Carlson Natural Regrade module with GeoFluv™ (Patent Pending)

The new computerized fluvial geomorphic approach to land reclamation

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Drawings and many photographs used in this talk are from these sources:

- Rosgen, D., 1996. **Applied River Morphology,** Wildland Hydrology, Pagosa Springs, Colorado, fig. 2-1, 2-7, 4-2, 4-22, 5-3, 5-15, 5-79, 5-161, 5-185.

- Bloom, A.L., 1978. **Geomorphology, a systematic analysis of late Cenozoic landforms,** Prentice Hall, New Jersey, p. 270.

Natural Regrade module with GeoFluv™ (Patent Pending)

- What is this new module?
- Why did we create this new module?
- How many of these new modules can ***I*** sell?

Natural Regrade module with GeoFluv™ (Patent Pending) is a new approach to designing landforms for disturbed lands

- Land developers, highway contractors, mining companies, etc. are <u>required</u> to grade the land to control storm water and minimize erosion

- People are demanding that this work is done to a higher standard

Land is filled, natural drainage is destroyed

Disturbed land is graded to “control” storm water

Storm water is controlled, but results don’t satisfy all needs

‘Good Enough’ isn’t anymore;

make your designs great, naturally.

Natural Regrade module with GeoFluv™ (Patent Pending)

"EPA would give more leeway to an innovative natural approach that would try to mimic natural conditions."

- John Tinger, EPA Region 9

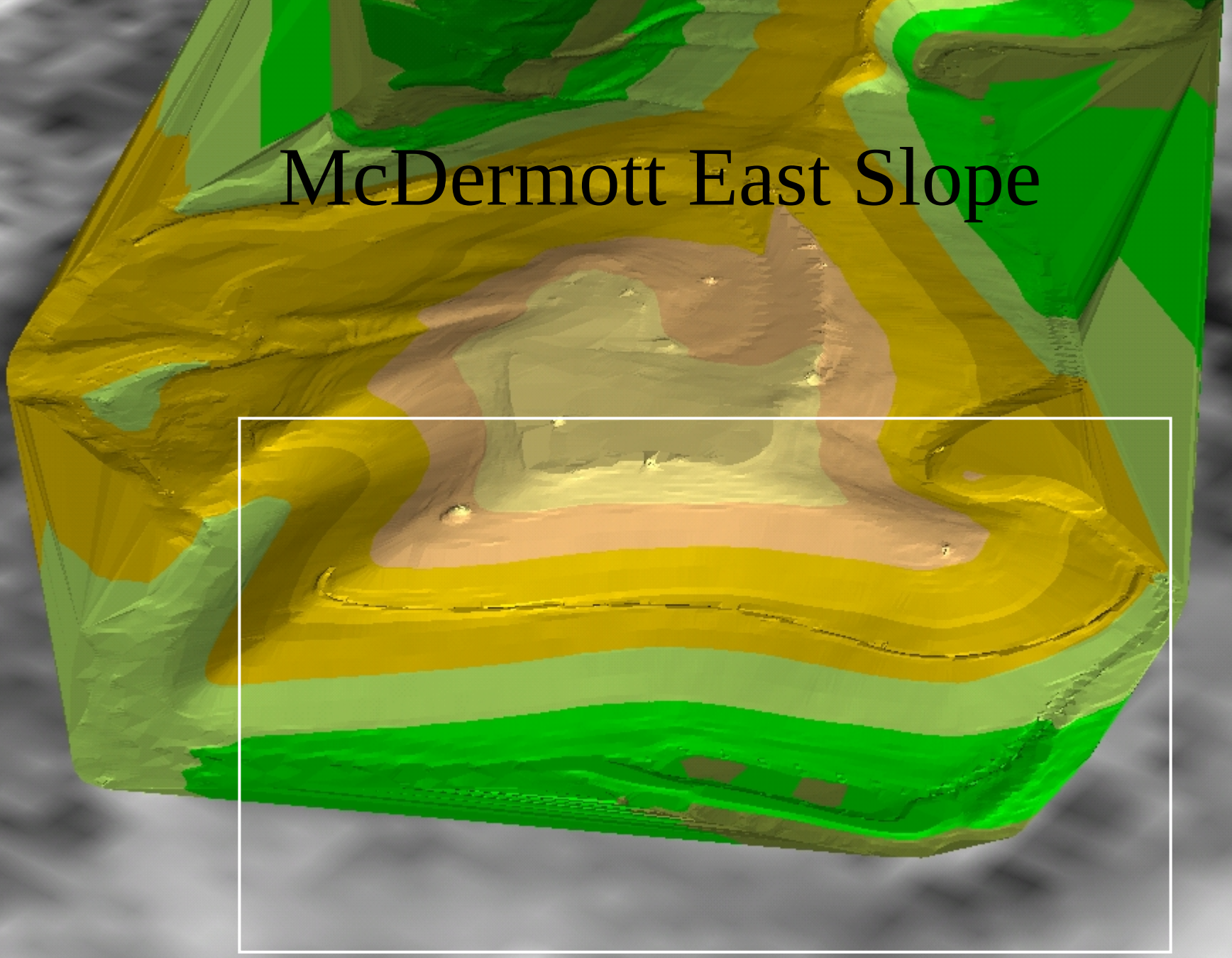
12 August 2003

Mining is another land-disturbing activity

Reclamation Grading Goals

- Provide long-term stabilization for steep slopes and drainages
- Provide great topographic diversity to enhance plant and wildlife opportunities
- Promote reclamation bond release

McDermott East Slope



East Face of McDermott Out-Of-Pit Dump spoil dump reclamation using conventional slope reclamation practice and rip-rapped channel design.

Gradient Terrace East Slope 1998 Reclaim

Conventional steep slope reclamation did not meet goals

- Terrace and down-drain structures can require long-term maintenance
- Terraced slopes do not provide desired topographic diversity
- Potential for recurrent failure and regular maintenance may interfere with bond release

"Crooked streams are a menace to life and crops in the areas bordering their banks. The twisting and turning of the channel retards the flow and reduces the capacity of the stream to handle large volumes of water. Floods result. Crops are ruined. Lives are lost….take the kinks out of crooked streams….Dupont dynamite has straightened many thousands of miles of crooked streams…."

- Dupont advertisement, 1935

Traditions Die Hard.

Natural Regrade module with GeoFluv™ (Patent Pending)

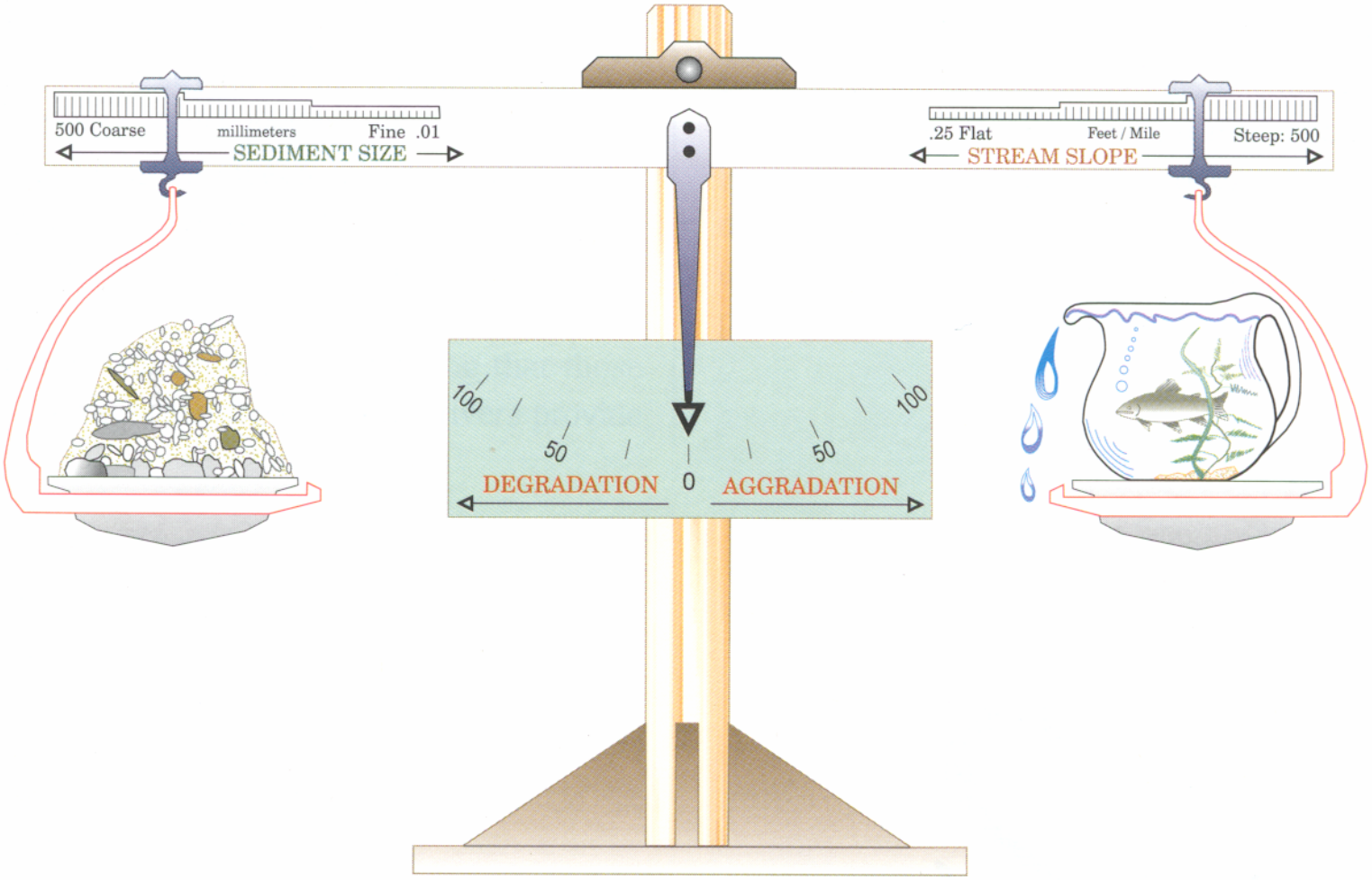
The *GeoFluv™* approach asks ,

What would be a stable, natural landform?

and designs and builds that.

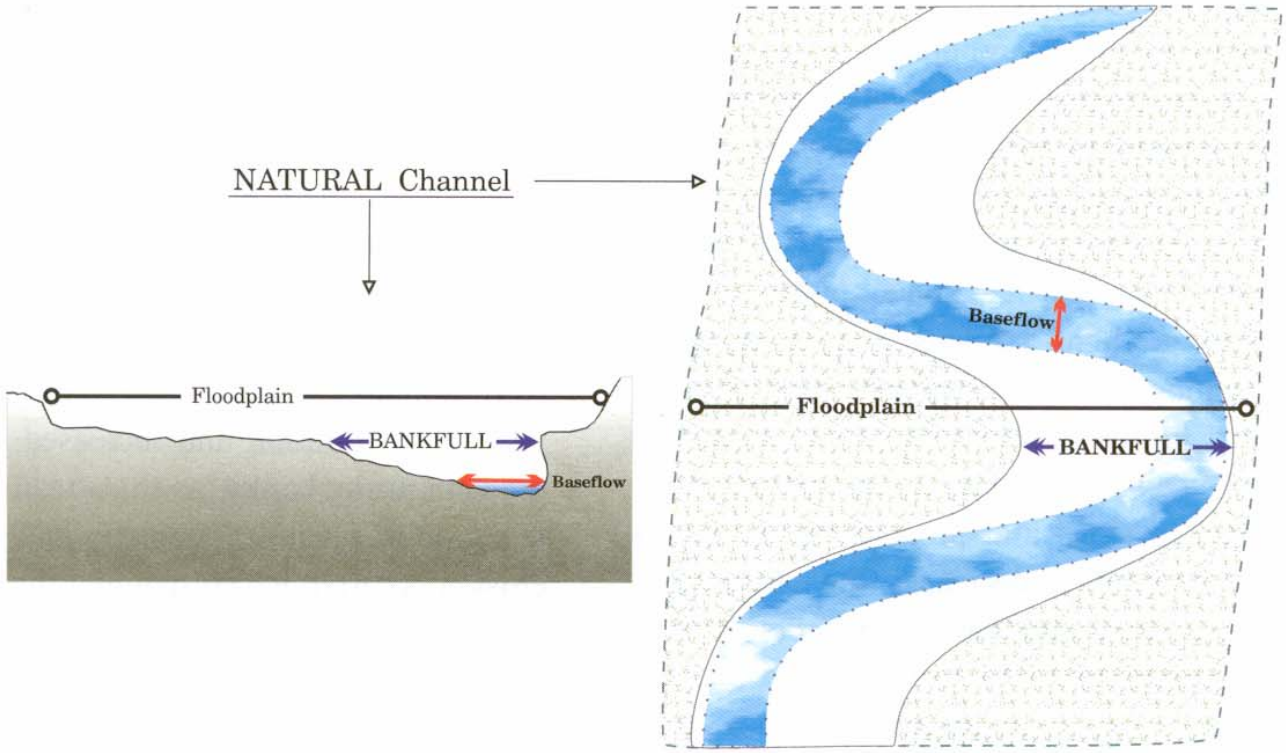
Hydrologic Balance

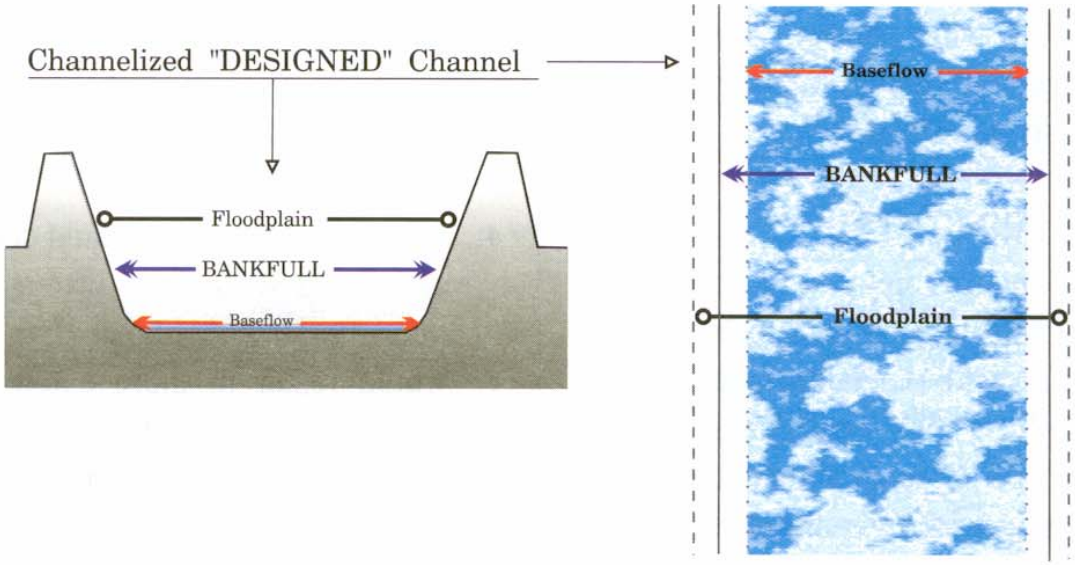
- **What does this mean for stream channels?**



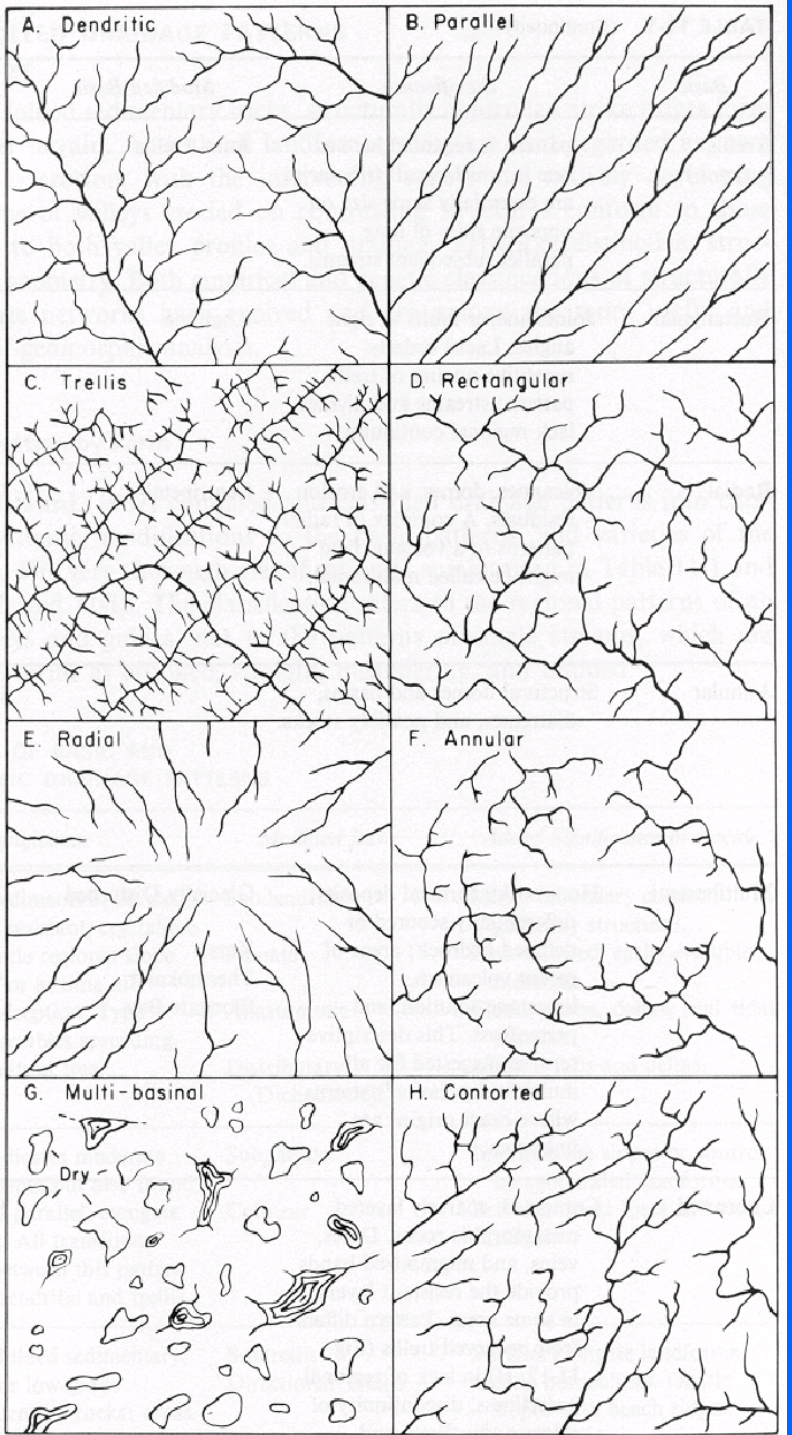
(Sediment LOAD) x (Sediment SIZE) $\propto$ (Stream SLOPE) x (Stream DISCHARGE)

Bankfull width is a critical channel dimension.


NATURAL Channel
Floodplain
BANKFULL
Baseflow
Baseflow
Floodplain
BANKFULL


Channelized "DESIGNED" Channel
Floodplain
BANKFULL
Baseflow
Baseflow
BANKFULL
Floodplain

Channel pattern and drainage density varies.


A. Dendritic
B. Parallel
C. Trellis
D. Rectangular
E. Radial
F. Annular
G. Multi-basinal
Dry
H. Contorted

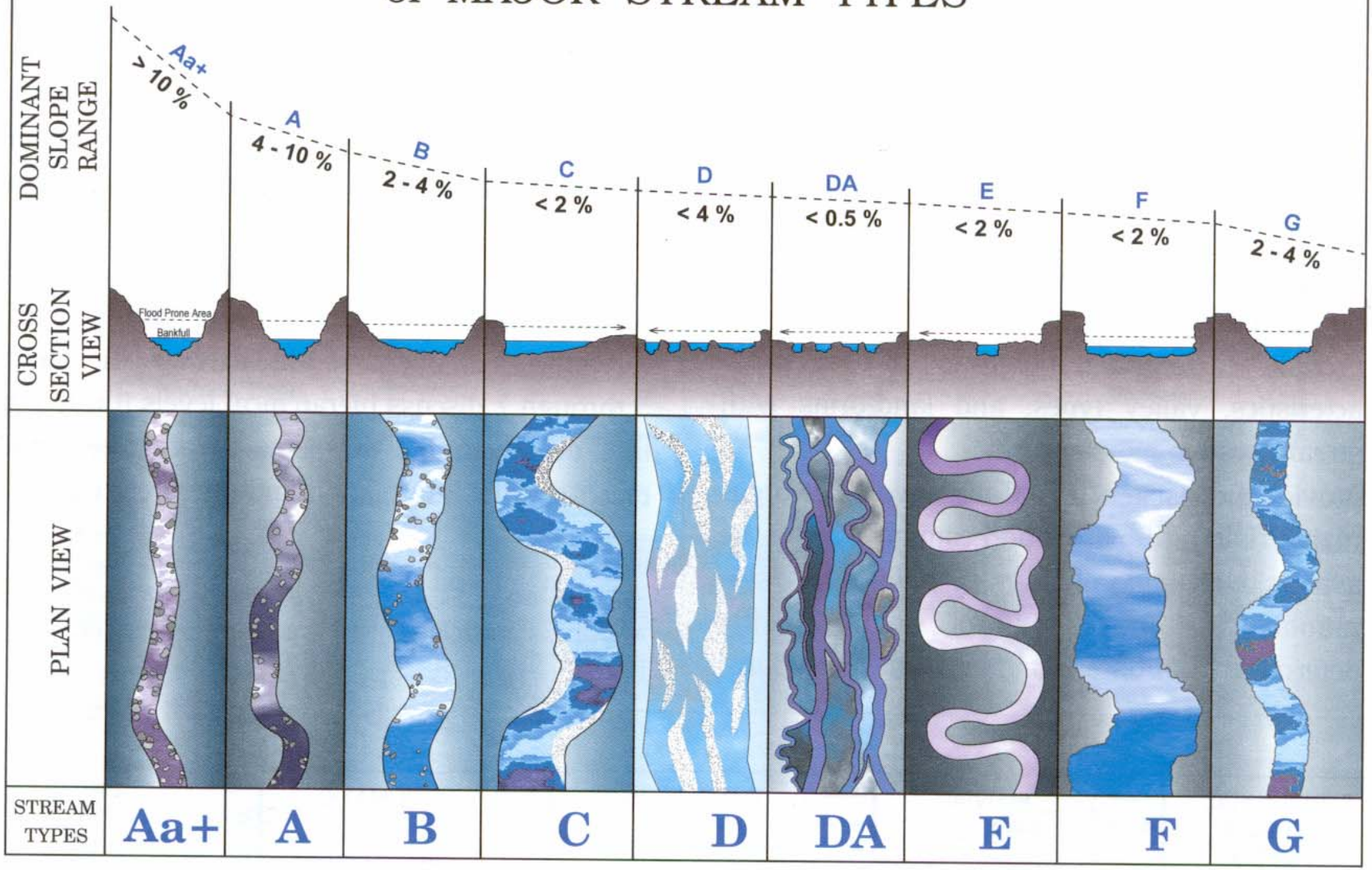
Drainage density

Different types of channels have different critical dimensions.

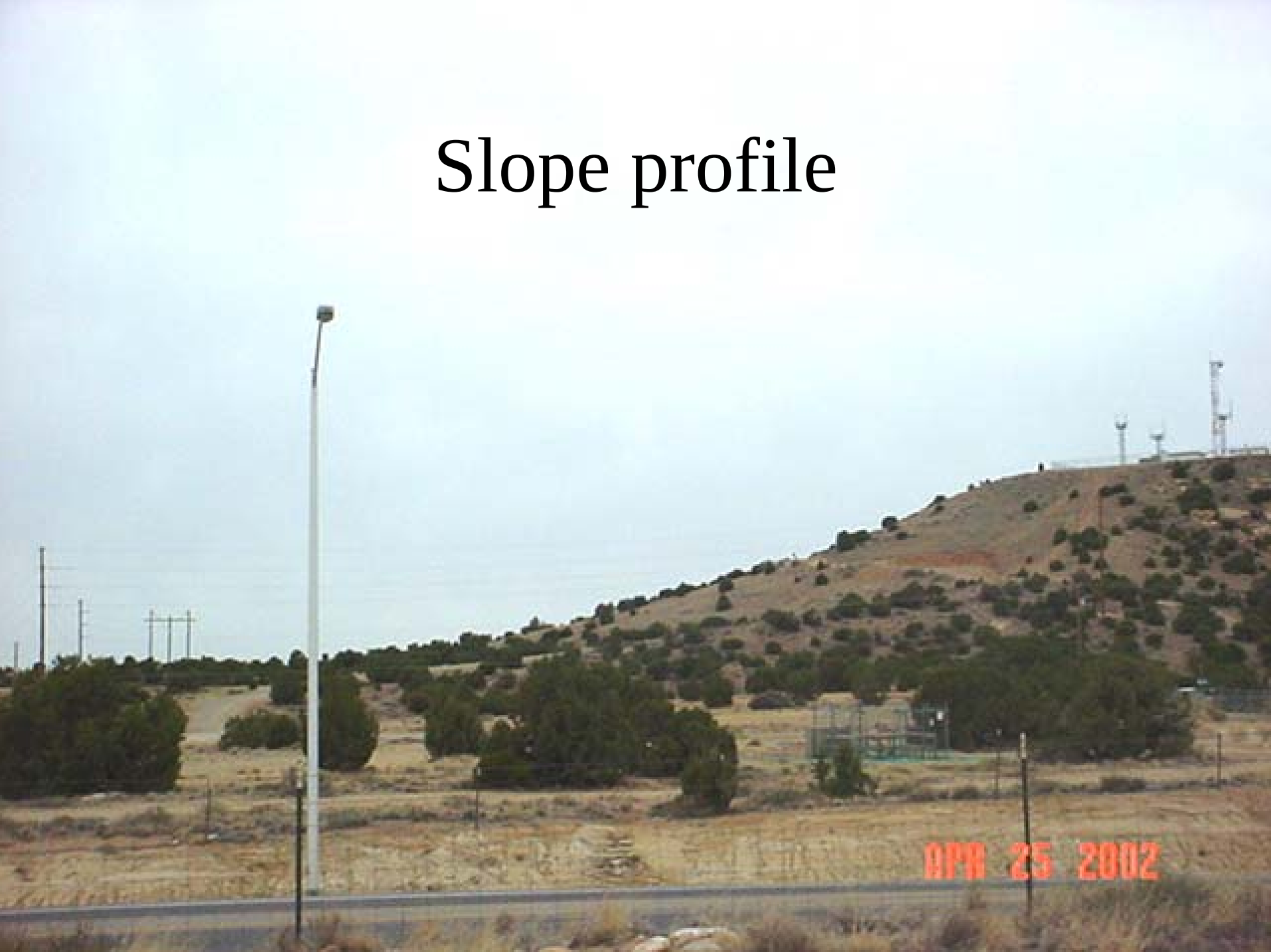
- Channel Cross Section
- Slope
- Sinuosity
- et cetera

- These interrelated factors are defined for different channel types.

LONGITUDINAL, CROSS-SECTIONAL and PLAN VIEWS of MAJOR STREAM TYPES



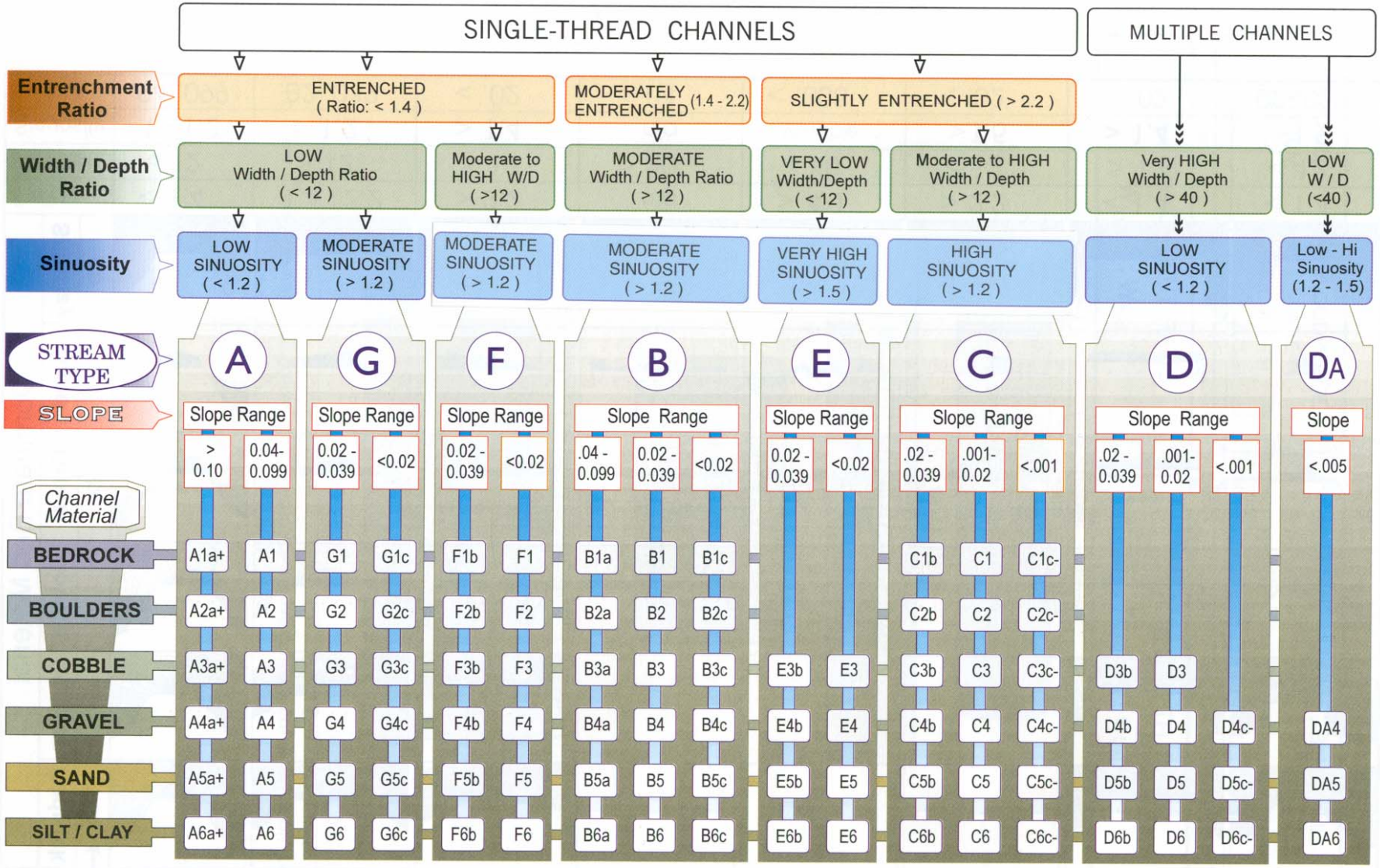
Slope profile



Regularity of natural drainage density and slope profile

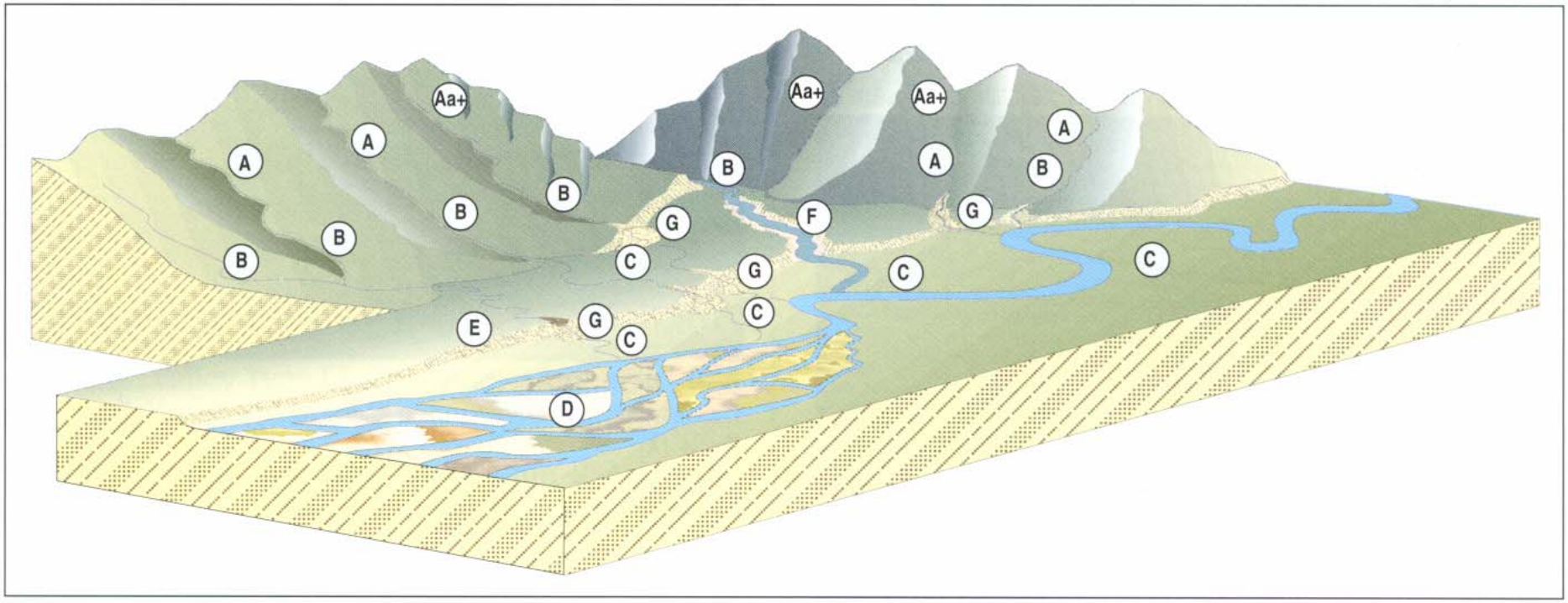
Natural channels are not all the same because:

- drainage areas vary
- slopes vary
- channel types vary
- channel bed materials vary



KEY to the *ROSGEN* CLASSIFICATION of NATURAL RIVERS. As a function of the "*continuum of physical variables*" within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

Different channel types are stable in different places.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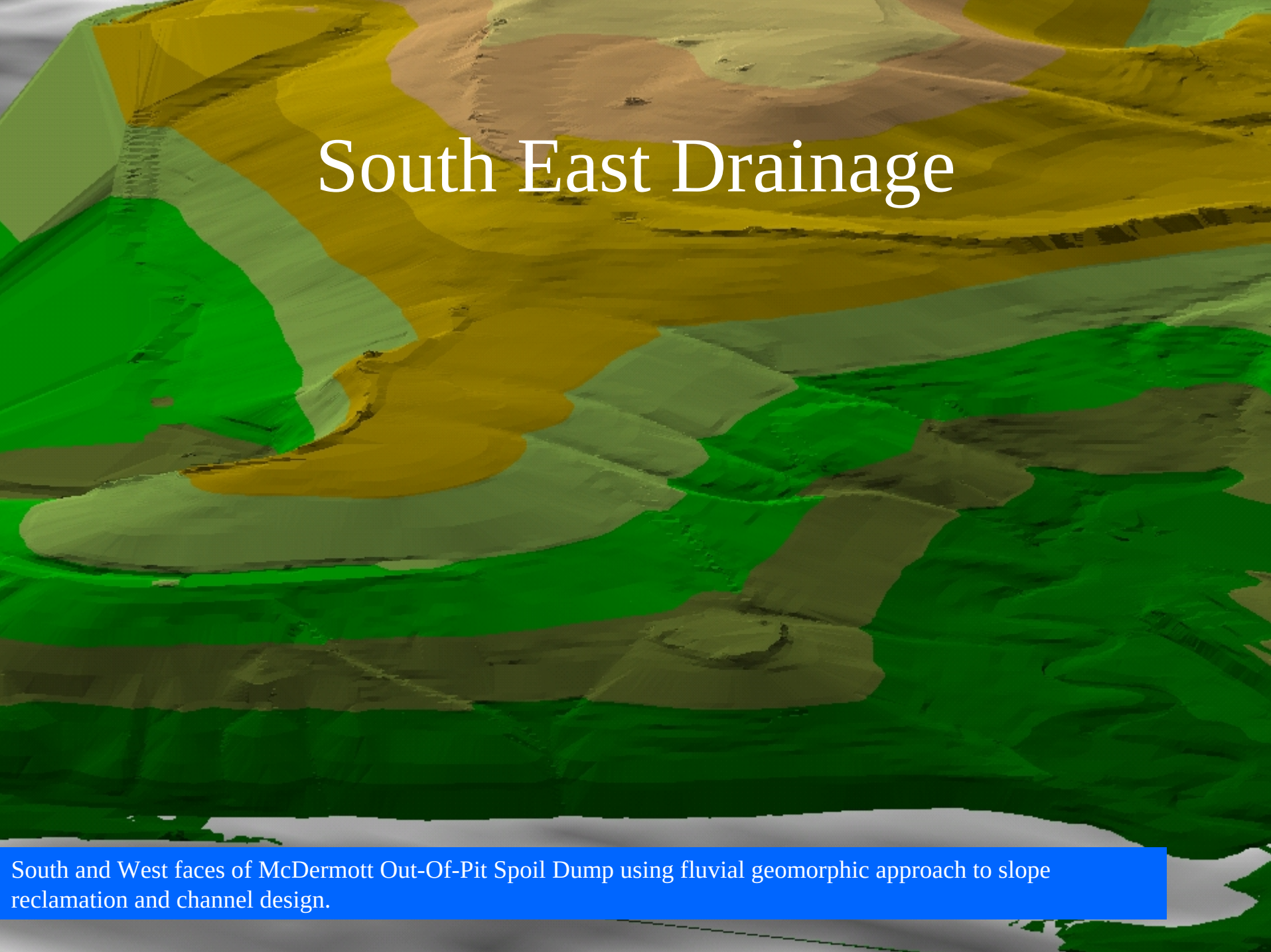
landforms grade into each other
APR 24 2002

Fluvial geomorphic principles applied to La Plata out-of-pit waste dump



South and West faces of McDermott Out-Of-Pit Spoil Dump using fluvial geomorphic approach to slope reclamation and channel design.

McDermott Dump, La Plata Mine
5. 21. 2001

JUN 25 2003

HP

Fluvial geomorphic principles applied to Cottonwood Reclamation

Gradient Terrace and Downdrain Approach to Steep Slope Reclamation

- High cost to construct
- High cost maintenance
- Doesn’t satisfy all reclamation goals
- Bond release uncertainty

Fluvial Geomorphic Approach to Steep Slope Reclamation

- Cost only 65% of constructing same area using gradient terraces and downdrain
- No maintenance
- Satisfies reclamation goals better
- Bond release more certain

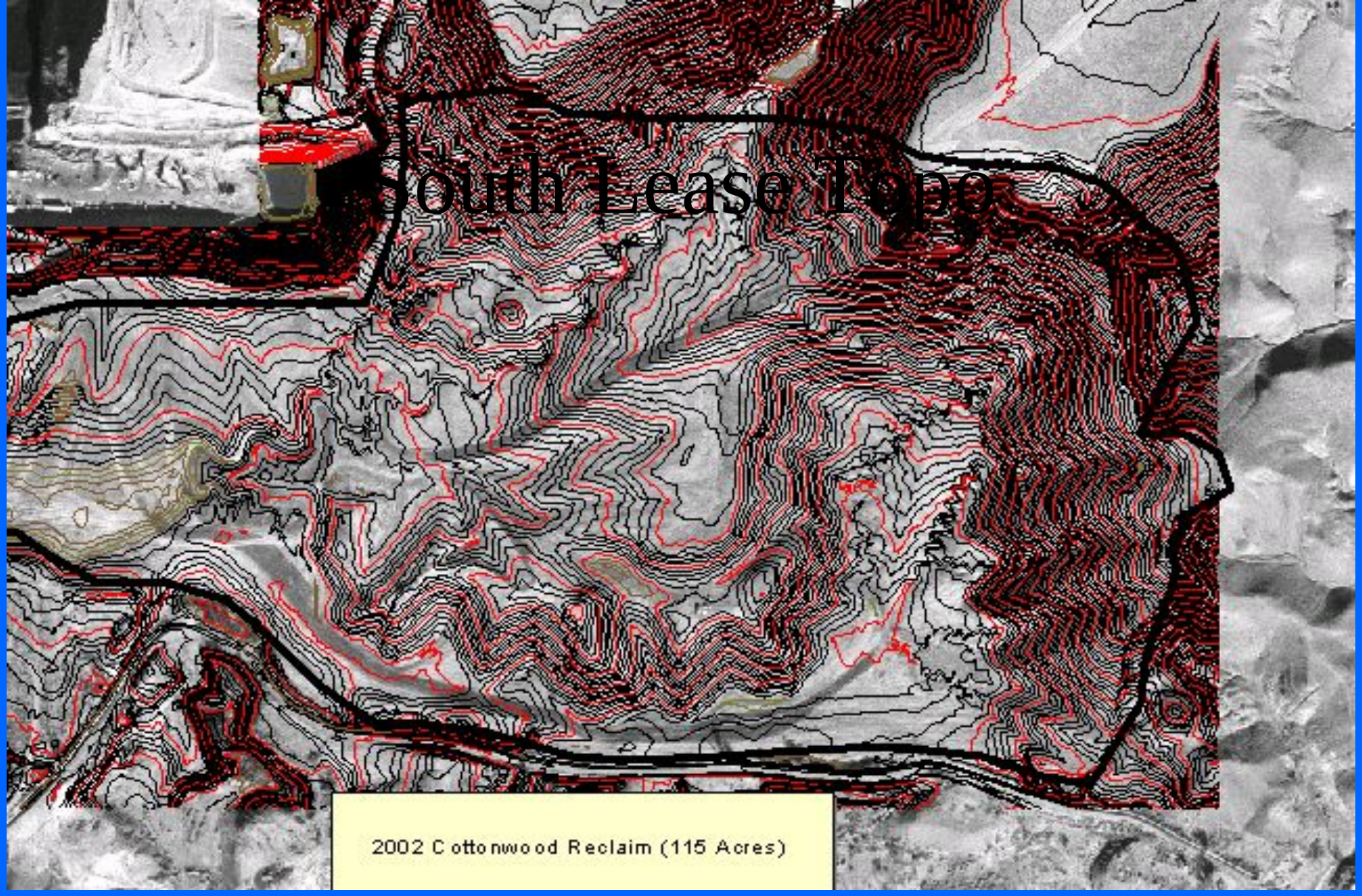
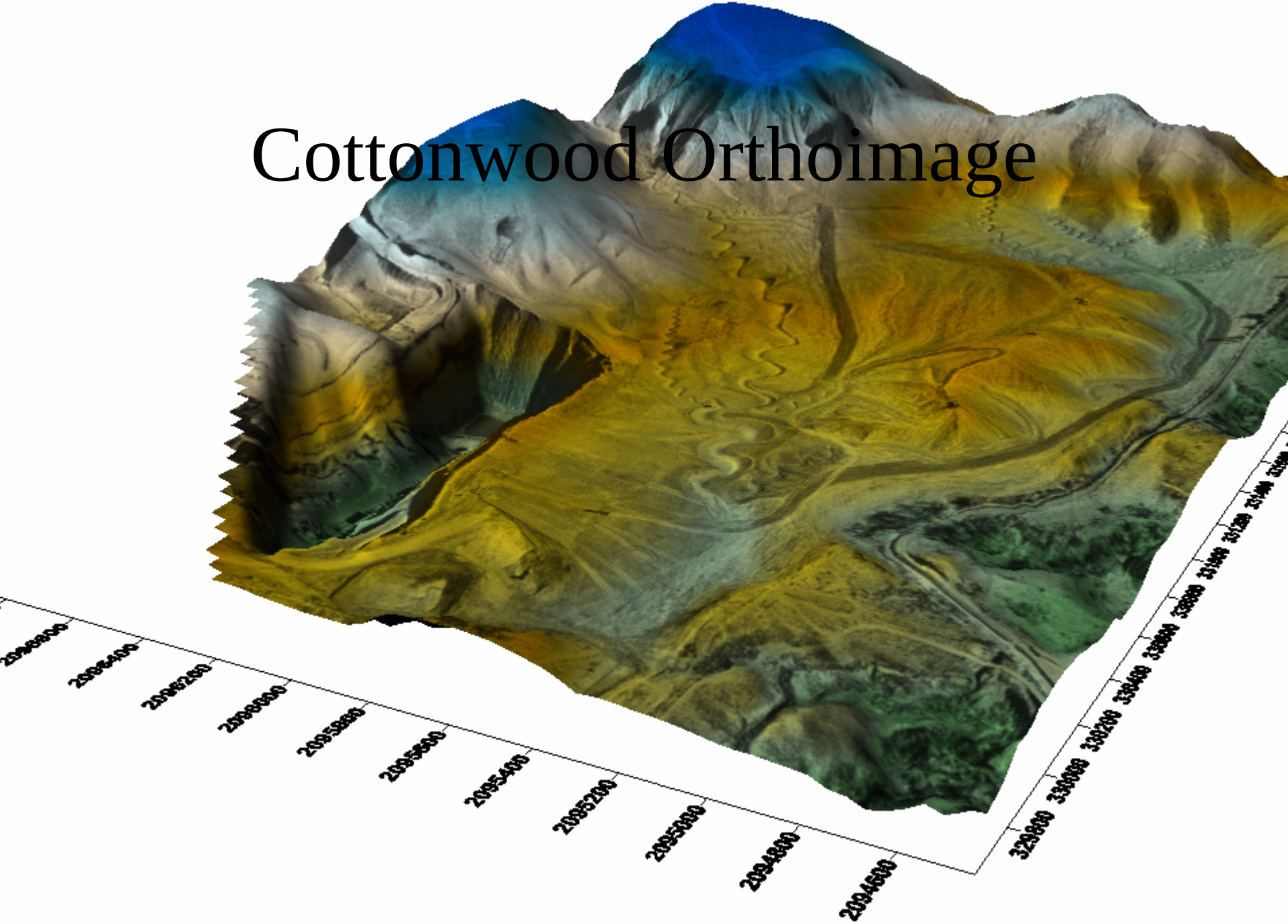


Photo 3: Successful application of geomorphic and hydrologic reclamation grading techniques to San Juan Mine dragline reclamation.

Cottonwood Orthoimage



There is something new happening in landform design. It's the future. It's natural. Be a part of it.

AUG 19 2002

Fluvial Geomorphic Approach

Computer

(Carlson)

GPS/Machine Control

(APS)

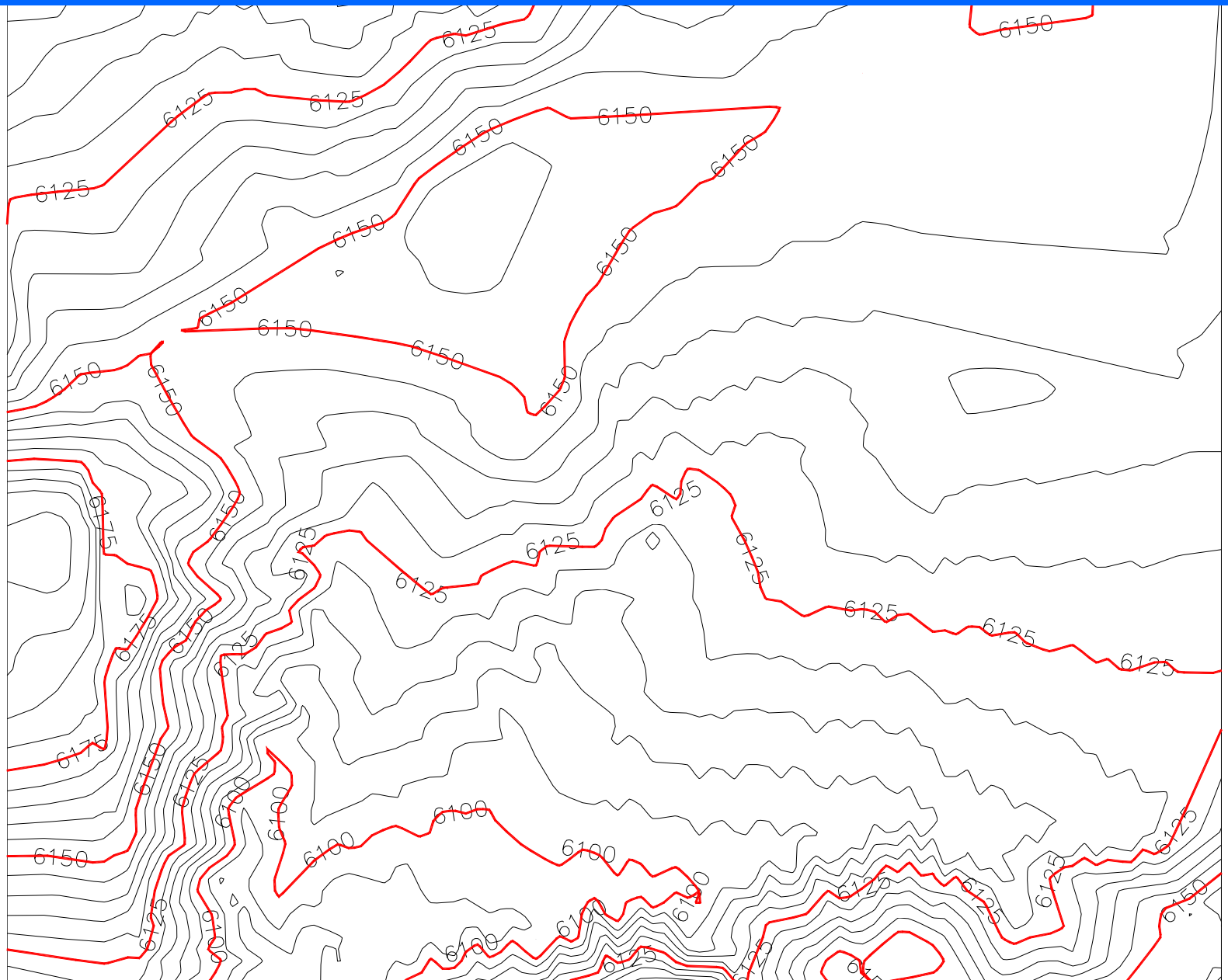
Efficiently create stable landscape

- Computer design /electronic surface output
- GPS-guidance
- Machine control
- Bench plan

Carlson®

APS

Fluvial geomorphic final surface configuration designed using computer and electronically output to field equipment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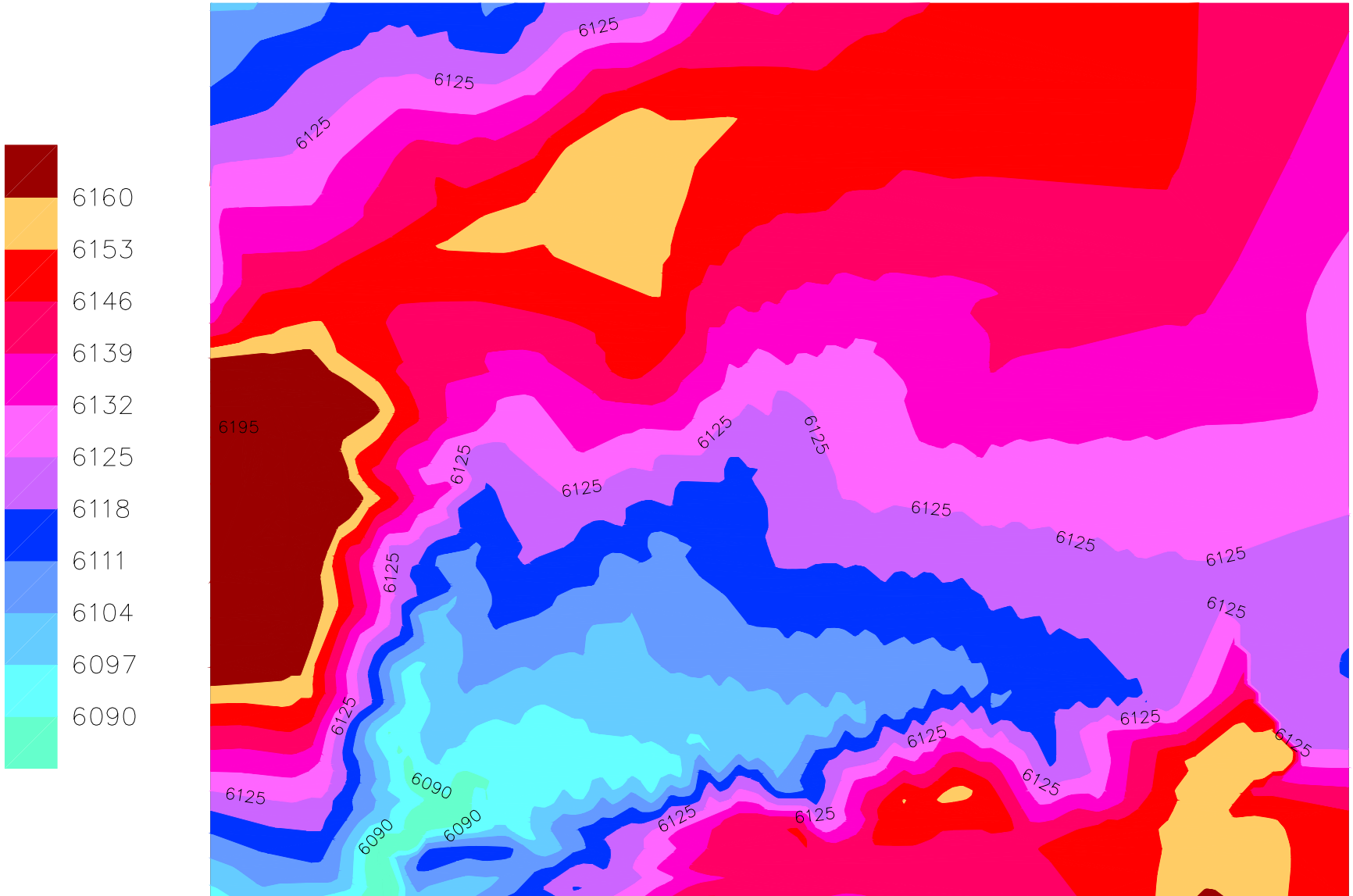
Creating topography with a truck-dump bench plan



La Plata Fluvial Geomorphic Reclamation Progress

- At the present rate of progress, the reclamation will be completed in approximately half the budgeted time
- During its first quarter of reclamation, La Plata Mine moved 40% <u>more</u> material for 35% <u>less</u> money.

Reclamation can no longer be considered an unnecessary expense, it is part of the cost of land-disturbing activity.

Given that reality, better reclamation designs can make money just as better disturbance plans do.

Natural Regrade module with GeoFluv™ (Patent Pending)

"OSM wants to be intimately involved with development of the bonding portion."

- Gene Hay, 30 December 2003

"OSM wants to participate as a beta tester for the bonding package."

- Gene Hay, 19 July 2004

How does the *Natural Regrade* module with *GeoFluv*™ *(Patent Pending)* do all these things?

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