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Maria Kamykowska, Ludwik Kaszowski, Kazimierz Krzemień

River channel mapping instruction. Key to the river bed description

Abstract: The authors propose a method for characterising channel systems during fieldwork. Depending on the degree of detail of a research project, some or all of the proposals included in the form may be used. This method has been field-tested in various areas of Poland, the Alps, the Massif Central in France and in Scotland.

Key words: river channel mapping instruction.

Introduction

The river channel mapping instruction is designated for a comprehensive description of channel systems during the course of research. Such a description leads to the definition of tendencies of the spatial channel structure diversity and understanding of their morphodynamic functions. The instruction facilitates collection of a large amount of qualitative and quantitative data from the area researched in a uniform way. The collection is quick and straightforward thanks to a number of standard answers provided for each item on the form. Field research is the main source of information supplemented by an analysis of maps and aerial photos. Normally channels consist of morphodynamic reach sequences: it is these types of homogenous reaches, defined on maps and aerial photos according to a set of rules, for which the basic information is gathered.

A special register is used as a tool for mapping and description. There are five groups of data in the register: (1) preliminary information, (2) channel characteristic (location, geology, morphometry, cross-section, long-profile, banks, river-bottom features, sediments, man-made features, and channel type), (3) hydrodynamic characteristic, (4) hydrometeorologic characteristic of the research period, and (5) catchment area characteristic. The register includes approximately 105 individual pieces of information of which 48 are of the qualitative type and 57 of the quantitative type. This is the basic data. The quantitative data is used to calculate dozens of numeric indices used for the channel analysis. The register is accompanied by a special instruction, a key, which lets the researcher select the right kind of information and record it in a shortened form on one of the register's columns.

An understanding of the structure and function of morphodynamic reaches requires an analysis of not just the channel itself, but of the catchment environment as well. Therefore, an analysis of cartographic material, aerial photos and other sources that provide information on the channels and their catchments should be conducted alongside the field research. The data characterising a catchment area can be entered in the fifth and last chapter of the register. The register itself may be slightly modified according to the needs of a particular research. Developed in the Polish Carpathian Mountains, this method has been field-tested in various upland and young-glacial areas of Poland, the Alps, the Massif Central in France, and in Scotland.

1. INTRODUCTORY INFORMATION

1.1. Mapping date

1.2. Person's name who conducts the mapping

2. DESCRIPTION OF THE CHANNEL

2.1. Channel location

2.1.1. River drainage basin, e.g. Jaszcze/Ochotnica/Dunajec (the first part of the name sequence denotes the name of the investigated channel)
2.1.2. Working number of the channel stretch
2.1.3. Unified number of the channel stretch
2.1.4. Symbol of the topographic map, scale 1:100 000

2.2. Geology

2.2.1. Stratigraphic unit, e.g. menillitic beds
2.2.2. Lithology and tectonics

2.2.2.1.Channels cut out in a sedimentary material

2.2.2.1.1. Genetic type of sediments

A. Waste-mantle and of slope origin,
B. Alluvial
C. Glaciofluvial
D. Glacial (moraine, drift)
E. Other (specify the type)

2.2.2.1.2. Size composition of sediments

A. Clay
B. Silt
C. Sand
D. Granules (2-8 mm)

E. Pebbles (8-64 mm)
F. Cobbles (64-256 mm)
G. Boulders (>256 mm)

2.2.2.2. Channels cut out in a solid bedrock

2.2.2.2.1. The surface of outcrops in the river-bed

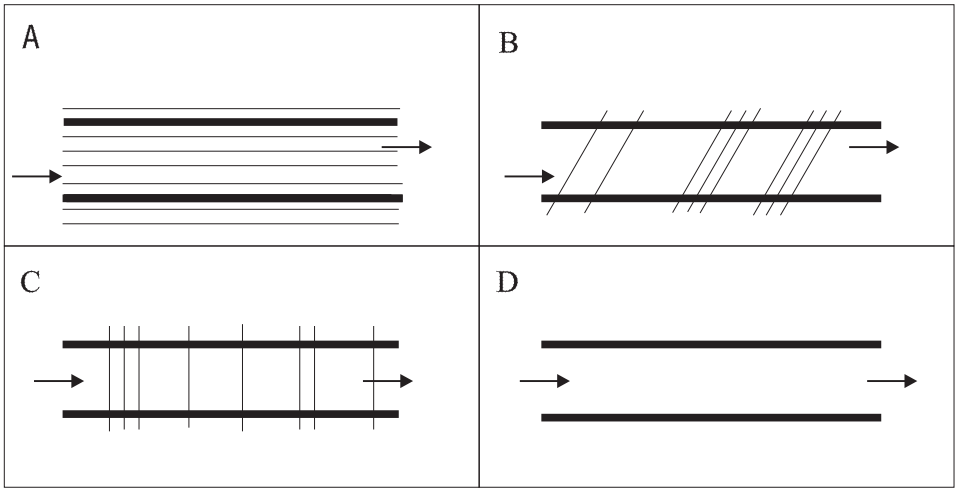
A.< 10% of the total area
B. 10-50% of the total area,
C. 50-90% of the total area
D. > 90% of the total area.

2.2.2.2.2. Bedrock lithology

sc-schist, gn-gneiss, q-quartzite, g-granite, a-andesite, c-clay, m-marl, ms-marl schist, d-dolomite, l-limestone, s-sandstone, cg-conglomerate, etc

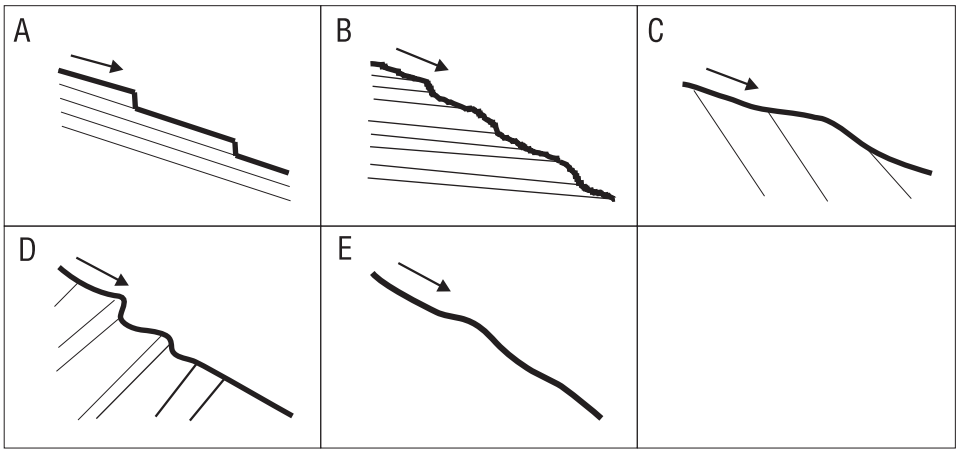
2.2.2.2.3. Course of the channel in relation to the strata

A. Parallel (a longitudinally oriented channel)
B. Oblique
C. Perpendicular (a transversaly oriented channel)
D. Neutral (in corse rock)



2.2.2.2.4. Pattern of the longitudinal profile in relation to the strata dip

A. Accordant parallel
B. Accordant convergent
C. Accordant divergent
D. Discordant
E. Neutral



2.3. Cross-section of the channel

A. Uniform, type of ... (record: e.g. A-6)
B. Predominant of ... type, locally of ... type (record: e.g. B-1/4)
C. Types .. .and ... alternatively

Geometrical cross-section types of a channel

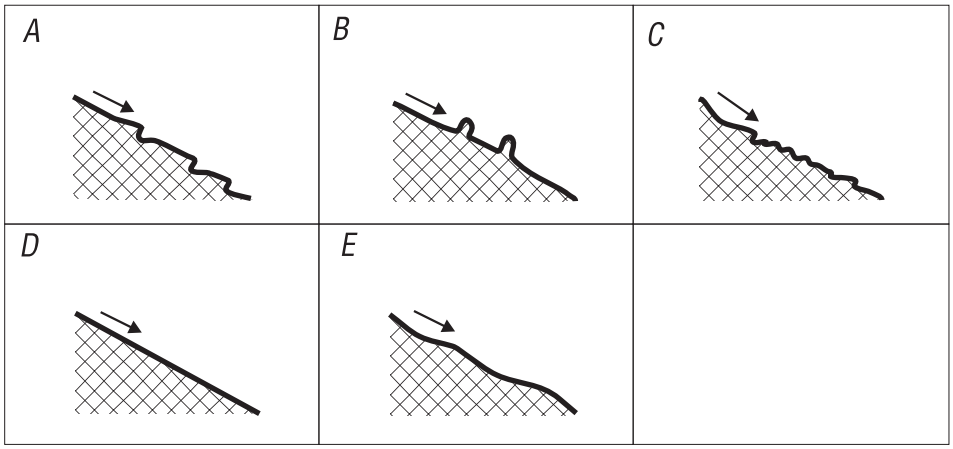
DEPTH>WIDTH		DEPTH=WIDTH		DEPTH<WIDTH		CROSS-SECTION
1	1a	2	2a	*	3a	triangular
4	4a	5	5a	6	6a	trapezoidal
7	*	8	*	9	*	rectangular
*	*	*	*	10	10a	elliptical
*	*	11	11a	12	12a	parabolic

a - asymmetrical; * - type doesn't exist

2.4. Longitudinal profile

A. Atepped
B. Toothed

C. Irregular
D. Levelled
E. Undulating



2.5. River banks

2.5.1. Appearance

A. Distinct
B. Indistinct

2.5.2. Predominant height of the natural banks [m]

0.0 - 0.5	1.0 - 1.5	2.0 - 2.5	3.0 - 4.0	and so on
0.5 - 1.0	1.5 - 2.0	2.5 - 3.0	4.0 - 5.0	

– if the banks are indistinct, their extent is determined as limit between plant cover and fresh deposits.

– if the height of the right (r) and left (l) banks differs considerably, then their height is determined separately.

2.5.3. Bank slope

A. Very gentle banks
B. Gentle banks
C. Steep banks
D. Vertical banks
E. Overhanging banks

2.5.4. River banks fixation

A. Naturally fixed
B. Artificially fixed – biologically

C. Artificially fixed – technically
D. Unfixed

2.6. Morfometry of the channel

2.6.1. Order[1]
2.6.2. Altitude (above sea level)[1]
2.6.3. River length[1]
2.6.4. Length of the river chord[1]
2.6.5. Development index[1]
2.6.6. Difference in elevation between the beginning and the end of the river stretch[1]
2.6.7. Channel gradient[1]
2.6.8. Bankfull width
(mean value of the estimation-survey in two or three sections) [m]

0.0 - 0.5	3.0 - 3.5	5 - 6	10 - 12 m	20 - 25	50 - 60
0.5 - 1.0	3.5 - 4.0	6 - 7	12 - 14	25 - 30	60 - 70
1.0 - 1.5	4.0 - 4. 5	7 - 8	14 - 16	30 - 35	70 - 80
1.5 - 2.0	4.5 - 5.0	8 - 9	16 - 18	35 - 40	80 - 90
2.0 - 2.5		9 - 10	18 - 20	40 - 45	90 - 100
2.5 - 3.0				45 - 50	and so on

2.6.9. Floodplain width [m]
(L - plain of local occurrence)

0 - 2	5 - 10	20 - 50	100 - 500
2 - 5	10 - 20	50 - 100	> 500

2.6.10. Width of sinuosity belt[1]
2.6.11. Maximum bankfull depth [m]
(mean value of the estimation-survey in two or three sections)

0.0 - 0.1	0.5 - 0.6	1.4 - 1.6	2.6 - 2.9	4.1 - 4.4
0.1 - 0.2	0.6 - 0.8	1.6 - 1.8	2.9 - 3.2	4.4 - 4.7
0.2 - 0.3	0.8 - 1.0	1.8 - 2.0	3.2 - 3.5	4.7 - 5.0
0.3-0.4	1.0 - 1.2	2.0 - 2.3	3.5 - 3.8	and so on
0.4 - 0.5	1.2 - 1.4	2.3 - 2.6	3.8 - 4.1	

[1] index calculated on the basis of aeral photographs and topographical maps

2.6.12. Channel shape index
(bankfull width to maximum bankfull depth ratio; on the basis of the data from: 2.6.8 and 2.6.11)

2.6.13. Index of river braiding (r_a)

$$r_a = \frac{q}{l_{ch}} 100$$

q - the number of islands and central bars
l_{ch} - river-stretch length

2.7. River-bed forms

2.7.1. List of river-bed forms

Enumerated should be the forms of the river-bed which occur in the characterized stretch; the order applied should reflect the frequency of their occurrence.

2.7.1.1. Bedrock forms:

A. Steps and step systems
B. Rapids
C. Bedrock floors
D. Uneven bedrock bottoms
E. Potholes and pothole systems

2.7.1.2. Forms built of deposits or cut out in the sedimentary material:

A. Debris steps and heaps
B. Alluvial bars
C. Islands (stabilized bars covered with vegetation)
D. Bar systems in the stretches of river braiding
E. Flat alluvial bottom
F. Riffles and pools
G. Erosional holes

2.7.2. Steps and step systems

2.7.2.1. Number

2.7.2.2. Predominant height
(measured from the water level) [m]

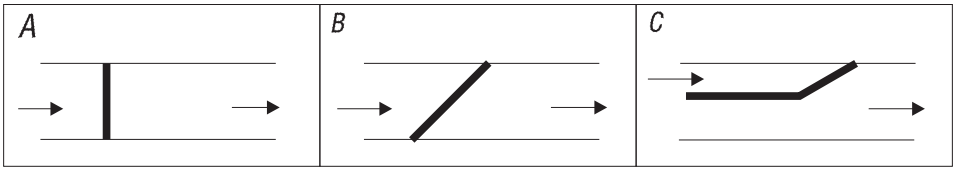
< 0.5	1.0 - 1.5	2.0 - 3.0	5.0 - 10.0
0.5 - 1.0	1.5 - 2.0	3.0 - 5.0	> 10.0

2.7.2.3. Maximum height [m] - up to:

0.5	1.5	3.0	and so on
1.0	2.0	5.0	

2.7.2.4. Step pattern in relation to the river course

A. Transverse
B. Oblique
C. Longitudinal



2.7.2.5. Lithology

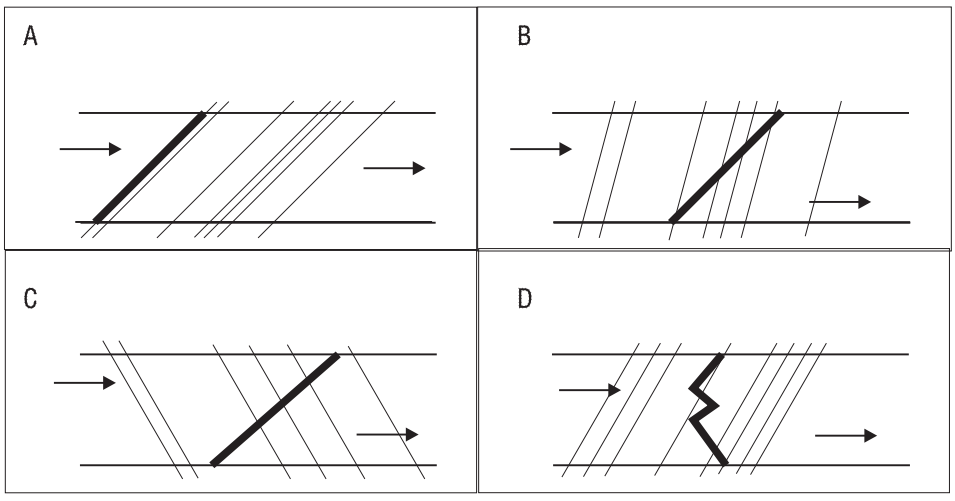
sc-schist, gn-gneiss, q-quartzite g-granite, a-andesite, c-clay, m-marl, d-dolomite, L-limestone ms-marl schist, s-sandstone, cg-conglomerate, etc.

– if a step is built of various rocks occurring side by side - e.g. Sandstone, marl and dolomite - then the fact is recorded in the diary in the following way: s/m/d.

– if the top and bottom part of the step are built of different rocks - e.g. Sandstone and argillaceous slate - then the fact is recorded in the diary in the form of a fraction: s/ms

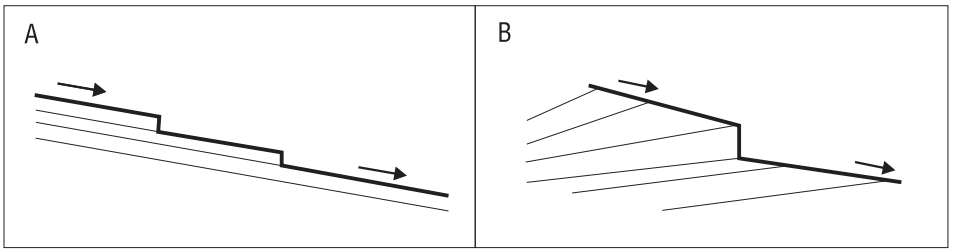
2.7.2.6. Step pattern in relation to the strata

A. Parallel (a longitudinal step)
B. Oblique (an oblique step)
C. Perpendicular (a transverse step)
D. Diversified (an irregular scarp)



2.7.2.7. Relation to the strata dip

A. Accordant steps
B. Discordant steps



2.7.3. Potholes and pothole systems

2.7.3.1. Number
2.7.3.2. Predominant depth [m]

< 0.5	1.0 - 2.0	> 5.0
0.5 - 1.0	2.0 - 5.0	

2.7.3.3. Maximum depth [m] - up to:

0.5	2.0	and so on
1.0	5.0	

2.7.3.4. Structure

A. Potholes cut out in a solid bedrock
B. Unconsolidatet sediments of alluvial or other origin

2.7.3.5. Location

A. Below the rocky steps
B. Behind the scarps
C. Between the steps
D. In the bedrock-floor
E. Within the rocky-ribs
F. In the river-bed narrowings
G. With no distinct reason
H. Below the debris heaps
I. Among the debris heaps
J. Other

2.7.3.6. Pothole groupings

A. Single potholes
B. Pothole systems

a. Occurring side by side
b. Arranged in stairway
c. Arranged in line sequences

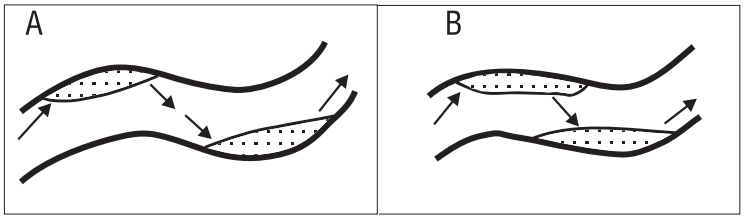
2.7.4. Riffles and pools

2.7.4.1. Number
2.7.4.2. Predominant distance between riffles or pools [m]

< 5	10 - 20	50 - 100	> 200
5 - 10	20 - 50	100 - 200	

2.7.4.3. Riffles and pools pattern

A. Riffles with removed pools
B. Riffles with overlapping pools
C. diversified or indistinct riffles and pools pattern



2.7.5. Cutbanks

2.7.5.1. Number
2.7.5.2. Predominant length [m]

< 1	5 - 10	50 - 100	200 - 300
1 - 5	10 - 50	100 - 200	300 - 500

2.7.5.3. Maximum length [m] - up to:

5	50	and so on
10	100	

2.7.5.4. Predominant height [m]

< 0.5	1 - 2	3 - 5	10 - 20
0.5 - 1.0	2 - 3	5 - 10	> 20

2.7.5.5. Maximum height [m] - up to:

0.5	2	5
1	3	and so on

2.7.5.6. The material supplied to the river-bed from the cutbanks

Origin:

A. Slope deposits
B. Alluvial
C. Fluvioglacial
D. Glacial (moraine)
E. Eolian
F. Other

Size composition:

A. Silty
B. Dusty
C. Sandy
D. Gravel (2-25 mm)
E. $Stony_1$ (25-60 mm)
F. $Stony_2$ (60-200 mm)
G. $Stony_3$ (> 200 mm)

2.7.5.7. Situation

In cross-section:

A. Left bank
B. Right bank
C. Islands' cliffs

Depending on the shape of river-banks:

A. Straight
B. Concave
C. Convex

2.7.6. Bars and islands

2.7.6.1. Number

A. Point bars
B. Central bars
C. Islands

2.7.6.2. Predominant bar length [m]

< 2	5 - 10	30 - 50	100 - 200	300 - 500
2 - 5	10 - 30	50 - 100	200 - 300	> 500

2.7.6.3. Maximum bar length [m] - up to:

2	10	50	500
5	30	100	>500

2.7.6.4. Predominant bar width [m]:

< 0.5	1-2	5-10	50-100
0.5-1.0	2-5	10-50	>100

2.7.6.5. Maximum bar width [m] - up to:

0.5	5	50
1	10	100
2	20	>100

2.7.6.6. Size composition

A. Clay
B. Dust
C. Sand
D. Gravel (2-25 mm)
E. $Stony_1$ (25-60 mm)
F. $Stony_2$ (60-200 mm)
G. $Stony_3$ (200-500 mm)
H. > 500 mm

2.7.7. Floodplain

2.7.7.1. Floodplain microrelief

A. Flat plain
B. System of stairway plains
C. Plain with abandoned channels
D. Plain with natural levees
E. Plain with a system of scroll bars

2.7.7.2. Natural levees

A. Single, with the height of [m]

< 0.1	0.1 - 0.5

B. Levee systems, up to the height of [m]

0.5 - 1.0	> 1.0

2.7.7.3. Abandoned channels in the floodplain

Preservation condition:

A. Traces of paleochannels
B. Single, of local occurrence
C. Paleochannel systems, of common occurrence

Course:

A. Straight
B. Meandering

2.7.7.4. Vegetation cover or land-use of the floodplain

A. No soil-vegetation cover
B. Osier bed
C. Forest
D. Meadow
E. Arable field

2.8. Channel deposits

2.8.1. Deposit thickness [m]

< 0.05	up to 0.3	up to 1.0
up to 0.1	up to 0.5	> 1.0 m

2.8.2. Size composition

2.8.2.1. Predominant size of material

A. Clay
B. Dust
C. Sand
D. Gravel (25-60 mm)
E. Stony$_1$ (25-60 mm)
F. Stony$_2$ (60-200 mm)
G. Stony$_3$ (over 200 mm)

2.8.2.2. Maximum size

It is determined by measuring the mean axis of ten biggest class and then calculating the arithmetic mean value.

2.8.3. Petrographical composition

In a flysch drainage basins we estimate the percentage of sandstones. In a catchment built of different rocks we determine the percentage of rock which is predominant in a given drainage basins.

Percentage ranges:

>10%	10-50%
50-90%	> 90%

2.8.4. Channel-bed sedimentary structure

– in case of coarse material (stone or gravel size):

A. Chaotic structures
B. Single cobbles revealing imbrication and lineation
C. Numerous cobbles revealing imbrication and lineation

– in a case of sands, as well as a finer sediments we determine the sedimentary structures:

D. Flat bottom with no ripples
E. Single ripples
F. Numerous ripples
G. Megaripples
H. Other structures.

2.8.5. Bed armouring

A. No armouring
B. Only in the point bars
C. Only in the central bars
D. General

We record the armouring by means of a size, where in the numerator we record the size of armouring particles and in the denominator the armoured ones, e.g.: 60-100 mm/2-5 mm

2.9. Channel regulation structures

2.9.1. System of lining

Enumerated should be the kinds of water structures, or the system of hydrotechnical lining should be specified in a concise form

2.9.1.1. Number of water structures
2.9.1.2. Structure height
2.9.1.3. Structure width
2.9.1.4. Structure length
2.9.1.5. Building material
2.9.1.6. Lining year
2.9.1.7. Preservation condition
2.9.1.8. Degree of basin filling

2.10. River-bed type

According to four principal criteria:

A. Channel pattern
B. Kind of rocks in which the channel is cut out
C. Floodplain presence
D. Lateral stability of the channel

The type of the channel is determined on the basis of the table (see page 24).

3. HYDRODYNAMIC CHARACTERISTICS OF THE STREAM

3.1. Standing wave

(the behaviour of the standing wave should be observed in several places of the river stretch, always in the current)

A. Does not occur
B. Moves downstream and disappears very quickly
C. Moves downstream and disappears relatively slowly, moves also upstream and disappears quickly
D. Moves also upstream and disappears relatively slowly

3.2. Maximum water stages

3.2.1. Information source

A. Interview
B. Traces of high water levels on bridge piers
C. Traces of high water levels on the floodplain and other

3.2.2. Water stage value and its occurrence date
3.2.3. Measurement methods

4. HYDRO-METEOROLOGICAL CONDITIONS OF THE RESEARCH PERIOD

4.1. Water stages

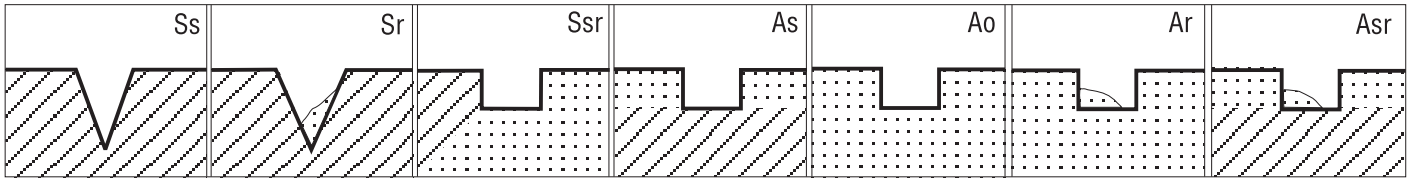
4.1.1.Actuel water stages

A. Extremely low water
B. Low water
C. High water

4.1.2. Water stages in period preceding research (last week)
4.1.3. Water stages during last catastrophic (very high) flood

			Channel pattern									
			Straight		Meandering				Braided			
			Withaut flood plain	With flood plain	Irregular		Regular		Within Floodplain		Within channel	
					Withaut flood plain	With flood plain	Withaut flood plain	With flood plain	Two-thread	Multi-thread	Two-thread	Multi-thread
Litho logy	Bedrock channel	ss**	1a	1b	2a	2b	3a	3b	*	*	*	*
		Sr	1c	1d	2c	2d	3c	3d				
		Ssr	1e	1f	2e	2f	3e	3f				
	Alluvial channel	As	4a	4b	5a	5b	6a	6b	7a	7b	8a	8b
		Ao	4c	4d	5c	5d	6c	6d	7c	7d		
		Ar	4e	4f	5e	5f	6e	6f	7e	7f	8c	8d
		Asr	4g	4h	5h	6g	6h	7g	7h			

* - type doesn't exist



5. MORPHOMETRY OF THE RIVER DRAINAGE BASIN

5.1. Catchment basin area[1]
5.2. Maximum catchment basin length[1]
5.3. Catchment basin shape index[1]
5.4. Valley systems length[1]
5.5. Drainage density [1]
5.6. Integration index[1]
5.7. Forested area[1]
5.8. Woodiness index [1]
5.9. Grassland area [1]
5.10. Arable land area[1]
5.11. Others

[1] index calculated on the basis of aeral photographs and topographical maps