UNIVERSITY OF AGRICULTURE
IN KRAKOW

Department of Water Engineering

"The influence of large roughness elements on natural morphological changes in bed of mountain river"

Strutyński Mateusz, Strużyński Andrzej, Kulesza Krzysztof

International School of Hydraulics

Łochów, May 2012

1 May 2004 -> UE

Water Framework Directive

Good ecological state until 2015

The presence of Large Roughness Elements (eg. boulders) change:

-Flow regime

-Continuity of the river

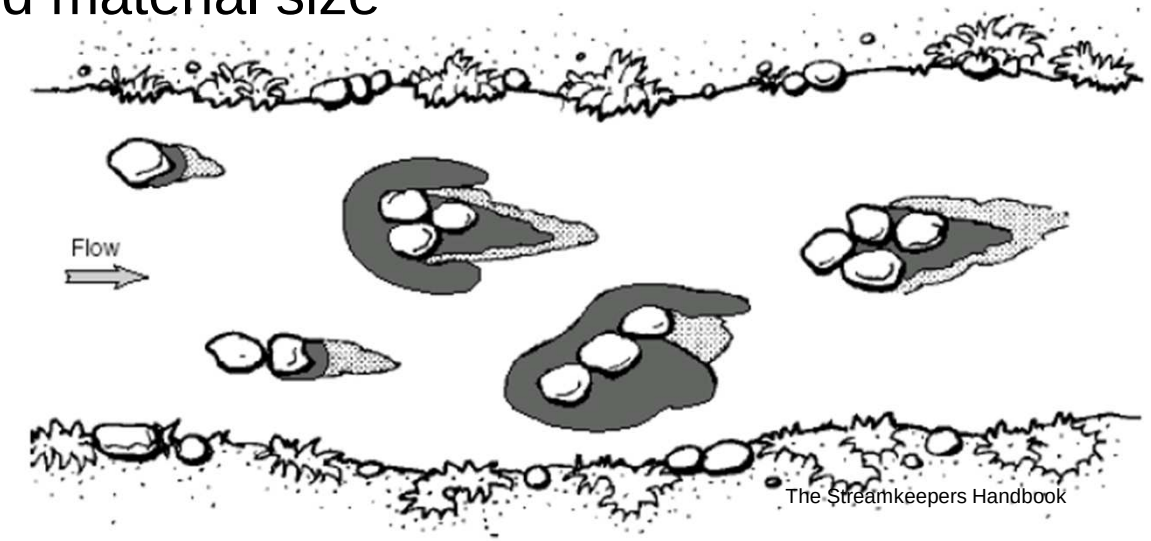
- transport and sedimentation of bed material

-Morphological conditions

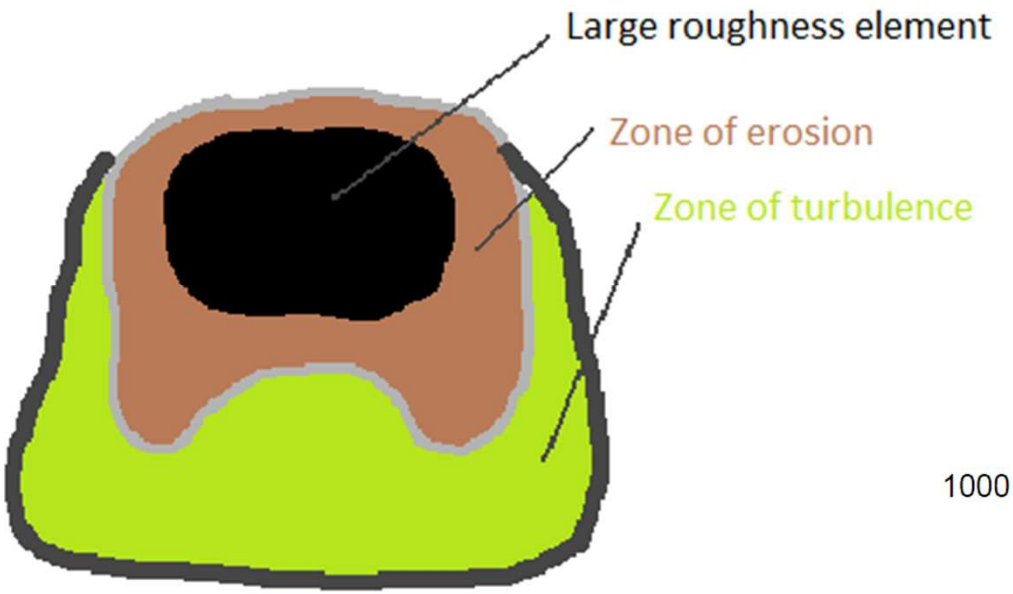
- water depth

- velocity magnitude

- bed material size

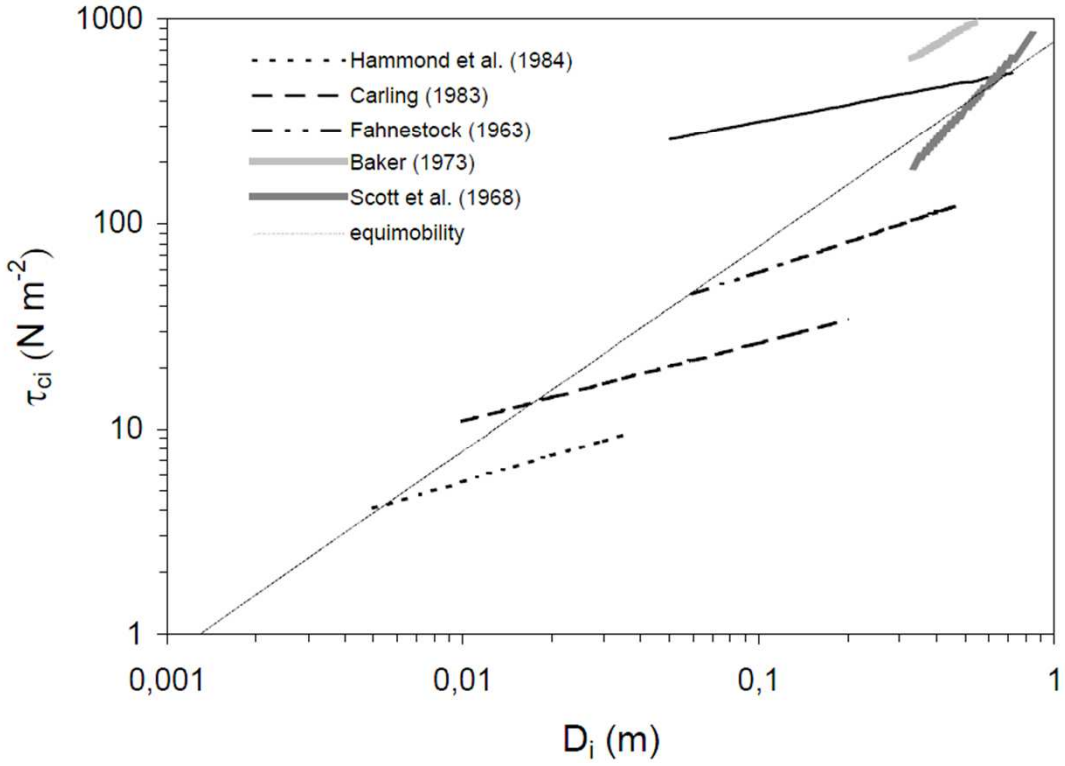


The Streamkeepers Handbook

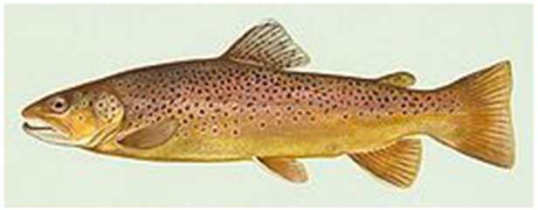


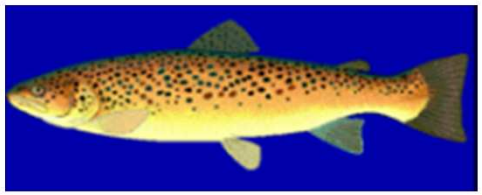
Boulder size [Carling 1998]

$$D = 25d_m$$



Habitat needs





FISH	WATER DEPTH [m]	VELOCITY MAGNITUDE [m/s]
TROUT */salmo trutta m. fario/*	0,15 – 0,5	0,15 – 0,5
BULL TROUT /salmo trutta m. trutta/	0,15 – 0,5	0,15 – 0,5
SALMON */salmo salar/*	0,25 – 0,55	0,3 – 0,6
GREYLING */thymallus thymallus/*	0,3 – 0,5	0,3 – 0,75
BARBEL */barbus barbus/*	0,2 – 0,5	0,8 – 1,1
STURGEON */acipenser oxyrinchus/*	>2	1 – 2

Data from Polish Inland Fisheries Institute

SPAWNING AREA

FISH	SPAWNING AREA [m^2] for 1 pair
TROUT */salmo trutta m. fario/*	10 – 12 +fine material
BULL TROUT /salmo trutta m. trutta/	12 – 14
SALMON */salmo salar/*	16 (30 cm height mound) + fine material
GREYLING */thymallus thymallus/*	mass spawning
STURGEON */acipenser oxyrinchus/*	70 - 100

Data from Polish Inland Fisheries Institute

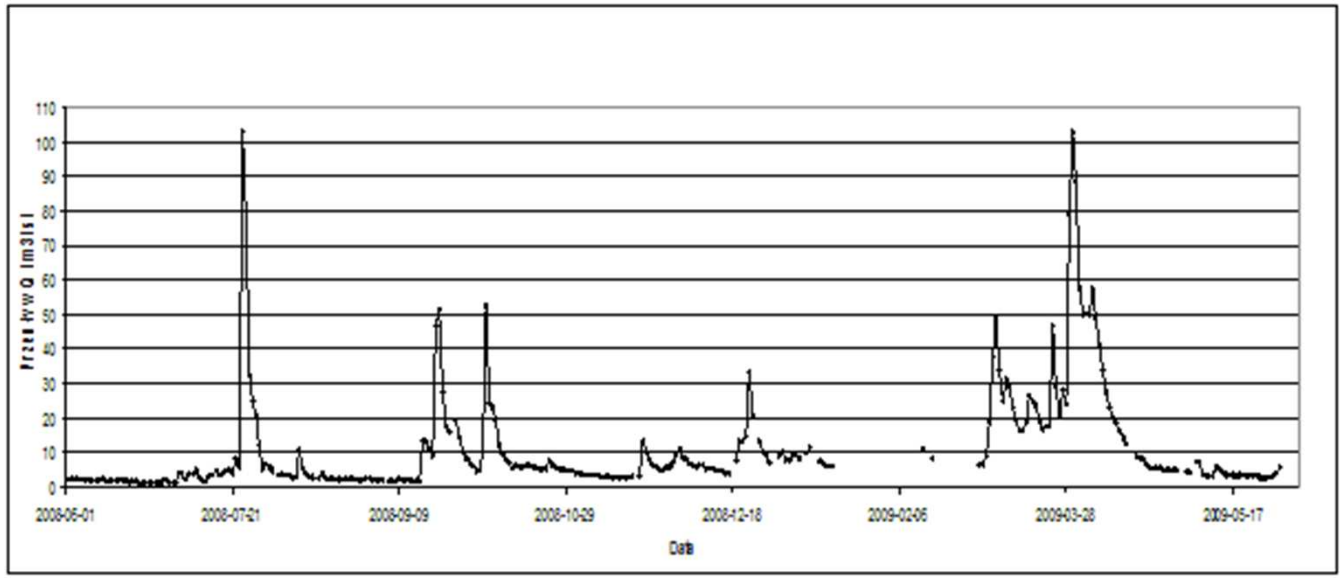
Field measurements

Raba River

Czarny Dunajec River

Porębianka River

Raba River

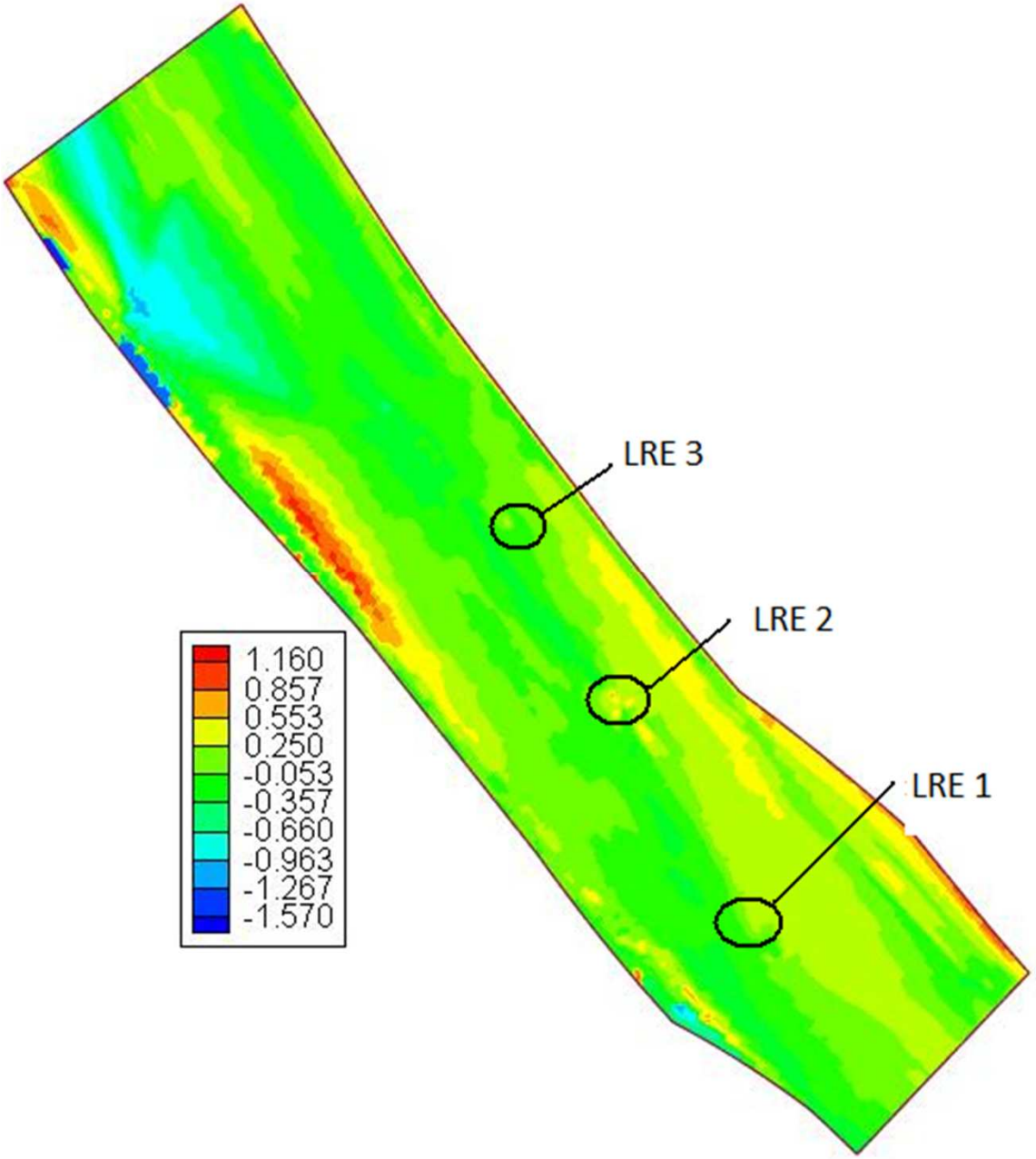


Daily water levels – Raba River – Stroza profile

Catasrophic flood
17 th May 2010

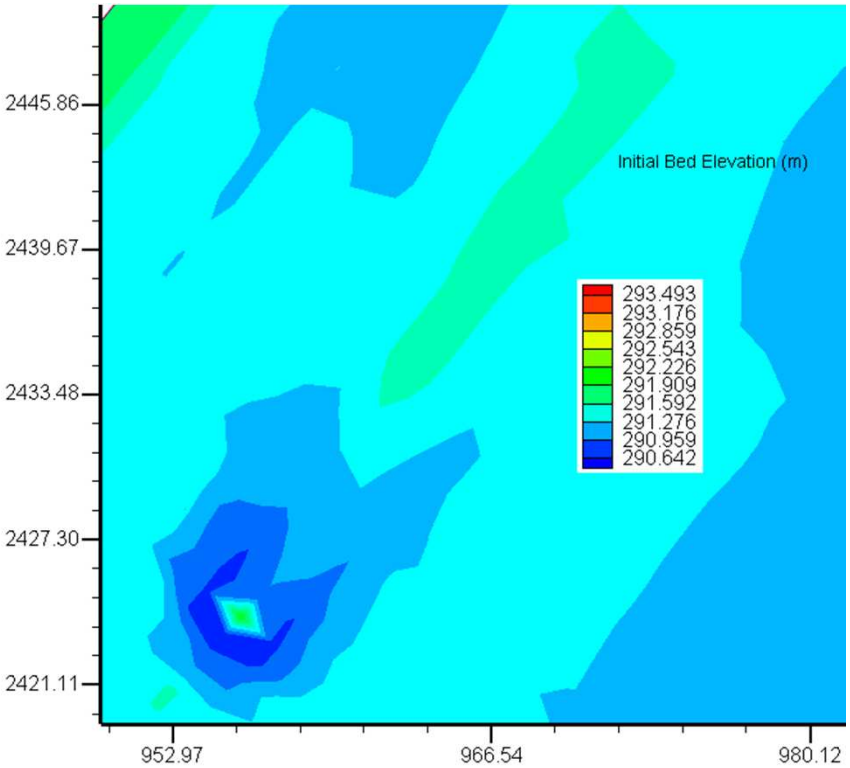
discharge = 758 m^3/s

water depth = 4,58 m

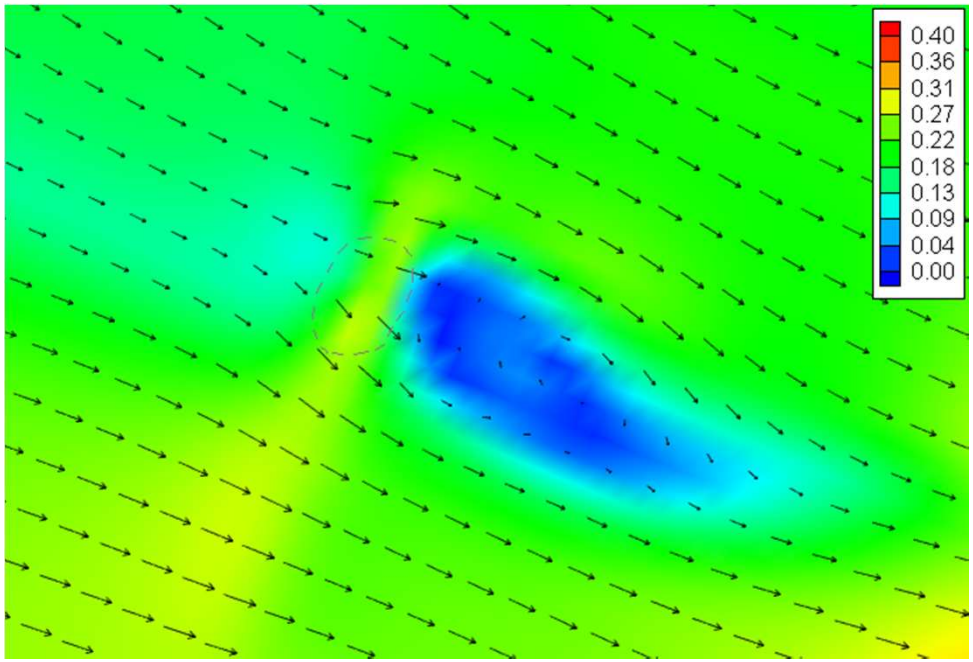


Bed changes after flood in 2010 (Raba River)

Numerical modelling using CCHE2D program



Zone of erosion behind Large Roughness Element

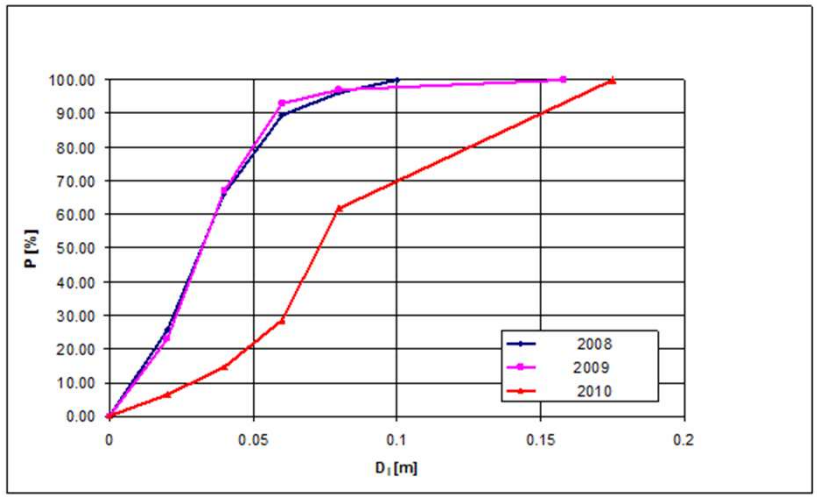


Velocity magnitude behind Large Roughness Element

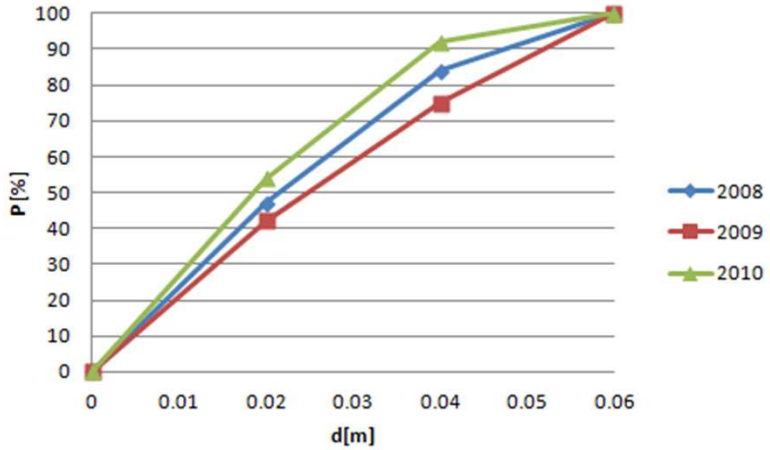
$Q = 3{,}1\ m^3 \cdot s^{-1}$,

CCHE2D simulation

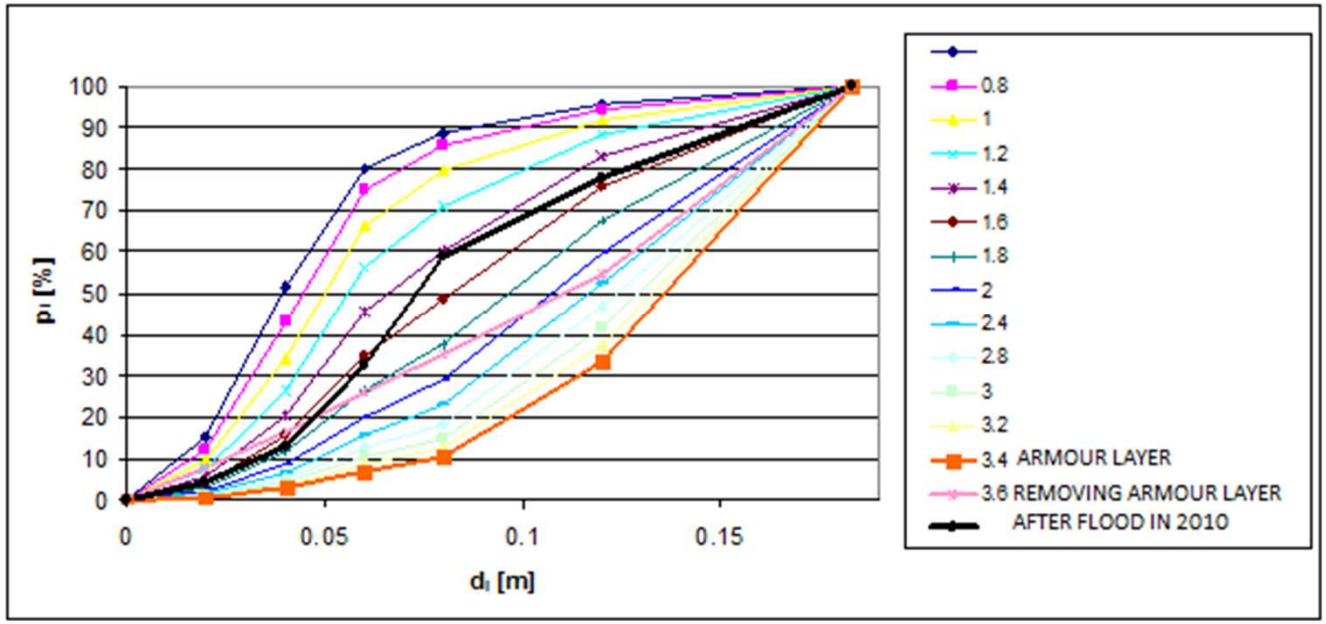
Bed stability – Raba River



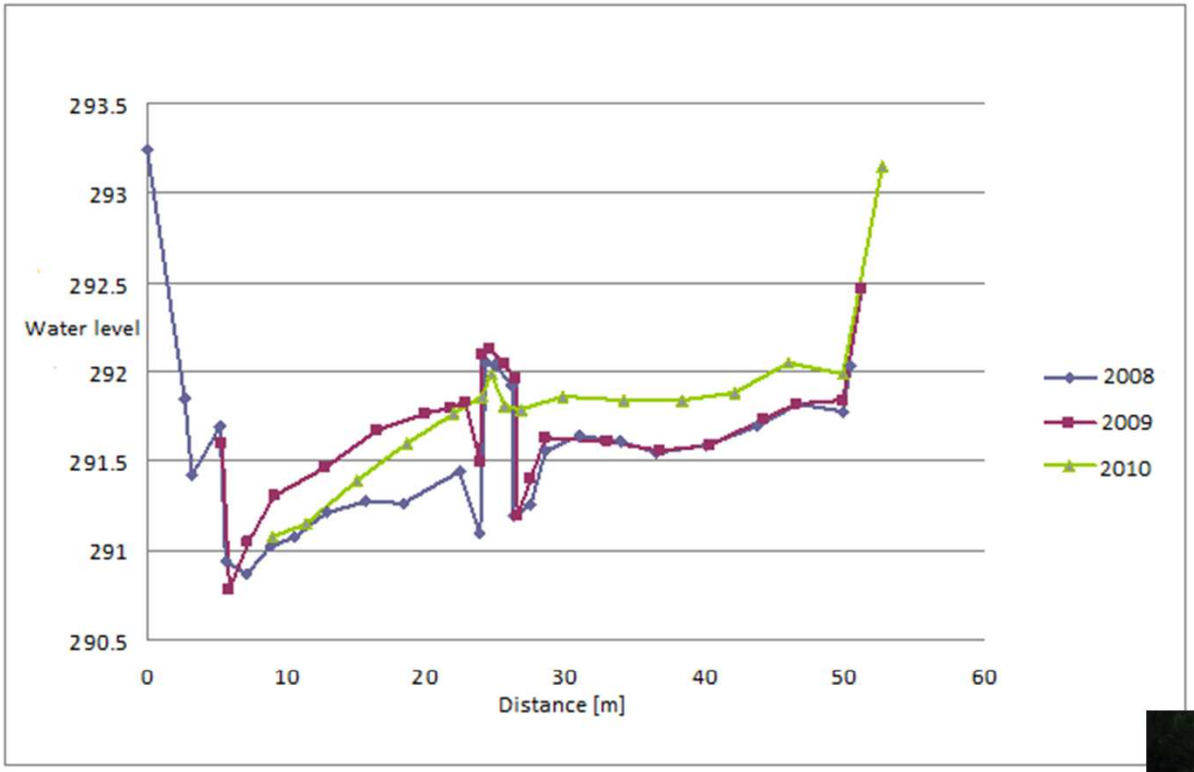
Sieve curve /current/



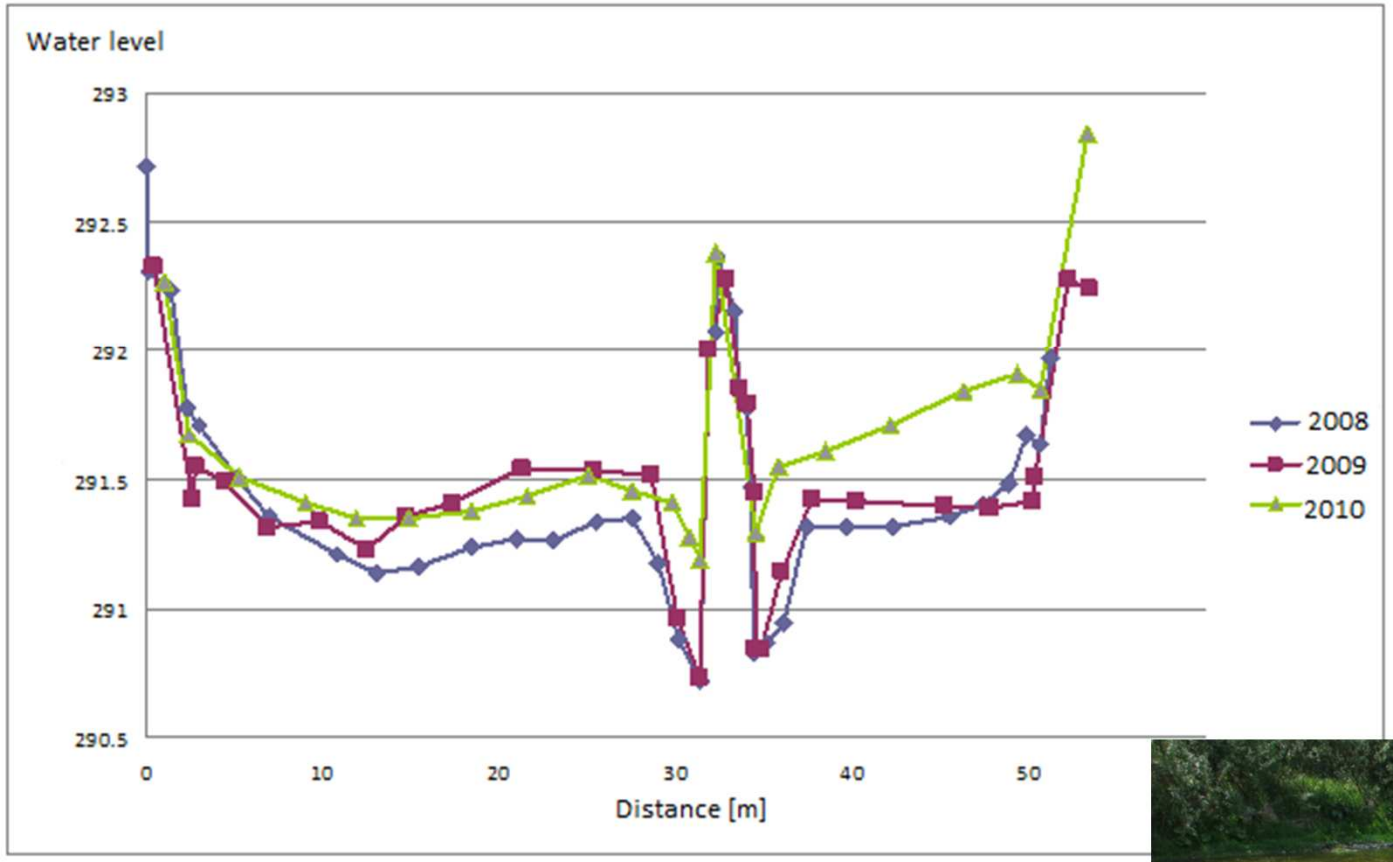
Sieve curve /behind LRE/



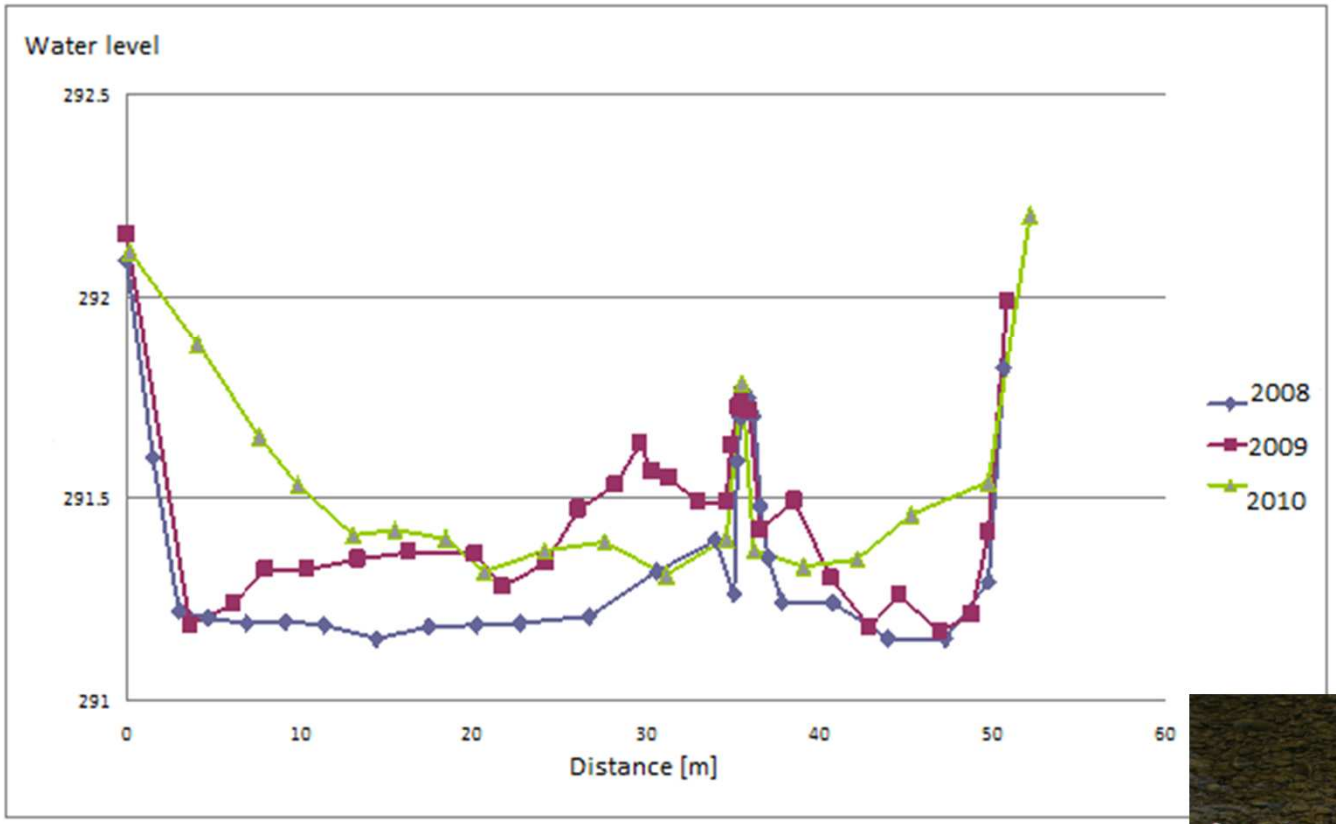
Armouring prognosis – Raba River



Cross sections with LRE 1



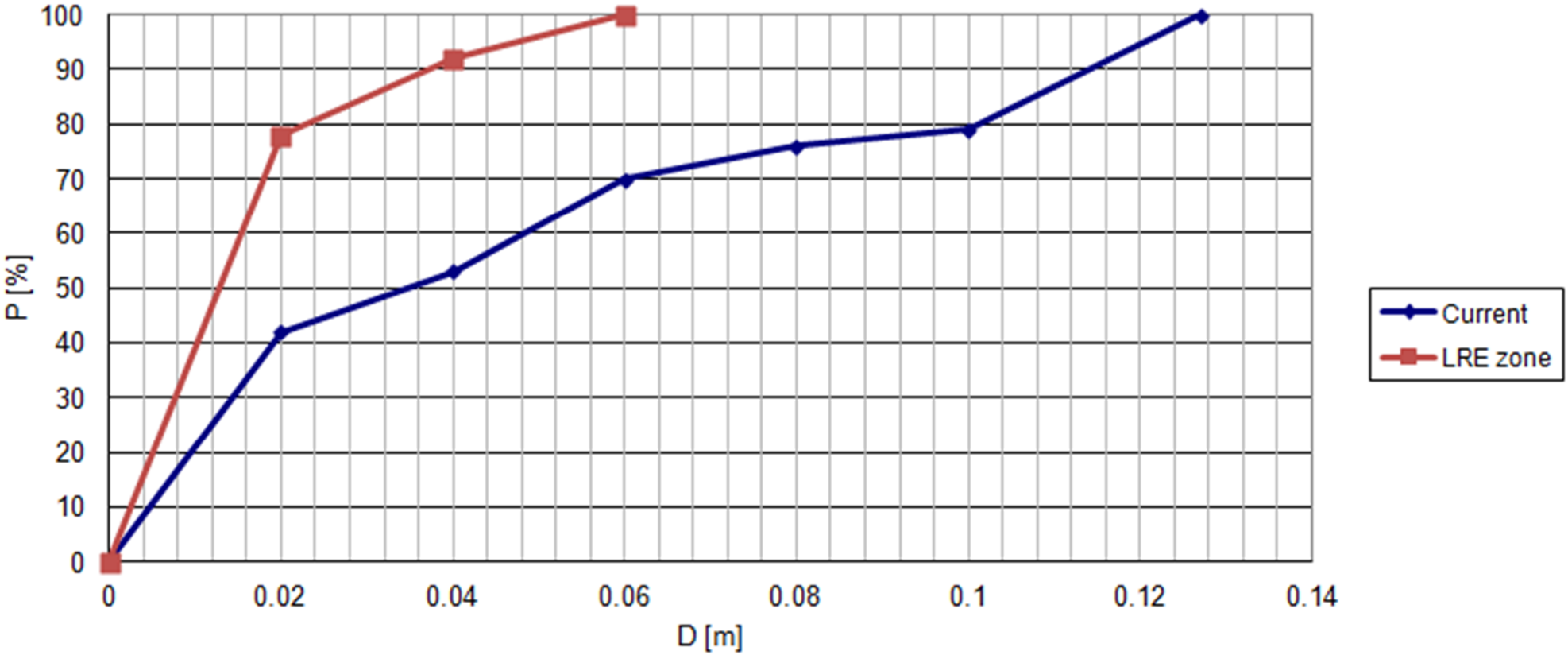
Cross sections with LRE 2



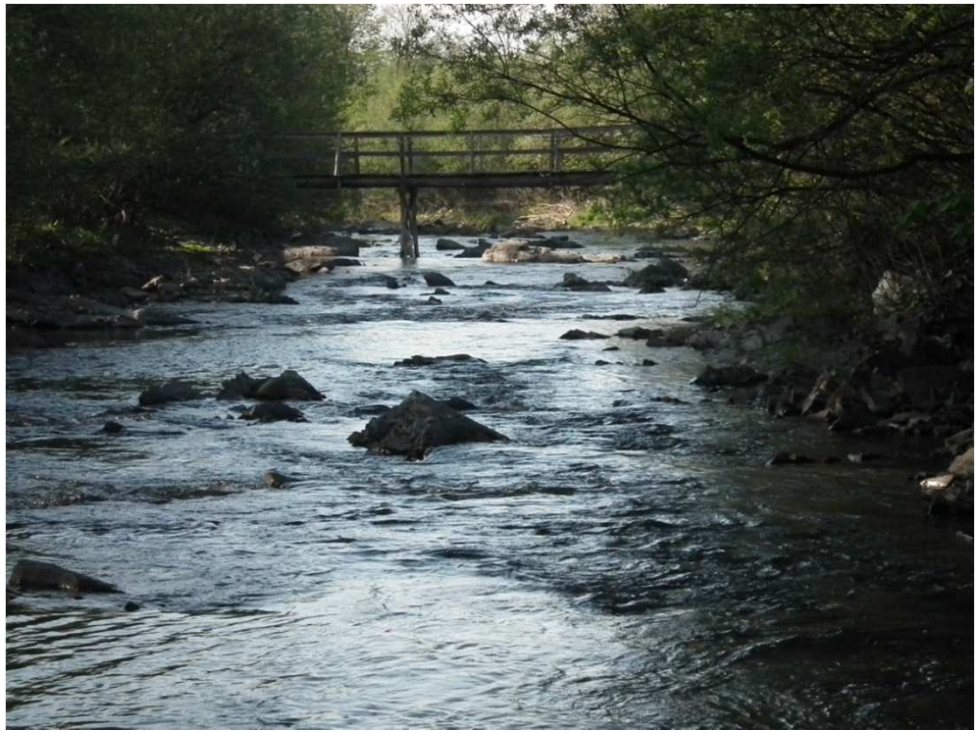
Cross sections with LRE 3

Czarny Dunajec River

Czarny Dunajec River



Porębianka River



Conclusions:

Large roughness elements improve fish habitat by changing the velocity magnitude, direction of flow and creating new riffles and pools.

Boulder placement in different constellations and sets could create spawning area for different species.

In the zone of large roughness elements the bed is stable even during big floods.

The size of bars with fine material depends on protrusion effect of large roughness element.

In the future…

Use the MesoHABSIM method to check the influence of Large Roughness Elements on number of fish and species.

THANK YOU !

fot. Brannaka L.