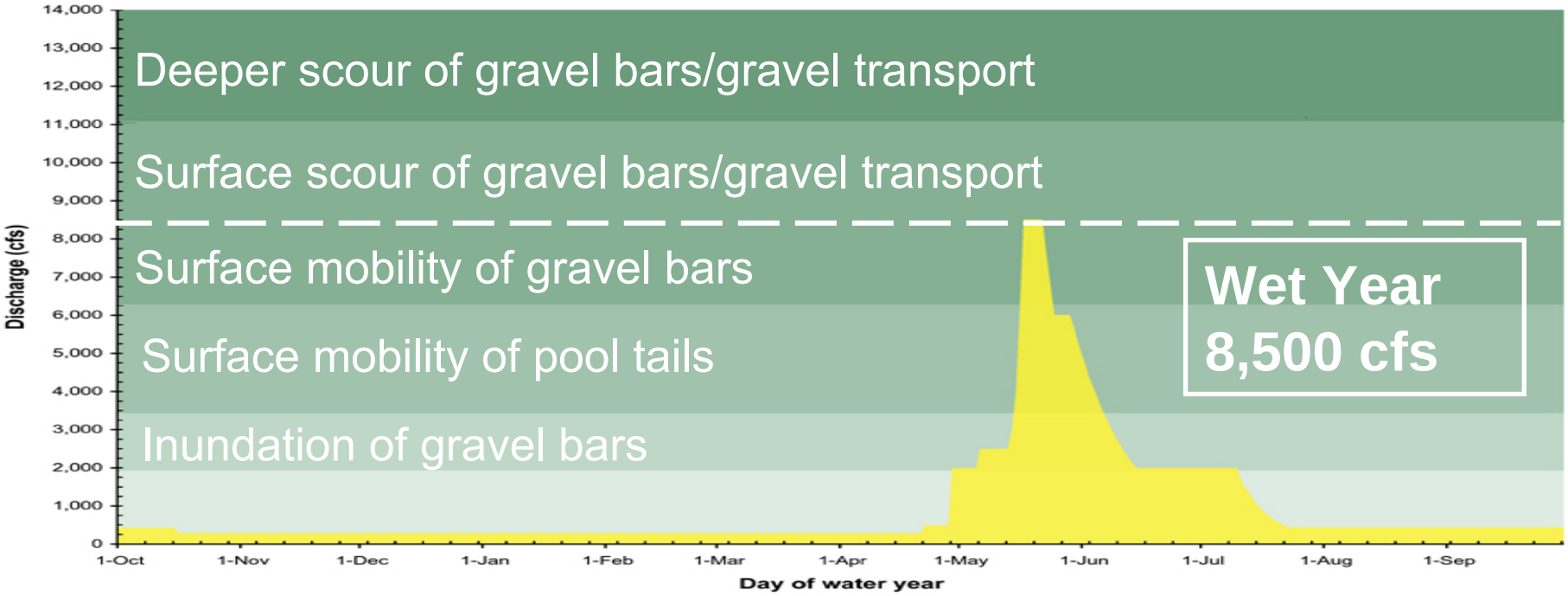


Figure 4. Comparative illustration (top) and photograph (bottom) of the Trinity River channel illustrating the dependency of channel processes and morphology on coarse sediment supply.

Restoration Tools
Flow Management



Restoration Tools
Mechanical Channel Bank Restoration

Restoration Tools
Coarse Sediment Augmentation

Short Term

- 3 years
- 84,000 yd^3

Long Term

- Annually
- Up to 67,000 yd^3

Based on multi-year average sediment budget

Restoration Tools
Watershed Sediment Source Control

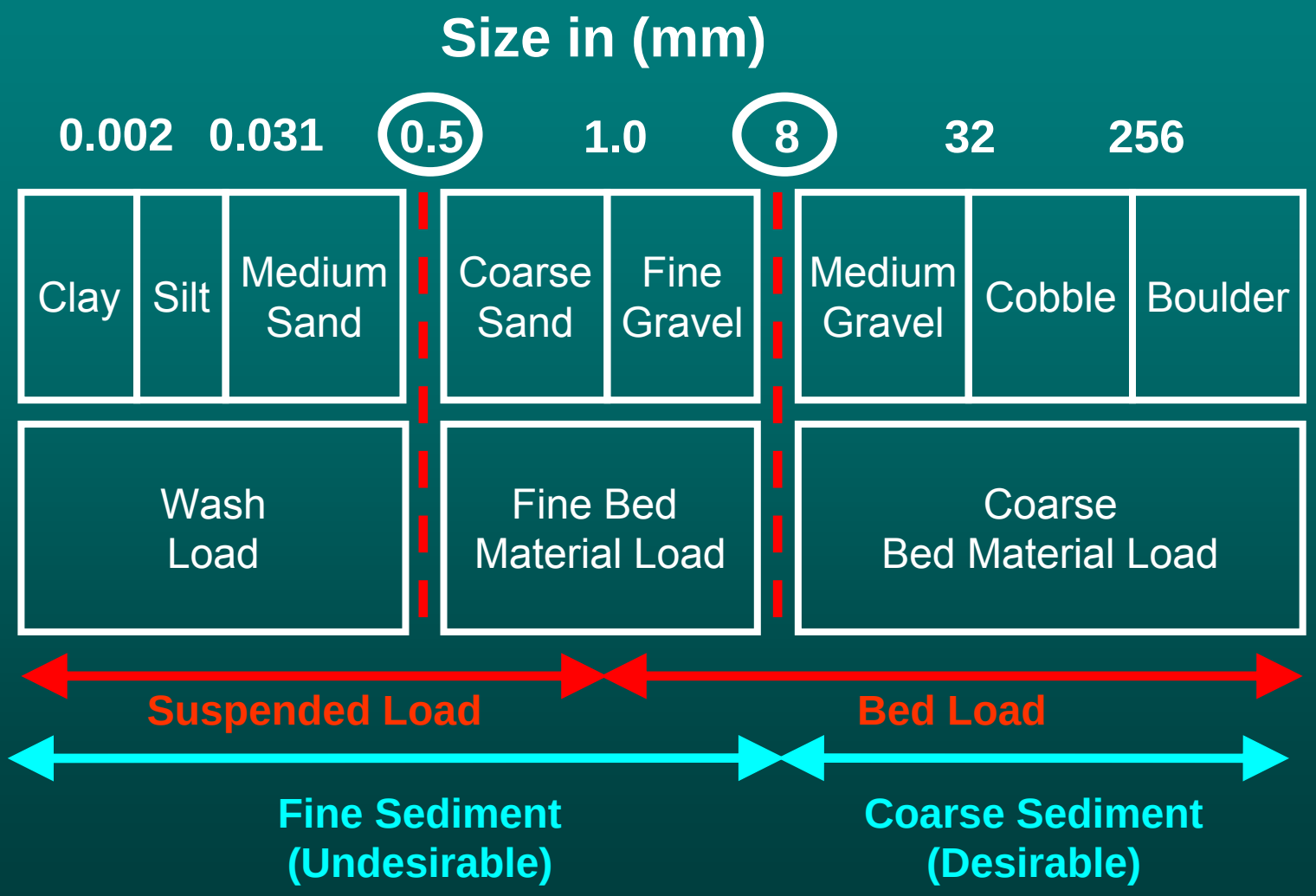
- Reduce fine sediment delivery
- Encourage coarse sediment delivery
- Reduce delivery of oversize material

Restoration Tools

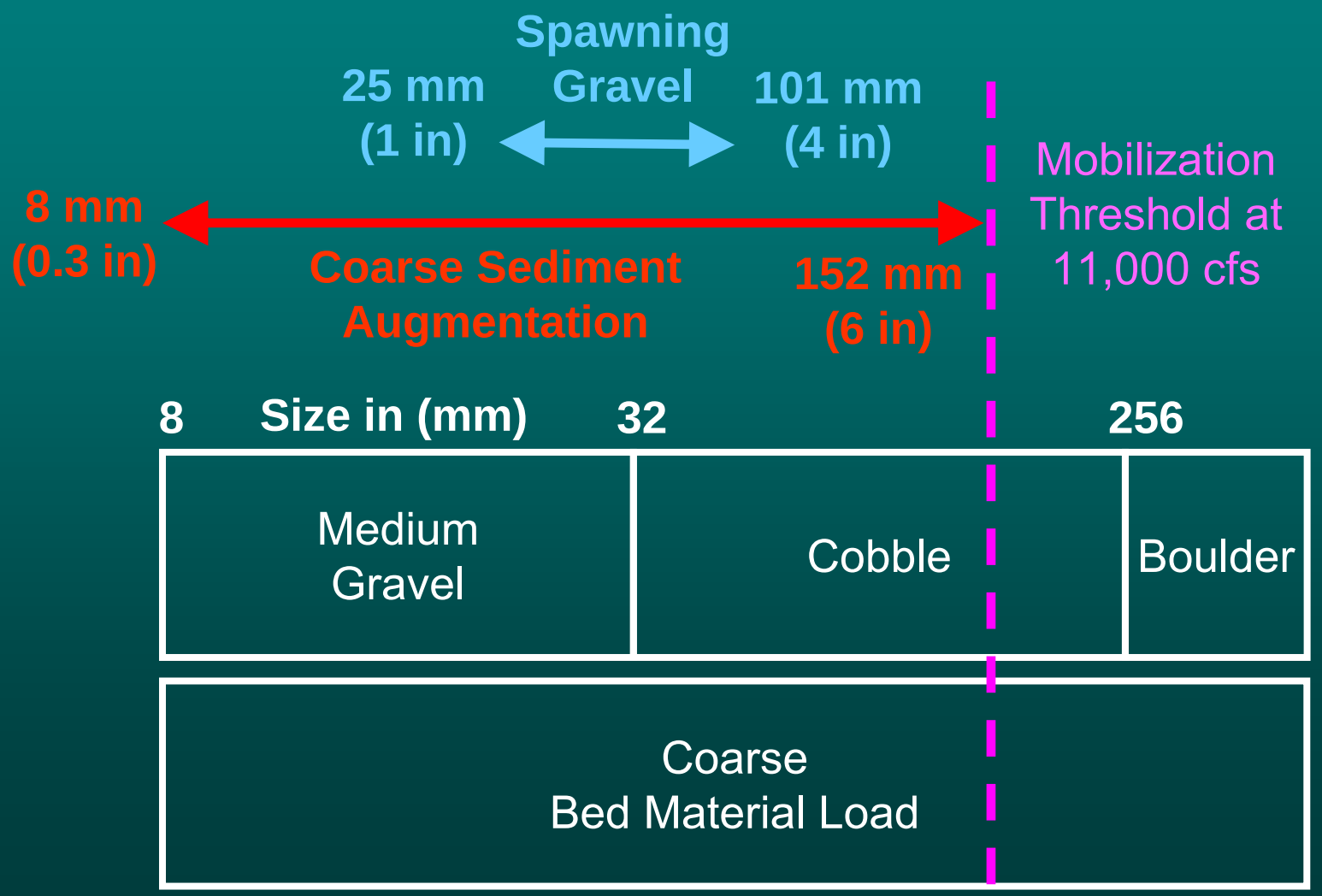
Adaptive Environmental Assessment and Management (AEAM)

- Predict
- Monitor
- Assess
- Adapt

Sediment Characteristics



Coarse Sediment for Geomorphic Processes



Sediment Management Goals

Restore ability of river to adjust its dimensions and create dynamic aquatic habitats

- Increase coarse sediment storage in bankfull channel
- Route coarse sediment through all reaches
- Prevent aggradation at tributary deltas
- Reduce mainstem fine bed material storage

Coarse Sediment Management Plan

- Links sediment management, geomorphology, and biology
- Provides framework and rationale of sediment management strategy
- Integrates and standardizes monitoring and assessment
- Educates partners, stakeholders, public
- Assessment based on sediment budget by size class (coarse, fine)

Preliminary Coarse Sediment Management Plan

(McBain and Trush 1/30/03)

- Need for coarse sediment augmentation
- Short and long tem injection strategies
- Delta management
- Size and composition of coarse sediment
- Injection sites (short and long term)
- Placement methods
- Monitoring procedures

Coarse Sediment Augmentation Placement Methods

- High flow stock pile
- Riffle supplementation (instream)
  - Uniform 2 ft layer along the low flow channel bed
- Instream contouring
  - mimic alluvial features
- High flow direct introduction
  - Only during wet and extremely wet years

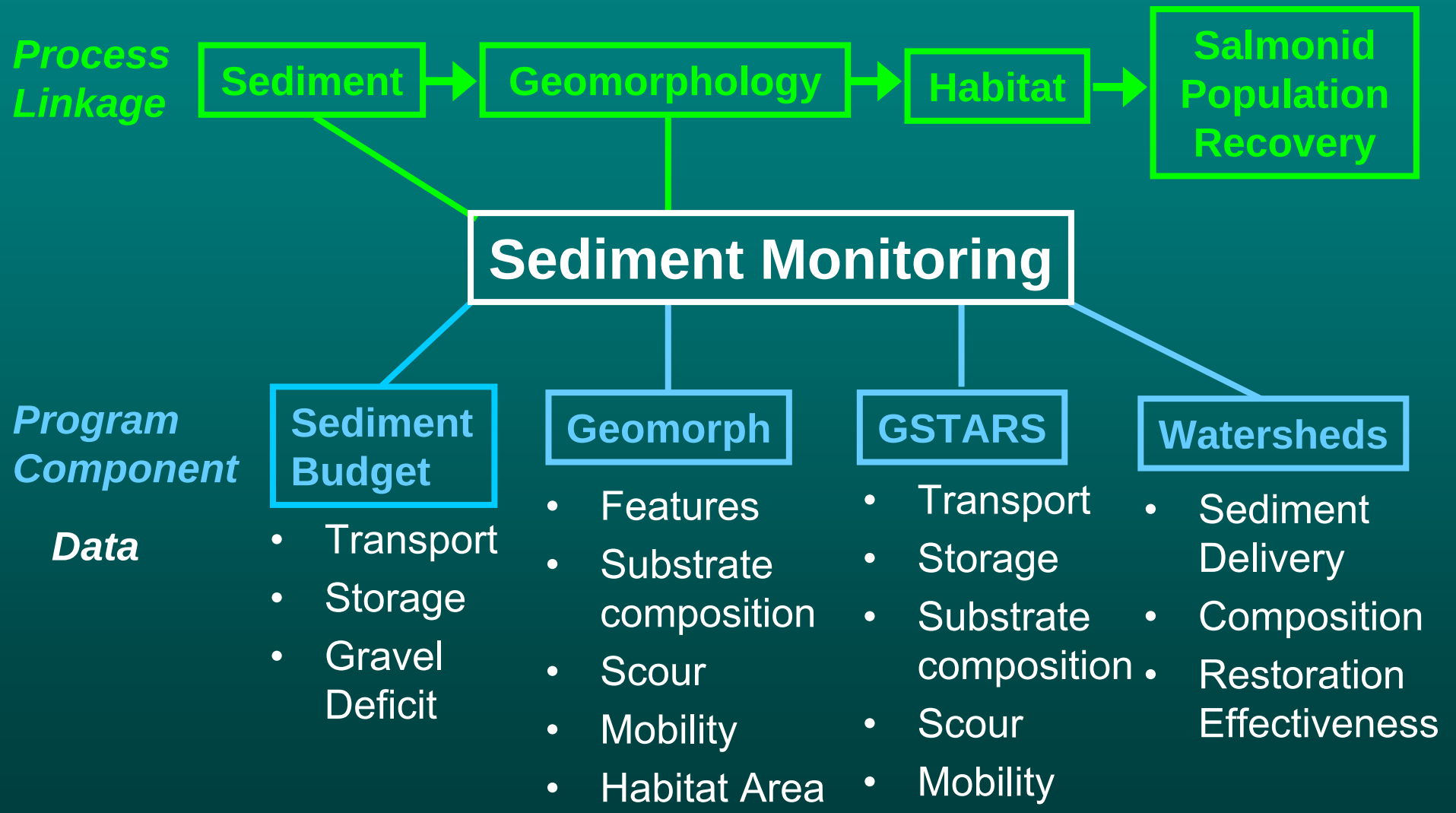
Preliminary Plan
Monitoring Plan

- Monitor placement method, storage, morphological evolution of injected sediments
- Monitor evolution of tributary deltas and downstream distribution of their coarse sediments
- Estimate annual volume needed to maintain equilibrium
- Evaluate benefits to spawning and rearing habitat quantity, quality, and use.

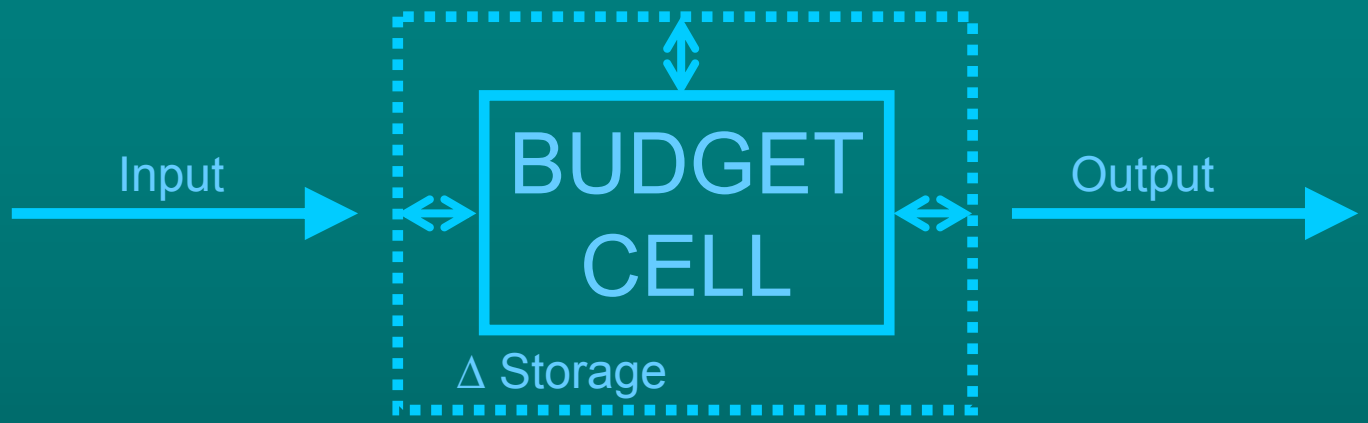
Envisioned Additions to Finalize

- Integrate with:
  - Sediment budget plan
  - GSTARS sediment model
  - Sediment monitoring
  - Science framework
  - Implementation plans
- Incorporate lessons learned from past placements
- Review proposed placement methods and logistics
- Address dispersion and residence time
- Develop engineering specs for augmented sediment
  - Particle size distribution
  - Composition and cleanness

Sediment Monitoring and Assessment



Sediment Budget



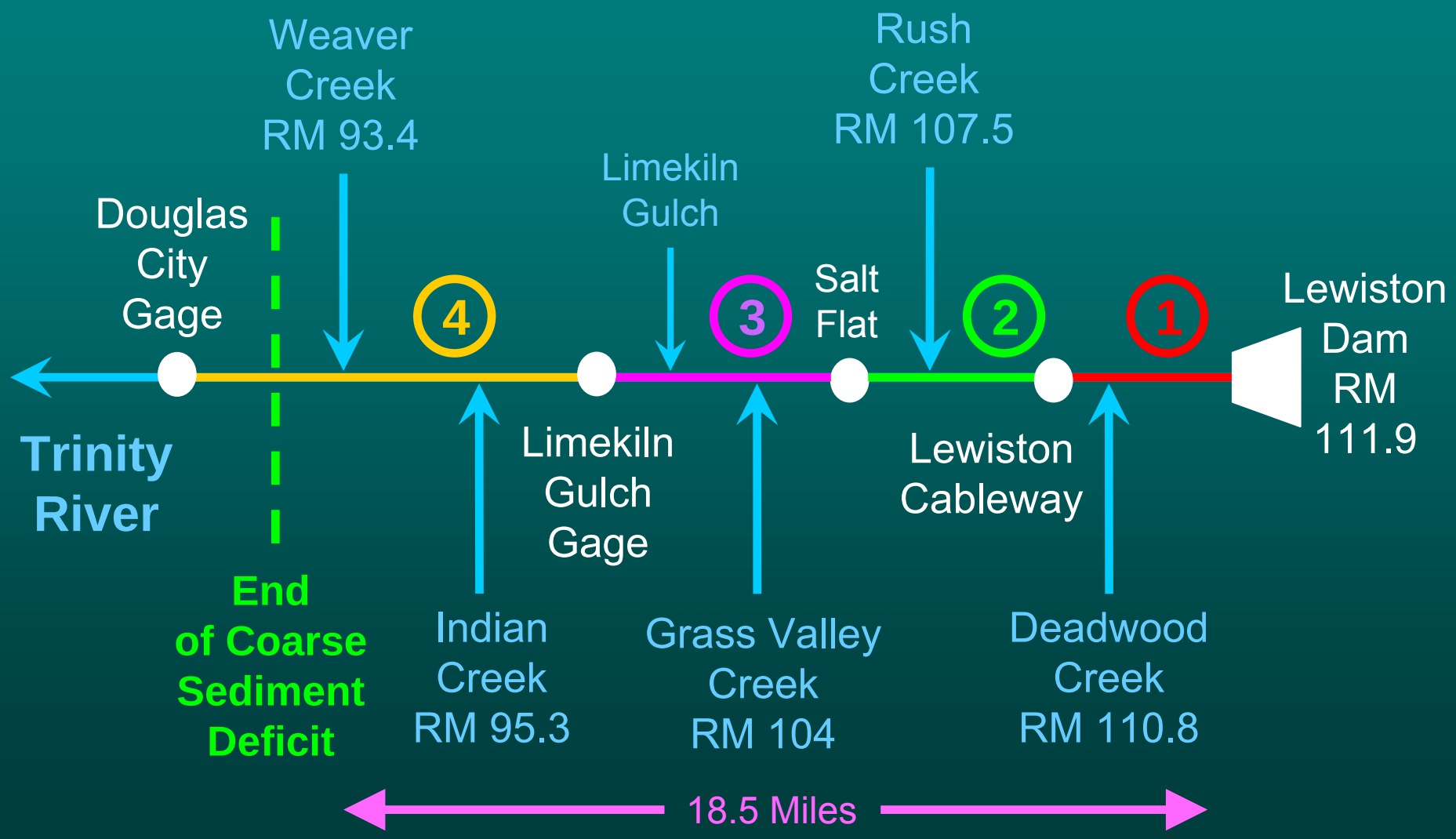
Input – Output + Δ Storage

=

0 ± Uncertainty

- Sediment budget per size fraction
  - Basis for all sediment related assessments

Sediment Budget Cells
(Source: Wilcock 2004)



Spatial Scale for Monitoring

- System Scale (40 miles)
  - Lower resolution / large spatial scale assessment
  - Understand system change
  - Ties to population response
  - Determine overall restoration success

  Examples:
    - Mapping (bathymetry, aerial, planform)
    - Redd counts
    - Sediment budget cells (each ~5 miles)
- Site Scale / Index reach (<1 mile)
  - High resolution / small spatial scale assessment
  - Process level understanding
  - Extrapolate site level process to system scale

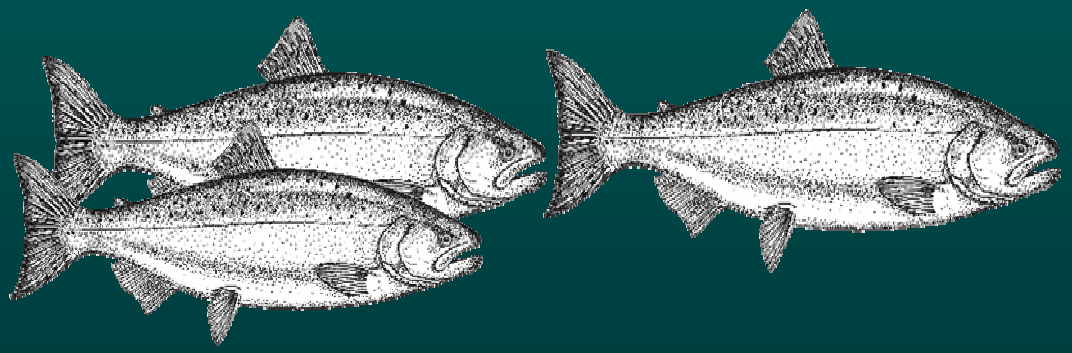
  Example: Redd Sour Modeling

Challenges: Process

- Share the Vision
  - Decision makers
  - Stakeholders
  - Researchers
  - Designers
  - Regulatory agencies
- Match monitoring, modeling, and assessment to management needs

Challenges: Technical

- Manage flows to create and maintain system
- Link sediment to population response
- Effects of restoration efforts on transport rates
  - Flow magnitude and duration
  - Coarse sediment augmentation
  - Fine sediment reduction
  - Bank Restoration



Challenges: Monitoring

- Reduce and quantify sampling bias
  - larger particles (3” to 6” +)
  - Unsampled zone
  - Lack of real-time sampling
  - Time integrated sample / sediment trap
- Quantifying bed material composition
  - Changing surface and subsurface size distributions
  - Storage (bathymetric mapping precision)
  - Quantify composition at reach scale
- Transport dynamics
  - Can meaningful real-time monitoring be accomplished
- Integration,Coordination, Standardization, Quality control, Centralized data archival

Challenges: Implementation

- Incorporate robust study design into project design / implementation schedule
- Environmental compliance
- FEMA
- Funding and Logistics
- 3 month construction time window for instream work

Summary

- Tie sediment management to biological benefit
- Consider all species / life stages
- Population recovery requires an ecosystem scale perspective, not site scale focus.
- Size injected sediment to flow regime
- Use sediment budgets
- AEAM integrates implementation, assessment, and management
- Actively share the Vision

Questions?

Point of Contact

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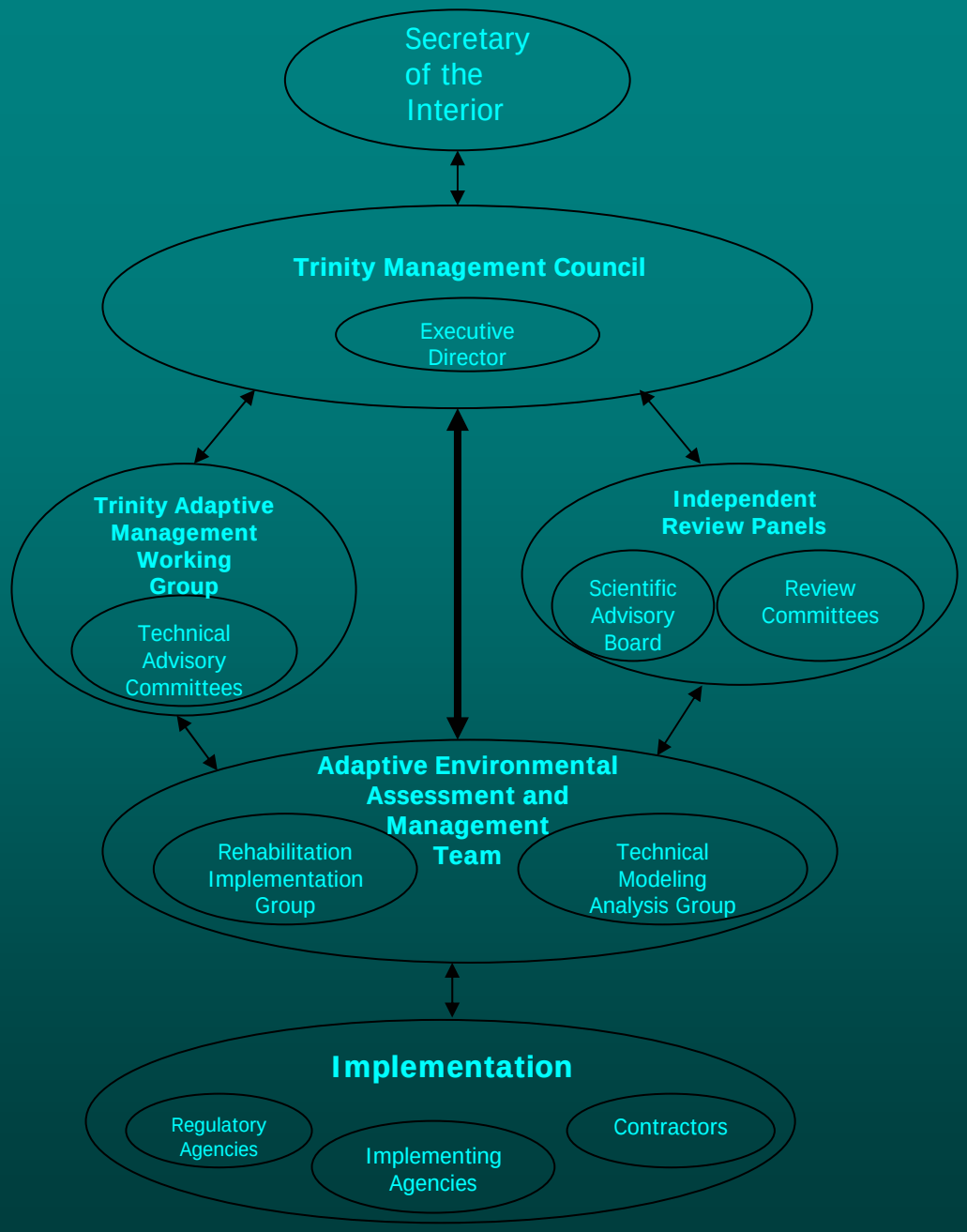
Backup Slides

Org Chart


Secretary of the Interior
Trinity Management Council
Executive Director
Trinity Adaptive Management Working Group
Technical Advisory Committees
Independent Review Panels
Scientific Advisory Board
Review Committees
Adaptive Environmental Assessment and Management Team
Rehabilitation Implementation Group
Technical Modeling Analysis Group
Implementation
Regulatory Agencies
Implementing Agencies
Contractors

Geomorphic Objectives

Year Class	Management Objectives
Extremely Wet	• Mobilization of matrix particles (D84) on alternate bar surfaces (Attribute 3) • Channelbed scour greater than 2 D84's depth and redeposition of gravels on face of alternate bars (Attribute 4) • Transport sand out of the reach at a volume greater than input from tributaries to reduce instream sand storage (Attribute 5) • Transport coarse bed material at a rate near equal to input from tributaries to route coarse sediment, create alluvial deposits, and eliminate tributary aggradation (Attribute 5) • Periodic channel migration (Attribute 6) • Floodplain creation, inundation, and scour (Attribute 7) • Channel avulsion (Attribute 8) • Woody riparian mortality on lower alternate bar surfaces and woody riparian regeneration on upper alternate bar surfaces and floodplains (Attribute 9) • Maintain fluctuating water table for off-channel wetlands and side channels (Attribute 10)
Wet	• Mobilization of matrix particles (D_{84}) on alternate bar surfaces (Attribute 3) • Channelbed scour greater than 1 D_{84}'s depth and redeposition of gravels (Attribute 4) • Transport sand out of the reach at a volume greater than input from tributaries to reduce instream sand storage (Attribute 5) • Transport coarse bed material at a rate near equal to input from tributaries to route coarse sediment, create alluvial deposits, and eliminate tributary aggradation (Attribute 5) • Periodic channel migration (Attribute 6) • Floodplain creation, inundation and occasional scour (Attribute 7) • Woody riparian mortality on lower alternate bar surfaces and woody riparian regeneration on upper alternate bar surfaces and floodplains (Attribute 9) • Maintain fluctuating water table for off-channel wetlands and side channels (Attribute 10)