River Architect: baseline-condition and alternative-design assessment software to promote sustainability of eco-physical river systems

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Many procedures exist to assess historical and current intertwined ecological and physical conditions in rivers. Understanding the past provides general insights into potential future vulnerabilities. However, management and rehabilitation of rivers based on generalities has resulted in many failed projects and poor long-term outcomes for both ecological and physical metrics. It is imperative to develop a new generation of systematized methods that yield spatially explicit, high-resolution analyses of past, current and future conditions with equal attention. Given the natural complexity of rivers, this can only be achieved with deterministic and holistic modeling. To solve the holistic modeling challenge, we have developed River Architect ([https://riverarchitect.github.io](https://riverarchitect.github.io/)) – a free, peer-reviewed, open source Python-based toolkit with a graphical user interface that has a growing number of modules to aid assessment of both real and alternative design conditions, considering environmental flow regimes, flood resilience, and engineered biophysical rehabilitation. River Architect receives input from any two-dimensional hydrodynamic model, a variety of geospatial data files, user-adjustable spreadsheet templates with ecological and geomorphic data, and hydrological time series. It standardizes procedures for data preparation, management, and pre-processing so that all modules can function in a unified framework. The current suite of modules include (1) geomorphic lifespan/sustainability assessment for many eco-physical features (e.g., young and established vegetation, landforms, large wood, and boulders), (2) traditional 2D physical habitat suitability assessment/mapping, including provision of abundance statistics and time series analysis, (3) fish stranding risk assessment during flow recession, (4) cottonwood riparian recruitment potential assessment, (5) river design terraforming tools, and (6) project planning tools to scope out financial cost and produce preliminary construction plans. Most importantly, River Architect’s modular framework readily facilitates additional development from everyone. Contributors can focus on their new features without having to code their own back-end framework.