Hydraulic Modeling Analysis for Abandoned Channel Restoration:

Cheongmi and Mangyeong Streams

Sponsored by
Korea Institute of Construction Technology (KICT)

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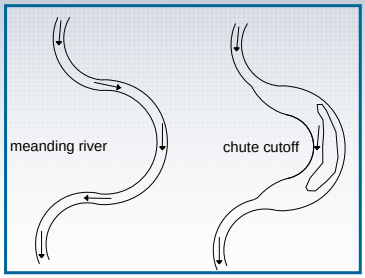
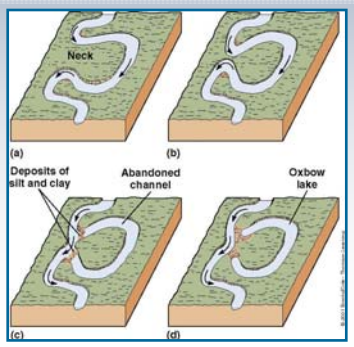
Outline

- Review of other Case Studies
- Review of Cheongmi Stream
- Review of Mangyeong Stream
- On-going Work…

Abandoned Channel Processes – Natural cutoffs

- **Chute cutoffs**
  - Occur when river cuts through the point bar, thus decreasing sinuosity
  - Channel forms a middle bar.
- **Neck cutoffs**
  - Lateral migration increases sinuosity of the channel until two bends connect
  - Sedimentation plug forms an abandoned channel called oxbow lake.





Examples of Natural Cutoffs

Chute Cutoff

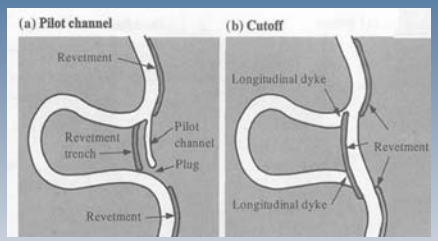
Williams River, AK
(Photo by N.D. Smith)

Neck Cutoff

Owens River, CA
(Photo by Marli Bryant Miller

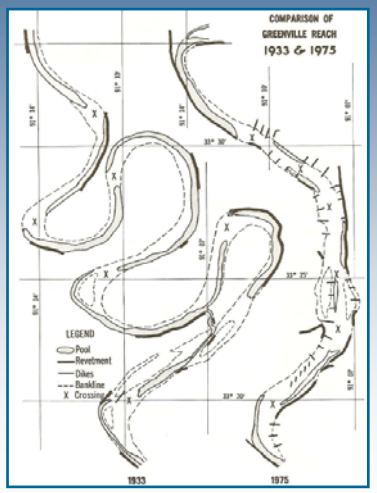
Abandoned Channel Processes – Engineered Cutoffs

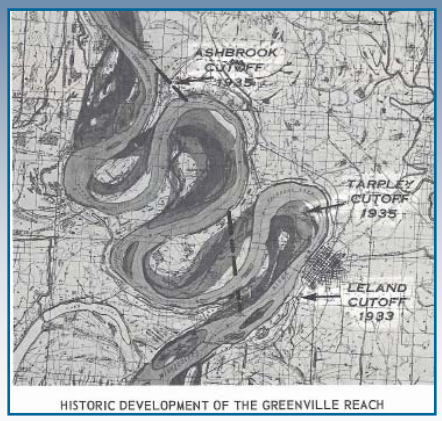
- **Designed for Navigation and/or Flood Control**
- **Protect river path by constructing revetment upstream and downstream of outer side of meander**
- **Excavate small trench and build revetment on inside at meander neck**
- **Excavate pilot channel at meander neck from downstream to near upstream (1V:3H Side Slope, 15 to 60 m bottom width, 2 to 4 m below low-water reference plane)**



(Julien, 2002)

Mississippi River - Greenville Reach





(Winkley 1977)

Examples of Engineered Cutoffs

Earth plug separating pilot channels

Dynamite removal of earthen plug

One hour after opening cutoff

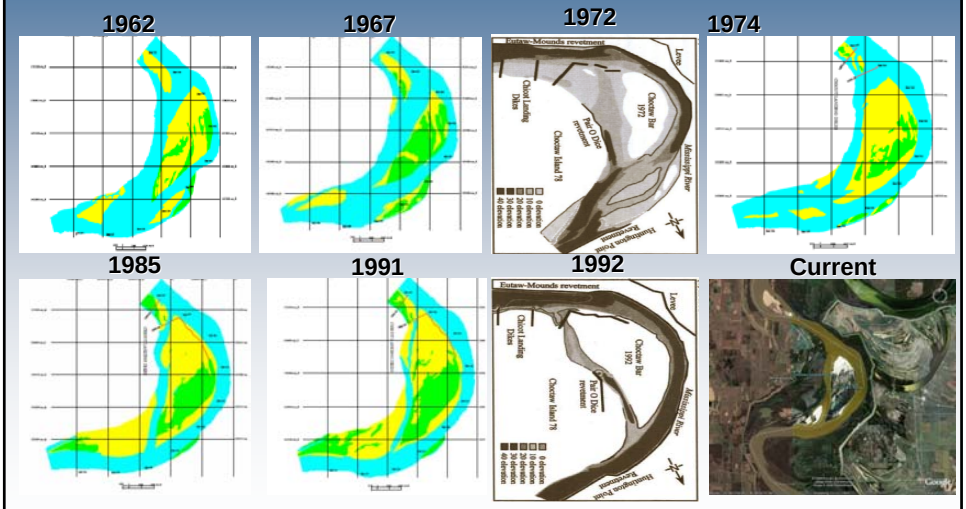
Greenville Bends
Ashbrook, Tarpley and Leland Cutoffs

http://www.mvd.usace.army.mil/mrc/Upon_There_Shoulders/Chapter12.htm

Mississippi River
Leland and Tarpley Cutoffs

(Winkley 1977)

Time Change
Choctaw Bar, Mississippi River



(red line = stone dikes, yellow = bare sandbar, blue = water and green = vegetation)

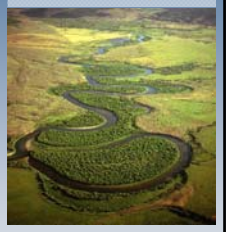
(USACE 1999)
(Julien 2002)

Other Sites

Red River, Minnesota

East Fork Des Moines River, Iowa

Green River, WY



Waal River, Netherlands

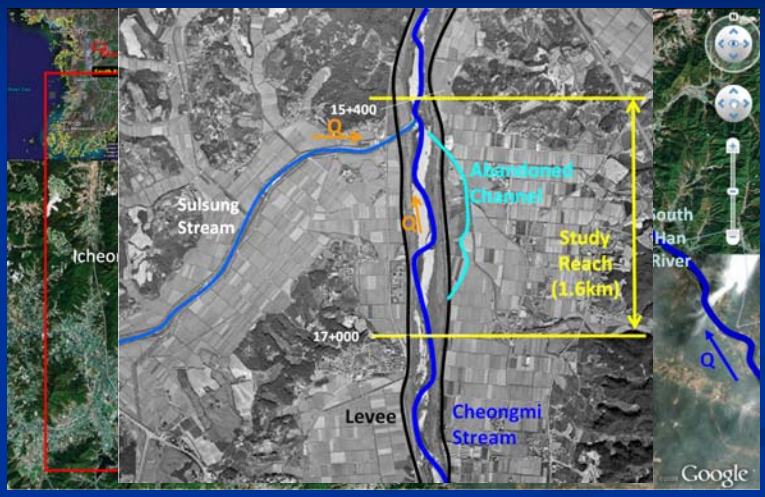
Murrumbidgee River, Australia

Napa River Oxbow, CA

Hydraulic Modeling Analysis

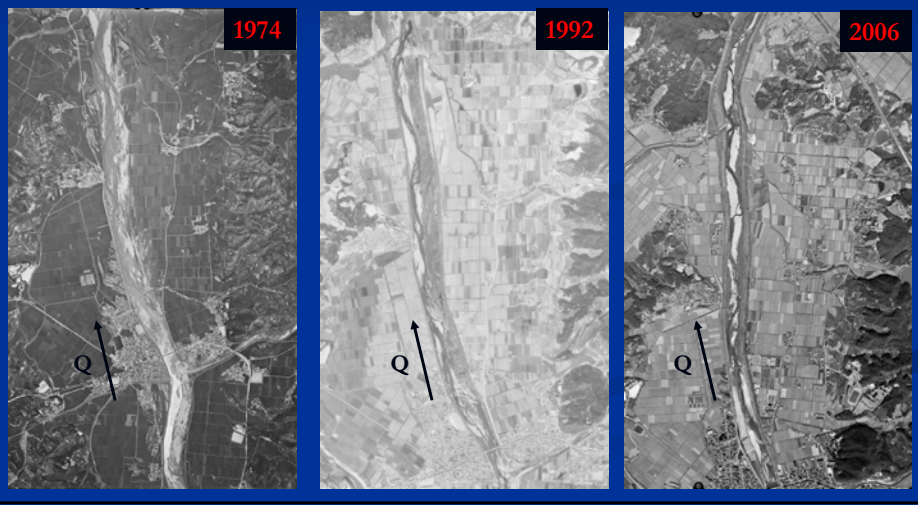
- Objective to reconnect the abandoned channel
  - Hydraulics
  - Bed Material and Sediment Transport
  - Equilibrium
  - Geomorphology

Cheongmi Stream Site Description

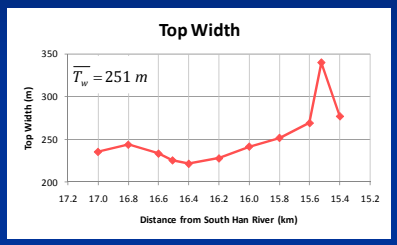


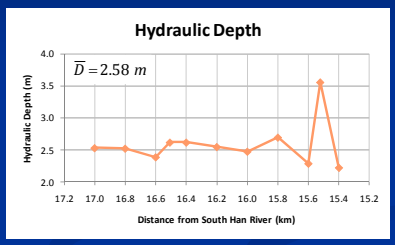
Cheongmi Stream Aerial Photos

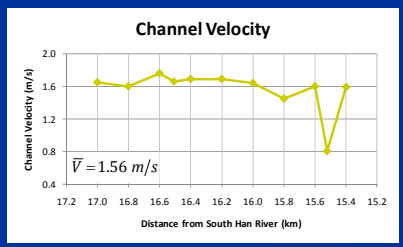
- Aerial Photos (1974, 1992 and 2006)

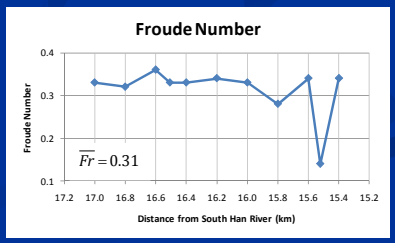


Spatial Trends based on Bankfull Discharge

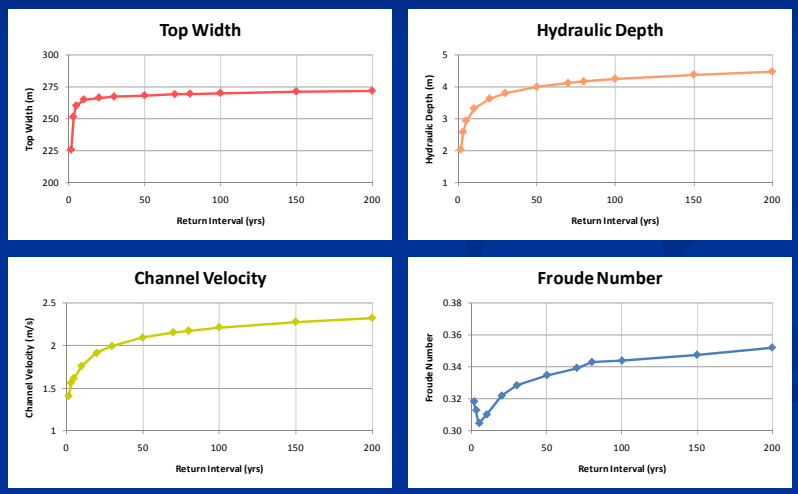




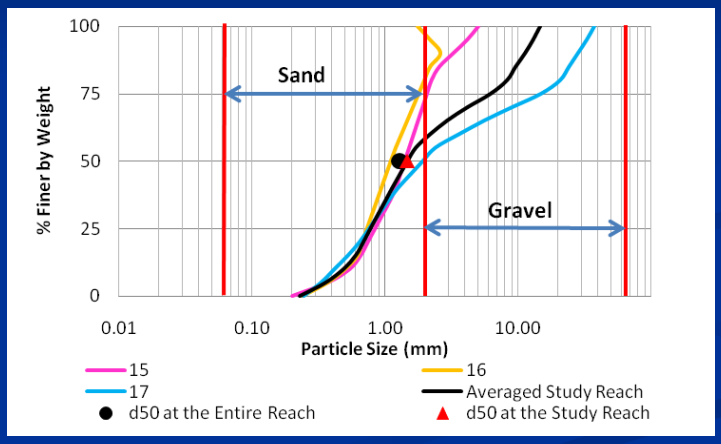




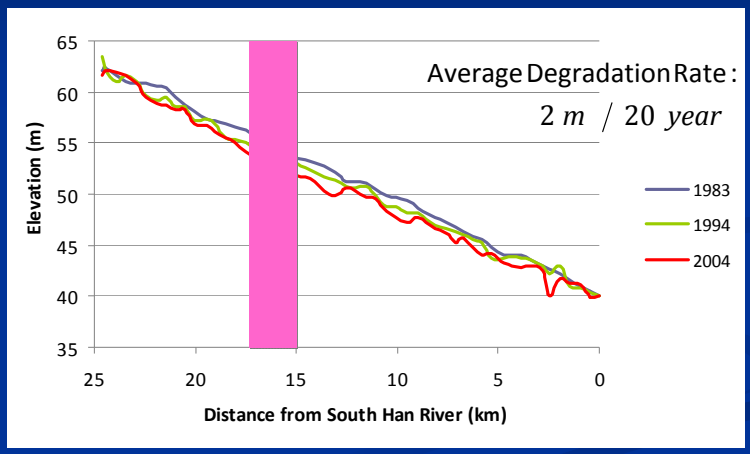
Reach Averaged Spatial Trends on Each Return Interval



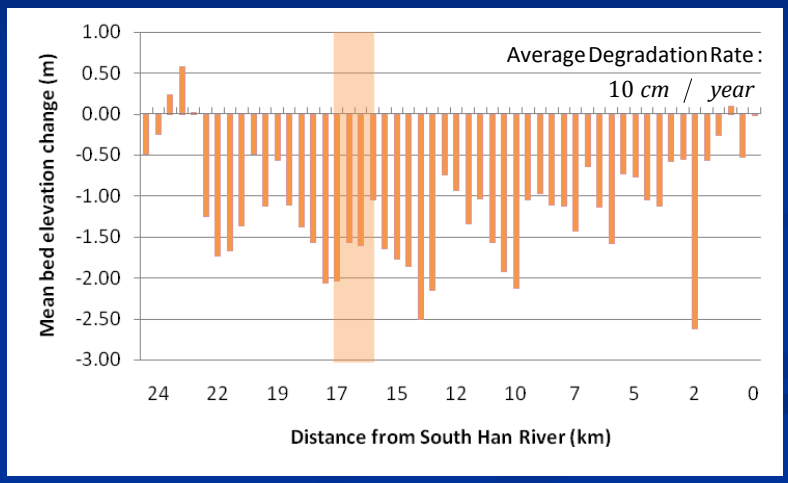
Bed Material Distribution for Study Reach



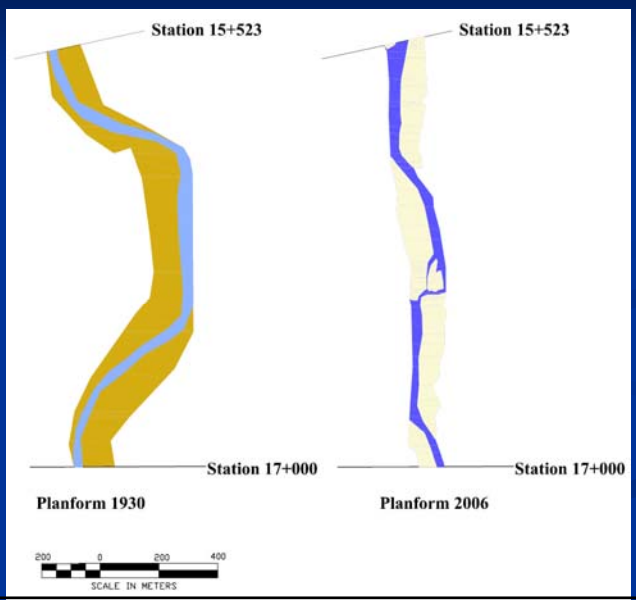
Thalweg Profile of Entire Reach



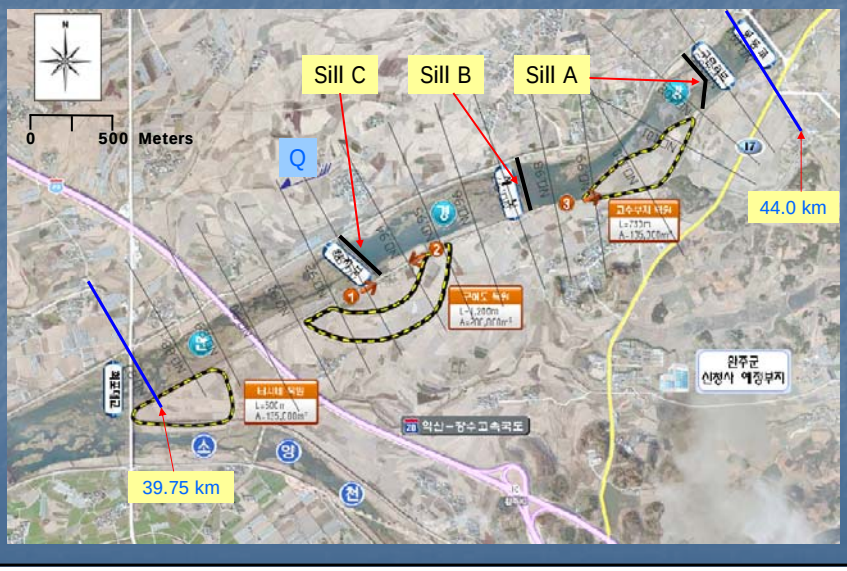
Mean Bed Elevation Change between 1983-2004

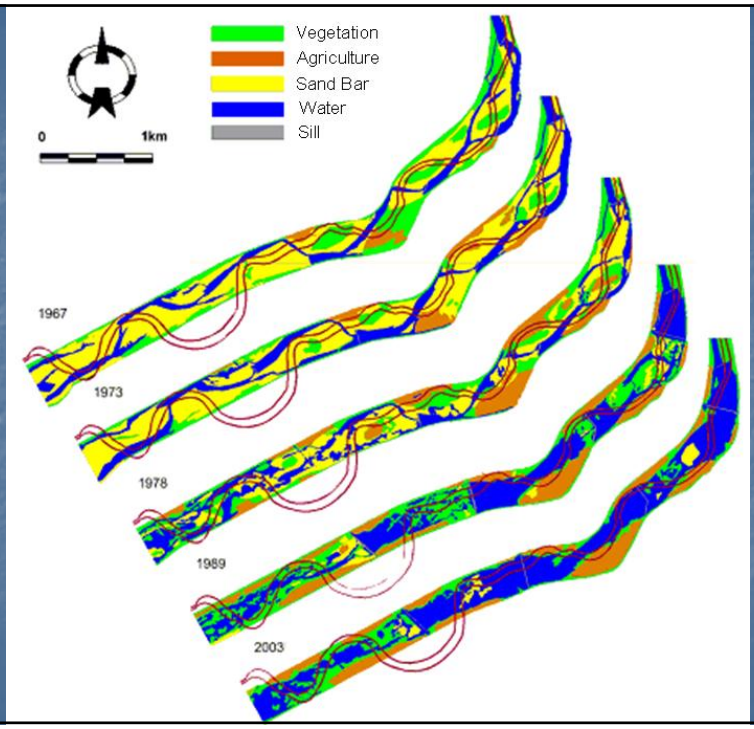


Channel Planform – Aerial Photo



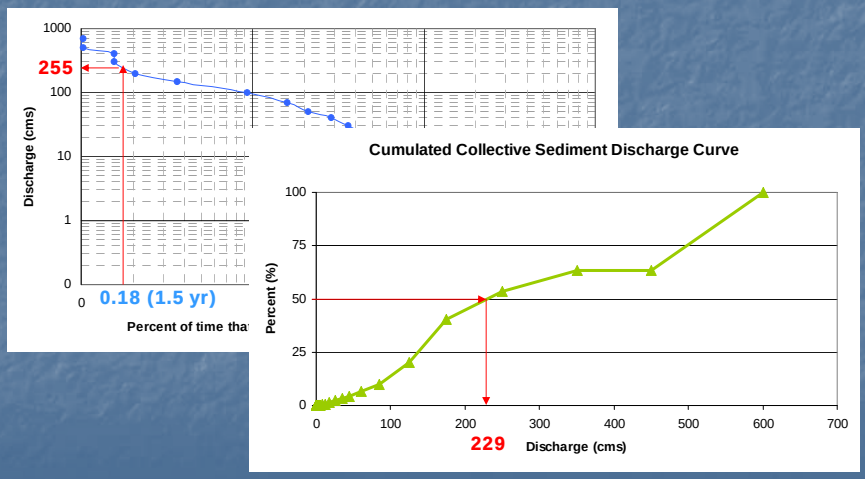
Mangyeong Stream Study Site



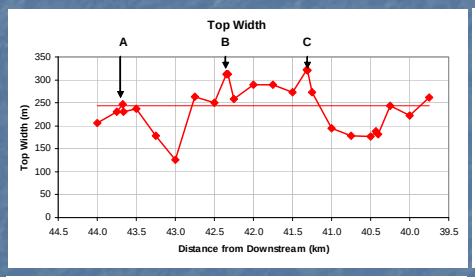


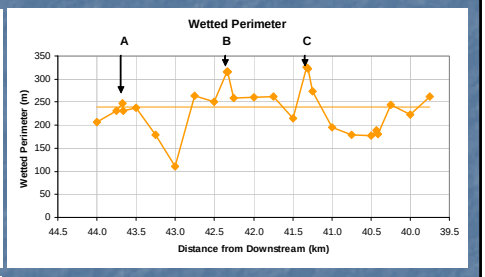
Discharge:

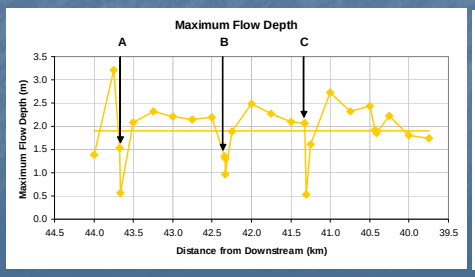
(Flow Duration Curve and Effective Discharge)

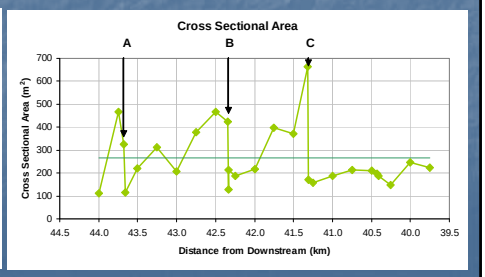


HEC-RAS Hydraulic Modeling









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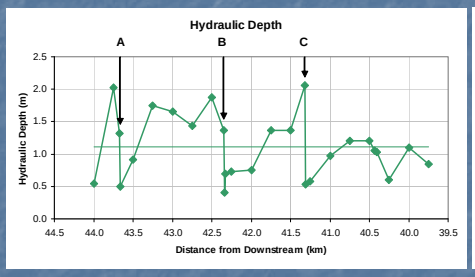
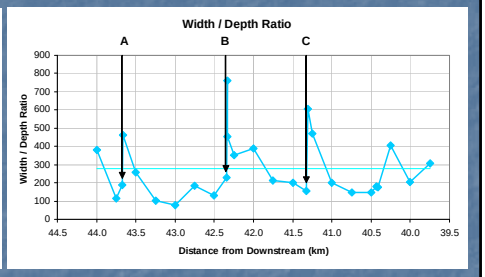
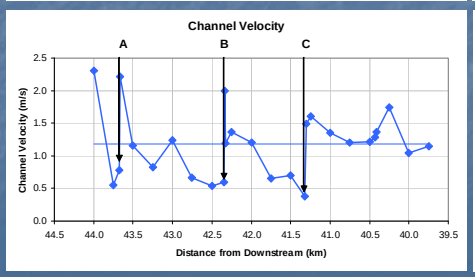
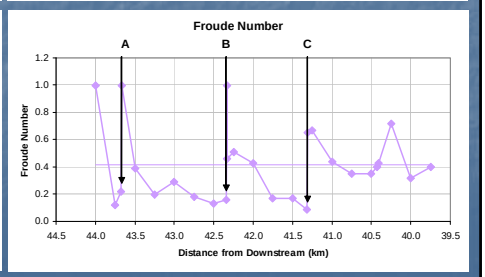
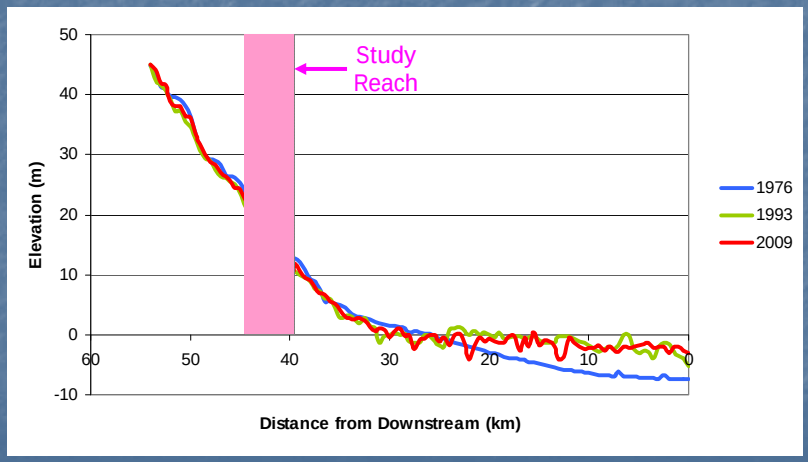




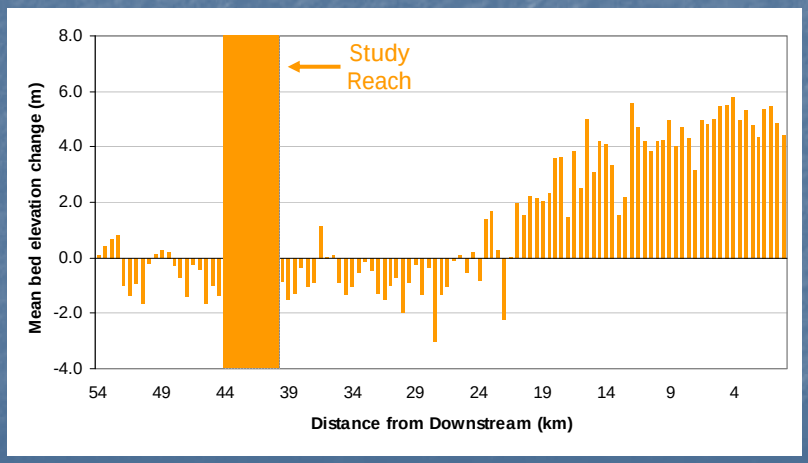




Longitudinal Profile



Mean Bed Elevation Change



(1976-2009)

Summary

Analysis	Sub Analysis	Cheongmi Stream	Mangyeong River
HEC-RAS	Top Width (m)	251	244
	Hydraulic Depth (m)	2.58	1.11
	Velocity (m/s)	1.56	1.18
	Froude Number	0.31	0.42
Bed Material	Particle Size (mm)	1.48	36
	Maximum Movable Particle Size (mm)	15	33
Sediment	Sediment Transport Capacity	Engelund-Hansen Yang	Engelund-Hansen
Equilibrium	Width	Julien-Wargadalam	Julien-Wargadalam
Planform	Channel Classification	Straight	Straight
Mean Bed Elevation	Degradation	up to 2 m	up to 2 m

Upcoming Work

- Review of Stabilization Methods for the Restoration of the Abandoned Channels at two sites: Cheongmi and Mangyeong Streams
  - Review of proposed design;
  - Identification of possible alternatives;
  - Position of structures in relation to fluvial geomorphology;
  - Structural performance at different stages and discharges;
  - Structural dimensions in regards to hydraulic geometry; and
  - Potential impact of sediments.

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- Dr. Jungu Kang (KICT)
- Il Hong (KICT)
- Dongbu Engineering
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