Natural Channel Design

Natural Channel Design is most commonly accomplished by restoring the dimension, pattern, and profile of a disturbed river system by emulating the natural, stable river.
**Dimension** (in cross section)

- Wave Length
- Crossover
- Point Bar

**Pattern** (in plan view)

- Radius of Curvature

**Profile** (in longitudinal X-section)

- Water Surface Profile
- High Flow
- Low Flow
- Pool
- Riffle
Stream Stability

The ability of a stream, over time, to maintain its pattern, dimension and profile such that, the channel neither aggrades or degrades and is able to transport without adverse impact the flow and sediment from it’s watershed.
Bank Full Discharge

That discharge which barely overtops the channel banks

Maximum deposition & erosion circulation cell development
The most effective sediment discharge, over time, occurs, at the bankfull flow rate which is between the 1 to 2 year recurrence interval.

At the bankfull flow, the stream bottom picks up and moves, then redistributes its self in the same pool & riffle patterns existing prior to the bankfull discharge.

FIGURE 2-2. Relations between DISCHARGE, Sediment TRANSPORT Rate, FREQUENCY of Occurrence, and the PRODUCT of Frequency and Transport Rate. (After Wolman and Miller, 1960)
From Lane, 1955
Reference Reach

A **reference reach** is a channel segment that is stable, neither aggrading nor degrading, and of the same morphological type as the channel being assessed. The reference reach should also have a valley slope similar to that of the assessment reach.

The reference reach is used as the standard against which the assessment reach is being judged. To account for differences in drainage area and discharge between a reference site and an assessment site, data on channel characteristics (dimension, pattern, and profile) in the form of dimensionless ratios are developed for the reference reach.
The Original Reference Curve, by Dunne and Leopold (1978)
Rosgen Stream Classification System

Straight, steep valley

Meandering alluvial streams

Incised gully
Stability Determination

- Regional Curves
- BEHI (Bank Erosion Hazard Index)
- NBS (Near Bank Stress)
- Pfankuch
- Tractive Stress
- Flashiness index
- Sediment Transport Analysis
- Biologic Indicators
Stability Determination
Causes of Channel Instability

- Changes in Climate
- Changes in Hydrology
- Changes in Topography
- Changes in Vegetation
- Changes in Geology
- Alterations of the Stream Channel
Applications
Figure 1. Flow chart depicting sequence of implementation of the 8 sequence phases associated with natural channel design using a geomorphic approach.
Natural Riffle
Newberry Riffles
Cross Vanes

ROCK CROSS VANE

PLAN VIEW

FLOODPLAIN BELL

1/2 SF Width

TOE OF BANK

VARIERS

SCOUR POOL

1/2 SF Width

TOE OF BANK

BANKFULL STAGE

NO GAPS BETWEEN BOULDERS

VARIERS (SEE TABLE)

BANKFULL STAGE

DEO
Cross Vanes

From NRCS National Engineering Handbook, Part 654
Log Vane

Root Wad/Log Vane
J-Hook Combo

Buried 8-10 feet
20°-30°
Geo-Textile Fabric
Cut-off Sill

Buried 10-15 feet

RIFFLE
RUN
POOL
GLIDE

DEO
Stream Crossings

M: Match Culvert Width to Bankfull Stream Width
E: Extend Culvert Length through side slope toe
S: Set Culvert Slope same as Stream Slope
B: Bury Culvert 4” to 1’ (2’-6’ Culverts. Dig 10”-1.5’ below bottom)
O: Offset Multiple Culverts (floodplain ~ splits lower buried one) (higher one about 1 ft. higher)
A: Align Culvert with Stream (or dig approach using stream sinuosity)
Mesboa Culvert Design – Micro version

- Match
- Extend Culvert through the side slope toe
- Set Culvert same as Channel Slope
- Bury 1/6th of vertical culvert height
- Align with channel

Useful for crossing small streams on logging roads, snowmobile trails, etc.
Drainage Channels

2 Stage Ditch
Drainage Channels

Self Forming Ditch
Dam Removals

Dave Kenyon
Stream Assessment and Restoration