CHOOSING ONE STREAM RESTORATION ALTERNATIVE AMONG MANY

David L. Smith, Jeff B. Allen, John Nestler, Ruth Cheng, Andy Goodwin, Michele Gomez, Tammy Threadgill
BUILDING STRONG
LWD
side channel
riffle
riffle
pool
irrigation outflow
cascade
run
run
bar
2D/3D representation
Photo
Plan
Profile
Cameron Run, near Washington D.C.

30 cfs
Alternatives considered
Domain generation

2D tessellation from the Terrain Mesh Importer

Tessellation Plane, before the Conform 3ds Max Modifier

Newly conformed tessellated object, after application of the Conform Modifier

Original Texture, shown with a representative design alternative, before texture map projection.

Texture map being projected onto the conformed 3D Surface

Geometry sculpting of wing deflectors via texture map and NURBS
Domain features
Information from CFD – there is lots of it!

**N = 1257**
Mean = 0.749 m/s  
S.D. = 0.514 m/s  
Min = 0 m/s  
Max = 2.542 m/s

**N = 414**
Mean = 0.793 m/s  
S.D. = 0.363 m/s  
Min = 0 m/s  
Max = 1.238 m/s
Important Attributes of the ELAM
- temporal & spatial scaling of each process optimally simulated,
- information transformed as needed to meet requirements of linked processes,
- distribution of processes to frameworks partially function size of domain
- venue for inter/trans-disciplinary education & integration, and
- maximum fidelity to “real world” using “first principles”.
Biological model basis – translating high fidelity model output into decision metrics

- 38 species with two broad behaviors – migratory and foraging
- Metric – path length (in meters)
  - Migratory – best movement behavior is direct and path length is short
  - Foraging – best movement behavior is indirect and path length is long
animation
Results
Implementation of SHAPE for stream restoration design - Baltimore District

Project site → Conceptual design (one of six alternatives) → Model domain with features from conceptual design

Hydrodynamic output → Fish movement in CFD → Fish movement analysis as function of CFD and selection of an alternative

[Diagram with path length and migration/forage bars for alternatives A to F]
Key Takeaway Points

- 10% conceptual designs with no bathymetry, CAD designs or biological data were the basis of a mechanistic model
- Similar alternatives produced measureable differences in output
- Very limited assumptions or judgment required in analysis
- Clear options for improving model accuracy and precision
- Cost effective and able to be completed on a schedule
- Stakeholder briefing and acceptance at project beginning
- Developing a virtual reference condition would allow comparison of model outputs at Cameron Run with other studies on different systems