Modeling high-flow coarse sediment injections in the Trinity River

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Adapt

Channel Rehabilitation

Flow

Gravel Augmentation

Watershed Restoration
Gravel Augmentation Objectives

- Replenish exported gravel over the long term
- Create habitat directly (spawning)
- Restore processes that build habitat
  - Scour and fill to build topographic relief
  - Stimulate avulsions
  - Promote channel migration
  - Rejuvenate riparian zone
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Dynamic Construction NEW!
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Dynamic Construction

Don’t create new problems!
April 2011: As built, but before 2011 release and gravel injection

2009: Pre-project

constructed meander

terrace lowering

low bar

lowbar
What was predicted...

- Injection point
- Lateral deposition
- Target bar
- Downstream anabranches

2900 tons

4300 tons
MODELED change in bed elevations after injection of 2900 tons

scour predicted here

injection point

target bar

Modeled_dZ
Elevation change, feet

- Red: 0.6 to 0.34
- Orange: 0.34 to 0.15
- Yellow: 0.15 to 0
- Gray: 0 to -0.05
- Blue: -0.05 to -0.13
Behold… a bar is born!
ACTUAL bed elevations BEFORE injection (summer 2010)
ACTUAL bed elevations AFTER injection (summer 2011)

- upstream scour zone
- injection point
- target bar
- middle scour zone

**bed2011**

Elevation in feet

- Blue: 1,734.7 to 1,737
- Dark grey: 1,737 to 1,738.3
- Light grey: 1,738.3 to 1,739.1
- Light orange: 1,739.1 to 1,739.7
- Red: 1,739.7 to 1,742.9
ACTUAL
change in bed elevation, 2010-2011

upstream scour zone

injection point

target bar

middle scour zone

2011-2010
\( \Delta \text{Elevation in feet} \)
-3.4 to -2
-2 to -1
-1 to 0
0 to 1
1 to 4.5
ACTUAL change in bed material storage, 2010-2011

Flux here = 2300

2170

+1230

-630

-500

+130

2011-2010

ΔElevation in feet

-3.4 to -2
-2 to -1
-1 to 0
0 - 1
1 - 4.5
Conclusions
(model performance)

Model correctly predicted substantial aggradation near the injection point.

Model correctly predicted deposition on the target bar, but under-predicted its magnitude.

Model under-predicted scour and completely failed to identify one of the scour zones.

Model tends to spread sediment evenly over bed, resulting in unrealistically smooth bed topography.
Conclusions
(geomorphic response)

Dynamic bar construction was successful:

- Height of the target bar increased by about 2 feet.
- Bed relief throughout response reach increased by 25-30%.
- A new alternate bar sequence was created.

But some outcomes were surprising:

- Adjustment was dominated by scour through much of the response reach.
- Bed material storage in the response reach decreased.
- Gravel transport rates in the response reach were low.
Default assumption: Injection propagates downstream.

This isn’t what happened…
Injection imposes a perturbation that propagates downstream?
Questions?