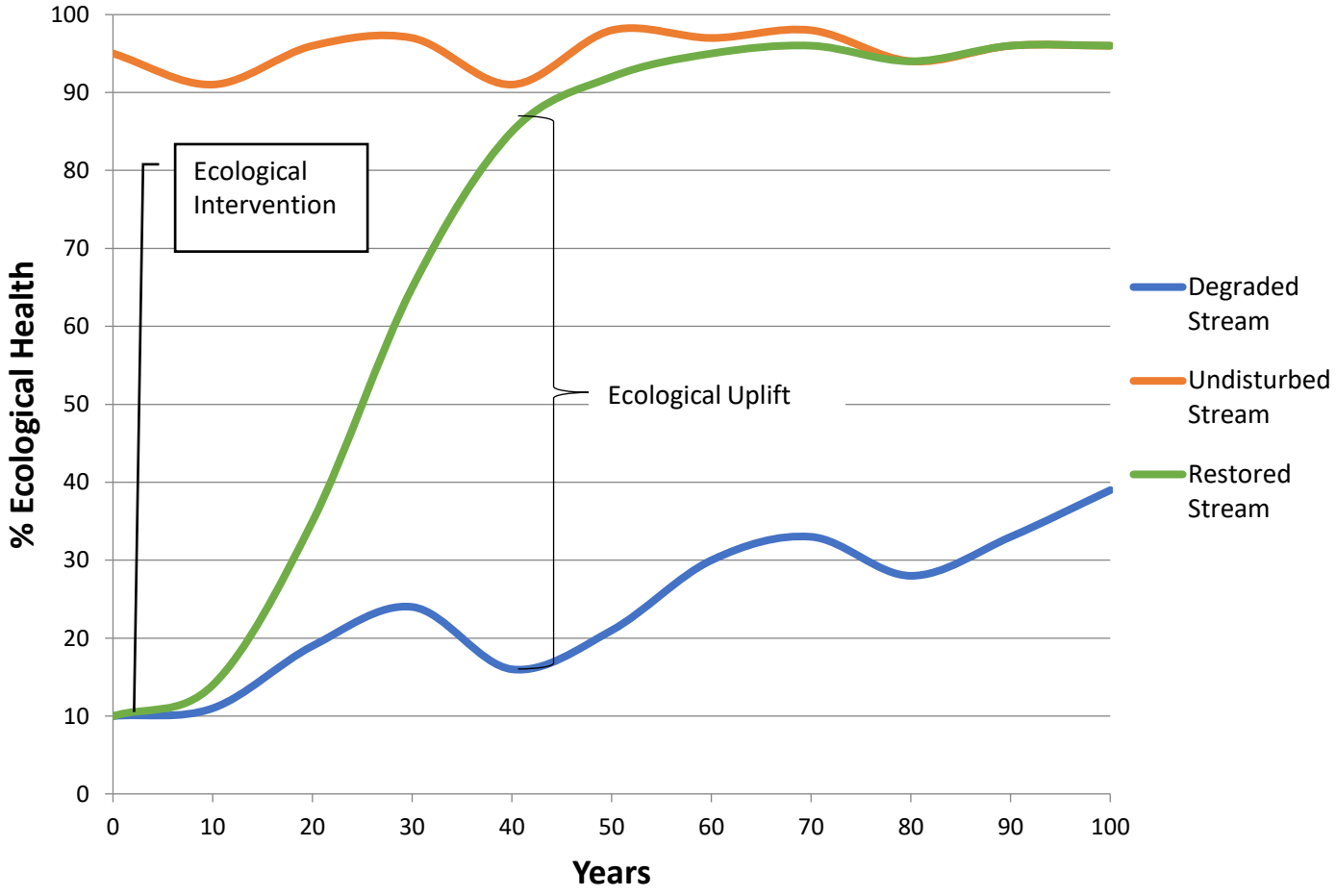
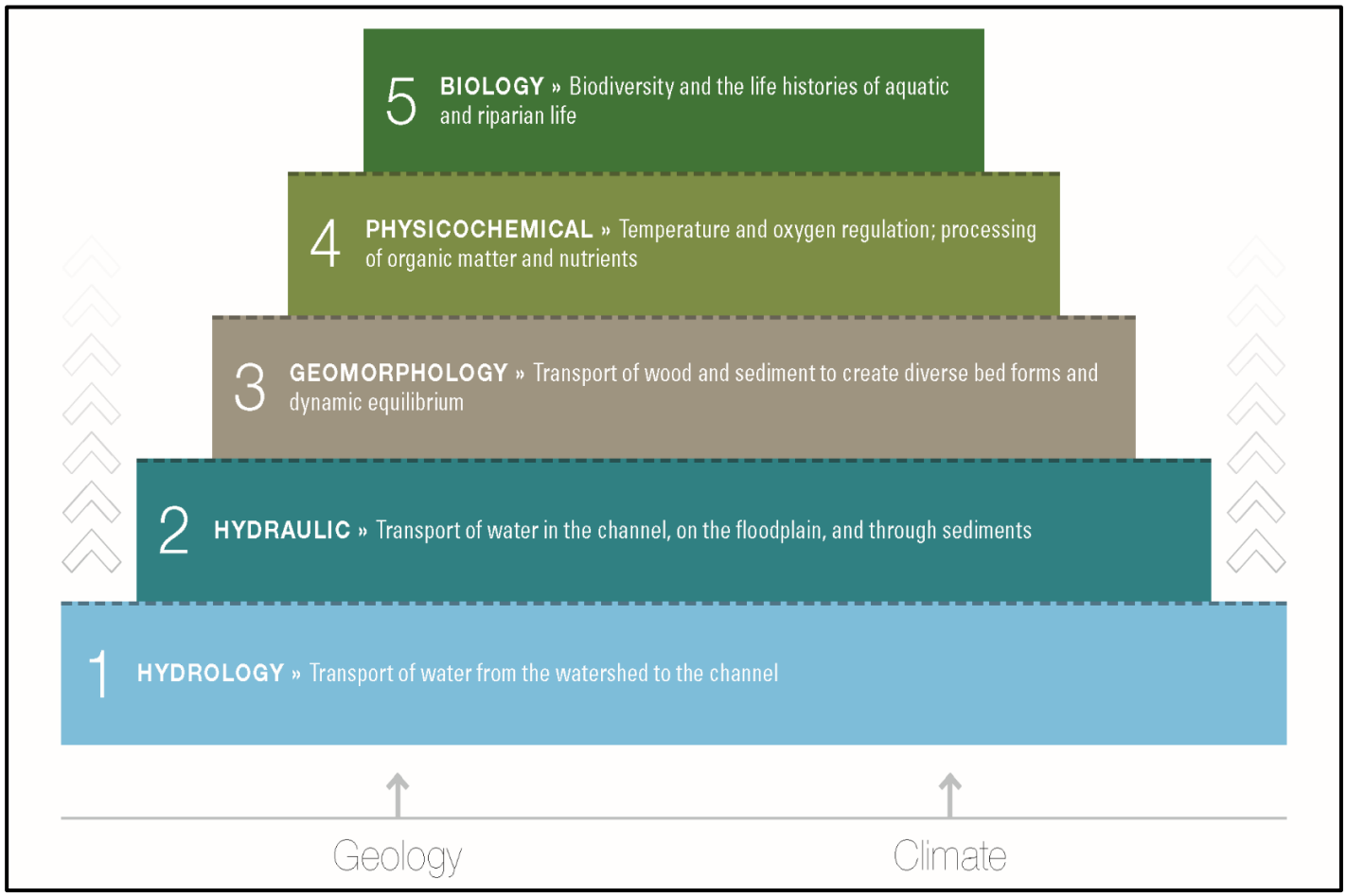
A Simplified Model of Ecological Recovery



The process of assisting in the recovery of an ecosystem that has been degraded, damaged or destroyed.
-Society of Ecological Restoration (SER)

Stream restoration, and all ecological restoration, seeks to increase the ecological function of the stream ecosystem and expedite its recovery. The graph above shows an "idealized" restoration where functions return to emulate an undisturbed condition. Restoration to a previous ecological state (i.e., historical condition) may not always be possible or even preferrable, and instead restoration may attempt to prioritize specific functions given the current watershed inputs and other constraints.

The Stream Function Pyramid

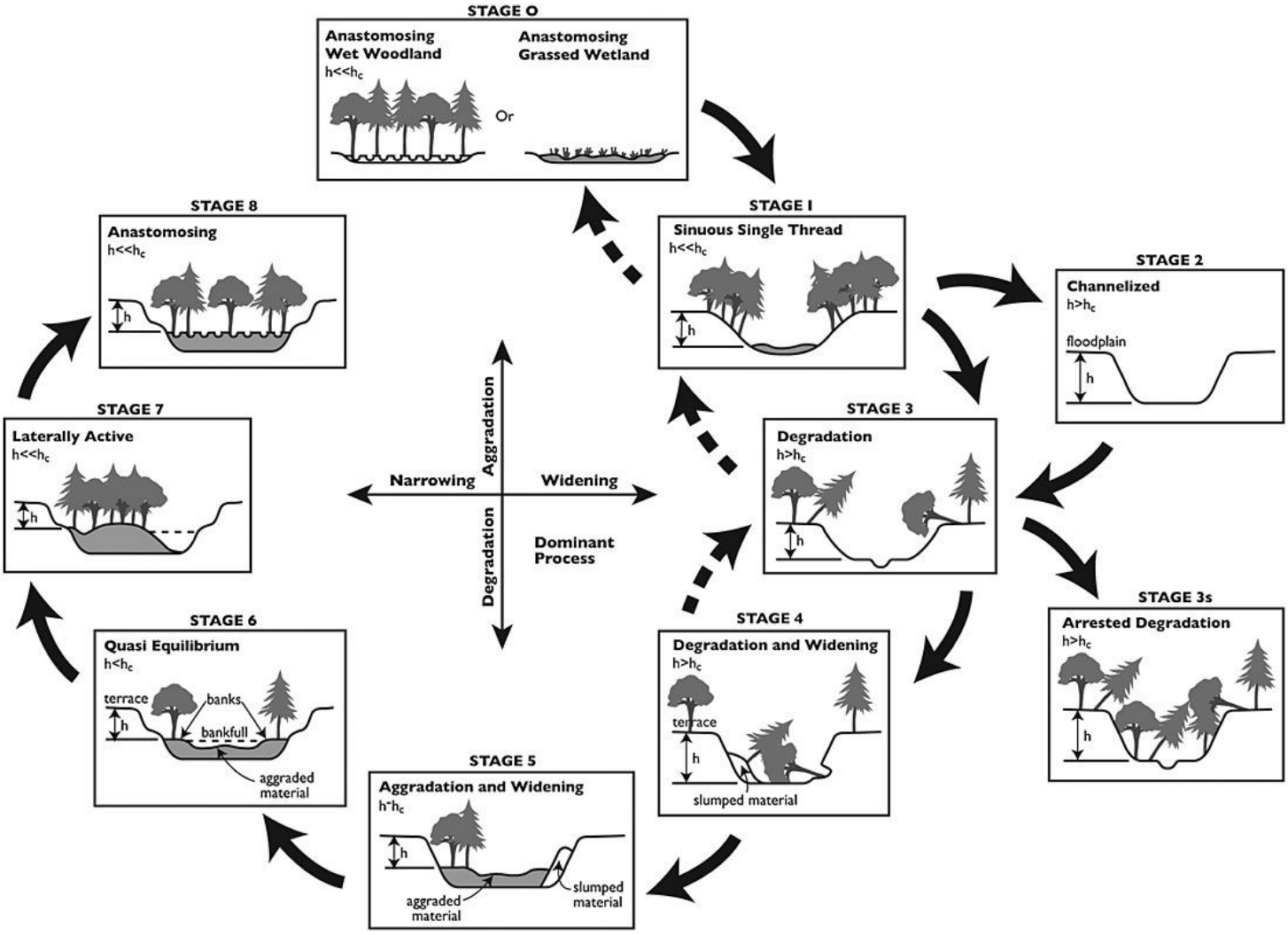


The Stream Function Pyramid is a useful conceptual hierarchy that shows how lower-level functions of stream corridors influence higher-level functions.

Reference:
Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. A Function-Based Framework for Stream Assessment and Restoration Projects. US Environmen-tal Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006.

https://www.epa.gov/cwa-404/function-based-framework-stream-assessment-and-restoration-projects-under-cwa-section-404

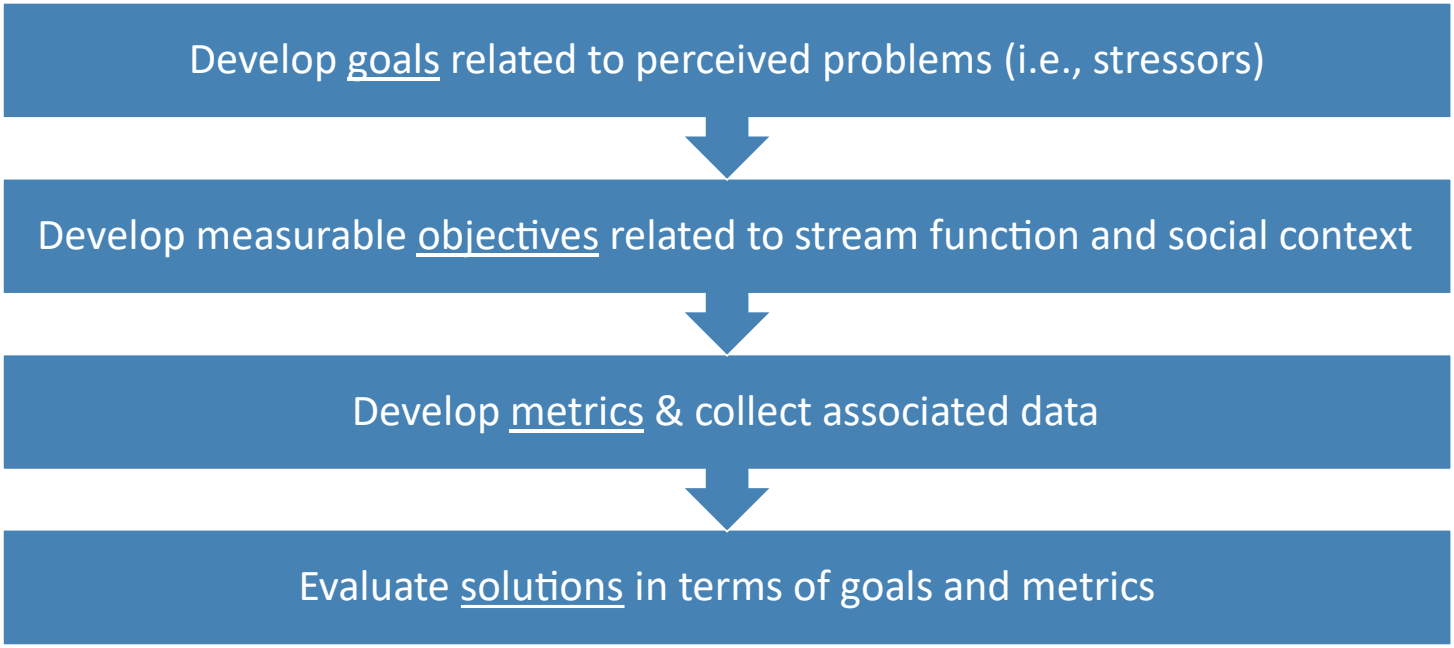
A Stream Evolution Model



The Stream Evolution Model is a conceptual model of stream process and morphological changes that follow disturbance through incision (i.e. vertical degradation). Understanding where a stream exists within this model can provide insight to its morphological and ecological trajectory. It can also provide help managers and practitioners determine the likely outcome of restoring to a particular channel form.

Reference:
Cluer, B. and Thorne, C., 2014. A stream evolution model integrating habitat and ecosystem benefits. River Research and Applications, 30(2): 135-154

A Framework for Stream Restoration Design



Stream restoration design frameworks vary in complexity, but most, at a minimum, involve the four steps shown in the graphic above. Creating broad goals for a potential project can help orient stakeholders and prompt additional questions about stressors and likely causes. While the above framework is shown as linear, it is typical that goals and objectives, and even metrics, may be iteratively defined and refined throughout the process. Inherent in this framework is the question of whether the solution will accomplish the stated goal, whether there are measurable objectives identified, and whether the metrics are appropriate in terms of methodology and resolution to validate the stressor pre and post restoration.

Reference:

NRCS, 2007a. Chapter 2: Goals, Objectives, and Risk. In: J. Bernard, J. Fripp and K. Robinson (Editors), Stream Restoration Design: Part 654 - National Engineering Handbook. United States Department of Agriculture - Natural Resources Conservation Service, Washington D.C., pp. 34

Wheaton J.M., Bennett S.N., Bouwes, N., Maestas J.D. and Shahverdian S.M. (Editors). 2019. Low-Tech Process-Based Restoration of Riverscapes: Design Manual. Version 1.0. Utah State University Restoration Consortium. Logan, UT. Available at: http://lowtechpbr.restoration.usu.edu/manual

Yochum, Steven E. 2018. Guidance for Stream Restoration. U.S. Department of Agriculture, Forest Service, National Stream & Aquatic Ecology Center, Technical Note TN-102.4. Fort Collins, CO.

Example of Stream Restoration Metrics

Environmental

- Riparian condition
- Erosion rate
- Instream habitat
- Trees
- Soil health

Regulatory

- Floodplain encroachment
- Sensitive features conflict
- Cultural resource conflict

Social

- Safety
- Recreation
- Aesthetics
- Restoration preference
- Economics

Physical

- Access
- Valley constraints
- Utility conflict
- Geology

Resilience

- Flow/Sediment Input
- Watershed condition
- Habitat connectivity
- Water storage

Stream restoration metrics are developed based on the goals and objectives of the project. As such, the example metrics above are not comprehensive and may include additional metrics or categories depending on the identified goals for a project. This list of metrics may be helpful to identify items for consideration. Each of these metrics would need to be defined further and specific methods of measurement determined. This allows a project's success to be predicted prior to project initiation and then to be validated post-restoration.