The Use of Natural Stream Channel Design in the Coalfields of Virginia

Geomorphic Reclamation & Natural Stream Design at Coal Mines

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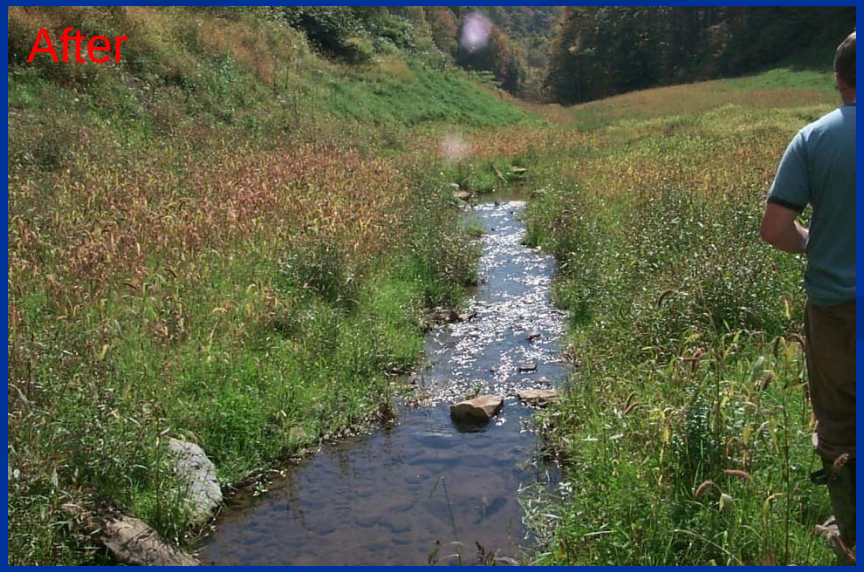
Evolution of Mitigation

- Aquatic resource mitigation plans prior to 2002 consisted of out-of-kind wetland creation and stream restoration
- Stream restoration designs used rip-rap armoring and dimensions based on 100 yr/6hr storm event
- D.R. Allen began using NSD techniques in VA coalfields in 2002

Stream Mitigation Plans

- Goals and Objectives
  - Offset impacts from mining
  - Restore impacted streams to a proper dimension, pattern, and profile
  - Emphasis on restoration of stream and riparian habitats



Design Summary

- Design x-sectional area and bankfull flow based on D.R. Allen & Associates observed field data from stable streams in southwest Virginia
- Compare with VA Ridge & Valley, NC Mountain, and Eastern Regional curve data
- Design parameters based on dimensionless ratios calculated from a reference reach of the same stream type

Dimensionless Ratios

- Pool Depth/Riffle Depth
- Pool Width/Riffle Width
- Max Pool Depth/Mean Bankfull Depth
- Riffle Slope/Avg. Water Surface Slope
- Pool Slope/Avg. Water Surface Slope
- Riffle Max Depth/Mean Bankfull Depth
- Pool Length/Bankfull Width
- Pool to Pool Spacing/Bankfull Width

Laurel Branch

January 2005

- Lower reach of stream channel is trapezoidal rip-rap channel
- Mouth of stream channel had a steep slope (~35-40%), acting as a barrier for fish migration

Site History – Upper Reach

January 2005

- Upper reach of stream channelized due to fill placement from construction of nearby railroad tunnel, circa 1955
- Minimal or non-existent flood plain has resulted in areas of excessive erosion and lack of habitat

Channel Construction

Looking downstream at fill removal effort

- Reconfigure upstream fill to construct new flood plain
- Construct new stream channel adjacent to old channel

Channel Construction

Construction of cross vane and pool

Before/After Comparison

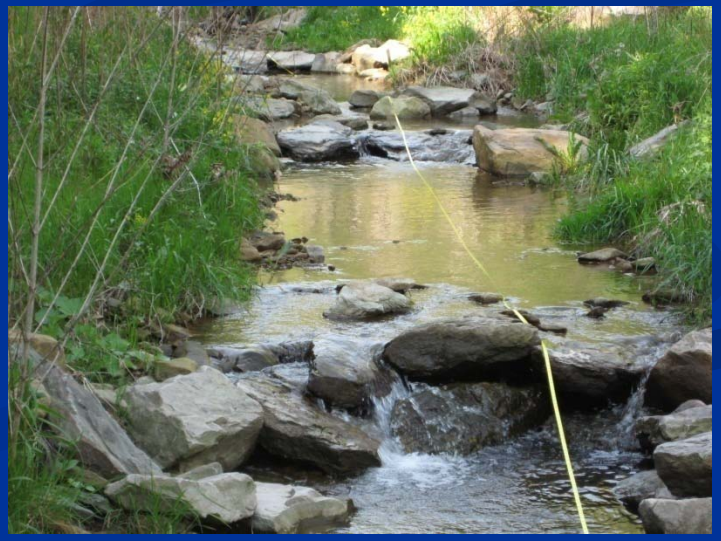
Chaney Creek

- Design Criteria
  - 1.6 sq. mi. drainage area
  - Stream Type B3, B3c, B3a
  - Slopes 1% - 6%
  - Width/Depth Ratio 10 – 13
  - Sinuosity 1.2 – 1.3
  - Bankfull Width 13.3 – 15.2
  - Max Pool Depth 3.0 – 3.5
  - Pool Length 14.7 – 25.9
  - Max Riffle Depth 1.4 – 1.7
  - Pool Spacing 26.6 – 53.2

Chaney Creek

Cane Creek

- Design Criteria
  - 2.9 sq. mi. drainage area
  - Restored on old fill
  - Stream Types B4 & C4
  - Slopes 0.25% - 3%
  - Width/Depth Ratio 10 – 30
  - Bankfull Width 11 – 15
  - Max Pool Depth 2 – 3 ft.
  - Pool Length 8 – 80 ft.
  - Max Riffle Depth 1.0 ft.
  - Pool Spacing 19-140



Riparian Corridor Establishment

Restoration Monitoring

Monitoring Event	Walk & Photograph	As-Built Survey	Fluvial Geomorphic Survey	Benthos	Fish	Riparian Zone Success
Immediately After Construction	X	X	-	-	-	-
Year 1	X	-	X	X	X	-
Year 2	X	-	-	X	X	-
Year 3	X	-	X	X	X	X
Year 4	X	-	-	X	X	-
Year 5	X	-	X	X	X	X

Monitoring Results

Laurel Branch						
Year	**MBI**	**Cond.**	**Habitat**	**Fish (#species)**	**Trees /acre**	**EKSAP**
2006	0.48	729	166	231 (3)	-	0.50
2007	0.52	768	166	547 (3)	750	0.51
2008	0.58	725	167	95 (3)	710	0.54
2009	0.66	452	173	94 (3)	1140	0.62
Chaney Creek						
2007	0.54	622	169	156 (5)	700	0.52
2008	0.59	500	181	89 (6)	-	0.56
2009	0.66	455	183	171 (6)	-	0.62

Fisheries Data

Species	Catch
Chaney Creek	
blacknose dace (*Rhinichthys atratus)*	**104**
pumpkinseed *(Lepomis gibbosus*)	**1**
bluegill (*Lepomis macrochirus*)	**1**
bluntnose minnow (*Pimephales notatus*)	**1**
central stoneroller (*Campostoma anomalum*)	**45**
creek chub (*Semotilus atromaculatus*)	**19**
Laurel Branch	
central stoneroller (*Campostoma anomalum*)	**6**
creek chub (*Semotilus atromaculatus*)	**5**
blacknose dace (*Rhinichthys atratus)*	**83**

Family Level Macroinvertebrate Data

- Laurel Branch
  - Perlodidae – 35
  - Perlidae – 3
  - Baetidae – 2
  - Ephemerellidae – 1
  - Limnephilidae – 3
  - Hydropsychidae – 25
  - Elmidae – 3
  - Chironomidae – 1
  - Corydalidae – 4
  - Tipulidae - 5
- Chaney Creek
  - Perlidae – 13
  - Nemouridae – 44
  - Chloroperlidae – 3
  - Peltoperlidae - 1
  - Baetidae – 2
  - Heptageniidae – 5
  - Limnephilidae – 1
  - Hydropsychidae – 36
  - Psephenidae - 9
  - Elmidae – 2
  - Chironomidae – 4
  - Corydalidae – 4
  - Tipulidae – 4
  - Oligochaeta – 1
  - Gomphidae - 1