REPORTS FROM TESTING THE STATIC METHOD TO ASSESS CUMULATIVE EFFECT OF N(S)WRM (PILOT ACTION)

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Pilot Catchment Aist/Austria

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1. INTRODUCTION

The purpose of developing the StaticTool method and the computer application StaticTool.xlsm is to enable the estimation of the effects of the implementation of a program of natural, small water retention measures (PoNSWRM) in a simplified way, which does not require the time-consuming and costly development of detailed models, hydrological or / and hydraulic, of the analysed catchment. This estimate is a grading, based on expert knowledge and is used to compare variants of the NSWRM program.

The potential effects of individual NSWRM may be different, depending on the climatic and physiographic conditions (e.g. slopes, ground permeability) of the analysed area, so the method parameters should be adapted to local conditions (climate type, landscape type). The StaticTool method thus consists of two parts:

- developing method parameters for local conditions,
- estimation of the effects of activities planned under the Natural Small Water Retention Program.

The StaticTool method assumes that the expected effect of the PoNSWRM is to improve catchment retention properties, which is understood as increasing low flows (LowQ), reducing high flows (HighQ) and / or limiting the load of pollutants yielded from the catchment area (Qual). This effect depends on the planned measures, in particular: i) their type and ii) the level of intensity. The measures included in the StaticTool method are summarized in the local catalogue of measures. For each measure, an intensity criterion is formulated, and threshold values are defined that correspond to the characteristic intensity levels (low, medium, high). Each measure is also assigned the expected improvement of retention properties of the SPU, expressed on a point scale (0-5 points). The greatest improvement that can be achieved (maximum points for a given measure) corresponds to the implementation of the measure with maximum intensity. For lower intensity levels, the assigned grades are proportional to the level of intensity of planned measure. Hence, developing parameters of the StaticTool method means defining a set of functions that make grade assessment dependent on the type of planned measures and their intensity for each measure from the local catalogue.

The StaticTool method and the StaticTool.xlsm application were developed as part of the project FramWat, Work Package T2 (Effectiveness of the Natural Small Water Retention Measure), activity A.T2.2 (Developing the GIS based method to assess cumulative effect of N(S)WRM at the river basin scale), deliverable D.T2.2.1 (Static method to assess cumulative effect of N(S)WRM in the river basins). A detailed description of the methodology is in a separate file created by the author of the program. This report presents the results of testing the static method (StaticTool.xlsm) to assess cumulative effect of N(S)WRM for the Pilot Catchment Kamienna.

2. DESCRIPTION OF INPUT DATA PREPARATION

The first step of the StaticTool program procedure is the selection of N(S)WRM types and variants for which calculations will be carried out.

For the pilot catchment Aist we analysed two variants (also in the dynamic modelling approach):

1. **Variant 1 „Maximum possible implementation“**

   The maximum possible implementation of selected measure types is being analysed to determine the maximal possible effects at catchment scale.

2. **Variant 2 Local measures variant**

   Based on habitat and sediment hotspots (identified in the status quo analyses of the catchment) and on stakeholder requirements a set of selected NSWRMs is located in selected sub-catchments and in upstream areas (see Fig 1).

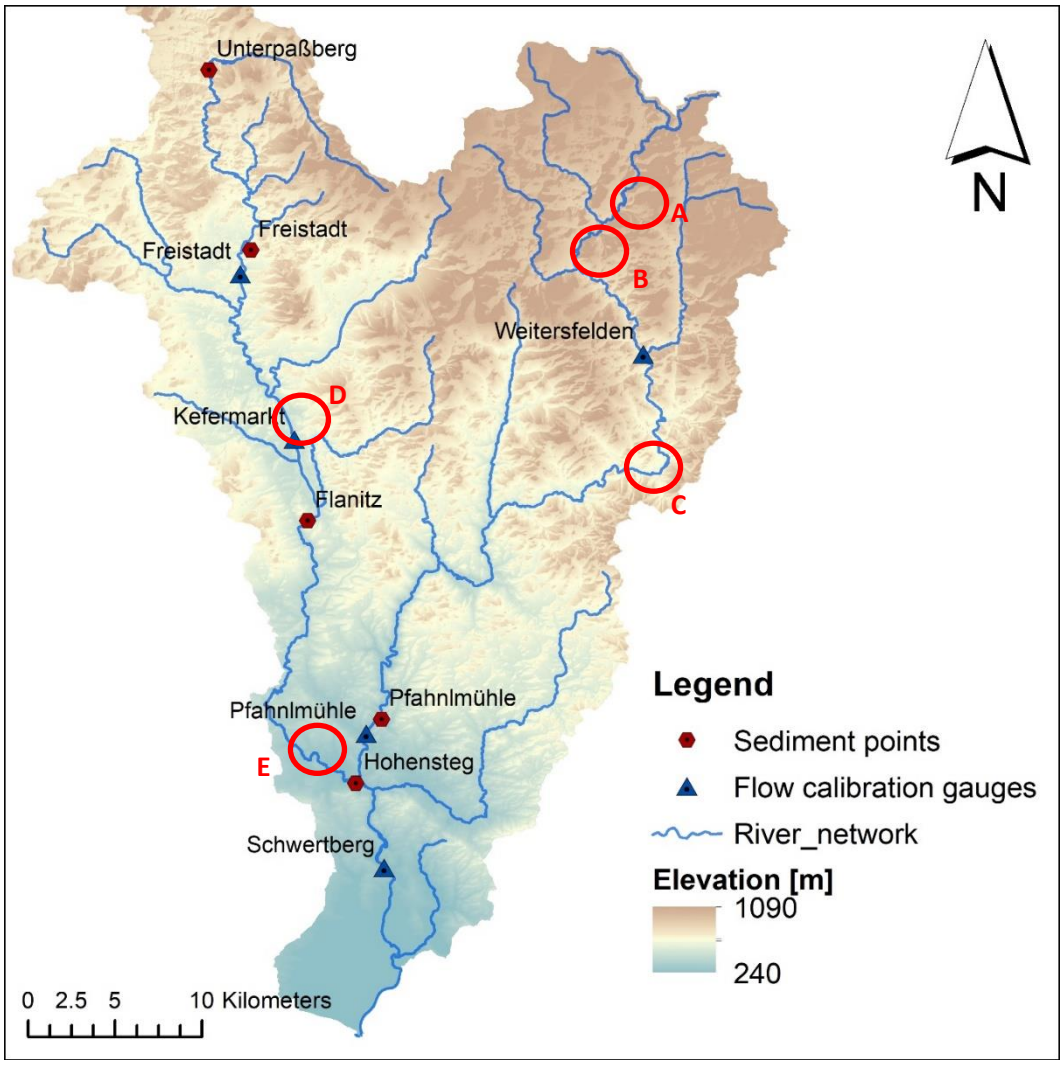

Figure 1 – The pilot catchment Aist and position of the reaches identified for testing the impact of NSWRMs

For the pilot catchment Aist we selected the following measure types:

1. **Vegetated Buffer Strips A02**

   A Vegetated buffer (or filter) strip is a strip of dense vegetation located i.a. along streams and rivers to intercept runoff from upslope pollutant sources and filter it.

2. **Hydromorphological Improvements / Natural channels and best practices of river channel maintenance BPRC**

   Hydromorphological improvements include several measures aiming at improving river channel conditions (channel widening, riverbed naturalizations, natural bank stabilisation…).

3. **Sediment Ponds / Best practices on drained areas BPDA**

   Sediment Ponds are located off stream, receive water from the sub-catchment they are located in and their outflow operates in a simplified way.

The identification of measures types and geographical position is based on the values of the predictors that are used in the random forest model that estimates the sand accumulation risk. Hydrological, sediment loads, and hydraulic predictors were analysed.

Sub-catchments were identified for sediment ponds BPDA, corresponding to the hotspots of sediment production in the upstream area. The sub-catchment sediment production (t/y) was used as criterion for the prioritization (Tables in appendix A). Sediment ponds were located in the area upstream of the accumulation hotspots. Up to a maximum of 3 sub-catchments were identified for each site to locate sediment ponds.

The same set of hydromorphological improvements (BPRC measures) were defined both for the maximum implementation variant and also for the measures variant for local improvement assessment. The reason for this is that the sites with bad hydromorphological status are supposed to be improved by law (Figure B1 in Appendix B).

Buffer strips were implemented as well in the 5 upstream sub-catchments with the highest sediment production.

Figure 2 shows the pilot catchment Aist divided into 103 sub-catchments. Table 1 gives an overview on the measures variant with selected measure types and sub-catchments.

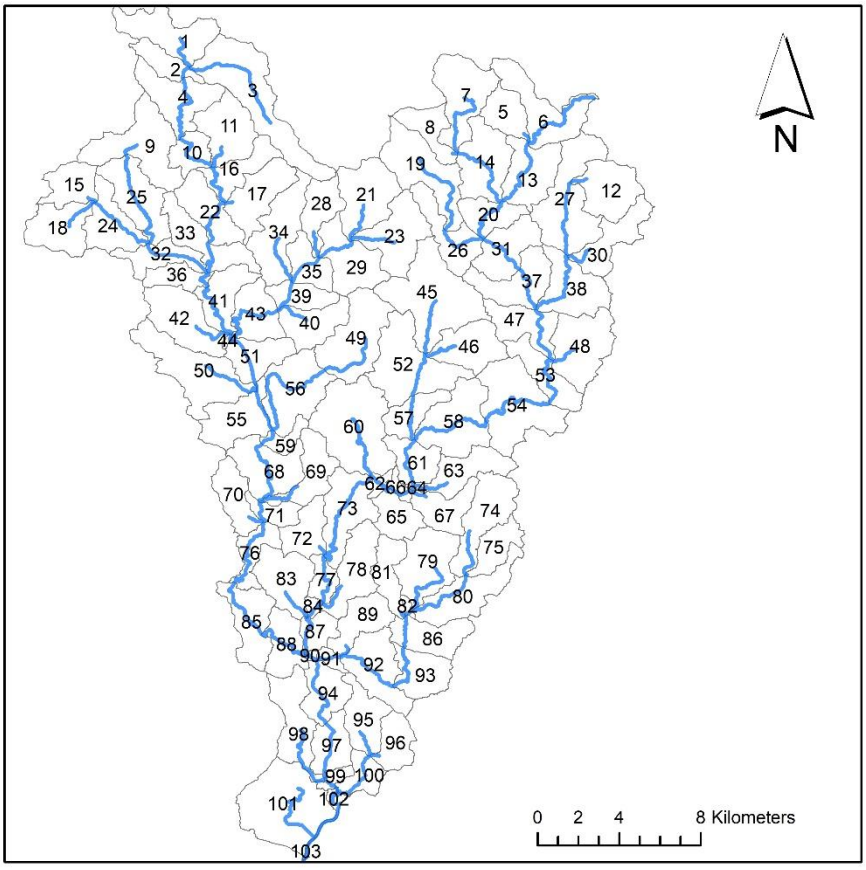

Figure 2 – Subcatchments (out of SWAT)

Tab. 1 The measures variant for the Aist catchment, chosen sub-catchments and measure types

Site A, Sub-catchment 13		
Measures	**Related sub-catchments**	**Rationale for the choice**
Sediment ponds (BPDA)	13	Responsible for 50% of sediment generation
Vegetated filter strips (A02)	13, 6	Responsible for 100% of sediment generation
Hydromorphological improvements (BPRC)	13, 6	Main channel, where WFD assessment is available
Site B, Sub-catchment 20		
Measures	**Related sub-catchments**	**Rationale for the choice**
Sediment ponds (BPDA)	13, 6	Responsible for 50% of sediment generation
Vegetated filter strips (A02)	13, 6, 20, 8, 7	Responsible for 90% of sediment generation
Hydromorphological improvements (BPRC)	13, 6, 20	Main channel, where WFD assessment is available
Site C, Sub-catchment 54		
Measures	**Related sub-catchments**	**Rationale for the choice**
Sediment ponds (BPDA)	54, 48, 13, 6	Responsible for 32% of sediment generation
Vegetated filter strips (A02)	54, 48, 19, 47, 38	Responsible for 50% of sediment generation
Hydromorphological improvements (BPRC)	54, 53, 47, 37, 31, 20, 13, 6	Main channel, where WFD assessment is available
Site D, Sub-catchment 51		
Measures	**Related sub-catchments**	**Rationale for the choice**
Sediment ponds (BPDA)	34	Responsible for 15% of sediment generation
Vegetated filter strips (A02)	34, 42, 32, 3, 11	Responsible for 50% of sediment generation
Hydromorphological improvements (BPRC)	3, 4, 10, 16, 22, 33, 36, 41, 44, 51	Main channel, where WFD assessment is available
Site E, Sub-catchment 85		
Measures	**Related sub-catchments**	**Rationale for the choice**
Sediment ponds (BPDA)	34, 50	Responsible for 25% of sediment generation
Vegetated filter strips (A02)	34, 50, 42, 32, 3	Responsible for 45% of sediment generation
Hydromorphological improvements (BPRC)	3, 4, 10, 16, 22, 33, 36, 41, 44, 51, 50, 55, 59, 68, 71, 76, 85	Main channel, where WFD assessment is available

At the initial stage, individual N(S)WRMs were merged under one of the selected measure types and then aggregation was performed. Aggregated measures include a group of measures whose implementation in a similar way improves the retention properties of the catchment area, where assessment of the effects of individual activities, without detailed field or model studies at the current level of knowledge, is not possible.

Tab. 2 Aggregated measures for the Aist catchment for maximum implementation variant and measures variant

No	Measure Code	Measure Description (NWRM/NSWRM)	Aggregated measure ID	Aggregated measure type
1	A02	Buffer strips and hedges	**A02**	Vegetated Filter strips
2	N05	Stream bed re-naturalization	**BPRC**	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance
3	N07	Reconnection of oxbow lakes and similar features	**BPRC**	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance
4	N08	Riverbed material renaturalization	**BPRC**	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance
5	N10	Natural bank stabilisation	**BPRC**	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance
6	N11	Elimination of riverbank protection	**BPRC**	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance
7	D01	Regulated outflow from drainage systems	**BPDA**	Sediment ponds BPDA - Best practices on drained areas
8	D02	Water damming in ditches, wires with constant crest (valleys)	**BPDA**	Sediment ponds BPDA - Best practices on drained areas
9	D03	Active water management on a drainage system (river valleys)	**BPDA**	Sediment ponds BPDA - Best practices on drained areas
10	D04	Construction of micro reservoirs on ditches	**BPDA**	Sediment ponds BPDA - Best practices on drained areas
11	D05	Infiltration reservoirs and ditches (similar to N13)	**BPDA**	Sediment ponds BPDA - Best practices on drained areas
12	D06	Construction of reservoirs on outflows from drainage systems	**BPDA**	Sediment ponds BPDA - Best practices on drained areas

For each measure the intensity criteria and the threshold values for characteristic intensity levels were defined. According to the assumptions of the StaticTool method, the expected improvement in the catchment retention properties depends on the type and level of intensity of planned measures. Three levels of measures' intensity were distinguished: low, medium and high. They correspond to three levels of expected improvement in the catchment retention properties (e.g. small, average and large). Four threshold values were used: T0 – no action, Tlow – the boundary between low and medium intensity, Thigh – the limit between medium and high intensity and Tmax, which corresponds to the maximum (hypothetically) possible intensity of measure. Additionally, the impact of aggregated measures on three elements of the catchment retention properties (low flows, high flows and erosion), with maximum intensity of measures' application was assessed. The tables below show the parameters used for calculations in the maximum implementation and measures variants (Tables 3, 4).

Tab. 3 The assessment of the impact of aggregated measures on three elements of the catchment retention properties (scale 0 - 5, where 0 means no positive impact on the retention of the catchment area, and 5 – very high positive impact) – for maximum implementation variant and measures variant

No	Code	Aggregated measure name	Low flows	High flows	Qual Erosion	AVG
1	A02	Vegetated Filter strips	0	0	3	1,00
2	BPRC	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance	1	4	0	1,67
3	BPDA	Sediment ponds BPDA - Best practices on drained areas	3	3	3	3,00

Tab 4 List of parameters for measures in maximum implementation variant and measures variant

AggregN	3				Intensity thresholds					Grade thresholds [%]				Grade values			
No sort_AVG	No	Measure ID	Aggregated English	Definition of the intensity criteria in English	T0	Tlow	Thigh	Tmax	Grade_max	E%0	E%low	E%high	E%max	E0	Elow	Ehigh	Emax
1	1	A02	Buffer strips and hedges	km2 vegetated buffer strip/km2 sub-catchment area	0,00	0,00	0,05	0,10	2	0	60	95	100	0,00	1,20	1,90	2,00
2	2	BPRC	Hydromorphological improvements BPRC - Natural channels and best practices of river channels maintenance	km2 river channel improved/km2 river channel in sub-catchment	0,00	0,10	0,30	1,00	3	0	60	95	100	0,00	1,80	2,85	3,00
3	3	BPDA	Sediment ponds BPDA - Best practices on drained areas	km2 of covered area/km2 sub-catchment area	0,00	0,20	0,60	1,00	5	0	20	60	100	0,00	1,00	3,00	5,00

3. MODIFICATIONS TO THE DEFAULT STATICTOOLS.XLSX TOOL PARAMETERS

Our aim is to compare the static tool results with the dynamic modelling results, therefore we had to adapt the default settings of the static tool excel spreadsheet to catchment and model specific assumptions. For the pilot catchment Aist the intensities for threshold values (Table 4) and the impact values (Table 3) were changed to be consistent with the SWAT assumptions in the dynamic modelling approach

Original parameters for measures impact were modified to match the expert opinion and the scientific literature (Table 3):

- Sediment trapping efficiencies for sediment ponds are between 50% and 100%, with average values of 75% (Verstraeten and Poesen, 2002, 2001, 2000). Therefore an impact of 3 was chosen for high and low flows and for sediments aspect.
- Vegetated filter strips efficiencies in Upper Austria are between 20% and 40% (Zessner et al., 2019). Little effects on hydrology are observed, therefore an impact of 0 was chosen for water component and an impact of 3 was chosen for sediments.
- Hydromorphological improvements are useful to slow down high flows, and are not effective during low flows. Direct sediment trapping is limited (Flödl and Hauer, 2019; Hauer, 2015) and related only to hydrodynamic fields modifications. Therefore an impact of 4 for high flows, 1 for low flows and 0 for sediments were chosen.

The thresholds were decided based on expert opinion as well:

- Sediment ponds are supposed to be applied to all the SPU. The area of the SPU that is in a 200 m buffer from water bodies was removed. Therefore on average only 60 % of the SPU is covered on average by sediment ponds (T high), low intensity implementation (T low) was assumed to be 20%.
- Hydromorphological improvements are applied only to small fractions of the reaches that are in a bad hydromorphological status. T high was set to 30% and T low to 10%
- Vegetated filter strips application range generally varies between 20 and 200 m2 of land per m2 of VFS (Neitsch et al., 2011). Therefore, T high was set to 0.05 and T low to 0.0025.

4. DESCRIPTION OF RESULTS

4.1 For the maximum potential implementation variant

The results of the assessment were obtained from the StaticAssessment tab (Tab. 5). This tab contains a table with the cumulative assessment for the entire catchment and partial assessments for each group of measures and for each sub-catchment.

Maximum potential variant improves the situation with a rank of 5.68; measures variant improves the situation with a rank of 1.59.

Highest improvements are for downstream SPUs, with ID 99, 97, 94, 71, 88 and 83. Most of these SPUs are located in the Aist.

Tab. 5 Assessment of the effectiveness of the maximum potential implementation variant

Number of measures	3		Grading of the Program of Small Water Retention Measures				
Number of SPUs	103	Measure No.	1	2	3		Catchment grade for current variant
Grade for a measure (total by SPUs):			155,64	126,00	320,03		5,68
No.	SPU Id	Measure Id by User	A02	BPRC	BPDA		SPU grades
		F_SPU [km^2]	km2/km2	km2/km2	km2/km2		
4	SPU_04	7,49	1,51	1,80	3,53		6,84
5	SPU_05	4,15	1,51		2,84		4,35
6	SPU_06	8,63	1,51	1,95	3,25		6,71
7	SPU_07	8,82	1,51		1,59		3,10
8	SPU_08	4,10	1,51		3,36		4,87
9	SPU_09	10,49	1,51		3,24		4,75
10	SPU_10	3,34	1,51	2,90	3,31		7,72
11	SPU_11	7,26	1,51		3,78		5,29
12	SPU_12	6,97	1,51	1,07	3,48		6,06
13	SPU_13	7,25	1,51	2,86	3,20		7,57
14	SPU_14	8,17	1,51	3,00	3,41		7,92
15	SPU_15	4,55	1,51		3,45		4,96
16	SPU_16	4,78	1,51	2,90	3,31		7,72
17	SPU_17	6,90	1,51		3,43		4,94
18	SPU_18	6,50	1,51		3,58		5,09
19	SPU_19	9,78	1,51		3,50		5,02
20	SPU_20	4,23	1,51	2,91	3,41		7,83
21	SPU_21	8,29	1,51		3,74		5,25
22	SPU_22	6,11	1,51	3,00	2,62		7,14
23	SPU_23	8,13	1,51		3,46		4,97
24	SPU_24	6,38	1,51		3,46		4,97
25	SPU_25	8,02	1,51		3,66		5,17
26	SPU_26	6,03	1,51		3,45		4,96
27	SPU_27	12,00	1,51		3,80		5,31
28	SPU_28	4,65	1,51		3,63		5,14
29	SPU_29	7,35	1,51		3,94		5,45
30	SPU_30	5,80	1,51		2,75		4,26
31	SPU_31	6,31	1,51	1,94	3,23		6,69
32	SPU_32	4,43	1,51		3,49		5,00
33	SPU_33	6,48	1,51	2,98	3,72		8,22
34	SPU_34	8,65	1,51		3,58		5,09
35	SPU_35	4,02	1,51		3,84		5,35
36	SPU_36	3,11	1,51	2,92	3,58		8,01
37	SPU_37	6,90	1,51	2,33	3,56		7,41
38	SPU_38	7,57	1,51	2,85	3,06		7,42
39	SPU_39	3,55	1,51		3,52		5,03
40	SPU_40	5,53	1,51		3,71		5,22
41	SPU_41	5,43	1,51	2,98	3,47		7,96
42	SPU_42	8,36	1,51	3,00	3,46		7,97
43	SPU_43	5,66	1,51		3,40		4,91
44	SPU_44	0,22	1,51	3,00	3,25		7,76
45	SPU_45	14,58	1,51		3,10		4,61
46	SPU_46	6,44	1,51		1,49		3,00
47	SPU_47	5,75	1,51	1,81	3,22		6,54
48	SPU_48	8,78	1,51		3,17		4,68
49	SPU_49	10,07	1,51		2,77		4,29
50	SPU_50	11,33	1,51	3,00	3,37		7,88

51	SPU_51	5,07	1,51	3,00	3,69		**8,20**
52	SPU_52	11,49	1,51		2,36		**3,87**
53	SPU_53	5,28	1,51	1,23	3,12		**5,86**
54	SPU_54	12,34	1,51	2,86	2,70		**7,08**
55	SPU_55	6,81	1,51	3,00	3,71		**8,22**
56	SPU_56	9,29	1,51	3,00	3,81		**8,32**
57	SPU_57	4,04	1,51		2,83		**4,34**
58	SPU_58	9,41	1,51	2,86	3,09		**7,46**
59	SPU_59	1,93	1,51	2,98	3,52		**8,01**
60	SPU_60	13,93	1,51		2,17		**3,68**
61	SPU_61	4,50	1,51	2,87	2,63		**7,01**
62	SPU_62	0,88	1,51	3,00	3,02		**7,52**
63	SPU_63	5,80	1,51		2,41		**3,93**
64	SPU_64	0,08	1,51	2,90	2,93		**7,34**
65	SPU_65	4,19	1,51		2,56		**4,08**
66	SPU_66	0,99	1,51	2,89	2,54		**6,94**
67	SPU_67	4,93	1,51		3,09		**4,60**
68	SPU_68	7,55	1,51	2,91	3,50		**7,93**
69	SPU_69	5,64	1,51		2,70		**4,21**
70	SPU_70	4,84	1,51		3,42		**4,93**
71	SPU_71	2,55	1,51	2,95	4,01		**8,47**
72	SPU_72	4,57	1,51				**1,51**
73	SPU_73	8,07	1,51	2,93	3,11		**7,55**
74	SPU_74	7,86	1,51		1,69		**3,20**
75	SPU_75	4,02	1,51				**1,51**
76	SPU_76	3,76	1,51	2,89	3,68		**8,08**
77	SPU_77	2,42	1,51	2,93	3,60		**8,04**
78	SPU_78	6,92	1,51		3,11		**4,63**
79	SPU_79	8,18	1,51				**1,51**
80	SPU_80	7,70	1,51		3,28		**4,79**
81	SPU_81	4,26	1,51		0,86		**2,37**
82	SPU_82	0,41	1,51		2,31		**3,82**
83	SPU_83	7,03	1,51	3,00	3,81		**8,32**
84	SPU_84	0,66	1,51	2,98	3,36		**7,85**
85	SPU_85	6,87	1,51	1,88	2,94		**6,33**
86	SPU_86	5,70	1,51		2,37		**3,88**
87	SPU_87	2,76	1,51	2,93	3,63		**8,08**
88	SPU_88	5,15	1,51	2,89	4,00		**8,40**
89	SPU_89	5,09	1,51		1,99		**3,50**
90	SPU_90	0,26	1,51	2,94	2,22		**6,67**
91	SPU_91	1,00	1,51		3,05		**4,56**
92	SPU_92	7,81	1,51		2,65		**4,16**
93	SPU_93	5,45	1,51		1,73		**3,24**
94	SPU_94	5,19	1,51	2,96	4,20		**8,67**
95	SPU_95	5,49	1,51		4,04		**5,55**
96	SPU_96	4,19	1,51		2,52		**4,03**
97	SPU_97	4,62	1,51	3,00	4,26		**8,78**
98	SPU_98	7,34	1,51		4,14		**5,65**
99	SPU_99	1,16	1,51	3,00	4,30		**8,81**
100	SPU_100	3,17	1,51		3,97		**5,48**
101	SPU_101	14,27	1,51		4,82		**6,33**
102	SPU_102	0,82	1,51	3,00	2,07		**6,58**
103	SPU_103	0,13	1,51	3,00	0,88		**5,39**

4.2 For the measures variant

Also for this variant the highest improvement is for downstream SPUs; 99, 97, 94. However, improvement is observed also for SPUs 71, 88, 83 (Waldaist) and 56, 55, 51 (Feldaist). Little room for improvement is in the small tributaries and in the upstream parts of the catchment.

Tab.6 Assessment of the effectiveness of the measures variant

Number of measures	3		Grading of the Program of Small Water Retention Measures				
Number of SPUs	103	Measure No.	1	2	3		Catchment grade for current variant
Grade for a measure (total by SPUs):			21,16	126,00	19,28		1,59
No.	SPU Id	Measure Id by User	A02	BPRC	BPDA		SPU grades
		F_SPU [km^2]	km2/km2	km2/km2	km2/km2		
1	SPU_01	7,78					0,00
2	SPU_02	3,23					0,00
3	SPU_03	14,08	1,51				1,51
4	SPU_04	7,49		1,80			1,80
5	SPU_05	4,15					0,00
6	SPU_06	8,63	1,51	1,95	3,25		6,71
7	SPU_07	8,82					0,00
8	SPU_08	4,10					0,00
9	SPU_09	10,49					0,00
10	SPU_10	3,34		2,90			2,90
11	SPU_11	7,26	1,51				1,51
12	SPU_12	6,97		1,07			1,07
13	SPU_13	7,25	1,51	2,86	3,20		7,57
14	SPU_14	8,17		3,00			3,00
15	SPU_15	4,55					0,00
16	SPU_16	4,78		2,90			2,90
17	SPU_17	6,90					0,00
18	SPU_18	6,50					0,00
19	SPU_19	9,78	1,51				1,51
20	SPU_20	4,23	1,51	2,91			4,42
21	SPU_21	8,29					0,00
22	SPU_22	6,11		3,00			3,00
23	SPU_23	8,13					0,00
24	SPU_24	6,38					0,00
25	SPU_25	8,02					0,00
26	SPU_26	6,03					0,00
27	SPU_27	12,00					0,00
28	SPU_28	4,65					0,00
29	SPU_29	7,35					0,00

30	SPU_30	5,80					**0,00**
31	SPU_31	6,31		1,94			**1,94**
32	SPU_32	4,43	1,51				**1,51**
33	SPU_33	6,48		2,98			**2,98**
34	SPU_34	8,65	1,51		3,58		**5,09**
35	SPU_35	4,02					**0,00**
36	SPU_36	3,11		2,92			**2,92**
37	SPU_37	6,90		2,33			**2,33**
38	SPU_38	7,57	1,51	2,85			**4,36**
39	SPU_39	3,55					**0,00**
40	SPU_40	5,53					**0,00**
41	SPU_41	5,43		2,98			**2,98**
42	SPU_42	8,36	1,51	3,00			**4,51**
43	SPU_43	5,66					**0,00**
44	SPU_44	0,22		3,00			**3,00**
45	SPU_45	14,58					**0,00**
46	SPU_46	6,44					**0,00**
47	SPU_47	5,75	1,51	1,81			**3,32**
48	SPU_48	8,78	1,51		3,17		**4,68**
49	SPU_49	10,07					**0,00**
50	SPU_50	11,33	1,51	3,00	3,37		**7,88**
51	SPU_51	5,07		3,00			**3,00**
52	SPU_52	11,49					**0,00**
53	SPU_53	5,28		1,23			**1,23**
54	SPU_54	12,34	1,51	2,86	2,70		**7,08**
55	SPU_55	6,81		3,00			**3,00**
56	SPU_56	9,29		3,00			**3,00**
57	SPU_57	4,04					**0,00**
58	SPU_58	9,41		2,86			**2,86**
59	SPU_59	1,93		2,98			**2,98**
60	SPU_60	13,93					**0,00**
61	SPU_61	4,50		2,87			**2,87**
62	SPU_62	0,88		3,00			**3,00**
63	SPU_63	5,80					**0,00**
64	SPU_64	0,08		2,90			**2,90**
65	SPU_65	4,19					**0,00**
66	SPU_66	0,99		2,89			**2,89**
67	SPU_67	4,93					**0,00**

68	SPU_68	7,55		2,91			2,91
69	SPU_69	5,64					0,00
70	SPU_70	4,84					0,00
71	SPU_71	2,55		2,95			2,95
72	SPU_72	4,57					0,00
73	SPU_73	8,07		2,93			2,93
74	SPU_74	7,86					0,00
75	SPU_75	4,02					0,00
76	SPU_76	3,76		2,89			2,89
77	SPU_77	2,42		2,93			2,93
78	SPU_78	6,92					0,00
79	SPU_79	8,18					0,00
80	SPU_80	7,70					0,00
81	SPU_81	4,26					0,00
82	SPU_82	0,41					0,00
83	SPU_83	7,03		3,00			3,00
84	SPU_84	0,66		2,98			2,98
85	SPU_85	6,87		1,88			1,88
86	SPU_86	5,70					0,00
87	SPU_87	2,76		2,93			2,93
88	SPU_88	5,15		2,89			2,89
89	SPU_89	5,09					0,00
90	SPU_90	0,26		2,94			2,94
91	SPU_91	1,00					0,00
92	SPU_92	7,81					0,00
93	SPU_93	5,45					0,00
94	SPU_94	5,19		2,96			2,96
95	SPU_95	5,49					0,00
96	SPU_96	4,19					0,00
97	SPU_97	4,62		3,00			3,00
98	SPU_98	7,34					0,00
99	SPU_99	1,16		3,00			3,00
100	SPU_100	3,17					0,00
101	SPU_101	14,27					0,00
102	SPU_102	0,82		3,00			3,00
103	SPU_103	0,13		3,00			3,00

4.3 Comparison of variants

Maximum potential variant improves the situation with a rank of 5.68; measures variant improves the situation with a rank of 1.59.

The differences between variants result mainly from the spatial distribution, structure and number of planned measures.

5. CONCLUSIONS

- When comparing variants, the same SPU layer has to be used, so that the results correspond with each other and are comparable
- StaticTool.xlsm is a good solution to enable the estimation of the effects of the implementation of a program of natural, small water retention measures (PoNSWRM) in a simplified way, which does not require the time-consuming and costly development of detailed hydrological or/and hydraulic models of the analysed area (catchment).
- Static Tool.xlsm is easy to use with the default values; for detailed catchment specific analyses expert knowledge is needed.

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7. APPENDIX A

Appendix A: Tables with subcatchmetns rankings

Site A, subcatchment 13

subcatchments	AREAkm2	Average of WYLDmm	Average of SYLDt_ha	Max of SYLDt_ha	YIELD (t/ha y)	Sed out (t/y)	%
13	7.25	55.48	0.02	0.293	0.23	168.97	49.48
6	8.63	55.76	0.02	0.178	0.18	157.41	46.09
5	4.15	54.85	0.00	0.075	0.04	15.12	4.43

Site B, subcatchment 20

subcatchments	AREAkm2	Average of WYLDmm	Average of SYLDt_ha	Max of SYLDt_ha	YIELD (t/ha y)	Sed out (t/y)	%
13	7.25	55.48	0.02	0.29	0.23	168.97	26.80
6	8.63	55.76	0.02	0.18	0.18	157.41	24.97
8	4.10	63.75	0.03	1.01	0.33	135.26	21.45
20	4.23	51.09	0.01	0.18	0.13	56.61	8.98
7	8.82	51.05	0.00	0.11	0.06	52.34	8.30
14	8.17	52.55	0.00	0.08	0.05	44.74	7.10
5	4.15	54.85	0.00	0.08	0.04	15.12	2.40

Site C, subcatchment 54

subcatchments	AREAkm2	Average of WYLDmm	Average of SYLDt_ha	Max of SYLDt_ha	YIELD (t/ha y)	Sed out (t/y)	%
54	12.34	47.82	0.04	0.49	0.47	584.15	13.13
48	8.78	52.80	0.05	0.89	0.63	554.36	12.46
19	9.78	63.16	0.03	0.71	0.34	329.86	7.41
47	5.75	51.46	0.05	0.77	0.55	315.91	7.10
38	7.57	51.43	0.03	0.54	0.41	308.09	6.92
30	5.80	52.54	0.04	0.58	0.53	306.54	6.89
31	6.31	51.50	0.04	0.93	0.47	296.18	6.66
27	12.00	52.99	0.02	0.29	0.22	262.49	5.90
53	5.28	51.11	0.04	0.50	0.49	260.15	5.85
37	6.90	53.79	0.03	0.44	0.33	230.16	5.17
12	6.97	55.00	0.03	0.31	0.32	224.59	5.05
13	7.25	55.48	0.02	0.29	0.23	168.97	3.80
6	8.63	55.76	0.02	0.18	0.18	157.41	3.54
26	6.03	54.85	0.02	0.46	0.24	146.98	3.30
8	4.10	63.75	0.03	1.01	0.33	135.26	3.04
20	4.23	51.09	0.01	0.18	0.13	56.61	1.27
7	8.82	51.05	0.00	0.11	0.06	52.34	1.18
14	8.17	52.55	0.00	0.08	0.05	44.74	1.01
5	4.15	54.85	0.00	0.08	0.04	15.12	0.34

Site C, subcatchment 54

subcatchments	AREAkm2	Average of WYLDmm	Average of SYLDt_ha	Max of SYLDt_ha	YIELD (t/ha y)	Sed out (t/y)	%
34	8.65	28.37	0.10	2.76	1.25	1079.71	15.74
42	8.36	25.15	0.07	2.02	0.86	721.80	10.52
32	4.43	24.56	0.14	4.07	1.63	720.99	10.51
3	14.08	39.09	0.04	0.49	0.43	606.07	8.84
11	7.26	36.90	0.05	0.84	0.59	426.74	6.22
23	8.13	50.44	0.03	0.98	0.41	333.51	4.86
21	8.29	49.79	0.03	0.51	0.39	321.29	4.68
24	6.38	27.78	0.04	0.78	0.47	297.82	4.34
28	4.65	40.40	0.05	1.06	0.62	288.96	4.21
18	6.50	32.94	0.03	0.48	0.33	213.16	3.11
16	4.78	36.52	0.04	0.55	0.42	201.36	2.94
17	6.90	34.71	0.02	0.42	0.29	199.99	2.92
29	7.35	35.49	0.02	0.42	0.24	176.10	2.57
1	7.78	34.82	0.02	0.28	0.21	165.33	2.41
9	10.49	24.77	0.01	0.27	0.16	164.24	2.39
25	8.02	26.69	0.01	0.28	0.16	131.29	1.91
22	6.11	33.21	0.02	0.24	0.18	110.51	1.61
4	7.49	34.32	0.01	0.18	0.15	108.89	1.59
40	5.53	26.84	0.01	0.28	0.17	91.35	1.33
2	3.23	34.71	0.02	0.22	0.23	73.24	1.07
43	5.66	25.66	0.01	0.31	0.11	64.08	0.93
15	4.55	30.83	0.01	0.25	0.13	61.38	0.89
10	3.34	33.55	0.02	0.13	0.18	60.19	0.88
33	6.48	23.57	0.01	0.25	0.09	57.48	0.84
35	4.02	28.88	0.01	0.41	0.13	52.38	0.76
51	5.07	27.85	0.01	0.25	0.07	37.09	0.54
41	5.43	24.35	0.00	0.20	0.06	32.42	0.47

39	3.55	26.56	0.01	0.32	0.09	30.90	0.45
36	3.11	25.06	0.01	0.27	0.10	29.89	0.44
44	0.22	23.13	0.00	0.06	0.01	0.31	0.00

8. APPENDIX B

Figure B1 – Evaluation of the hydromorphological status in the Aist catchment. 0 = good, 5=very bad