Stream Restoration Prospects – Questions from the edge

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Prospects for the Stream Restoration Profession

- Background: varied
- Training: short course
- Methods: varied, rapidly evolving
- Monitoring: ad hoc, isolated

Humility, commitment to improving the environment, collaboration, good humor

Restoring, healing, or engineering?

Applying a direct, predictive connection between project objectives and project design that links cause and effect, allows a quantitative evaluation of alternatives, supports learning from doing, and supports explicit consideration of uncertainty
Why are we doing this?

If the salmon south of Alaska will soon be poached anyway …

Education of the public …

Precautionary principle inverted – don’t act until you have some idea that you will do some good

There are other objectives …

“One of the objectives of the Baltimore City Department of Public Works is to correct stream channel stability problems in order to reduce sediment and nutrient loading from channel sources, improve in-stream habitat, protect public infrastructure, protect public and private property, and reduce the need for future channel maintenance in city streams.”

Success = Achieving Objectives
Are objectives well defined?
Are they predictable and predicted?
Are the objectives integrated into the design process?
Is uncertainty quantified and accounted for?
Are objectives connected to environmental drivers in an explicit, predictive, and testable fashion?

Drivers
- Channel size, shape, slope, roughness, grain size
- Floodplain elevation and extent
- Riparian vegetation type, density, location

Design Variables
- Reduce sediment and nutrient loading
- Restore aquatic & riparian populations
- Protect infrastructure & property

Objectives

What are we designing for?

The flows that happen 90% of the time?
The flows that produce channel change?
Stream stability is morphologically defined as the ability of the stream to maintain, over time, its dimension, pattern, and profile in such a manner that it is neither aggrading or degrading and is able to effectively transport the flows and sediment delivered to it by its watershed. Morphologic stability permits the full expression of natural stream characteristics.

Is this balance of sediment deliver & transport predicted, or merely invoked?

Even if the sediment balance is maintained, is morphologic stability predicted, or merely assumed?

Will ‘morphologic stability’ produce the desired objectives? To what degree?

Incorporating Uncertainty in Channel Design

(Large Uncertainty ≠ Unpredictable)

We can evaluate the stability of the installed project for flows of specified likelihood.

We can evaluate whether there is much of a chance that the channel might fill in with sediment such that further study is warranted.
The standard: Choose *bankfull geometry* from a template: a reference reach, regional hydraulic geometry

- resistance eqn. $\rightarrow$ bankfull flow
- flood frequency curve $\rightarrow$ flood frequency
- incipient motion, transport criteria $\rightarrow$ flow competence, capacity

The alternative: specify flood frequency *AND* sediment supply

- flood frequency curve $\rightarrow$ bankfull flow +
- hydraulic & transport relations $\rightarrow$ channel *slope & width* +
- channel shape relations $\rightarrow$ *bankfull geometry*

The problem for the alternative approach: it is hard to get an accurate estimate of sediment supply.

But this is a problem for the template approach as well!
NCED Purpose:
to catalyze development of an integrated, predictive science of the processes shaping the surface of the Earth, in order to transform management of ecosystems, resources, and land use

20 Principal Investigators at 10 institutions across the U.S.

- Geomorphology
- Sedimentary geology
- Hydrology
- Ecology
- Biogeochemistry
- Civil engineering
- Environmental economics

NCED Stream Restoration Project

"To advance the science and practice of stream restoration by conducting and coordinating research & by working with agency and industry partners to identify information needs, develop improved tools, and transfer this knowledge into practice."

http://www.nced.umn.edu/
### NCED Stream Restoration Toolbox

- **iSURF** – Channel slope, bed, and threshold calculator
- **Bankfull Discharge Estimator**
- **The Spawning Gravel Refresher**
- **Bankfull Channel Estimator**
- **Bend Geometry Designer**
- **Gravel Transport Calculator**
- **The Monte Carlo Calculator**
- **The Dam Remover**
- **Bank Stabilization**

[http://www.nced.umn.edu/](http://www.nced.umn.edu/)

### Prospects for Stream Restoration Education & Training

**Stream Restoration Training Working Group**

- Methods, background, training – diverse, uncoordinated need improved understanding, methods & a different culture
- Today: Diverse backgrounds, training in short courses
  - Future: University training + continuing education
- Hierarchy of Training Courses – to match restoration tasks
  - Overview
  - Principles
  - Design
  - Specialty
- Proposed: Exam-based Certificate in Stream Restoration
- Open source notes and tools
Prospects for Stream Restoration Monitoring

Ecological monitoring; physical observation

Correlation is not causality

Hypotheses → prediction → monitoring

Publish → archiving and coordinated learning

Limited monitoring resources best used collectively

Regional monitoring centers, part of a national network
careful selection of projects to maximize learning
standardization of methods
archiving of information in useful format

http://uwrl.usu.edu/icrrr/

Intermountain Center for
River Rehabilitation and Restoration

Are we doing good? At what cost?

"One of the objectives of the Baltimore City Department of Public Works is to correct stream channel stability problems in order to reduce sediment and nutrient loading from channel sources, improve in-stream habitat, protect public infrastructure, protect public and private property, and reduce the need for future channel maintenance in city streams."

- Can we demonstrate that we are achieving the objectives?
- Can we justify the project cost & disturbance relative to the objectives? Can we do it for (much) less?
In Maryland, we don’t see much of this anymore

But there is an emerging standard approach that includes lots of earth-moving and large rocks and cost and disturbance.
• Is stream restoration design evolving in a conservative direction, making extensive use of stabilizing measures that protect contractor liability above project objectives, cost, and disturbance?
• Can the objectives be accomplished for a fraction of the cost?
• If attainment of objectives is not only unverified, but assumed, we can’t say!
• The objectives, for sediment, channel dynamics, habitat, water quality, fish recovery… have to be fully integrated into a predictive design process