Sue Galatowitsch, U Minnesota

(1) *Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed*

(2) Restoration actions ≠ ecosystem recovery

(3) Establish vegetation GOALS and actions using a **Conceptual Ecological Model** that provides **context** and specifies **drivers, stressors, effects, attributes**

(4) Define **SMART GOALS:**

- Specific, Measurable, Achievable, Reasonable, Time-bound

Articulate goals up front ... Use them to evaluate project alternatives ... Base subsequent decision making on progress toward goals
Sue Galatowitsch, U Minnesota

_Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed_

(1) **Actions ≠ ecosystem recovery**

(2) **Establish vegetation GOALS and actions using a Conceptual Ecological Model** that provides context and specifies drivers, stressors, effects, attributes

(3) **Define SMART GOALS:**
   - **Specific,** **Measurable,** **Achievable,** **Reasonable,** **Time-bound**
   - Articulate goals up front ... Use to evaluate project alternatives ... Base subsequent decision making on progress toward goals

(a) **Expand the GOALS**
   - *We use rivers for many things ... engage all interested parties in a structured, constructive conversation*

(b) **Refine the GOALS:** What, specifically, do people want?

(c) **Learn from projects**
   - Data must be collected, standardized, archived, and accessed ... *even then*
   - To learn, we need clear, testable methods and design hypotheses
A Stream Restoration world in which everyone’s goals are welcome we learn from completed projects we define, and predict, and achieve, all we want our streams to be.

The Key: Effective Decision Analysis
Decision Framework Implemented in 18 steps
Organizes stream restoration decision process
Promotes appropriate project objectives, predictive design, and transparent decision analysis
Much of this is old hat. Why is it not happening?
Goals = what people want.
No goal is intrinsically wrong.
Some are unclear, ineffective, or inappropriate.

A goal should be sufficiently clear that
(1) possible actions to achieve the goals can be clearly defined
(2) appropriateness of reach-scale actions to achieve the goals can be effectively evaluated
(3) success can be defined

**Assessment:** the cause-and-effect link between GOALS → PROJECT OBJECTIVES.
(1) Can this goal be achieved at this site, under present and future watershed conditions?
(2) Can this goal be better achieved with actions other than stream restoration?

Stream restoration **project objectives:**
appropriate (defined at the project scale)
relevant (achieving the objective correlates to achieving the associated goal)
feasible (capable of being achieved)
measurable (support definition of metrics that demonstrate progress toward goals)

Given appropriate, relevant, feasible, and measurable **objectives,**
develop **metrics** that demonstrate progress toward objectives
Healthy, functioning, elevating aquatic & riparian ecosystem
For what purposes? What services?

Reconnect floodplain
For what purpose? What services?

Reduce nutrient, sediment loading
By how much? For how long?
How does this compare to alternative BMPs?

Increase habitat
So what?
A means to an end.
Don’t you want more fish? birds? frogs?
Line up objectives with the actual goals

A channel of particular type
Really? Why?
You say it is better.
I ask “better for what?”
“Is it the best way to achieve that?”
An action is not an objective

Healthy, function, elevating aquatic & riparian ecosystem
For what purposes? What services?
If we specify objectives in terms of actions, appearance, structure ... 

We have no basis for developing and evaluating alternatives.

Any evaluation of SUCCESS becomes disconnected from real goals.

“Build this kind of channel and here is the list of good things that should happen”

Here is the list of good things I want to happen. What kind of channel (or other alternative) is most likely to meet the most objectives?
<table>
<thead>
<tr>
<th>Category</th>
<th>Broad Goal</th>
<th>Appropriate Local Objective</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem</td>
<td>Recover endangered fish population</td>
<td>Stable population of a specific species</td>
<td>Percent recruitment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Target for salmonid adult returns</td>
<td></td>
</tr>
<tr>
<td>Ecosystem</td>
<td>Restore functioning aquatic and riparian ecosystem</td>
<td>Restore songbird population</td>
<td>Number of breeding pairs of desired birds</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>Restore functioning aquatic and riparian ecosystem</td>
<td>Establish self-sustaining pop. of native riparian plants</td>
<td>Density, percentage, health of desired native plants</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Reduce sediment and nutrient discharge from watershed</td>
<td>Maximize nitrogen removal</td>
<td>Annual mass nitrogen removal</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Reduce sediment and nutrient discharge from watershed</td>
<td>Minimize sediment &amp; phosphorus loading</td>
<td>Annual mass sediment and phosphorus loading</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Protect against utility breaches</td>
<td>Protect against sewer main breaches (no change)</td>
<td>Probability of zero breaches of sewer main in 25 years</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Flood protection, specified RI</td>
<td>Flood protection, specified RI (no change)</td>
<td>Probability distribution of flood height</td>
</tr>
<tr>
<td>Social Benefits</td>
<td>Improve access and condition for walking, jogging</td>
<td>Improve access and condition for walking, jogging (no change)</td>
<td>Public preference; Willingness to pay</td>
</tr>
<tr>
<td>Cost ($000)</td>
<td>Minimize cost</td>
<td>Minimize cost (no change)</td>
<td>$</td>
</tr>
</tbody>
</table>

Design to achieve these
Appropriate project objectives and metrics support a **predictive approach** to design.

Develop restoration **actions** that may achieve project objectives.
Assemble actions into portfolios of **alternatives**.

Always evaluate do-nothing and passive restoration alternatives.

**Multi-criteria decision analysis**

- robust, transparent basis for evaluating alternatives
- a basis for evaluating tradeoffs and making decisions
- estimate the range of objective performance for different costs
  - include uncertainty in performance
- use to improve and focus objectives
What do we do when things do not work well?

If the action did not produce the desired result, predictive design provides a basis for making corrections.

You can’t do that with an approach based on narrative using unquantified assertions that the project will make things better in which an action is the objective

The key elements for learning:

- appropriate project objectives and metrics, allowing predictive design, which leads to hypothesis-based monitoring, the data for which must be archived and analyzed, supporting learning (!)
Are restoration projects succeeding?

Is *better* good enough?
How much should *better* cost?

Appropriate project objectives, with effective metrics,
Allow success to be demonstrated
And failure to be productive
Much of this is old hat. Why is it not happening?

What keeps us from driving design with appropriate, relevant, feasible, & measurable project objectives that represent what people actually want?
Much of this is old hat. Why is it not happening?

(1) Do we not have the tools?
Much of this is old hat. Why is it not happening?

(1) Do we not have the tools?
(2) Is it sponsors with narrowly defined scope?
(3) Is it particular regulatory dominance?
   Mitigation
   Water quality
   ESA
(4) Is it business as usual, based on trust & understanding developed between sponsor and designer?
(5) Is it a reluctance to ask the big questions that cannot be answered at present?
(6) Is this just plain dumb? Or too abstract? Or irrelevant?

Can we Require this analysis in the permit review process?
A Stream Restoration world in which everyone’s goals are welcome we learn from completed projects we define, and predict, and achieve, all we want our streams to be.