

Technical Basis for the Proposed 2015 Gravel Augmentation

**TMC Meeting
March 26, 2015**

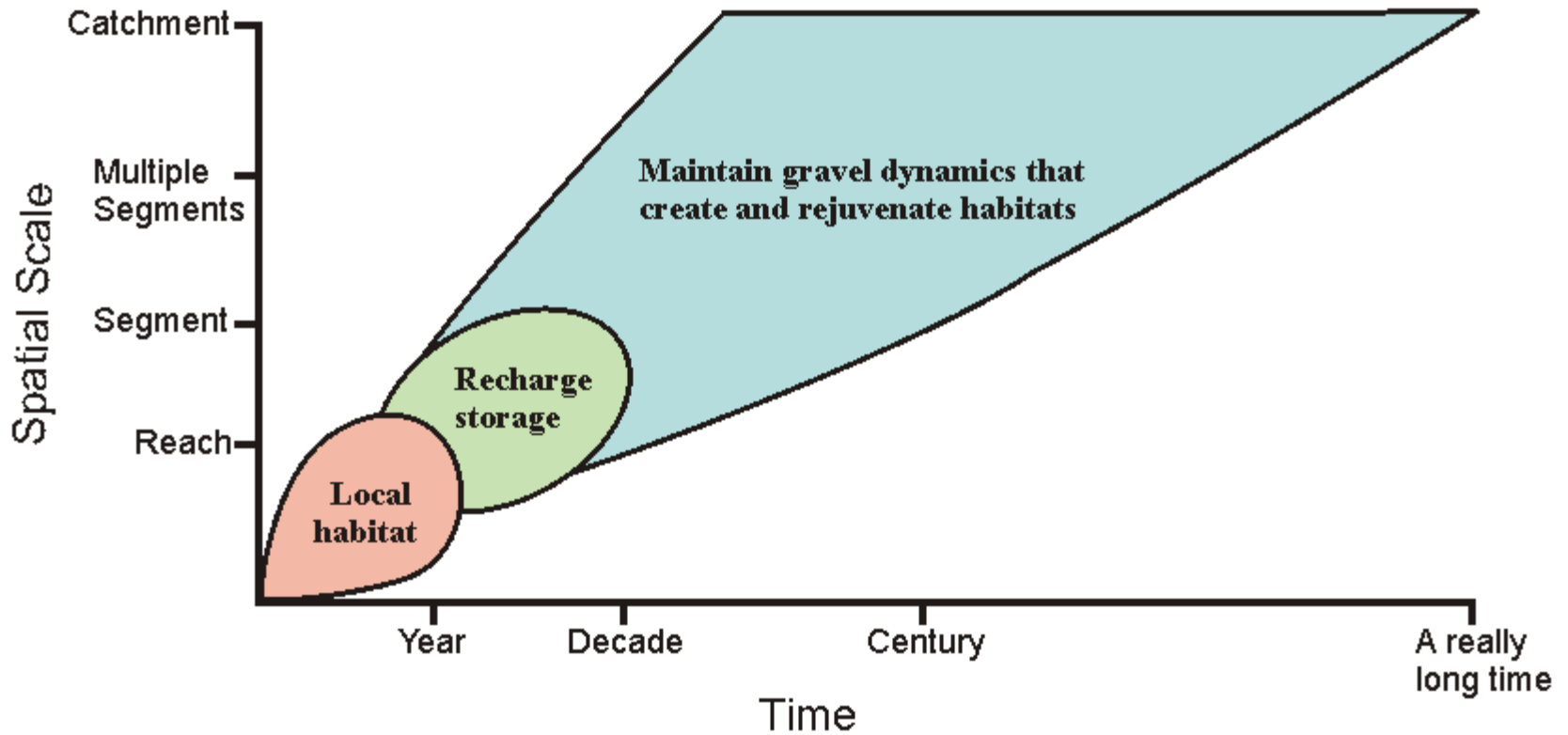
Gravel Augmentation Objectives (TRFES and ROD)

“Short-term Coarse Sediment Supplementation” –
Mitigate for dam-induced deficit
TRFES calls for 16,000 yds in Lewiston area
Immediate increase in spawning and rearing habitat

“Annual Coarse Sediment Introduction” –
Maintain a coarse sediment balance
Support geomorphic process into the future
Habitat creation/rejuvenation into the future (implicit)

Gravel Management Objectives

Range of Scales



Coarse Sediment Augmentations 2003-2014

Direct Placements –

Cableway, 2003
Hatchery, 2006-07
Cableway, 2008
Hoadley Gulch, 2008
Deadwood Creek, 2008
Dark Gulch, 2008
Sawmill Bars, 2009
Lowden Ranch, 2010
Trinity House Gulch, 2010
Reading Creek, 2010 *
Sawmill Bar, 2013

High-flow injections –

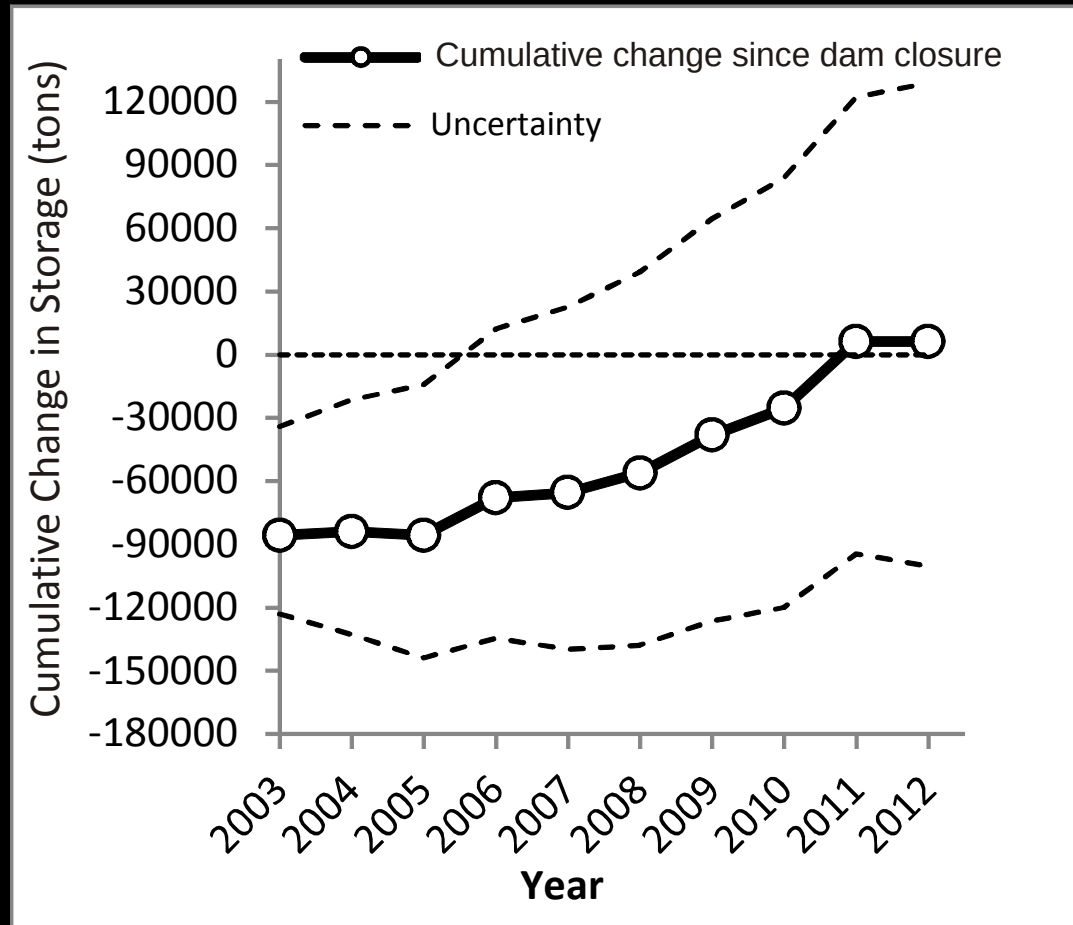
Diversion Pool, 2008
Sawmill Burner Hole, 2008
Diversion Pool, 2009
Sawmill Burner Hole, 2009
Diversion Pool, 2010
Lowden Ranch, 2010
Diversion Pool, 2011
Lowden Ranch, 2011
Diversion Pool, 2013

**Total mobile coarse sediment augmented since 2003 –
52,000 yd³ (78,000 tons)**

(Grey highlighting indicates gravel placements performed in conjunction with a channel rehabilitation project)

Recharge Storage: 2012 Budget

Upstream from Limekiln Gulch



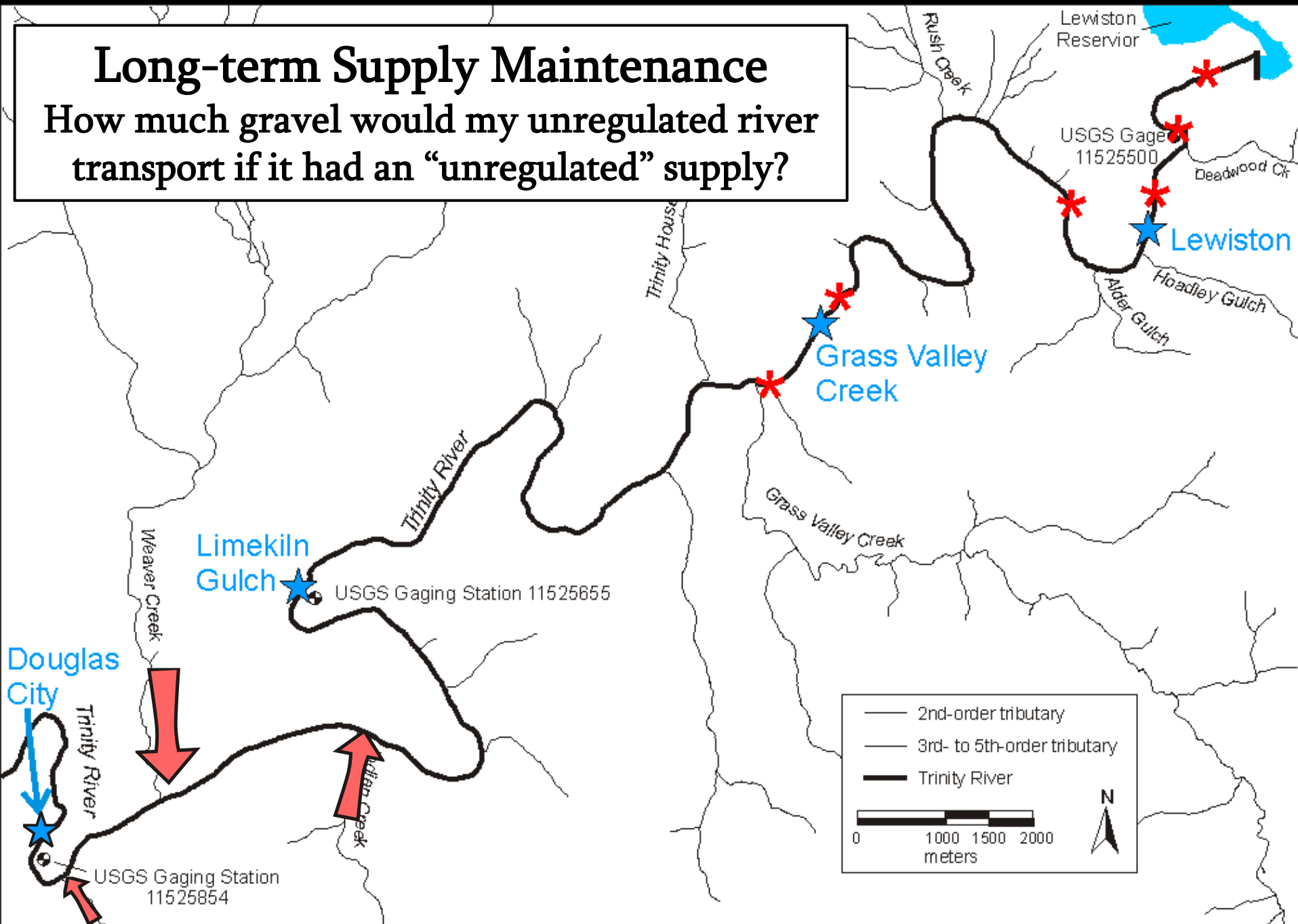
Gaeuman, D. 2013. *2012 sediment budget update, Trinity River, Lewiston Dam to Douglas City, California*. Trinity River Restoration Program, Weaverville, CA, TRRP Technical Report TR-TRRP-2013-2, <http://odp.trrp.net/Data/Documents/Details.aspx?document=2156>

Long-term Supply Maintenance

How much gravel would my regulated river transport if it had an “unregulated” gravel supply?

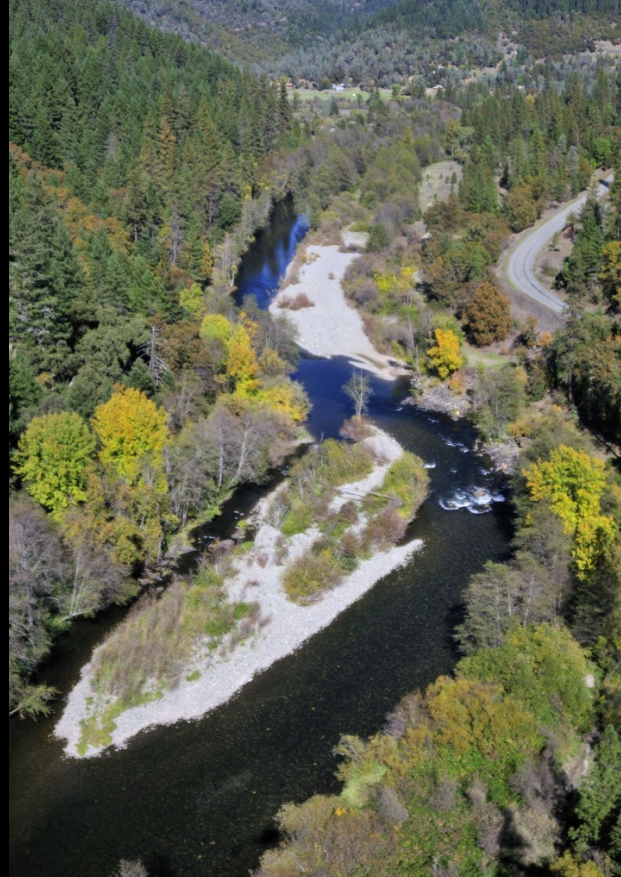
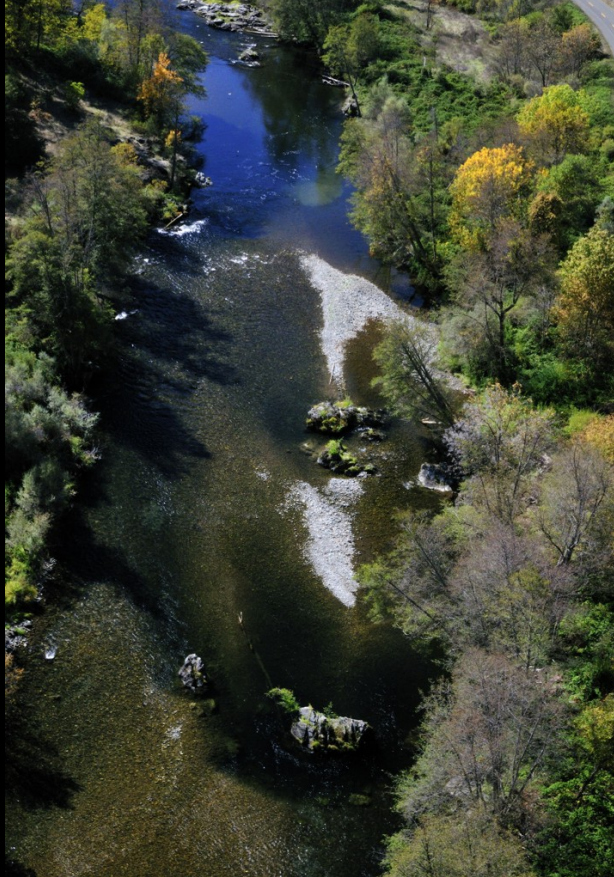
Long-term Supply Maintenance

How much gravel would my unregulated river transport if it had an “unregulated” supply?



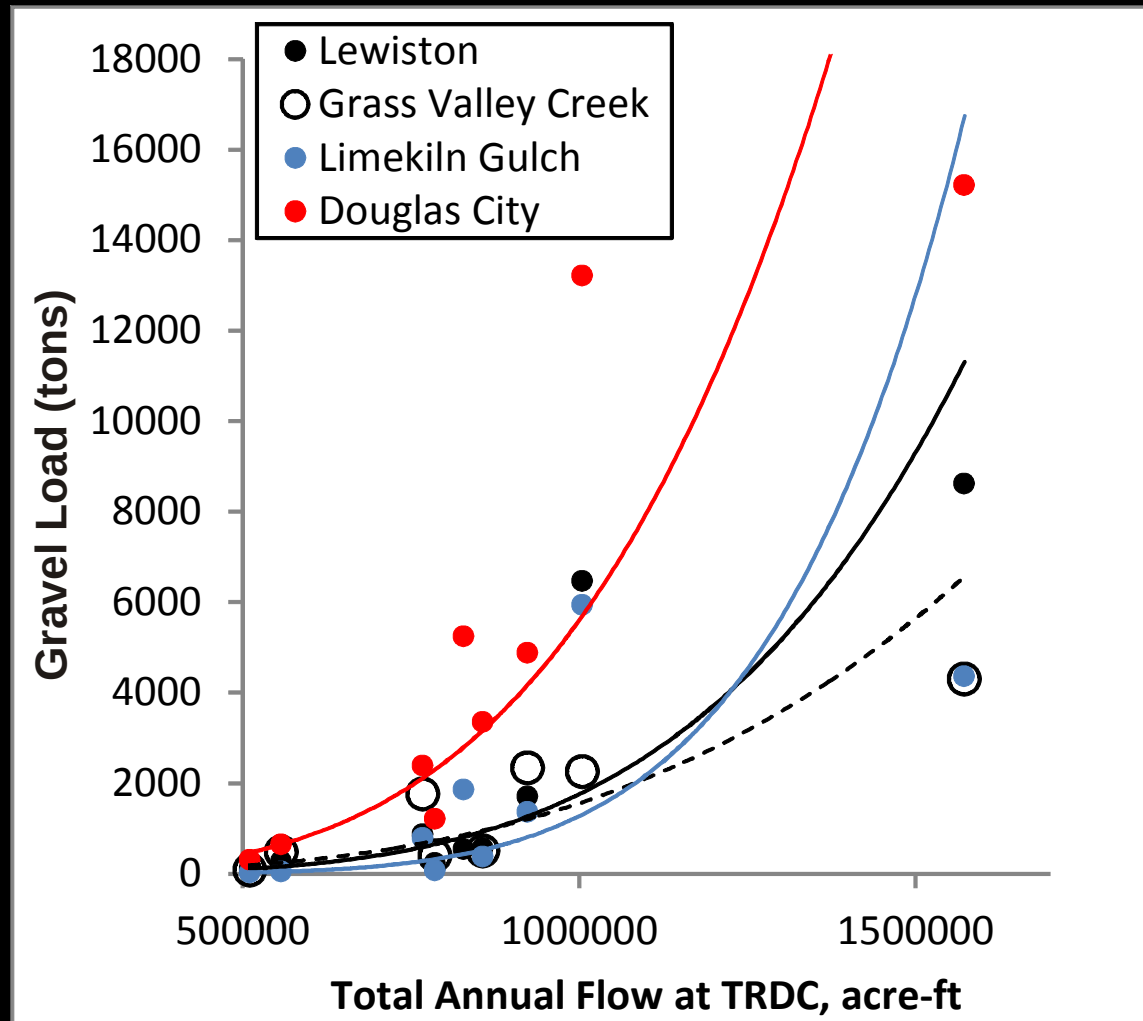
0 250 500 1,000
Feet

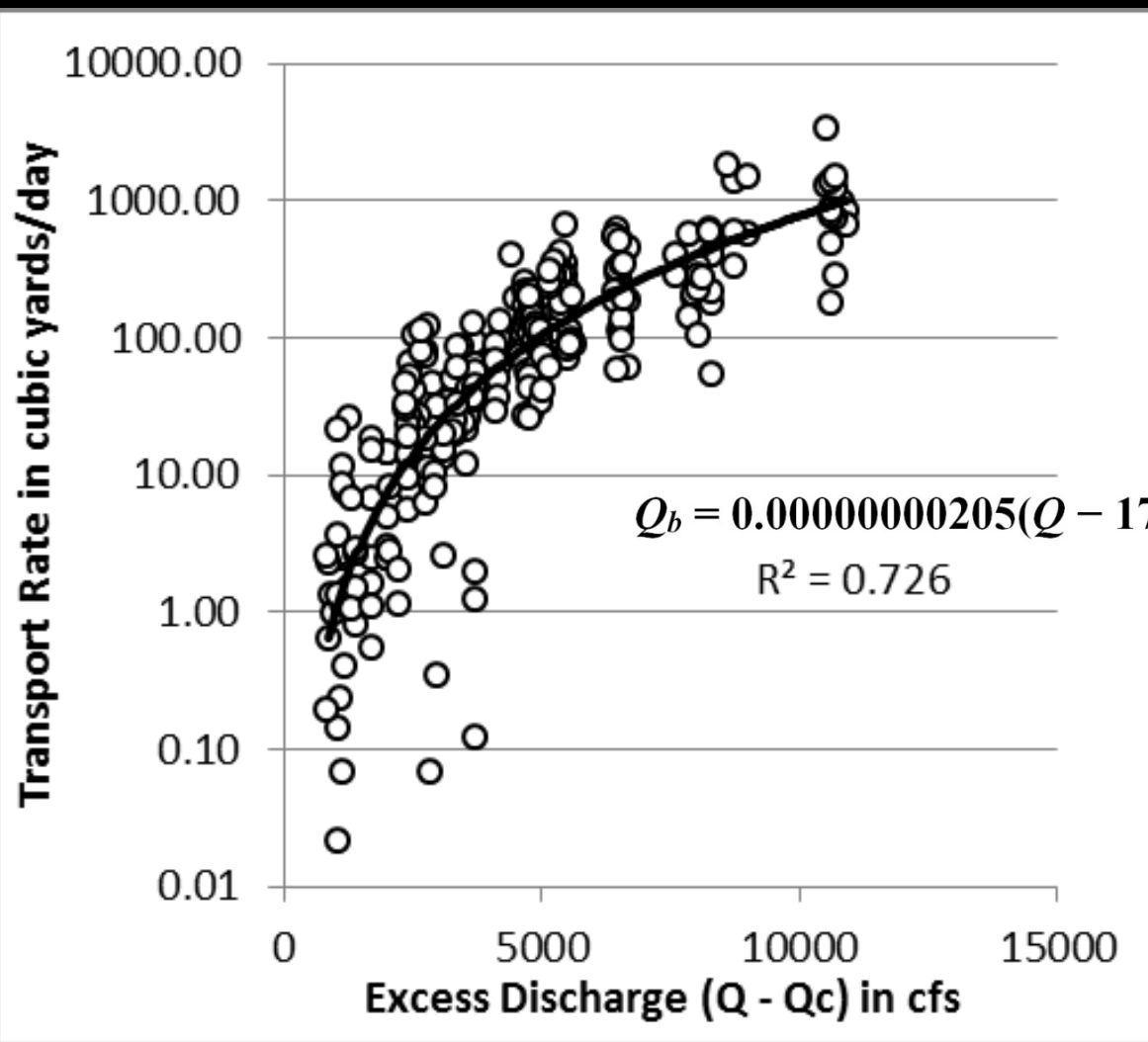




Long-term Supply Maintenance

Transport at Douglas City as a reference for upstream reaches





$$q_b = [11.2 (1 - 0.846(Q_c/Q)^b)^{4.5}] / [g (\rho_s/\rho - 1)/(\tau_r^* g(\rho_s - \rho)d(Q/Q_c)^{b/\rho})^{1.5}]$$

Most Recent (2014) Recommendations

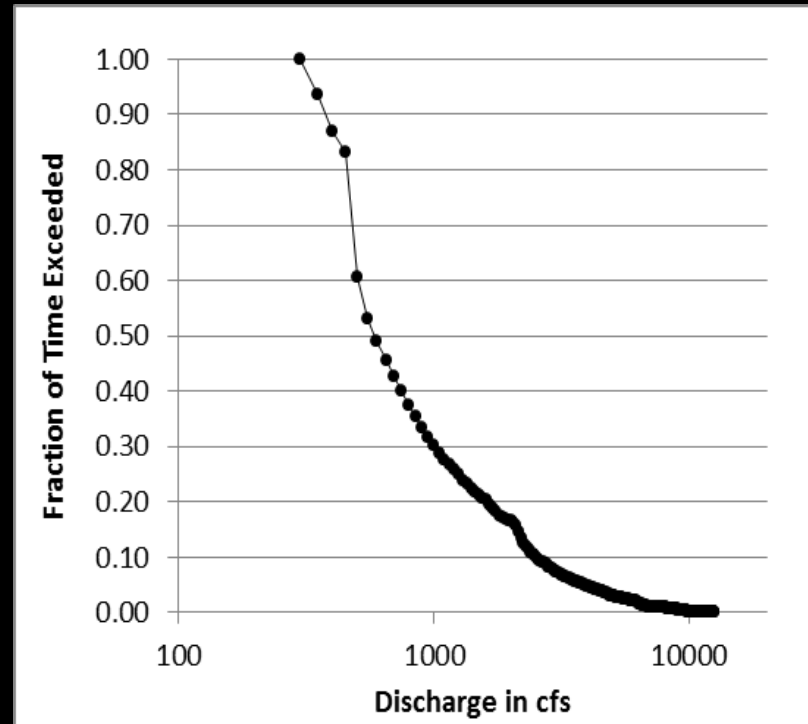


Table 3: Average annual unimpeded coarse sediment loads in yd³ of bulk sediment in different reaches of the Trinity River as estimated with equation (1) and equation (5).

Analysis	TRDC	TRLG	TRAL
Rating Curve	2040 ± 593 yd ³	1630 ± 473 yd ³	1475 ± 423 yd ³
Calibrated Transport Equation	2930 ± 850 yd ³	2370 ± 687 yd ³	2165 ± 628 yd ³

Most Recent (2014) Recommendations

Table 4: Combined results for average annual unimpeded coarse sediment loads in yd^3 of bulk sediment for TRAL and TRLG, and the final recommended long-term augmentation rate for the reaches upstream from Indian Creek.

Analysis	TRLG	TRAL
Intersection of Equations (1) and (5)	$2000 \pm 490 \text{ yd}^3$	$1820 \pm 440 \text{ yd}^3$
Recommended Long-term Augmentation Rate	All reaches upstream from Indian Creek $1910 \pm 440 \text{ yd}^3$	

Table 7: Practical target augmentation rates for each water year type (G_i) in yd^3 . A_i and f_{Ai} are defined in the text. Values of G_i exceed A_i and so are maximum recommended values for all water year types except extremely wet.

WY Type	f_{Ai}	A_i	G_i
Critically Dry	0	0	0
Dry	0.031	215	670
Normal	0.089	865	1670
Wet	0.393	2695	3000
Extremely Wet	0.487	7690	5000

Define $Z_{WY\text{ type}}$ by $Z_{\text{dry}} = 1$, $Z_{\text{normal}} = 2$, $Z_{\text{wet}} = 3$, $Z_{\text{extremely wet}} = 4$

Empirical fit to transport capacities of ROD hydrographs:

$$A_i = 69.61 e^{1.19 Z_{WY\text{ type}}} \\ (r^2 = 0.996)$$

Inverting that relation and replacing A_i with A_H and $Z_{WY\text{ type}}$ with Z_H yields:

$$Z_H = \ln(A_H/69.61)/1.19$$

Hydrograph-specific augmentation targets (G_H) are then estimated as:

$$G_H = (Z_H - 1) (G_3 - G_2) + G_2; \quad \text{if } Z_H < 2$$

$$G_H = (Z_H - 2) (G_4 - G_3) + G_3; \quad \text{if } 2 < Z_H < 3$$

$$G_H = (Z_H - 3) (G_5 - G_4) + G_4; \quad \text{if } 3 < Z_H$$

Local Gravel Deficits Can be Hard to Identify

Gravel may take a long time to reach deficit areas

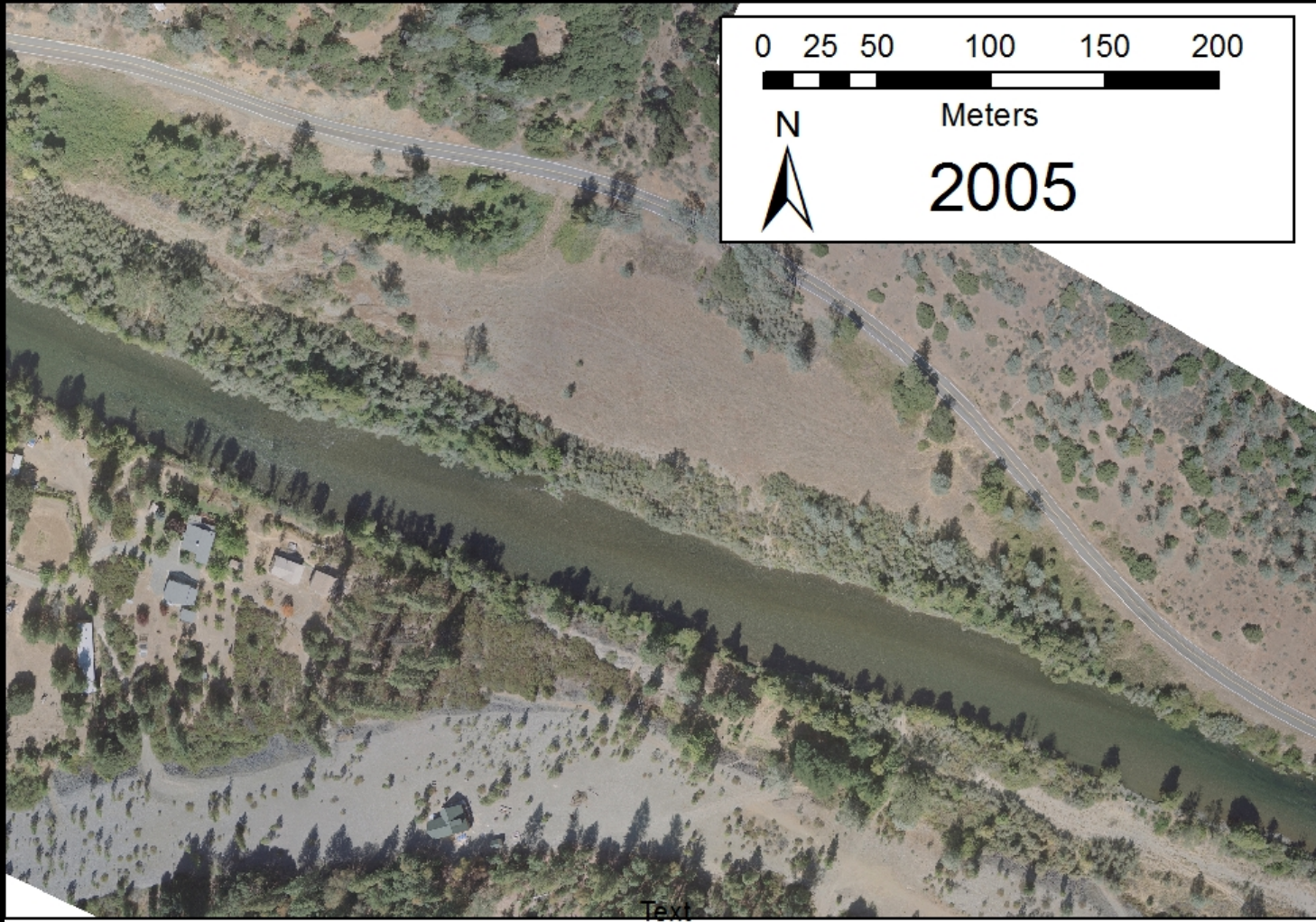
Some reaches just don't store much gravel

Gravel Supply is Just One Piece of the Puzzle

Gravel alone doesn't equal good habitat

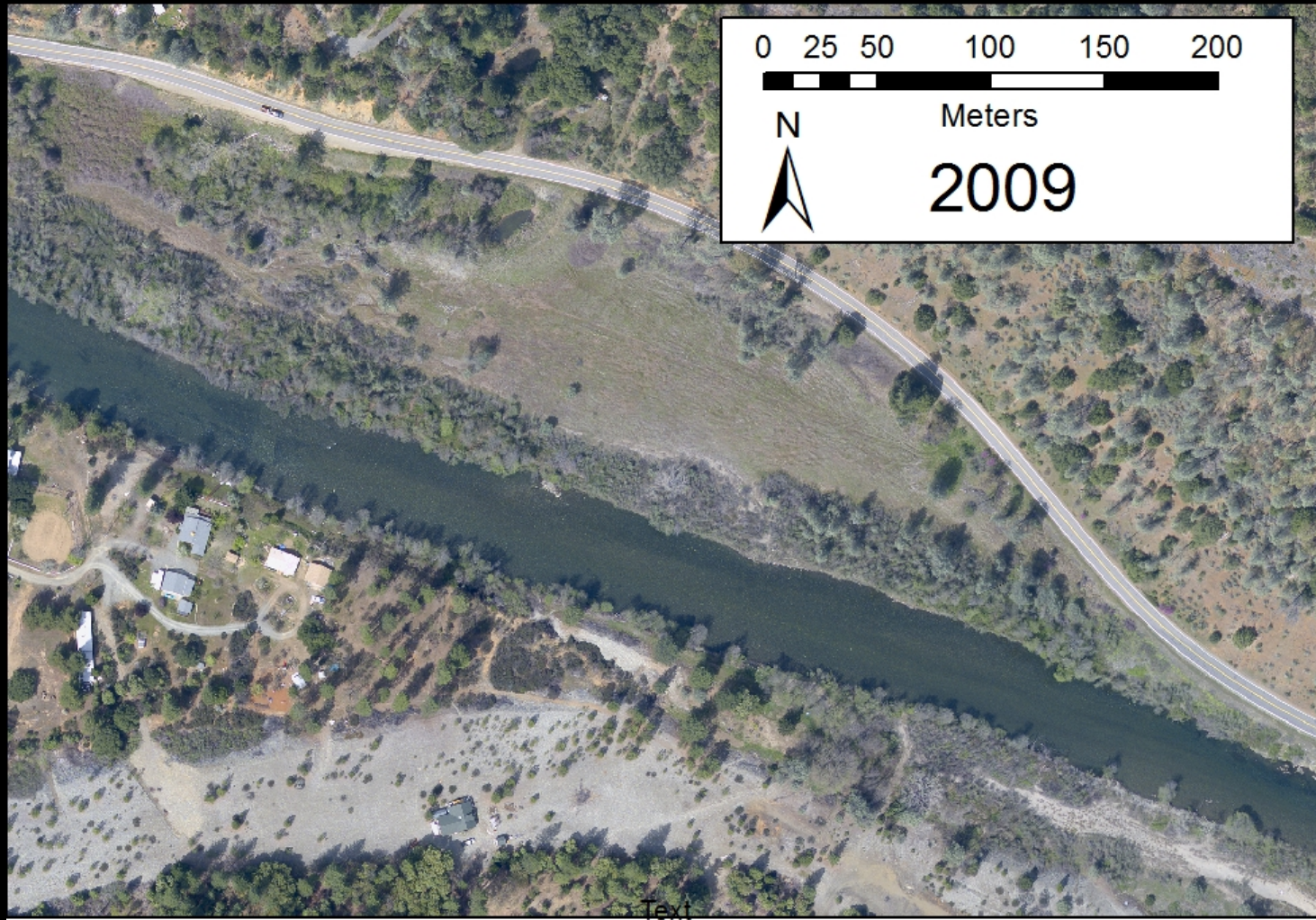
Flows and existing geomorphic structure are key

Gravel May Not be Enough



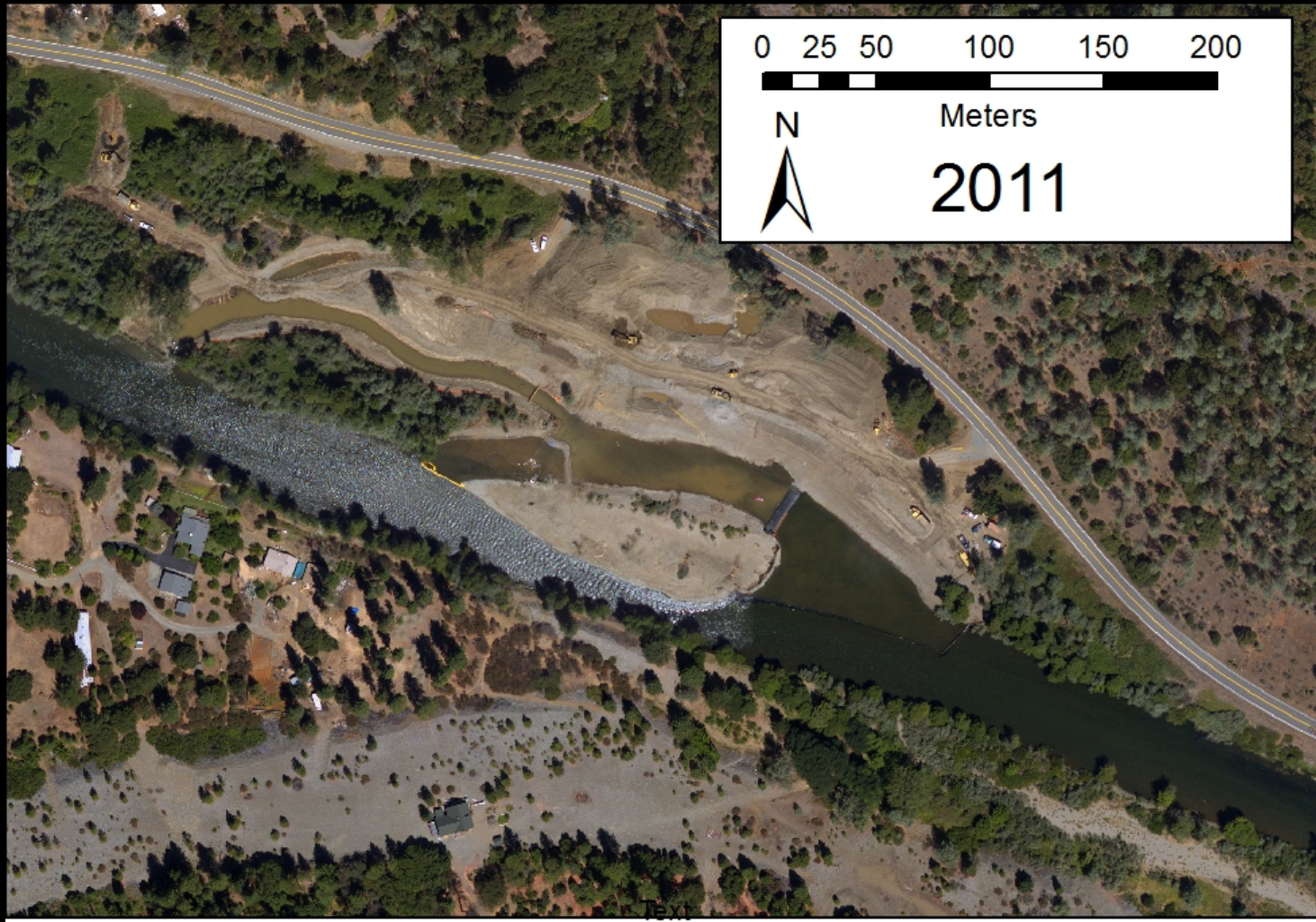
Wheel Gulch, pre-project

Gravel May Not be Enough



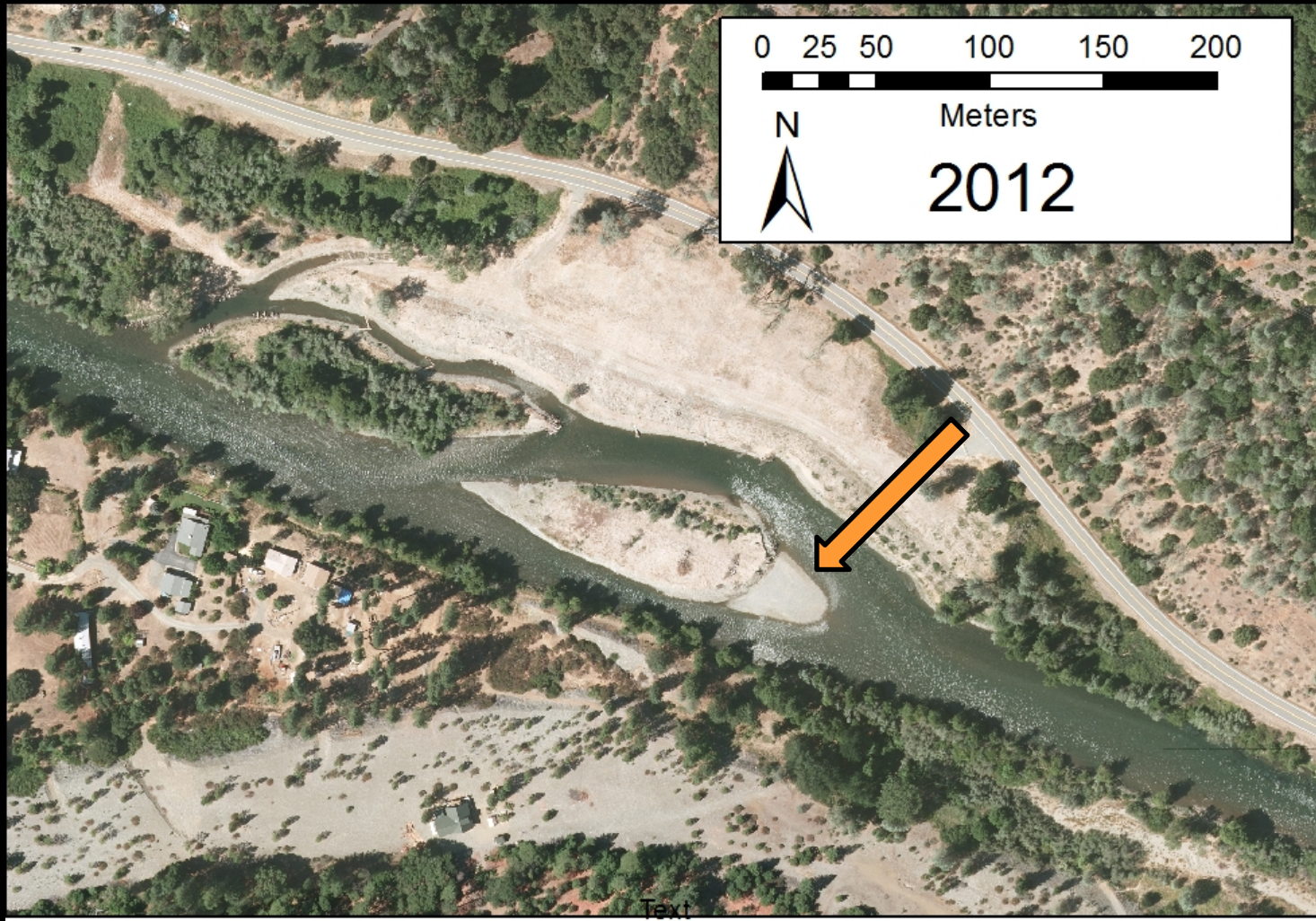
Wheel Gulch, pre-project
(2006 peak flow of $815 \text{ m}^3/\text{s}$ was 2.6 times the maximum fishery flow release)

Gravel May Not be Enough



Wheel Gulch
Project near completion

Gravel May Not be Enough

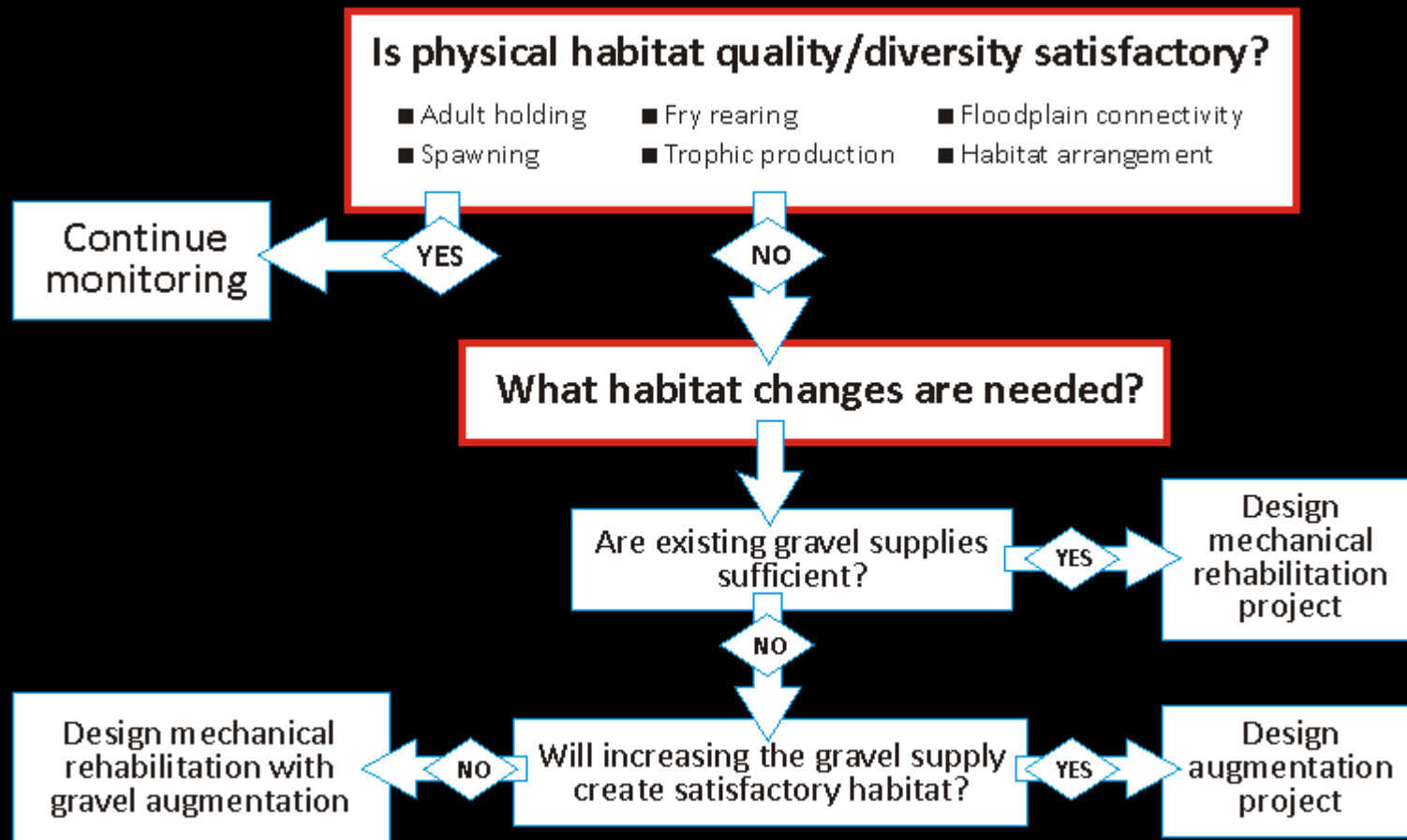


Wheel Gulch

1450 m³ gravel deposited during the very next release

Short-term Augmentation

The fundamental questions are biological

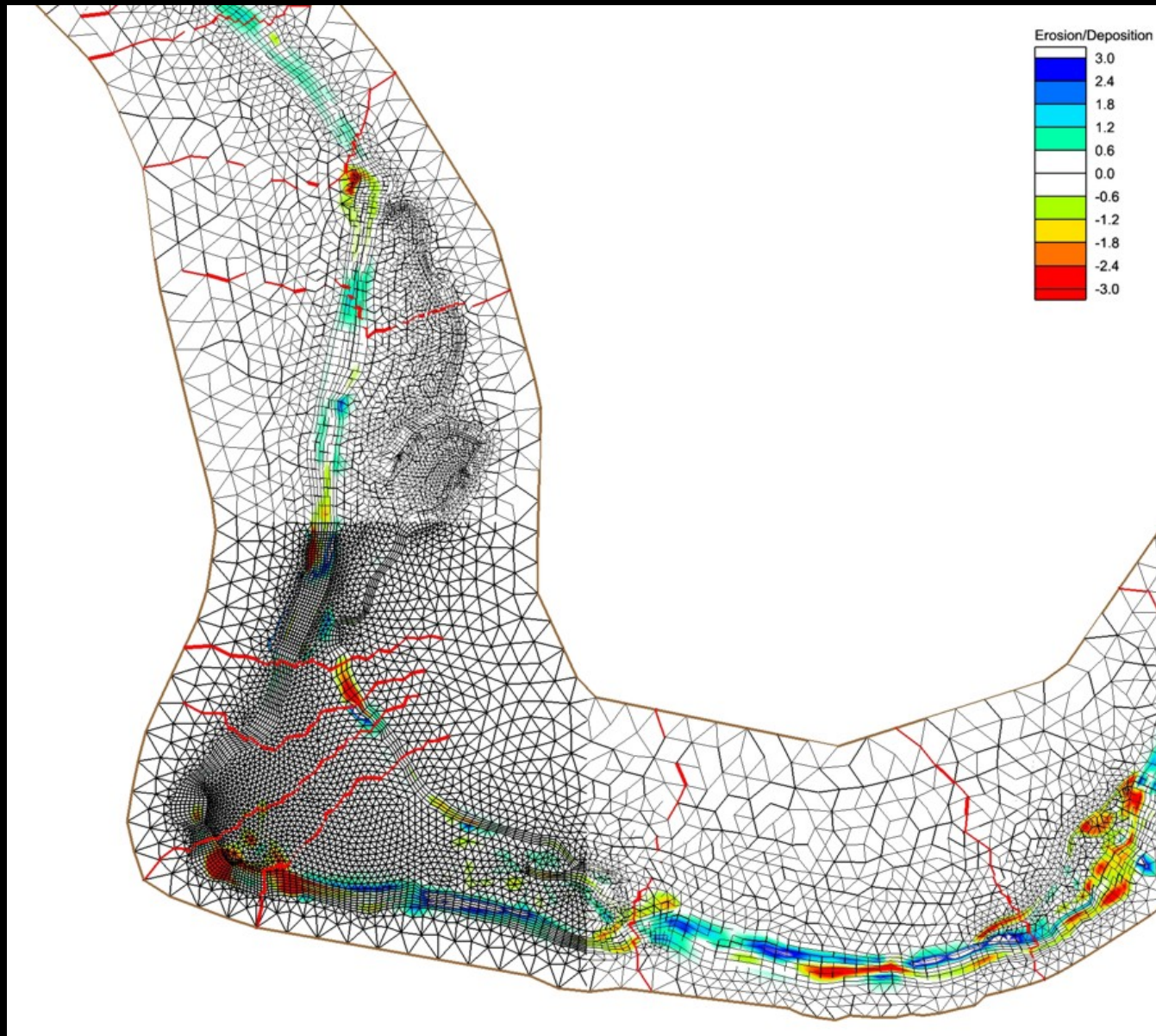


That all I have to say about that.

--- *Forest Gump*

Gravel Propagation and Routing

Morphodynamic Modeling with SRH-2D



Gravel Propagation and Routing

Preliminary Morphodynamic Modeling Results

