



Natural Channel Design
Engineering Inc.

ncdengineeringinc.com

LESSONS LEARNED USING STREAM MORPHOLOGY AND SIMPLE EROSION CONTROL STRUCTURES FROM THE PAST DECADE

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Natural Channel Design Engineering

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- There is a long history of failed channel improvements that did not incorporate basic stream channel morphology

Hand Built, Low Tech Structures

- Ease of installation
- Relatively inexpensive
- Low impacts to site
- Volunteer labor
- Ease of permitting
- Can have huge positive impact
- High Failure Rate
- Frequent Maintenance
- Failures can create harm to site resources
- May not be able to achieve goals that more extensive projects can

What is the Problem - What can be achieved?

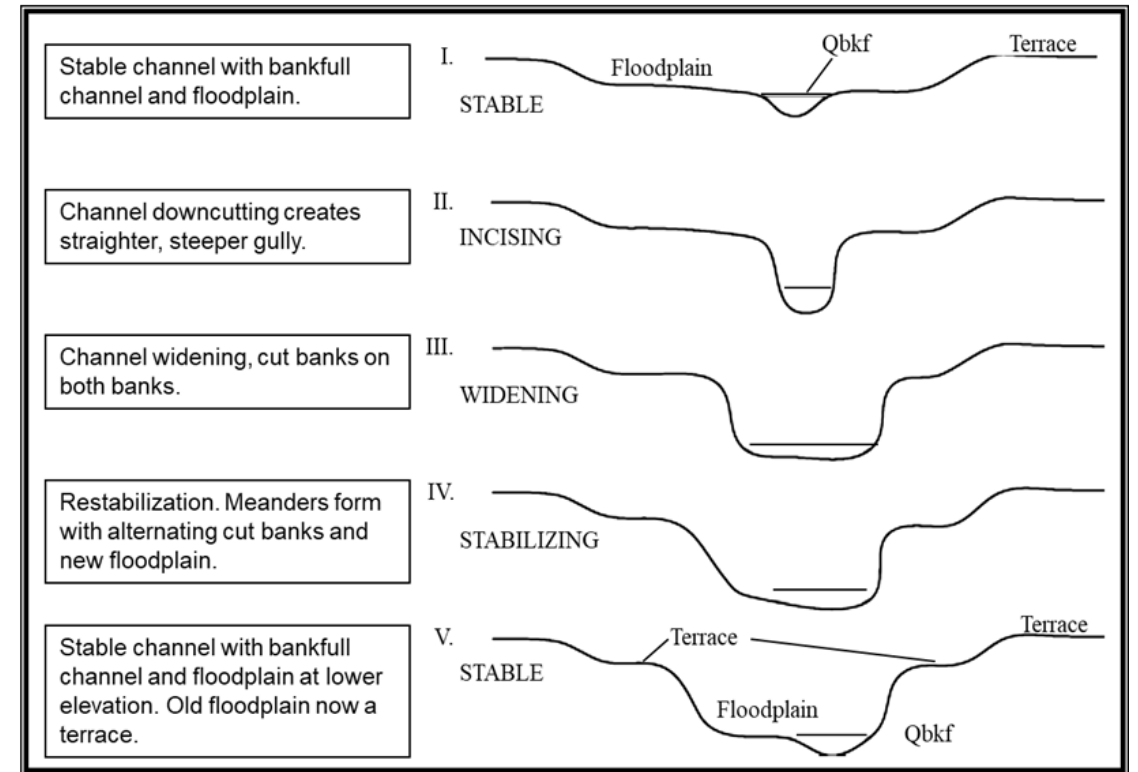
Grade Control-
Active head
cutting



Incision and loss of
floodplain
connectivity, wetland
function



Lateral instability –
Bank erosion,
channel and flood
plain widening



Choose Appropriate Low Tech Structure

- Rock and Brush
- ORD
- Barbs or Vanes
- Brush Revetment
- Choose appropriate materials
- Don't forget revegetation and bioengineering principles



Material Type is Important

Wood

- Lighter
- Often available
- Short lived unless permanently wet
- Harder to shape and will not adjust



Rock

- Heavy
- Not always available
- Long life
- Easy to create channel shape



Vegetation

- Easily portable
- Requires appropriate water and disturbance
- Self sustaining with minimal management
- Can be utilized to create shape and flow path
- Can improve habitat quality



Consider The Sediment Load



Too low to fill Incision
Wetland, forested, spring fed



High sediment potential: structures can rebuild the channel

Consider Hydrology and Potential Energy

REGIONAL RATIOS OF VARIOUS HIGH FLOWS TO BANKFULL FLOW

<u>U.S. Sites</u>	<u>Q2.0/Qb_{kf}</u>	<u>Q5/Qb_{kf}</u>	<u>Q10/Qb_{kf}</u>	<u>Q25/Qb_{kf}</u>
Salmon River		1.6	1.9	2.2
Maryland		2.7	4.2	7.5
Eastern U.S.		1.8	2.1	3.3
Eel River, CA		2.4		
Coast Range, CA		4.5		

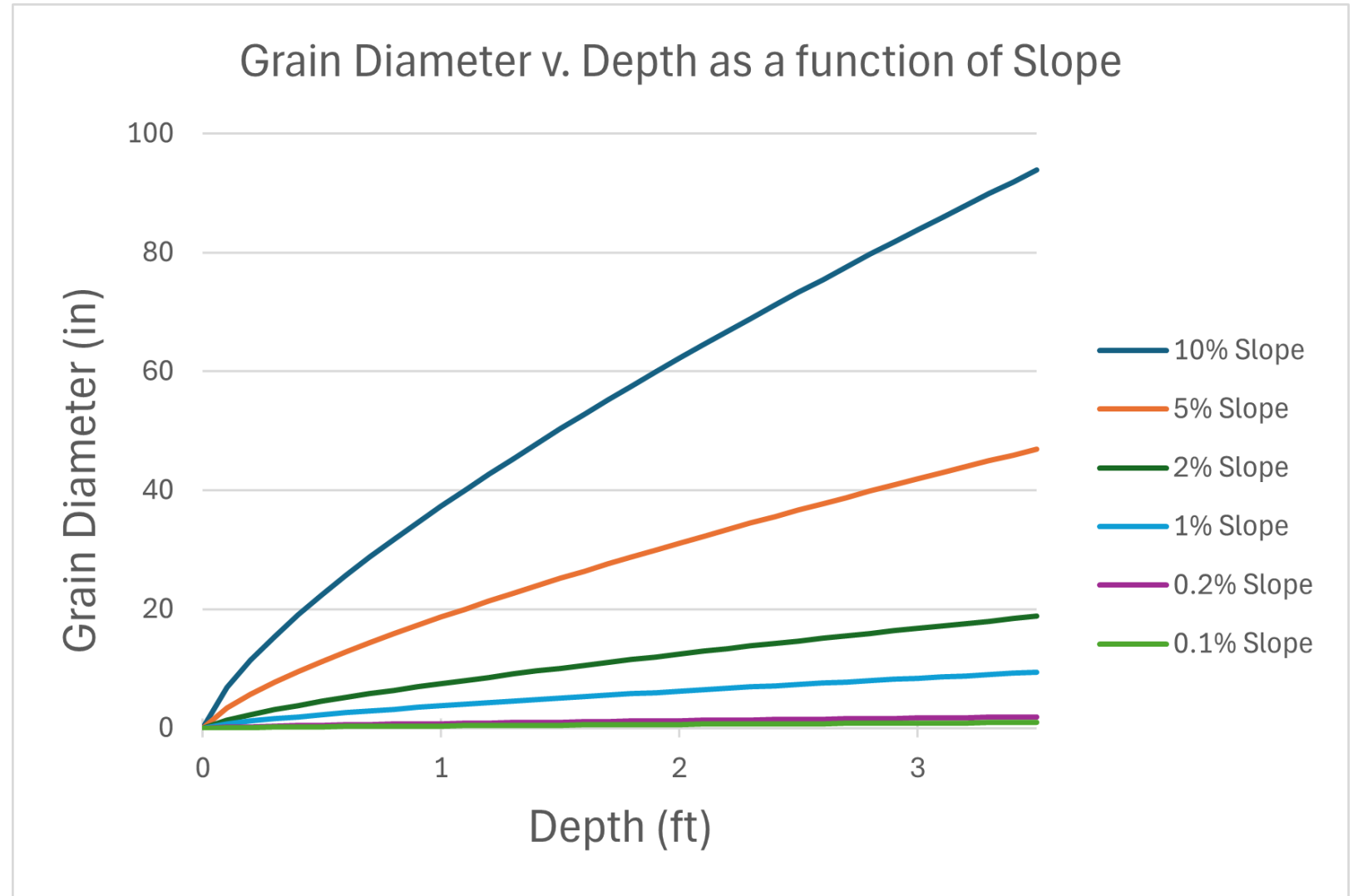
(Leopold, 1994)

AZ Sites

Mogollon Rim (A)	2.0	5.4	9.0	17.0
Upper Gila/Salt (B)	2.0	5.5	10.7	30.0
San Pedro (C)	4.1	8.3	12.0	18.0
Eastern Santa Cruz/Agua Fria (D)	2.6	5.8	9.3	14.0
Western Santa Cruz (E)	1.4	3.8	6.8	13.3

(Moody, Odem, 1998)

Energy will affect the material size and design



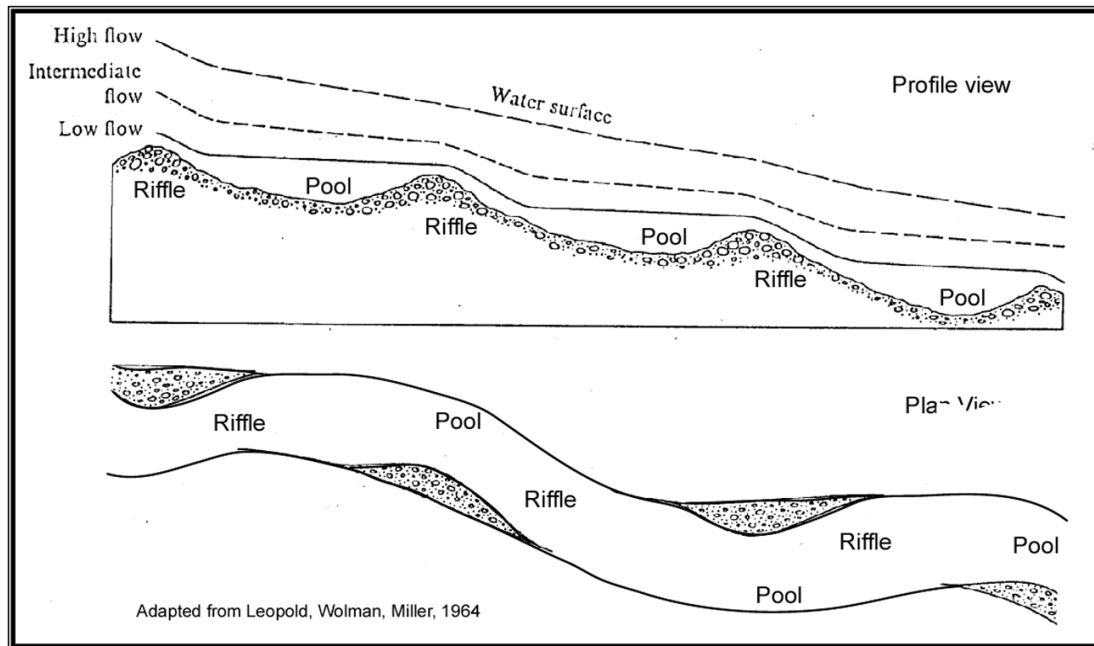
Consider the Shape and Elevation relative to floodplain

- Try to connect the channel back to the geomorphic floodplain (bankfull) to reduce energy at high discharges.



Place Structures in Appropriate Channel Location

Structure placement (riffle spacing) is predicted by stream width and slope
Use riffles for grade control and keep pools deep for energy dissipation



Choose the width of the structure with function in mind



Aggrading reach purposefully kept wide



Flat structure unintentionally widened channel



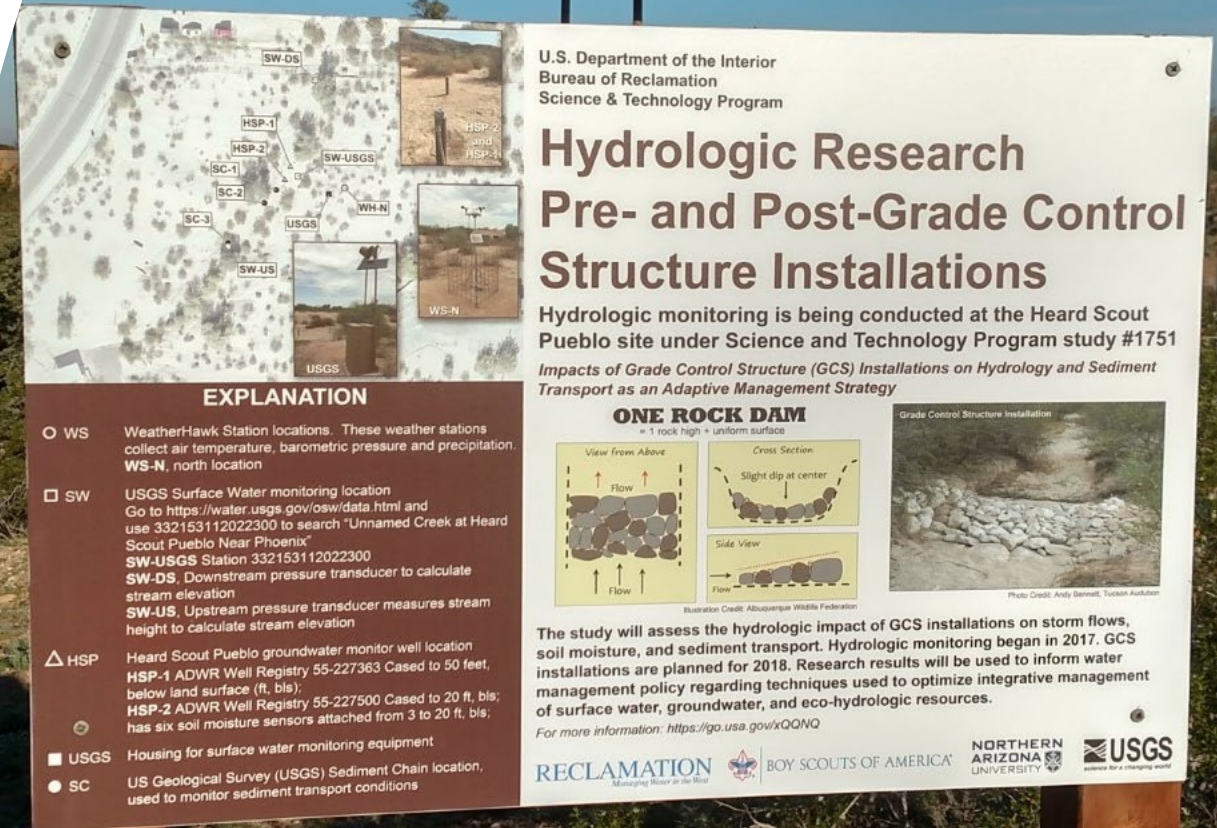
Consider the energy the structure will create

Additional energy created by the structure should be focused where it can be resisted or utilized.



Take a long-term approach for success

- Consider intermediate stages that lead to ultimate goal
- Utilize channel evolution to your benefit
- Build appropriate structure to aid the channel function you want to utilize
- Plan for high discharges and mitigate potential harm to the site
- Utilize native vegetation to manage channel dimension
- Recognize both the limitations and benefits of the low tech approach



U.S. Department of the Interior
Bureau of Reclamation
Science & Technology Program

Hydrologic Research Pre- and Post-Grade Control Structure Installations

Hydrologic monitoring is being conducted at the Heard Scout Pueblo site under Science and Technology Program study #1751
Impacts of Grade Control Structure (GCS) Installations on Hydrology and Sediment Transport as an Adaptive Management Strategy

ONE ROCK DAM

= 1 rock high + uniform surface

View from Above
Flow

Cross Section
Slight dip at center

Side View
Flow

Grade Control Structure Installation

Photo Credit: Andy Bennett, Tucson Audubon

Illustration Credit: Albuquerque Wildlife Federation

The study will assess the hydrologic impact of GCS installations on storm flows, soil moisture, and sediment transport. Hydrologic monitoring began in 2017. GCS installations are planned for 2018. Research results will be used to inform water management policy regarding techniques used to optimize integrative management of surface water, groundwater, and eco-hydrologic resources.

For more information: <https://go.usa.gov/xQQNQ>

RECLAMATION
Managing Water in the West

BOY SCOUTS OF AMERICA

NORTHERN ARIZONA UNIVERSITY

USGS
United States Geological Survey

EXPLANATION

- WS WeatherHawk Station locations. These weather stations collect air temperature, barometric pressure and precipitation. WS-N, north location
- SW USGS Surface Water monitoring location
Go to <https://water.usgs.gov/osw/data.html> and use 332153112022300 to search "Unnamed Creek at Heard Scout Pueblo Near Phoenix"
SW-USGS Station 332153112022300
SW-DS, Downstream pressure transducer to calculate stream elevation
SW-US, Upstream pressure transducer measures stream height to calculate stream elevation
- △ HSP Heard Scout Pueblo groundwater monitor well location
HSP-1 ADWR Well Registry 55-227363 Cased to 50 feet, below land surface (ft. bls);
HSP-2 ADWR Well Registry 55-227500 Cased to 20 ft. bls; has six soil moisture sensors attached from 3 to 20 ft. bls;
- USGS Housing for surface water monitoring equipment
- SC US Geological Survey (USGS) Sediment Chain location, used to monitor sediment transport conditions