Can Appalachian Mine Reclamation Be Called Sustainable Using Current Practices?

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Geomorphic Reclamation and Natural Stream Design at Coal Mines
Bristol, Virginia

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Who has *Natural Regrade* worldwide?
Economic competition demands most efficient use of resources

• Coordinating mine development, operational, and closure plans adds efficiency

• Leads to *land use sustainability*
‘Land Use Sustainability’

definitions share recognition of the need to maintain:

*environmental* functions related to landforms when conducting

*economic* development activities for the benefit of

*future users* of the land.

“The triple bottom line”

- Rajaram, V., Dutta, S., Parameswaram, K., 2005
What are traditional design criteria?

- Smooth surfaces
- Route water away
- Minimize footprint
If you don’t add *drainage density*, nature will!!
constant gradient
no drainage density
Slope is creeping, landslide beginning
Will these houses be buried?
Knickpoints can be BIG problems
One storm corrects longitudinal profile!
Terraces can be expensive to build and maintain (if you don’t see it in nature, don’t do it!)
Something just tells you it isn’t right . . .
Coal mine reclamation in the region

“... has not been accompanied by widespread replacement of forests disturbed by mining.”

- Appalachian Regional Reforestation Initiative (ARRI)
Traditional Reclamation Landforms:

• fewer ecological niches = *monoculture*

• or worse, are *unsuitable* for the desired species while inviting *invasive* species
Natural Regrade module with GeoFluv™ (Patent Pending)

The GeoFluv™ approach asks,

What would be a stable, natural landform?

and designs and builds that
GeoFluv landform has diversity similar to the native, undisturbed land

• provides the optimal niches for native species productivity

• simultaneously provides natural invasive species control

• promotes suitable water quality
What other requirements are related to sustainable landform design?

- Free from maintenance, ‘forever’
- NPDES storm water discharge (sediment)
- Vegetation composition & diversity
- COE 404 permit
- Stream ‘mitigation’
- Prove stability against erosion, ‘forever’
- Post-mining land use
- Low cost to achieve these criteria
- Bond release
View of “A” channels and ridges designed using Natural Regrade, to replace constant 3:1 slope.
GeoFluv design and natural
Rip-rap downdrains blow out repeatedly.
GeoFluv™ landform and existing quarry

three days of rain; no problems

a mountaintop removal?
Dept. of Interior “National” and “Best of the Best” 2004 reclamation awards

There is something new happening in landform design. It’s the future. It’s natural. Be a part of it.
Before *Natural Regrade* GeoFluv design

– Dan Hause, Indiana AML
After *Natural Regrade* GeoFluv design
Mid Continent Regional Award
- Log Creek Church AML, *Indiana DNR*

- sequestered >70 acres of acid producing waste
- established forested wetlands
- *sustainable* geomorphic stream channels and upland areas
- natural slopes replaced 4,000 feet of highwall
highwall to ‘wildlife enhancement feature’
(~370,000 cubic yards not moved)
Storm Water Total Suspended Sediment at Native and GeoFluv-designed sites

7 OCT 2007 Sample Site

TSS mean value (mg/L)

- native
- graded spoil
- topsoiled
- veg started
Contoured at 0.2 foot contour interval, vertices densified to enhance 3D view detail of RIVERMorph riffles and pools.
GeoFluv data on channel 'Denver Gulch'
Station (ft.): 868.72
Watershed area (ac.): 11.84
Bankfull Qpk (cfs): 6.38
Bankfull width (ft.): 4.26
Bankfull depth (ft.): 0.34
Flood prone width (ft.): 8.97
Flood prone depth (ft.): 0.93
Slope at station: -3.81%
Flood prone area (sq.ft.): 4.90
Bankfull area (sq.ft.): 0.99
Bottom width (ft.): 1.53
Right side slope: 26.41%
Left side slope: 23.92%
GeoFluv data on channel 'Denver Gulch'

Station (ft.): 907.35
Watershed area (ac.): 13.08
Bankfull Qpk (cfs): 7.04
Floodprone Qpk (cfs): 23.48
Bankfull width (ft.): 4.49
Bankfull depth (ft.): 0.36
Flood prone width (ft.): 9.50
Flood prone depth (ft.): 0.98
Slope at station: -3.74%
Flood prone area (sq.ft.): 5.47
Bankfull area (sq.ft.): 1.10
Bottom width (ft.): 1.62
Right side slope: 19.83%
Left side slope: 33.63%
Material Cut / Fill Centroids
# Cut & Fill Centroid Report

**Original Ground:** C:\Documents and Settings\Nicholas\Desktop\Materials\GCP\Project\Name\6\Original.dtm

**Design Surface:** C:\Documents and Settings\Nicholas\Desktop\Materials\GCP\Project\Name\6\Design.dtm

**Cut/Swell factor:** 1.0000

**Fill/Shrink factor:** 1.0000

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# Earth Movement Report:

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Grade Operator Screen with three views
What about steep mountain terrain and valley fills?
Undisturbed mountain landform
Mountain top removal
Mountain top removal with traditional valley fill
What is a natural analogy?
Stream re-routed to side of valley
One possible GeoFluv valley fill
GeoFluv -designed mountain top and valley fill
GeoFluv - designed mountain top and valley fill
Can this provide sustainability?
Highwall and contour mining alternatives?
A stable GeoFluv alternative for highwalls and contour mining

July 2006 received ~ 200-yr, 3-hr event
3D GeoFluv design in Natural Regrade
3D GeoFluv design in *Natural Regrade* provides *environmental* functions related to landforms when conducting *economic* development activities for the benefit of *future users* of the land

“*The triple bottom line*”
GeoFluv-designed waste dump reclamation

Natural Regrade
GeoFluv channel and uplands
There is something new happening in landform design.

It’s the future. It’s natural.

Be a part of it.