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Rapid assessment of stream integrity on stream segments in the upper Vardar watershed in Skopje Region

Брза проценка на интегритетот на водните текови на сегментите од реките и потоците во горното сливно подрачје на Вардар во скопскиот регион

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The paper presents the results of the rapid assessment of stream integrity of stream segments in the upper Vardar watershed in Skopje region, with an emphasis on the Vardar as the biggest and the most important watercourse in Macedonia. The river Vardar is under significant anthropogenic pressure, especially in Skopje and its surroundings.
The aim of this study is to evaluate stream segments integrity by estimating the land use impact on adjacent riparian habitats, and the impact that multiscale environmental properties have on subbasin features. The results have principally been derived from field data, combined with satellite images and Corine Land Cover, which have been computer-processed with ArcGIS software and set in a model build up on Watershed Habitat Evaluation and Stream Integrity Protocol (WHEBIP).
The upper Vardar basin in Skopje region has been divided into 323 subbasins and 323 stream segments as appropriate; 41 of these have been rated as streams with excellent integrity, 53 as very good, 61 as good, 72 as fair and 96 as poor.
The results obtained in this study can contribute towards setting priorities for integrated management and a conservation plan for watersheds and streams in Skopje region, which is crucial since the area is characterized by a high rate of urbanization.

Keywords: Vardar, Skopje, basin, subbasin, stream assessment, riparian habitats, ArcGIS, WHEBIP

Во студијата се презентирани резултатите од „Брзата проценка на интегритетот на речните текови“ на сегментите од реките во горното сливно подрачје на Вардар во скопскиот регион, со акцент на Вардар како најголем и најважен водотек во Македонија. Воедно овој водотек е под најголем антропоген притисок, особено во Скопје и околината.
Целта на оваа студија е да се оцени интегритетот на водотеците преку проценка на влијанието на искористеноста на земјиштето врз крајречните станишта и проценка на влијанијата кои атрибутите на животната средина ги имаат врз карактеристиките на суб-базените. Методологијата на проценатa базира на податоци од теренските истражувања, комбинирани со сателитски снимки и Corine Landcover и поставени во модел разработен со ArcGIS софтвер, а врз основа на Протоколот за проценка на интегритетот на тековите и сливните подрачја (WHEBIP).

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Горното сливно подрачје на Вардар во скопскиот регион беше поделено на 323 суб-базени и 323 речни сегменти соодветно. Од сите 323 речни сегменти, 41 беа оценети како текови со одличен интегритет, 53 со многу добар интегритет, 61 со добар интегритет, 72 со сиромашен и 96 со многу сиромашен интегритет.

Резултатите од оваа студија можат да придонесат кон поставување на приоритети во изработка на планови за интегрирано управување и зачувување на речните сливови во скопскиот регион, што е од клучно значење, бидејќи областа се карактеризира со висока стапка на урбанизација.

Клучни зборови: Вардар, Скопје, сливно подрачје, подсливно подрачје, проценка, текови, крајречни станишта, ArcGIS, WHEBIP

Introduction

Intense anthropogenic land use activities induce conversion and fragmentation of natural habitats, thereby affecting the physical and biological relations of adjacent stream ecosystems (Schlosser 1991; Roth et al. 1996; Allan 2004). The environmental-societal need for providing sound stream ecosystems has been recognized worldwide, while improving stream integrity by restoration and revitalization of riparian habitats is a common practice nowadays (Jensen & Platts 1985; Knopf et al. 1988; Rood & Hughes 2003; Xiaoping 2006). Hence, the need for practical approximation of the ecological integrity of streams consequently prompts development of rapid stream integrity assessment methods based on remote sensing data on landscape indicators.

Even if characterization of causal effects of land use on both structural and functional integrity of streams cannot fully capture the complexity of their relations (Diana et al. 2006; Clapcott et al. 2012), a general assessment of land use and physical habitat variables of streams provides an equitable first approximation of its ecological integrity (Rooth et al. 1996; Lammert & Allan 1999; Goforth & Bain 2012). Evaluation of a variety of subbasin features and riparian vegetation as a significant additional variable enables a holistic approach in stream habitat quality assessment (Roth et al. 1996; Allan et al. 1997). In this regard, Goforth & Bain (2012) have put forward a stream-integrity protocol that relies on "interpretations of remotely sensed land-cover patterns of riparian and subbasin areas adjacent to and upstream from reaches of interest", primarily for the purpose of guiding watershed restoration priorities.

The river Vardar ecosystem has been a subject of several studies to date. These include riverbed regulation and hydromorphology (Levkovski 1999; Škoklevski 1999, 2000), water quality and pollution data based on physical-chemical parameters (Grizo 1995; Melovski et al. 1997; Milovanovic 2007), diatom flora (Krstić & Melovski 1994; Krstić et al. 1994a, 1994b, 1999; Levkov & Krstić 2002) and physiologically active bacterial groups (Kungulovski 1994). However, there is no survey addressing the effects of surrounding land use activities on the river Vardar general stream integrity.

The goal of this study is assessment of stream integrity of the Vardar within Skopje valley and its tributaries while considering the applicability of a multimetric assessment tool - Watershed Habitat Evaluation and Stream Integrity Protocol (WHEBIP) (Goforth & Bain 2012), and preferably identification of management and conservation priorities.

Studied area

The survey area is represented by a part of the upper Vardar watershed that is limited to Skopje Valley, defined by Skopska Crna Gora (1,626 m) to the north, mountains Žeden (1,260 m) and Osoj (1,368 m) to the west, mountain Karađica (2,473 m) to the south ,and Katlanovo hill to the east (Jovanović 1931), and extending to the hilltops of Bilo and Preslap to the northeast. The assessed watershed segment is confined by the state boundary of Macedonia with Kosovo to the north, the stream Raduša subbasin to the west, Suva Planina Mt and Kozjak man-made accumulation to the south (excluding Kadina Reka subbasin and Pčinja subbasin to the east) (Fig. 1).

Skopje Valley is under significant Mediterranean and moderate continental climatic influence. The result of these two influences is existence of a particular local climate highly modified by the features of the valley. The average annual precipitation in Skopje valley is 515 mm; thus, this valley may be characterized as one of the most arid regions in Macedonia. The vegetation period starts in May and ends in November (Lazarevski 1993). The soil is mostly alluvial dominated by clay, with high content of organic substances. In the lower part of Skopsko Pole field, the soil is fertile and of high agricultural value (Todorović 1931).The groundwater level in the south-east part is artificially kept below the surface of the terrain by a drainage network and it is discharged into the Vardar before Taor gorge. The drainage network was constructed in the 1950s to

drain most of the Katlanovo marsh for the sake of agricultural expansion (Levkovski 1999).

The upper Vardar river basin is densely populated. The central part is occupied by city of Skopje - the major administrative and industrial centre in Macedonia, with a total population of 506,926 (State Statistical Office of the Republic of Macedonia 2002). Along with the city of Skopje, the basin comprises the municipalities of Želino, Sopište, Čučer-Sandevo, Studeničani, Zelenikovo, Ilinden, Aračinovo and Petrovec – municipalities with a total population of 78,367. More than 80% of the settlements and villages situated in the area are adjacent to rivers and streams. These data indicate the severity of the anthropogenic pressure upon the river Vardar and its tributaries.

Materials and Methods

The data for quantifying the stream integrity in the upper Vardar watershed segment have been generated from vector and topography maps, scale 1:25,000 (Agency for Real Estate Cadastre of the Republic of Macedonia), coupled by CORINE Land Cover 2006 layers. The vector land use layer has only been used for calculating the river Vardar segments' integrity (given its significance as a carrying watercourse). The vector land use layer has been digitized based on topography maps (1:25,000), combined with 2007 Google Earth satellite imagery. The data quality for the land use layer has been complemented by field surveys, conducted during autumn and spring in 2009/10. Computer processing has been performed with the ArcGIS 9.3 software package.

In order to assess stream integrity, anchored in evaluations of riparian and subbasin environmental properties, interpreted from the available remotely sensed data sources (land cover/use maps), we have adapted an ArcGIS model, founded on the multimetric assessment tool - the Watershed Habitat Evaluation and Biotic Integrity Protocol (WHEBIP), elaborated by Goforth & Bain (2012) and preliminary presented in Carlsen et al. (2004).

The model generates and sums up the scores of 12 category metrics (Tab. 1), comprising four groups of riparian and subbasin properties, which, according to Goforth & Bain (2012), significantly influence stream ecological processes and functions: riparian structure, subbasin land-use composition, watershed slope gradient, populated places and conservation enhancements.

All streams in the upper Vardar watershed have been digitized and categorized by order of stream and consistency of flow. The following have been taken into consideration as relevant for the analysis: streams with continuous flow, intermittent streams with noticeable basins and intermittent streams that delineate considerable change in land use along the mainstream basin. Segmentation has been avoided on minor streams or those whose basins are characterized by consistent land use. Channels have also been assessed due to their large catchment area and the nature of the substrate of regulated watercourses and aquifers. Each segment's integrity has been calculated separately. All stream segments and basins have been marked with a unique code. For calculating the WHEBIP scores of category 7 and 8, both the values of its upstream tributary subbasin and its prior segment subbasin have been calculated as an upstream effect. Where a stream segment has no upstream tributaries, then the values for WHEBIP scores of category 7 and 8 have been reentered from category 1 and 6, respectively (the analyzed stream segments are considered as their own tributaries), otherwise, the scores have been calculated as a sum of all the upstream tributaries (tributary subbasins).

For calculating scores of WHEBIP categories 1-8, the existing land use/cover types have been reclassified in order to address the 4 land use/cover groups relevant for the analysis (riparian woodlands; riparian scrubland, grassland and wetland; pastures and grasslands; agricultural, barren and artificial areas). All input data have been vectorized prior to the analysis, and additional "buffer" layers (polygon vector data covering the area of and around features of other vector layers, up to a specified distance) have been generated prior to the analysis. The scores of WHEBIP categories 1 (stream subbasin) and 7 (upstream) have been determined by the dominant land use/cover group inside the 30 m stream segment(s) buffer(s) area. The calculation of the score of WHEBIP 7 category that has been assigned to a stream segment includes 30m buffer(s) of the upstream segment(s). The score of WHEBIP category 1 has been calculated by applying only the particular streams' 30m segment buffer. The score for WHEBIP category 2 has been calculated as the area of riparian land cover inside a 50 m buffer of the stream segment divided with twice the stream segment length, thus representing the average width of the riparian belt. The score for WHEBIP category 3 has been calculated as the percentage of the stream segment length that is intersected with the 5 m buffer of the riparian land cover, thus representing the riparian canopy continuity. The WHEBIP score 4 has been calculated as the area of wetland land cover categories inside a 30 m buffer of the stream segment. WHEBIP scores 5, 6 and 8 refer to the stream segment subbasin(s), where score 5 refers to the agriculture land cover percentage in the subbasin, and scores 6 and 8 (upstream score) refer to the forest or brush land cover percentage in the subbasin(s). The score of WHEBIP 8 category assigned to a stream

segment has been calculated from all upstream subbasins. The score of WHEBIP category 6 has been calculated directly, using only the particular stream segment subbasin. The score of WHEBIP category 9 has been calculated as the most common of the three terrain slope range categories in stream segments' subbasin (1. [0-4]; 2. [4-8]; 3. [>8] degrees slope). The slope raster data have been yielded from the Digital Elevation Model (ASTER GDEM). The score for WHEBIP category 10 has been calculated as the presence or absence of intersection between the union of populated places polygons and 50 m buffer(s) of the pollution source points (PE "Water Supply and Drainage") with the stream segments (for differentiation between the low and middle score) and the stream segments' subbasin (for differentiation between middle and high score). The score for WHEBIP category 11 has been calculated as the presence or absence of intersection between the stream segment and the 30 m buffer(s) of roads and bridges (differentiation between the high and middle score) or as an intersection of the stream segment with 2 m buffer(s) of roads and 10 m buffer(s) of bridges (differentiation between middle and low scores). The score of WHEBIP category 12 has been calculated by the time length of a conservation activity (Macedonian Ecological Society 2011) in a stream segments' vicinity (the presence of a protected area in a 50 m buffer of a stream segment). In addition, if a stream segment's WHEBIP category 6 score has been high - 35 (76-100 % forest or brush in the subbasin), then the score of WHEBIP category 12 becomes high (25).

The integrity ratings have been assessed by the generated sums of scores for all metrics on the basis of the scale presented in Goforth & Bain (2012) (< 80 poor; 81–159 fair; 160–254 good; 255–314 very good; 315–360 excellent). The terminology in this study follows the one of Goforth & Bain (2012).

Results

The assessed part of the upper Vardar watershed (as defined above), covers 140,400 ha and it includes the basins of the river Vardar (the main watercourse with narrow basin drainage area of 21,450 ha) and its larger tributaries: Lepenec and Serava to the left and Treska and Markova Reka to the right. Their basins occupy a total of 75,978 ha of the watershed. Several minor rivers and brooks, such as Raduška Reka, Reka, Mala Rada (Krnjova Reka), Moranska Reka and Orešanska Reka river inflow into the Vardar with total basin drainage area of 8,139 ha, and a number of streams of intermittent nature with total drainage coverage of 3,229 ha. The Suva Reka basin and the basins of the rivers and streams draining from Skopska Crna Gora Mt that are directed into Taor channel (Skopsko Pole drainage system) occupy a total of 31,643 ha. Individual stream segments integrity ratings are detailed in Tab.1 (see also Fig. 1).

The river Vardar basin drainage area has been divided into 15 subbasin areas (coded 1000001 to 1000015). The integrity of 73 % of the stream segments has been rated as poor. There are no stream segments rated as very good or excellent.

The stream Raduška Reka basin (1001001) covers only 405 ha, and its stream integrity has been rated as fair.

The Reka river covers 1,996 ha, and it has been divided into 11 subbasins containing 11 stream segments (codes 1002001 to 1002011), 8 of which, up to the river confluence in the vicinity of. Svilare village, are rated as fair, but it enters the Vardar rated as poor.

The Lepenec river basin, with total area of 16,360 ha, includes the basin of the Vražanska Reka river, which in turn encompasses the basins of rivers Krbijička Reka, Banjanska Reka and Kučevishka Reka (Mirkovačka Reka). The river Lepenec basin has been divided into 56 subbasins (segments' subbasin codes starting with 1003). The quality of the river Lepenec declines from good (upon entry into Macedonia) to fair, and then to poor upon the confluence with the river Vardar. In general, 40 % of the streams' segments in Lepenec basin have been rated as fair or poor.

The Serava river basin covers 9,478 ha, and it includes the basins of the rivers of Mala Reka, Ljubska Reka, Ljubanska Reka, Turchevska Reka and Jazirska Reka. The Serava river basin has been divided into 31 subbasins (segments' subbasins code starting with 1004). The integrity of 56 % of the stream segments in the Lepenec basin has been rated as poor or fair.

The Treska river basin (as defined above) includes the basin of theReka river, the Treska's major tributary in the area. The Treska basin covers 23,260 ha in the area of interest, and it has been divided into 39 subbasins with codes starting with 1006. The integrity of 54 % of the stream segments in the Treska river basin has been rated as poor or fair, 90% of which can be attributed to its tributary – the Reka river. The stream integrity of the Treska river declines from good to fair right before the river exits Matka Canyon, and upon receiving the waters of the Reka river its integrity rates as poor.

The Markova Reka river basin covers 26,880 ha, comprising the basins of the rivers of Patiška Reka, Ramna Reka, Suva Reka, Brezovička Reka, Umovska Reka, Štagarska Reka, Cvetkovska Reka, Ganareva Reka and Reka. The Markova Reka basin has been divided into 66 subbasins with codes starting with 1007. Only 18 % of the stream segments in the Markova Reka basin have been rated as excellent and very good, 32 % are good, while 50 % of the

stream segments have been rated as fair or poor.

The Mala Rada/Krnjova Reka basin encompasses the basins of the rivers of Mala Rada and Krnjova Reka. It covers 2,877 ha, and it has been divided into 16 subbasins with a code starting with 1008. The integrity of 56 % of the stream segments in the basin has been rated as fair or poor).

The Moranska Reka basin covers 1,677 ha, and it has been divided into 5 subbasins only, coded 1009001 to 1009005. The integrity of 80 % of the stream segments in the basin has been rated as very good or excellent.

The Orešanska Reka basin covers 1,183 ha, and it has been divided into 7 subbasins with codes starting with 1010. The integrity of 70 % of the stream segments in the basin has been rated as good, very good or excellent.

Discussion

The low scores of stream integrity of the stream segments of the Vardar river watershed are consistent with the general condition of the habitats in the Vardar basin observed during the field surveys. The fragments of natural habitats observed along the Vardar are scattered and with different degradation stages as a result of the high anthropogenic impact.

The riparian vegetation mostly consists of poplar and willow belts, while the riparian groves of poplar and willow [Populetum albae-nigrae Slavnic (1942) 1952 and Salicetum albae fragilis, Soo (1930) 1934] are highly fragmented. The reed belts along the river are often associated with bulrush and willows (Typha latifolia and Salix alba). The reed belts can also be found on the periphery of excavation depressions in the degraded portions of the river bank. Fragmentation is the most extensive where the riverbed is completely regulated, near settlements or agricultural areas. The best preserved and most representative riparian vegetation has been recorded in the vicinity of Rašče (in the north-western part of the basin).

The forests in the basin predominantly entail Pubescent Oak forests (Querco-Carpinetum orientalis), commonly found in a degraded state, developed on the eroded hills. Better developed forests, or only with partial degradation have been observed in Taor and Zelenikovo (the south-eastern part of the basin). At present there are few areas left with typically developed plant communities.

Grasslands are represented by partially eroded hill pastures with xerophytic composition. Riparian grasslands are primarily of a ruderal type, on sites with Rubus sanguineus, Alnus glutinosa and riparian willow stands remnants. Meadows and wet meadows are mainly found within the poplar and willow groves at Rašče.

Most of the area along the study corridor of the Vardar accounts for settlements and an agricultural area. Prior to irrigation, most of the agricultural areas had been located in the narrow drainage basin of the Vardar and some adjacent to the river. Landfills and refuse disposal sites in and around the river, numerous sand extraction sites and excavation points are common.

All of the assessed streams in the case of the upper Vardar watershed segment, using WHEBIP (Goforth & Bain, 2012), have confirmed the relation of stream integrity decrease with intensification of land use (Fig.1; Tab. 1).

There have not been any studies whatsoever dealing with the influence of land use on stream integrity in Macedonia. The noteworthy studies in regard to the river Vardar have chiefly been based on physical-chemical parameters and focused on water quality and pollution (Grizo 1995; Melovski et al. 1997; Milovanovic 2006). More complex saprobiological studies that make a reference to the diatom flora of the river have been done by Krstić & Melovski (1994) and Krstić et al. (1994a, 1994b). When determining the ground for employing diatom microflora as a parameter for monitoring of water quality, Krstić et al. (1999) and Levkov & Krstić (2002) have provided an overview of the intensity of anthropogenic impact on the river Vardar. These studies point to the high level of contamination and abundance of diatom species assemblages known for severely polluted waters. A more general discussion of the unfavourable status of the river Vardar in terms of riverbed regulation and hydromorphology has been rendered in Školevski (1999, 2000). The literature with respect to complex surveys linking stream integrity with benthos, micro-invertebrate or vertebrate diversity of the Vardar tributaries (the rivers and streams assessed in this study) is scarce. Thus, the studies referred to cannot be viewed as a direct assertive reference to the results on stream integrity of all stream segments assessed in this study, except partially for the river Vardar, in view of Clapcott et al. (2012) indications that physical-chemical variables of streams can be significantly correlated to land use/cover effect on stream integrity. There are many questions raised as to whether site-specific features (Rooth et al. 1996; Lammert & Allan 1999; Dolph et al. 2011) or catchment-wide factors (Allan et al. 1997; Allan 2004), or a combination of both (Clapcott et al. 2012; Cianfrani et al. 2012) offer better insight into stream integrity. Nonetheless, it has been recognized by all that stream integrity is strongly influenced by land use at multiple scales. In this regard, the WHEBIP protocol ensures a multiscale approach in assessment of streams by referring to the related effects of the immediate riparian vegetation and the landscape attributes in the stream subbasin. The resulting approximate estimations of stream segments integrity in the current study offer a

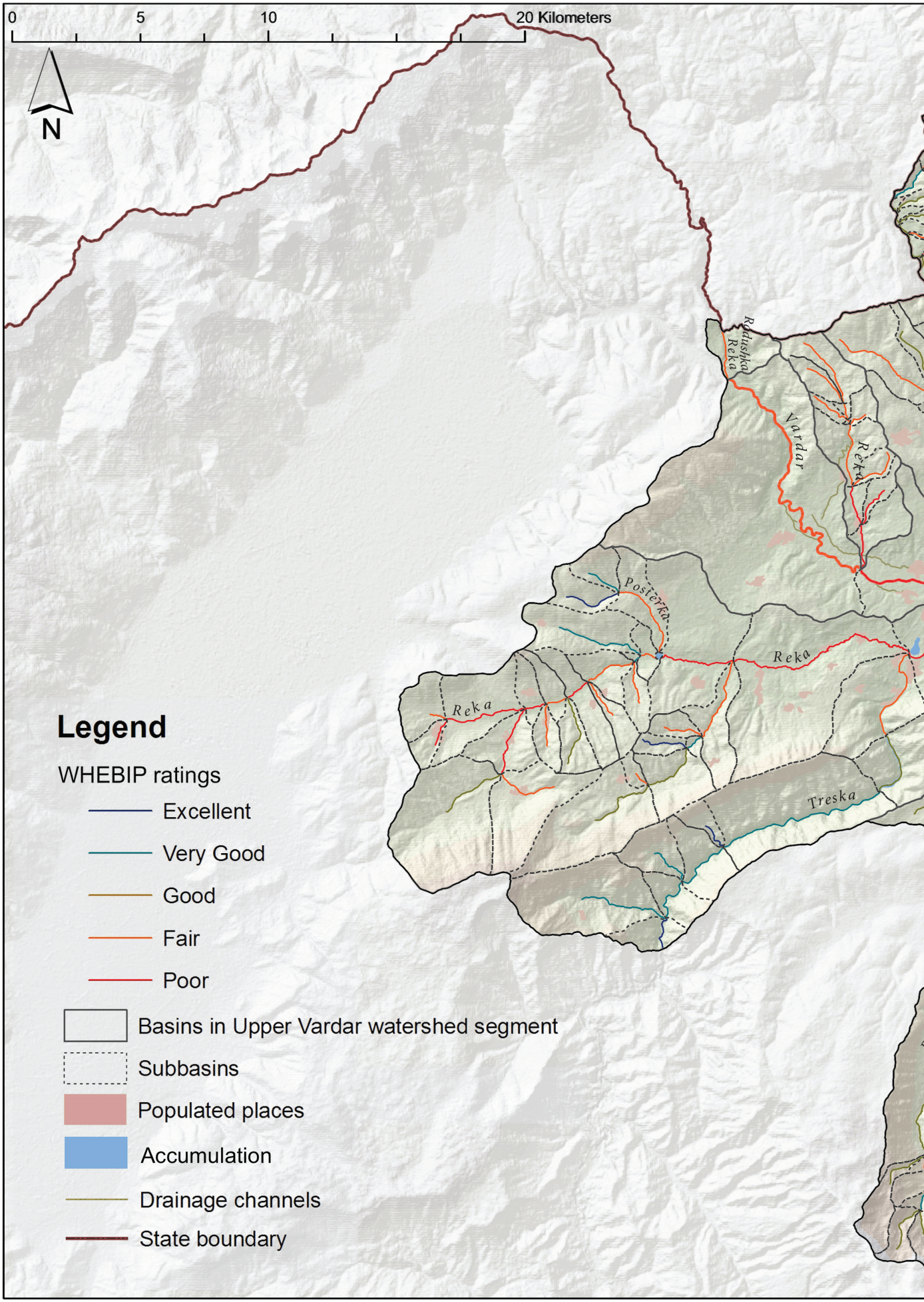
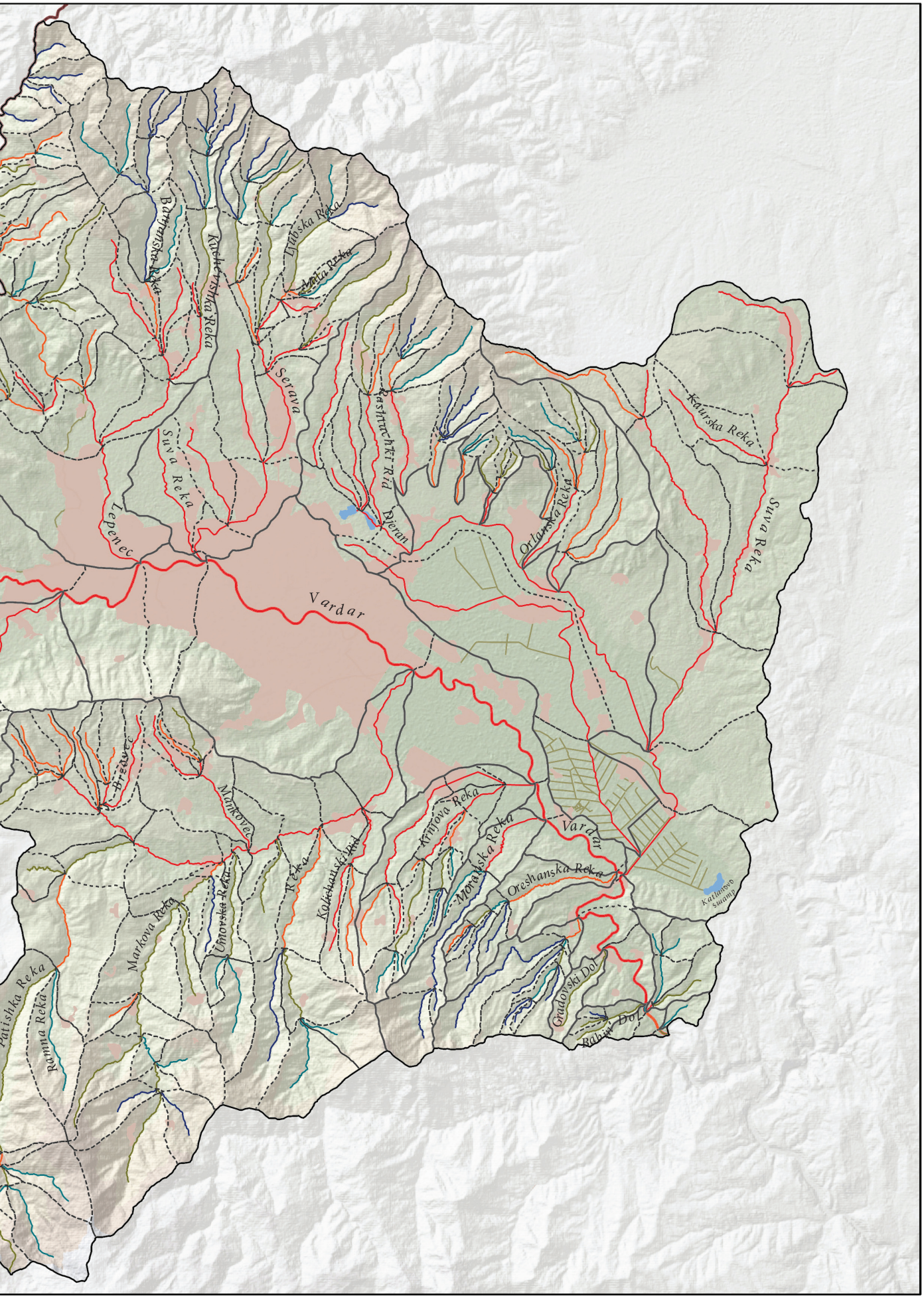


Fig. 1. Overview of stream integrity in Upper Vardar watershed in Skopje region


Kuchevishka Reka
Serava
Suva Reka
Lepenec
Vardar
Kaširuchki Rid
Bjeran
Orlanska Reka
Kaširska Reka
Suva Reka
Brezovec
Markovec
Reka
Kolichanski Rid
Krnjova Reka
Moravska Reka
Oreshanska Reka
Vardar
Markova Reka
Umorska Reka
Patishka Reka
Ramna Reka
Gradovski Do
Rabiin Do

solid foundation for defining priority areas for management of Vardar watershed and its streams. Moreover, the simplicity of integration and adaptation of basic assessment metrics into the ArcGIS-supported model allows for rapid and practical approximation of the ecological integrity of streams, and, if adjusted, the model is applicable to any watershed.

The stream integrity ratings presented in (Fig.1) provide a relevant overview of the overall status of the stream integrity in the upper Vardar watershed segment, while the individual ratings of categories (Tab. 1) provide an outline of the key land use attributes that contribute most to the negative stream integrity rating.

For the purpose of this study, comments will be made only for the river Vardar, as the carrying watercourse in this watershed. Management should primarily be focused on maintenance and improvement of the stream integrity upon entry to the city of Skopje - 1000001, where protection practices have already been established owing to the location of Rašče (Skopje water supply source). Management practices should be aimed at fostering the well-preserved riparian vegetation, enhancing riparian canopy continuity not only around Rašče but in the wider area. This also implies mitigating the erosion and the integrity of Raduška Reka. Improvement of the stream segments integrity - 1000013, 1000014 and 1000015 downstream from Zelenikovo - could also be considered. So as to tackle and improve the general state of the river Vardar in the city of Skopje and in accordance with recommendations of Miltner et al. (2003), management should be directed first towards control of environmental stressors and recreational uses. In this regard, management plans should ponder stream considerable urban planning and riverbed regulation, full treatment of household and industrial wastewater, and regulation of solid waste dumps and establishing a regular monitoring of the river Vardar.

Conclusions

The stream integrity and individual category ratings obtained in this study indicate that WHEBIP is a useful tool in general assessment of stream integrity even with vast watersheds and through different land use patterns.

Increasing anthropogenic pressure and intensification of land use, as an intensive process of degradation and fragmentation of riparian habitats in the upper Vardar watershed segment, significantly impairs the integrity of all rated watercourses, which gradually declines from source to inflow points. More than 50 % of all of the assessed stream segments have resulted in poor or fair stream integrity. All of the Vardar's largest tributaries in the area inflow this watercourse with stream integrity rated as poor, thus contributing to the unfavourable state of the Vardar.

The resulting data of the current study allow for an initial orientation of management and restoration practices towards streams, and they can be used as baselines for further more detailed research.

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Tab. 1. WHEBIP stream integrity ratings in Upper Vardar watershed in Skopje region

Stream	Length (m)	Subbasin code	Code of the downstream subbasin	WHP1	WHP2	WHP3	WHP4	WHP5	WHP6	WHP7	WHP8	WHP9	WHP10	WHP11	WHP12	WHP Sum	WHEBIP rating
Vardar	12828	1000001	1000002	1	1	1	10	15	20	1	1	10	10	1	10	81	f
Vardar	5677	1000002	1000003	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Vardar	4526	1000003	1000004	1	1	1	1	15	10	1	1	10	1	1	1	44	p
Vardar	2884	1000004	1000005	1	1	1	1	25	10	1	1	10	1	1	1	54	p
Vardar	10591	1000005	1000006	1	1	1	1	15	1	1	1	20	1	1	1	45	p
Vardar	9056	1000006	1000007	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Vardar	1571	1000007	1000008	1	1	1	1	1	1	1	1	20	10	25	1	64	p
Vardar	3993	1000008	1000009	1	1	1	1	1	1	1	1	20	10	25	1	64	p
Vardar	297	1000009	1000010	1	1	1	1	1	1	1	1	20	1	25	1	55	p
Vardar	3181	1000010	1000011	1	1	1	1	5	1	1	1	10	1	1	1	25	p
Vardar	3374	1000011	1000012	1	1	1	1	1	1	1	1	10	10	25	1	54	p
Vardar	3828	1000012	1000013	1	25	10	1	5	10	1	1	10	10	1	1	76	p
Vardar	357	1000013	1000014	35	35	35	1	25	35	50	1	10	10	25	25	287	vg
Vardar	855	1000014	1000015	35	35	10	1	5	10	1	10	10	10	10	1	138	f
Vardar	458	1000015	0	35	35	35	1	5	10	50	1	10	10	10	25	227	g
Raduška Reka	2032	1001001	n/a	1	1	1	1	25	20	1	20	10	10	1	10	101	f
Reka	2958	1002001	1002003	5	1	1	1	25	10	10	10	10	10	25	10	118	f
Stream	2001	1002002	1002003	5	1	1	1	25	1	10	1	10	25	25	10	115	f
Reka	703	1002003	1002005	5	1	1	1	25	1	10	1	10	25	25	10	115	f
Stream	1712	1002004	1002005	5	1	1	1	25	20	10	20	10	25	25	10	153	f
Reka	174	1002005	1002007	5	1	1	1	25	1	10	20	10	25	25	10	134	f
Stream	778	1002006	1002007	5	1	1	1	25	10	10	10	10	25	25	10	133	f
Reka	2633	1002007	1002009	1	1	1	1	25	1	10	1	10	10	25	10	96	f
Stream	2295	1002008	1002009	5	1	1	1	25	1	10	1	10	25	25	1	106	f
Reka	1579	1002009	1002011	1	1	1	1	15	1	10	1	10	1	1	1	44	p
Stream	1774	1002010	1002011	1	1	1	1	5	1	1	1	10	1	25	1	49	p
Reka	1887	1002011	1000002	1	1	1	1	1	1	1	1	10	1	1	1	21	p
Skakalo	1995	1003001	1003003	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Urvički rid	633	1003002	1003003	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Urvički rid	1011	1003003	1003005	35	35	35	1	25	35	50	10	10	25	25	25	311	vg
Stream	2510	1003004	1003005	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Kučeviska Reka	2141	1003005	1003007	35	35	35	1	25	35	50	10	10	25	25	25	311	vg
Belinski Rid	1620	1003006	1003007	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Kučeviska Reka	4489	1003007	1003009	1	25	1	10	25	10	50	30	10	1	1	1	165	g
Stream	1401	1003008	1003009	1	1	1	1	25	10	1	10	10	10	1	1	72	p
Mirkovačka Reka	3259	1003009	1003114	1	1	1	1	1	1	1	1	15	1	1	1	26	p
Banjanska Reka	2863	1003101	1003103	35	35	10	1	25	35	50	30	10	25	1	25	282	vg
Slubički Rid	2891	1003102	1003103	35	35	35	1	25	35	50	30	10	25	1	25	307	vg
Banjanska Reka	1360	1003103	1003107	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Grnčarica	2182	1003104	1003106	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Koritnjak	2251	1003105	1003006	35	35	25	1	25	35	50	30	10	25	25	25	321	e
Krbijička Reka	2202	1003106	1003107	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Banjanska Reka	3796	1003107	1003109	35	35	35	10	25	35	50	30	10	25	1	25	316	e
Slivovih	3872	1003108	1003109	35	35	10	10	25	35	50	30	10	10	1	25	276	vg
Banjanska Reka	2390	1003109	1003111	1	25	1	1	5	1	50	1	10	1	1	1	98	f
Samljikovec	4919	1003110	1003111	1	1	1	1	5	1	1	1	10	1	1	1	25	p
Banjanska Reka	830	1003111	1003113	1	1	1	1	15	1	1	1	10	1	25	1	59	p
Stream	3694	1003112	1003113	1	1	1	1	5	1	1	1	10	1	1	1	25	p
Banjanska Reka	1056	1003113	1003114	5	1	1	1	5	1	1	1	15	1	1	1	34	p
Vražanska Reka	4288	1003114	1003310	1	1	1	1	5	1	1	1	20	25	1	1	59	p
Proi i Konopit	2215	1003201	n/a	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Proi i Studeniš	2319	1003202	n/a	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Stream	1450	1003203	n/a	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Proi i Bačiles	1408	1003204	1003206	1	25	1	1	15	20	1	20	10	25	25	1	145	f
Stream	1018	1003205	1003206	35	35	10	1	25	20	50	20	10	25	25	1	257	vg
Proi i Konopit	1805	1003206	1003208	35	25	10	1	5	10	1	20	10	10	25	1	153	f
Stream	1497	1003207	1003208	35	25	10	1	5	10	50	10	10	1	25	1	183	g
Proi i Konopit	1697	1003208	1003301	35	35	10	1	25	35	50	10	10	10	25	25	271	vg
Proi i Leskovecit	2891	1003209	1003302	35	25	10	1	15	10	50	10	10	10	1	1	178	g
Proi i Mulakis	1368	1003210	1003303	35	25	10	1	15	20	50	20	10	10	1	1	198	g
Proi i Njom	2369	1003211	1003304	1	25	10	1	15	20	1	20	10	10	1	1	115	f
Stream	3881	1003212	1003305	1	25	1	1	15	20	1	20	10	1	1	1	97	f
Morav Dol	1800	1003213	1003306	25	35	10	20	25	35	40	30	10	25	1	25	281	vg

Stream	Length (m)	Subbasin code	Code of the downstream subbasin	WHP1	WHP2	WHP3	WHP4	WHP5	WHP6	WHP7	WHP8	WHP9	WHP10	WHP11	WHP12	WHP Sum	WHEBIP rating
Pasji Dol	5127	1003214	1003216	35	35	10	10	25	20	50	20	10	25	10	1	251	g
Banjica	1658	1003215	1003216	35	35	10	10	25	10	50	10	10	25	25	1	246	g
Banjica	405	1003216	1003307	25	35	35	20	25	20	50	1	10	25	1	10	257	vg
Lopotenec	2481	1003217	1003309	5	1	1	1	25	10	10	10	10	25	1	1	100	f
Lepenec	263	1003301	1003302	35	25	35	1	1	1	50	30	10	10	25	1	224	g
Lepenec	513	1003302	1003303	35	35	35	1	5	10	50	1	10	25	25	1	233	g
Lepenec	523	1003303	1003304	35	35	35	1	15	20	50	10	10	10	25	1	247	g
Lepenec	1255	1003304	1003305	35	35	25	1	25	20	50	1	10	25	25	1	253	g
Lepenec	1978	1003305	1003306	1	25	1	10	15	20	50	1	10	25	1	10	169	g
Lepenec	792	1003306	1003307	1	25	1	1	25	35	1	1	10	25	1	25	151	f
Lepenec	3692	1003307	1003308	1	25	1	10	25	10	1	1	10	25	10	10	129	f
Lepenec	1258	1003308	1003309	1	1	1	1	5	1	1	1	10	25	25	10	82	f
Lepenec	2553	1003309	1003310	1	1	1	1	5	1	10	1	10	10	25	1	67	p
Lepenec	5831	1003310	1000004	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Stream	4675	1003401	1003403	1	25	1	1	25	20	1	20	10	10	1	1	116	f
Stream	3216	1003402	1003403	5	25	1	1	25	35	10	30	10	25	25	25	217	g
Stream	1508	1003403	1003405	1	25	10	1	5	10	10	1	10	1	25	1	100	f
Stream	1954	1003404	1003405	5	1	1	1	25	1	10	1	10	1	10	1	67	p
Stream	1582	1003405	1003308	1	1	1	1	15	1	10	1	10	1	1	10	53	p
Stream	1960	1003501	n/a	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Stream	2096	1004001	1004003	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Palavski Rid	2108	1004002	1004003	35	35	10	1	25	20	50	20	10	25	25	1	257	vg
Vodenički Rid	1689	1004003	1004005	35	35	35	1	25	35	50	10	10	10	25	25	296	vg
Izvorski Rid	4339	1004004	1004005	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Pobuška Reka	2531	1004005	1004007	35	35	10	1	25	20	50	30	10	10	10	1	237	g
Stream	1706	1004006	1004007	1	25	1	10	15	10	1	10	10	25	10	1	119	f
Pobuška Reka	2689	1004007	1004302	1	1	1	1	1	1	50	1	15	10	1	1	84	f
Brodečki Rid	3610	1004101	1004103	35	35	10	1	15	10	50	10	10	1	25	1	203	g
Treščenski Rid	1643	1004102	1004103	35	35	35	1	25	20	50	20	10	25	25	1	282	vg
Turčevska Reka	4349	1004103	1004301	1	25	1	10	15	20	50	10	10	25	1	1	169	g
Ljubanska Reka	2302	1004201	1004203	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Peščina	2290	1004202	1004203	35	35	35	1	25	20	50	20	10	25	25	1	282	vg
Ljubanska Reka	3530	1004203	1004207	35	35	10	10	25	35	50	1	10	1	1	25	238	g
Mala Reka	3092	1004204	1004206	35	35	10	10	25	35	50	30	10	10	10	25	285	vg
Stream	1286	1004205	1004206	5	25	1	10	25	35	10	30	10	25	25	25	226	g
Mala Reka	506	1004206	1004207	1	1	1	1	5	1	50	10	10	1	1	1	83	f
Ljubanska Reka	397	1004207	1004209	1	1	1	1	5	1	50	1	10	1	10	1	83	f
Stream	1795	1004208	1004209	1	1	1	1	1	1	1	1	10	1	1	1	21	p
Ljubska Reka	1496	1004209	1004301	1	1	1	1	1	1	1	1	10	10	25	1	54	p
Ljubanska Reka	651	1004301	1004302	1	1	1	1	1	1	1	1	15	25	25	1	74	p
Radiška Reka	1184	1004302	1004501	1	1	1	1	1	1	1	1	15	25	25	1	74	p
Ljubotenska Reka	5742	1004401	1004403	25	35	10	10	25	20	40	20	10	1	1	1	198	g
Stream	1678	1004402	1004403	1	1	1	1	1	1	1	1	10	1	1	1	21	p
Jazirska Reka	1781	1004403	1004501	1	1	1	1	1	1	1	1	15	10	1	1	35	p
Radiška Reka	4295	1004501	1004503	1	1	1	1	1	1	1	1	15	1	1	1	26	p
Bara	4644	1004502	1004503	1	1	1	1	1	1	1	1	15	1	10	1	35	p
Serava	3348	1004503	1004505	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Stream	4617	1004504	1004505	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Serava	2420	1004505	1004507	1	1	1	1	15	1	1	1	20	1	1	1	45	p
Suva Reka	5676	1004506	1004507	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Serava	557	1004507	1000005	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Raštački Rid	5962	1005001	1005003	35	25	10	1	15	20	50	20	10	1	1	1	189	g
Stream	3166	1005002	1005003	1	25	1	10	15	20	1	20	10	10	1	1	115	f
Raštački Rid	5722	1005003	1016002	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Stream	4461	1005004	1016001	1	1	1	1	1	1	1	1	15	1	1	1	26	p
Stream	2048	1005005	1016001	1	1	1	1	1	1	1	1	15	10	1	1	35	p
Bulačanska Reka	1943	1005101	1005103	35	35	35	1	25	20	50	20	10	25	25	1	282	vg
Surinska Reka	1757	1005102	1005103	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Bulačanska Reka	1497	1005103	1005105	1	25	1	1	15	10	50	1	10	1	25	1	141	f
Straška Reka	4316	1005104	1005105	35	35	25	10	25	35	50	30	10	1	25	25	306	vg
Bulačanska Reka	4446	1005105	n/a	1	1	1	1	5	1	50	1	10	1	1	1	74	p
Stream	2083	1005201	1005203	35	35	35	10	25	35	50	30	10	1	25	25	316	e
Vrelo	2703	1005202	1005203	35	35	35	10	25	35	50	30	10	25	25	25	340	e
Vrelo	249	1005203	1005205	25	35	35	20	5	10	50	10	10	10	25	1	236	g

Stream	Length (m)	Subbasin code	Code of the downstream subbasin	WHP1	WHP2	WHP3	WHP4	WHP5	WHP6	WHP7	WHP8	WHP9	WHP10	WHP11	WHP12	WHP Sum	WHEBIP rating
Stream	2315	1005204	1005205	25	35	35	20	25	35	40	30	10	25	25	25	330	e
Vrelo	1901	1005205	n/a	1	25	1	10	1	1	40	10	10	10	25	1	135	f
Stream	1080	1005301	1005303	25	35	25	20	25	20	40	20	10	25	25	1	271	vg
Stream	1151	1005302	1005303	25	35	10	20	25	20	40	20	10	25	25	1	256	vg
Stream	2143	1005303	n/a	1	1	1	1	15	1	40	20	10	25	25	1	141	f
Stream	1185	1005401	1005403	25	35	10	20	25	10	40	10	10	25	25	1	236	g
Stream	1332	1005402	1005403	25	35	10	20	25	10	40	10	10	25	25	1	236	g
Stream	743	1005403	1005405	5	1	1	10	25	1	40	1	10	25	25	1	145	f
Stream	2683	1005404	1005405	25	25	10	20	25	10	40	10	10	25	25	1	226	g
Stream	1432	1005405	1016003	1	1	1	1	1	1	10	1	20	1	1	1	40	p
Stream	2939	1005501	1005503	25	35	25	20	25	20	40	20	10	25	25	1	271	vg
Stream	828	1005502	1005503	25	35	35	20	15	10	40	10	10	10	25	1	236	g
Stream	2087	1005503	n/a	1	25	1	10	5	1	40	1	10	10	1	1	106	f
Orlanska Reka	2315	1005601	1005603	25	35	10	20	25	20	40	20	10	25	25	1	256	vg
Stream	2457	1005602	1005603	25	35	10	20	15	10	40	10	10	10	25	1	211	g
Orlanska Reka	505	1005603	1005605	5	1	1	1	25	1	40	1	10	10	25	1	121	f
Stream	1495	1005604	1005605	25	35	10	20	25	10	40	10	10	25	25	1	236	g
Orlanska Reka	1609	1005605	1005607	1	1	1	10	1	1	40	1	15	1	25	1	98	f
Stream	2444	1005606	1005607	1	25	1	10	15	1	1	1	10	10	25	1	101	f
Orlanska Reka	3996	1005607	1016003	1	1	1	10	1	1	1	1	15	25	1	1	59	p
Krivi Dol	5366	1005701	1005703	5	1	1	10	5	1	10	1	10	25	25	1	95	f
Stream	3880	1005702	1005703	1	25	1	10	5	1	1	1	10	25	25	1	106	f
Krivi Dol	1834	1005703	1016003	1	1	1	1	1	1	10	1	20	1	25	1	64	p
Suva Reka	5886	1005801	1005803	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Stream	2257	1005802	1005803	1	1	1	1	1	1	1	1	20	25	1	1	55	p
Suva Reka	3342	1005803	1005805	1	1	1	1	1	1	1	1	15	1	10	1	35	p
Kaurska Reka	5202	1005804	1005805	1	1	1	1	1	1	1	1	15	1	1	1	26	p
Suva Reka	7539	1005805	1005806	1	1	1	1	1	1	1	1	10	1	10	1	30	p
Suva Reka	5614	1005806	1005807	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Suva Reka	3014	1005807	1005808	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Suva Reka	3321	1005808	1000010	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Stream	2780	1006101	1006103	1	25	1	10	25	35	1	30	10	25	25	25	213	g
Stream	2490	1006102	1006103	1	25	1	10	25	20	1	20	10	1	1	1	116	f
Reka	2926	1006103	1006301	1	1	1	1	5	10	1	1	10	1	25	1	58	p
Stream	718	1006201	1006203	1	1	1	1	15	20	1	20	10	10	1	1	82	f
Stream	1121	1006202	1006203	1	1	1	1	15	20	1	20	10	1	1	1	73	p
Stream	3340	1006203	1006204	1	1	1	1	5	10	1	1	10	10	1	1	43	p
Reka	862	1006301	1006303	1	1	1	1	5	10	1	1	10	10	25	1	67	p
Stream	1683	1006302	1006303	1	25	1	10	25	20	1	20	10	1	1	1	116	f
Reka	888	1006303	1006305	1	1	1	1	15	20	1	1	10	25	10	1	87	f
Stream	2873	1006304	1006305	35	35	10	10	25	20	50	20	10	25	1	1	242	g
Reka	1058	1006305	1006307	1	1	1	1	15	20	1	1	10	10	1	1	63	p
Kovaja	1670	1006306	1006307	1	25	1	10	25	20	1	20	10	10	1	1	125	f
Reka	2118	1006307	1006309	5	25	1	10	25	10	1	1	10	10	10	1	109	f
Proi i Rogle	1693	1006308	1006309	1	25	1	10	15	20	1	20	10	25	25	1	154	f
Reka	357	1006309	1006601	25	35	35	20	25	35	1	1	10	25	25	25	262	vg
Stream	3594	1006401	1006601	25	25	10	20	25	35	40	30	10	10	1	25	256	vg
Stream	2335	1006501	1006503	35	35	10	10	25	35	50	30	10	25	25	25	315	e
Proi i Zelenika	1468	1006502	1006503	25	25	10	20	25	35	40	30	10	25	25	25	295	vg
Posterka	3387	1006503	1006602	1	1	1	1	15	20	50	1	10	10	1	1	112	f
Reka	756	1006601	1006602	1	1	1	10	5	10	40	1	10	25	25	1	130	f
Reka	3167	1006602	1006603	1	1	1	1	5	10	1	1	10	10	10	1	52	p
Reka	8478	1006603	1006604	1	1	1	1	5	10	1	1	10	1	1	1	34	p
Treska	4758	1006604	1000003	1	25	1	1	5	10	1	1	10	1	1	1	58	p
Proi i Dukaš	2902	1006701	1006703	1	35	10	10	25	20	1	20	10	10	25	1	168	g
Čepave Česma	693	1006702	1006703	5	25	1	10	5	1	10	1	10	10	25	1	104	f
Proi i Dukaš	2466	1006703	1006705	1	35	10	10	25	20	40	1	10	25	25	1	203	g
Stream	1926	1006704	1006705	35	35	10	10	25	35	50	30	10	25	25	25	315	e
Proi i Dukaš	767	1006705	1006707	25	35	10	20	25	35	40	1	10	25	25	25	276	vg
Stream	1607	1006706	1006707	5	25	1	10	25	20	10	20	10	10	10	1	147	f
Paničarska Reka	3503	1006707	1006603	1	25	1	10	15	10	40	1	10	10	25	1	149	f
Rečište	3709	1006801	1006803	25	35	25	20	25	35	40	30	10	10	25	25	305	vg
Treska	1437	1006802	1006803	25	35	35	20	25	35	40	30	10	25	25	25	330	e
Treska	2037	1006803	1006805	35	35	35	10	25	35	40	1	10	25	25	25	301	vg

Stream	Length (m)	Subbasin code	Code of the downstream subbasin	WHP1	WHP2	WHP3	WHP4	WHP5	WHP6	WHP7	WHP8	WHP9	WHP10	WHP11	WHP12	WHP Sum	WHEBIP rating
Turčin	1819	1006804	1006805	25	35	10	10	25	35	40	30	10	25	25	25	295	vg
Treska	2408	1006805	1006807	35	35	10	10	25	35	50	1	10	25	25	25	286	vg
Stream	1255	1006806	1006807	35	35	10	10	25	35	50	30	10	25	25	25	315	e
Treska	6962	1006807	1006808	25	35	10	10	25	35	50	1	10	25	25	25	276	vg
Treska	2868	1006808	1006809	1	25	1	10	25	35	40	1	10	25	25	25	223	g
Treska	4056	1006809	1006604	1	25	1	10	15	20	1	1	10	10	1	25	120	f
Markova Reka	4022	1007001	1007003	1	25	1	1	25	20	1	20	10	10	25	25	164	g
Stream	2178	1007002	1007003	35	35	35	1	25	35	50	30	10	10	25	25	316	e
Markova Reka	197	1007003	1007005	35	25	1	1	15	20	50	1	10	25	25	10	218	g
Volče	1983	1007004	1007005	35	35	25	10	25	35	50	30	10	25	25	25	330	e
Markova Reka	1194	1007005	1007007	35	35	10	10	15	20	50	1	10	25	25	10	246	g
Štagarska Reka	1447	1007006	1007007	35	35	25	10	25	20	50	20	10	10	25	10	275	vg
Markova Reka	1409	1007007	1007009	35	35	10	10	25	35	50	1	10	25	25	25	286	vg
Stream	4941	1007008	1007009	35	35	10	1	25	20	50	20	10	10	25	10	251	g
Markova Reka	1898	1007009	1007011	35	35	10	1	15	10	50	1	10	10	25	10	212	g
Siborovica	1581	1007010	1007011	1	25	1	10	25	20	1	20	10	1	25	10	149	f
Markova Reka	4326	1007011	1007013	35	35	25	10	5	10	50	1	10	10	1	10	202	g
Cvetkovska Reka	3973	1007012	1007013	25	35	10	10	25	10	40	10	10	1	25	1	202	g
Markova Reka	1871	1007013	1007015	1	25	1	1	25	35	50	1	10	1	1	25	176	g
Stream	3324	1007014	1007015	35	35	10	10	25	35	50	30	10	25	25	25	315	e
Markova Reka	830	1007015	1007017	1	1	1	1	5	10	50	1	10	1	25	1	107	f
Markova Reka	580	1007016	1007017	1	1	1	1	5	10	1	1	10	10	25	1	67	p
Markova Reka	816	1007017	1007018	1	1	1	1	5	10	1	1	10	10	10	1	52	p
Markova Reka	1447	1007018	1007020	1	1	1	1	5	1	1	10	10	10	25	1	67	p
Stream	3390	1007019	1007020	25	25	1	10	15	10	40	10	10	25	25	1	197	g
Markova Reka	2111	1007020	1007021	1	1	1	1	5	1	1	1	10	10	10	1	43	p
Markova Reka	1792	1007021	1007022	1	1	1	1	1	1	1	1	15	1	25	1	50	p
Markova Reka	6894	1007022	1000006	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Umovska Reka	3123	1007101	1007103	25	35	10	10	25	35	40	30	10	1	25	25	271	vg
Stream	1458	1007102	1007103	25	35	35	20	25	20	40	20	10	25	25	1	281	vg
Umovska Reka	4484	1007103	1007017	25	35	10	10	25	10	40	1	10	25	25	1	217	g
Ganareva Reka	1647	1007201	1007203	35	25	10	1	25	35	50	30	10	25	25	25	296	vg
Reka	3349	1007203	1007205	35	35	10	10	15	20	50	10	10	10	25	10	240	g
Timi Dol	4832	1007204	1007205	35	35	35	10	25	35	50	30	10	25	25	25	340	e
Reka	5739	1007205	1007021	1	25	10	10	15	10	50	1	10	1	1	1	135	f
Količanski Rid	3718	1007301	1007303	1	1	1	1	5	10	1	10	10	1	1	1	43	p
Stream	4268	1007302	1007303	1	25	1	10	5	10	1	10	10	10	1	10	94	f
Količanski Rid	2881	1007303	1007022	1	1	1	1	1	1	1	1	10	1	1	1	21	p
Stream	2100	1007401	1007403	35	25	10	1	25	10	50	10	10	25	25	25	251	g
Stream	2925	1007402	1007403	5	25	1	1	25	10	10	10	10	25	25	25	172	g
Stream	1071	1007403	1007502	35	35	35	1	25	35	10	1	10	25	25	25	262	vg
Stream	3652	1007501	1007502	35	35	10	1	25	10	50	10	10	25	25	25	261	vg
Patiška Reka /Suva Reka	813	1007502	1007504	1	25	1	1	25	35	50	1	10	1	25	25	200	g
Stream	3397	1007503	1007504	35	35	10	1	25	20	50	20	10	1	25	25	257	vg
Patiška Reka	574	1007504	1007506	1	1	1	1	15	10	50	1	10	1	25	25	141	f
Izmi Dol	2078	1007505	1007506	35	25	10	1	25	1	50	1	10	1	25	25	209	g
Patiška Reka	8567	1007506	1007508	1	25	1	10	25	35	50	1	10	1	25	25	209	g
Ramna Reka	5115	1007507	1007508	35	35	10	1	25	35	50	30	10	10	25	25	291	vg
Suva Reka	4167	1007508	1007510	1	25	10	10	15	20	1	1	10	10	10	10	123	f
Izmi Dol	1973	1007509	1007510	25	35	10	20	5	10	40	10	10	10	25	1	201	g
Suva Reka	3204	1007510	1007609	25	35	10	10	25	20	40	1	10	25	1	1	203	g
Rzol	2468	1007601	1007603	35	25	10	10	15	10	50	10	10	25	25	1	226	g
Stream	1945	1007602	1007603	1	25	1	10	15	20	1	20	10	1	25	25	154	f
Studeno	1147	1007603	1007605	1	25	1	1	5	10	40	1	10	10	25	1	130	f
Stream	2864	1007604	1007605	1	25	1	10	15	20	1	20	10	10	1	25	139	f
Preod	67	1007605	1007607	1	1	1	1	1	1	1	1	20	25	25	1	79	p
Stream	2869	1007606	1007607	1	25	1	10	15	20	1	20	10	1	1	25	130	f
Preod	2091	1007607	1007608	1	1	1	1	5	1	1	10	10	10	10	1	52	p
Brezovička Reka	1958	1007608	1007609	1	1	1	1	15	1	1	1	10	25	1	1	59	p
Suva Reka	4064	1007609	1007016	1	1	1	10	5	1	10	1	10	1	1	1	43	p
Čiflichki Dol	2294	1007701	1007703	1	25	1	10	15	20	1	20	10	25	1	25	154	f
Rasoica	1550	1007702	1007703	1	25	1	10	15	20	1	20	10	10	1	25	139	f
Rasoica	867	1007703	1007705	1	1	1	1	1	1	1	1	20	10	25	1	64	p
Brzovec	4524	1007704	1007705	1	1	1	10	5	10	1	10	10	1	1	25	76	p

Stream	Length (m)	Subbasin code	Code of the downstream subbasin	WHP1	WHP2	WHP3	WHP4	WHP5	WHP6	WHP7	WHP8	WHP9	WHP10	WHP11	WHP12	WHP Sum	WHEBIP rating
Rasoica	171	1007705	1007707	1	1	1	1	25	35	1	1	10	25	10	25	136	f
Umište	3425	1007706	1007707	1	25	1	10	15	20	1	20	10	10	1	25	139	f
Rasoica	210	1007707	1007608	1	1	1	1	5	10	1	1	20	25	10	1	77	p
Šarkova Voda	2669	1007801	1007803	25	25	10	10	15	20	40	20	10	1	1	25	202	g
Stream	2499	1007802	1007803	1	25	1	10	5	10	1	10	10	1	1	25	100	f
Cimkovec	565	1007803	1007805	1	1	1	1	1	1	1	1	10	1	25	1	45	p
Stream	3442	1007804	1007805	1	1	1	10	5	10	1	10	10	1	1	25	76	p
Mankovec	3856	1007805	1007018	1	1	1	1	1	1	1	1	10	1	1	1	21	p
Stream	1884	1008001	1008003	35	35	10	1	25	35	50	30	10	25	25	25	306	vg
Stream	792	1008002	1008003	35	35	10	1	25	35	50	30	10	25	25	25	306	vg
Stream	4175	1008003	1008005	1	25	1	1	5	10	50	30	10	1	25	25	184	g
Stream	695	1008004	1008005	1	25	1	1	1	1	1	1	10	25	25	1	93	f
Krnjova Reka	2814	1008005	1008006	1	25	1	1	1	1	1	1	10	10	1	1	54	p
Krnjova Reka	1963	1008006	1008007	1	1	1	1	1	1	1	1	20	10	1	1	40	p
Mala Rada / Krnjova Reka	1152	1008007	1000007	1	1	1	1	1	1	1	1	20	25	25	1	79	p
Stream	3432	1008101	1008103	35	35	35	1	15	20	50	20	10	25	25	10	281	vg
Meris	1534	1008102	1008103	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Meris	1802	1008103	1008105	35	35	10	1	25	20	50	1	10	25	25	1	238	g
Stream	1223	1008104	1008105	35	35	10	1	25	35	50	30	10	25	25	25	306	vg
Meris	1665	1008105	1008006	1	1	1	1	5	1	50	20	10	1	1	1	93	f
Stream	2860	1008201	1008203	1	25	1	1	5	10	1	10	10	1	25	10	100	f
Stream	2204	1008202	1008203	1	1	1	1	1	1	1	1	10	25	25	10	78	p
Mala Rada	5237	1008203	1008204	1	1	1	1	1	1	1	1	10	1	1	1	21	p
Mala Rada	2524	1008204	1008007	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Moranska Reka	2269	1009001	1009003	35	35	25	1	25	35	50	30	10	25	25	25	321	e
Stream	867	1009002	1009003	35	35	35	10	25	35	50	30	10	25	25	25	340	e
Moranska Reka	5860	1009003	1009005	35	35	25	10	25	35	50	30	10	10	25	25	315	e
Suvi Dol	2655	1009004	1009005	35	35	25	1	25	20	50	20	10	25	25	1	272	vg
Moranska Reka	3889	1009005	1000008	1	1	1	1	1	1	50	1	10	1	1	1	70	p
Orešanska Reka	2812	1010001	1010002	35	35	35	10	25	35	50	30	10	25	25	25	340	e
Orešanska Reka	948	1010002	1010004	25	35	35	20	25	35	50	1	10	25	25	25	311	vg
Stream	2338	1010003	1010004	35	35	35	10	25	35	50	30	10	10	25	25	325	e
Orešanska reka	5174	1010004	1000009	1	1	10	10	15	10	50	1	10	1	1	1	111	f
Stream	1661	1010101	1010103	1	1	1	10	15	1	1	1	10	25	25	10	101	f
Stream	1340	1010102	1010103	35	35	10	10	25	35	50	30	10	25	25	25	315	e
Stream	964	1010103	1010002	35	35	25	1	15	20	1	1	10	25	25	1	194	g
Stream	7114	1011001	1011002	35	35	35	10	25	35	50	30	10	25	25	25	340	e
Stream	1258	1011002	1000011	1	25	1	1	5	10	50	1	10	1	1	1	107	f
Stream	1298	1011101	1011103	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Stream	1557	1011102	1011103	35	35	35	10	25	35	50	30	10	25	25	25	340	e
Stream	1793	1011103	1011105	35	35	35	1	25	35	50	10	10	25	25	25	311	vg
Stream	1585	1011104	1011105	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Stream	737	1011105	1011107	35	35	35	1	15	20	50	1	10	25	25	1	253	g
Stream	2795	1011106	1011107	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Stream	360	1011107	1011002	35	35	35	1	25	35	50	1	10	25	25	25	302	vg
Gradovski Dol	3836	1012001	1000012	35	35	10	1	5	10	50	10	10	1	1	10	178	g
Babin Dol	1527	1013001	1013002	35	35	25	1	15	20	50	20	10	25	1	1	238	g
Babin Dol	1717	1013002	1000013	35	35	10	1	25	35	50	1	10	25	1	25	253	g
Stream	723	1013101	1013103	35	35	35	1	25	35	50	30	10	25	25	25	331	e
Stream	1051	1013102	1013103	35	35	35	1	5	10	50	10	10	25	25	1	242	g
Stream	90	1013103	1013002	35	35	35	1	25	35	50	1	10	25	10	25	287	vg
Stream	940	1014001	1014003	35	35	25	1	15	20	50	20	10	25	25	1	262	vg
Stream	1033	1014002	1014003	35	35	35	1	15	20	50	20	10	25	25	1	272	vg
Stream	2038	1014003	1014005	35	35	10	10	25	35	50	1	10	1	25	25	262	vg
Stream	2314	1014004	1014005	35	35	10	10	15	20	50	20	10	1	25	1	232	g
Stream	412	1014005	1000014	1	1	1	1	1	1	50	1	15	1	1	1	75	p
Stream	1504	1015001	1000015	35	35	10	1	25	35	50	30	10	25	1	25	282	vg
Đeran	1282	1016001	1016002	1	1	1	1	1	1	1	1	20	10	25	1	64	p
Đeran	1598	1016002	1016003	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Channel	16264	1016003	1005807	1	1	1	1	5	1	1	1	20	1	1	1	35	p
Stream	2058	1016101	1016102	1	1	1	1	1	1	1	1	15	1	25	1	50	p
Channel	14190	1016102	1016103	1	1	1	1	1	1	1	1	20	1	1	1	31	p
Channel	5207	1016103	1005808	1	1	1	1	1	1	1	1	20	10	1	1	40	p
Bri Nerezi	3347	1017201	1007203	25	35	10	10	25	35	40	30	10	10	25	25	280	vg

Stream	Length (m)	Subbasin code	Code of the downstream subbasin	WHP1	WHP2	WHP3	WHP4	WHP5	WHP6	WHP7	WHP8	WHP9	WHP10	WHP11	WHP12	WHP Sum	WHEBIP rating
Burinarski Rid	6122	1025003	n/a	1	1	1	1	1	1	1	1	10	10	1	1	30	p
Stream	7012	1025701	1025703	1	25	1	10	15	10	1	10	10	1	1	1	86	f
Stream	1897	1025702	1025703	1	1	1	1	1	1	1	1	15	1	25	1	50	p
Metlarica	10165	1025703	1005806	1	1	1	10	1	1	1	1	15	1	1	1	35	p

Watershed Habitat Evaluation and Biotic Integrity Protocol (WHEBIP) metric descriptions and rating criteria for each metric according to Goforth & Bain (2012): **Dominant riparian land cover (WHP1):** riparian woodlands (35); riparian scrubland, grassland and wetland (25); pastures and grasslands (5); agricultural, barren and artificial areas (1)**; Average Width of Riparian Belt (WHP2):** > 30 m (35); 5–30 m (25); < 5 m (1)**; Riparian canopy continuity along stream reach (WHP3):** No breaks in the riparian canopy (35); Breaks up to 10% of canopy (25); Breaks of 10-50% of canopy (10); Breaks compose >50% of canopy (1)**; Presence of Wetlands (WHP4):** Wetlands compose more than 50% of riparian area (20); Wetlands compose less than 50% of riparian area (10); No wetlands present (1)**; Active Agriculture (WHP5):** 0-25% (25); 26-50% (15); 51-75% (5); 76-100% (1)**; Forest or Brush (WHP6):** 76-100% (35); 51-75% (20); 26-50% (10); 0-25% (1)**; Upstream Riparian Vegetation (WHP7):** riparian woodlands (50); riparian scrubland, grassland and wetland (40); pastures and grasslands (10); agricultural, barren and artificial areas (1)**; Upstream Forest or Brush (WHP8):** 76-100% (30); 51-75% (20); 26-50% (10); 0-25% (1)**; Watershed Land Gradient (WHP9):** Low or flat (20); Moderate (15); High (10)**; Point Source Pollution (WHP10):** No point source(s) likely (25); Point source(s) likely within watershed (10); Point source(s) likely along stream (1)**; Presence of Roads (WHP11):** No roads (25); Roads pass within 30m of stream (10); Roads cross through streambed or cross over bridges (1)**; Conservation Activity (WHP12):** Conservation actions for > 10 yrs (25); Conservation actions 5-10 yrs (15); Conservation actions within <5 yrs (10); No conservation actions (1); **WHEBIP rating**: p - poor, f - fair; g - good; vg - very good; e - excellent