

UNIVERSITY OF BOLOGNA
Sustainable Design of Water Resources Systems

Exercise – Application of pairwise comparison to estimate the design flow of a hydropower plant

A small hydropower plant (with no regulation) is to be designed for a cross river section. The design flow can assume values of 80, 90, 100, 110 or 120 l/s. After a careful assessment of the environmental and economic behaviors of the project the following indicators have been identified for evaluating the most appropriate alternative:

- 1) The economic benefit – I1
- 2) The impact on the fish community – I2
- 3) The impact on the landscape – I3
- 4) The fruition of the downstream river reach for recreational purposes – I4

The utility functions associated to the above indicators, depending on the design water withdrawal, are piecewise linear functions whose coordinates are given in the following tables.

Indicator I1	
Design flow	U(I1)
0	0
30	0
150	1

Indicator I2	
Design flow	U(I1)
0	1
60	1
150	0

Indicator I3	
Design flow	U(I1)
0	1
100	1
150	0

Indicator I4	
Design flow	U(I1)
0	1
10	1
100	0
150	0

The optimal river flow withdrawal should be identified by using pairwise comparison, by making sure that the evaluation is consistent.