



## Preliminary Flood Risk Assessment for the Drin/Drim – Buna/Bojana River Basin



Implemented by:

**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH



This study was implemented within the project

## **Climate Change Adaptation in Transboundary Flood Risk Management for the Western Balkans**

Commissioned by: German Federal Ministry for Economic Cooperation and Development (BMZ)

Implemented by: Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH

Gerrit Bodenbender, Merita Meksi, Fationa Sinojmeri, Biljana Medenica, Nikoleta Bogatinovska

### **Lead executing agencies:**

- Albania: Ministry of Tourism and Environment;
- Kosovo: Ministry of Environment and Spatial Planning;
- North Macedonia: Ministry of Environment and Physical Planning;
- Montenegro: Ministry of Sustainable Development and Tourism



### **Members of the Technical Working Group:**

#### ALBANIA

- Rovena Metaja; Agency for management of water resources; Specialist
- Marsel Veli; Agency for management of water resources; Specialist
- Stela Guxo; Dipper Shpk; Consultant
- Erjola Keci; Global Water Partnership Med; National Coordinator
- Dukate Dodaj; Ministry of Defense; Specialist
- Meri Zefaj; Agency for management of water resources; Specialist
- Arben Gjuraj; Shkodra Municipality; Vice Mayor
- Anisa Qorri; National Territorial Planning Agency; Cheif of planning sector
- Eduart Cani; Dipper Shpk; National expert
- Arduen Karagiozi; Agency for management of water resources; Director
- Miranda Deda; Cima foundation; Project coordinator
- Klaudio Collaku; State authority for geostation information; Director of GIS directorate
- Arben Mukaj; Ministry of Agriculture and Rural Development; Head of sector
- Klodian Zaimi; Institute of GeoSciences Energy Water and Environment /IGEWE; Head of Department of Water Economy and Renewable Energy
- Erjon Qosja; Albanian Electropower; Specialist
- Maksimilian Dhima; Ministry of Defense; Director of Planning and Coordination of Civil Emergencies.
- Amparo Samper; Institute of GeoSciences Energy Water and Environment /IGEWE; CIM Expert

## MACEDONIA

- Blazhe Nikcevski; Ministry of Environment and Physical Planning (MOEPP); Department for waters; Unit for water rights; Junior associate
- Mahi Seadini; Ministry of Environment and Physical Planning (MOEPP); Department for waters; Unit for planning and development of waters; Junior associate for strategic planning
- Vasko Stojov; Hydro-meteorological Service (HMS) Macedonia; Head of Department in Sector of hydrology
- Atanas Ugrinski; Hydro-meteorological Service (HMS) Macedonia; Advisor in Sector of hydrology
- Dragan Jovanovski; Protection and Rescue Directorate (PRD) ; Department for prevention, development and training; Advisor for rescue and protection from floods
- Vera Raunik; Municipality of Ohrid; Sector for environmental protection and waste management; Head of Department for waste management and regional landfills
- Boris Kjeleshoski; Municipality of Struga; Department for legal and general affairs; Unit for cooperation with local communities and protection and rescue; Advisor for protection and rescue and crisis management
- Armend Zhaku; Municipality of Struga; Department for support of the Major, organization of the work of the council and information technology; IT Unit; Senior associate - IT administrator
- Dushko Petrovski; Crisis Management Center (CMC); Head of Department for operations and coordination
- Valbona Mena Lacka; Crisis Management Center (CMC), Regional Unit Struga; Regional Unit Struga, Junior Associate
- Ylber Mirta; Ministry of Environment and Physical Planning (MOEPP); Head of Department for waters
- Lendita Dika; Ministry of Environment and Physical Planning (MOEPP); State Counsellor, Industrial Pollution and Risk Management"
- Biljana Apostolova; Ministry of Environment and Physical Planning (MOEPP); Department for waters; Unit for concessions and inter-ministerial cooperation; Senior associate for the implementation of a procedure for granting concessions
- Renata Barutovska; Ministry of Environment and Physical Planning (MOEPP); Department for waters; Unit for water rights; Advisor for issuing permits for water use and discharge of waters
- Lulijeta Dashi; Ministry of Environment and Physical Planning (MOEPP); Department for waters; Unit for implementation of the plan and program for the river Vardar; Junior associate
- Admir Gorenca ; Protection and Rescue Directorate (PRD), Regional Unit Debar; Sector for logistics and operation; Regional Unit for protection and rescue - Debar; Junior associate
- Marjan Glavinceski; ELEM, JSC Macedonian Power Plants ; HPS "Crn Drim", Struga; Technical monitoring and maintenance at dams and other civil objects, Responsible engineer"

## KOSOVO

- Makfirete Dibrani; Ministry of Defence and Spatial planning ; Specialist, River Basin Authority
- Shpend Agaj; Ministry of Defence and Spatial planning ; Specialist, Spacial planning Institute
- Bashkim Kastrati; Institute of GeoSciences Energy Water and Environment /IGEW; Head of hydrology sector
- Myrvete Mulaj; Ministry of Defence and Spatial planning ; Specialist
- Manduha Gojani; Ministry of Defence and Spatial planning ; Head of Drini i bardhë sector / River basin Authority
- Rizah Murseli; Ministry of Defence and Spatial planning ; Director, Spatial planning Institute
- Muhamet Pllana; Agency for Civil Emergencies; Specialist at Agency for Civil Emergencies
- Lindita Morina; Ministry of Defence and Spatial planning ; Specialist, Water department
- Lindita Radoniqi; Ministry of Defence and Spatial planning ; Specialist, Directory of spatial planning

## MONTENEGRO

- Dragana Djukić; Ministry of Agriculture and Rural Development; Advisor I Directorate of Water Management
- Miroslava Neneadić; Ministry of Agriculture and Rural Development; Associate in the Water Management Directorate
- Milo Radović; Water Administration; Adviser
- Radosav Rašović; Water Administration; Adviser

- Darko Novaković; Institute for Hydrometeorology and Seismology; Head of the Department of the Hydro Network
- Branko Micev; Institute for Hydrometeorology and Seismology; Head of Section for analysis and weather forecast
- Ervin Kalač; Institute for Hydrometeorology and Seismology; Adviser in the Hydrology sector
- Ljuban Tmušić; Directorate for Emergency Situations; Head of Department for Civil Protection and Humanitarian Aid
- Kristina Plajsa Backović; Directorate for Emergency Situations; Independent Advisor I in Department for Civil Protection and Humanitarian Aid
- Vojin Vojinovic; Directorate for Emergency Situations; Independent Advisor in Department for Civil Protection and Humanitarian Aid
- Milan Vlahović; Montenegrin Electric Enterprise AD Nikšić; Specialist for geological works in HPP "Perućica"
- Dražen Bjelobrković; City Municipality of Golubovci; Associate for Sports and Development

**Team of consultants:**

- Dr.-Ing. Peter Heiland (Team Leader),  
Dr.-Ing. Sandra Pennekamp, Nicolas Specklin;  
INFRASTRUKTUR & UMWELT Professor Böhm und Partner,  
Darmstadt, Germany
- Angel Panov, PointPro Consulting, Skopje, Macedonia
- Lavdim Osmani, Pristina, Kosovo
- Eduart Cani, Stela Guxo, Tirana, Albania
- Zdenka Ivanovic, Podgorica, Montenegro
- Dr.-Ing. André Assmann, Dr.-Ing. Stefan Jäger; Geomer GmbH, Heidelberg, Germany



**Photo Credits:**

- Jutta Benzenberg

28<sup>th</sup> November 2018

## TABLE OF CONTENT

<b>1</b>	<b>Background .....</b>	<b>1</b>
1.1	Objectives and scope.....	1
1.2	Flood Risk management according to the EU Floods Directive .....	2
1.3	Flood Risk Management in the Drin/Drim-Buna/Bojana River Basin .....	4
1.3.1	<i>Flood Risk Management in Macedonia</i> .....	4
1.3.2	<i>Flood Risk Management in Kosovo</i> .....	6
1.3.3	<i>Flood Risk Management in Albania</i> .....	7
1.3.4	<i>Flood Risk Management in Montenegro</i> .....	9
1.3.5	<i>Flood risk management in the Greek part of the Drin/Drim-Buna/Bojana River Basin</i> .....	10
1.3.6	<i>Transboundary flood risk management in the Drin/Drim-Buna/Bojana River Basin</i> .....	10
<b>2</b>	<b>Methodology of the preliminary flood risk assessment .....</b>	<b>11</b>
2.1	Requirements according to the EU Floods Directive .....	11
2.2	Types of flood .....	12
2.3	Consideration of climate change .....	13
2.4	Identification of Areas of Potential Significant Flood Risk (APSFR) .....	14
2.4.1	<i>Working steps</i> .....	14
2.4.2	<i>Determination of APSFR</i> .....	15
2.4.3	<i>Assets at risk and significance criteria</i> .....	16
2.4.3.1	<i>Significance criteria for human health and economic values</i> .....	18
2.4.3.2	<i>Significance criteria for environmental risk</i> .....	19
2.4.3.3	<i>Significance criteria for cultural heritage</i> .....	19
2.4.4	<i>Collection and documentation of risk information for the APSFR</i> .....	19
2.4.5	<i>GIS-based validation of the risk assessment</i> .....	20
2.4.5.1	<i>Process description</i> .....	21
2.4.5.2	<i>Input data and gaps</i> .....	23
2.5	Plausibility check by experts .....	24
<b>3</b>	<b>The Drin/Drim – Buna/Bojana River Basin .....</b>	<b>24</b>
3.1	Hydro-geographic overview and map of sub basins.....	24
3.2	River network and characteristics of the sub-catchments .....	28
3.2.1	<i>Rivers in Macedonia</i> .....	28
3.2.2	<i>Rivers in Kosovo</i> .....	28
3.2.3	<i>Rivers in Albania</i> .....	28
3.2.4	<i>Rivers in Montenegro</i> .....	29
3.2.5	<i>Rivers in Greece</i> .....	30
3.3	Land use .....	31

<b>4</b>	<b>Results of the Preliminary Flood Risk Assessment .....</b>	<b>33</b>
4.1	Overview of flood hazards and flood risk in the river basin .....	33
4.1.1	<i>Flood risk in Macedonia .....</i>	33
4.1.2	<i>Flood risk in Kosovo.....</i>	34
4.1.3	<i>Flood risk in Albania.....</i>	35
4.1.4	<i>Flood risk in Montenegro.....</i>	37
4.1.5	<i>Flood risk in Greece.....</i>	37
4.2	Past events and the risk of similar future events .....	38
4.3	Assessment of flood risks according to the significance criteria.....	39
<b>5</b>	<b>Outlook and recommendations for further flood risk management activities in the transnational scope .....</b>	<b>44</b>
5.1	Next steps for flood risk management in the APSFR .....	44
5.2	Transnational measures for flood risk management .....	44
5.2.1	<i>Measures at river basin level.....</i>	45
5.2.1.1	<i>Coordinated implementation of the EU Floods Directive in the Drin/Drim-Buna/Bojana River Basin .....</i>	45
5.2.1.2	<i>Improvement of knowledge, capacities and knowledge transfer .....</i>	45
5.2.1.3	<i>Improvement of jointly used data and models.....</i>	46
5.2.1.4	<i>Flood risk management in relevant disciplines / sectors .....</i>	46
5.2.2	<i>Measures at sub-basin level (regional / local) in transnational coordination .....</i>	48
<b>6</b>	<b>References and sources.....</b>	<b>49</b>

## ANNEXES

- Annex 1: Characteristic data of relevant rivers and list of cities/villages along the rivers
- Annex 2: List of evaluated past flood events
- Annex 3: Land use in evaluated APSFR (data)
- Annex 4: Fact sheets of the APSFR
- Annex 5: Maps for the preliminary flood risk assessment for the APSFR in the Drin/Drim-Buna/Bojana River Basin

## LIST OF FIGURES

Figure 1:	The steps and milestones of FRM according to the EU-Floods-Directive (reference to articles of the Directive in brackets) [graphic: INFRASTRUKTUR & UMWELT]	2
Figure 2:	Updating Cycle with Assessment steps	3
Figure 3:	Existing FRM Documents in Macedonia	5
Figure 4:	Structure of flood risk management processes in Albania (figure based on the presentation of Arduen Karagjozi technical working group meeting June 2018)	8
Figure 5:	Work steps of the preliminary flood risk assessment for the identification of areas with potential significant flood risk	15
Figure 6:	Steps for the assessment of potential significant risks	16
Figure 7:	Fact sheet for the assessment and documentation of APSFR	20
Figure 8:	Estimative correlation of water levels and catchment size as used for the analyses	21
Figure 9:	Intersection of flood extents scenario 1 (lower) and 2 (higher) with terrain	22
Figure 10:	Sub-basins of the Drin/Drim-Buna/Bojana River Basin (own figure based on open source data)	25
Figure 11:	Elevation of the Drin/Drim-Buna/Bojana River Basin (map: INFRASTRUKTUR & UMWELT based on Krye 2013, OSM 2018, SRTM DTM 2015 by U.S. geological survey)	26
Figure 12:	Map of the river network with dams and lakes in the Drin/Drim – Buna/Bojana River Basin [Source: Meon, 2014]	27
Figure 13:	River Basin Districts in Greece	31
Figure 14:	Land use map of the Drin/Drim-Buna/Bojana River Basin	32
Figure 15:	Map of the relevant Greek APSFR at Lake Prespa (pink / orange coloured area)	38
Figure 16:	Geographic (map) overview of the APSFR in the Drin/Drim-Buna/Bojana River Basin	40
Figure 17:	Land use in evaluated APSFR (a) (based on own assessments, see methodology)	42
Figure 18:	Land use in evaluated APSFR (b) (based on own assessments, see methodology)	43

## LIST OF TABLES

Table 1:	Indicative timetable for implementation EU Floods directive in Macedonia	5
Table 2:	Types of flood / sources (from: Guidance for reporting under the EU Floods Directive; EU 2013)	12
Table 3:	Risk receptors and risk indicators	17
Table 4:	Significance criteria for the PFRA	17
Table 5:	Aggregation of the land use classes of the BEAM data	22
Table 6:	Land use in the Drin/Drim-Buna/Bojana River Basin (generated from CLC 2012)	33
Table 7:	Areas with potential significant flood risk	41
Table 8:	Rivers and their characteristics in the Drin/Drim – Buna/Bojana River Basin [Source: GIZ Report Meon; adjusted by national consultants based on national data]	51
Table 9:	Main rivers and tributaries in the Drin/Drim-Buna/Bojana River Basin in Macedonia	51
Table 10:	Morphological parameters of main Drin tributaries in Kosovo (source: GFA, 2008)	52
Table 11:	Main rivers and lakes in the Drin/Drim-Buna/Bojana River Basin in Albania	53
Table 12:	Main rivers and lakes in the Drin/Drim-Buna/Bojana River Basin in Montenegro	53
Table 13:	Main cities and villages along the rivers in the Drin/Drim-Buna/Bojana River Basin	53
Table 14:	Documented and verified past flood events in the Drin/Drim-Buna/Bojana River Basin	55



## LIST OF ABBREVIATIONS

AL	Albania
ALL	Albanian Leke (Albanian currency)
APFSR	Areas of potential significant flood risk
BMZ	German Federal Ministry for Economic Cooperation and Development
DEM	Digital elevation model
DRM	Disaster Risk Management
EC	European Commission
ECRAN	Environment and Climate Regional Accession Network
EU	European Union
EU FD	EU Floods Directive (2007/60/EC)
EUR	Euro
FHRM	Flood hazard and flood risk mapping
FRM	Flood risk management
FRM-Dir	Flood risk management Directive
FRMP	Flood risk management plan
FYROM	Former Yugoslavian Republic of Macedonia <i>(note: this term/abbreviation is only used in this report when quoting documents, which refer to FYROM).</i>
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für internationale Zusammenarbeit
HPP	Hydro Power Plant
IU	INFRASTRUKTUR & UMWELT Professor Böhm und Partner
KESH	Korporata Elektroenergjitike Shqiptare
KO	Kosovo
MARD	Ministry of Agriculture and Rural Development
ME	Montenegro
MK	Macedonia
OSM	Open Street Map
PFRA	Preliminary Flood Risk Assessment
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WA	Water Administration
WRMA	Water Resources Management Agency

## EXECUTIVE SUMMARY

### **Background and objectives**

In the transboundary river basin of the Drin/Drim-Buna/Bojana River floods occur regularly. They cause economic and ecologic damage at public and private assets. Some recent floods also caused casualties. To identify the Areas of Potential Significant Flood Risk (APSFR) this project aimed at a systematic river basin wide Preliminary Flood Risk Assessment as basis for the joint decision on risk management priorities in the transnational river basin context. The project activities were coordinated in close cooperation with the transnational Technical Working Group with over 40 representatives of the participating countries Montenegro, Albania, Kosovo and North Macedonia and with support of GIZ within the regional project "Climate Change Adaptation in Transboundary Flood Risk Management for the Western Balkans". Information about flood risk management in Greece has been added to this report based on published documents.

The project was implemented according the standards of the EU Floods Directive ("European Directive 2007/60/EC on the assessment and management of flood risks"). It foresees three major flood risk management steps that build up on each other:

1. Preliminary flood risk assessment (PFRA) resulting in the identification of areas of potential significant flood risk (APSFR);
2. Flood hazard and flood risk mapping (FHRM);
3. Flood risk management planning (FRMP).

This report focuses on the first step, PFRA. The second and third step shall be done for the identified areas of potentially significant flood risk. The EU Floods Directive requests to review and if necessary to update each step of flood risk management (PFRA, FHRM and FRMP) every 6 years.

### **Methodology**

As a first step, the current state of flood risk assessment and flood risk management in the riparian countries was analysed in close cooperation with the partner countries. Furthermore, the existing data and already implemented flood risk management projects were compiled and reviewed. Based on this situation analysis the methodology was adjusted to the needs and the existing data.

The methodology and the working steps follow the EU Floods Directive chapter III, article 4. According to the directive the analysis of the preliminary flood risk assessment includes maps of the river basin districts and sub-basins, the description of historic floods and past events as well as their negative impacts on human life, economy, environment and cultural heritage. It further includes a description of the expected future events and their potential effects.

The assessments consider different types of floods according to the European floods risk management guidelines of the EU flood working group. Although the focus is set on riverine flood risk (fluvial flooding), further types of floods were considered such as:

- Pluvial floods (heavy rain risks and flash flood events)
- Groundwater flooding (if known as relevant from past events)

Coastal floods (caused by seawater, high tides and spring floods) were discussed, but were identified as not significant in the project area compared to the other types of floods in the river basin.

Impacts of climate change are generally considered in this assessment to assess the risk of increasing heavy rain events and number of fluvial floods. As a consequence of the potential risk of climate change, in the future steps of flood risk management needs to be considered increasing short and heavy rainfall in the projections of hydrological data. For the preliminary flood risk assessment, the projections of climate change impacts are expected to lead to different results on APSFR-determination.

The assessment and identification of areas of potential significant flood risk (APSFR) included two parallel approaches:

- From existing data and local knowledge:

The approach focussed on the collection of existing information and data for the whole river basin including known flood events, past flood damages and known flood risk areas. These were analysed according to the key question if the observed risk situation in one location is still present, and if similar floods must be expected also in future. Data collection and risk information led to a closer analysis of the pre-selected areas in working groups, to discuss the risk situation and to assess the data based on regional and local experience. The documentation of the results was done in 46 fact sheets for all potential flood risk areas and they are documented in the report.

- GIS-analysis for the preselected areas:

Based on the 46 fact sheets a GIS-based analysis was done for the determined locations to further assess the significance of the results. The GIS-analysis built up on the provided digital elevation models (DTM) of the countries, and the global/world DEM light data. The World DEM light is a TanDEM X dataset edited by Airbus (void removal, land cover corrections) and further corrected by the consultants using the Open Street Map (OSM) river network. DEMs of better resolution were integrated if available (as provided by the partner countries). Furthermore, the analysis used other available morphological and topographic data and the BEAM land use 2012 datasets. The minimum analysed catchment size was > 20 km<sup>2</sup> because smaller catchments should be assessed with methods of flash flood evaluation.

Two scenarios for the potential extreme flood extent were calculated using estimative correlation of water levels and catchment size as follows:



Historic flood events, namely those of Jan and Dec 2010 in Albania, and others if flood extension lines are available, were used to validate the results.

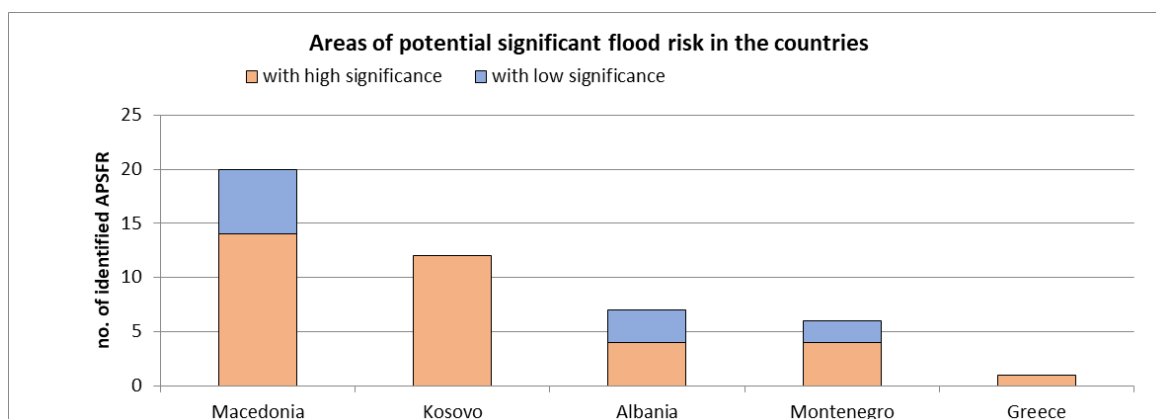
The verification of the results from the described steps for the significance checks was done by competent water management experts of the responsible administrations, agencies and ministries, and specific municipalities at risk. The validation was organised in transnational and national meetings of the Technical Working Group in June and October 2018 and the verification and the final adjustment results was done in November 2018. The checks based on expert knowledge mainly confirmed the results of the calculations. All identified APSFR were approved by the experts. Additional APSFR resulted from types of flooding other than river floods, such as groundwater and flash floods, due to known past events or even recurring damages.

The determination of the significance of potential flood risk areas followed the approach of the EU Floods Directive using discussed and agreed significance criteria for the assets at risk (human life, economic and ecologic assets as well as cultural heritage). The significance criteria were proposed by the consultants based on their experience from flood risk management projects in Germany and other European countries and adjusted to the characteristics of the Drin/Drim-Buna/Bojana River Basin. The proposed criteria were discussed in workshops of the Technical Working Group. After discussion in the Technical Working Group and adjustment of the criteria, all identified risks were measured against the significance criteria to determine the APSFR.

## **Results**

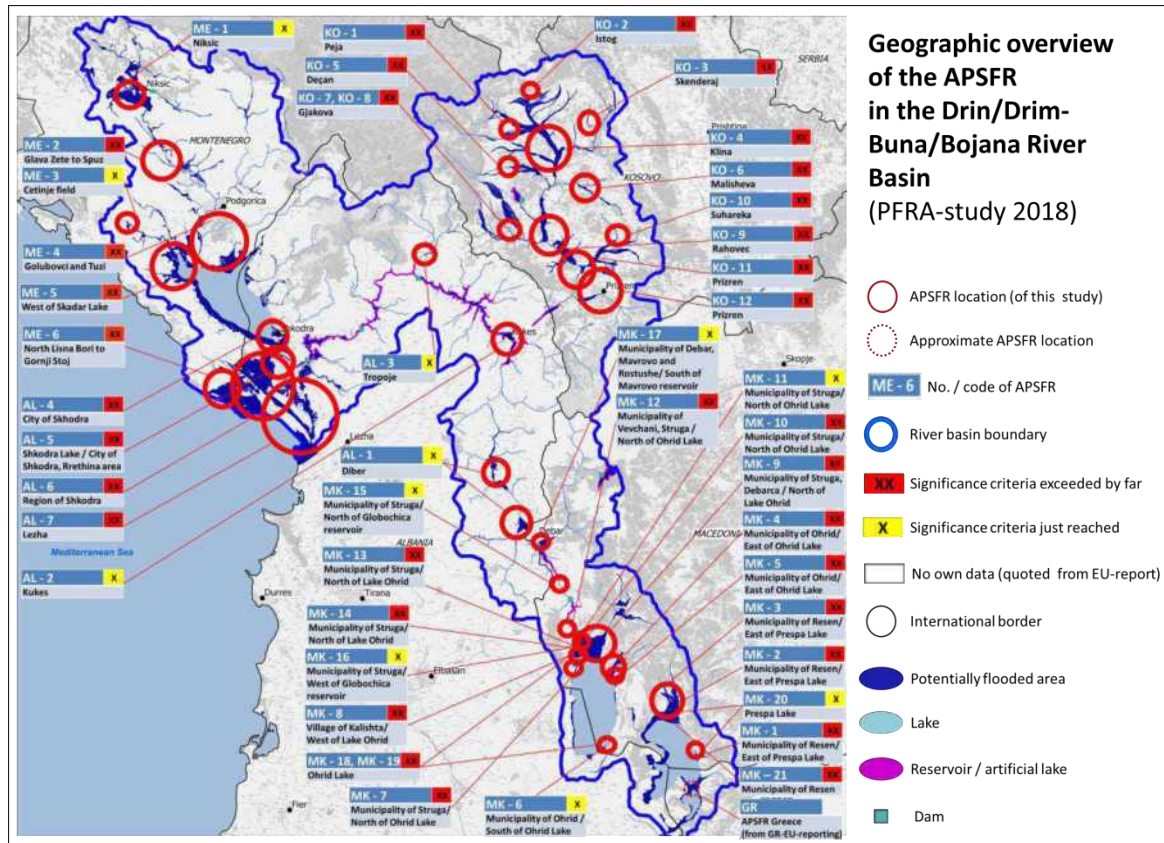
As main result of the preliminary flood risk assessment 46 areas of potential significant flood risk (APSFR) were identified throughout the Drin/Drim-Buna/Bojana River Basin. Of these 21 are located in North Macedonia, 12 in Kosovo, 7 in Albania and 6 in Montenegro. The numbers do neither reflect the extent of potential risk nor the size of the risk areas. The bigger flood risk areas are situated in Albania in the delta of the Drin River Basin and around Lake Shkodra, whereas the number of smaller risk locations is found in the upstream countries. Areas in Kosovo and North Macedonia are facing flash flood risk and pluvial flood risk (in smaller catchments and along the headwaters of smaller streams that cross villages).

The APSFR were categorised with two levels of potential significant risks: high significance characterises the areas in which more than 2 of the significance criteria were exceeded; low significance stands for areas in which 1 or 2 criteria were exceeded. Looking at the areas about 76% of all potential flood risk areas can be called highly significant (in Kosovo 100%, also because the available level of data is comparably low). One quarter of the APSFR is of low significance, exceeding just one or two significance criteria (see the following chart):



In addition to the results of this exercise, one area of potential significant flood risk is shown for Greece. This is not a result from the study, but the information is added from the green river basin based on published preliminary flood risk assessments of the Greek Government.

The APSFR are shown in one overview map (see following figure) and in a list in the report. For each of the APSFR a map in the annex shows the result of the GIS assessment.



### **Further recommendations and outlook on further flood risk management steps**

The activities of the preliminary flood risk assessment were completed by discussing and summarising recommendations for future steps on flood risk management in the transnational scope of the Drin River Basin. They are the result of discussions of the Technical Working Group to document additional outputs of the working group processes and to provide achievements to the Drin Core Group and its Expert Group on Floods. The conclusions include measures at river basin level like the coordinated implementation of the European Floods Directive, activities to improve expert knowledge, important information and data for the different relevant disciplines and sectors. They further document measures at sub-basin level that need to be implemented in regional and national responsibilities but that should be coordinated and/or harmonised on the transnational platform to deliver the most effective outcome. The outlook also includes a number of topics and questions that should be answered in the subsequent processes in which harmonised detailed flood hazard and flood risk maps for the identified APSFR should be modelled and produced.

## 1 Background

### 1.1 Objectives and scope

In the light of expected impacts of climate change the project shall support the improvements of resilience and preparation of population, economy, natural resources and infrastructure towards floods. In the transboundary river basin of the Drin/Drim-Buna/Bojana River a systematic river basin wide Preliminary Flood Risk Assessment is the basis for the joint decision on risk management priorities. The transboundary assessment concludes in the determination of Areas of Potential Significant Flood Risk (APSFR). For the APSFR further flood risk management activities like precise hazard and risk mapping as well as flood risk management planning shall be done, according to the procedures of the EU Floods Directive.

The Preliminary Flood Risk Assessment (PFRA) in the international Drin/Drim-Buna/Bojana River Basin was completed in November 2018. It was developed within the project's transnational Technical Working Group with over 40 representatives of the participating countries Montenegro, Albania, Kosovo and Macedonia and with support of GIZ within the regional project "Climate Change Adaptation in transboundary flood risk management for the Western Balkans". Since Greece is a riparian country in the Drin/Drim-Buna/Bojana River Basin and water from its territory contributes to the headwaters of the Drin/Drim River information about flood risk management in Greece have been added to this report<sup>1</sup>, even if Greece was not actively represented in the project.

Beside a comprehensive indicative risk assessment this component aims at mapping the "areas of potentially significant flood risk" (APSFR, according to the EU Floods Directive) and the documentation of transnational measures for future flood risk management, to support the follow-up activities in the framework of the Drin Core Group. Ideally this support can contribute to the work of the Expert Working Group (EWG) on Floods of the Drin Core Group, once this architecture is there. The Technical Working Group of this project would highly appreciate if the results, findings and products are later taken up by the EWG on Floods.

The governments of the respective countries have taken initiatives for improving the legal and regulatory framework in line with the EU legislation, as well as for developing management tools and mechanisms for some parts or some aspects of the Drin/Drim-Buna/Bojana River Basin. According to the National Communications to UNFCCC from Albania, Montenegro and Macedonia, as well as to the report 'The state of water in Kosovo', climate change will have serious impacts in the Drin/Drim-Buna/Bojana River Basin. The Memorandum of Understanding signed November 2011 under the Drin Dialogue Process, has set goals for climate change risk reduction, especially the cooperation on flood prevention. This river basin wide, transboundary Preliminary flood risk assessment generally considers both, potential climate change impacts and the process to improve transboundary cooperation in flood risk management in the Drin/Drim-Buna/Bojana River Basin.

---

<sup>1</sup> All information on flood risk management in Greece were taken and quoted from official published documents and official reports of Greece to the EU, published on the EU web pages.

## 1.2 Flood Risk management according to the EU Floods Directive

The assessments, maps and developed catalogues of measures shall fulfil the obligations of the “European Directive 2007/60/EC on the assessment and management of flood risks”. This is not binding to non EU-member states, but a well-accepted standard and a contribution to the accession process. It builds up on the change of strategy in fighting against flood risks: the traditional approach was to protect people, economic goods and agricultural land from floods (which regularly fails when extreme floods overtop the protection works). The modern approach of the Directive is to cooperate with all relevant actors to “live with the floods”, to protect if possible, to adapt uses and constructions to flood risks in respective areas, and especially to prepare for being flooded, in a holistic approach with all potentially affected people, organisations, administrations and businesses.

Thus, the purpose of the Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the community. According to the Directive flood risk management shall address all aspects of floods risk management, including prevention, protection and preparedness.

The Directive has to be implemented in coordination with other legal acts, mainly the Directive 2000/60/EC (Water Framework Directive), and requires cyclical implementation. The Directive focusses on the integration of all relevant sectors, including land use management, civil protection, dam management, strategic and environmental impact assessments, nature legislation, public consultation etc. A major objective is the coordination across the river basin, including requirements for transboundary coordination.

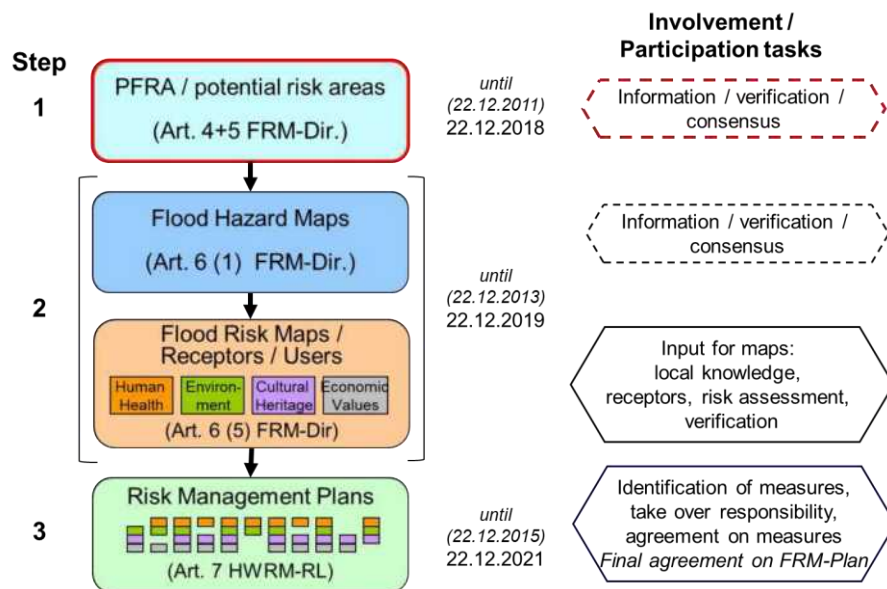


Figure 1: The steps and milestones of FRM according to the EU-Floods-Directive (reference to articles of the Directive in brackets) [graphic: INFRASTRUKTUR & UMWELT]

**Note:**

All deadlines in the figures above are valid for the reporting by the EU member states to the EU on the results of the respective step. They are not automatically binding for the Drin/Drim-Buna/Bojana River Basin.

In general the EU Floods Directive foresees three steps, which have to be implemented in all member states within the given deadlines for all river basins:

1. Preliminary flood risk assessment (PFRA) resulting in the identification of areas of potential significant flood risk (APSFR);
2. Flood hazard and flood risk mapping (FHRM);
3. Flood risk management planning (FRMP).

Within the Drin/Drim-Buna/Bojana River Basin single flood risk management plans exist (e.g. Shkodër region, regional and communal plans, GIZ, 2015). Also some flood hazard maps were developed for small selected areas of the river basin, especially after the big floods of 2010 (e.g. Mott McDonald, 2012). However, due to a missing comprehensive run-off-model and missing input data there are doubts about the accuracy of the flood hazard maps.

Many flood risk management activities in the Drin/Drim-Buna/Bojana River Basin can be called single, isolated and exemplary approaches. No systematic identification of main risk areas for the whole river basin has been done yet, to set priorities for the steps 2 and 3. The idea of the EU Floods Directive to first identify “Areas of Potential Significant Flood Risk” (APSFR) based on available, existing information and data in a “Preliminary Flood Risk Assessment” has not been followed in the Drin/Drim-Buna/Bojana River Basin yet. However, this is not a problem because the existing Hazard and Risk Maps and the Flood Risk Management Plans can be used for the river basin wide PFRA and are integrated.

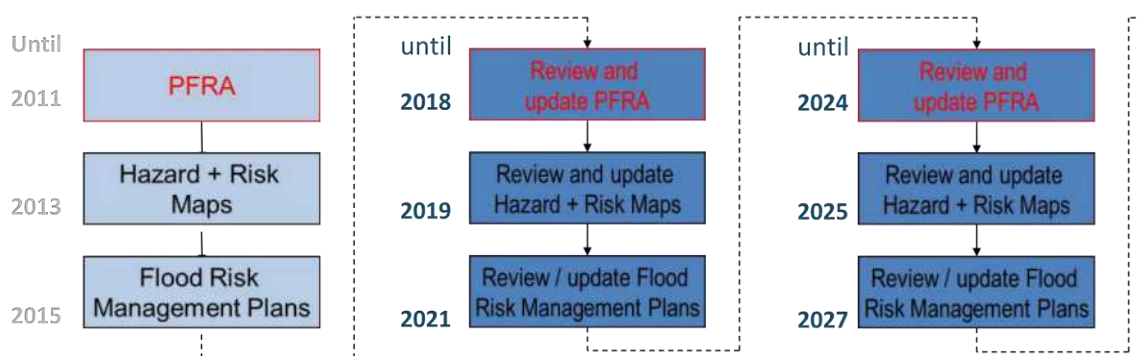


Figure 2: Updating Cycle with Assessment steps

According to the schedule the EU Floods Directives requests to review and if necessary update the steps of flood risk management (PFRA, maps and flood risk management plans).

The schedule of all FRM activities should be realistically set for the River Basin. The reporting obligations and the respective deadline are not valid for the Drin/Drim-Buna/Bojana River Basin countries being not member states yet. Realistically the schedule should be adjusted to the EU schedule step by step. By end of 2018 this PFRA can be used to form a ground for Flood Hazard and Risk Mapping as well as Flood Risk Management Planning. So The Drin/Drim-Buna/Bojana River Basin countries might prepare to catch up with the EU-cycle schedule in the 3<sup>rd</sup> cycle (2022 – 2027).



## 1.3 Flood Risk Management in the Drin/Drim-Buna/Bojana River Basin

### 1.3.1 Flood Risk Management in Macedonia

The most important sources of the present national regulatory and legal framework dealing with water management in the country or having reference to water related matters, including protection against harmful effects from water (e.g. floods), include:

- Law on Waters (OG 87/2008, 06/2009, 161/2009, 83/2010, 51/2011, 44/2012, 23/2013, 163/2013)
- Law on Protection and Rescue (OG 93/2012, 41/2014).

The Law on Waters provides legal basis for water management and protection in the country. It regulates the framework for water resources use and exploitation, protection against harmful effects of water, protection of water against exhaustive water extraction and pollution, water resources management, sources for and manner of financing water management activities, concessions, transboundary water resources, and other issues of relevance with regard to the provision of a unique water use regime. As regards specifically flood risk assessment and flood protection the Law on waters stipulates the following:

- Section V.2 – Protection against harmful effects from water – Flood protection, defines: Basic and supplementary measures for flood protection; preparation of flood protection plans; flooding of protected areas (floodplains); responsibilities for maintenance of flood protection facilities; and reporting responsibilities.
- Section VIII.4 – Water resource management facilities and services – Dams and reservoirs, defines that the entity which is responsible for management of larger dams is obligated to prepare flood risk assessment analysis in case of a dam break.
- Section X – Material Base and Financing of Water Management and Development stipulates that funds collected by surface water use charges shall be used for, inter alia, construction and maintenance of riverbed regulation facilities and preparation of flood protection plans.

The Law on Protection and Rescue defines the system for protection of the population, environment, material assets, natural resources, biodiversity, and cultural heritage from disaster events including floods. The Law specifies the following: (1) basic provisions for protection and rescue; (2) rescue and protection planning; (3) responsibilities of central government, local government, public and private organizations regarding rescue and protection; (4) responsibilities of the population and the civil sector; (5) measures for rescue and protection; (6) rescue and protection forces; (7) self-defence rights and mechanisms; (8) monitoring of rescue and protection planning and implementation; (9) education and training for rescue and protection; (10) financing arrangements for rescue and protection; etc.

Following the Institutional framework for flood risk management and planning, the responsibilities are shared between MoEPP as a Competent Authority for integrated water management including flood risk management, Crisis Management System (CMS), Protection and Rescue Directorate (PRD) and municipalities.

Transposition of the EU Floods Directive is at an early stage. The designation of the competent authorities has been completed. An indicative timetable (Table 1) for the implementation the EU Floods directive has been set up, according to the Ministry of Environment and Physical Planning.

Table 1: Indicative timetable for implementation EU Floods directive in Macedonia

Actual or estimated date for:	until
Setting up of administrative arrangements– identification of the competent authority (Art. 3)	Completed
Description of Floods which have occurred in the past and which had significant adverse impacts on human health, the environment, cultural heritage and economic activity (Art. 4)	31.12.2017
Assessment of potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity (Art. 4)	31.12.2017
Preparation of flood hazard maps and flood risk maps (Art. 5)	31.12.2020
Establishing appropriate objectives for the management of flood risks (Art. 7)	31.12.2024
Establishing measures for achieving appropriate objectives for the management of flood risks (Art. 7)	31.12.2024
Establishing appropriate steps for coordinating the application of Directive 2007/60/EC and Directive 2000/60/EG (Art. 9)	31.12.2018
Publishing preliminary risk assessment, flood hazard maps and flood risk maps, flood risk management plans and making them available to the public (Art. 10)	01.01.2024
Full implementation	

As regards flood risk management in accordance with the EU Floods Directive, in recent years planning documents have been developed for several major sub-basins with financial support provided by development organizations active in the country, through different projects (see figure 3): Preliminary Flood Risk Assessment (PFRA) for Crna Reka, Bregalnica and Crn Drim Rivers, and Flood Risk Management Plans (FRMP) for Strumica and Upper Vardar river sub-basins.

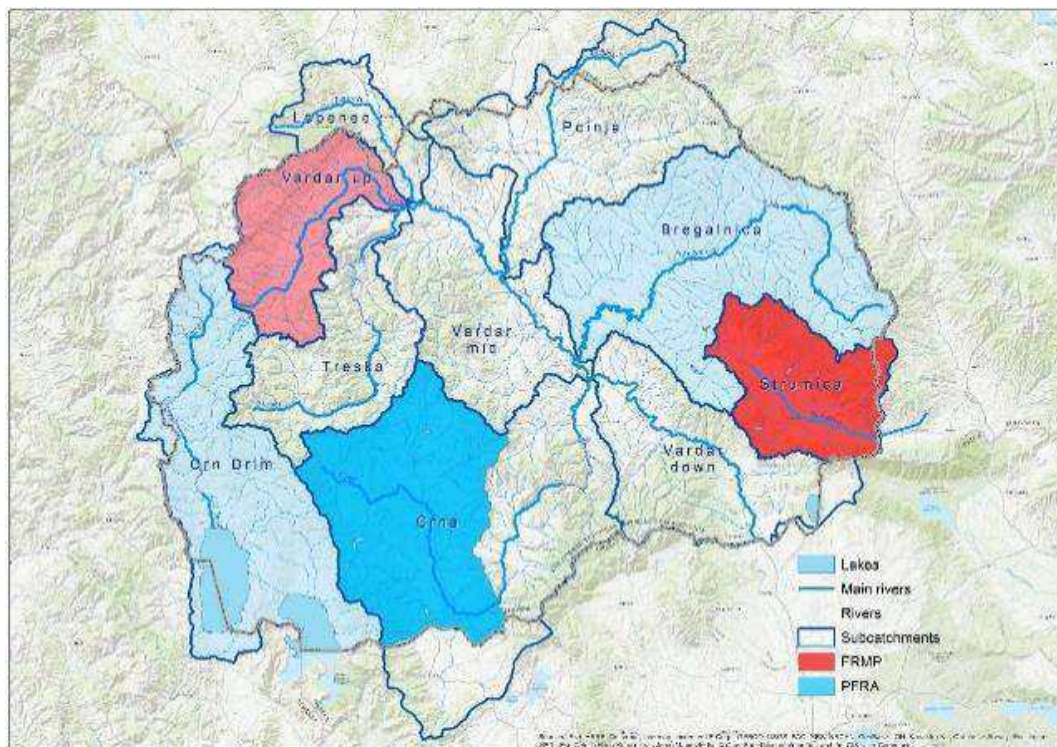


Figure 3: Existing FRM Documents in Macedonia

However, all these plans are not fully in compliance with the EU Floods Directive. Further activities are needed that the prepared plans are additionally improved and put to the required level to meet the EU Floods Directive's requirements and harmonization of envisage activities among different plans are needed and their prioritization.

In order to improve the situation significant efforts are needed for further harmonization with the relevant EU legislation in the country. Straightening of the capacity of relevant administration in regards to flood management is one key task.

### **1.3.2 Flood Risk Management in Kosovo**

Flood Risk Management in Kosovo is in the responsibility of the Ministry of Environment and Spatial Planning according to the Law on Waters of Kosovo (no. 04 / L-147 on April 29, chap. I). The responsibilities of the Ministry are drafting laws and sub-legal acts dealing with all water resource issues in the Republic of Kosovo.

The protection from harmful water activities includes activities and measures for protection and safety from floods, protection against erosion and torrents, and the elimination of consequences from harmful water activities. This shall be carried out under conditions, in the manner and in the procedures provided by the Law on Waters and the legislation in force (Water Law, art. 45).

Competent for protection from damaging waters and protection from erosion and other damaging actions in urban areas within the city limits is the municipality (art. 46, Water Law). Protection against erosion and other damaging actions in the river basin is in the competence of the Water Management Authority. Municipalities and the Authority are also competent to regulate and maintain the protection infrastructure in the river beds, including mountain ranges, defensive walls and other protective facilities. Financing for maintenance and maintenance is done by the budget of Kosovo, Ministry, Municipalities and other sources. The Ministry shall monitor the coordination of the activities undertaken by the municipalities and the Water Management Authority. All activities and measures undertaken in the regulation, maintenance and protection of waters, including erosion, are required to be conducted in accordance with the State Water Strategy and plans for River Basin Management, including urban development plans and urban plans.

It is planned to draft a Program for Protection from Harmful Water Activities by the Municipalities and the Water Management Authority in cooperation with other state administration bodies, competent for the conclusion of works in the field of water (art. 47, Water Law). The Ministry defines in sub-legal acts the content, manner and procedures of the program. The Ministry of Environment and Spatial Planning has issued the Administrative Instruction on Protection from Harmful Water Activities in 2015 (no. 19/2015). This administrative instruction is in compliance with the EU Floods Directive.

A concept for the first flood risk management plans is part of the administrative instruction (art. 7). Conclusions of the preliminary flood risk assessment shall include a summary map of the river basin region showing the areas of potentially significant flood risk (APSFR). Flood hazard maps and flood risk maps shall be prepared (art. 8). Flood risk management objectives shall be set up (art. 9). The FRM-plans include a summary of the measures and their priorities aiming at achieving the objectives for flood risk management. They include flood related measures arising from the assessment of the effects on the environment, specific public or private projects in the environment as well as flood related measures that take into account the risk control of accidents involving hazardous substances. For international river basins, a description of the methodology of cost and

benefit analysis used for the evaluation of cross border measures shall be included, if such methodology exists.

During the implementation of the FRM-plans the priorities and the implementation progress shall be monitored, based on a concept described in the plan. In this regard all actions taken for public consultation and information shall be defined. Further the plans include a list of competent authorities, a description of the coordination process within international river basins and the coordination process with the Law on Waters. Components of the FRM-Plan update are also described in the administrative instruction document (also according to the annex of the EU Floods Directive):

- any change or update from the publication of the previous version of the risk management plan from the outbreak, including a summary of the undertaken revisions;
- a description of the progress in achieving the objectives;
- a description and explanation of any measures envisaged in the previous version of the FRM-plan that have been planned to be undertaken and have not been undertaken;
- a description of any additional measures from the publication of the previous version of the Flood Risk Management Plan.

So far no FRM-plans have been drafted according to the abovementioned laws or guidance. A first study on "Flood hazard assessment" including a "Preliminary flood assessment on the Drini River Basin" and a "Local flood risk map on Skenderaj" was developed 2008/2009 by the international consortium of consultants GFA/BRLingenierie/OIE in the framework of the project Institutional Support to the Ministry of Environment and Spatial Planning (MESP), financed by the EU (GFA, 2009).

Kosovo is represented in the Drin Core Group by the River Basin Management Agency.

### **1.3.3 Flood Risk Management in Albania**

The National Water Council (NWC) is the main inter-institutional body responsible for drafting policies and plans for integrated water resource management, acting under the law 111/2012. It is chaired by the Prime Minister of Albania and composed of seven main stakeholder ministries. The Water Resources Management Agency (WRMA) is the responsible executive institution responsible for the implementation of policies and strategies related to water resources as approved by the National Water Council. The WRMA thus is also responsible for implementing flood risk management policies (according to law 111/2012 for integrated water resources management).

The EU Directive 2007/60/EC on Floods is transposed into Albanian policy as part of the policy "The Content, Development and Implementation of National Water Strategies, of River Basin District Management Plans and of Flood Risk Management Plans", approved by National Water Council decision no. 1 dated 17.2.2015 (shall be adopted by the Council of Ministers soon, as this is one of the priorities of WRMA at present). The policy includes a package of sub laws prepared with support of EU on transposition of EU legislation, like the Directive 2006/118/EC, Directive 2007/60/EC and Directive 2009/90/EC.

The WRMA contributes, in collaboration with the Ministry of Interior, to prevent civil emergencies (according to Article 70 of the Law 111/2012 - Flood risk management Plans). This includes the coordinated implementation of policies for river basin management and flood risk management in compliance with the legislation in force for civil emergencies and the National Management Plan for Civil Emergency.

Practically WRMA is in charge of preparing the flood risk management plans and to coordinate the process with different institutions. MARD (Ministry of agriculture and rural development) is responsible to prepare and implement the investments for the protection of agriculture land and drainage pumping stations based on the FRM-plans. The municipalities are responsible to protect urban areas from flood risk, also based on the FRM-plan. The General directorate for civil emergencies prepares and implements the national plan for civil emergencies which shall be coordinated with the flood risk management plans.

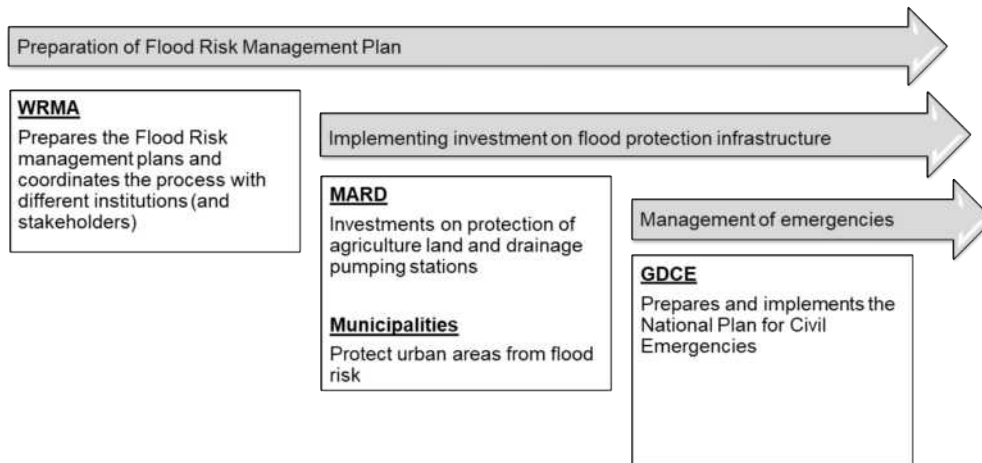


Figure 4: Structure of flood risk management processes in Albania (figure based on the presentation of Arduen Karagjozi technical working group meeting June 2018)

FRM-plans shall – in future – be integrated in a River Basin Management Plan. According to the law 111/2012, the WRMA coordinates all the activities in this area. In detail the following institutions are part of the FRM implementation strategy:

Responsible institutions for planning and policies:

- WRMA responsible for policy and planning on central level;
- River Basin Council is responsible for approval of Flood risk management plan;
- General Directorate for civil emergencies is responsible for preparation and approval of Management plan for civil emergencies.

Responsible institutions for flood protection investments and risk reduction measures:

- Ministry of Agriculture and Rural Development is responsible for flood protection infrastructure on Agriculture land;
- Municipalities are responsible for investments on flood protection of urban areas and risk reduction measures.

Responsible institutions for flood emergencies situations:

- Ministry of Defence and General Directorate of Civil Protection is responsible for coordination of actions and intervention to protect human life and property;
- Prefecture is responsible to coordinate the local institutions during the emergency events on Qark level;
- Municipalities are responsible to coordinate their structures on protection of human life and property.

Besides others some important FRM-projects have been implemented or are ongoing with relevance for the Albanian Drin/Drim-Buna/Bojana River Basin: with GIZ-support the project “FRM-plan for the Skhodra Region” was implemented according to the EU standards from 2012-2015 within the GIZ-programme “Climate Change Adaptation for the Western Balkans” as one of the first FRM-plans in the Western Balkan region. The ongoing project PRONEWS, financed by EU, is contributing to the Preliminary Flood Risk Assessment (PFRA) and flood risk maps (FRM) for Albania but does not focus explicitly on the Drin/Drim-Buna/Bojana River basin. Until now the consortium has delivered the second draft of PFRA and by April 2019 they have planned to deliver the FRM for the Albanian territory.

Albania is represented in Drin Core Group by the Water Resources Management Agency.

### **1.3.4 Flood Risk Management in Montenegro**

The framework for management and protection of water resources in the country is set with the Water Law (WL), which is the main legal document transposing the Water Framework Directive. The Water Law is harmonized around 95% with the Water Framework Directive.

The transition of the EU Floods Directive 2007/60/EC is completed (100%) but the implementation is at an early stage. The date of the full implementation has determined as following:

- Development of preliminary flood risk assessment until 2019,
- Determination of areas of potential significant flood risks until 2019,
- Preparation of flood hazard maps and flood risks maps until 2021, and
- Development of flood risk management plans until 2024.

According to the WL, the Ministry of Agriculture and Rural Development (MARD) has the leading role in the water management process. Water Administration (WA) as the administrative body within the Ministry of Agriculture and Rural Development is responsible for implementation of water management strategy and plans. Specific responsibilities and obligations are shared among several other ministries in their respective areas of competence. The Ministry of the Interior (Directorate for Emergency Services) is responsible for risk management and emergency situations response, including the event of floods, in cooperation with the Institute of Hydro-Meteorology and Seismology of Montenegro (IHMS).

The institutions that are responsible for the management and implementation of FRM in Montenegro are:

- Ministry of Rural Development and Agriculture;
- Water Administration, under the Ministry of Rural development and Agriculture
- Directorate for Emergency Situations under the Ministry of Interior (Mol);
- Institute for Hydrometeorology and Seismology of Montenegro (ZHMS), under the Mol;
- Local Authorities – Secretariats involved in water management.

In accordance with the Montenegrin legislation, the Ministry of Agriculture and Rural Development (MARD), within which there is a separate Directorate of Water Management, has a leading role in water management process. The Directorate performs tasks related to proposing and developing flood risk management policies. The Water Administration (WA) is a body responsible for preparing and implementing a flood risk management plan as well as of all the steps preceding the adoption of the plan.

Montenegro is an active member of the International Commission for the Protection of the Danube River (ICPDR) and has the status of observer in the International Commission for the Sava River Catchment Area. Relations of Montenegro with its neighbouring countries Croatia and Albania are regulated by respective Inter-state Agreements. The Agreement between the Government of Montenegro and the Government of Croatia on mutual relations in the area of water management was made and signed on September 4, 2007 in Zagreb. The Agreement between the Government of Montenegro and the Government of the Republic of Albania on water-related problems was concluded on October 31, 2001 in Podgorica. The Framework Agreement on Water Management between Montenegro and Albania was signed at the joint session of the governments of Montenegro and Albania which was held on July 3, 2018 in Shkodra.

In addition to the Albania-Montenegro Agreement in the field of water management, the following are also signed:

- Agreement between the Academy of Sciences and Arts of Montenegro and Albania in 2005;
- Memorandum of Understanding between the Council of Ministers of the Republic of Albania and Montenegro for the "Intercultural Development of the Skadar Lake".

In order to coordinate and harmonize the implementation activities, both short-term and long-term measures, both countries have been set up by the Commissions, which have elaborated an action plan and defined in detail the urgent measures that need to be taken.

### **1.3.5 Flood risk management in the Greek part of the Drin/Drim-Buna/Bojana River Basin**

As Greece is an EU member state it has implemented the EU Floods Directive within the EU-schedule. Greece has prepared the PFRA, flood hazard and flood risk maps and flood risk management plans for the APSFR during the first cycle of the EU Floods Directive (2007 – 2015). It has updated the PFRA and reported to the EU by end of 2018 in the second cycle.

The Special Water Secretariat of the Ministry of Environment and Energy (EGY / RIS) coordinates Flood Risk Management in Greece and publishes the results of the FRM-processes. Greece is represented in the Drin Core Group.

### **1.3.6 Transboundary flood risk management in the Drin/Drim-Buna/Bojana River Basin**

In 2011, the five Riparians signed a Memorandum of Understanding committing to a Shared Strategic Vision for the Sustainable Management of the Drin/Drim-Buna/Bojana River basin. To support their cooperation, projects funded by the Global Environmental Facility are being implemented by the Global Water Partnership in partnership with UNECE. The projects aim to improve the joint analysis and understanding of transboundary issues.

The Drin Core Group was established in December 2009 after International Roundtables and Drin Consultation Meetings. The Drin Dialogue Process is based on further sequential Consultation Meetings. The focus of realised activities within the consultations and the Drin Core Group until today is on ecology and water quality. International cooperation in flood risk management is one of the objectives of the Drin Core Group but it was not put into action in this context yet.

In 2011 a Memorandum of understanding for the management of the extended transboundary Drin Basin was agreed by all riparian countries. It includes the objective to develop the cooperation and measures to minimise flooding especially in the lower parts of the Drin Basin. An ad hoc Expert Working Group on Floods is being established but not in place until now. Transnational coordina-

tion of flooding issues, like risk assessments, upstream-downstream solidarity actions, burden sharing and reduction of conflicts between flood risk and hydropower reservoir management could not be managed under the existing cooperation umbrella yet.

## 2 Methodology of the preliminary flood risk assessment

### 2.1 Requirements according to the EU Floods Directive

The Directive sets the framework for the preliminary flood risk assessment in chapter III, article 4:

*„2. Based on available or readily derivable information, such as records and studies on long term developments, in particular impacts of climate change on the occurrence of floods, a preliminary flood risk assessment shall be undertaken to provide an assessment of potential risks. The assessment shall include at least the following:*

- (a) Maps of the river basin district at the appropriate scale including the borders of the river basins, sub-basins and, where existing, coastal areas, showing topography and land use;*
- (b) A description of the floods which have occurred in the past and which had significant adverse impacts on human health, the environment, cultural heritage and economic activity and for which the likelihood of similar future events is still relevant, including their flood extent and conveyance routes and an assessment of the adverse impacts they have entailed;*
- (c) A description of the significant floods which have occurred in the past, where significant adverse consequences of similar future events might be envisaged;*

*And, depending on the specific needs of Member States, it shall include:*

- (d) an assessment of the potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity, taking into account as far as possible issues such as the topography, the position of watercourses and their general hydrological and geomorphological characteristics, including floodplains as natural retention areas, the effectiveness of existing manmade flood defence infrastructures, the position of populated areas, areas of economic activity and long-term developments including impacts of climate change on the occurrence of floods.*

*3. In the case of international river basin districts, or units of management referred to in Article 3(2)(b) which are shared with other Member States, Member States shall ensure that exchange of relevant information takes place between the competent authorities concerned.”*



## 2.2 Types of flood

The following types of floods (or: “source of flood”) may be considered when identifying the areas of potential significant flood risk within the preliminary flood risk assessment (according to the EU reporting guidance under the EU Floods Directive; EU 2013; Technical Report-2013-071) (Table 2):

Table 2: Types of flood / sources (from: Guidance for reporting under the EU Floods Directive; EU 2013)

Type / Source	Description
Fluvial	Flooding of land by waters originating from part of a natural drainage system, including natural or modified drainage channels. This source could include flooding from rivers, streams, drainage channels, mountain torrents and ephemeral watercourses, lakes and floods arising from snow melt.
Pluvial	Flooding of land directly from rainfall water falling on, or flowing over, the land. This source could include urban storm water, rural overland flow or excess water, or overland floods arising from snowmelt.
Groundwater	Flooding of land by waters from underground rising to above the land surface. This source could include rising groundwater and underground flow from elevated surface waters.
Sea Water	Flooding of land by water from the sea, estuaries or coastal lakes. This source could include flooding from the sea (e.g., extreme tidal level and / or storm surges) or arising from wave action or coastal tsunamis.
Artificial Water-Bearing Infrastructure	Flooding of land by water arising from artificial, water-bearing infrastructure or failure of such infrastructure. This source could include flooding arising from sewerage systems (including storm water, combined and foul sewers), water supply and wastewater treatment systems, artificial navigation canals and impoundments (e.g., dams and reservoirs).

The focus of the here documented preliminary flood risk assessment was agreed to be on potential risks resulting through floods along surface waters from rivers and streams (fluvial).

Other possible types of flooding were discussed in the Technical Working Group. It was agreed to consider them as follows:

### Pluvial / heavy rain / flash flooding (also: torrential flooding)

For the Drin/Drim-Buna/Bojana River Basin pluvial floods are not modelled and thus systematic risk assessment is not possible yet based on existing information. But due to the importance of this type of flood according to the increasing damages from these in the last years at least past flash flood events are documented and considered in the evaluation of potential risk areas. If recurrent past events hit one location or one region this shall be called significant risk in the light of this PFRA.

The determination of flash floods in the context of this study is based on the characteristic of the specific location in which the flood occurs: if the size of the catchment that drains water to this location is < 20 km<sup>2</sup>, and no permanent river or stream exists, it shall be defined as heavy rain event or flash flood. If the catchment is > 20 km<sup>2</sup> and a permanent river or stream exists, it is defined as river flood.

### Groundwater

Risks from groundwater often occur in lowland areas, marshland or meadows that are at the same time regularly flooded from rivers (fluvial floods). Thus the potential risk areas are already identified

under fluvial floods. If large areas that are not flooded from rivers have been flooded just from groundwater, and if these events have been recorded, those areas are additionally documented and evaluated according to the significance criteria. In the PFRA for the Drin/Drim-Buna/Bojana River Basin such areas were identified (in ME and MK).

#### Sea Water / coastal flooding

In the Drin/Drim-Buna/Bojana River Basin the mouth of the Buna, where the Drim/Drim - Buna/Bojana River feeds into the Adriatic Sea, coastal flood risk is relevant (AL and ME). According to local experiences and documentations flooding along the coast is not caused by sea water itself but by the combination of river flood (from Buna River) and high sea water levels. The origins of the flood risk are the coastal rivers that cannot discharge into the sea due to high sea water level. Thus no potential significant flood risk areas can be identified just by sea water risk.

#### Artificial Water-Bearing Infrastructure

The technical working group agreed to consider the risk of dam failure as not significant risks because the probability of dam failure is lower than 1/10.000, according to dam design and dam failure studies. Compared with probabilities of fluvial floods (1/100, 1/500) this cannot be called significant in the methodology of the PFRA to determine APSFR for FRM. However it was discussed and it shall be pointed out that there is a risk of dam failure around and below the numerous dams in the course of the Drin/Drim-Buna/Bojana River, especially in Albania. This risk needs to be regularly assessed (dam failure studies) and considered in maintenance plans and risk management scenarios.

The retroactive effects of reservoir management upstream of the reservoirs (rising water levels upstream as consequence of small water consumption in HPP in wet seasons) is considered as fluvial floods due to rising lake/reservoir levels.

The effects of reservoir management downstream (release of water from reservoirs in flood situations) are also considered with fluvial flooding because the downstream channels of reservoirs are also in the focus of fluvial flood risk below the dams.

Drainage channels (like in the Shkodra area or delta area of the Drin/Drim-Buna/Bojana River), are considered as fluvial flooding since they are closely connected with the water levels and the floods in the main Drin/Buna channels and create no additional risk areas.

### **2.3 Consideration of climate change**

Flood events are expected to increase in terms of both, intensity and frequency due to climate change. Although the total yearly precipitation in the study region is predicted to decrease, short term heavy rainfall, often in combination with melting snow and saturated soil, is expected to cause increasing risk of flash floods, great amount of runoff water and river floods in future.

In the course of this flood risk assessments, the expected impacts of climate change are considered by using an extreme flood scenario (extreme flood events, return periods  $\geq 500$  years). This includes all proved or known or estimated future impacts, including climate change.

A preliminary flood risk assessment (PFRA) is, by nature, based on existing data and is done without sophisticated meteo-hydrologic modelling (if this information does not exist). But the PFRA is based on more or less approximate flood risk areas, generated by estimations of maximum water levels, mainly without modelling. Impacts of climate change on the identification of Areas of Poten-

tial Flood Risk (APSFR) are fully covered by working with extreme flood event scenarios. The extreme scenario includes an addition of 25 % in the water level, which leads to flood areas that often have not been observed yet but which should represent the maximum risk area.

With this approach it can be stated that climate change impacts are covered by the risk assessment. By using the described methodology it can be ensured that all reasonable potential flood risk areas are included which may result from future extreme rising discharges.

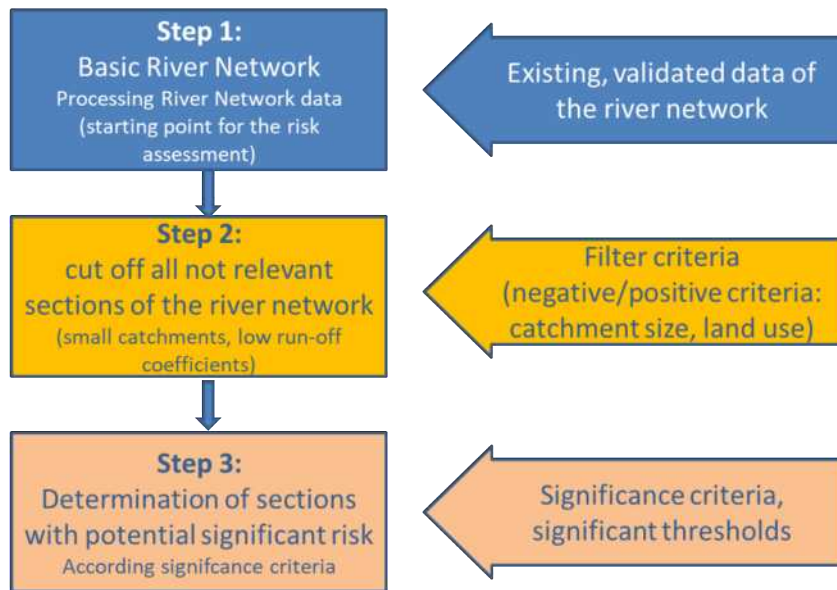
If in the PFRA one or the other area is determined larger than necessary this will be evaluated in the second step of the more detailed flood hazard maps and flood risk maps. In the EU-Member States in the second cycle about 5 % of the APSFR of the first cycle were adjusted (added or reduced from the APSFR).

## 2.4 Identification of Areas of Potential Significant Flood Risk (APSFR)

### 2.4.1 Working steps

Generally, the identification of areas at potential significant flood risk follows three main working steps, which were basically done in the 1<sup>st</sup> cycle in the PFRA – processes in the EU member states:

1. Determination of the initial river network: the river network is generated from the DEMs of the river basin, and by validation with existing river network-data (only existing for some parts). In addition a validation with Open Street Map (OSM) data and with satellite images ensured the correctness. The whole relevant river network is processed in one GIS project and validated to be used for the further filtering process.
2. Determination of the river network that might have flood risk (filtering out not relevant river stretches according to negative criteria like size of the catchment, length of the stretch or characteristics of the river banks or flood plains (very steep or canyons, only 100 % rural land uses). Here the threshold for the relevant catchment area was determined in an iteration using 50 km<sup>2</sup>, 30 km<sup>2</sup>, 20 km<sup>2</sup> and 10 km<sup>2</sup>. The results show that for the characteristics of the Drin/Drim-Buna/Bojana River Basin 50 and 30 km<sup>2</sup> reduce the network too much so that past river flood events would not be covered. The threshold of 10 km<sup>2</sup> results in a river network including many stretches which are dry for most of the year. So 20 km<sup>2</sup> were determined as adequate threshold for relevant river stretches. Nevertheless smaller river sections were evaluated. All flooding along river stretches with catchments < 20 km<sup>2</sup> the flood event can be defined as flash flooding or heavy rain event, while > 20 km<sup>2</sup> is defined as river floods.
3. Assessment of the remaining river network in terms of potentially affected assets at risk (for economic, human life, cultural heritage, and environment), land uses or risk of pollution in case of floods and comparison with agreed significance criteria. The results are river stretches at potential risk, named: "areas potential significant risk" (APSFR).



INFRASTRUKTUR & UMWELT 2016

Figure 5: Work steps of the preliminary flood risk assessment for the identification of areas with potential significant flood risk

The quality of the single steps depends extremely on the available data and other information. Since the EU Floods Directive states that just existing information and data shall be used in this case all information are gathered in the participating countries and merges for the assessment. No new modelling has been done for the PFRA.

#### 2.4.2 Determination of APSFR

The determination of the areas of potential significant flood risk is based on the analyses of the river sections (or lakes), for which from recent events damage potential has to be expected and added by those stretches of the river network in which floods may have adverse consequences on human life, economy, ecology or cultural heritage. For the single assets at risk the significance of the risk is checked stepwise.

The steps are visualized in the scheme below (Figure 6):

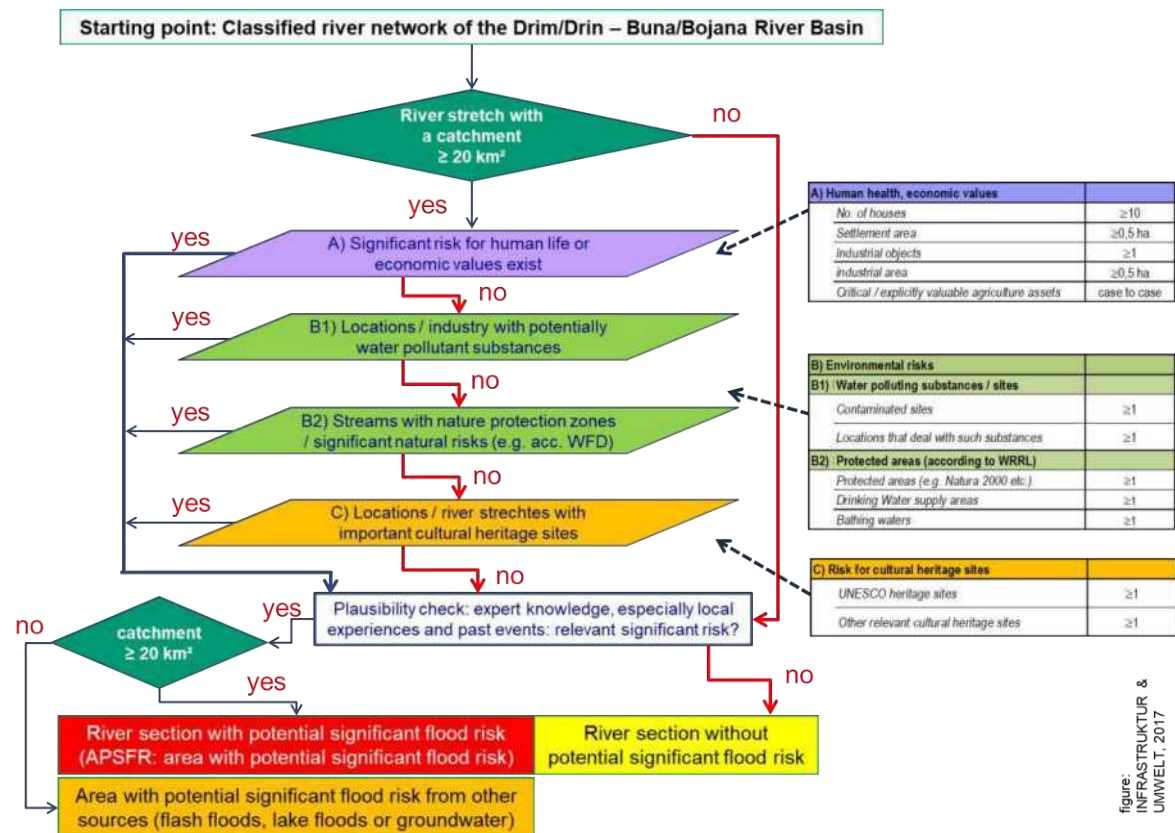


Figure 6: Steps for the assessment of potential significant risks

For the assessment steps the significance criteria according to Table 4 are used, which cover all considerable assets at risk. Each step (A-C as in Figure 6) is linked to one criteria. Thus the potential significant risk in each area is systematically checked and documented with the respective criteria in fact sheets.

### 2.4.3 Assets at risk and significance criteria

According to the specifications of the Directive four groups of assets at risk shall be considered in flood risk management and in the preliminary flood risk assessment. The risk assessment and consequent risk reduction measures shall aim at all four groups of receptors and according indicators (Table 3 and Table 4):

Table 3: Risk receptors and risk indicators

Risk on:	Example for flood risk indicators:
Human Health	<ul style="list-style-type: none"> <li>Number of residential properties.</li> <li>Critical services (Hospitals, Police/Fire/Ambulance Stations, Schools, Nursing Homes, etc.).</li> </ul>
Economic Activity	<ul style="list-style-type: none"> <li>Number of non-residential properties.</li> <li>Length of road or rail.</li> <li>Area of agricultural land.</li> </ul>
Environment	<ul style="list-style-type: none"> <li>Designated sites (water protection areas, areas with water pollutant substances) and flora / fauna according to the EU-habitat directive</li> </ul>
Cultural Heritage	<ul style="list-style-type: none"> <li>Cultural heritage sites (World Heritage Sites).</li> </ul>

Assets at risk were determined to identify potential significant risks for all risk receptors. Significance criteria and the threshold define what is identified as potential significant (see following Table 4). The criteria and the thresholds were presented, discussed and adjusted in the meetings of the technical working group in June 2018 and October 2018.

Table 4: Significance criteria for the PFRA

Assets at risk & significance criteria for PFRA	Receptors				Significance Criteria	Threshold of significance
	Human health	Economic activity	Environ- ment	Cultural heritage		
<b>A) Human health, economic values</b>						
<i>No. of houses</i>	x	x			existing objects or area in the flood area of the extreme event	≥10
<i>Settlement area</i>	x	x				≥0,5 ha
<i>Industrial objects</i>		x				≥1
<i>industrial area</i>		x				≥0,5 ha
<i>Critical / explicitly valuable agriculture assets</i>		x				case to case
<b>B) Environmental risks</b>						
<b>B1) Water polluting substances / sites</b>						
<i>Contaminated sites</i>			x		existing objects at risk (extreme event scenario)	≥1
<i>Locations that deal with such substances</i>			x			≥1
<b>B2) Protected areas (according to WRRL)</b>						
<i>Protected areas (e.g. Natura 2000 etc.)</i>			x		existing assets at risk (extreme event scenario)	≥1
<i>Drinking Water supply areas</i>	x		x			≥1
<i>Bathing waters</i>	x					≥1
<b>C) Risk for cultural heritage sites</b>						
<i>UNESCO heritage sites</i>				x	existing assets at risk (extreme event scenario)	≥1
<i>Other relevant cultural heritage sites</i>				x		≥1

For all areas in which floods have ever been observed and in which flood risk can be expected evaluations are done to assess if the risk for one of the receptors exceeds the threshold (=significant) or not (=not significant).

#### 2.4.3.1 Significance criteria for human health and economic values

An essential factor for the assessment of adverse consequences of flood events and their significance according to the Directive is the extent of risks for settlements, trade and industry areas. This also reflects the respective damage potential in the areas.

To determine the significance threshold for human health and economic values the economic damage potential – if assessments are existing – may be used. This is not the case so far for the Drin/Drim-Buna/Bojana River Basin. Alternatively, here a threshold of ca. 0,25 Mio € is used with the assumption that this damage can be reached by flooding 10 or more houses (leaving water depth and damage functions out of the estimations). If only housing area size can be assessed the approximate of 0,05 ha per house, consequently 0,5 ha of housing area is considered to be the threshold for a potential significant risk.

In addition, as result of the Technical Working Group discussions, risk for agricultural areas or agricultural assets is determined significant when in local or regional context substantial economic damage is possible that can ruin the basis for the existence of farmers. This includes vulnerable special crops, animals and machinery. The assessment of these criteria was done by expert judgement (significant agricultural risk areas or objects).

A fixed threshold or limit for the flood agricultural area or economic risk for agriculture is not used in the PFRA because:

- Economic data are not available (especially not for the whole river basin).
- Damage values in agriculture depend, like for all other land uses, but here much more, on the individual situation: grassland, cropping or special cultures or even structures cannot be assessed by the size of the inundated area.
- The individual agricultural land use can change from year to year and can consequently not be used as criteria for a flood risk management process that is determined to take 6 years.
- If agricultural land use would be used as a significance criteria almost all inundated areas in a river basin would have to be determined as significant. This would result in the need of a very large hazard and risk mapping plan area and flood risk management plans accordingly.

This approach was agreed in the technical working group, although it was mentioned frequently that agricultural land is very important for flood risk management in the region. This fact was evaluated intensively in the preliminary flood risk assessment.

Retrospectively, based on different risk area assessments, it can be stated that no APSFR would have added or reduced due to the aspect agricultural values at risk, according to the expert assessments.

Specific damage potentials result from different factors like population density, specific real estate values and added value and differ from location to location. These aspects need to be considered when preparing detailed risk maps. For the preliminary flood risk assessment the use of the named indicators is sufficient to determine areas of potential significant flood risk.

#### 2.4.3.2 *Significance criteria for environmental risk*

Adverse consequences of flooding for the environment mainly occur if water polluting substances are mobilised by flood water and enter rivers, lakes and coastal waters. Thus the most important assets at risk in this respect are contaminated sites (soil) and locations for storing or using water pollutant substances. The highest environmental risk can be found if water pollutions meet most vulnerable natural areas, like nature conservation areas or protected natural sites. Thus the assessment of significant risks includes the steps B1 „River sections with locations or facilities to store water polluting substances” and B2 “River sections with significant risk for protected areas”.

#### 2.4.3.3 *Significance criteria for cultural heritage*

In the course of the verification step C „River sections with important or UNESCO cultural heritage” the significance of the risk of flood events is assessed by:

- UNESCO world heritage sites are classified as significant, if damage as consequence of flooding is possible.
- River sections with at least one cultural heritage site or object with special regional or national importance, if damage as consequence of flooding is possible.

#### **2.4.4 Collection and documentation of risk information for the APSFR**

Based on the evaluation of recorded and documented past flood events and including local knowledge and expert judgement areas or stretches of rivers with damages in flood events or potential (observed) risk were identified. For these areas all available information and data on flooding, land use, objects at risk and urban or infrastructure planning were collected and analysed. The results are documented in risk fact sheets (Figure 7 and Annex 4). The data are assessed and compared with the significance criteria.

For the whole river basin the river network is analysed (based on the available DEMs, see chapter 2.4.5) to identify all river sections with a catchment area > 20 km<sup>2</sup>. For the remaining parts the potential flood corridor was constructed. Land use and assets at risk according to the significance criteria were evaluated for the inundation areas. Thus a second set of data was created for all potential risk areas to prove or validate the data and results collected for the fact sheets.

Based on the comprehensive documentation of hazard information, risk information and assessment steps in fact sheets the determination of each single APSFR is made transparent. The fact sheets can be found in Annex 4.



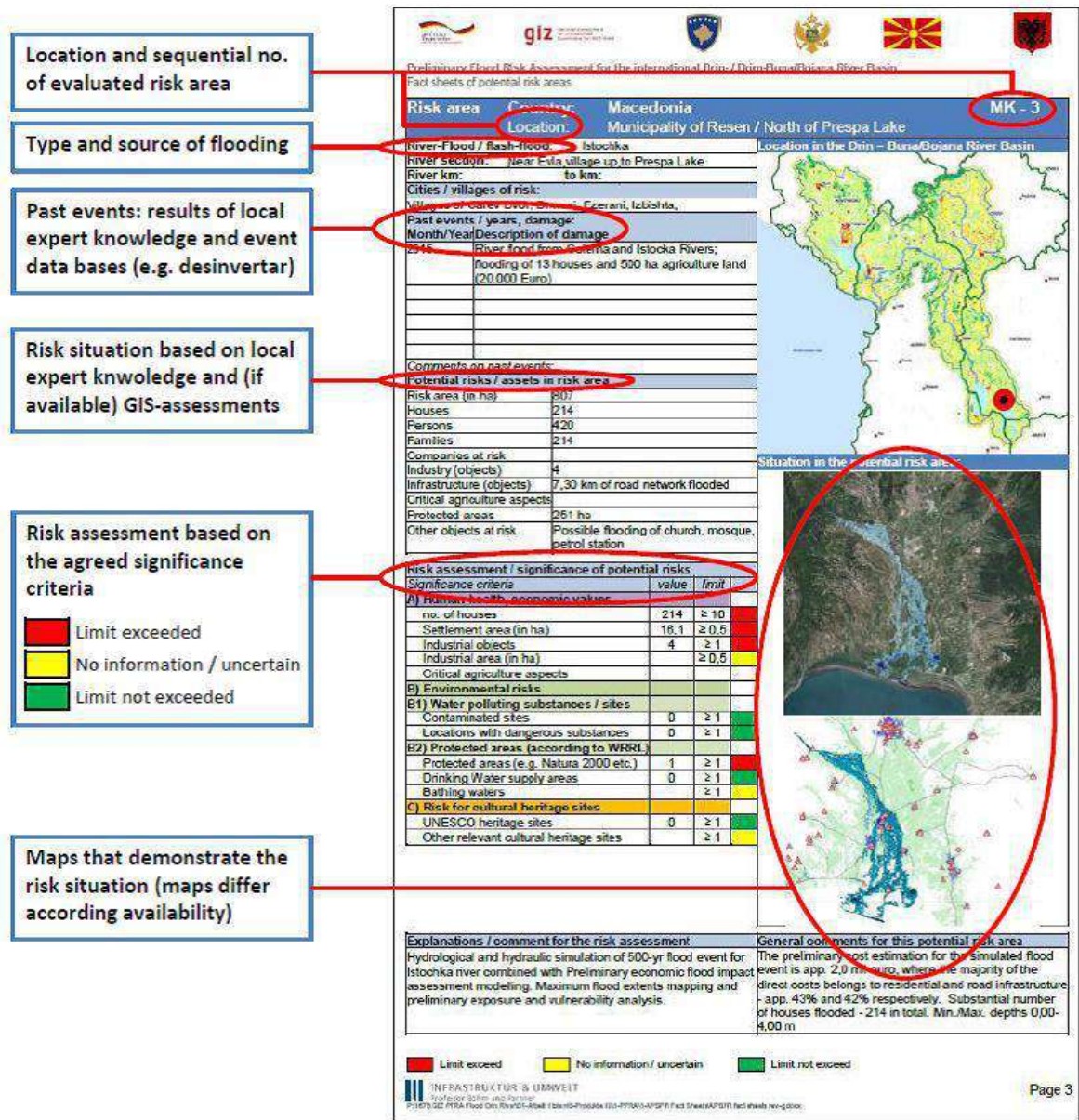


Figure 7: Fact sheet for the assessment and documentation of APSFR

## 2.4.5 GIS-based validation of the risk assessment

In addition to the preliminary flood risk assessment based on local experience (past events) and local knowledge (assets at risk and exposition), as described in chapter 2.4.4, a GIS-based analysis was done to validate the results. Based on available digital elevation models, analysis of the morphological and topographic situation and using available land use data the maximum potential flood areas and critical land uses within these areas were evaluated. The results are maps and statistics of critical land uses in potential risk areas. These were compared and combined with the findings of the local expert assessments so that the determination of Areas of Potential Significant

Flood Risk are the combined result of documented flood events, expert knowledge to assess the future risk based on past events and the GIS-based statistics.

#### 2.4.5.1 Process description

The preliminary flood risk areas mainly result from analysis of the World DEM light and the BEAM land use 2012 datasets. The World DEM light is a TanDEM X dataset edited by Airbus (void removal, land cover corrections) and further corrected by the consultants using the Open Street Map (OSM) river network. DEMs of better resolution were integrated if available (if these were provided by the partners).

The first step, after DEM processing, was the generation of a river network from the DEM based on the flow accumulation (water catchment size). With this an outline was created that represents the potential (maximum possible) extent of the flood. This maximum flood area should include an addition for uncertainty and potential rises due to climate change impacts. By analysing the correlation between sample points of water-levels and the calculated water catchment, a function was developed (see Figure 8) to generate the flood level for each point in the river network with a catchment size of more than 20 km<sup>2</sup>. Smaller catchments cannot be considered as river floods but have to be assessed with methods of flash flood evaluation (see chapter 2.4.1). Hydrologic and hydraulic models do not exist for the whole study area so that this holistic approach seems to be adequate for the purpose of the preliminary risk assessment.

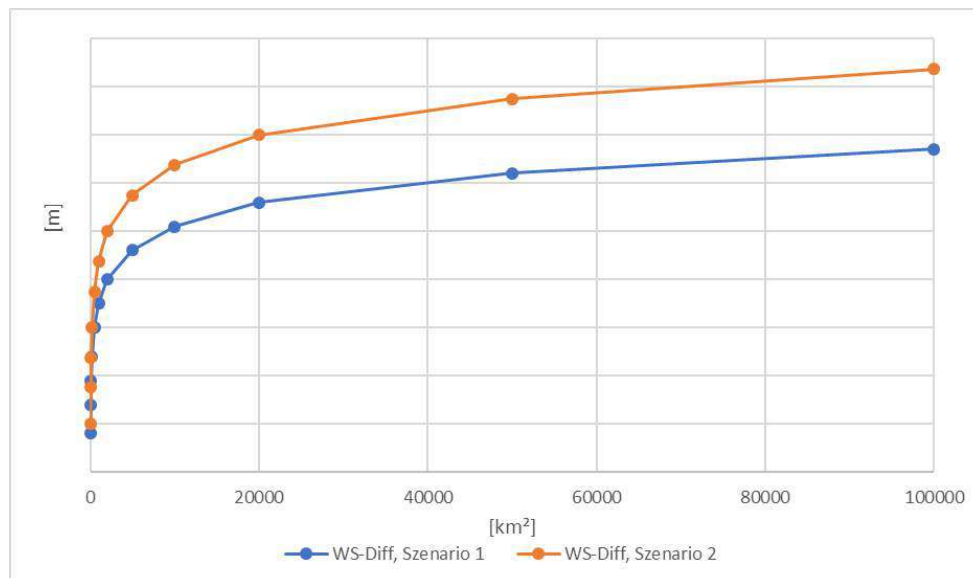


Figure 8: Estimative correlation of water levels and catchment size as used for the analyses

In the second step the potential maximum flood extent area was calculated according to two scenarios of hydraulic behaviour: the maximum and the maximum +25%. Thus the maximum flood water level is 6,7 m for catchments of >100.000 km<sup>2</sup> in scenario 1 and 8,4 m in scenario 2. For smaller catchments the approach is accordingly. The potential flood area for the scenarios is generated as intersection of the water level with the terrain elevation based on the DEM (Figure 9).



Figure 9: Intersection of flood extents scenario 1 (lower) and 2 (higher) with terrain

The third step focusses on the potential risk assessment. Critical land uses that represent the risk receptors (see chapter 2.4.3) were evaluated in the potential risk areas. A land use dataset was generated, based on the European BEAM dataset. This is a combination of CORINE, Urban Atlas, and HERE (street data) datasets. Their different land uses were reclassified into 6 land use classes relevant for the risk assessment (Table 5).

Table 5: Aggregation of the land use classes of the BEAM data

Land use class for the assessment	Code	Includes:
<b>Urban areas</b>	110	<ul style="list-style-type: none"> <li>• Continuous urban fabric</li> <li>• Discontinuous urban fabric</li> </ul>
<b>Transport</b>	120	<ul style="list-style-type: none"> <li>• Road and rail networks and associated land</li> <li>• Port areas</li> <li>• Airports</li> </ul>
<b>Industrial areas</b>	121	<ul style="list-style-type: none"> <li>• Industrial or commercial units</li> </ul>
<b>Mineral extraction / Dump Sites</b>	130	<ul style="list-style-type: none"> <li>• Mineral extraction sites</li> <li>• Dump sites</li> </ul>
<b>Other Urban Areas</b>	140	<ul style="list-style-type: none"> <li>• Construction sites</li> <li>• Land without current use</li> <li>• Green urban areas</li> <li>• Sport and leisure facilities</li> </ul>
<b>Agriculture</b>	200	<ul style="list-style-type: none"> <li>• Non-irrigated arable land</li> <li>• Permanently irrigated land</li> <li>• Rice fields</li> <li>• Vineyards</li> <li>• Fruit trees and berry plantations</li> <li>• Olive groves</li> <li>• Pastures</li> <li>• Annual crops</li> <li>• Complex cultivation patterns</li> <li>• Land principally occupied by agriculture</li> <li>• Agro-forestry areas</li> </ul>

The various forest, shrubland/grassland, and wetland covers were left out of the evaluation as they do not present risk receptors.

The potential flood risk areas were generated as intersection of the reclassified land uses with the 2 flood extent scenarios. Using expert knowledge as documented in the fact sheets the scenarios were validated. Evaluations of single situations lead to the conclusion that the maximum scenario (2) represents the best estimation of the potential extreme flood risk including some buffer for potential raise of floods in future. Thus scenario 2 is presented in the maps.

As fourth step a statistical analysis of the distribution of the 6 land use classes was performed within the analysed areas (search areas), which were geographically delimited by the experts, based on past events and local experiences (see fact sheets, chapter 2.4.4). Main criteria for the selection of these areas for more detailed statistical analysis were villages or cities situated along the rivers of the Drin Basin. The size of critical land uses within the potential risk area was analysed with the generated potential flood outline and, in addition, with outlines from different sources for validation, namely:

- The extent of the flood of December 2010 for the Drin and Buna estuaries in the Shkodra Region in Albania
- The extents of hydrological and hydraulic simulations of 500-year flood events for the rivers of the upper Drin Basin in Macedonia in the Region of Lake Prespa and Lake Ohrid, provided by the expert

As result the determination of APSFR could be validated according to the indicative potential flood risk maps and the statistical data on land uses at risk.

#### 2.4.5.2 *Input data and gaps*

The following data and sources were used in the described processes:

- BEAM land use 2012
- World DEM light (Airbus D&S)
- DEM for the Bojana River Basin in Montenegro (provided by the cadastral office)
- DEM for the Drin/Buna River Basin in Albania (from ASIG); the defined 10 m resolution appeared to be correct. For the described process the DEM brought no sufficient results and needs to be processed with higher efforts and more time. This was not possible in this project.
- OSM (open street map, 2018)
- CORINE Land Cover 2012
- Flood extent (shape files) of simulation of 500-year events for Macedonia (provided by the national consultant)
- Flood extent (shape files) of flood line estimations for some evaluated locations in Montenegro (GIZ)
- Flood extent (shape files) of the December 2010 event and the January 2010 event in the Shkodra Region, Albania (GIZ).

These data are sufficient for the purpose of the preliminary flood risk assessment and for the chosen methodology, in which in parallel the local evaluation and the GIS-based assessment were done to validate each other's results.

For more accurate flood hazard and risk mapping (as next step in the flood risk management process), the following additional data would be necessary:

- DEM-data in higher resolutions (e.g. 2x2 m) and higher precision. These data exist for Albania and Macedonia. For Montenegro the available resolution is lower. For Kosovo a DEM is expected to be available for 2019 (the resolutions have to be assessed).
- Cross-sections of the river stretches in the identified APSFR.

- For hydrological and hydraulic modelling the hydrological data would have to be assessed (not done in this project because no modelling was foreseen)
- A harmonised hydraulic model for the whole river basin.

To produce more accurate risk maps the actual land use on the level of objects and census data would be necessary to quantify the risk assessment. Economic data (e.g. based on the European BEAM-data classes, generated to each of the countries) would allow to do economic risk assessments.

## 2.5 Plausibility check by experts

The verification of the results from the described steps for the significance checks was done by competent water management experts of the responsible administrations, agencies and ministries, and if possible including the specific municipalities at risk. The validation was organised in transnational and national meetings of the Technical Working Group in June and October 2018. The final meeting to discuss and verify the adjusted results was held in November 2018.

The checks based on expert knowledge mainly confirmed the results of the calculations. All identified APSFR could be proven by the experts. Additional APSFR resulted from other types of flooding other than river floods, like groundwater and flash floods, due to known past events or even recurring damages.

## 3 The Drin/Drim – Buna/Bojana River Basin

### 3.1 Hydro-geographic overview and map of sub basins

The Drin/Drim-Buna/Bojana River is formed by the confluence of two rivers, the transboundary Black Drin and the White Drin, at Kukës in Albania. The Black Drin/Drim River drains an area of 9.209 km<sup>2</sup> (including Prespa and Ohrid watersheds); 58% of this area extends in Albania (5.369 km<sup>2</sup>) and 42% in Macedonia (3.840 km<sup>2</sup>). Its main tributary - apart from Ohrid Lake - is the transboundary River Radika. The White Drin/Drim River rises in Zljeb Mountain in Kosovo; it drains an area of 4.964 km<sup>2</sup>, 88% of which extends in Kosovo (4.360 km<sup>2</sup>) and 12% in Albania (604 km<sup>2</sup>). Its average annual flow is 66,6 m<sup>3</sup>/s (at Vermice Kosovo, close to the Albanian borders).

The map in Figure 10 provides an overview on the seven sub-basins, which are part of the Drin/Drim-Buna/Bojana River Basin.

The interconnected hydrological system of the Drin/Drim-Buna/Bojana River Basin comprises the transboundary sub-basins of the Black Drin, White Drin, and Buna/ Bojana (outflow of Skadar/ Shkoder Lake in the Adriatic Sea) Rivers, and the sub-basins of Prespa, Ohrid and Skadar/Shkoder Lakes. Albania, Greece, Macedonia, Kosovo and Montenegro share the Drin Basin (UNECE, 2011a). With its three major lakes and several connecting rivers and groundwater flows, the Drin Basin has a complex hydrological structure. Parts of the basin are economically developed, while others are virtually undisturbed. The water resources are important for irrigation and hydropower production, and there are plans for the construction of new dams. Fishing is an important source of income around the three lakes. Tourism is significant, particularly at Lake Ohrid, and there are plans for its development in other parts of the basin.

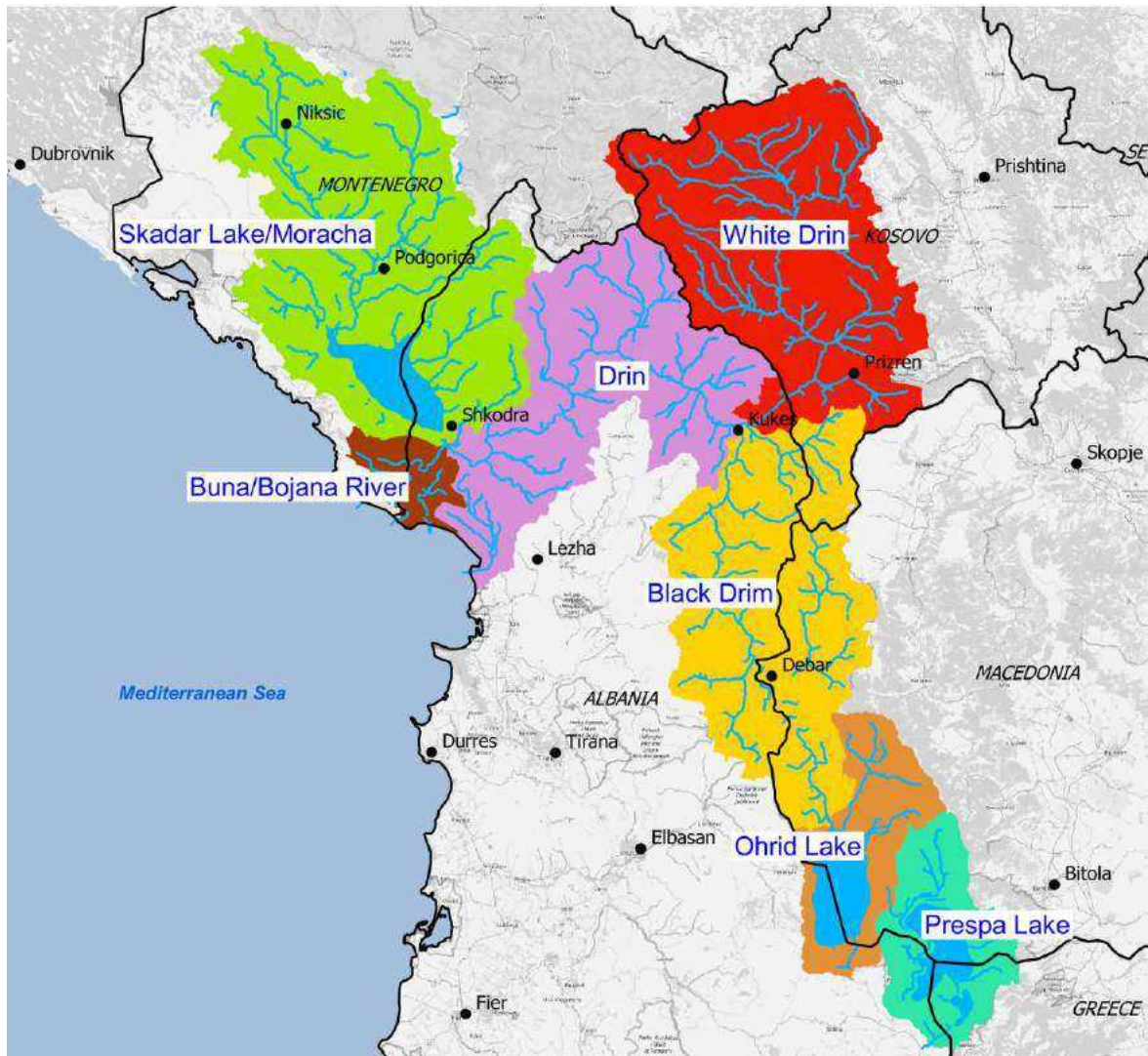


Figure 10: Sub-basins of the Drin/Drim-Buna/Bojana River Basin (own figure based on open source data)

Significant problems result from frequent and severe floods, as well as the protection of ecosystems. Mining is still important in the Albanian part of the Drin Basin and, along with other industries and sanitation; it contributes to pollution (UNECE 2014). Figure 11, Figure 12 and Annex 1 give an overview of the main rivers and their characteristics.

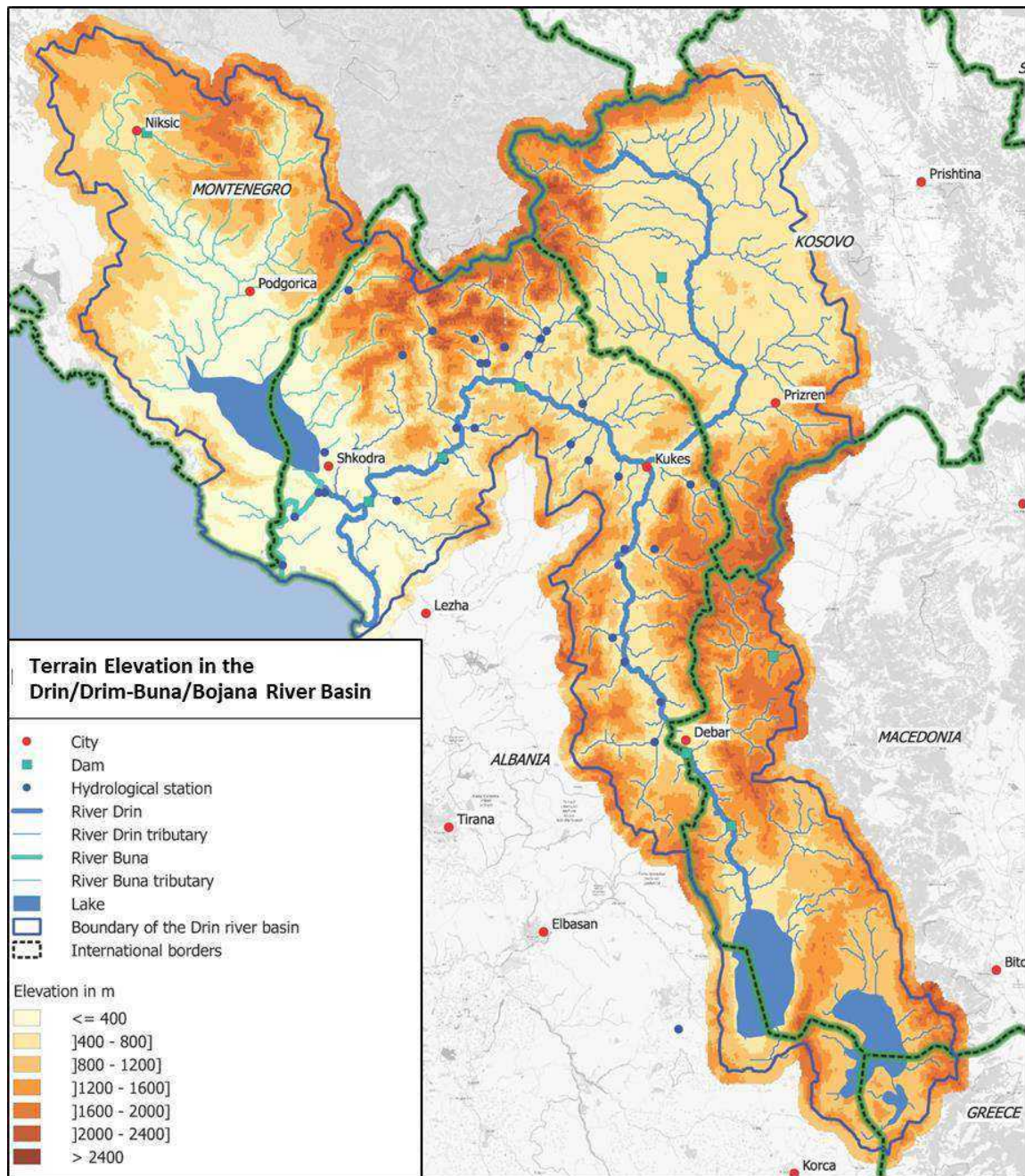


Figure 11: Elevation of the Drin/Drim-Buna/Bojana River Basin (map: INFRASTRUKTUR & UMWELT based on Krye 2013, OSM 2018, SRTM DTM 2015 by U.S. geological survey)

Torrential runoffs, over-exploitation of sand and gravel from the river bed, deforestation combined with poor maintenance of flood protection facilities are among the factors that result in extended flooding in the White Drin sub-basin. It is estimated that 50% of the basin are threatened by flooding. The length of the regulated part of the White Drin, aiming to prevent floods, represents 15.6% of its total length.

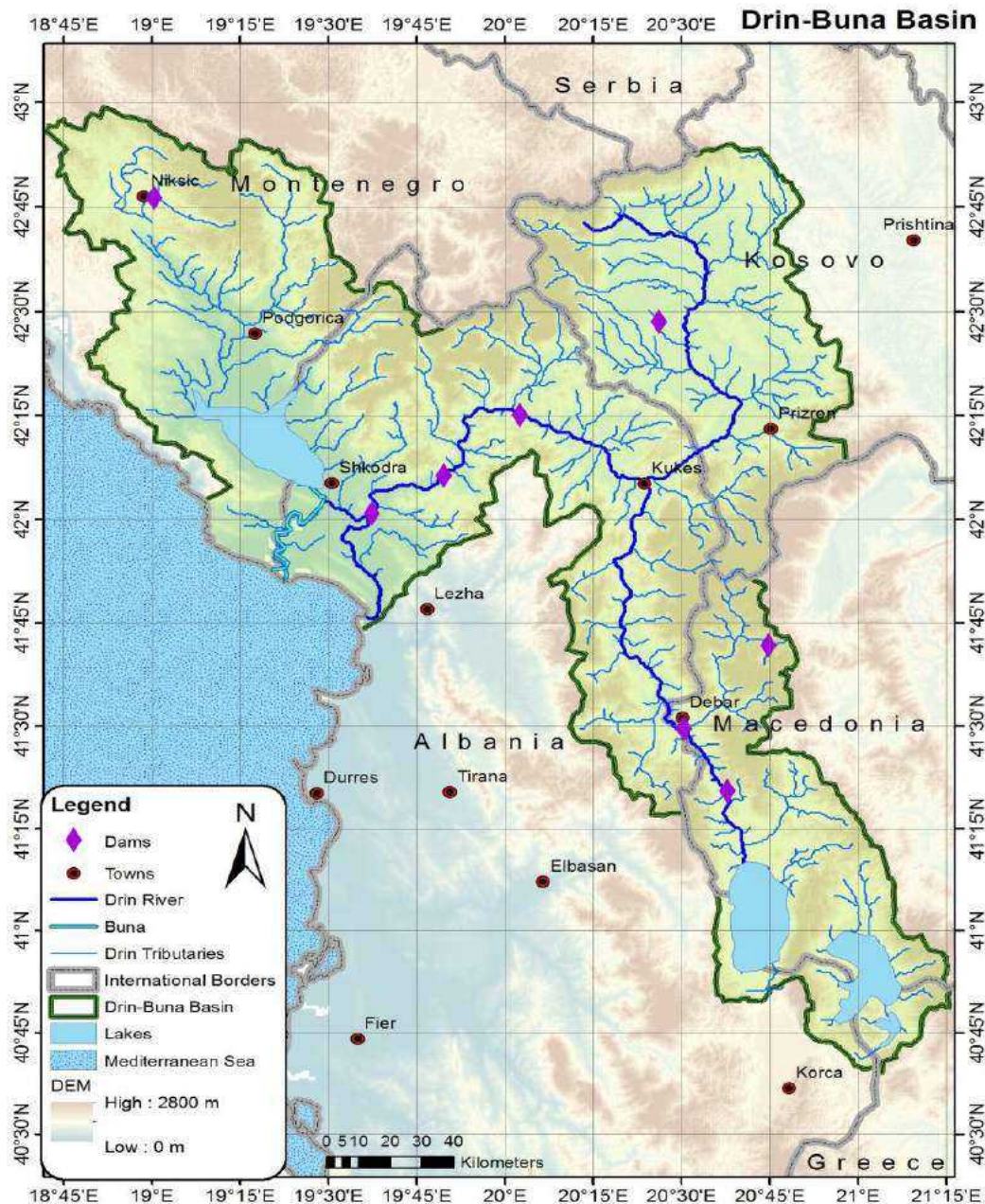


Figure 12: Map of the river network with dams and lakes in the Drin/Drim – Buna/Bojana River Basin  
 [Source: Meon, 2014]

The White Drin/Drim joins the Black Drin/Drim River at Kukes (Albania) to form the Drin/Drim-Buna/Bojana River. It is estimated that half of the surface water bodies of Albania run through the Drin watershed. Its hydrologic network is dense, consisting of numerous rivers, streams, springs and natural lakes. Additionally, there are three artificial reservoirs created in the late 1960s to early 1970s in the Albanian territory with the purpose of hydropower production: the Fierza Lake (the largest one with surface area 82,60 km<sup>2</sup> and length 72 km), the Koman Lake (surface area: 12 km<sup>2</sup>, length: 34,5 km) and the Vau Dejes Lake.



The Drin/Drim River used to flow solely through the fields of Zadrime, across the Lezha city, into the Drin Bay of the Adriatic Sea; after the floods of 1848 to 1858 and 1896, the Drin was split into two branches: one flowing in the original channel (old Drin - Drini i Lezha) and a new one flowing into the Buna/Bojana River, ca. 1,5 km downstream of the Shkoder/Skadar Lake's outlet. From here the Buna/Bojana River flows towards the Adriatic Sea and enters it as Border River between Montenegro and Albania.

## 3.2 River network and characteristics of the sub-catchments

### 3.2.1 Rivers in Macedonia

From the flood risk point of view, the watershed of the Crni Drim through Macedonia can be divided into several sub-basins. The Lake Prespa sub-basin comprises the two lakes of Small Prespa and Prespa which are linked together through a channel. Greater part of Small Prespa is in Greece, while Prespa Lake is shared between Macedonia and Albania. Lake Prespa drains into Lake Ohrid through underground karst cavities of Galichica and Mali I Thatë mountains. The dominant streams in the Macedonian part of the watershed are Istočka Reka, Golema Reka, Brajčinska Reka, Kranska Reka, and Kurbinska Reka.

The total area of the Ohrid Lake sub-basin equals 919 km<sup>2</sup>, or 4,6% of the entire Drin/Drim-Buna/Bojana River Basin. Lake Ohrid is the largest lake by water volume in South-East Europe, with estimated volume of 55.500 million m<sup>3</sup>. The lake is shared between Macedonia (272,8 km<sup>2</sup>) and Albania (84 km<sup>2</sup>). The dominant streams in the Macedonian part of the watershed are Sateska and Koselska Rivers.

Crni Drim River Basin: the main river flow originating from Lake Ohrid at the town of Struga in Macedonia is the Crni Drim River. After roughly 56 km the Black Drin/Drim River crosses into Albania between Debar and Peshkopi. The major tributary of Crni Drim in the Macedonian part is Radika River.

Annex 1 gives an overview of the main rivers and tributaries in the Drim River Basin in Macedonia.

### 3.2.2 Rivers in Kosovo

In Kosovo 43,5 % of the country's territory is part of the Drin/Drim-Buna/Bojana River Basin and is encompassed by the drainage basin of the Adriatic Sea. The area includes the largest rivers flowing in the country, the White Drin with its tributaries Erenik, Lumëbardhi i Decanit, Lumëbardhi Pejës, Lumëbardhi Prizrenit, Klina, Istogu, Mirusha, Pllava and Toplluha. The rest belongs to the Aegean Sea drainage basin, where the largest river by far is the Lepenac. In total there are four river basins in Kosovo, which are Drini Bardhe, Ibri, Morava Binces and Lepenc. The Drin/Drim-Buna/Bojana River network is situated within a flat fluvial basin with an elevation of 400-700 m above sea level surrounded by several high mountain ranges with elevations of 2.000 to 2.500 m. All sub-basins are located entirely within the territory of the Republic of Kosovo with the exception of a small part (about 45 km<sup>2</sup>) of the Bistrica Pëjë, which is located within the territory of Montenegro. Annex 1 shows the morphological parameters of the main sub-basins.

### 3.2.3 Rivers in Albania

The Albanian part of the Drin/Drim-Buna/Bojana River is dominated by a cascade of reservoirs and dams. Upstream of the confluence with the Shkodra lake outlet, the Drin passes the dam cascade of the three reservoirs Fierzë (73 km<sup>2</sup>), Koman (12 km<sup>2</sup>) and Vau Dejës (25 km<sup>2</sup>) operated by the

Albanian power corporation KESH (Korporata Elektroenergjitike Shqiptare). The dams have been constructed till 1975 (lowest dam Vau Dejës), till 1978 (highest dam Fierzë) and till 1985 (Koman). Several tributaries flow directly into the reservoirs. Among them, the river Valbonë draining the central eastern Albanian Alps is the largest one. The outflow of the Vau Dejës reservoir is influenced by a weir at Spathar further downstream.

Annex 1 gives an overview of the main rivers in the Drin/Drim-Buna/Bojana River Basin in Albania.

### **3.2.4 Rivers in Montenegro**

The Zeta River is the right tributary of the Morača River and springs on the territory of Nikšić municipality. Its length, with underground flow, is about 89 km and the surface of the basin is 1.547 km<sup>2</sup>. It runs 29 km after which it enters underground. It re-enters the surface on Glava Zete and flows 56 km into the Moraca. The tributaries of the Zeta are the river Bistrica, Moštanica, Gracanica and Bratica in the area of the municipality of Niksic, as well as Susica and Matica on the territory of Danilovgrad municipality. The catchment area of the Zeta River covers an area of 1.597 km<sup>2</sup>. The average flow of the Zeta River is 75,5 m<sup>3</sup>/s, while the maximum reaches 463 m<sup>3</sup>/s. Amplitude between low and high water levels is 10,26 m.

Bistrica River is the left tributary of the river Zeta, whose source is at the foot of Tovic and consists of three groups of springs. In the river Zeta it is flowing through the Duklov Bridge. In the dry part of the year, Bistrica dries up, and in the rainy season Zeta gives significant amounts of water. River Mrkosnica has its spring in the southwestern foothills of Trebjesa. The second branch of the same river flows out in the southern part of Niksic, and its riverbed is partially channelled. These two branches meet in Straševina and form river Mrkosnica, and they are poured into the Zeta River in the southern periphery of the field. All springs that feed the river Mrkosnica dry up during the summer period.

Gracanica is a left tributary of the Zeta River. It springs above the village of Morakova and has a length of 29 km. The mean annual flow is 1,32 m<sup>3</sup>/sec. This is an extremely periodic river, stopped by the dam and the accumulation of Liverovici. Through the Župa it flows in the direction of the southeast-northwest, after which it changes direction and flows to the south and flows into Zeta. The Sušica River originates from many periodic sources, of which the most exquisite is the Blue Eye. It runs along the peripheral part of Mount Garač and, after a stream of 14 km, flows into the Zeta River. The Sušica River flows out of its riverbed during high altitudes and the blue surrounding area. The river Matica is located in the southern part of Danilovgrad municipality, in the area of Bandići, Koman and Zagarac. The largest tributary of this river is the periodic watercourse of the Crkovnica River. The river Matica flows into the Moraca River near the village of Botun. During the December floods in 2010, the Crkovnica River, which is a tributary of the Matica River, flooded several facilities in Livade Bandičke.

Rijeka Zeta is the most typical representative of karst hydrography and water of the richest river of Montenegro, after the river Bojana, but with great oscillations of water levels. It is the largest river sink with the largest drop in the underground profile (height difference of 563 m).

The hydro-geological river Zeta consists of Upper and Lower Zeta and about 4 km of underground stream. Lower Zeta is formed from the strong spring of the head of the Zeta and is 35 km long. Its water power was used by the implementation of a larger part of the Upper Zeta waters through a tunnel to the HPP Perućica (Municipality of Niksic) and two smaller hydroelectric power plants on the head of the Zeta and the Zeta Waterfall (Municipality of Danilovgrad).

Important surface waters of Niksic Municipality are also artificial lakes that were created in favourable places where the land is watertight and where surface streams can be stopped for a longer or shorter period. The water of larger accumulation lakes is usually used for the production of electricity, and less for irrigation or for water supply of the settlement. For the needs of HPP "Perućica", the following artificial lakes were created: Krupačko, Slansko, Vrtačko, compression basin Slivlje and Liverovići.

The Morača River originates in northern Montenegro, under the Rzača Mountain. In its northern part, the Morača is a fast mountain river, and has cut a canyon north of Podgorica. After merging with its largest tributary, Zeta, just north of Podgorica, the Morača enters the Zeta plain. It flows through this flat area of Montenegro until it empties into Lake Skadar. The Morača river flow is 97,1 km, the catchment covers an area of 3.200 km<sup>2</sup> and is characterized by large oscillations in the water level. Tributaries of the Morača River are Ribnica, Zeta, Sitnica and Cijevna.

Ribnica runs its way through the Ćemovsko Field and flows into Morača in the centre of Podgorica. The river is about 10 km long. Its water level is directly dependent on the variable volume of the spring, so Ribnica almost dries out in the summer months.

The Cijevna River is formed in the high mountain massif of Prokletije. The length of 26,5 km runs through Albania, while in the territory of Montenegro it runs a length of 32,3 km. The most characteristic part is a deep, hardly accessible canyon that gives it a particularly attractive appearance. Sitnica is a river that springs near Podgorica. After a short flow, it flows into the Morača River between Podgorica and Skadar Lake. The current flow is often without water, because in that part of the river it dries up.

Large areas around the Skadar Lake in Montenegro (mainly agricultural land) are affected by flooding. The lake is 50 km long, 14 km wide and the coastline is 207 km in the middle water. Skadar Lake covers an area of less than 400 km<sup>2</sup> at minimum water levels, up to 525 km<sup>2</sup> at the highest registered water levels. It is primarily filled with the waters of the Morača River, and it is filled with Rijeka Crnojevića, Orahovštica in Montenegro and the river Kiri in Albania. The discharge is done by the river Bojana. The total flooded area on the shores of Lake Skadar is above the level of 6,5 m above sea level and amounted to 5.000 ha.

The Bojana River (Albanian Buna) is 41 km long and located on the border of Montenegro and Albania. The Bojana River flows from Lake Skadar and into the Adriatic Sea. It runs in big curves with an average drop of 0,6%.

### **3.2.5 Rivers in Greece**

Greece has 14 River Basin Districts (RBDs, see Figure 13), of which one is part of the Drin/Drim-Buna/Bojana River Basin. It is one of the two largest RBDs (GR09, the Lake Prespa Basin in Western Macedonia). It is a shared transboundary catchment with Albania. It has a surface of 15.218 km<sup>2</sup> and the significant flood sources (according the WISE aggregation) are artificial water-bearing infrastructure and fluvial. The characteristics of significant floods are flash floods (EU-reports: The Water Framework Directive and the Floods Directive: Actions towards the 'good status' of EU water and to reduce flood risks, 2016 and: Background to the PFRA European Overview - UC9810.5b, 2014).



Figure 13: River Basin Districts in Greece

The RBD GR09 is part of the Prespa Basin and extends geographically in the neighbouring countries of FYROM and Albania; thus these basins are transboundary. However, there are no international RBMPs, as these countries are not EU MS; and thus not obligated to submit these plans. Regarding the Prespa Basin there has been an international agreement between the three countries (Greece, Albania, FYROM) on the protection and sustainable development of the Prespa National Park. Several actions and programmes have been implemented in the sub-basin of Prespa with the cooperation of Albania and FYROM. Also a working group has been established from 2006 for the monitoring and protection of the Prespa Basin. This group has organised four meetings so far. International Flood Risk Management activities or plans have not been implemented yet.

### 3.3 Land use

Land use was analysed based on the European Corinne Land Cover dataset (2012), improved by Copernicus data of the Urban Atlas (2012) and Open Street Map. The land cover and land use classes were summarised to create land use classes that match the needs of the preliminary flood risk assessment.

Figure 14 shows (exemplary in small scale) the land use map which was applied for the risk assessments. Table 6 summarises the land use in the Drin/Drim-Buna/Bojana River Basin according to the evaluation results of the land use data.

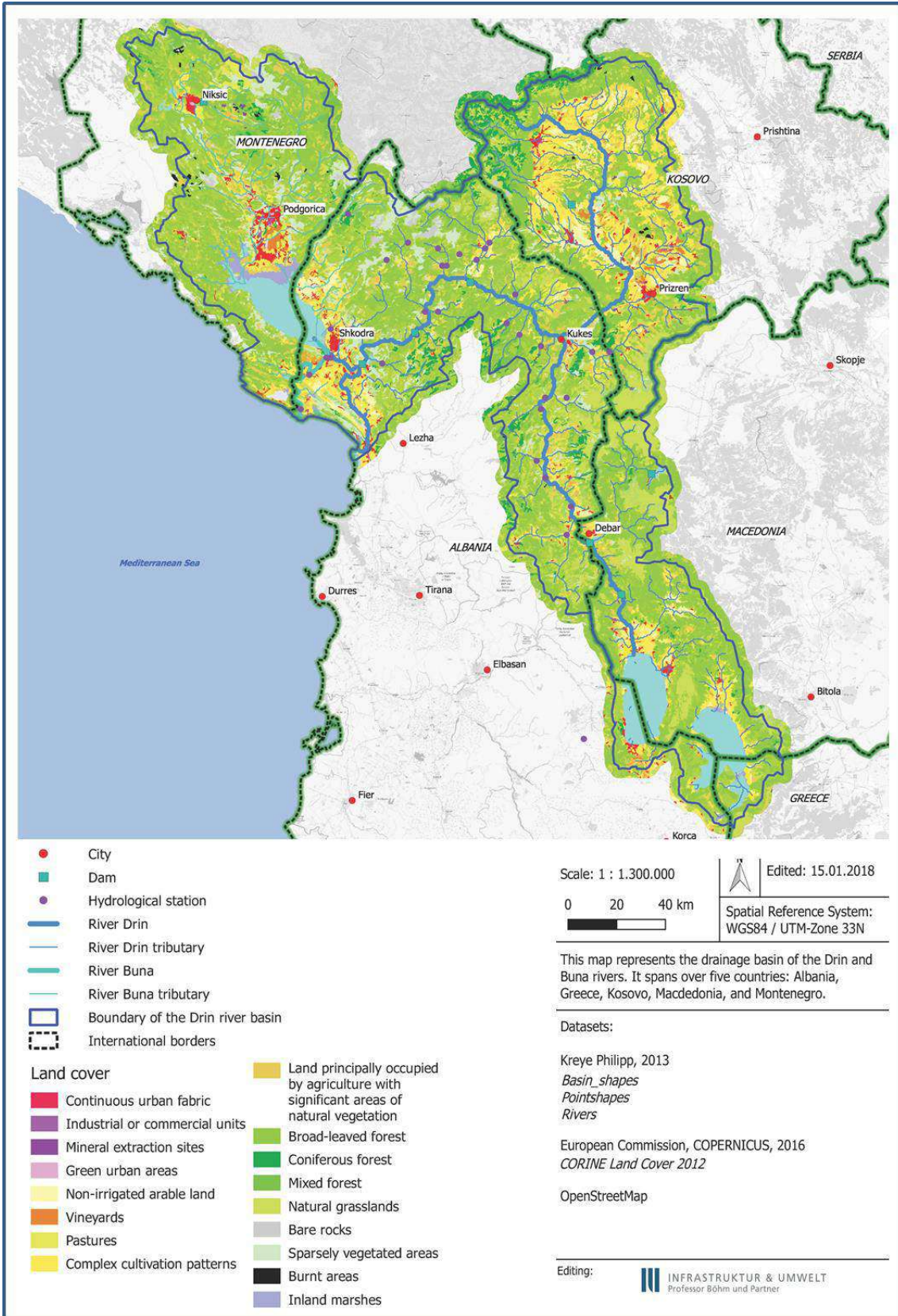


Figure 14: Land use map of the Drin/Drim-Buna/Bojana River Basin

Table 6: Land use in the Drin/Drim-Buna/Bojana River Basin (generated from CLC 2012)

Land use	Total		Macedonia		Kosovo		Albania		Montenegro	
	km <sup>2</sup>	%	km <sup>2</sup>	%	km <sup>2</sup>	%	km <sup>2</sup>	%	km <sup>2</sup>	%
Urban fabric	351,5	1,0%	32,7	1,0%	103,9	2,3%	115,2	1,5%	99,7	2,2%
Industrial areas	36,5	0,08%	2,6	0,08%	21,6	0,47%	2,5	0,03%	9,8	0,21%
Transport infrastructure	9,8	0,02%	0,7	0,02%	4,4	0,10%	2,9	0,04%	1,8	0,04%
Other urban land uses	15,8	0,1%	1,7	0,1%	7,5	0,2%	0,7	0,01%	5,9	0,1%
Agriculture	4.718,9	16,9%	554,5	16,9%	717,2	15,6%	1.466,2	18,7%	1.981,0	42,7%
Forests	6.728,9	38,4%	1.258,8	38,4%	1.665,6	36,1%	2.263,4	28,8%	1.541,2	33,2%
Non-forest vegetation	5.958,4	28,8%	944,7	28,8%	1.248,8	27,1%	2.866,6	36,5%	898,2	19,4%
Water bodies	1.316,9	14,0%	458,4	14,0%	409,2	8,9%	430,8	5,5%	18,5	0,4%
Other	1.231,7	0,7%	21,9	0,7%	431,0	9,4%	698,8	8,9%	80,0	1,7%
<b>Total</b>	<b>20.368,5</b>	<b>100,0%</b>	<b>3.276,0</b>	<b>100,0%</b>	<b>4.609,2</b>	<b>100,0%</b>	<b>7.847,1</b>	<b>100,0%</b>	<b>4.636,1</b>	<b>100,0%</b>

In Macedonia ca. 17% of the sub-basin area serves for agricultural production. This land use affects strongly the region northwards of the lakes Ohrid and Prespa including the catchments of the tributaries Sateska, Koselska and Golema and the region around the Debar reservoir at the northern border. In Kosovo the agriculture is of even greater importance as ca. 43% of the area within the sub-basin is used for agricultural production. The huge Dukagjini plain is exposed to complex cultivations in the centre of the sub-basin forest and semi-natural areas are located. The mountainous areas are covered with forest and scrubs. In Montenegro agriculture is mainly practised in the Zeta plain around the cities Niksic and Podgorica northwards of the lake Shkodra. Northwards wetlands (inland marshes) border the area of the lake. Forest and semi-natural areas are the main land use types in mountainous regions. The land use in the sub-basin Albania is mainly characterized by semi natural areas (natural grassland, sclerophyllous vegetation, transitional woodland-shrub and sparsely vegetated areas). Ca. 29% of the region is forest (mainly broad-leaved forest). Cultivation focuses on the Buna/Bojana Basin and the region of the lake Shkodra.

The main cities and villages along the relevant rivers in the river basin are listed in the Annex 1.

## 4 Results of the Preliminary Flood Risk Assessment

### 4.1 Overview of flood hazards and flood risk in the river basin

#### 4.1.1 Flood risk in Macedonia

The Republic of Macedonia's water resources are highly vulnerable towards the changing climate. Following the climate projections of the third national communication to the UNFCCC, an increase in temperatures and a decrease in precipitation is predicted. Overall water availability in the country is expected to decrease by as much as 18% by 2100. Droughts and flash floods are predicted to become more frequent and more severe. Macedonia has suffered lately from flash floods and riverine floods, especially in the eastern part of the country. The most affected areas in the country are the surroundings of Ohrid Lake, Struga Valley (where the Black Drin is formed), and the municipality of Debarca. The most extreme flood events there took place in 1963 and 2015.

In 1962, larger areas were flooded along the courses of Koselska River, Letnicka River, Skrabatska River, and the suburban areas Radojica Novichikj, Leskajca, Voska and Daljan as part of the mu-

nicipality of Ohrid, but there is no further precise data on the extent of the damage caused to buildings, and other material damages.

A major flood in 2010 was caused by the overflow of Ohrid Lake and Drim River, due to a trans-boundary effect when Albania asked Macedonia to close the outflow of the Drim River from the lake and Globobica Dam. This resulted in flooding of the urban areas and the agricultural land around the city of Struga. During the flooding of 2010, around 100 buildings were affected (individual residential buildings and agricultural auxiliary facilities) in the villages of Miseshevo, Moroishta, Drslajca, Vranishta and Dobovjani. Parts of the urban environment in the settlement Ezerski Lozja and Miseshevski Road were also endangered and flooded. Furthermore, problems occurred in the functioning of the collector system of sewerages as well at the rain gauge station in the village of Vranishta.

For all the above mentioned floods, even though an assessment of damages from the local government has been carried out, it seems to be not accessible so far.

A more recent flood in Macedonia happened in January 2015 when the ground floors of buildings and agricultural areas in the villages Kalishta, Miseshevo, Moroishta, Lozjani, Livada, Bidjevo, Draslajca, Vranishta and the settlements Ezerski Lozja, and basements in Struga were affected. In general most floods in the Macedonian part of the River Basin can be classified as river floods in combination with heavy rain and flash floods events because the catchments of these headwaters are often small and the origin of the floods are often small creeks or non-permanent water bodies. The impact of constructions in or along the river beds is high.

#### Torrential floods in Macedonia

In the Republic of Macedonia torrential flows are very often. Numerous settlements are endangered with torrents and consequences of them: sedimentation of material in urban areas, destroyed streets, bridges, houses and other infrastructure facilities. For the Republic of Macedonia, together with Serbia, Montenegro and Albania an analysis "red zone of water erosion in Europe" was performed. Generally 96,5 % of the total territory of Republic of Macedonia is under processes of erosion. More than 38 % is encompassed by more intensive categories.

According to the map of erosion of Republic of Macedonia, in the Crni Drim River Basin, there are more than 180 smaller and larger torrential watercourses. The total annual production of erosive materials on the whole territory of Crni Drim basin is about 1,6 Mio m<sup>3</sup>/year. Due to the adopted benchmark for delineation of the watersheds, they are not thoroughly treated. However, due to the significant potential risk, they should be considered in more detail in the future phases of flood risk management in whole Drin/Drim-Buna/Bojana River Basin.

#### **4.1.2 Flood risk in Kosovo**

Kosovo is experiencing similar climate change trends as its neighbouring countries. Extreme weather events have intensified during the last decade. The rainfall patterns have changed with higher precipitation in shorter periods and less snow accumulated in the mountains. The changes in the climate have put Kosovo at a higher risk of flooding (especially flash flooding) and droughts. The Drin/Drim-Buna/Bojana River Basin is the largest basin in Kosovo and it flows into a large reservoir which extends into Albanian territory. Within the Drin/Drim-Buna/Bojana River Basin are large alluvial flood plains. The principal cause of major floods is nearly always precipitation that is significantly higher than normal, possibly exacerbated by high groundwater levels, snow-melt or reservoir releases. In the basin there are three types of flood: upper tributary floods generating

from heavy rainfall, riverine floods and flash floods from the mountain, and, in theory, floods resulting out of “dam break situation”. As a result, the town of Gjakova has a high flooding risk. The region has flood records since at least 1955. Since then the frequency of flood has been every 6 months and the latest one was in November 2016, with 3 fatalities and around 1.000 affected families. The most affected sectors are agriculture and livestock. Exact data on the damages in terms of costs are not available.

In Kosovo most floods can also be characterised as flash floods and heavy rain event driven. Floods in Kosovo are mainly regional and not much influenced by transboundary upstream-areas. In the Kosovo-Albanian border area floods are influenced by the mountainous headwaters of the streams and rivers in northwest Kosovo.

Kosovo has already done some work in terms of flood risk assessment, and Drin/Drim-Buna/Bojana River Basin is the first basin for which PFRA has been undertaken in 2011.

#### **4.1.3 Flood risk in Albania**

The geographical position of Albania makes it a disaster prone country, exposed to several natural hazards like flood, drought, heavy rainfall or snow, windstorms, heat waves, landslides, avalanches, forest fires, airborne sand from deserts and some epidemics, all being directly or indirectly related to hydrology, meteorology and weather conditions.

The river system poses the highest risk of flooding to the country. Floods are generally of pluvial origin and occur during the period November-March when the country receives about 80-85% of its annual precipitation.

Shkodra is the region of Albania that is among the most vulnerable areas, affected by two major georisks: flooding and earthquakes. The region borders the Adriatic Sea in the west and includes the artificial lake “Vau i Dejes”, two large reservoirs: Rragami and Shtodri, Shkodra Lake (the biggest Balkan lake) and four smaller rivers Cemi of Shala, Gjader, Kir and Buna. Flooding is favoured by the country’s geomorphology and is encouraged due to the effects of climate change. The Drin-Buna Lowland in the Shkodra Region is prone to regular and severe floods which might increase in frequency and intensity due to climatic changes. The latest major floods occurred in January 2010, December 2010 and March 2013 resulting in high economic and environmental losses. The post-disaster analysis of the Shkodra region areas affected by the flood of 2010, conclude that 14.100 ha of land were flooded and 4.600 houses were submerged. Theft and burglary occurred when some took advantage of the situation. 12.150 people were evacuated and the economic loss was estimated at ALL 2,5 billion (EUR 18 million). Following these events, local and regional flood risk management plans were developed, including regional and local risk maps depicting the flood extent of 2010 (GIZ 2014).

Based on the international disaster database (University of Louvain, ongoing) Albania has a relatively high risk profile, mostly associated with climatic events that range from drought to floods.

The effects in agriculture are very relevant: although decreasing over the past years, the contribution of the agriculture to GDP is estimated at 17%. Flooding in rural areas potentially affects 46,3 % of the Albanian population, who depends on agriculture as the main source of income. Therefore agricultural land is an important flood risk factor.

The transport sector has been in recent years benefited by investments that are part of the country’s modernization aiming at increasing its competitiveness and be in a better position to integrate its value chains to the region. In the flooded areas new highways are systematically replacing old



roads. These vast works not in all cases have been accompanied by risk assessments and may have been a contributing factor to flooding as the culverts and drainage under them may have slowed the flow of water in certain areas.

In the water sector the direct consequences of the floods include damage to major water supply pipeline, pumping stations, electrical equipment and energy transmission lines to the pumping stations. Besides that, disposal of waste in the water supply lines and pumping stations as a result of flooding creates ponds with bacteriological contamination in the aquifer areas, warehouses and waterlines. In terms losses, these are associated decreases on the production of drinking water and higher costs of supply for drinking water by trucks and special equipment for water filtration and packaging and its distribution to consumers.

Floods have enormous effects on housing: The last two decades have brought considerable changes to the housing sector in Albania. In the flooded areas there are about 30% of the houses, illegal constructions, because of informal settlements and uncontrolled urban sprawl. The withdrawal of the State from maintenance and management of the existing housing stock, in particular the multi-unit stock, has led to a continuous deterioration of this stock, due to lack of investment in refurbishing or upgrading. On the other hand about thousands illegal buildings were constructed during this period of time, part of them in risk prone areas all over the country.

Effects on the environment include mobilisation of flooded contaminated sites and of waste along the rivers, especially from unofficial waste disposal sites. They cause water pollution in the rivers and down to the Adriatic Sea.

In looking into the future, Albania should consider the occurrence of the disaster as an opportunity to solve longstanding deficiencies and the recovery and reconstruction program should be viewed as an integral part of socio-economic development plans. In that respect, issues such as identification and reduction of risk should be made part of the development agenda, since they negatively affect the most vulnerable groups (the poor, the lower income, people with disabilities, women etc.).

Investments to be made in recovery and reconstruction should also be seen as part of risk reduction and not only as unexpected expenditures. Infrastructures and productive activities would be less vulnerable after completion of recovery and reconstruction.

A well planned recovery and reconstruction process in the face of the most recent climatic events could be part of such positive impact. It seems clear that access to financial resources and a better planning, monitoring and evaluation of these efforts would not only restore and improve local conditions in the affected areas, but contribute to general development, introducing in the agenda the issues of improved resilience, reduce risk in the face of disasters and contribute to the climate change agenda by incorporating adaptation and mitigation measures in the recovery process.

The impact of these recent climactic shocks shows the importance of building increased resilience to extreme weather events and climate change. Given the Balkan region's profile and resulting exposure of economic activity to natural hazards, exposure of GDP to floods is high enough to induce some level of fiscal stress and delayed recovery and reconstruction. The impact of less frequent events could be even more significant. The resulting public damage and losses could amount to 9,4 and 5% of each country's GDP, respectively. Large shares of the population would also be exposed to a once in a hundred year flood. In the case of Albania, the World Bank projections put the exposure to the one hundred year flood at 6% for GDP and 7% for the population. Climate change could make the region even more vulnerable, so preparing for the present and for

the future should promote the mainstreaming of Disaster Risk Management (DRM) and adaptation into long-term development strategies.

#### **4.1.4 Flood risk in Montenegro**

According to the data of the Hydro-meteorological Institute of Montenegro, at the end of December 2009 and early January 2010, large floods caused by heavy precipitation in the territory of Montenegro occurred in the Skadar Lake and Bojana River. They were manifested by the flooding of the coastal part of Bojana in the municipality of Ulcinj and the coast of Skadar Lake, on the territory of Montenegro. These were the largest floods after the catastrophic floods of January 1963, when the level of Skadar Lake reached a maximum recorded water level of 9,86 m above sea level.

During November and December of 2010 the area of Montenegro was hit by very specific and extreme meteorological conditions. The adverse combination of meteorological conditions in terms of abundant precipitation, exceptionally high air temperatures for that time of the year and strong southerly wind, led to a sudden deterioration of hydrological conditions. Water levels and floods in the mentioned period were recorded and water level of Skadar Lake was 10,44 m above sea level. This was especially evident on the hydrological system of Zeta-Morača-Skadar Lake-Bojana. The whole of Montenegro, in various borders, was hit by the floods of the rivers Čehotina, Grnčar, Ljuča, Morača, Lim, Bojana and Zeta with tributaries and the area of Skadar Lake.

The total damage caused by floods at the end of November and beginning of December 2010 was 18 million EUR, according to estimations documented in the reports on the evaluation of damages of the respective National Commission, based on documentations of local self-governments. Out of this amount the damages in households were 4 million EUR, to agricultural land 3,7 million EUR, while on infrastructural facilities it was estimated at 10 million EUR. Flash floods have been identified as a special problem in recent years.

To date, a lot work has been done in terms of preparing local flood protection and rescue plans for the 17 municipalities all over Montenegro which are affected by floods.

#### **4.1.5 Flood risk in Greece**

In the Greek part of the Drin/Drim-Buna/Bojana River Basin one area of potential significant flood risk (APSFRR) was determined in the course of the PFRA in the first FRM cycle: it is located at the North-East of Lake Prespa (see following Figure 15).

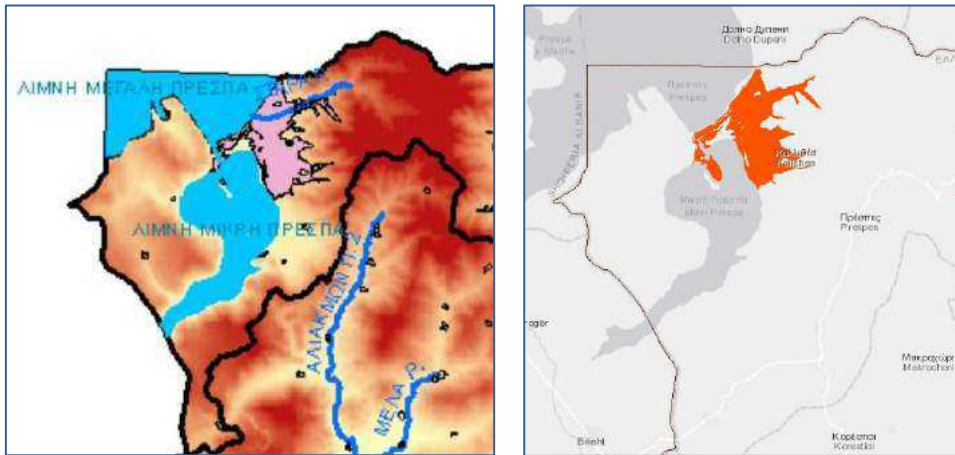


Figure 15: Map of the relevant Greek APSFR at Lake Prespa (pink / orange coloured area)

Sources:

- left figure: Flood-CBA ([http://www.floodcba.eu/main/?page\\_id=7570&lang=en](http://www.floodcba.eu/main/?page_id=7570&lang=en))

- right figure: EEA

(<http://maps.eea.europa.eu/EEABasicviewer/v3/?appid=3c997f1ce7db4b5ba3fa17d7f0188690&embed=true>)

The significant flood risk in this area is characterised by

- Floods from artificial water-bearing infrastructure in APSFR GR09
- Categories for the significance of historical floods (general methodology for the PFRA in Greece):
  - Very high: human casualties or compensations greater than 500.000 Euro or flooded area greater than 1.000 hectares
  - High: compensations from 200.000 to 500.000 Euros or area flooded from 500 to 1.000 hectares
  - Medium: compensations of 50.000 to 200.000 Euros or area flooded from 200 to 500 hectares
  - Low: compensations up to 50.000 Euros or area flooded up to 200 hectares.
- No risk assessment for fluvial flooding due to missing data on fluvial flooding.

## 4.2 Past events and the risk of similar future events

Past events were evaluated based on different sources: published data banks, reports and local knowledge (provided by the national experts). Annex 2 gives an overview of most relevant, documented and verified past flood events in the Drin/Drim-Buna/Bojana River Basin. Some facts or details could not be gathered or not be verified so that these were left out in the further assessment.

The evaluated past events served in the PFRA as background for the identification of potential significant flood areas. The fact sheets (Annex 4) refer to the past events for the different evaluated areas or rivers. Remaining documentation gaps can be assessed as not fundamental bottleneck of the study as for all potential risk areas verified past events could be used to assess the future risk, especially in case of recurrent floods and damages in the areas. For all past events of the last ca.

20 years it can be stated that similar events can happen again because since then no general changes in the discharge management can be found.

According to the transfer of experiences of past events around Lake Ohrid the described impact of the management of the lake discharges (inflow and outflow) on flooding in villages around the lake has to be considered. However, from local expert judgement, a similar flood risk as in past events has not been generally reduced. So the past events can still serve as reference cases.

The similar can be stated for all past events in the lower part of the Drin/Drim-Buna/Bojana River Basin, in the Shkodra area and north of Lake Shkodra/Skadar but also upstream in Kukes. Here the significant impact of the management of the reservoirs and of the hydropower stations on the extreme past flood events (namely January and December 2010) has to be considered when using the past events as reference cases for the future risk assessment. But also here must be stated that no general or reliable changes in the management rules have been made binding until date so that similar events can still occur in similar meteorological situations with similar reservoir management approaches.

When drawing conclusions from past events for the estimation of future risks the impact of climate change should be considered. This can only be done as a rough tendency-estimation due to missing detailed and quantified climate change impact scenarios on the hydrology in the river basin. But the known facts allow the qualitative estimation that an additional discharge (future events compared with past events) has to be expected to be on the safe side. In this respect the preliminary flood risk assessment maps show a maximum scenario that includes an add-on of ca. 25% in the estimated water levels. Compared with past events this leads to little larger risk areas than the experienced flooded areas.

### **4.3 Assessment of flood risks according to the significance criteria**

The following Figure 16 gives an overview of the locations of evaluated areas as result of the screening of the whole river network in the Drin/Drim-Buna/Bojana River Basin regarding past events and local knowledge on potential risks.

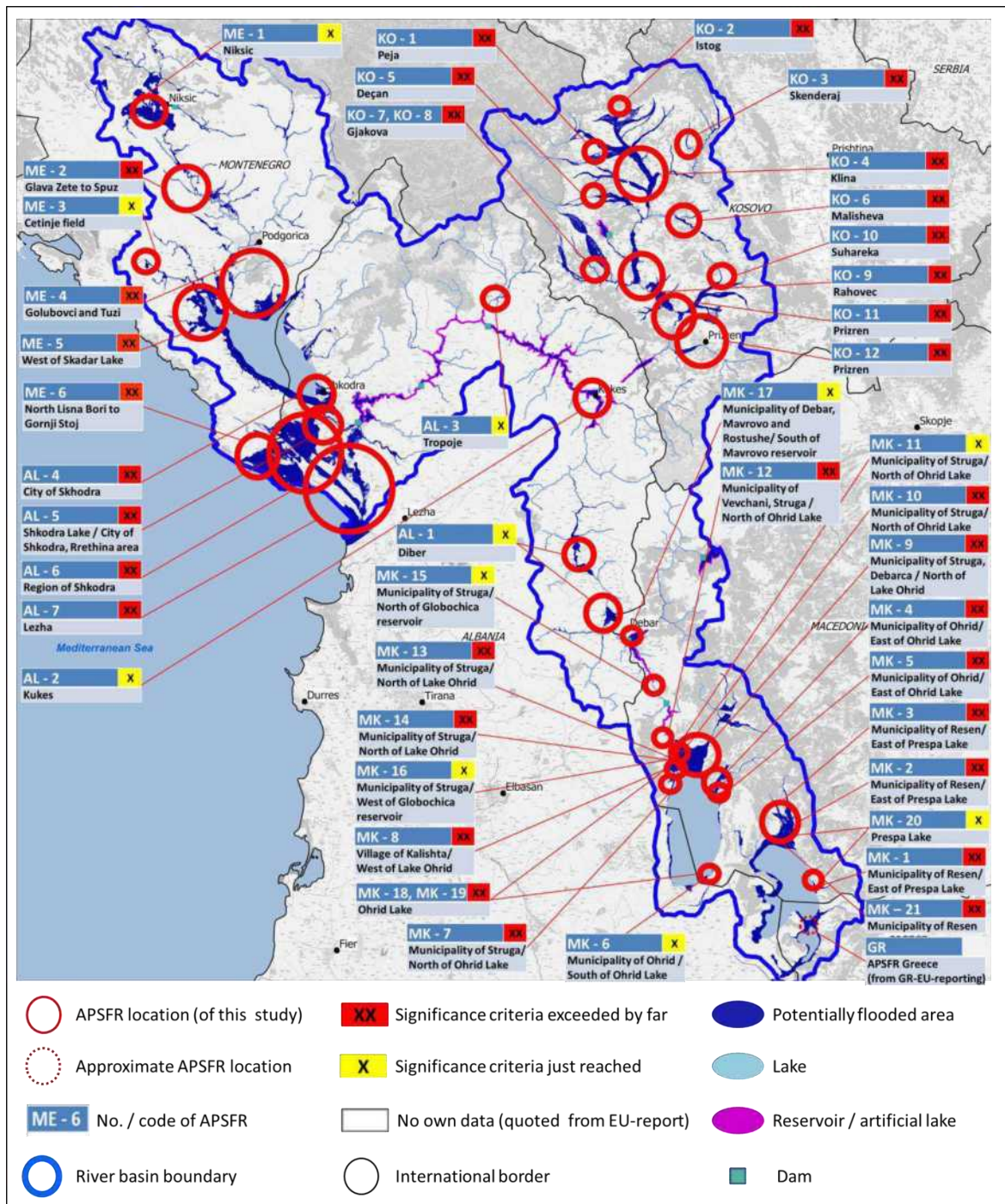


Figure 16: Geographic (map) overview of the APSFR in the Drin/Drim-Buna/Bojana River Basin

Of all evaluated river stretches 43 areas were assessed to be Areas of Potential Significant Flood Risk (APSFR). 33 of these fulfilled the significance criteria by far (red colour in the map). 10 of these just reach the significance criteria but were identified as APSFR according to the methodology. Especially for those the determination as APSFR might be critically examined and revised based on more detailed risk assessments within the FHRM and FRMP in later stages.

Table 7 and Figure 16 give an overview of the areas that are determined as significant (APSFR). Detailed information and data for all APSFR are documented in the fact sheets in Annex 4.

Table 7: Areas with potential significant flood risk

No.	Country – no.	Location	River / Lake	Type of flood	APSFR
1.	MK - 1	Municipality of Resen / East of Prespa Lake	Brajchinska	River-flood / flash flood	XX
2.	MK - 2	Municipality of Resen / East of Prespa Lake	Golema	River-flood / flash flood	XX
3.	MK - 3	Municipality of Resen / East of Prespa Lake	Istochka	River-flood / flash flood	XX
4.	MK - 4	Municipality of Ohrid / East of Ohrid Lake	Koselska, Vapilica and Skrebatska	River-flood / flash flood	XX
5.	MK - 5	Municipality of Ohrid / East of Ohrid Lake	Sushichka	River-flood / flash flood	XX
6.	MK - 6	Municipality of Ohrid / South of Ohrid Lake	Cherava	River-flood / Lake-flood	X
7.	MK - 7	Village of Kalishta / West of Lake Ohrid	Kalishta	River-flood / flash flood	XX
8.	MK - 7	Municipality of Struga / North of Ohrid Lake	Black Drin	River-flood / flash flood	XX
9.	MK - 9	Municipality of Struga, Debarca / North of Lake Ohrid	Sateska	Flash River flood	XX
10.	MK - 10	Municipality of Struga / North of Ohrid Lake	Shum	River-flood / flash flood	XX
11.	MK - 11	Municipality of Struga / North of Ohrid Lake	Sushica	River-flood / flash flood	X
12.	MK - 12	Municipality of Vevchani, Struga / North of Ohrid Lake	Vevchanska	River-flood / flash flood	XX
13.	MK - 13	Municipality of Struga / North of Lake Ohrid	Belichka	River-flood / flash flood	XX
14.	MK - 14	Municipality of Struga / North of Lake Ohrid	Dzepinska	River-flood / flash flood	XX
15.	MK - 15	Municipality of Struga / North of Globochica reservoir	Black Drin (between Globochica and Shpile reservoirs)	River-flood / flash flood	X
16.	MK - 16	Municipality of Struga / West of Globochica reservoir	Piskupshatina	River-flood / flash flood	X
17.	MK - 17	Municipality of Debar, Mavrovo and Rostushe / South of Mavrovo reservoir	Radika	River-flood / flash flood	X
18.	MK - 18	Ohrid Lake	Ohrid Lake	Groundwater flooding	XX
19.	MK - 19	Ohrid Lake	Ohrid Lake	Lake-flood	XX
20.	MK - 20	Prespa Lake	Prespa Lake	Lake-flood	X
21.	MK - 21	Municipality of Resen	Brajchinska, Golema, Istochka	River-flood	XX
22.	KO - 1	Peja	Lumbardhi i Pejes	River-flood / flash flood	XX
23.	KO - 2	Istog	Lumi i Istogut	Flash floods	XX
24.	KO - 3	Skenderaj	Klina	River-flood / flash flood	XX
25.	KO - 4	Klina	Drini i Bardh	River-flood / flash flood	XX
26.	KO - 5	Deçan	Bistrica Deçan	Flash floods	XX
27.	KO - 6	Malisheva	Mirusha	River-flood / flash flood	XX
28.	KO - 7	Gjakova	Krena	River-flood / flash flood	XX
29.	KO - 8	Gjakova	Erenik	River-flood / flash flood	XX
30.	KO - 9	Rahovec	Drini i Bardh	River-flood / flash flood	XX

No.	Country – no.	Location	River / Lake	Type of flood	APSFR
31.	KO - 10	Suhareka	Toplluha	River-flood / flash flood	XX
32.	KO - 11	Prizren	Toplluha	River floods	XX
33.	KO - 12	Prizren	Lumbardhi I Prizrenit	River-flood / flash flood	XX
34.	AL - 1	Diber	Black Drin	River-flood	X
35.	AL - 2	Kukes	Black Drin	HPP-reservoir-management	X
36.	AL - 3	Tropoje	Valbona River (Drin tributary)	Flash-flood	X
37.	AL - 4	City of Shkodra	Kiri River	River-flood	XX
38.	AL - 5	Shkodra Lake / City of Shkodra, Rrethina area	Lake Shkodra	Lake-flood	XX
39.	AL - 6	Region of Shkodra	Drin, Buna / Bojana	River-flood	XX
40.	AL - 7	Lezah	Old (former) Drin River	River-flood	XX
41.	ME - 1	Niksic	Zeta	River flood Heavily Modified Waterbody flood	X
42.	ME - 2	Glava Zete to Spuz	Zeta	River flood	XX
43.	ME - 3	Cetinje field	(groundwater and drainage channels)	Groundwater	X
44.	ME - 4	Golubovci and Tuzi	Moraca and Skadar lake area	River flood & Lake Flood	XX
45.	ME - 5	North of Skadar Lake	Skadar lake area	River flood & Lake flood	XX
46.	ME - 6	Lisna Bori to Gornji Stoj	Buna / Bojana	River flood	XX
47.	GR	North-West Prespa Lake	Prespa Lake	Lake / River flood	

Explanations:

XX	APSFR / Risk exceeds the value of 2 or more significance criteria clearly
X	APSFR / Risk exceed the value 1 or 2 significance criteria slightly
O	No APSFR / Risk does not exceed the value of the significance criteria
	Not assessed in this study; here quoted to complete the information (source: PFRA-report Greece; EEA, 2018)

For the APSFR the following land use statistics were calculated (for data see Annex 3).

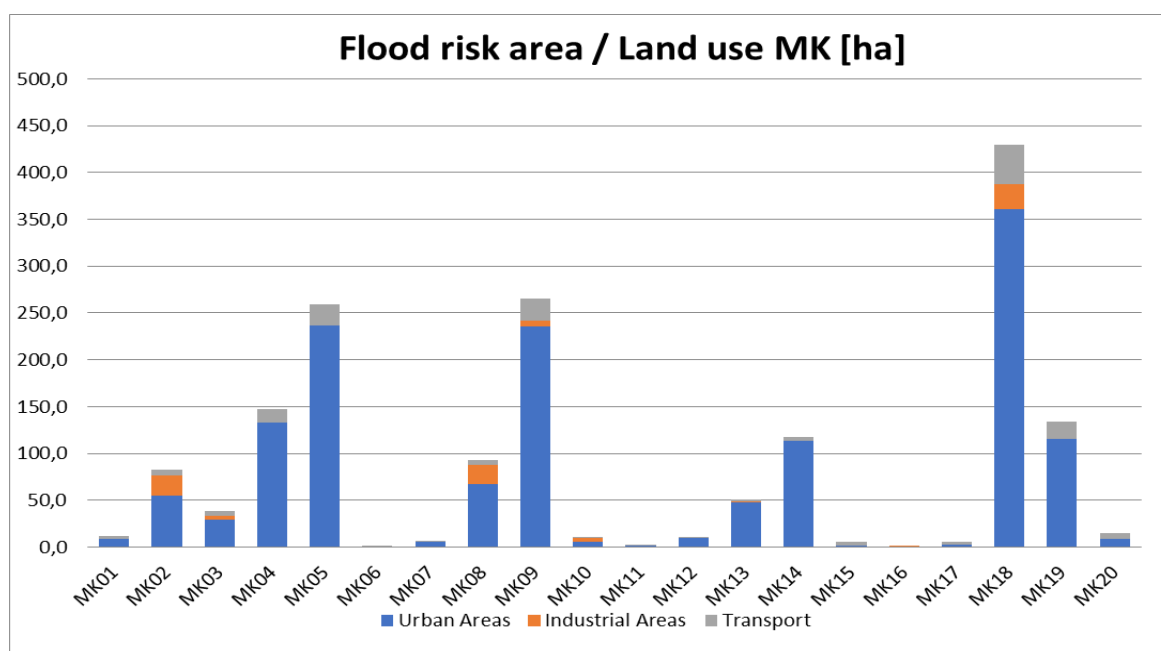


Figure 17: Land use in evaluated APSFR (a) (based on own assessments, see methodology)

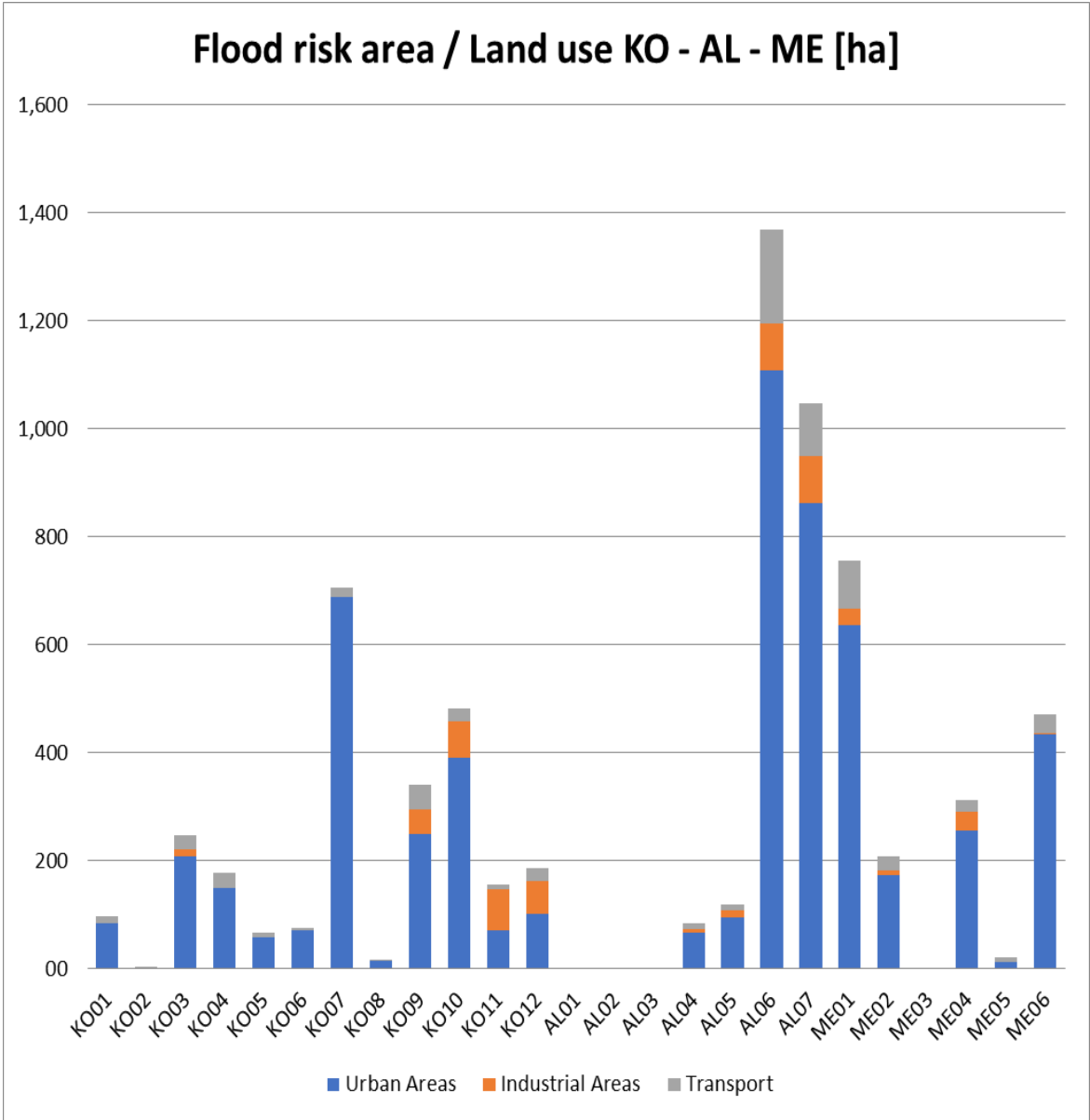


Figure 18: Land use in evaluated APSFR (b) (based on own assessments, see methodology)



## **5 Outlook and recommendations for further flood risk management activities in the transnational scope**

### **5.1 Next steps for flood risk management in the APSFR**

For all APSFR, detailed Flood Hazard and Risk Mapping is necessary to determine the flood extent lines according to different scenarios. A joint transnational approach would be ideal to save capacities and to aim at similar, compatible types of maps that show hazards and risks across borders. To prepare the mapping activities, a common participatory definition process should be started. This should include representatives of different end user groups, such as disaster risk management, urban and regional spatial planning, the transport sector, the hydropower sector, nature conservation, and river basin management. Other interested users should be identified and involved. The joint process should aim at answering questions like:

- Which scenarios shall be shown in the maps (what is relevant for the users)?
- Which scale and level of detail shall the maps have?
- Which classifications of land use, and which objects, shall the maps show?
- How shall the maps be provided to the users (paper maps, digital, web, what level of detail, etc.)?
- Do different users receive maps with different levels of detail?
- How will users use the maps? What are the requests for formats and transfer to be used in maps for disaster risk management, or maps for urban development, or others?
- Other questions may be collected in the start phase of such a process.

After production of the flood hazard and risk maps the process of flood risk management planning shall be started, aiming at development of local and regional as well as national and transnational flood risk management measures (see chapter 1.3). This process shall include all relevant and interested stakeholders and disciplines that may contribute to flood risk reduction and damage prevention.

Based on the flood risk management plans for all APSFR, a monitoring and update process is to be set up, including regular updates of the FRM-products and an evaluation of the stepwise reduction of flood risk.

### **5.2 Transnational measures for flood risk management**

In the working process of the Preliminary Flood Risk Assessment for the international river basin of the Drin/Drim-Buna/Bojana River, the Technical Working Group identified several superordinated measures (or: activities) on the transnational level, that might be followed-up in the river basin management processes within the Drin Core Group and also in the FRM-processes in the participating countries. These transnational measures are documented in the following, as agreed by the Technical Working Group. They shall be provided to the Drin Core Group (to the Expert Group on Floods once it is in place) for their further use.

## 5.2.1 Measures at river basin level

### 5.2.1.1 Coordinated implementation of the EU Floods Directive in the Drin/Drim-Buna/Bojana River Basin

- **Implementation of EU Floods Directive (FD)**  
In all parts of the Drin/Drim-Buna/Bojana RB comparable steps to implement the EU FD should be taken in a coordinated way. This includes the 3 steps of FRM: hazard and risk mapping for potentially significant risk areas and setting up of Flood Risk Management Plans for those risk areas.
- **Coordinated schedule for the FRM-steps**  
The riparian countries should agree on a realistic schedule for the next steps, since the reporting deadlines of the EU are not valid for the countries yet and the EU-schedule is too tight for the status of FRM in most of the regions of the Drin/Drim-Buna/Bojana River Basin. The indicative schedules of the different countries shall be regularly updated and discussed with each other in international cooperation to aim at coordinated implementation. The following indicative national schedules were reported:

	AL*	KO**	ME***	MK****
PFRA	2020		2019 / 2020	2018
Flood hazard and risk maps	2025		2021	2020
Flood Risk Management plans	2027		2024	2024

Sources:

\* workshop of technical working group 7-8 Nov 2018

\*\* under discussion

\*\*\* Dragana Đukić (MARD); workshop of technical working group 25-27 June 2018 / Milo Radović, Water Admin.

\*\*\*\* Ylber Mirta (MoEPP); workshop of technical working group 25-27 June 2018

The schedules shall be an orientation for the coordination of FRM-activities in the River Basin; the schedule finally depends on available resources and national decisions.

- **Regular coordination of FRM-activities and information exchange**  
The participating countries set up regular mutual information procedures about their progress in the FRM processes and about activities in this respect. The Technical Working Group, created for the transnational PFRA-project, provides the project results to the Expert Working Group on floods of the Drin Core Group for further coordination.  
Additional information bases could be created to inform each other about the status of FRM in the countries and sub-basins. A web-based platform should provide all relevant documents for FRM in the River Basin (linking FRM-plan and maps etc.).  
A focal point or coordinator, for the transnational river basin and corresponding for each country, should be agreed and determined for these information exchange processes.

### 5.2.1.2 Improvement of knowledge, capacities and knowledge transfer

- **Effective regular exchange and coordination on practical working level should focus on e.g.**
  - information sharing on hydro meteorological information in the river basin

- permanent coordination of Hydro meteorological Services regarding forecast and flood event analysis
- mutual information on water management infrastructure (existing, planned)
- mutual management of water management tasks related to flood prevention
- exchange of information on spatial planning
- information and data for disaster risk management.

Essential for an effective regular exchange is a systematic evaluation and agreement on relevant institutions that shall be involved in the exchange platforms.

- Forums for exchange of expert knowledge  
Regular exchange forums should create a platform for local, national, regional, and international experts in FRM in the international RB. The Expert Working Group on floods of the Drin Core Group could function as focal point but should open forums to experts from different levels and disciplines.
- Knowledge and information bases  
The coordination platform could be extended to a web-based knowledge platform for further actors in the field of FRM.

#### 5.2.1.3 *Improvement of jointly used data and models*

- Transboundary harmonisation of data bases and models, e.g.
  - digital elevation model
  - gauging networks and data
  - hydraulic and hydrological models.

#### 5.2.1.4 *Flood risk management in relevant disciplines / sectors*

##### Water Management and flood forecasting

- Flood prevention: Realisation of water retention facilities throughout the river basin to retain rain water, runoff and flood waves in the streams.
- Flood protection: Identification of necessary flood protection works based on risk assessment and flood risk management planning. Realisation of highest priority flood protection works.
- Flood forecasting: Further improvements regarding the transnational cooperation in flood forecasting and the interconnection of the national processes.
- Monitoring of all activities regarding their actual effects and benefits for the reduction of flood risk (and adjustment of measures if necessary).

##### Spatial Planning / Territorial Planning

- Framework for flood risk adapted spatial planning  
Development of principles and guidelines for flood risk adapted spatial urban and regional planning. This includes strategies and exchange of experiences regarding “buffer zones” along rivers and how to deal with illegal constructions in flood risk areas. Besides river flooding this also includes the risk of flash floods.  
(This is based on the existence of flood hazard and risk maps; see below).

- Good Practice examples  
Collection and presentation of good practice for flood risk reducing spatial planning in the regions of the River Basins; expert's exchange on experiences on spatial planning in flood risk areas.
- Flood risk adapted spatial planning in local, regional and national policies  
Expert discussion on adaptation of spatial planning policies to integrate flood risk management in territorial development practice and law.
- Flood risk adapted constructions  
Development of guidelines for flood risk adapted (new or adaptation of existing) construction in flood risk areas. Distribution of experiences and knowledge from demonstration sites on expert platforms. Strategies to implement construction guidance into policies.
- Critical infrastructure at risk  
Assessment and risk mitigation strategies for infrastructure of national or transnational importance (e.g. roads, railway, energy, waste management, hospitals etc.); mapping critical infrastructure in flood risk areas and joint risk check approaches for individual risk assessment and risk mitigation planning.
- Water pollution in flood situations  
Develop joint strategies and good practice guidance regarding risk assessment and risk reduction strategies for potentially water polluting industries. Special attention should be given also to contaminated sites in flood risk areas.

#### Waste management

- Prevent waste in flooded rivers  
Development of strategies and implementation of joint actions to prevent floating of disposed waste from river banks or from waste disposal sites due to flooding. This also includes effective strategies to prevent the floating waste to enter the Adriatic Sea.

#### Nature protection

- Principles and strategies synergies of nature protection and flood prevention  
Development, discussion and agreement on principles and strategies to create benefit of synergies between nature protection and flood prevention, like protection and conservation of flood plains and nature oriented river development (including flood plains and river banks).

#### Disaster risk management / civil protection

- Evaluate and improve the status of (transboundary) alarm systems  
Alarm systems are not in place or do not work properly in all risk areas of the River Basin. A joint evaluation and the identification of necessary actions should provide the basis for decision making and improvements, if possible. Strategies, agreements and trainings for emergency situations (memorandum of understanding is under development).
- Early warning systems
  - Improvement of the early warning systems and their transboundary interconnections in transboundary cooperation.
  - Establishment of community based warning systems for flash floods in connection with regional, national and international warning systems

- The 112 emergency phone number  
Harmonisation of the 112 - emergency phone number based on an evaluation of the specific situations in the river basin.

#### Hydropower / management of reservoirs

- Assessment of mutual (transboundary but also regional) impacts of management procedures of reservoirs.
- Transboundary and interdisciplinary communication on procedures and improvements of reservoir management.
- Joint action plans of all relevant actors to reduce adverse consequences of reservoir management in flood situations in a transboundary commitment, including potential contributions of upstream actors to reduce the pressure on downstream actors.

### **5.2.2 Measures at sub-basin level (regional / local) in transnational coordination**

The following actions have to be implemented in the sub river basins, locally or regionally. However, the transnational task is to coordinate and harmonize the realisation of measures in a transnational approach. The Expert Working Group on floods of the Drin Core Group could obtain the mandate to coordinate their implementation.

The coordination of flood risk management in international river basins is an obligation of the EU FD (Art. 8 (2)).

#### Flood hazard and risk assessment and mapping in potentially significant risk areas

- Flood hazard and risk maps (FHRM)  
For all areas of potentially significant flood risk (APSFR) identified and agreed in the PFRA, more detailed flood hazard and flood risk maps (FHRM) shall be developed in a comparable format, based on jointly agreed approach, layout and methodology.
- Regular update of the maps  
According to the EU FD the maps shall be reviewed and updated, if necessary, every 6 years.

#### Flood risk management plans for potentially significant risk areas

- Flood risk management plans (FRMP)  
For all areas of potentially significant flood risk (APSFR) identified and agreed in the PFRA, flood risk management plans shall be developed. They shall follow the structure according to the EU FD and include at least:
  - the documentation of the risk assessment for the specific risk area / sub-river basin
  - objectives for the reduction of flood risk
  - measures to reduce the flood risk.

The FRM-process shall involve all relevant actors and stakeholders that might contribute to the reduction of flood risks in the risk area.
- Regular update of the flood risk management plans  
According to the EU FD the FRM-plans shall be reviewed and updated, if necessary, every 6 years.

### Information and awareness raising

- Awareness raising  
Information on flood risk and flood risk management, and individual requests for contributions by specific actors, and activities for raising awareness for flood risk at specific locations are mainly local tasks that need to reflect the specific local situation and needs. However information and awareness raising campaigns and actions should be coordinated on national and transnational level to exchange experiences and to ensure a holistic picture of flood risk management in the river basin.
- Joint documentation  
The flood hazard and risk maps, and flood risk management plans for the risk areas throughout the river basin, could be published on a joint platform to provide a transnational view on the flood risk management situation, for the public and specific actors.
- Information platform  
A joint information platform provides general material and risk information for transnational flood risk management for the public and specific actors. This platform can support local actors with prepared material and guidance.

## 6 References and sources

Desinventar (ongoing): Disaster Information Management System / disaster data bank by UNISDR, the United Nations Office for Disaster Risk Reduction and UNDP; <https://www.desinventar.net/>

EEA (ongoing): European Environment Agency, Flood Events Data Base (<https://www.eea.europa.eu/data-and-maps/data/european-past-floods>)

EEA (2018): EEA basic map viewer; layer Areas with Potential Significant Flood Risk (APSFRR) as reported by the EU member states (<http://maps.eea.europa.eu/EEABasicviewer/v3/?appid=3c997f1ce7db4b5ba3fa17d7f0188690&embed=true>); download 12<sup>th</sup> November 2018

EU (2015): Gap analysis and needs assessment in the context of implementing EU Floods Directive (in Balkan countries)

EU Floods Directive (2007) Directive 2007/60/EC of the European Parliament and of the council of 23 October 2007 on the assessment and management of flood risks

European Corinne Land Cover data set, CLC (2012)

European Union (2013): EU reporting guidance; Guidance for Reporting under the Floods Directive (2007/60/EC); Guidance Document No. 29, A compilation of reporting sheets adopted by Water Directors Common Implementation Strategy for the Water Framework Directive (2000/60/EC)

Flood-CBA (2018): Knowledge Platform for the use of stakeholders dealing with the Cost-Benefit Analysis (CBA) of flood prevention measures; page: Preliminary Flood Risk Assessment maps in Greece ([http://www.floodcba.eu/main/?page\\_id=7570&lang=en](http://www.floodcba.eu/main/?page_id=7570&lang=en)); download 12<sup>th</sup> November 2018

GFA (2008): Technical Report on the Hydrology of the Drini River Basin in Kosovo

GFA (2009): Flood hazard assessment, technical report (Kosovo)

GIZ (2015): Flood Risk Management Plan Shkodër region; regional and communal flood risk management plans

Global Water Partnership (2017): Albania and Montenegro: Creating an Integrated Water Resources Plan for the Buna / Bojana Watershed

Government of the Republic of Macedonia (2015): Rapid Damage and Needs Assessment Report, March 2015

Heiland, Peter (2002): Flood Prevention with instruments of spatial planning, economic burden sharing and international cooperation; Darmstadt

Meon (2014): Institute for Water Management IfW GmbH, Braunschweig, Germany, in cooperation with Leichtweiss Institute for Hydraulic Engineering and Water Resources, University of Braunschweig, Germany: Development and Application of a (rough) Hydrological Model for the Drin/Drim – Buna/Bojana Basin; on behalf of GIZ, September 2014

Mott McDonald (2012): Final Report of the post-disaster comprehensive flood risk assessment and management study national communications to UNFCCC from Albania, Montenegro and Macedonia

MoU (2011): The Drin: A Strategic Shared Vision; Memorandum of Understanding for the Management of the Extended Transboundary Drin Basin

Open Street Map (OSM); 2018

Panovski, Dejan (2016): The Drin Core Group: Presentation in the ECRAN Workshop, Podgorica

Poci, E. (2012) THE DRIN RIVER BASIN – Transboundary Waters, February 9th 2012 (Department of Civil, Architectural and Environmental Engineering, Cockrell School of Engineering, The University of Texas at Austin)

UNECE (2009) Transboundary flood risk management - Experiences from the UNECE region, [http://www.unece.org/fileadmin/DAM/publications/oes/Transboundary\\_Flood\\_Risk\\_Management\\_Final.pdf](http://www.unece.org/fileadmin/DAM/publications/oes/Transboundary_Flood_Risk_Management_Final.pdf) United Nations Development Programme: Enabling transboundary cooperation and integrated water resources management in the extended Drin River Basin

UNECE (2014): The UNECE Water Convention and the development of transboundary cooperation in the Chu-Talas, Kura, Drin and Dniester River basins

University of Louvain under the OFDA/CRED (ongoing): EM-DAT Database, The international disaster data base; School of Public Health, Université catholique de Louvain: <https://www.emdat.be/>

Urban Atlas, 2012: Copernicus data of the Urban Atlas (2012)

Water Task Force, Office of the Prime Minister (2011): Kosovo Flood Risk Management Framework: An Action Plan for Policy, Procedures and Coordination, February 2011

## Annex 1: Characteristic data of relevant rivers and list of cities/villages along the rivers

Table 8: Rivers and their characteristics in the Drin/Drim – Buna/Bojana River Basin [Source: GIZ Report Meon; adjusted by national consultants based on national data]

Country	River	Station	Basin [km <sup>2</sup> ]	MQ [m <sup>3</sup> /s]	Mq [l/(skm <sup>2</sup> )]	MHQ [m <sup>3</sup> /s]	MNQ [m <sup>3</sup> /s]	HHQ [m <sup>3</sup> /s]
Macedonia	Brajcinska	Brajcino	46,0	0,9	19,7	7,6	0,1	22,7
Macedonia	Golema River	Resen	94,0	0,9	9,6		0,1	33,4
Macedonia	Drim	Lozani	2.833,0	23,6	8,3	50,0	8,1	84,0
Macedonia	Drim	Spilje	4.225,0	30,0*	7,1*	72*	1,1*	106*
Macedonia	Mala Reka	Elenskok	200,0	5,2	25,9	28,3	1,1	64,0
Macedonia	Radika	Boskov Most	751,0	15,2	20,2	85,0	4,1	139,0
Macedonia	Sateska	Botun	368,0	5,8	15,7	36,5	1,4	80,0
Kosovo	Bistriça e Pejës	Drelaj	120,0	4,2	35,0	33,4	0,6	84,0
Kosovo	Bistriça e Pejës	Gryke	264,0	5,9	22,4	50,0	0,9	194,0
Kosovo	Bistriça e Prizren	Gryka Prizren	158,0	3,8	24,0	33,5	0,8	134,0
Kosovo	Bistriça e Decanit	Deçan	114,0	4,2	37,0	25,3	0,9	58,0
Kosovo	Drini i Bardhë	Gjonaj	3.951,0	48,4	12,3	396,0	3,5	830,0
Kosovo	Drini i Bardhë	Kepuzi	2.116,0	24,6	11,6	199,0	2,5	358,0
Kosovo	Drini i Bardhë	Krajk	3.916,0	37,4	9,6	379,0	3,7	564,0
Kosovo	Drini i Bardhë	Radavc	23,0	4,6	198,0	19,3	1,2	23,3
Kosovo	Drini i Bardhë	Vermice	4.381,0	59,0	13,6	645,0	6,0	976,0
Kosovo	Eriniku	Gjakova	455,0	12,3	26,9	236,0	0,8	542,0
Kosovo	Istog	Berkovë	432,0	3,4	7,9	25,3	0,7	45,8
Kosovo	Klina	Klinë	423,0	1,5	3,5	31,3	0,1	49,2
Kosovo	Mirusha	Mirusha	127*	1,0	7,6	17,2	0,1	34,0
Kosovo	Pllava	Orqusha	252,0	4,7	18,7	25,3	0,7	53,0
Kosovo	Toplluha	Piranë	512,0	3,5	6,8	40,1	0,1	55,0
Albania	Bulqize	Sofracan	n.a.	5,1	n.a.	48,0	1,2	130,0
Albania	Buna	Shkodër	5.179,0	341,0	66,0	1.087,0	7,9	1.471,0
Albania	Drin	Bahcallek	14.173,0	345,0	24,4	2.309,0	33,1	3.325,0
Albania	Drin	Sparthar	n.a.	506*	n.a.	1.961,0	104,6	9.500,0*
Albania	Drini i Bardhë	Kukës	4.965,0	70,0	14,1	571,0	8,8	869,0
Albania	Drin i Zi	Skavica	n.a.	88,0	n.a.	370,0	25,4	853,0
Albania	Drin i Zi	Ura e Dodes	5.395,0	90,0	16,6	347,0	18,7	690,0
Albania	Drini i Zi	Kovashica	n.a.	62,0	n.a.	207,0	14,2	509,0
Albania	Kiri	Prekal	n.a.	11,7	n.a.	195,0	1,4	320,0
Albania	Kiri	Rasek	231,0	17,0	74,0	236,0	0,2	557,0
Albania	Perroi Muhures	Muhure	n.a.	3,6	n.a.	29,8	0,6	123,0
Albania	Perroi i Gomsiqes	Gomziqe	137,0	6,2	45,3	82,0	0,8	139,0
Albania	Shala	Breg Lume	n.a.	18,7	n.a.	223,0	3,1	756,0
Albania	Valbonë	Dragobi	172,0	8,8	51,0	60,0	2,1	185,0
Albania	Valbonë	Gri	622,0	33,2	53,0	231,0	6,8	650,0
Montenegro	Bojana (see Buna)			640				
Montenegro	Morača	Pernica	441,0	27,5	62,0	339,0	3,3	747,0
Montenegro	Morača	Podgorica	2.628,0	148,0	56,0	1.167,0	15,1	1.893,0
Montenegro	Morača	Zlatica	985,0	61,0	62,0	718,0	1,7	1.173,0
Montenegro	Zeta	Danilovgrad	1.216,0	77,9	60,0	398,0	8,0	577,0
Montenegro	Zeta	Duklov Most	342,0	18,9	52,0	182,9	0,2	286,0

Table 9: Main rivers and tributaries in the Drin/Drim-Buna/Bojana River Basin in Macedonia



River	Minor tributaries	River length km (ca.)	Catchment area (basin) km <sup>2</sup>	Medium discharge [m <sup>3</sup> /s]	Peak / flood discharge [m <sup>3</sup> /s]	Low discharge [m <sup>3</sup> /s]
Brajcinska	NA	17	29,6	0,9	45,7	0,1
Golema river	Leva Reka, Cheshinska Reka	26	183	0,90	33,4	0,1
Istochka river	NA	19	169	0,35	NA	NA
Sateska river	Golema, Kochunska, Pesochanska, Slatinska, Zlestovska	38	436	5,58	29,87	0,91
Koselska river	Grmeshnica, Liojshnica, Rasinska, Kriva Reka, Skrebatska	13,9	191	1,20	6,61	0,21
Sushichka river	NA	13	57	NA	NA	NA
Mala reka	Jadovska, Garska Reka	25	195	5,66	42,7	1,95
Radika river (inflow to Shpilje reservoir)	Bogdevska, Brodska, Galichka, Lopushnik, Mala, Mavrovska, Valavicharska Reka	51	830	17,65	111	2,92
Crni Drim (Ohrid lake to Spilje reservoir)	Belichka, Breshtanska, Dolgashka, Golema, Jablanichka, Kodjadjichka, Labunishka, Modrichka, Rechica, Selechka, Shum, Vevchanska	58	2.928	26,65	79	5,75
Crni Drim (from Shpilje reservoir to Albanian border)	Radika, Crni Drim	59	3.758	47,50	190	3,5

Table 10: Morphological parameters of main Drin tributaries in Kosovo (source: GFA, 2008)

Station	River	Catchment (km <sup>2</sup> )	Highest elevation (m)	Outlet elevation (m)	Length of flow path (m)	Watershed slope (%)
Berkovë	Istogut	438,4	620,0	389,0	17.480,0	1,32%
Drelaj	Bistrica e Pejës	166,1	1.840,0	940,0	17.300,0	5,20%
Grykë	Bistrica e Pejës	254,2	940,0	540,0	11.260,0	3,55%
Klinë	Klina	430,1	1.390,0	359,0	70.890,0	1,45%
Mirushë	Kpuzaj	332,5	860,0	330,0	37.470,0	1,41%
Deçani	Bistrica e Deqanit	118,9	2.080,0	670,0	21.050,0	6,70%
Gjakovë	Ereniku	355,0	2.310,0	310,0	39.850,0	5,02%
Ura e Terzive	Erenik	510,5	315,0	298,0	1.060,0	1,60%
Piranë	Toplluha	501,0	910,0	300,0	33.230,0	1,84%
Prizren	Bistrica e Prizrenit	167,9	2.050,0	490,0	19.360,0	8,06%
Vllashnje	Bistrica e Prizrenit	247,5	490,0	320,0	12.700,0	1,34%
Orqush	Plava	253,4	1.400,0	769,0	19.530,0	3,23%
Radavc	Drini i Bardhë	142,6	620,0	460,0	3.670,0	4,36%
Kepuz	Drini i Bardhë	2.050,0	460,0	340,0	43.980,0	0,27%
Gjonaj	Drini i Bardhë	3.904,0	340,0	300,0	52.180,0	0,08%
Vermicë	Drini i Bardhë	4.320,0	300,0	276,0	13.600,0	0,18%

Table 11: Main rivers and lakes in the Drin/Drim-Buna/Bojana River Basin in Albania

Name	Size/lengths	Type	Normal Discharge	Source
White Drin	136 km (full length)	River	68,2 m <sup>3</sup> /s	Kosovo
Black Drin	149 km	River	118 m <sup>3</sup> /s	Macedonia
Drin	285 km	River	352 m <sup>3</sup> /s (before Buna)	(confluence)
Buna	44 km	River	672 m <sup>3</sup> /s	(confluence)
Valbona	50,6 km	River		Albania
Fierzë	73 km <sup>2</sup>	Reservoir	202 m <sup>3</sup> /s	
Komani	12 km <sup>2</sup>	Reservoir	289 m <sup>3</sup> /s	
Vau i Dejës	25 km <sup>2</sup>	Reservoir	310 m <sup>3</sup> /s	
Shkodra		Lake		

Table 12: Main rivers and lakes in the Drin/Drim-Buna/Bojana River Basin in Montenegro

Name	Catchment Size	Length	Type	Discharge	Source
Zeta	1.547 km <sup>2</sup>	89 km	River	Min 75,5 m <sup>3</sup> /s Max 463 m <sup>3</sup> /s	Montenegro
Moraca	3.300 km <sup>2</sup>	97,1 km	River	200 m <sup>3</sup> /s	Montenegro
Skadar	min 400 km <sup>2</sup> max 525 km <sup>2</sup>		Lake		Montenegro
Bojana		41 km	River	640 – 650 m <sup>3</sup> /s	Montenegro

Table 13: Main cities and villages along the rivers in the Drin/Drim-Buna/Bojana River Basin

Country	River	Km	City / village
MK	Koselska, Sushica	1,02	Ohrid
MK	Vapilica	1,99	Vapila
MK	Skrebatska	2,20	Leskoec
MK	Koselska	0,18	Kosel
MK	Ohrid Lake	--	Peshtani
MK	Local creek, Sateska	3,48	Livoishta
MK	Sateska	0,15	Lakoheraj
MK	Sushica	1,08	Velgoshti
MK	Golema River	0,75	Resen
MK	Golema River	0,30	Dolna Bela Crkva
MK	Golema River	0,47	Gorna Bela Crkva
MK	Golema River	0,33	Ezerani
MK	Golema River	0,56	Jankovec
MK	Golema River	0,70	Drmeni
MK	Golema River	3,83	Pokrvenik
MK	Golema River	0,83	Kozjak
MK	Crni Drim, Ohrid lake	0,36	Struga
MK	Crni Drim	0,09	Dabovjani
MK	Sushica	0,03	Livada
MK	Crni Drim	0,57	Vranishta
MK	Crni Drim	0,57	Lozani
MK	Sushica	2,64	Bidzevo
MK	Sateska	1,54	Misleshevo
MK	Sateska	1,95	Moroishta
MK	Sateska	0,46	Volino
MK	Local creek, Sateska	3,39	Dolno Sredorecie
MK	Crni Drim	0,46	Lukovo
MK	Crni Drim	0,38	Dolno Kosovrasti
KO	Bistrica Peje	62	Boge - Kuqishte - Drelaj - Shtupeqe - Peje - Gorazhdec - Jabllanice - Zajm
KO	Bistrica Deçan	53	Beleje - Deçan - Isnij - Krushec - Baran I Ulet - Kosurij - Glllogjan - Kralan - Rakovine
KO	Erenik	51	Molliq - Junik - Ponoshec - Shishman - Guske - Gjakove - Bishtazhin
KO	Istog		Istog - Lluge - Gurakoc - Zallq - Berkove - Zllakuqan
KO	Klina	62	Sternce - Kuqice - Kline - Skenderaj - Llaushe - Toshile - Aqareve - Ujmire - Pograxhe
KO	Mirusha	32	Duhel - Bllace - Banje - Malisheve - Turjake - Ponorc
KO	Toplluha		Budakove - Suhareke - Gelance - Mamushe - Smaq - Serbice

Country	River	Km	City / village
KO	Bistrica Prizren		Gornjaselle - Mushnikove - Sredska - Reqan - Prizren - Vlashnje
KO	Plaves		Brod - Dikance - Mlike - Vranishte - Orqush
KO	Drini I Bardhe	136	Radac - Dubove - Terbuhoc - Zllakuqan - Krusheve - Kline - Zajm - Dollove - Rakovine - Kramovike - Ratkoc - Marmulle - Xerxe - Rogove - Dobrushe - Vermice
AL	Drini River (Fierza lake)	70 (from AL-MK border)	Village of Përbreg (Terthore commune)
AL	Drini River	175 - 250 (from AL-MK border)	Shkodër city and administrative units of Vau Dejes, Guri i Zi, Bërdicë, Dajç, Ana e Malit, Velipojë, Rrethina, and Bushat. Specific areas/villages within this area (Livadhe, Bahçallëk, Persash, Bahçja e Cakajve, Ajasëm, Kuç, Rrenc, Guri i Zi, Trush, Bërdicë e Sipërme, Bërdicë e Mesme, Bërdicë e Madhe, Beltoje, Belaj, Rrushkull, Shirq, Mushan, Samrish, Suka, Pentar, Obot, Oblikë, Muriqan, Baks-Rrjoll, Cas, Luarz, Pulaj, Fshat i Ri (Trush i Poshtëm), Mali i Jushit, Rranxa, Konaj, Hoten
AL	Kiri River	175 km	Villages of Bardhaj and Bleran
AL	Old Lezha Drin	175 - 250 (from AL-MK border)	Lezha city and villages of Mabe, Zojz, Gocaj, Torovic, Ishull Shengjin
ME	Zeta	65	Niksic-Poljica; Štedim
ME	Zeta	62	Nksic-Strasevina
ME	Zeta	60	Niksic-Klicevo
ME	Zeta	57	Niksic-Ozrinici
ME	Zeta	27	Danilovgrad
ME	Zeta	27	Pazici
ME	Zeta	9,5	Spuz
ME	Zeta		Podanje
ME	Zeta	15,5	Kosic
ME	River Matica	Tributary of River Zeta	Bandici
ME	River Susuca	Tributary of River Zeta	Strahinjici
ME	Zeta	31	Bogicevici
ME	Zeta	23	Curilac
ME	Zeta		Podkraj
ME	Zeta		Gorica
ME	Zeta	14	Martinici
ME	Zeta	40	Vis
ME	Zeta	34	Frutak
ME	Moraca	19,5	Botun
ME	Moraca	15	Ljajkovici
ME	Moraca	15	Mitrovici
ME	Moraca	16,5	Grbavci
ME	Moraca	19	Lekici
ME	Moraca	12	Vukovci
ME	Moraca	7,5	Ponari
ME	Sitnica River	19	Beri
ME	Moraca	12	Golubovci
ME	Moraca	11,5	Goricani
ME	Moraca	10,5	Susanja
ME	Moraca	14	Mojanovici
ME	Moraca	12	Golubovci
ME	Skadarsko jezero		Pothum I Vranj/ Tuzi
ME	Skadarsko jezero		Dodosi
ME	Skadarsko jezero		Zabljak Crnojevica
ME	Skadarsko jezero		Rijeka Crnojevica
ME	Skadarsko jezero		Plavnica
ME	Skadarsko jezero		Karuc
ME	Skadarsko jezero		Rogane /Bobija
ME	Skadarsko jezero		Poseljani
ME	Skadarsko jezero		Pevlaka
ME	Bojana		Lisna Bori
ME	Bojana		Fraskanjel
ME	Bojana		Sveti Djordje
ME	Bojana		Rec
ME	Bojana		Donji Stoj

## Annex 2: List of evaluated past flood events

Table 14: Documented and verified past flood events in the Drin/Drim-Buna/Bojana River Basin

(Grey lines show entries from published data banks, partly proved; white lines show events mentioned in local evaluations see also fact sheets in Annex 4)

Date	Fact sheet	Location	River or source	Description / damages
Nov 1962 - Feb 1963	AL - 6	Region of Shkodra	Drin, Buna / Bojana	Inundated zones during the floods of November 1962- February 1963 (Zadrime of Shkodres and Lezha, Bregu Bunes, 18.575 ha; Fields between Drini of Lezha and Mati, 3.122 ha)
	AL - 7	Lezha	Old (former) Drin River	The entire low land of Lezha region flooded by the old river bed. Severe land degradation. No data on settlements.
Dec 1992	ME	Niksic, Danilovgrad		<i>Not documented</i>
Nov 1992	AL - 6	Region of Shkodra	Drin, Buna / Bojana	Heavy rain during three days resulted in serious flooding in Northern Albania. The Mat and Drini Rivers overflowed their banks and inundated large areas with up to one meter of water. Most damage occurred to housing, livestock, and crops. The floods also caused damage to roads, bridges, riverbanks and irrigation networks. 17.000 ha of agricultural land were inundated. There was major disruption to electrical power.
Aug 1995	AL	Provinces: Lezhe, Miredita, Laci		<i>Not documented</i>
Dec 1995	AL	Shkadra, Malesi, Modhe, Lezhe, Kruja districts, Shkoder, Grande Montuosa, Lezhe and Kruje provinces	Drin, Buna / Bojana	<i>Not documented</i>
Nov 1996	AL	Northwest Albania: Lezha area	Drin, Buna / Bojana	<i>Not documented</i>
Dec 1997	AL	Lezhe (North-Western)	Drin, Buna / Bojana	<i>Not documented</i>
Dec 2000	ME	Danilovgrad, Lake Skadar, Cetinje	Zeta, Skadar lake	<i>Not documented</i>
2002	AL - 7	Lezha	Old (former) Drin River	The critical quota of the Drin River in the Lezha area is + 2,2 meters. In this quota, the water flooded Blinisht commune, Bacel village and 200 ha of agricultural land. With the quota increase, as was the case in September 2002, when the quota went + 3,04 meters, over 5.000 ha of soils flooded, so the flooded area is linked to the increase of the Drin River quota. In the area of Torovica, with a surface of 2.200 ha, the critical quota is + 1,7 to 1,8 meters and with this quota floods 600 ha, with the increase of quotas the surface of the flood increases.
Mar 2004	KO - 3	Skenderaj	Klina	Flash floods & river floods These floods have affected the above mentioned villages and the Klina River, usually after melting snow and the intensity of the rain, but it is an agricultural area along the river and a part of the Skenderaj town in the outskirts.
Dec 2004	AL	Obot (Shkodra Prefecture)	Buna / Bojana	<i>Not documented</i>
Feb 2006	KO - 3	Skenderaj	Klina	Flash floods & river floods These floods have affected the above mentioned villages and the Klina River, usually after melting snow and the intensity of the rain, but it is an agricultural area along the river and a part of the Skenderaj town in the outskirts.
	KO - 4	Klina	Drini i Bardh	Flash floods & river floods These veins have touched the abovementioned villages and the White Drin River, usually after snow melting and rainfall intensity, but it is an agricultural area along the river.
	KO - 6	Malisheva	Mirusha	Flash floods & river floods These floods have affected the above mentioned villages and the Mirusha River, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 7	Gjakova	Krena	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting

Date	Fact sheet	Location	River or source	Description / damages
				of snow and intensive rainfall.
	KO - 8	Gjakova	Erenik	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 9	Rahovec	Drini i Bradh	Flash floods & river floods These veins have touched the above mentioned villages and the White Drin, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river.
	KO - 10	Suhareka	Toplluha	Flash floods & river floods These veins have touched the above mentioned villages and by the River Toplluha, usually after melting snow and intensive rainfall but is an agricultural area along the river and a part of Suhareka.
Nov 2007	KO - 1	Peja	Lumbardhi i Pejes	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi i Pejes River, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river as there are also inert extractions.
	KO - 2	Istog	Lumi i Istogut	Flash floods Most of these floods affected the above mentioned villages and the Istog / Istog River, usually after the melting of snow and intensive rainfall, but it is an agricultural area.
	KO - 3	Skenderaj	Klina	Flash floods & river floods These floods have affected the above mentioned villages and the Klina River, usually after melting snow and the intensity of the rain, but it is an agricultural area along the river and a part of the Skenderaj town in the outskirts.
	KO - 4	Klina	Drini i Bardh	Flash floods & river floods These veins have touched the abovementioned villages and the White Drin River, usually after snow melting and rainfall intensity, but it is an agricultural area along the river.
	KO - 5	Deçan	Bistrica Deçan	Flash floods These floods have affected the above mentioned villages of Deçani and Lumbardhi River, usually after the melting of snow and the intensity of the rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 6	Malisheva	Mirusha	Flash floods & river floods These floods have affected the above mentioned villages and the Mirusha River, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 7	Gjakova	Krena	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 8	Gjakova	Erenik	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 9	Rahovec	Drini i Bradh	Flash floods & river floods These veins have touched the above mentioned villages and the White Drin, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river.
	KO - 10	Suhareka	Toplluha	Flash floods & river floods These veins have touched the above mentioned villages and by the River Toplluha, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 11	Prizren	Lumbardhi i Prizrenit	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 12	Prizren	Toplluha	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river.
Dec 2009	AL - 5	Shkodra Lake and City of Shkodra	Lake Shkodra	The area called "Ivadhë" inundated.

Date	Fact sheet	Location	River or source	Description / damages
	AL - 6	Region of Shkodra	Drin, Buna / Bojana	Heavy rainfall caused severe flooding in many parts of Albania. The counties of Shkoder and Lezhe, in the Drin Basin, were the most severely affected. In total, almost 10.000 ha of land were flooded. Over 5.000 people were evacuated from their homes; the number would have been higher but many people refused to leave their homes. 22.000 houses were damaged by flooding.
	MK - 2	Municipality of Resen / North of Prespa Lake	Golema	River flood from Golema River; flooding of 5 houses and 300 ha agriculture land (5.000 Euro)
	MK - 4	Municipality of Ohrid / East of Ohrid Lake	Koselska, Vapilica and Skrebatska	River flood from Vapilica River; flooding of 53 houses and 11 ha agriculture land (24.000 Euro)
	MK - 21	Municipality of Resen	Brajchinska ,Golema, Istochka	River flood from Golema River; flooding of 5 houses and 300 ha agriculture land (5.000 Euro)
	ME	Ulcinj, Golubovci, Zeta, Cetinje, Rijeka Cmojevica, Zabljak, Crnojevica, Bjolopavlici, Niksici	Ribnica, Moraca	
2009	MK	Vilages of Vapila, Leskoec, Kosel	Vapilica	23.906 € economic damage, 53 houses, 10.5 ha arable land
Jan 2010	AL - 5	Shkodra Lake and City of Shkodra	Lake Shkodra	The city of Shkodra (area called "livadhe") inundated. 400 objects flooded from which 200 businesses flooded.
	AL - 6	Region of Shkodra	Drin, Buna / Bojana	Heavy rainfall caused severe flooding in many parts of Albania. The counties of Shkoder and Lezhe, in the Drin Basin, were the most severely affected. In total, almost 10.000 ha of land were flooded. Over 5.000 people were evacuated from their homes; the number would have been higher but many people refused to leave their homes. 22.000 houses were damaged by flooding.
Jan 2010	KO - 1	Peja	Lumbardhi i Pejës	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi i Pejës River, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river as there are also inert extractions.
	KO - 2	Istog	Lumi i Istogut	Flash floods Most of these floods affected the above mentioned villages and the Istog / Istog River, usually after the melting of snow and intensive rainfall, but it is an agricultural area.
	KO - 3	Skenderaj	Klina	Flash floods & river floods These floods have affected the above mentioned villages and the Klina River, usually after melting snow and the intensity of the rain, but it is an agricultural area along the river and a part of the Skenderaj town in the outskirts.
	KO - 4	Klina	Drini i Bardh	Flash floods & river floods These veins have touched the abovementioned villages and the White Drin River, usually after snow melting and rainfall intensity, but it is an agricultural area along the river.
	KO - 5	Deçan	Bistrica Deçan	Flash floods These floods have affected the above mentioned villages of Deçani and Lumbardhi River, usually after the melting of snow and the intensity of the rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 6	Malisheva	Mirusha	Flash floods & river floods These floods have affected the above mentioned villages and the Mirusha River, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 7	Gjakova	Krena	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 8	Gjakova	Erenik	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 9	Rahovec	Drini i Bradh	Flash floods & river floods These veins have touched the above mentioned villages and the

Date	Fact sheet	Location	River or source	Description / damages
				White Drin, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river.
	KO - 10	Suhareka	Toplluha	Flash floods & river floods These veins have touched the above mentioned villages and by the River Toplluha, usually after melting the rainfall and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 11	Prizren	Lumbardhi I Prizrenit	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of the rainfall and intensive rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 12	Prizren	Toplluha	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river.
Feb 2010 – Mar 2010	MK - 4	Municipality of Ohrid / East of Ohrid Lake	Koselska, Vapilica and Skrebatska	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 648 houses and 334 ha agriculture land (960.000 Euro)
	MK - 7	Municipality of Struga / North of Lake Ohrid	Black Drin	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 29 houses and 40 ha agriculture land
	MK - 9	Municipality of Struga, Debarca / North of Lake Ohrid	Sateska	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 29 houses and 40 ha agriculture land
	MK - 19	Ohrid Lake	Ohrid Lake	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 648 houses and 334 ha agriculture land (960.000 Euro)
Nov 2010 – Dec 2010	ME - 1	Niksic	Zeta	They were endangering settlements, roads and agricultural land.
	ME - 2	Glava Zete to Spuz	Zeta	They were endangering settlements, roads and agricultural land.
	ME - 4	Golubovci and Tuzi	Moraca and Skadar lake area	Floods in the municipalities of Golubovci and Tuzi are mostly endangered by large areas of land along the periphery of the Skadar Lake and in the lower flow zone of the Morača River. They were endangering settlements, roads and agricultural land.
	ME - 5	West of Skadar Lake	Skadar Lake area	Major damage was on orchards and vineyards, boats and fishing material and a part of livestock and food for livestock also disappeared. Infrastructure facilities were endangered by the Old Bridge on Rijeka Crnojević and three bridges on the road of Rijeka Crnojevića - Virpazar. Also, the pumping station of the Cetinje Water Supply in Podgora was endangered, from where Cetinje is supplied with water.
	ME - 6	Lisna Bori to Gornji Stoj	Buna / Bojana	The biggest areas of land and private facilities near the river Bojana are endangered. It is primarily about ground-level houses and houses with a maximum of one to two floors, as well as large plantations of fruits and vegetables.
2010	AL - 5	Shkodra Lake and City of Shkodra	Lake Shkodra	Shkodra city Xhabija neighborhood at city entrance was flooded. The city of Shkodra (area called "livadhe") inundated. 400 objects flooded from which 200 businesses flooded.
	AL - 6	Region of Shkodra	Drin, Buna / Bojana	The final data received from the government's Emergency Commission on the flooded area and the people evacuated is as follows: • 2.000 evacuated people accommodate in the collective centers. • 12.500 evacuated people accommodated with their relatives; • 15.000 acres of land flooded, • 4.800 houses surrounded by water, most of them already flooded • 16.500 animals evacuated • 373 other affected families by floods or lands slide in other districts.
	AL - 7	Lezha	Old (former) Drin River	The land area of Blinisht Administrative unit and the surrounding area flooded by heavy rain and low water retention capacity. No affected houses. An area of 2.000 ha of arable land in Torovice flooded. Barbulloja village, 100 houses affected. Lezha city flooded, Beslidhja neighborhood 20 ha of housing area with buildings flooded.
2010	MK - 2	Municipality of Resen / North of Prespa Lake	Golema	River flood from Golema River; flooding of 2 houses and 20 ha agriculture land (1.000Euro)
	MK - 15	Municipality of Struga / North of Globochica reservoir	Black Drin (between Globochica and Shpile reservoirs)	River flood from Radika and Crni Drim (no reported affected infrastructure)

Date	Fact sheet	Location	River or source	Description / damages
	MK - 17	Municipality of Debar, Mavrovo and Rostushe / South of Mavrovo reservoir	Radika	River flood from Radika and Crni Drim (no reported affected infrastructure)
	MK - 21	Municipality of Resen	Brajchinska ,Golema, Istochka	River flood from Golema River; flooding of 2 houses and 20 ha agriculture land (1.000 Euro)
2011	MK - 2	Municipality of Resen / North of Prespa Lake	Golema	River flood from Golema River; flooding of 10 houses and 100 ha agriculture land (2.000 Euro)
	MK - 5	Municipality of Ohrid / East of Ohrid Lake	Sushichka	River flood from Susica River; flooding of 46 houses and 53 ha agriculture land (350.000 Euro)
	MK - 21	Municipality of Resen	Brajchinska ,Golema, Istochka	River flood from Golema River; flooding of 10 houses and 100 ha agriculture land (2.000 Euro)
Feb 2012	MK - 4	Municipality of Ohrid / East of Ohrid Lake	Koselska, Vapilica and Skrebatska	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 143 houses and 29 ha agriculture land (1.010.000 Euro)
	MK - 19	Ohrid Lake	Ohrid Lake	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 143 houses and 29 ha agriculture land (1.010.000 Euro)
May 2012	AL - 1	Kukes	Black Drin	River Floods: Village of Përbreg / BregLume (Terthore Administrative Unit)
Dec 2012	AL - 4	Lake Shkodra	Kiri River	Torrential river. Active in heavy rains. 15 houses in Bardhaj heavy damaged.
2012	MK - 4	Municipality of Ohrid / East of Ohrid Lake	Municipality of Ohrid / East of Ohrid Lake	River flood from Koselska, Vapilica, Skrebatska and Susica Rivers; flooding of 27 houses and 66 ha agriculture land (180.000 Euro)
Feb 2013	MK - 2	Municipality of Resen / North of Prespa Lake	Golema	River flood from Golema River; flooding of 2 houses and 10 ha agriculture land (500 Euro)
	MK - 21	Municipality of Resen	Brajchinska ,Golema, Istochka	River flood from Golema River; flooding of 2 houses and 10 ha agriculture land (500 Euro)
Mar 2013	AL - 6	Region of Shkodra	Drin, Buna / Bojana	During the flood event in December 2010 the documented total number of affected resp. evacuated inhabitants in this area was about 12.145 and the number of affected houses was about 7.120 (4.540 flooded houses and 2.580 houses surrounded by water), while the number of assets at risk in this area was more than 400 of different types.
Apr 2014	KO - 1	Peja	Lumbardhi i Pejës	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi i Pejës River, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river as there are also inert extractions.
	KO - 2	Istog	Lumi i Istogut	Flash floods Most of these floods affected the above mentioned villages and the Istog / Istog River, usually after the melting of snow and intensive rainfall, but it is an agricultural area.
	KO - 3	Skenderaj	Klina	Flash floods & river floods These floods have affected the above mentioned villages and the Klina River, usually after melting the rainfall and the intensity of the rain, but it is an agricultural area along the river and a part of the Skenderaj town in the outskirts.
	KO - 4	Klina	Drini i Bardh	Flash floods & river floods These veins have touched the abovementioned villages and the White DrinRiver, usually after snow melting and rainfall intensity, but it is an agricultural area along the river.
	KO - 5	Deçan	Bistrica Deçan	Flash floods These floods have affected the above mentioned villages of Deçani and Lumbardhi River, usually after the melting of snow and the intensity of the rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 6	Malisheva	Mirusha	Flash floods & river floods These floods have affected the above mentioned villages and the Mirusha River, usually after melting snow and intensive rainfall, but it



Date	Fact sheet	Location	River or source	Description / damages
				is an agricultural area along the river and a part of Suhareka.
	KO - 7	Gjakova	Krena	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 8	Gjakova	Erenik	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 9	Rahovec	Drini i Bradh	Flash floods & river floods These veins have touched the above mentioned villages and the White Drin, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river.
	KO - 10	Suhareka	Toplluha	Flash floods & river floods These veins have touched the above mentioned villages and by the River Toplluha, usually after melting the rainfall and intensive rainfall, but is an agricultural area along the river and a part of Suhareka.
	KO - 11	Prizren	Lumbardhi i Prizrenit	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 12	Prizren	Toplluha	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river.
Nov 2014	AL	Tirana, Lezhë, Shkodër and Fier	Drin River (Shkodra)	7500 houses damaged, 11.000 people evacuated, 3 people died
Nov 2015	AL	Northern counties of Kukës, Dibër, Durrës, Shkodër, southern county of Gjirokastrë, and around the capital in Tirana district, central Albania		Heavy Rain, 11.409,69 affected km <sup>2</sup> , 1 person died, 300 people displaced
2015	MK - 2	Municipality of Resen / North of Prespa Lake	Golema	River flood from Golema and Istocka Rivers; flooding of 13 houses and 500 ha agriculture land (20.000 Euro)
	MK - 3	Municipality of Resen / North of Prespa Lake	Istochka	River flood from Golema and Istocka Rivers; flooding of 13 houses and 500 ha agriculture land (20.000 Euro)
	MK - 6	Municipality of Struga / North of Lake Ohrid	Black Drin	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 10 houses and 30 ha agriculture land (55.000 Euro)
	MK - 9	Municipality of Struga, Debarca / North of Lake Ohrid	Sateska	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 10 houses and 30 ha agriculture land (55.000 Euro)
	MK - 21	Municipality of Resen	Brajchinska, Golema, Istochka	River flood from Golema and Istocka Rivers; flooding of 13 houses and 500 ha agriculture land (20.000 Euro)
	MK	Ohrid, Kosel, Peshtani, Livoishta, Lakoheraj, Velgoshti, Leskoec	Ohrid lake, Koselska, Sushica, Vapilica	1.008.409 € economic damage, 143 houses, 29 ha arable land
May 2016	KO - 1	Peja	Lumbardhi i Pejes	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi i Pejes River, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river as there are also inert extractions.
	KO - 2	Istog	Lumi i Istogut	Flash floods Most of these floods affected the above mentioned villages and the Istog / Istog River, usually after the melting of snow and intensive rainfall, but it is an agricultural area.

Date	Fact sheet	Location	River or source	Description / damages
	KO - 3	Skenderaj	Klina	Flash floods & river floods These floods have affected the above mentioned villages and the Klina River, usually after melting snow and the intensity of the rain, but it is an agricultural area along the river and a part of the Skenderaj town in the outskirts.
	KO - 4	Klina	Drini i Bardh	Flash floods & river floods These veins have touched the abovementioned villages and the White Drin River, usually after snow melting and rainfall intensity, but it is an agricultural area along the river.
	KO - 5	Deçan	Bistrica Deçan	Flash floods These floods have affected the above mentioned villages of Deçani and Lumbardhi River, usually after the melting of snow and the intensity of the rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 6	Malisheva	Mirusha	Flash floods & river floods These floods have affected the above mentioned villages and the Mirusha River, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 7	Gjakova	Krena	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 8	Gjakova	Erenik	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 9	Rahovec	Drini i Bradh	Flash floods & river floods These veins have touched the above mentioned villages and the White Drin, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river.
	KO - 10	Suhareka	Toplluha	Flash floods & river floods These veins have touched the above mentioned villages and by the River Toplluha, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 11	Prizren	Lumbardhi I Prizrenit	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 12	Prizren	Toplluha	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river.
Nov 2016	AL - 1	Diber	Black Drin	Torrential river. Active in heavy rains. 15 houses in Barshaj heavy damaged.
	AL - 3	Tropoje	Valbona River (Drini tributary)	Flash floods by heavy rains. Several villages affected. 15 houses affected by floods at Partizani neighborhood of Bajram Curri. 2 houses damaged in Bujan mostly due to land slides. Bridges damaged in the villages of Viçidol, Tropojë e Vjetër, Lekbibaj, Geghysen, T'pla të rrethit të Tropojës, Bashkia Tropojë. Land area flooded in the villages of T'plan, Viçdol, Tropojë.
	AL - 5	Shkodra Lake and City of Shkodra	Lake Shkodra	The Dajç Administrative area was flooded.
	AL	Tiranë, Lezhë, Durrës, Dibër, Fushë Bulqizë	Drin River	15 houses Shkoder, 8 houses Tirane", 360 ha (Dajç, Guri i Zi, Vau Dejës, Ana Malit, Postribë)
2017	MK - 7	Municipality of Struga / North of Lake Ohrid	Black Drin	River flood from several small rivers; flooding of 2 houses and 10 ha agriculture land (55.000 Euro)
Mar 2018	AL - 4	Lake Shkodra	Kiri River	Bardhaj village surrounded by waters.
	AL - 5	Shkodra Lake and City of Shkodra	Lake Shkodra	Rrethinat flooded. No objects flooded only land.
	AL - 6	Region of Shkodra	Drin, Buna / Bojana	Affected the areas of Dajç, Bërdicë and Ana e Malit. 4.900 ha of arable land flooded, 315 houses surrounded by water and 140 families evacuated.
Aug 2018	KO - 6	Malisheva	Mirusha	Flash floods & river floods These floods have affected the above mentioned villages and the

Date	Fact sheet	Location	River or source	Description / damages
				Mirusha River, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 7	Gjakova	Krena	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 8	Gjakova	Erenik	Flash floods & river floods These floods have crossed the above mentioned villages and the town of Gjakova from the Krena river branch, usually after the melting of snow and intensive rainfall.
	KO - 9	Rahovec	Drini i Bradh	Flash floods & river floods These veins have touched the above mentioned villages and the White Drin, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river.
	KO - 10	Suhareka	Toplluha	Flash floods & river floods These veins have touched the above mentioned villages and by the River Toplluha, usually after melting snow and intensive rainfall, but it is an agricultural area along the river and a part of Suhareka.
	KO - 11	Prizren	Lumbardhi i Prizrenit	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.
	KO - 12	Prizren	Toplluha	Flash floods & river floods These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of snow and intensive rainfall, but it is an agricultural area along the river and this part of the river.

### Annex 3: Land use in evaluated APSFR (data)

The land use statistics is based on the assessment of land use classes and objects as described in the chapter methodology (see also there for source).

Land use class	110	121	120	130	140	200
Land use	Urban Areas	Industrial Areas	Transport	Mineral Extraction/ Dump Sites	Other Urban Areas	Agriculture
Area Code	[ha]	[ha]	[ha]	[ha]	[ha]	[ha]
MK01	8,7		2,8			155,4
MK02	55,3	21,6	6,2		0,8	631,0
MK03	28,9	4,1	5,4		2,7	506,7
MK04	133,4	0,0	13,4			636,3
MK05	236,3		22,5			4,6
MK06	0,2		0,3			67,0
MK07	5,9		0,6			92,9
MK08	67,4	20,7	5,3			493,3
MK09	236,0	6,1	22,9			1.234,2
MK10	5,8	4,4	0,3			245,8
MK11	1,4		0,5			168,4
MK12	10,0		0,1			11,1
MK13	48,2	0,4	2,7			523,7
MK14	113,3		3,8			198,5
MK15	1,7		3,6			2,0
MK16	0,0	1,8				9,3
MK17	2,8		2,5			66,3
MK18	360,4	27,4	41,6		0,3	1.396,5
MK19	115,2		18,5		0,3	402,9
MK20	9,0		6,1		12,2	774,9
KO01	85,7		10,9			1024,6
KO02	0,5		3,8			761,5
KO03	208,4	13,6	25,6		7,6	903,6
KO04	150,4		28,6			2463,2
KO05	59,2		9,1			1232,6
KO06	70,6		4,8			491,0
KO07	688,6		16,6			1170,0
KO08	16,1		0,8			101,4
KO09	249,2	46,5	46,0	26,8	4,1	3309,1
KO10	391,5	65,9	25,6	0,9	11,4	1210,0
KO11	71,6	76,1	9,0	0,4	1,8	739,0
KO12	101,8	60,2	24,6	2,3	35,6	547,6
AL01	0,5					4,7
AL02	0,2		0,2			194,2
AL03	67,3	6,1	10,6	0,8	2,5	55,5
AL04	95,4	13,2	10,0	3,3	4,5	687,2
AL05	1107,2	86,9	173,8	26,2	39,0	11415,9
AL06	862,6	87,9	97,2			8586,8
ME01	637,3	29,6	89,4	104,9	0,7	2846,8
ME02	173,4	8,8	26,1	11,3	1,2	895,3
ME03	0,0	0,0	0,0	0,0	0,0	0,0
ME04	257,1	33,1	22,2	222,2	6,7	1177,9
ME05	13,1		8,2			184,0
ME06	435,0	1,8	34,7		55,9	3081,4

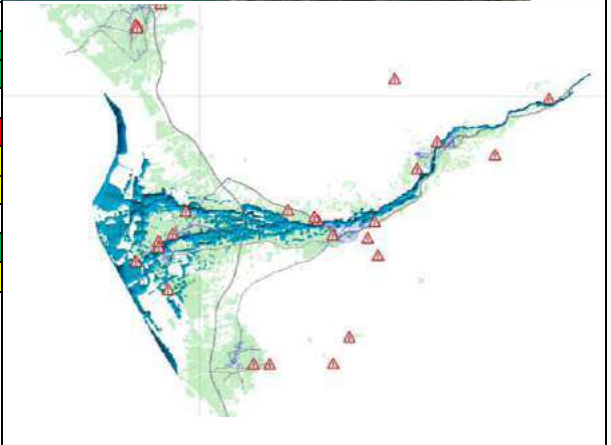




## **Annex 4: Fact sheets of the APSFR**

Risk area		Country:	Macedonia	MK - 1
		Location:	Municipality of Resen / East of Prespa Lake	
<b>River-Flood / flash-flood:</b>	Brajchinska		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	Above village of Brajchino up to Prespa Lake			
<b>River km:</b>	to km:			
<b>Cities / villages of risk:</b>	Villages of Brajchino, Ljubojno, Nakolec			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	239			
Houses	85			
Persons	213			
Families	85			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	2,40 km of road network flooded			
Agriculture [ha] / objects	ca. 150 ha			
Protected areas	69,6 ha			
Other objects at risk				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	85	≥ 10	Red	
Settlement area (in ha)	8	≥ 0,5	Red	
Industrial objects	0	≥ 1	Green	
Industrial area (in ha)	0	≥ 0,5	Green	
Critical agriculture aspects	--		Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	Green	
Locations with dangerous substances	0	≥ 1	Green	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Red	
Drinking Water supply areas		≥ 1	Yellow	
Bathing waters		≥ 1	Yellow	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1	Green	
Other relevant cultural heritage sites		≥ 1	Yellow	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Brajchinska combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 1,0 mil euro. 95% of the direct flood damages are to residential and road infrastructure - app 48 and 46% respectively. Substantial number of houses flooded - 85. Min./Max. depths 0,00-3,06 m		




Situation in the potential risk area:



Risk area		Country:	Macedonia	MK - 2
		Location:	Municipality of Resen / North of Prespa Lake	
<b>River-Flood / flash-flood:</b>		Golema		<b>Location in the Drin – Buna/Bojana River Basin</b> 
<b>River section:</b>		From village of Izbishte up to Prespa Lake		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City Resen, Villages of Izbishta, Gorna Bela Crkva, Gorna Bela Crkva, Ezerani		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Dec 2009	River flood from Golema River; flooding of 5 houses and 300 ha agriculture land (5.000 Euro)			
2010	River flood from Golema River; flooding of 2 houses and 20 ha agriculture land (1.000 Euro)			
2011	River flood from Golema River; flooding of 10 houses and 100 ha agriculture land (2.000 Euro)			
Feb 2013	River flood from Golema River; flooding of 2 houses and 10 ha agriculture land (500 Euro)			
2015	River flood from Golema and Istocka Rivers; flooding of 13 houses and 500 ha agriculture land (20.000 Euro)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	987			
Houses	225			
Persons	788			
Families	225			
Companies at risk				
Industry (objects)	30			
Infrastructure (objects)	6,30 km of road network flooded			
Agriculture [ha] / objects	ca. 630 ha			
Protected areas	279 ha			
Other objects at risk	possible flooding of WWTP Ezerani, group of drilled wells for water supply of Resen			
<b>Situation in the potential risk area:</b> 				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	225	≥ 10	Limit exceeded	
Settlement area (in ha)	13,1	≥ 0,5	Limit exceeded	
Industrial objects	30	≥ 1	Limit exceeded	
Industrial area (in ha)	10,3	≥ 0,5	Limit exceeded	
Critical agriculture aspects	--		No information / uncertain	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	1	≥ 1	Limit exceeded	
Locations with dangerous substances	1	≥ 1	Limit exceeded	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Limit exceeded	
Drinking Water supply areas	1	≥ 1	Limit exceeded	
Bathing waters		≥ 1	No information / uncertain	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1	Limit not exceeded	
Other relevant cultural heritage sites		≥ 1	No information / uncertain	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for Golema river combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		Substantial number of houses flooded - 225. The number of residents directly affected from the flood event is 788. The preliminary cost estimation for the simulated flood event is app. 4,0 mil euro. with 1,8 mil damage to residential infrastructure. Min./Max. depths 0,00-3,41 m		

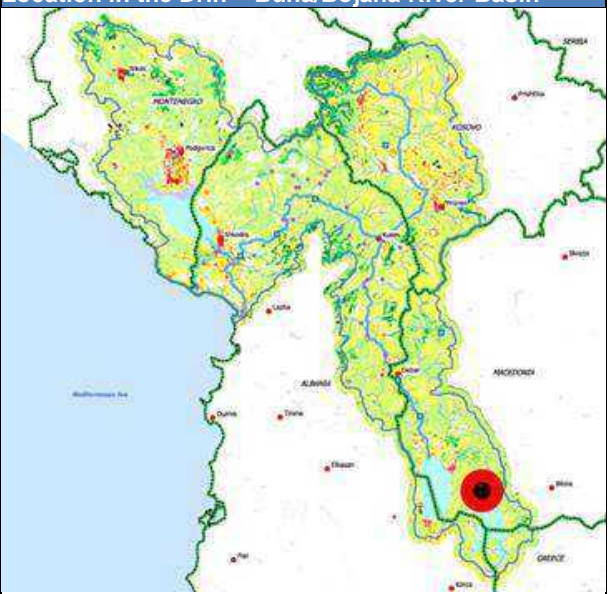
 Limit exceeded

 No information / uncertain

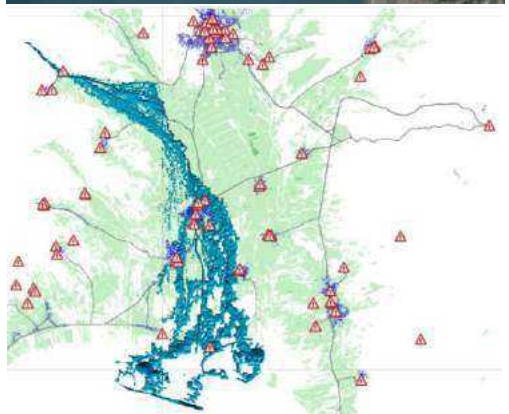
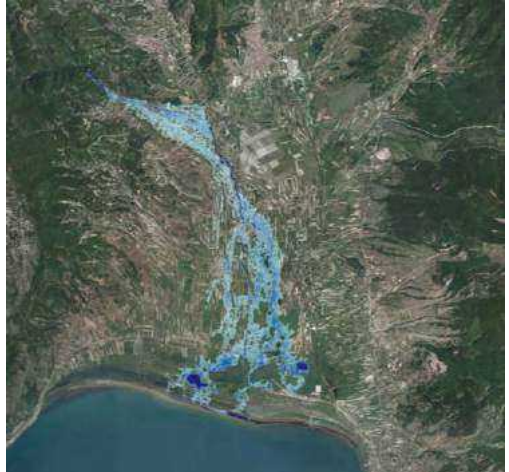
 Limit not exceeded



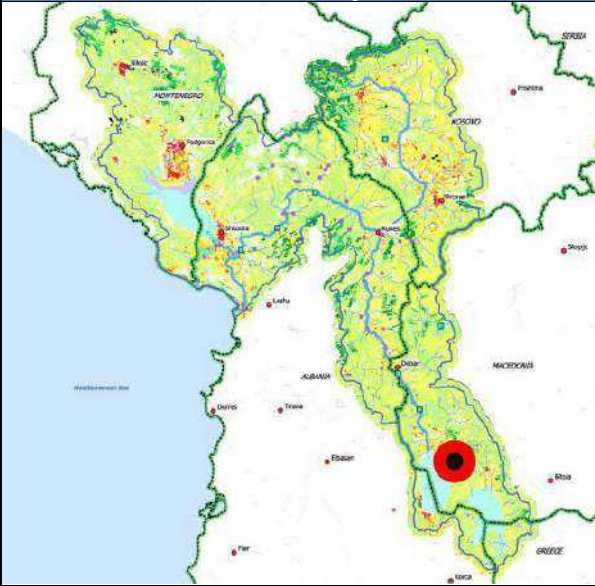

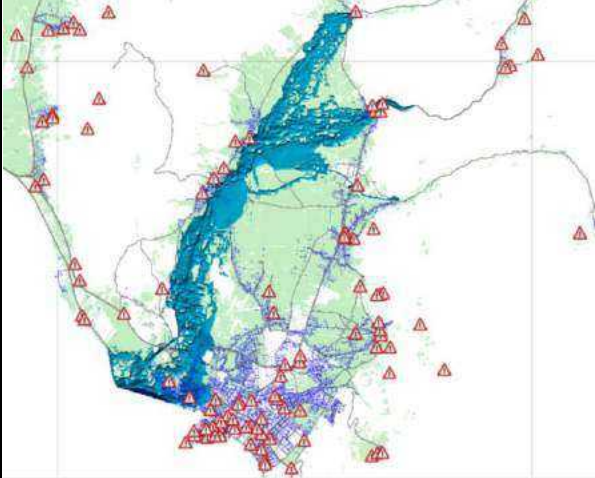
Risk area		Country:	Macedonia	MK - 3
		Location:	Municipality of Resen / North of Prespa Lake	
<b>River-Flood / flash-flood:</b>		Istochka	<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>		Near Evla village up to Prespa Lake		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		Villages of Carev Dvor, Drmeni, Ezerani, Izbishta,		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
2015	River flood from Golema and Istochka Rivers; flooding of 13 houses and 500 ha agriculture land (20.000 Euro)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	807			
Houses	214			
Persons	420			
Families	214			
Companies at risk				
Industry (objects)	4			
Infrastructure (objects)	7,30 km of road network flooded			
Agriculture [ha] / objects	ca. 500 ha			
Protected areas	251 ha			
Other objects at risk	Possible flooding of church, mosque, petrol station			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	214	$\geq 10$		Red
Settlement area (in ha)	16,1	$\geq 0,5$		Red
Industrial objects	4	$\geq 1$		Red
Industrial area (in ha)	4	$\geq 0,5$		Red
Critical agriculture aspects				Yellow
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	$\geq 1$		Green
Locations with dangerous substances	0	$\geq 1$		Green
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	$\geq 1$		Red
Drinking Water supply areas	0	$\geq 1$		Green
Bathing waters		$\geq 1$		Yellow
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	$\geq 1$		Green
Other relevant cultural heritage sites		$\geq 1$		Yellow
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for Istochka river combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 2,0 mil euro, where the majority of the direct costs belongs to residential and road infrastructure - app. 43% and 42% respectively. Substantial number of houses flooded - 214 in total. Min./Max. depths 0,00-4,00 m		



Situation in the potential risk area:



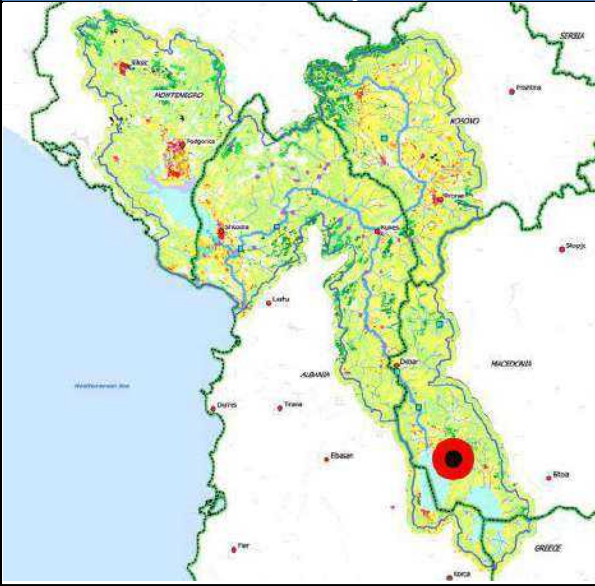
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Macedonia	MK - 4
		Location:	Municipality of Ohrid / East of Ohrid Lake	
<b>River-Flood / flash-flood:</b>		Koselska, Vapilica and Skrebatska		
<b>River section:</b>		Koselska with its tributaries up to Ohrid Lake		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City Ohrid, Villages of Vapila, Kosel, Gorno Lakochere, Dolno Lakochere Leskoec, Orman,		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
2009	River flood from Vapilica River; flooding of 53 houses and 11 ha agriculture land (24.000 Euro)			
Feb 2010 – Mar 2010	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 648 houses and 334 ha agriculture land (960.000 Euro)			
2012	River flood from Koselska, Vapilica, Skrebatska and Susica Rivers; flooding of 27 houses and 66 ha agriculture land (180.000 Euro)			
Feb 2012	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 143 houses and 29 ha agriculture land (1.010.000 Euro)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	788			
Houses	1.017			
Persons	2.782			
Families	1.017			
Companies at risk	0			
Industry (objects)	0			
Infrastructure (objects)	17 km of road network flooded			
Agriculture [ha] / objects	ca. 600 ha			
Protected areas				
Other objects at risk	Possible flooding of schools, mosque			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	1.017	≥ 10		Red
Settlement area (in ha)	71,7	≥ 0,5		Red
Industrial objects	0	≥ 1		Green
Industrial area (in ha)	0	≥ 0,5		Green
Critical agriculture aspects				Yellow
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		Green
Locations with dangerous substances	0	≥ 1		Green
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1		Green
Drinking Water supply areas		≥ 1		Yellow
Bathing waters		≥ 1		Yellow
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	1	≥ 1		Red
Other relevant cultural heritage sites	1	≥ 1		Red
<b>Situation in the potential risk area:</b>				
				
				
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for Koselska river with its main tributaries combined with Preliminary economic flood impact assessment modelling.		The preliminary cost estimation for the simulated flood event is app. 24,4 mil euro, where the majority of the direct costs belongs to residential - app. 85%. Min./Max. depths 0,00-4,63 m		

Red Limit exceeded

Yellow No information / uncertain

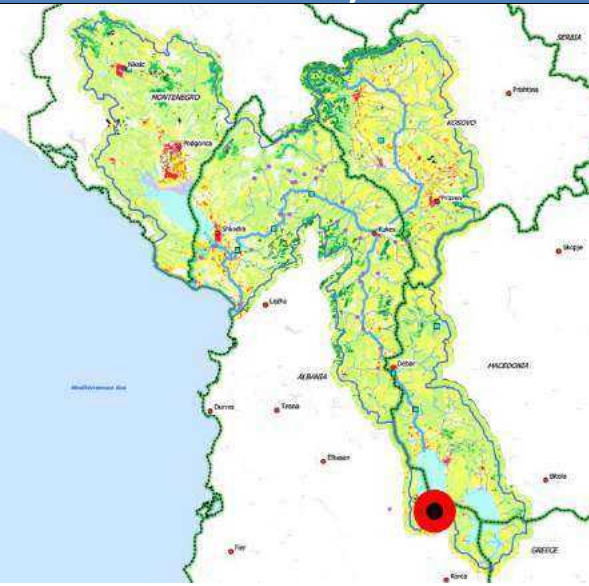

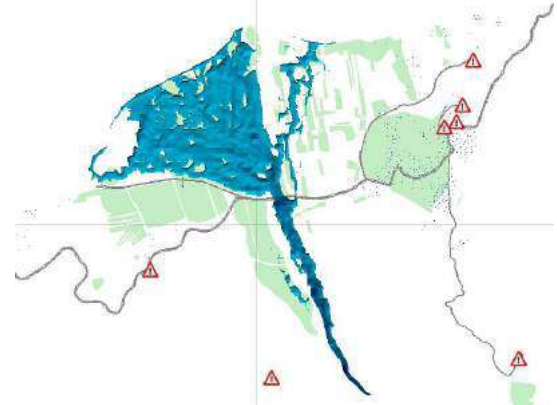
Green Limit not exceeded

Risk area		Country:	Macedonia	MK - 5
		Location:	Municipality of Ohrid / East of Ohrid Lake	
<b>River-Flood / flash-flood:</b>		Sushichka		
<b>River section:</b>		Above city of Ohrid up to Ohrid Lake		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City Ohrid, Village of Veliki Dobishta		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
2011	River flood from Susica River; flooding of 46 houses and 53 ha agriculture land (350.000 Euro)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	263			
Houses	1.980			
Persons	8.423			
Families	1.980			
Companies at risk				
Industry (objects)	89			
Infrastructure (objects)	23,4 km of road network flooded			
Agriculture [ha] / objects	ca. 5 ha			
Protected areas	2,6 ha			
Other objects at risk	Possible flooding of schools, church, petrol station, drilled well for water supply			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	1.980	≥ 10	Limit exceeded	
Settlement area (in ha)	201,7	≥ 0,5	Limit exceeded	
Industrial objects	89	≥ 1	Limit exceeded	
Industrial area (in ha)	41,5	≥ 0,5	Limit exceeded	
Critical agriculture aspects			No information / uncertain	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	Limit not exceeded	
Locations with dangerous substances	0	≥ 1	Limit not exceeded	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Limit exceeded	
Drinking Water supply areas	1	≥ 1	Limit exceeded	
Bathing waters		≥ 1	No information / uncertain	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	1	≥ 1	Limit exceeded	
Other relevant cultural heritage sites	1	≥ 1	Limit exceeded	
<b>Explanations / comment for the risk assessment</b>			<b>General comments for this potential risk area</b>	
Based on: hydrological and hydraulic simulation of 500-yr flood event for Sushichka river combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.			The preliminary cost estimation for the simulated flood event is app. 6,4 mil euro, where the majority of the direct costs belongs to residential - app. 78%. Substantial number of houses flooded - 1980 in total - mostly in the city center. The number of residents directly affected from the flood event is 8.423. Min./Max. depths 0,00-2,77 m	

Limit exceeded

No information / uncertain

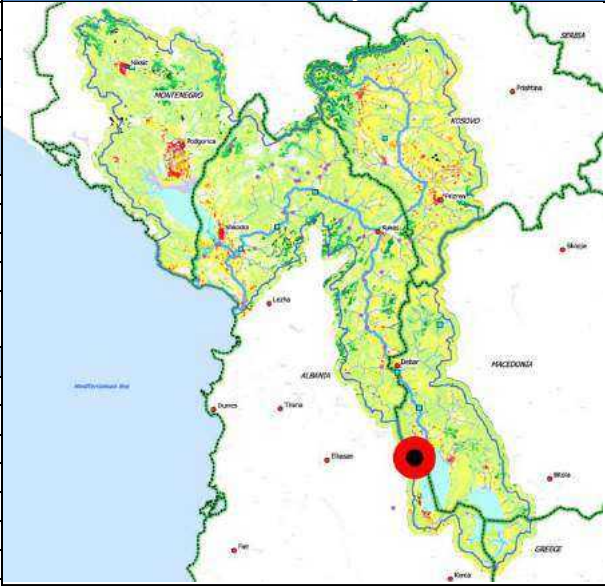

Limit not exceeded

Risk area		Country:	Macedonia	MK - 6
		Location:	Municipality of Ohrid / South of Ohrid Lake	
<b>Flash-flood / lake-flood:</b>		Cherava		<b>Location in the Drin – Buna/Bojana River Basin</b> 
<b>River section:</b>		Albanian border up to Ohrid Lake		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
<i>Comments on past events: No detailed data of economic losses from Cherava River</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	75			
Houses	2			
Persons	10			
Families	2			
Companies at risk				
Industry (objects)	1			
Infrastructure (objects)	0,1 km of road network flooded			
Agriculture [ha] / objects	ca.65 ha			
Protected areas	74 ha			
Other objects at risk				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses		2	≥ 10	<span style="color: green;">■</span>
Settlement area (in ha)		0,2	≥ 0,5	<span style="color: green;">■</span>
Industrial objects		1	≥ 1	<span style="color: red;">■</span>
Industrial area (in ha)			≥ 0,5	<span style="color: yellow;">■</span>
Critical agriculture aspects				<span style="color: grey;">■</span>
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		0	≥ 1	<span style="color: green;">■</span>
Locations with dangerous substances		0	≥ 1	<span style="color: green;">■</span>
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		1	≥ 1	<span style="color: red;">■</span>
Drinking Water supply areas		0	≥ 1	<span style="color: green;">■</span>
Bathing waters			≥ 1	<span style="color: yellow;">■</span>
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites			≥ 1	<span style="color: green;">■</span>
Other relevant cultural heritage sites		1	≥ 1	<span style="color: red;">■</span>
<b>Situation in the potential risk area:</b> 				
				
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for Cherava river combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 0,2 mil euro. Min./Max. depths 0,00-3,20 m		

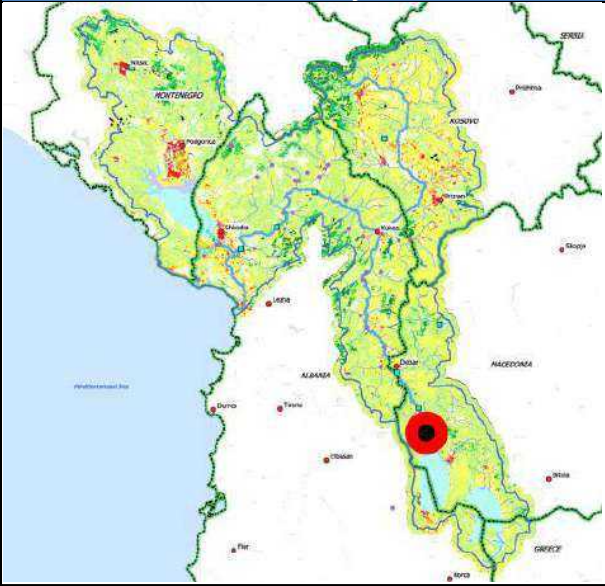

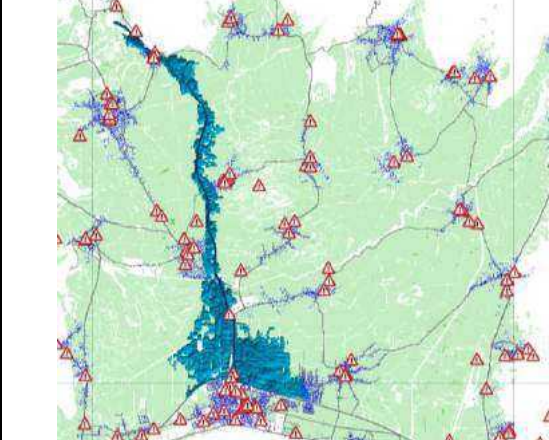
■ Limit exceeded

■ No information / uncertain

■ Limit not exceeded

Risk area		Country:	Macedonia	MK - 7		
		Location:	Village of Kalishta / West of Lake Ohrid			
<b>River-Flood / flash-flood:</b>	Kalishta					
<b>River section:</b>	From Frangovo up to Ohrid Lake					
<b>River km:</b>	to km:					
<b>Cities / villages of risk:</b>	Villages of Frangovo, Kalishta					
<b>Past events / years, damage:</b>						
<b>Month/Year</b>	<b>Description of damage</b>					
<i>Comments on past events: No detailed data of economic losses from Kalishta River</i>						
<b>Potential risks / assets in risk area</b>						
Risk area (in ha)	100					
Houses	24					
Persons	79					
Families	24					
Companies at risk						
Industry (objects)						
Infrastructure (objects)	1,9 km of road network flooded					
Agriculture [ha] / objects	ca. 90 ha					
Protected areas						
Other objects at risk	flooding of Kalishko wetland					
<b>Risk assessment / significance of potential risks</b>						
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>				
<b>A) Human health, economic values</b>						
no. of houses	24	≥ 10			Red	
Settlement area (in ha)	5,9	≥ 0,5	Red			
Industrial objects	0	≥ 1	Green			
Industrial area (in ha)	0	≥ 0,5	Green			
Critical agriculture aspects			Yellow			
<b>B) Environmental risks</b>						
<b>B1) Water polluting substances / sites</b>						
Contaminated sites	0	≥ 1	Green			
Locations with dangerous substances	0	≥ 1	Green			
<b>B2) Protected areas (according to WRRL)</b>						
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1	Green			
Drinking Water supply areas	0	≥ 1	Green			
Bathing waters		≥ 1	Yellow			
<b>C) Risk for cultural heritage sites</b>						
UNESCO heritage sites		≥ 1	Green			
Other relevant cultural heritage sites	1	≥ 1	Red			
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>				
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Kalishta combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 0.4 mil euro, where the majority of the direct costs belongs to road infrastructure - app. 72%. There are no industrial facilities flooded. The number of residents directly affected from the flood event is 79. Min./Max. depths 0,00-1,62 m				

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

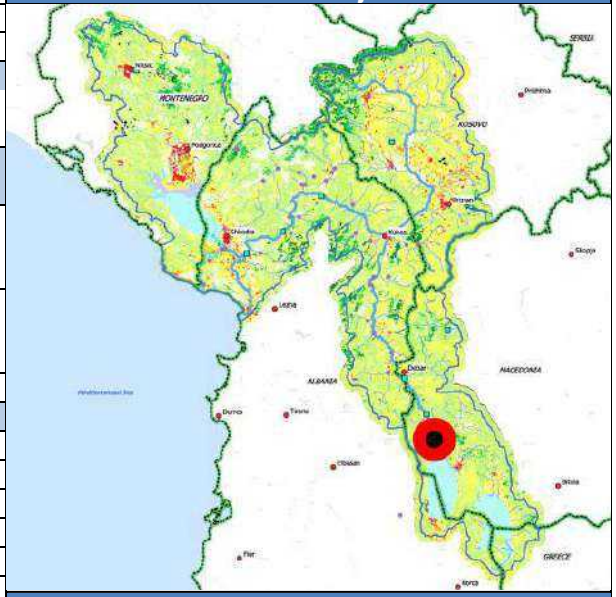
Risk area		Country:	Macedonia	MK - 8
		Location:	Municipality of Struga / North of Lake Ohrid	
<b>River-Flood / flash-flood:</b>		Black Drin		
<b>River section:</b>		From city of Struga up to Globocica reservoir		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City Struga, Villages of Misleshevo, Vranishta, Lozhani, Dobovjani		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2010 – Mar 2010	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 29 houses and 40 ha agriculture land			
2015	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 10 houses and 30 ha agriculture land (55.000 Euro)			
2017	River flood from several small rivers; flooding of 2 houses and 10 ha agriculture land (55.000 Euro)			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	591			
Houses	228			
Persons	857			
Families	228			
Companies at risk				
Industry (objects)	29			
Infrastructure (objects)	4,5 km of road network flooded			
Agriculture [ha] / objects	ca. 490 ha			
Protected areas				
Other objects at risk	possible flooding of WWTP Vranishta, landfill areas			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	228	≥ 10	Red	
Settlement area (in ha)	16,3	≥ 0,5	Red	
Industrial objects	29	≥ 1	Red	
Industrial area (in ha)	30	≥ 0,5	Red	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	1	≥ 1	Red	
Locations with dangerous substances	1	≥ 1	Red	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1	Green	
Drinking Water supply areas		≥ 1	Yellow	
Bathing waters		≥ 1	Yellow	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Green	
Other relevant cultural heritage sites	1	≥ 1	Red	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Black Drin combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 5,0 mil euro, where the majority belongs to residential infrastructure - app. 47%. Road infrastructure accounts for 30% of the total direct damages. The number of residents directly affected from the flood event is 857. Min./Max. depths 0,00-53,5 m		

Red Limit exceeded

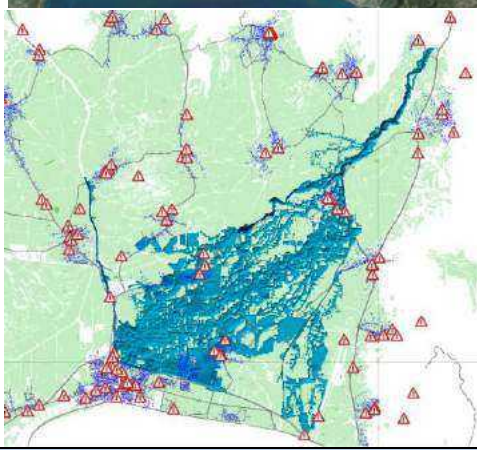
Yellow No information / uncertain

Green Limit not exceeded


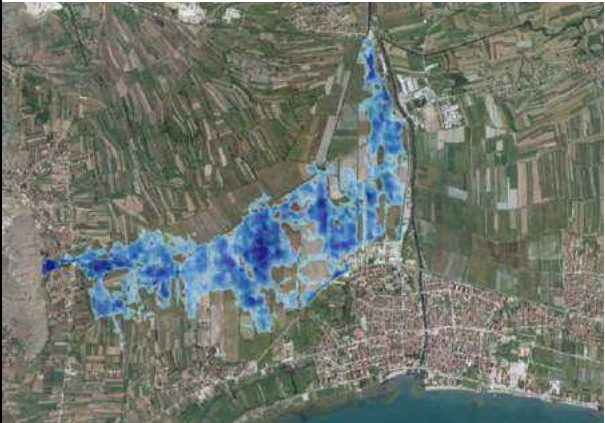
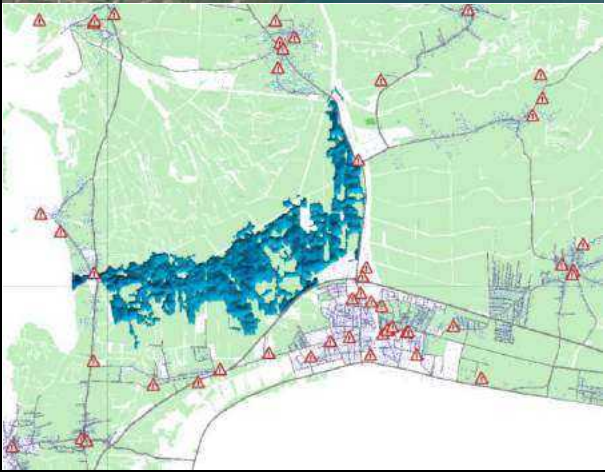
Risk area		Country:	Macedonia	MK - 9
		Location:	Municipality of Struga, Debarca / North of Lake Ohrid	
<b>River-flood:</b>	Sateska	<b>Location in the Drin – Buna/Bojana River Basin</b>		
<b>River section:</b>	Above Klimeshtani up to Struga/Ohrid Lake			
<b>River km:</b>	to km:			
<b>Cities / villages of risk:</b>	City of Struga, Villages of Mesheishta, Volino, Moroishta, Draslajca, Misleshevo			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2010 – Mar 2010	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 29 houses and 40 ha agriculture land			
2015	River flood from Crni Drim, Sateska several small rivers and canals; flooding of 10 houses and 30 ha agriculture land (55.000 Euro)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	1.500			
Houses	1.257			
Persons	2.619			
Families	1.257			
Companies at risk				
Industry (objects)	3			
Infrastructure (objects)	23 km of road network flooded			
Agriculture [ha] / objects	ca. 1.200 ha			
Protected areas				
Other objects at risk	possible flooding of Ohrid international airport, flooding of schools, churches, monuments			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	1.257	≥ 10	Red	
Settlement area (in ha)	9,3	≥ 0,5	Red	
Industrial objects	3	≥ 1	Red	
Industrial area (in ha)	14,14	≥ 0,5	Red	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	Green	
Locations with dangerous substances	0	≥ 1	Green	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1	Green	
Drinking Water supply areas		≥ 1	Yellow	
Bathing waters		≥ 1	Yellow	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Green	
Other relevant cultural heritage sites	1	≥ 1	Red	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Sateska combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 13,2 mil euro, where the majority of the direct costs belongs to residential infrastructure - app. 76%. Substantial number of houses flooded in the municipalities Struga and Debarca – 1.257 (number of residents directly affected from the flood event is 2.619) Min./Max. depths 0,00-4,96 m		



Situation in the potential risk area:




Red Limit exceeded      Yellow No information / uncertain      Green Limit not exceeded

Risk area		Country:	Macedonia	MK - 10	
		Location:	Municipality of Struga / North of Lake Ohrid		
<b>River-Flood / flash-flood:</b>		Shum			
<b>River section:</b>		From Shum village up to Crn Drim			
<b>River km:</b>		to km:			
<b>Cities / villages of risk:</b>		City of Struga, Villages of Shum, Vranishta			
<b>Past events / years, damage:</b>					
<b>Month/Year</b>	<b>Description of damage</b>				
<i>Comments on past events: No detailed data of economic losses from Shum River</i>					
<b>Potential risks / assets in risk area</b>					
Risk area (in ha)	256				
Houses	12				
Persons	17				
Families	12				
Companies at risk					
Industry (objects)	4				
Infrastructure (objects)	0,22 km of road network flooded				
Agriculture [ha] / objects	ca. 240 ha				
Protected areas					
Other objects at risk	possible flooding of landfill areas				
<b>Situation in the potential risk area:</b>					
					
					
<b>Risk assessment / significance of potential risks</b>					
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>					
no. of houses	12	≥ 10			
Settlement area (in ha)	0,91	≥ 0,5			
Industrial objects	4	≥ 1			
Industrial area (in ha)	4,7	≥ 0,5			
Critical agriculture aspects					
<b>B) Environmental risks</b>					
<b>B1) Water polluting substances / sites</b>					
Contaminated sites	1	≥ 1			
Locations with dangerous substances	1	≥ 1			
<b>B2) Protected areas (according to WRRL)</b>					
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1			
Drinking Water supply areas		≥ 1			
Bathing waters		≥ 1			
<b>C) Risk for cultural heritage sites</b>					
UNESCO heritage sites		≥ 1			
Other relevant cultural heritage sites	1	≥ 1			
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>			
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Shum combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 0,33 mil euro. Almost equal damage distribution between residential, road, industry and agriculture infrastructure. Min./Max. depths 0,00-2,48 m			

 Limit exceeded


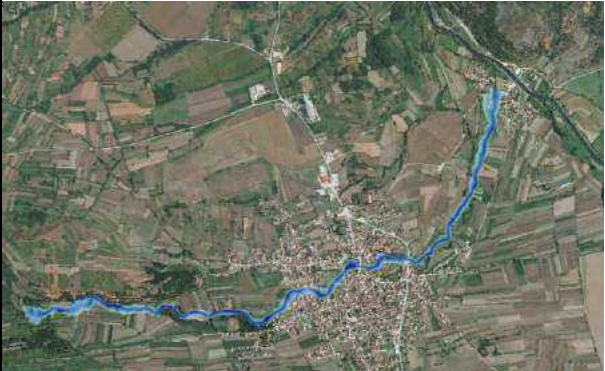

 No information / uncertain

 Limit not exceeded



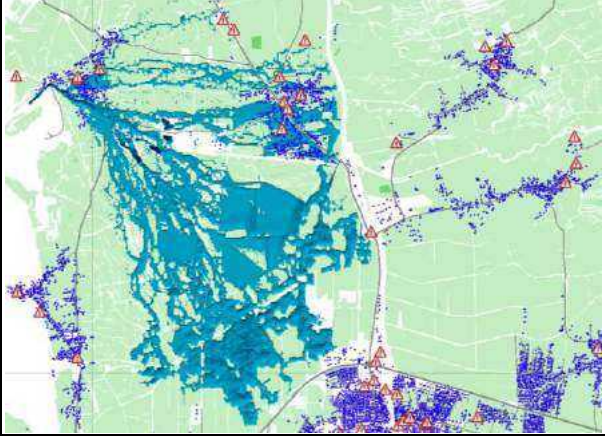


Risk area		Country:	Macedonia	MK - 11	
		Location:	Municipality of Struga / North of Lake Ohrid		
<b>River-Flood / flash-flood:</b>		Sushica			
<b>River section:</b>		Above D.Tateshi village up to Crn Drim			
<b>River km:</b>		to km:			
<b>Cities / villages of risk:</b>					
<b>Past events / years, damage:</b>					
<b>Month/Year</b>	<b>Description of damage</b>				
<i>Comments on past events: No detailed data of economic losses from Shum River</i>					
<b>Potential risks / assets in risk area</b>					
Risk area (in ha)	170				
Houses	1				
Persons	2				
Families	1				
Companies at risk					
Industry (objects)					
Infrastructure (objects)	0,17 km of road network flooded				
Agriculture [ha] / objects	ca. 168 ha				
Protected areas					
Other objects at risk					
<b>Situation in the potential risk area:</b>					
<b>Risk assessment / significance of potential risks</b>					
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>					
no. of houses	1	≥ 10			
Settlement area (in ha)	0,2	≥ 0,5			
Industrial objects	0	≥ 1			
Industrial area (in ha)	0	≥ 0,5			
Critical agriculture aspects					
<b>B) Environmental risks</b>					
<b>B1) Water polluting substances / sites</b>					
Contaminated sites	0	≥ 1			
Locations with dangerous substances	0	≥ 1			
<b>B2) Protected areas (according to WRRL)</b>					
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1			
Drinking Water supply areas		≥ 1			
Bathing waters		≥ 1			
<b>C) Risk for cultural heritage sites</b>					
UNESCO heritage sites		≥ 1			
Other relevant cultural heritage sites	1	≥ 1			
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>			
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Sushica combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 0,12 mil euro. Low overall direct flood damage cost - agriculture damage app 50%. No industry infrastructure flooded. Min./Max. depths 0,00-3,95 m			

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country: Macedonia	MK - 12
Location: Municipality of Vevchani, Struga / North of Lake Ohrid			
<b>River-Flood / flash-flood:</b>	Vevchanska	<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	between Vevcani and Oktisi up to Crn Drim		
<b>River km:</b>	to km:		
<b>Cities / villages of risk:</b>	Village of Veleshta, Dobovjani		
<b>Past events / years, damage:</b>			
<b>Month/Year</b>	<b>Description of damage</b>		
<i>Comments on past events: No detailed data of economic losses from Shum River</i>			
<b>Potential risks / assets in risk area</b>			
Risk area (in ha)	21		
Houses	44		
Persons	144		
Families	44		
Companies at risk			
Industry (objects)			
Infrastructure (objects)	0,17 km of road network flooded		
Agriculture [ha] / objects	ca.11 ha		
Protected areas			
Other objects at risk			
<b>Risk assessment / significance of potential risks</b>		<b>Situation in the potential risk area:</b>	
<i>Significance criteria</i>		 	
<b>A) Human health, economic values</b>	<i>value limit</i>		
no. of houses	44 ≥ 10		
Settlement area (in ha)	4,53 ≥ 0,5		
Industrial objects	0 ≥ 1		
Industrial area (in ha)	0 ≥ 0,5		
Critical agriculture aspects			
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites	0 ≥ 1		
Locations with dangerous substances	0 ≥ 1		
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)	0 ≥ 1		
Drinking Water supply areas	0 ≥ 1		
Bathing waters	≥ 1		
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites	≥ 1		
Other relevant cultural heritage sites	≥ 1		
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>	
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Vevchanska combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 0,8 mil euro. 95% of the direct flood damages are to residential infrastructure. Min./Max. depths 0,00-2,49 m	



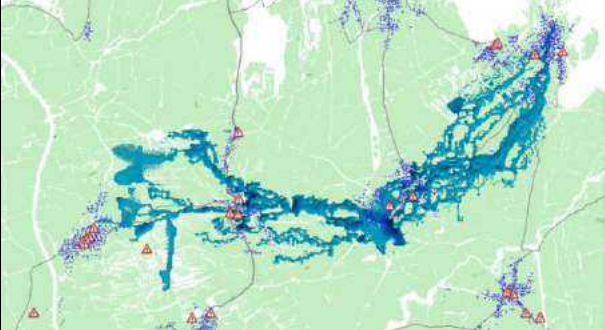
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Macedonia	MK - 13	
		Location:	Municipality of Struga / North of Lake Ohrid		
<b>River-Flood / flash-flood:</b>		Belichka			
<b>River section:</b>					
<b>River km:</b>		to km:			
<b>Cities / villages of risk:</b>		Village of Dolna Belica, Vranishta			
<b>Past events / years, damage:</b>					
<b>Month/Year</b>	<b>Description of damage</b>				
<i>Comments on past events: No detailed data of economic losses from Shum River</i>					
<b>Potential risks / assets in risk area</b>					
Risk area (in ha)	576				
Houses	309				
Persons	941				
Families	309				
Companies at risk					
Industry (objects)	5				
Infrastructure (objects)	4,0 km of road network flooded				
Agriculture [ha] / objects	ca. 525 ha				
Protected areas					
Other objects at risk					
<b>Situation in the potential risk area:</b>					
					
					
<b>Risk assessment / significance of potential risks</b>					
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>			
<b>A) Human health, economic values</b>					
no. of houses	309	≥ 10	Limit exceeded		
Settlement area (in ha)	29,7	≥ 0,5	Limit exceeded		
Industrial objects	5	≥ 1	Limit exceeded		
Industrial area (in ha)	0,5	≥ 0,5	Limit exceeded		
Critical agriculture aspects					
<b>B) Environmental risks</b>					
<b>B1) Water polluting substances / sites</b>					
Contaminated sites	0	≥ 1	Limit not exceeded		
Locations with dangerous substances	0	≥ 1	Limit not exceeded		
<b>B2) Protected areas (according to WRRL)</b>					
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1	Limit not exceeded		
Drinking Water supply areas	0	≥ 1	Limit not exceeded		
Bathing waters		≥ 1	Limit not exceeded		
<b>C) Risk for cultural heritage sites</b>					
UNESCO heritage sites	1	≥ 1	Limit exceeded		
Other relevant cultural heritage sites		≥ 1	Limit not exceeded		
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>			
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Belichka combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 0,66 mil euro, where the majority of the direct costs belongs to residential infrastructure - app. 50%. Large agricultural area flooded with estimated damages of 0,15 mil euro. Min./Max. depths 0,00-3,96 m			

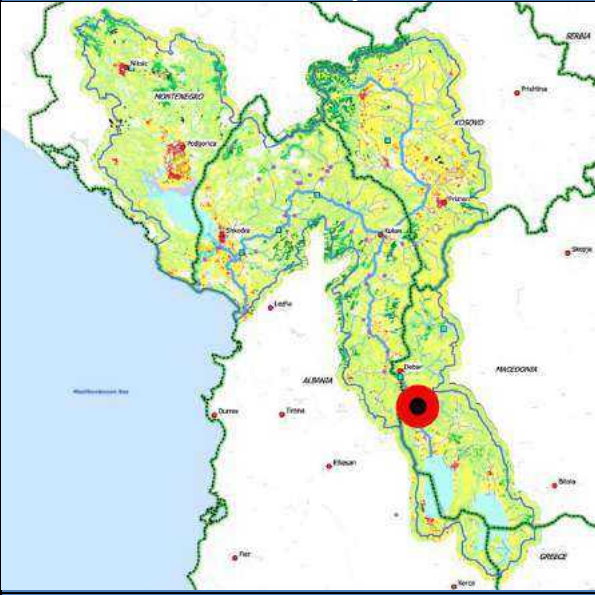

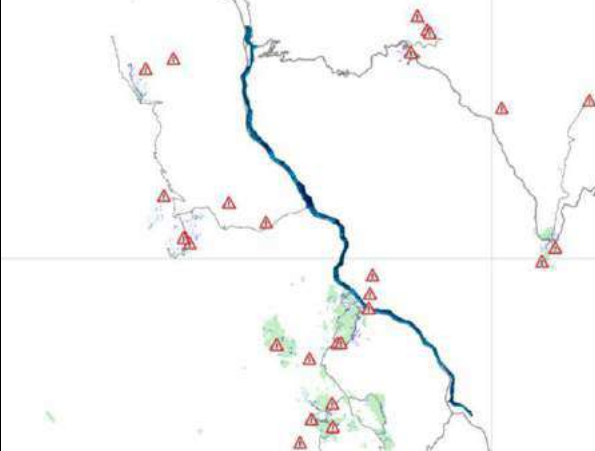
■ Limit exceeded

■ No information / uncertain

■ Limit not exceeded

Risk area		Country: Macedonia	MK - 14
		Location: Municipality of Struga / North of Lake Ohrid	
<b>River-Flood / flash-flood:</b>	Dzepinska	<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	From village of Koroshishta up to village of Lozahni		
<b>River km:</b>	to km:		
<b>Cities / villages of risk:</b>	Village of Koroshishta, Dzepin, Livada, Bidzovo, Novo Selo, Lozahni		
<b>Past events / years, damage:</b>			
<b>Month/Year</b>	<b>Description of damage</b>		
<i>Comments on past events: No detailed data of economic losses from Shum River</i>			
<b>Potential risks / assets in risk area</b>			
Risk area (in ha)	316		
Houses	536		
Persons	1.633		
Families	536		
Companies at risk			
Industry (objects)			
Infrastructure (objects)	2,9 km of road network flooded		
Agriculture [ha] / objects	ca. 200 ha		
Protected areas			
Other objects at risk	Possible flooding of schools		
		<b>Situation in the potential risk area:</b>	
			
			
<b>Risk assessment / significance of potential risks</b>			
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>			
no. of houses	536	≥ 10	Red
Settlement area (in ha)	6,5	≥ 0,5	Red
Industrial objects	0	≥ 1	Green
Industrial area (in ha)	0	≥ 0,5	Green
Critical agriculture aspects			Yellow
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites	0	≥ 1	Green
Locations with dangerous substances	0	≥ 1	Green
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1	Green
Drinking Water supply areas	0	≥ 1	Yellow
Bathing waters		≥ 1	Yellow
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites	1	≥ 1	Red
Other relevant cultural heritage sites	0	≥ 1	Green
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>	
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Dzepinska combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 2,0 mil euro, where the majority of the direct costs belongs to residential infrastructure - app. 89%. Min./Max. depths 0,00-0,12 m	

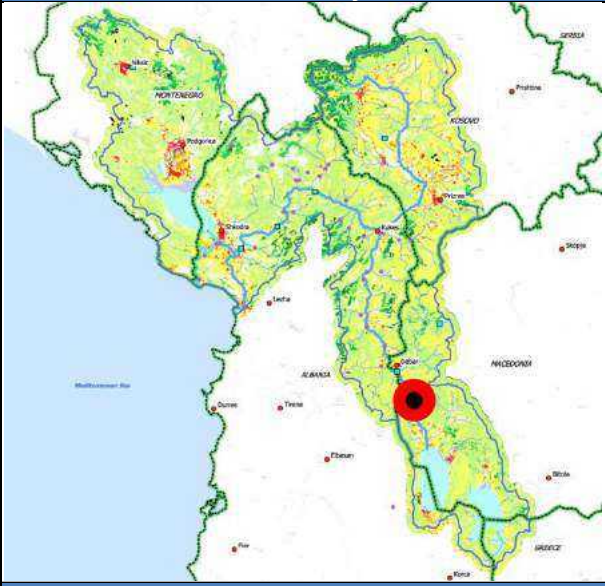
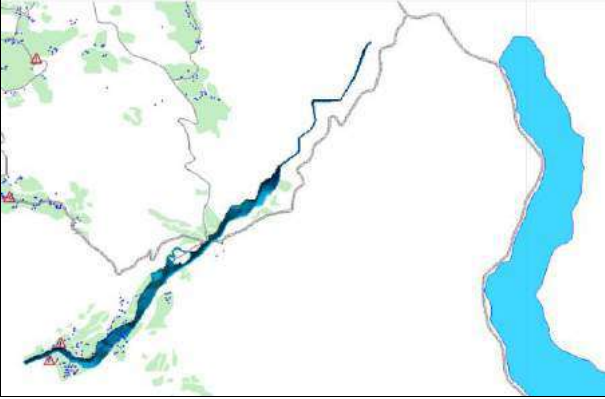
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Macedonia	MK - 15
		Location:	Municipality of Struga / North of Globochica reservoir	
<b>River-Flood / flash-flood:</b>	Black Drin (between Globochica and Shpile reservoirs)		<b>Location in the Drin – Buna/Bojana River Basin</b>	
				
<b>River section:</b>	From Globochica dam up to Shpilje reservoir			
<b>River km:</b>	<b>to km:</b>			
<b>Cities / villages of risk:</b>				
Village of Koroishta, Dzepin, Livada, Bidzovo, Novo Selo, Lozahni				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
2010	River flood from Radika and Crni Drim (no reported affected infrastructure)			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	63			
Houses	9			
Persons	15			
Families	9			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	4,4 km of road network flooded			
Agriculture [ha] / objects	ca. 2 ha			
Protected areas				
Other objects at risk	possible flooding of HPP Globochica, post office			
<b>Situation in the potential risk area:</b>				
				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses		9	≥ 10	
Settlement area (in ha)			≥ 0,5	
Industrial objects		0	≥ 1	
Industrial area (in ha)		0	≥ 0,5	
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		0	≥ 1	
Locations with dangerous substances		0	≥ 1	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		0	≥ 1	
Drinking Water supply areas		0	≥ 1	
Bathing waters			≥ 1	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		0	≥ 1	
Other relevant cultural heritage sites			≥ 1	
				
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for Black Drin river between the reservoirs Globochica and Shpile, combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 4,8 mil euro, where the majority of the direct costs belongs to road infrastructure - app. 90% Min./Max. depths 0,00-7,30 m		

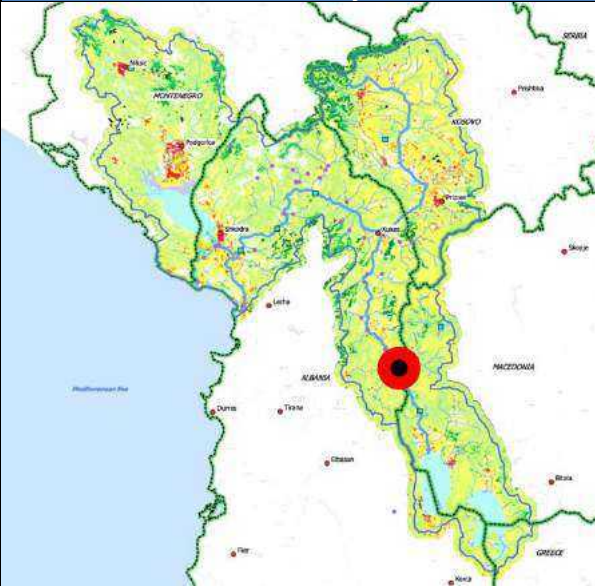

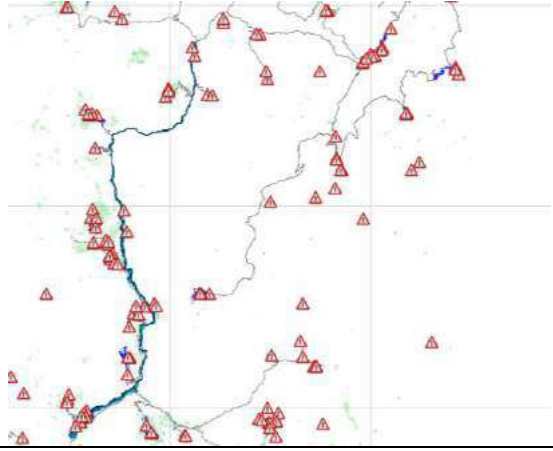
■ Limit exceeded

■ No information / uncertain

■ Limit not exceeded

Risk area		Country:	Macedonia	MK - 16
Location:		Municipality of Struga / West of Globochica reservoir		
<b>River-Flood / flash-flood:</b>	Piskupshtina		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	From village of Piskupshtina up to Globochica reservoir			
<b>River km:</b>	<b>to km:</b>			
<b>Cities / villages of risk:</b>				
Village of Piskupshtina				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
<i>Comments on past events: No detailed data of economic losses from Piskupshtina River</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	12			
Houses	23			
Persons	39			
Families	23			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	1,0 km of road network flooded			
Agriculture [ha] / objects	ca. 9 ha			
Protected areas				
Other objects at risk				
<b>Situation in the potential risk area:</b>				
				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	23	≥ 10		
Settlement area (in ha)	0,5	≥ 0,5		
Industrial objects	0	≥ 1		
Industrial area (in ha)	0	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		
Locations with dangerous substances	0	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1		
Drinking Water supply areas		≥ 1		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites	0	≥ 1		
				
<b>Explanations / comment for the risk assessment</b>				
Based on: hydrological and hydraulic simulation of 500-yr flood event for river Piskupshtina combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		<b>General comments for this potential risk area</b>		
		The preliminary cost estimation for the simulated flood event is app. 0,35 mil euro, with almost equal damage distribution to residential and road infrastructure - 47% and 52% respectively. Min./Max. depths 0,00-4,10 m		

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

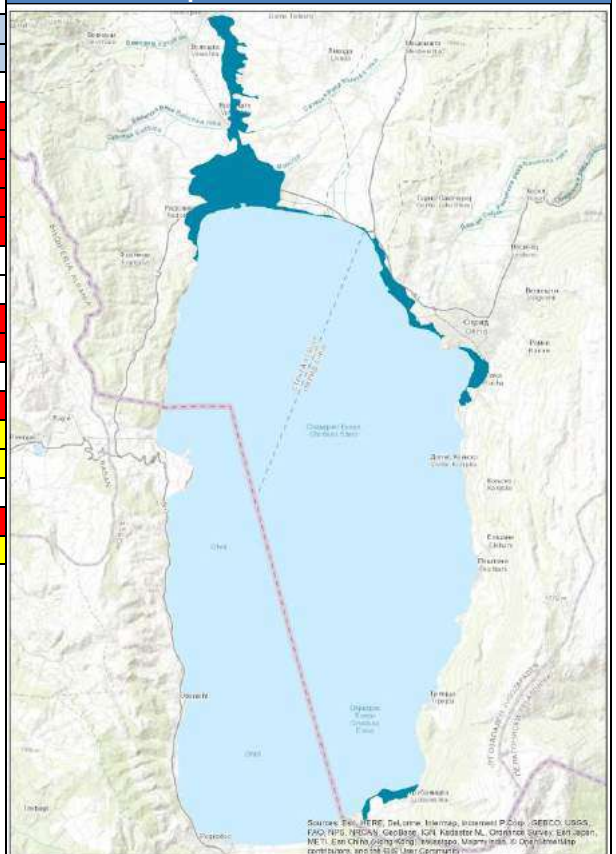
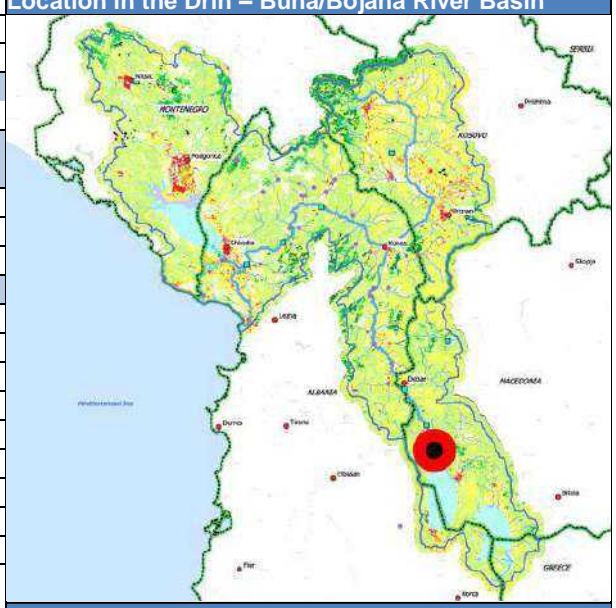
Risk area		Country:	Macedonia	MK - 17
		Location:	Municipality of Debar, Mavrovo and Rostushe / South of Mavrovo reservoir	
<b>River-Flood / flash-flood:</b>		Radika		
<b>River section:</b>		From Mavrovo dam up to Shpilje reservoir		
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		Village of Dolno Kosovrasti		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>		<b>Description of damage</b>		
2010	River flood from Radika and Crni Drim (no reported affected infrastructure)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	192			
Houses	5			
Persons	18			
Families	5			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	4,4 km of road network flooded			
Agriculture [ha] / objects	ca. 65 ha			
Protected areas	138 ha			
Other objects at risk				
<b>Situation in the potential risk area:</b>				
				
				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	5	≥ 10		
Settlement area (in ha)		≥ 0,5		
Industrial objects	0	≥ 1		
Industrial area (in ha)	0	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		
Locations with dangerous substances	0	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1		
Drinking Water supply areas	0	≥ 1		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites		≥ 1		
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Based on: hydrological and hydraulic simulation of 500-yr flood event for Radika river with its main tributaries combined with Preliminary economic flood impact assessment modelling. Maximum flood extents mapping and preliminary exposure and vulnerability analysis.		The preliminary cost estimation for the simulated flood event is app. 4,5 mil euro, where the majority of the direct costs belongs to road infrastructure - app. 90%. Min./Max. depths 0,00-6,51 m		

■ Limit exceeded



■ No information / uncertain

■ Limit not exceeded

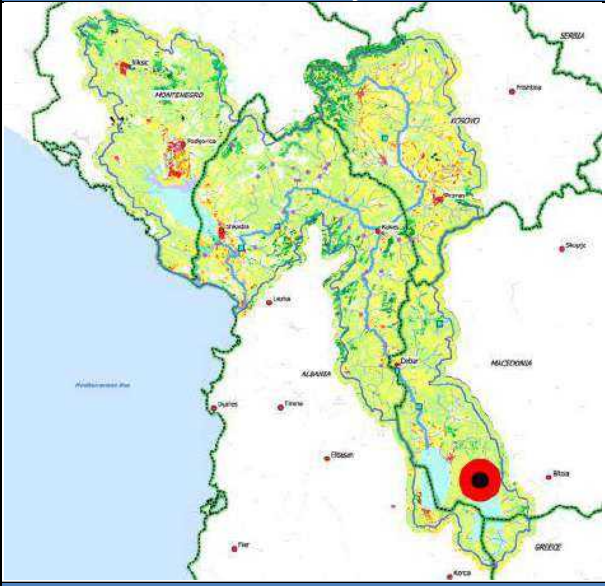
Risk area		Country:	Macedonia	MK - 18
		Location:	Ohrid Lake	
<b>Groundwater Flooding</b>	Ohrid Lake		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>				
<b>River km:</b>		<b>to km:</b>		
<b>Cities / villages of risk:</b>				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	1.925			
Houses	1.944			
Persons	10.543			
Families	1.944			
Companies at risk				
Industry (objects)	52			
Infrastructure (objects)	59 km of road network flooded			
Agriculture [ha] / objects	ca. 1.400 ha			
Protected areas	179 ha			
Other objects at risk	potential flooding of WWTP Vranishta			
<b>Situation in the potential risk area:</b>				
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	1.944	≥ 10		
Settlement area (in ha)	265	≥ 0,5		
Industrial objects	52	≥ 1		
Industrial area (in ha)	51,5	≥ 0,5		
Critical agriculture aspects	xx			
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	1	≥ 1		
Locations with dangerous substances	1	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1		
Drinking Water supply areas		≥ 1		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	1	≥ 1		
Other relevant cultural heritage sites		≥ 1		
<b>Explanations / comment for the risk assessment</b>			<b>General comments for this potential risk area</b>	
Analysis of potential groundwater flooding in the Ohrid region				





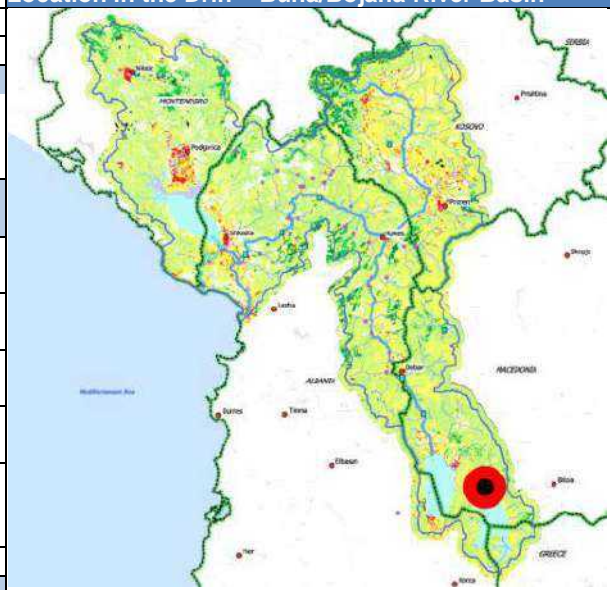
Risk area		Country: Macedonia	MK - 19
Location: Ohrid Lake		Ohrid Lake	
<b>Lake-Flood:</b>	Ohrid Lake	<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	Ohrid Lake Shoreline		
<b>River km:</b>	to km:		
<b>Cities / villages of risk:</b>			
<b>Past events / years, damage:</b>			
<b>Month/Year</b>	<b>Description of damage</b>		
Feb 2010 – Mar 2010	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 648 houses and 334 ha agriculture land (960.000 Euro)		
Feb 2012	River flood from Koselska, Vapilica, Susica Rivers and Ohrid lake; flooding of 143 houses and 29 ha agriculture land (1.010.000 Euro)		
<b>Comments on past events:</b>		<b>Situation in the potential risk area:</b>	
<b>Potential risks / assets in risk area</b>			
Risk area (in ha)	636		
Houses	610		
Persons	3.423		
Families	610		
Companies at risk			
Industry (objects)			
Infrastructure (objects)	25,5 km of road network flooded		
Agriculture [ha] / objects	ca. 400 ha		
Protected areas	180 ha		
Other objects at risk			
<b>Risk assessment / significance of potential risks</b>			
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>			
no. of houses	610	≥ 10	Limit exceeded
Settlement area (in ha)	109	≥ 0,5	Limit exceeded
Industrial objects	0	≥ 1	Limit not exceeded
Industrial area (in ha)	0	≥ 0,5	Limit not exceeded
Critical agriculture aspects			No information / uncertain
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites	0	≥ 1	Limit not exceeded
Locations with dangerous substances	0	≥ 1	Limit not exceeded
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Limit exceeded
Drinking Water supply areas	0	≥ 1	Limit not exceeded
Bathing waters		≥ 1	No information / uncertain
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites	1	≥ 1	Limit exceeded
Other relevant cultural heritage sites		≥ 1	Limit exceeded
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>	
Analysis of potential surface flooding from Ohrid Lake due to rise of the water level (projected lake elevation 694,50 m.a.s.l.)			

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

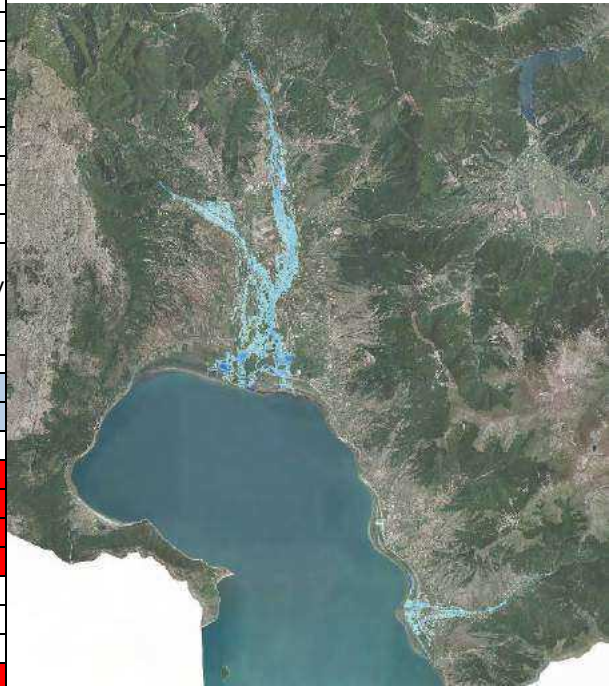
Risk area		Country:	Macedonia	MK - 20
		Location:	Prespa Lake	
<b>Lake-Flood:</b>	Prespa Lake		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	Prespa Lake Shoreline			
<b>River km:</b>	to km:			
<b>Cities / villages of risk:</b>				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	2.148			
Houses	29			
Persons	40			
Families	29			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	8,4 km of road network flooded			
Agriculture [ha] / objects	ca. 770 ha			
Protected areas	1.827 ha			
Other objects at risk				
			<b>Situation in the potential risk area:</b>	
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	29	≥ 10		
Settlement area (in ha)		≥ 0,5		
Industrial objects	0	≥ 1		
Industrial area (in ha)	0	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		
Locations with dangerous substances	0	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1		
Drinking Water supply areas	0	≥ 1		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites		≥ 1		
<b>Explanations / comment for the risk assessment</b>			<b>General comments for this potential risk area</b>	
Analysis of potential surface flooding from Prespa Lake due to rise of the water level (projected lake elevation 851,50 m.a.s.l.)				

Limit exceeded
  No information / uncertain
  Limit not exceeded

Risk area		Country: Macedonia	MK - 21
		Location: Municipality of Resen	
<b>River-Flood:</b>	Brajchinska ,Golema, Istochka		<b>Location in the Drin – Buna/Bojana River Basin</b>
<b>River section:</b>			
<b>River km:</b>	<b>to km:</b>		
<b>Cities / villages of risk:</b>	City of Resen, Villages of Izbishta, Gorna Bela Crkva, Ezerani, Brajchino, Ljubojno, Nakolec, Carev Dvor, Drmeni, Ezerani, Izbishta		
<b>Past events / years, damage:</b>			
<b>Month/Year</b>	<b>Description of damage</b>		
Dec 2009	River flood from Golema River; flooding of 5 houses and 300 ha agriculture land (5.000 Euro)		
2010	River flood from Golema River; flooding of 2 houses and 20 ha agriculture land (1.000 Euro)		
2011	River flood from Golema River; flooding of 10 houses and 100 ha agriculture land (2.000 Euro)		
Feb 2013	River flood from Golema River; flooding of 2 houses and 10 ha agriculture land (500 Euro)		
2015	River flood from Golema and Istocka Rivers; flooding of 13 houses and 500 ha agriculture land (20.000 Euro)		
<i>Comments on past events:</i>			
<b>Potential risks / assets in risk area</b>			
Risk area (in ha)	2.033		
Houses	524		
Persons	1.421		
Families	524		
Companies at risk			
Industry (objects)	34		
Infrastructure (objects)	16 km of road network flooded		
Agriculture [ha] / objects			
Protected areas	600 ha		
Other objects at risk	possible flooding of WWTP Ezerani, group of drilled wells for water supply of Resen, possible flooding of churches, mosques, petrol station		
<b>Risk assessment / significance of potential risks</b>			
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>			
no. of houses	2.033	≥ 10	Limit exceeded
Settlement area (in ha)	29	≥ 0,5	Limit exceeded
Industrial objects	34	≥ 1	Limit exceeded
Industrial area (in ha)	10	≥ 0,5	Limit exceeded
Critical agriculture aspects			
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites	1	≥ 1	Limit exceeded
Locations with dangerous substances	1	≥ 1	Limit exceeded
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)	600	≥ 1	Limit exceeded
Drinking Water supply areas		≥ 1	No information / uncertain
Bathing waters		≥ 1	No information / uncertain
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites	0	≥ 1	Limit not exceeded
Other relevant cultural heritage sites		≥ 1	No information / uncertain

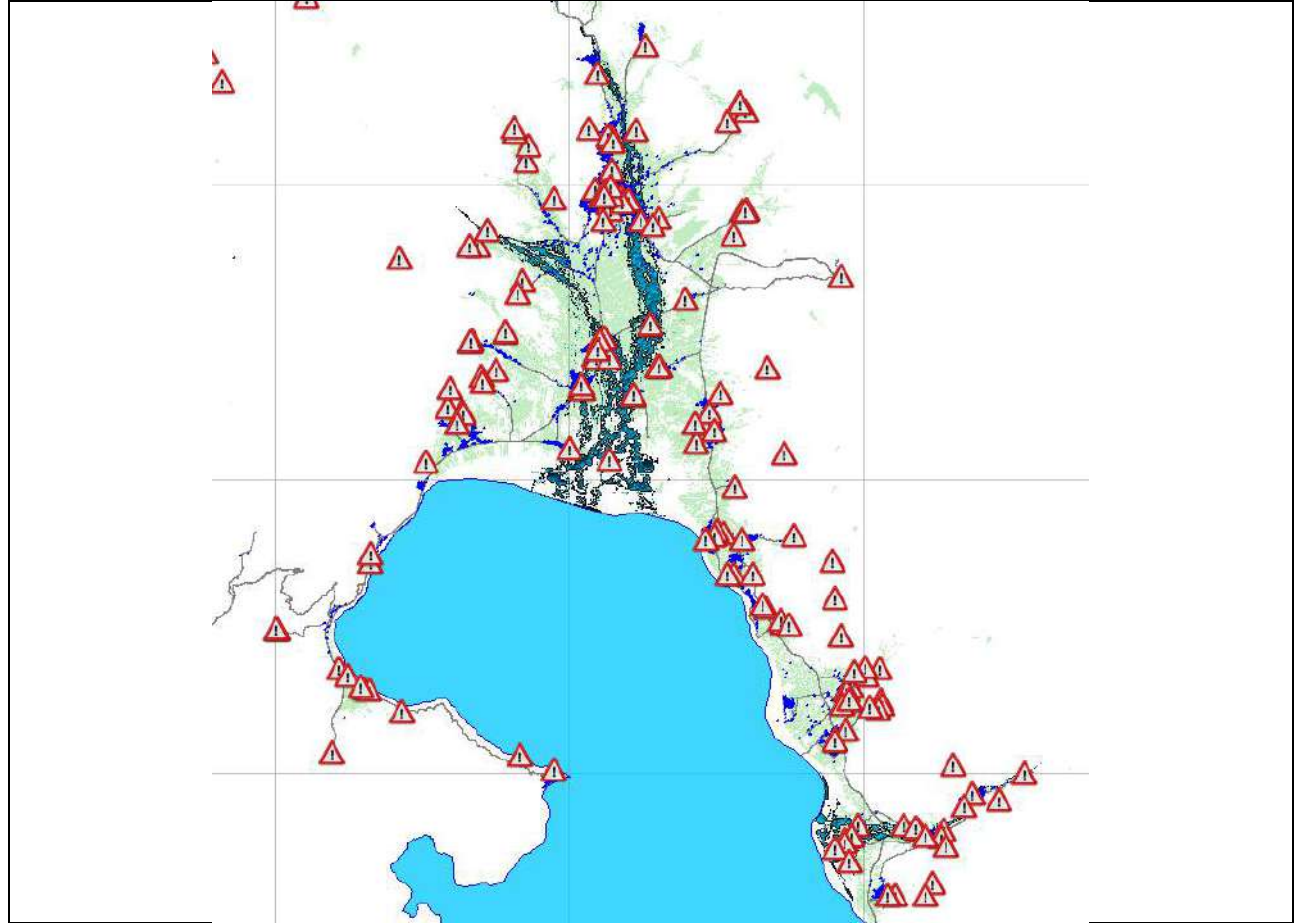


**Situation in the potential risk area:**



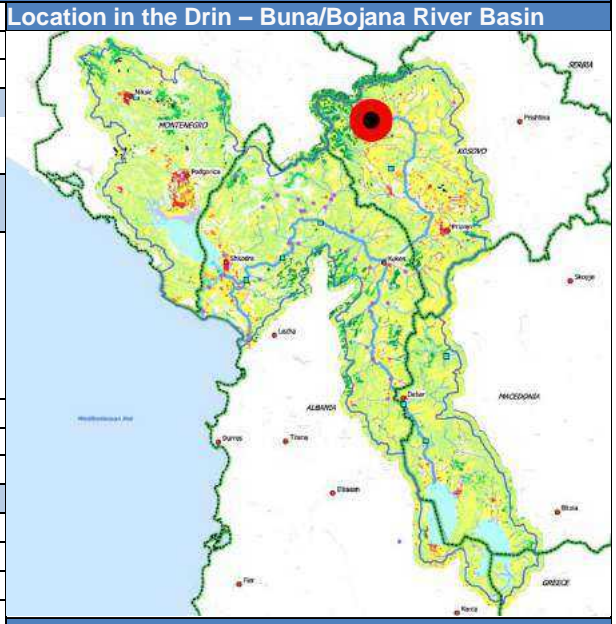
Explanations / comment for the risk assessment	General comments for this potential risk area
<p>Summary output from the hydrological and hydraulic modelling of flood affected areas in Drin river basin. Flood inundation mapping and preliminary economic flood impact assessment.</p>	<p>The preliminary analysis showed that residential and road infrastructure are most vulnerable to potential flood event - app. 45% and 32% of the total flood damages respectively. The damages to industry infrastructure are estimated at 1,1 M euro - app. 16% of the total flood damages. App. 1.400 ha of agriculture land is at risk of flooding from a potential flood event with low probability of occurrence.</p>

**Additional maps to picture the situation**

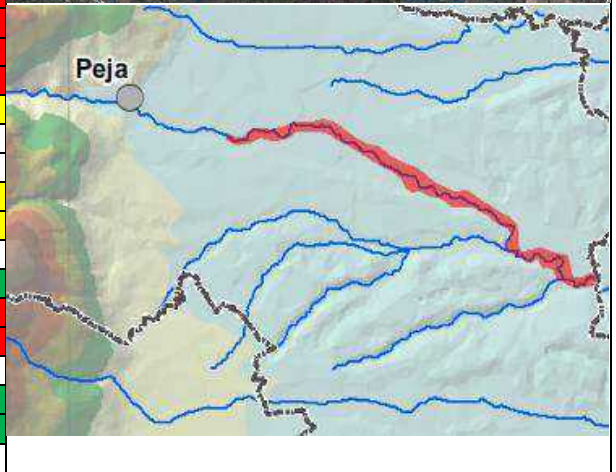


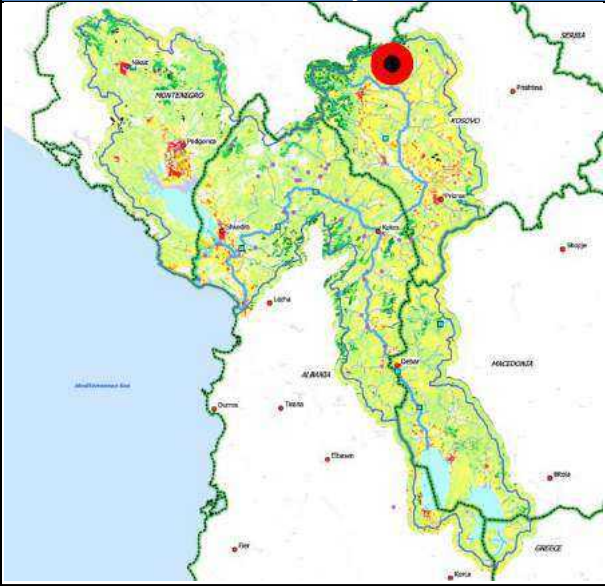
Limit exceeded
  No information / uncertain
  Limit not exceeded

Risk area		Country:	Kosovo	KO - 1
		Location:	Peja	
<b>Flash-floods &amp; river floods:</b>		Lumbardhi i Pejes		<b>Location in the Drin – Buna/Bojana River Basin</b>
<b>River section:</b>				
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City of Peja, Villages of Pavlan, Gorazhdec. Vragoc, Babiç, Jabllanicë		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 2007	Flash floods & Floods			
Jan 2010	These floods have affected the above mentioned villages and the Lumbardhi i Pejes River, usually after the melting of the snowfall and the intensity of rainfall, but it is an agricultural area along the river as there are also inert extraction.			
Apr 2014				
May 2016				
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	1.900 ha			
Houses	70			
Persons	450			
Families	70			
Companies at risk	23			
Industry (objects)	1			
Infrastructure (objects)	2 (Bridge and Road)			
Agriculture [ha] / objects	ca. 1.000 ha			
Protected areas				
Other objects at risk	Housing area, public services including school, business buildings			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses		70	≥ 10	Red
Settlement area (in ha)		80	≥ 0,5	Red
Industrial objects		1	≥ 1	Red
Industrial area (in ha)		0,5	≥ 0,5	Red
Critical agriculture aspects				Yellow
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites			≥ 1	Yellow
Locations with dangerous substances			≥ 1	Yellow
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)			≥ 1	Green
Drinking Water supply areas		2	≥ 1	Red
Bathing waters		1	≥ 1	Red
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites			≥ 1	Green
Other relevant cultural heritage sites			≥ 1	Green
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		

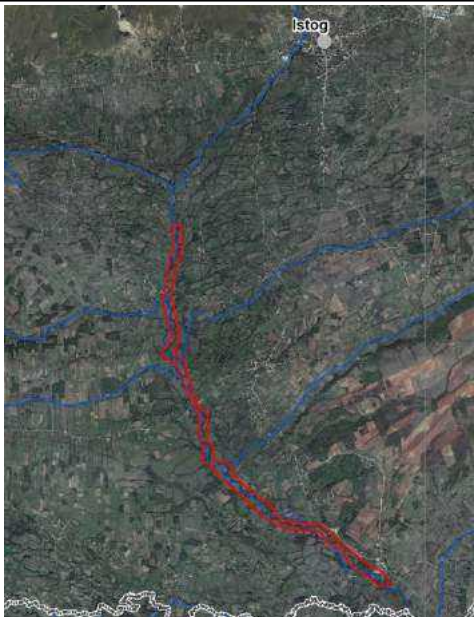


Situation in the potential risk area:



Risk area		Country: Kosovo	KO - 2
Location: Istog			
<b>Flash-floods:</b>	Lumi i Istogut	<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>	Istog		
<b>River km:</b>	to km:		
<b>Cities / villages of risk:</b>	Village of Istog, Lluge, Gurakoc, Zallçë		
<b>Past events / years, damage:</b>			
<b>Month/Year</b>	<b>Description of damage</b>		
Nov 2007	Flash floods		
Jan 2010	Most of these floods affected the above mentioned villages and the Istog / Istog River, usually after the melting of the snowfall and the intensity of rainfall, but it is an agricultural area		
Apr 2014			
May 2016			
<i>Comments on past events:</i>			
<b>Potential risks / assets in risk area</b>			
Risk area (in ha)	950 ha		
Houses	35		
Persons	200		
Families	35		
Companies at risk	9		
Industry (objects)	1		
Infrastructure (objects)	1 (Bridge)		
Agriculture [ha] / objects	ca. 760 ha		
Protected areas			
Other objects at risk	Housing area, agricultural land		
<b>Risk assessment / significance of potential risks</b>			
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>			
no. of houses	35	≥ 10	Red
Settlement area (in ha)	145	≥ 0,5	Red
Industrial objects	1	≥ 1	Yellow
Industrial area (in ha)		≥ 0,5	Yellow
Critical agriculture aspects			Yellow
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites		≥ 1	Yellow
Locations with dangerous substances		≥ 1	Yellow
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)		≥ 1	Green
Drinking Water supply areas		≥ 1	Green
Bathing waters		≥ 1	Green
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites		≥ 1	Green
Other relevant cultural heritage sites		≥ 1	Green
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>	

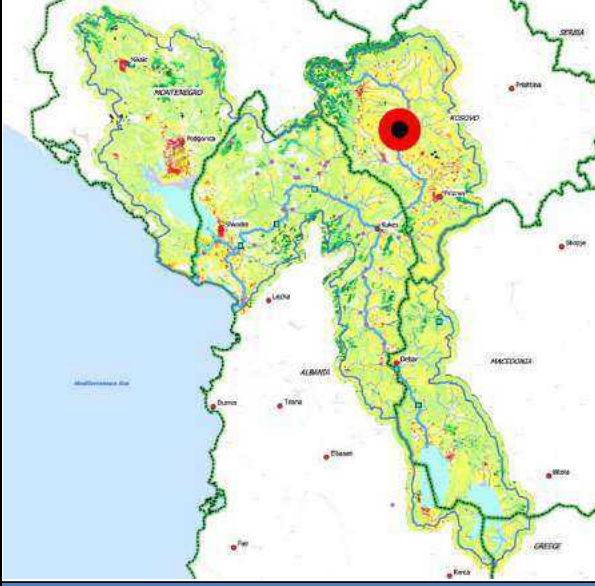
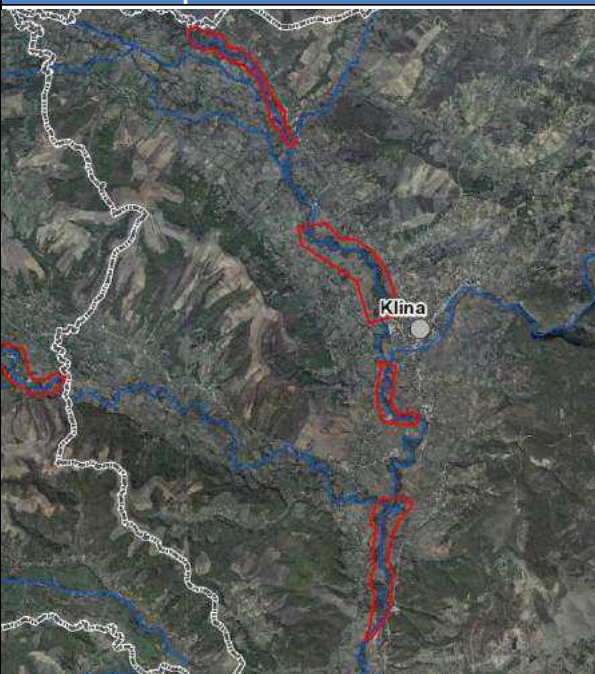
**Situation in the potential risk area:**



■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Kosovo	KO - 3
		Location:	Skenderaj	
<b>Flash-floods &amp; river floods:</b>		Klina		
<b>River section:</b>				
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City of Skenderaj, Villages of Kline, Llaushe, Toshile, Aqareve, Runik, Turiqevc		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Mar 2004	Flash floods & Floods			
Feb 2006	These floods have affected the above mentioned			
Nov 2007	villages and the Klina River, usually after melting			
Jan 2010	the rainfall and the intensity of the rain, but is an			
Apr 2014	agricultural area along the river and a part of the			
May 2016	Skenderaj town in the outskirts.			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	96			
Houses	550			
Persons	3.300			
Families	550			
Companies at risk	25			
Industry (objects)	1			
Infrastructure (objects)	5 Bridge and Road			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, agricultural land and WWTP – Skenderaj.			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	550	≥ 10	Red	
Settlement area (in ha)	96	≥ 0,5	Red	
Industrial objects	2	≥ 1	Red	
Industrial area (in ha)	1	≥ 0,5	Red	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1	Yellow	
Locations with dangerous substances		≥ 1	Yellow	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Red	
Drinking Water supply areas	1	≥ 1	Red	
Bathing waters	1	≥ 1	Red	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Green	
Other relevant cultural heritage sites		≥ 1	Green	
<b>Explanations / comment for the risk assessment</b>				<b>General comments for this potential risk area</b>

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded




Risk area		Country:	Kosovo	KO - 4
Location:		Klina		
<b>Flash-floods &amp; river floods:</b>		Drini i Bardh		
<b>River section:</b>				
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City of Klina, Villages of Kpuzë, Dellovë, Zajmë, Videj, Deič, Krusheve e Vogel, Zllakuqan, Berkove, Rudicë		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2006	Flash floods & Floods			
Nov 2007	These veins have touched the abovementioned			
Jan 2010	villages and the White Drine River, usually after			
Apr 2014	snow melting and rainfall intensity, but it is an agri-			
May 2016	cultural area along the river.			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	487			
Houses	340			
Persons	2.000			
Families	340			
Companies at risk	37			
Industry (objects)	2			
Infrastructure (objects)	Bridge, Road, Sewage, Water Supply,			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, business buildings, agricultural land, School, Administrative Institution			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	340	≥ 10	Red	
Settlement area (in ha)	487	≥ 0,5	Red	
Industrial objects	2	≥ 1	Red	
Industrial area (in ha)	1	≥ 0,5	Red	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1	Yellow	
Locations with dangerous substances		≥ 1	Yellow	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1	Yellow	
Drinking Water supply areas		≥ 1	Yellow	
Bathing waters		≥ 1	Yellow	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Yellow	
Other relevant cultural heritage sites		≥ 1	Yellow	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Floods in this area cause big problem to the drinking water factory.				

Red Limit exceeded

Yellow No information / uncertain

Green Limit not exceeded

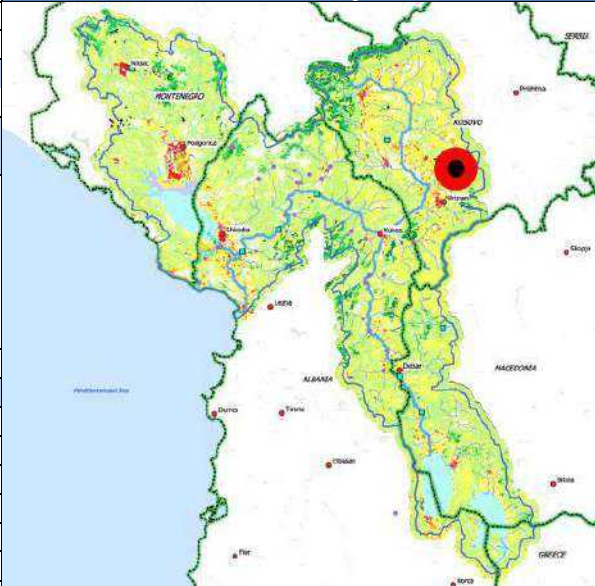



Risk area		Country:	Kosovo	KO - 5
		Location:	Deçan	
<b>Flash-floods:</b>	Bistrica Deçan		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>				
<b>River km:</b>				
<b>Cities / villages of risk:</b>	City of Deçan, Villages of Dubocik, Strelc I Ulët, Lebush, Irznig			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 2007	Flash floods			
Jan 2010	These floods have affected the above mentioned villages of Deçani and Lumbardhi River, usually after the melting of the snowfall and the intensity of the rainfall, but it is an agricultural area along the river and this part of the river is narrowed by the existing bed.			
Apr 2014				
May 2016				
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	320			
Houses	15			
Persons	80			
Families	15			
Companies at risk	3			
Industry (objects)				
Infrastructure (objects)	1 (Bridge) Road			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, agricultural land			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	15	≥ 10	Red	
Settlement area (in ha)	320	≥ 0,5	Red	
Industrial objects		≥ 1	Yellow	
Industrial area (in ha)		≥ 0,5	Yellow	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1	Green	
Locations with dangerous substances		≥ 1	Green	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1	Green	
Drinking Water supply areas		≥ 1	Green	
Bathing waters		≥ 1	Green	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Green	
Other relevant cultural heritage sites		≥ 1	Green	
<b>Situation in the potential risk area:</b>				
				
				
				
<b>Explanations / comment for the risk assessment</b>				
<b>General comments for this potential risk area</b>				

■ Limit exceeded

■ No information / uncertain

■ Limit not exceeded

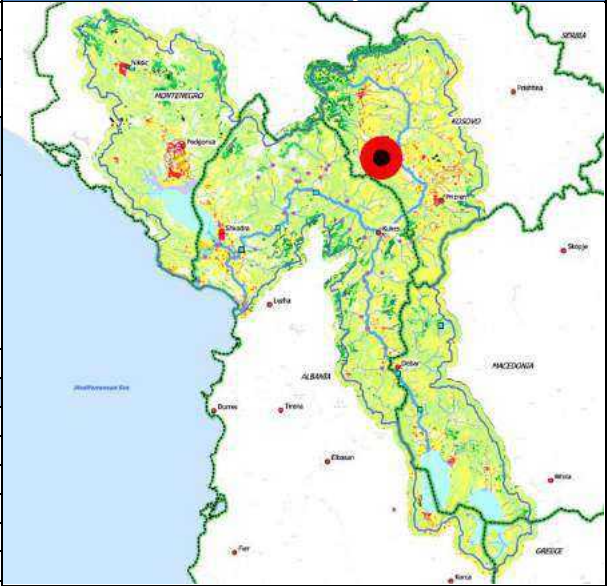
Risk area		Country:	Kosovo	KO - 6
		Location:	Malisheva	
<b>Flash-floods &amp; river floods:</b>		Mirusha	<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>				
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2006	Flash floods & Floods			
Nov 2011	These floods have affected the above mentioned			
Jan 2010	villages and the Mirusha River, usually after melt-			
Apr 2014	ing the rainfall and the intensity of rainfall but is an			
May 2016	agricultural area along the river and a part of Suha-			
Aug 2018	reka.			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	408			
Houses	640			
Persons	3.500			
Families	640			
Companies at risk	35			
Industry (objects)	3			
Infrastructure (objects)	Bridge, Road, Sewage, Water			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, business buildings, agricultural land, School, Administrative Institution.			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	640	≥ 10	Red	
Settlement area (in ha)	408	≥ 0,5	Red	
Industrial objects	3	≥ 1	Red	
Industrial area (in ha)	1	≥ 0,5	Red	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1	Yellow	
Locations with dangerous substances		≥ 1	Yellow	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1	Yellow	
Drinking Water supply areas	2	≥ 1	Yellow	
Bathing waters		≥ 1	Yellow	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Yellow	
Other relevant cultural heritage sites		≥ 1	Yellow	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
The main problem in this region is Dam in Mirushe, it is very damaged and cause big problems, the Dam was build 10 years ago.				
<b>Situation in the potential risk area:</b>				
				

Red Limit exceeded

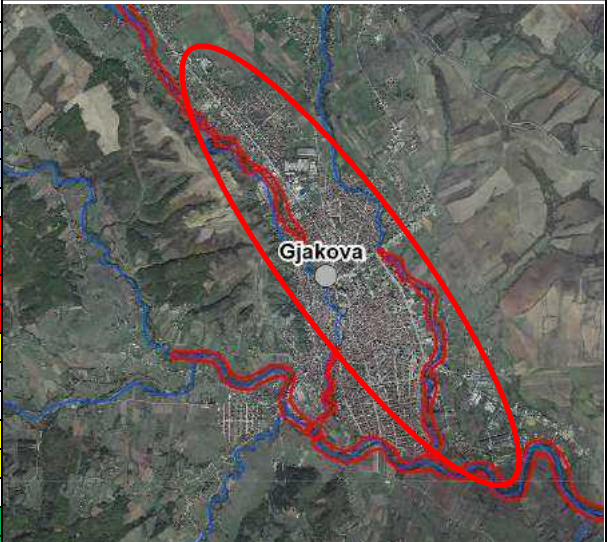
Yellow No information / uncertain

Green Limit not exceeded

Risk area		Country:	Kosovo	KO - 7
		Location:	Gjakova	
<b>Flash-floods &amp; river floods:</b>		Krena		
<b>River section:</b>				
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City of Gjakova, Villages of Skivjan, Osek Hilë, Osek Pashë		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2006	Flash floods & Floods			
Nov 2011	These floods have crossed the above mentioned			
Jan 2010	villages and the town of Gjakova from the Krena			
Apr 2014	river branch, usually after the melting of the snow-			
May 2016	fall and the intensity of rainfall.			
Aug 2018				
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	about 84 ha rural and urban areas,			
Houses	60			
Persons	300			
Families	60			
Companies at risk	13			
Industry (objects)	1			
Infrastructure (objects)	1 (Bridges) Road & Railway			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, agricultural land			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses		60	≥ 10	Limit exceeded
Settlement area (in ha)		20	≥ 0,5	Limit exceeded
Industrial objects		1	≥ 1	Limit exceeded
Industrial area (in ha)		1	≥ 0,5	Limit exceeded
Critical agriculture aspects				No information / uncertain
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites			≥ 1	No information / uncertain
Locations with dangerous substances			≥ 1	No information / uncertain
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)			≥ 1	Limit not exceeded
Drinking Water supply areas			≥ 1	Limit not exceeded
Bathing waters			≥ 1	Limit not exceeded
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites			≥ 1	Limit not exceeded
Other relevant cultural heritage sites			≥ 1	Limit not exceeded
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		



Situation in the potential risk area:



■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Kosovo	KO - 8
		Location:	Gjakova	
<b>Flash-floods &amp; river floods:</b>		Erenik		
<b>River section:</b>				
<b>River km:</b>		to km:		
<b>Cities / villages of risk:</b>		City of Gjakova, Villages of Mejë, Jahoc, Brekoc		
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2006	Flash floods & Floods			
Nov 2011	These floods have crossed the above mentioned			
Jan 2010	villages and the town of Gjakova from the Krena			
Apr 2014	river branch, usually after the melting of the snow-			
May 2016	fall and the intensity of rainfall.			
Aug 2018				
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	about 93 ha rural and urban areas,			
Houses	90			
Persons	450			
Families	90			
Companies at risk	15			
Industry (objects)	1			
Infrastructure (objects)	2(Bridges) Road & Railway			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, agricultural land			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	90	≥ 10	Red	
Settlement area (in ha)	13	≥ 0,5	Red	
Industrial objects	1	≥ 1	Red	
Industrial area (in ha)	1,2	≥ 0,5	Red	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1	Yellow	
Locations with dangerous substances		≥ 1	Yellow	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1	Green	
Drinking Water supply areas		≥ 1	Green	
Bathing waters		≥ 1	Green	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1	Green	
Other relevant cultural heritage sites		≥ 1	Green	
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		



Situation in the potential risk area:

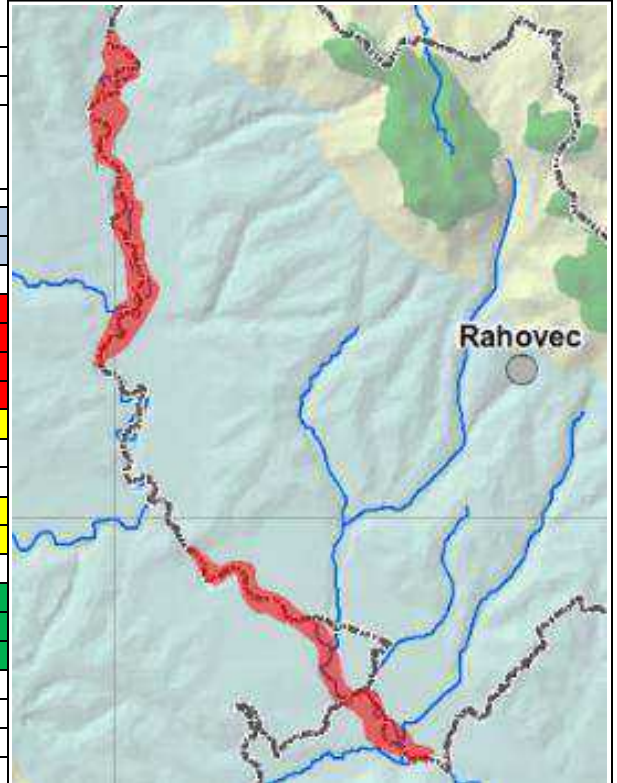


■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Kosovo	KO - 9
		Location:	Rahovec	
<b>Flash-floods &amp; river floods:</b>		Drini i Bardh		<b>Location in the Drin – Buna/Bojana River Basin</b>
<b>River section:</b>				
<b>River km:</b>		<b>to km:</b>		
<b>Cities / villages of risk:</b>				
Xerxa, Rogove, Krusha e Madhe, Kramovik, Qifllak, Dejne, Ratkoc				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2006	Flash floods & Floods			
Nov 2011	These veins have touched the above mentioned villages and the White Drin, usually after the melting of the snowfall and the intensity of rainfall, but it is an agricultural area along the river.			
Jan 2010				
Apr 2014				
May 2016				
Aug 2018				
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	708 ha			
Houses	835			
Persons	4.200			
Families	835			
Companies at risk	68			
Industry (objects)	3			
Infrastructure (objects)	Bridge, Road, Sewage, Water Supply,			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, business buildings, agricultural land, School, Administrative Institution.			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	835	≥ 10		
Settlement area (in ha)	708	≥ 0,5		
Industrial objects	3	≥ 1		
Industrial area (in ha)	1	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1		
Locations with dangerous substances		≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1		
Drinking Water supply areas		≥ 1		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1		
Other relevant cultural heritage sites		≥ 1		
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Floods in this region are caused mainly because of improper use and sand extraction without control from the river Drini I Bardhe.				

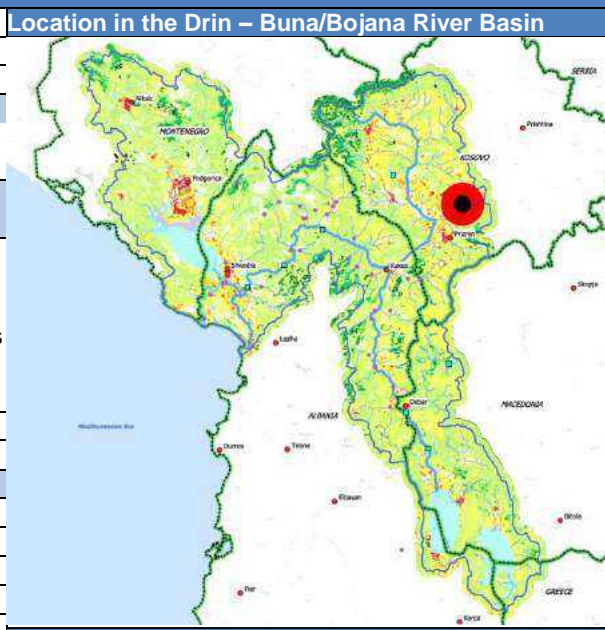


**Situation in the potential risk area:**

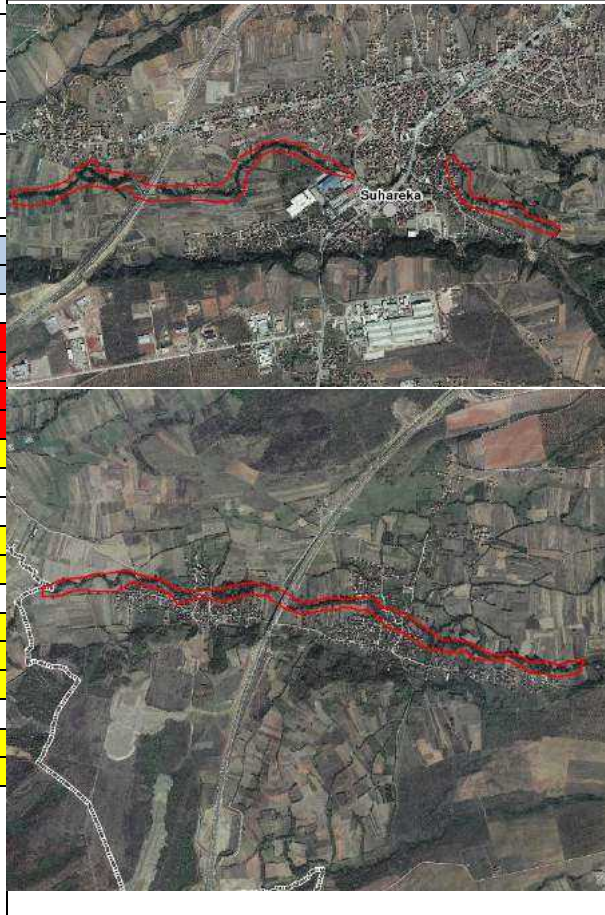




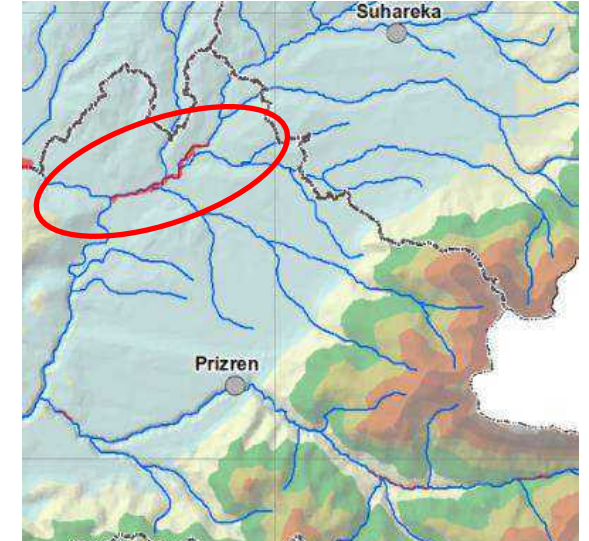
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Kosovo	KO - 10
		Location:	Suhareka	
<b>Flash-floods &amp; river floods:</b>		Toplluha		<b>Location in the Drin – Buna/Bojana River Basin</b>
<b>River section:</b>				
<b>River km:</b>		<b>to km:</b>		
<b>Cities / villages of risk:</b>				
City of Suhareka, Villages of Sopi, Leshan, Ternje, Neperbisht, Savrovë, Grejkoc, Reshtan, Studenčan				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Feb 2006	Flash floods & Floods			
Nov 2011	These veins have touched the above mentioned			
Jan 2010	villages and by the River Toplluha, usually after			
Apr 2014	melting the rainfall and the intensity of rainfall but is			
May 2016	an agricultural area along the river and a part of			
Aug 2018	Suhareka.			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	378			
Houses	1.342			
Persons	7.800			
Families	1.342			
Companies at risk	72			
Industry (objects)	4			
Infrastructure (objects)	3 Bridge, Road, Sewage, Water Supply,			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, business buildings, agricultural land, Schools 6, 3 Administrative Institution			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	1.342	≥ 10		
Settlement area (in ha)	378	≥ 0,5		
Industrial objects	4	≥ 1		
Industrial area (in ha)	2	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1		
Locations with dangerous substances		≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1		
Drinking Water supply areas	1	≥ 1		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1		
Other relevant cultural heritage sites		≥ 1		
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Floods on 08/2018 were the most damaging floods ever in this area, The total damages where evaluation about 2.2 Million Euro				



**Situation in the potential risk area:**



Risk area		Country:	Kosovo	KO - 11
		Location:	Prizren	
<b>River-Flood:</b>	Toplluha	<b>Location in the Drin – Buna/Bojana River Basin</b>		
<b>River section:</b>				
<b>River km:</b>	to km:			
<b>Cities / villages of risk:</b>	Medvec, Zoiz, Piranë			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 2011	Flash floods & Floods			
Jan 2010	These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of the snowfall and the intensity of rainfall but is an agricultural area along the river and this part of the river.			
Apr 2014				
May 2016				
Aug 2018				
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	470			
Houses	30			
Persons	200			
Families	30			
Companies at risk	10			
Industry (objects)	1			
Infrastructure (objects)	3 Bridge Road			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Housing area, agricultural land			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	30	≥ 10		
Settlement area (in ha)	470	≥ 0,5		
Industrial objects	1	≥ 1		
Industrial area (in ha)	0,2	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites		≥ 1		
Locations with dangerous substances		≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)		≥ 1		
Drinking Water supply areas	2	≥ 3		
Bathing waters		≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites		≥ 1		
Other relevant cultural heritage sites		≥ 1		
		<b>Situation in the potential risk area:</b>		
				
				
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		

■ Limit exceeded

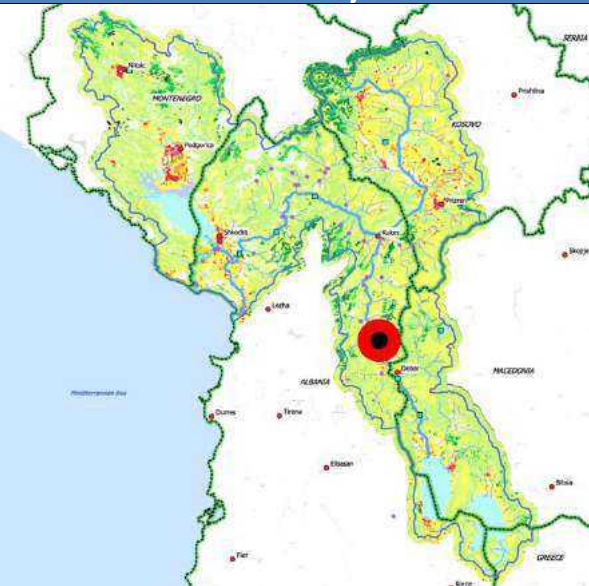
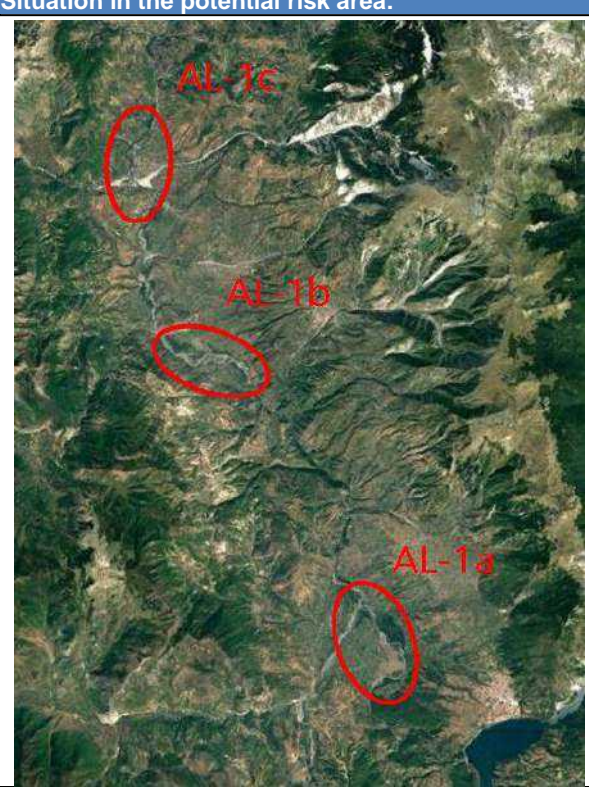
■ No information / uncertain

■ Limit not exceeded


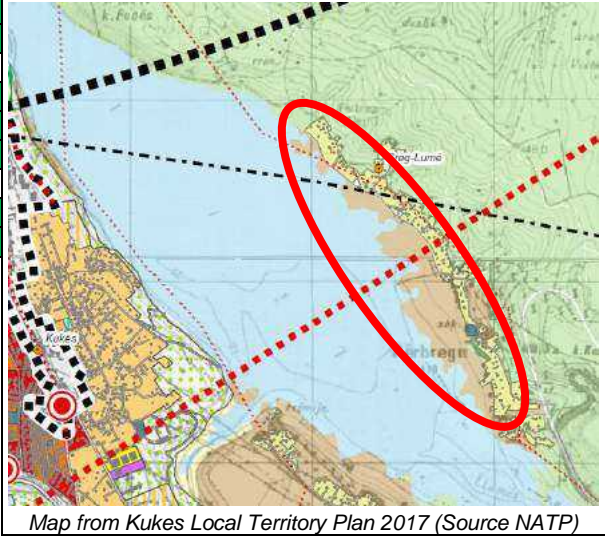
Risk area		Country:	Kosovo	KO - 12			
		Location:	Prizren				
<b>Flash-floods &amp; river floods:</b>			Lumbardhi I Prizrenit	<b>Location in the Drin – Buna/Bojana River Basin</b>			
<b>River section:</b>							
<b>River km:</b>			to km:				
<b>Cities / villages of risk:</b>			Rečanë, Mushnikovë, Gornja Sella, Vlashnje				
<b>Past events / years, damage:</b>							
<b>Month/Year</b>	<b>Description of damage</b>						
Nov 2011	Flash floods & Floods						
Jan 2010	These floods have affected the above mentioned villages and the Lumbardhi River in Prizren, usually after the melting of the rainfall and intensity of rainfall but is an agricultural area along the river and this part of the river is narrowed by the existing bed.						
Apr 2014							
May 2016							
Aug 2018							
<b>Comments on past events:</b>				<b>Situation in the potential risk area:</b>			
<b>Potential risks / assets in risk area</b>							
Risk area (in ha)	200						
Houses	30						
Persons	180						
Families	30						
Companies at risk	10						
Industry (objects)	2						
Infrastructure (objects)	1 Bridge Road						
Agriculture [ha] / objects							
Protected areas							
Other objects at risk	Housing area, agricultural land						
<b>Risk assessment / significance of potential risks</b>							
<i>Significance criteria</i>			<i>value</i>			<i>limit</i>	
<b>A) Human health, economic values</b>							
no. of houses	30	≥ 10					
Settlement area (in ha)	200	≥ 0,5					
Industrial objects	2	≥ 1					
Industrial area (in ha)	0,8	≥ 0,5					
Critical agriculture aspects							
<b>B) Environmental risks</b>							
<b>B1) Water polluting substances / sites</b>							
Contaminated sites		≥ 1					
Locations with dangerous substances		≥ 1					
<b>B2) Protected areas (according to WRRL)</b>							
Protected areas (e.g. Natura 2000 etc.)		≥ 1					
Drinking Water supply areas		≥ 1					
Bathing waters		≥ 1					
<b>C) Risk for cultural heritage sites</b>							
UNESCO heritage sites		≥ 1					
Other relevant cultural heritage sites		≥ 1					
<b>Explanations / comment for the risk assessment</b>			<b>General comments for this potential risk area</b>				

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded



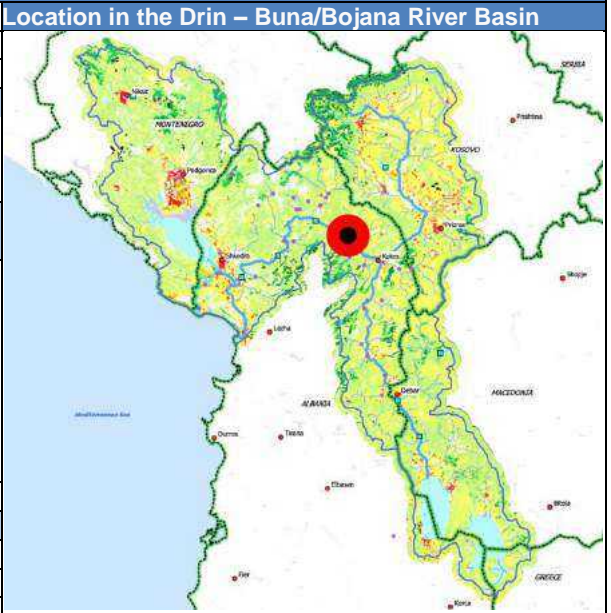
Risk area		Country:	Albania	AL - 1
River-Flood:		Black Drin	Location in the Drin – Buna/Bojana River Basin	
River section:				
River km: _____ to km: _____				
Cities / villages of risk:				
Village Potgorcë , Brezhdan,Zalldardhe,Gjorice				
Past events / years, damage:				
Month/Year	Description of damage			
Nov 2016	Torrential river. Active in heavy rains. 15 houses in Barshaj heavy damaged.			
Comments on past events:			Situation in the potential risk area:	
Potential risks / assets in risk area				
Risk area (in ha)	90			
Houses	50-60			
Persons				
Families				
Companies at risk				
Industry (objects)				
Infrastructure (objects)	1			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	The bridge is surrounded by the waters			
<b>Risk assessment / significance of potential risks</b>				
Significance criteria		value	limit	
<b>A) Human health, economic values</b>				
no. of houses			≥ 10	Limit exceeded
Settlement area (in ha)			≥ 0,5	Limit exceeded
Industrial objects			≥ 1	Limit exceeded
Industrial area (in ha)			≥ 0,5	Limit not exceeded
Critical agriculture aspects				No information / uncertain
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites			≥ 1	Limit not exceeded
Locations with dangerous substances			≥ 1	Limit not exceeded
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)			≥ 1	Limit not exceeded
Drinking Water supply areas			≥ 1	Limit not exceeded
Bathing waters			≥ 1	Limit not exceeded
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites			≥ 1	Limit not exceeded
Other relevant cultural heritage sites			≥ 1	Limit not exceeded
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
<p>Village Potgorcë, Maqellarë Administrative Unit, due to the increase of the Drin River water level, due to rainfall are threatened about 3-5 dwellings, as well as agricultural land. The village of Brezhdan, the Tomin Administrative Unit, due to the increase of the Drin River water level, due to the precipitation, are endangered about 50 ha of agricultural land. Zalldardhe Village, Zalldardhe Administrative Unit, due to the increase of the Drin River water level, due to rainfall are threatened about 40 ha of agricultural land. Village Gjorica, Gjorica Administrative Unit, due to the increase of the level of Drin river waters, due to rainfall are at risk about 40-50 flats as well as agricultural land.</p>				

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Albania	AL - 2
Location:		Kukes		
<b>HPP-reservoir-management:</b>		Black Drin		<b>Location in the Drin – Buna/Bojana River Basin</b>
<b>River section:</b>		Kukes city		
<b>River km:</b>		75	<b>to km:</b>	80
<b>Cities / villages of risk:</b>				
Village of Perbreg				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
May 2012	River Floods: Village of Përbreg / BregLume (Terthore Administrative Unit)			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	50 ha			
Houses	~30			
Persons	~200			
Families	~30			
Companies at risk				
Industry (objects)				
Infrastructure (objects)				
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Houses and arable land			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	30	≥ 10		
Settlement area (in ha)	>1	≥ 0,5		
Industrial objects	0	≥ 1		
Industrial area (in ha)	0	≥ 0,5		
Critical agriculture aspects	0			
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		
Locations with dangerous substances	0	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1		
Drinking Water supply areas	0	≥ 1		
Bathing waters	0	≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites	0	≥ 1		
<b>Situation in the potential risk area:</b>				
				
 <p>Map from Kukes Local Territory Plan 2017 (Source NATP)</p>				
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
The assessment is based on the data gathered from the GDCE Albania and news reports.		Risk area is caused by management of Fierza HPP(when waters of the reservoir raise up to 297 m asl)		

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

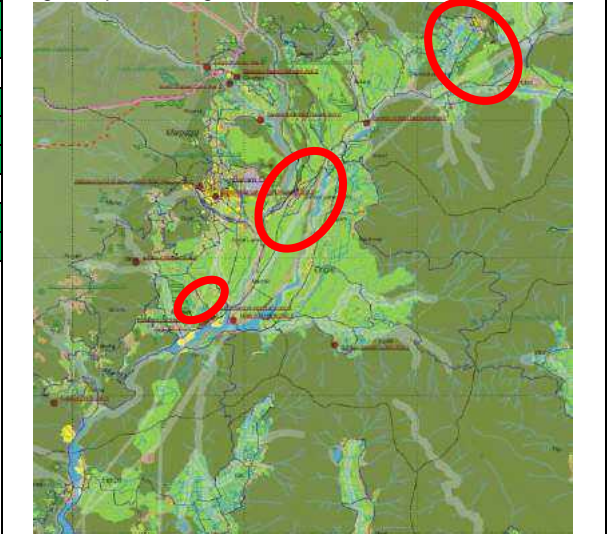
Risk area		Country:	Albania	AL - 3
		Location:	Tropoje	
<b>Flash-flood:</b>	Valbona River (Drini tributary)		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>				
<b>River km:</b>	115	<b>to km:</b>		
<b>Cities / villages of risk:</b>	The Administrative Unit of Tropoja. Villages of Selimaj, Muldakaj, Vidricë, Rosujë etc. Torrential flood by streams of Murataj, Dedaj, Mejdan, Lug i Zi			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 2016	Flash floods by heavy rains. Several villages affected. 15 houses affected by floods at Partizani neighborhood of Bajram Curri. 2 houses damaged in Bujan mostly due to land slides. Bridges damaged in the villages of Viçdol, Tropojë e Vjetër, Lekbibaj, Geghysen, T'pla të rrethit të Tropojës, Bashkia Tropojë. Land area flooded in the villages of T'plan, Viçdol, Tropojë.			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	>100			
Houses	>20			
Persons	>100			
Families	>20			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	1			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	Mainly bridges, roads and some houses. (20 reported)			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	>20	≥ 10	Limit exceeded	
Settlement area (in ha)	>1	≥ 0,5	Limit exceeded	
Industrial objects	0	≥ 1	Limit not exceeded	
Industrial area (in ha)	0	≥ 0,5	Limit not exceeded	
Critical agriculture aspects			No information / uncertain	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	Limit not exceeded	
Locations with dangerous substances	0	≥ 1	Limit not exceeded	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Limit not exceeded	
Drinking Water supply areas	0	≥ 1	Limit not exceeded	
Bathing waters	0	≥ 1	Limit not exceeded	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1	Limit not exceeded	
Other relevant cultural heritage sites	0	≥ 1	Limit not exceeded	



**Situation in the potential risk area:**



Google map indicating the area where flash floods occurs.

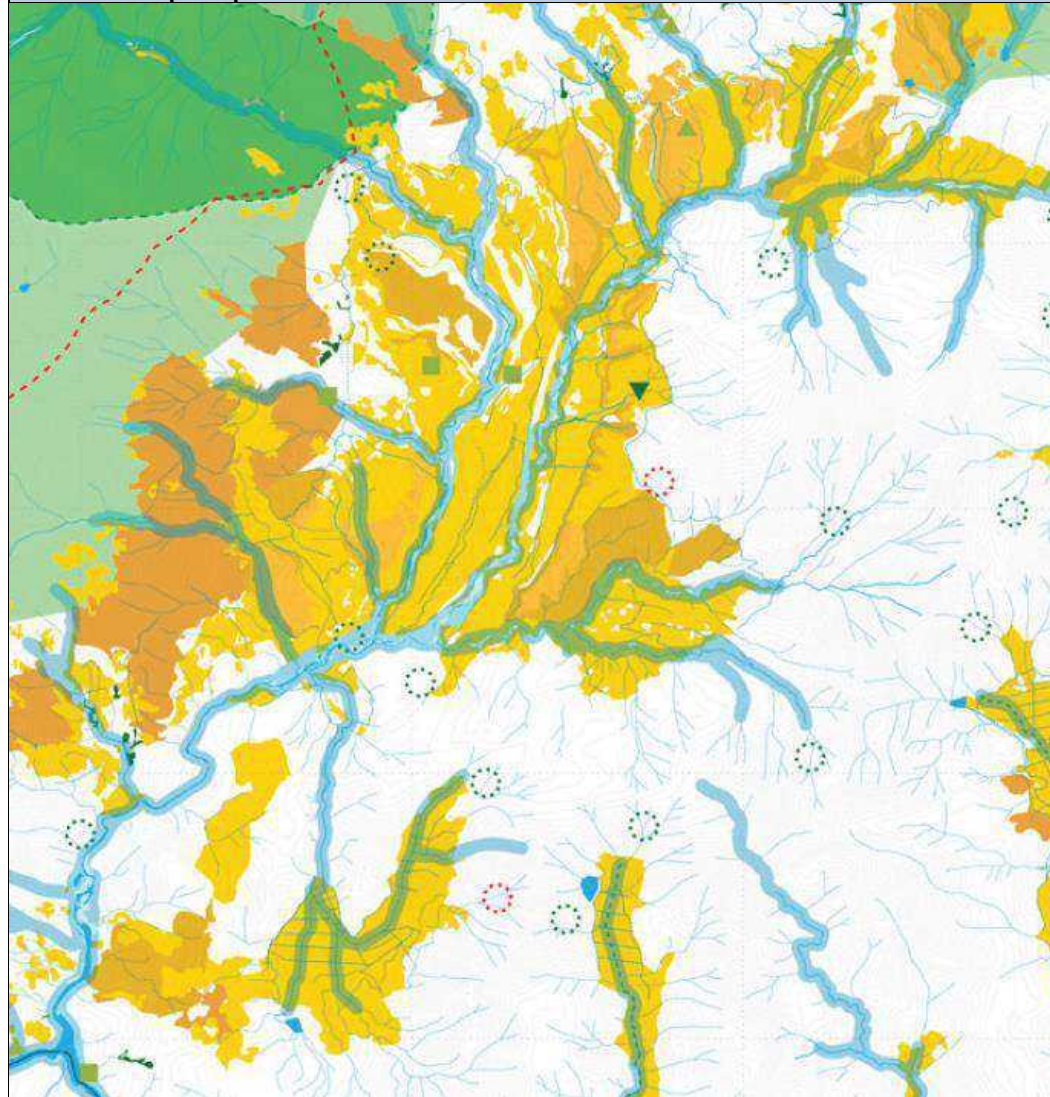


Map, Local Territory Plan of Tropoja Municipality (Source, NTPA))


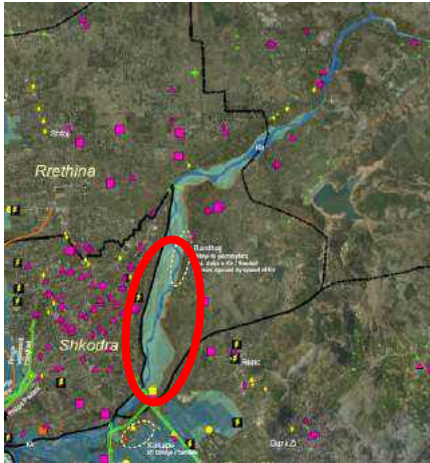

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Explanations / comment for the risk assessment	General comments for this potential risk area
The observations are collected from media news. The Civil Emergency Directorate has considered those as flash floods and data have to be documented.	The area is flooded by flash floods caused by heavy rains.




**Additional maps to picture the situation**



Potential flood risk area in light blue. Source: Local Territory Plan of Tropoja Municipality (NTPA)

Risk area		Country:	Albania	AL - 4
		Location:	City of Shkodra	
<b>River-Flood:</b>	Kiri River		<b>Location in the Drin – Buna/Bojana River Basin</b>	
<b>River section:</b>				
<b>River km:</b>	185 (of Drini)	<b>to km:</b>		
<b>Cities / villages of risk:</b>	Villages of Bleran			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Dec 2012	Torrential river. Active in heavy rains. 15 houses in Bardhaj heavy damaged.			
Mar 2018	Bardhaj village surrounded by waters			
<i>Comments on past events: Whenever there is a high flood caused by heavy rains, the village of Bardhja is flooded.</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	250			<b>Situation in the potential risk area:</b> 
Houses	30			
Persons	150			
Families	30			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	1			
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	The bridge is surrounded by the waters			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>	
<b>A) Human health, economic values</b>				
no. of houses	30	≥ 10		
Settlement area (in ha)	>1	≥ 0,5		
Industrial objects	0	≥ 1		
Industrial area (in ha)	0	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		
Locations with dangerous substances	0	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1		
Drinking Water supply areas	0	≥ 1		
Bathing waters	0	≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites	0	≥ 1		
				
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
Kir River, are with high flood risk.				


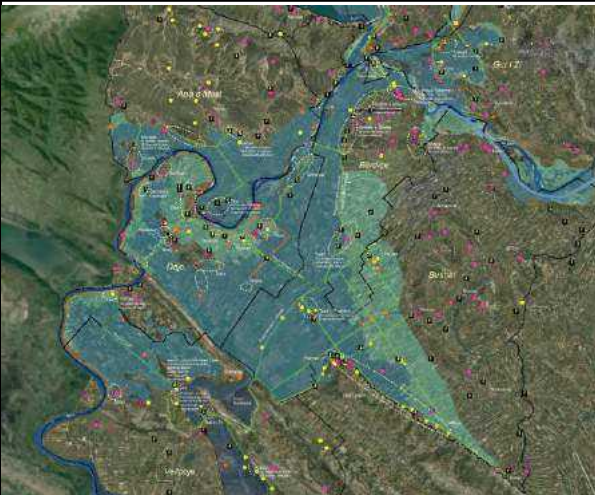
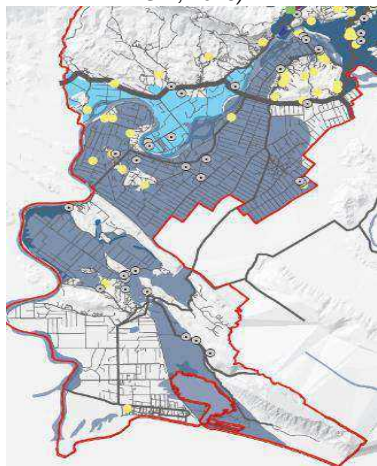
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Albania	AL - 5
Location:		Shkodra Lake / City of Shkodra, Rrethina area		
Lake-Flood:	Lake Shkodra		Location in the Drin – Buna/Bojana River Basin	
				
<b>River section:</b>				
River km: 185 (of Drini) to km:				
<b>Cities / villages of risk:</b>				
City of Shkodra (Xhabija) Rrethina Administrative unit				
<b>Past events / years, damage:</b>				
Month/Year	Description of damage			
2009	The area called "livadhe" inundated.			
Jan 2010	The city of Shkodra The area called "livadhe" inundated. 400 objects was flooded from which 200 businesses was flooded			
Dec 2010	Xhabija neighbourhood in the entrance of Shkodra city was flooded. The city of Shkodra The area called "livadhe" inundated. 400 objects was flooded from which 200 businesses was flooded			
Nov 2016	The Dajc Administrative area was flooded			
Mar 2018	Rrethinat was flooded. No objects flooded only land			
Comments on past events: Drini low delta were, only land was inundated.				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	11.000			
Houses	200			
Persons	>1.000			
Families	>150			
Companies at risk	200			
Industry (objects)	>5			
Infrastructure (objects)	>5			
Agriculture [ha] / objects				
Protected areas	2			
Other objects at risk	Water supply infrastructure; businesses, roads			
<b>Situation in the potential risk area:</b>				
				
Map of objects at risk Shkodra Flood Risk Management Plan (GIZ, 2015)				
				
Map of the high risk flood area of Shkodra Lake in dark blue. Source Shkodra Local Territory Plan (NTPA)				
<b>Risk assessment / significance of potential risks</b>				
Significance criteria		value	limit	
<b>A) Human health, economic values</b>				
no. of houses	200	≥ 10		
Settlement area (in ha)	>1	≥ 0,5		
Industrial objects	>5	≥ 1		
Industrial area (in ha)	>5	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	>2	≥ 1		
Locations with dangerous substances	>2	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	2	≥ 1		
Drinking Water supply areas	>2	≥ 1		
Bathing waters	>2	≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites	>2	≥ 1		
<b>Explanations / comment for the risk assessment</b>				
The area is well studied. Measures are part of the Shkodra Flood Management Plan of 2015. This area is a lake retention Risk area where settlements reach beyond the risk line. But the city of Shkodra is the area with the highest risk impact, where a number of objects and infrastructure were highly damaged				
<b>General comments for this potential risk area</b>				
A very high risk area and very frequently under potential flood risk.				

Limit exceeded

No information / uncertain

Limit not exceeded

Risk area		Country:	Albania	AL - 6
		Location:	Region of Shkodra	
<b>River-Flood:</b>	Drin, Buna / Bojana			
<b>River section:</b>	Below Shkodra City to Adria (mounth) / & Vau Dejes			
<b>River km:</b>	170	<b>to km:</b>	220	
<b>Cities / villages of risk:</b>	Shkodër city and Administrative units of Vau Dejes, Guri i Zi, Bërdicë, Dajç, Ana e Malit, Velipojë, Rrethina, and Bushat. <i>* additional information see comments</i>			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 1962 – Feb 1963	Zadrime of Shkodres and Lezha, Bregu Bunes, 18.575 ha; Fields between Drini of Lezha and Mati, 3.122 ha			
Nov 1992	most damage occurred to housing, livestock, and crops. Also: roads, bridges, riverbanks and irrigation networks. 17.000 ha of agricultural land inundated. There was major disruption to electrical power.			
Dec 2009 & Jan 2010	In the counties of Shkoder & of Lezhe, flooded: almost 10.000 ha; > 5.000 people evacuated (could have been more); 22.000 houses were damaged. (Emerg. Sommissions report: ca. 14.500 person)			
Dec 2010	12.145 evacuated inhabitants; 7.120 affected houses (4.540 flooded, 2.580 in flood area); flooded objects > 400 of different types.			
Mar 2013	Dajç, Bërdicë & Ana e Malit: 4.900 ha arable land flooded, 315 houses in flooded area, 140 families evacuated.			
Mar 2018	Dajç, Bërdicë & Ana e Malit: 6.800 ha arable land flooded, 59 houses surrounded by waters.			
<b>Comments on past events:</b>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	> 12.000			
Houses	> 7.000			
Persons	> 15.000			
Families	> 3.000			
Companies at risk	business buildings			
Industry (objects)				
Infrastructure (objects)	> 400 (see below)			
Agriculture [ha] / objects	Large agricult. area, vulnerable crops and large no. of animals			
Protected areas	Buna river protected area			
Other objects at risk	Public services (water supply, hospitals, schools, religious buildings, energy supply)			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	7.000	≥ 10	Limit exceeded	
Settlement area (in ha)	>5.000	≥ 0,5	Limit exceeded	
Industrial objects	>5	≥ 1	Limit exceeded	
Industrial area (in ha)	>2	≥ 0,5	Limit exceeded	
Critical agriculture aspects	X		Limit exceeded	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	No information / uncertain	
Locations with dangerous substances	0	≥ 1	No information / uncertain	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Limit exceeded	
Drinking Water supply areas	3	≥ 1	Limit exceeded	
Bathing waters	0	≥ 1	Limit not exceeded	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1	No information / uncertain	
Other relevant cultural heritage sites	3	≥ 1	Limit exceeded	
<b>Situation in the potential risk area:</b>				
				
Map of objects at risk (Shkodra Flood Risk Management Plan, GIZ, 2015)				
				
Map of the high risk flood area of Buna River. The color dark blue indicates flood extend. Source: Shkodra Local Territory Plan (NTPA) – in large see below				

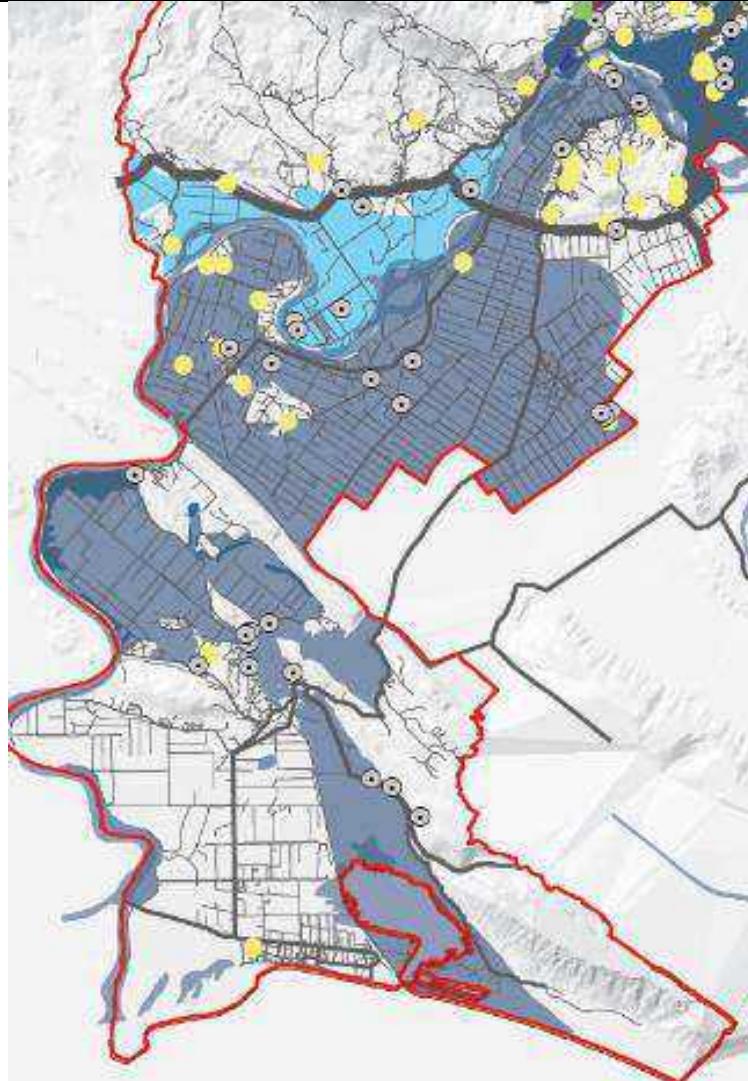
Limit exceeded

No information / uncertain

Limit not exceeded


Explanations / comment for the risk assessment	General comments for this potential risk area
	Specific areas/villages within this area (Livadhe, Bahçallëk, Persash, Bahçja e Cakajve, Ajasëm, Kuç, Rrenc, Guri i Zi, Trush, Bërdicë e Sipërme, Bërdicë e Mesme, Bërdicë e Madhe, Beltoje, Belaj, Rrushkull, Shirq, Mushan, Samrish, Suka, Pentar, Obot, Oblikë, Muriqan, Baks-Rrjoll, Cas, Luarz, Pulaj, Fshat i Ri (Trush i Poshtëm), Mali i Jushit, Rranxa, Konaj, Hoten

**Additional maps to picture the situation**






Map of the high risk flood area of Buna River. The color dark blue indicates the flood extend.  
 Source: Shkodra Local Territory Plan (NTPA)



Risk area		Country: Albania	AL - 7
River-Flood		Location: Lezha	
River section:		Old (former) Drin River	
River km: to km:			
Cities / villages of risk:		The affected area extends to Lezha city; villages of Blinisht; Mabe; Zojz; Gocaj; Trorovice; and Ishull Shengjin. Barbullonje, Tresh, Zejmen, Kolsh.	
Past events / years, damage:			
Month/Year	Description of damage		
Nov 1962	low land Lezha region flooded by the old river bed		
Feb 1963	low land Lezha region flooded by the old river bed. Severe land degradation. No data on settlements.		
2002	critical quote of Drin River in Lezha area is + 2,2 m, flooded; Blinisht commune, Bacel village and 200 ha of agricultural land. quote increase (Sep 2002) at + 3,04 m, over 5.000 ha of soils flooded. Torovica area, surface of 2.200 ha, critical quota is + 1,7 – 1,8 m and 600 ha		
2010	land area of Blinisht Administrative unit and surrounding area flooded by heavy rain and low water retention capacity. area of 2.000 ha of arable land in Torovice, Barbulloja village, 100 houses. Lezha flooded, Beslidhja 20 ha of area of buildings.		
<p><i>Comments on past events: Drin river used to pass in this area, but after the flood of the 1963 and the building of the dams the river is now dormant, mostly used as a drainage channel. The affected area in this area is more to the low land level and the low capacity of the land to retain the waters.</i></p>			
<p><b>Potential risks / assets in risk area</b></p>			
Risk area (in ha)	9.500 ha		
Houses	>100		
Persons	>2.000		
Families	>400		
Companies at risk			
Industry (objects)			
Infrastructure (objects)	>1		
Agriculture [ha] / objects	ca. 8.500 ha		
Protected areas	1		
Other objects at risk	Housing area, public services including water supply, hospitals, schools, religious buildings, energy supply systems, business buildings,		
<p><b>Risk assessment / significance of potential risks</b></p>			
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>
<b>A) Human health, economic values</b>			
no. of houses	>100	≥ 10	Red
Settlement area (in ha)	860	≥ 0,5	Red
Industrial objects	0	≥ 1	Green
Industrial area (in ha)	80	≥ 0,5	Red
Critical agriculture aspects	x		Red
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites	0	≥ 1	Green
Locations with dangerous substances	0	≥ 1	Green
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)	>2	≥ 1	Red
Drinking Water supply areas	0	≥ 1	Green
Bathing waters	>1	≥ 1	Red
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites	0	≥ 1	Green
Other relevant cultural heritage sites	>1	≥ 1	Red

Indicated flood extend (Google maps). Lezha Local Territory Plan (Source NTPA)

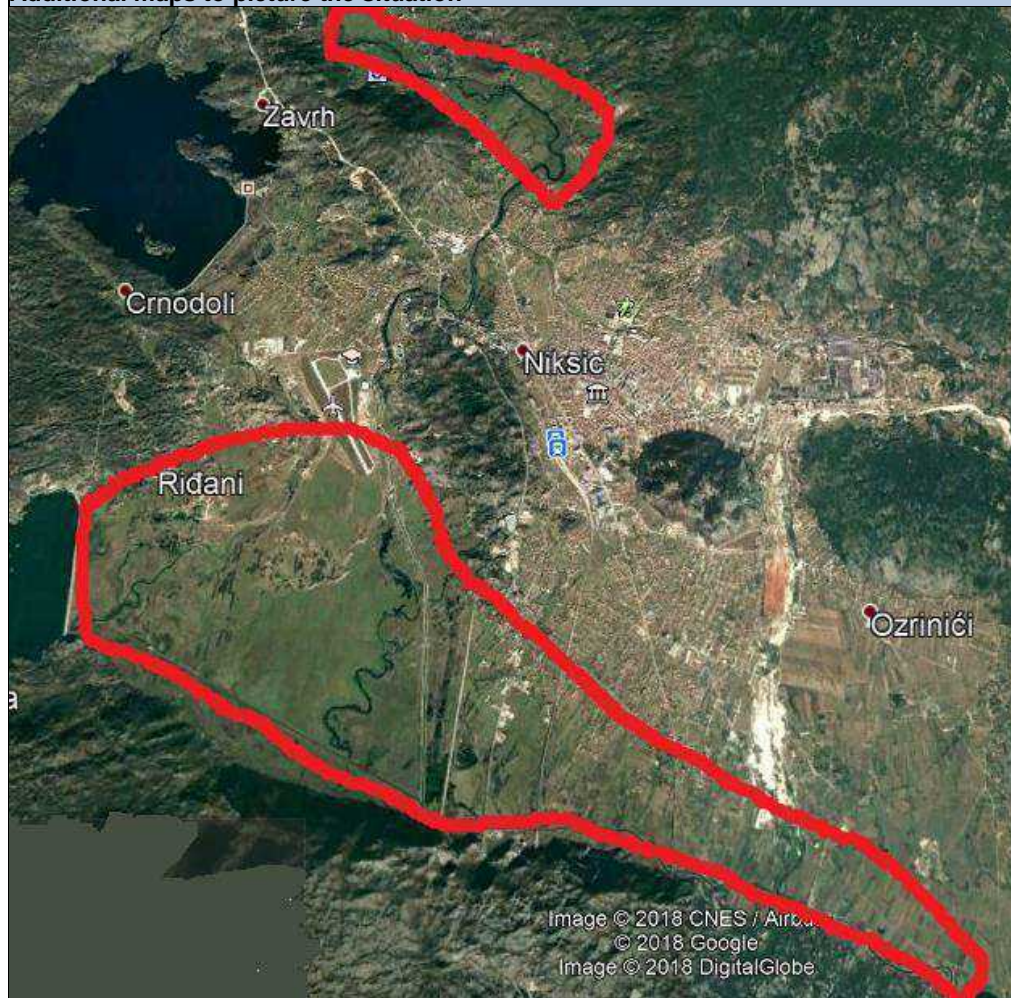
Explanations / comment for the risk assessment	General comments for this potential risk area
<p>Lezha area is at high risk from many sources: sea, river, torrential streams, inundation, land degradation, drainage system.</p>	<p>The risk in Lezha is coming from both sides. The river and drainage system and the sea level rise which has been advancing very much in the last years increasing the severity of the events. In 2010 the sea rise blocked the waters to drain. The city of Lezha is a hotspot as one of the neighborhoods is frequently affected. The Barbull-oja village is an area at high risk indicated by a rectangle with letter B on the map.</p>

Risk area		Country:	Montenegro	ME - 1
Location:		Niksic		 <p>Location in the Drin – Buna/Bojana River Basin</p>
River-Flood	Zeta			
River section:	Upper Zeta			
River km:	70	to km:	40	
Cities / villages of risk:				
Flooded areas of the town of Niskic are settlements: Strasevina, Klicevo, Pzrinici, Poljica, Stedim				
Past events / years, damage:				
Month/Year	Description of damage			
Nov 2010 – Dec 2010	They were endangering settlements, roads and agricultural land.			
Comments on past events:				
Potential risks / assets in risk area				
Risk area (in ha)	2.200			
Houses	42			
Persons	186			
Families	40			
Companies at risk				
Industry (objects)				
Infrastructure (objects)				
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	The floods has endangered the following economic facilities: three warehouses, one bakery and two craft plants, as well as nine livestock farms			
Risk assessment / significance of potential risks				
Significance criteria		value	limit	
<b>A) Human health, economic values</b>				
no. of houses	20	≥ 10		
Settlement area (in ha)		≥ 0,5		
Industrial objects	0	≥ 1		
Industrial area (in ha)	0	≥ 0,5		
Critical agriculture aspects				
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		
Locations with dangerous substances	0	≥ 1		
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1		
Drinking Water supply areas	0	≥ 1		
Bathing waters	0	≥ 1		
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		
Other relevant cultural heritage sites	0	≥ 1		
 <p>Situation in the potential risk area:</p> <p>Line of flooding in Niskic field</p>				
 <p>Line of flooding in Niskic field</p> <p>The flood line in the upper part of the Niskic</p>				

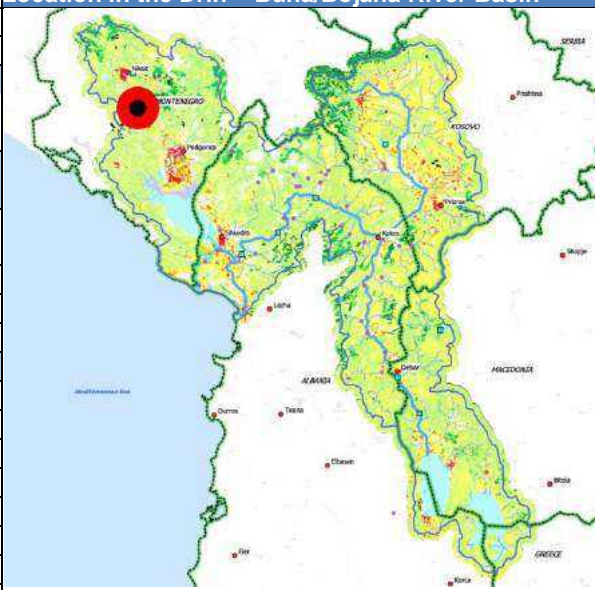
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Explanations / comment for the risk assessment	General comments for this potential risk area
<p>The assessment is based on the data gathered from the INFORMATION ON FLOODS IN MONTENEGRO for the period November-December 2010 (February, 2011), prepared by the Ministry of Internal Affairs for the needs of the Government of Montenegro in order to undertake urgent sanitary measures. Also, data from the Plan of protection and rescue of floods for the territory of the Municipality of Niksic is used.</p>	<p>HPP "Perućica" is the oldest large hydropower plant in Montenegro, and was put into operation in 1960. It is named after the well Perućica, which originates in the vicinity of hydroelectric power plant. For electricity production, HPP "Perucica" uses water catchment of river Gornja Zeta, which is water that flows into Niksic field. HPP "Perucica" consist the following facilities: accumulations "Krupac" and "Slano" and retention "Vrtac" and the system of channels. The management of reservoirs should be such that they can amortize the flood wave that is reflected downstream.</p>

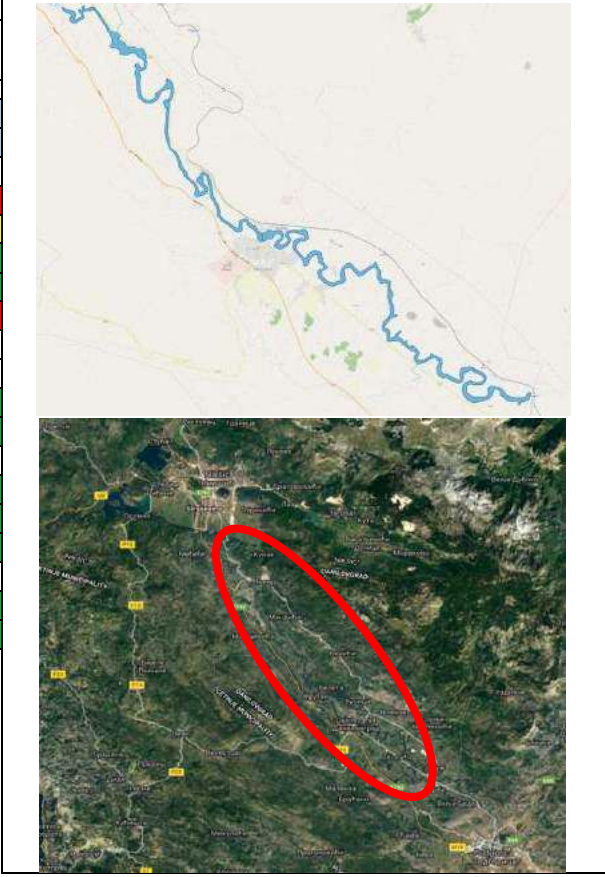
**Additional maps to picture the situation**





Limit exceeded
  No information / uncertain
  Limit not exceeded

Risk area		Country:	Montenegro	ME - 2
		Location:	Glava Zete to Spuz	
<b>River-Flood</b>	Zeta	<b>Location in the Drin – Buna/Bojana River Basin</b>		
<b>River section:</b>	Lower Zeta			
<b>River km:</b>	30 to km: 9,5			
<b>Cities / villages of risk:</b>	Danilovgrad, Frutak, Bogicevici, Curilac, Podanje, Kosic, Martinici, Strahinjici, Spuz			
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 2010 – Dec 2010	They were endangering settlements, roads and agricultural land.			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	600			
Houses	44			
Persons	145			
Families	40			
Companies at risk				
Industry (objects)				
Infrastructure (objects)				
Agriculture [ha] / objects				
Protected areas				
Other objects at risk	165 ha of arable land and 29 agricultural facilities			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	44	≥ 10		Red
Settlement area (in ha)		≥ 0,5		Yellow
Industrial objects	0	≥ 1		Green
Industrial area (in ha)	0	≥ 0,5		Green
Critical agriculture aspects	XX			Red
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1		Green
Locations with dangerous substances	0	≥ 1		Green
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1		Green
Drinking Water supply areas	0	≥ 1		Green
Bathing waters	0	≥ 1		Green
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1		Green
Other relevant cultural heritage sites	0	≥ 1		Green
<b>Explanations / comment for the risk assessment</b>		<b>General comments for this potential risk area</b>		
<p>The assessment is based on the data gathered from the INFORMATION ON FLOODS IN MONTENEGRO for the period November-December 2010 (February, 2011), prepared by the Ministry of Internal Affairs for the needs of the Government of Montenegro in order to undertake urgent sanitary measures. Also, data from the Plan of protection and rescue of floods for the territory of the Municipality of Danilovgrad is used.</p>				




**Situation in the potential risk area:**



■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country: Montenegro	ME - 3
Location: Cetinje field			
Groundwater: (groundwater and drainage channels)		Location in the Drin – Buna/Bojana River Basin	
River section:			
River km: to km:			
Cities / villages of risk: Cetinje			
Past events / years, damage:			
Month/Year	Description of damage		
	No documented / assessed events		
Comments on past events:			
Potential risks / assets in risk area		Situation in the potential risk area:	
Risk area (in ha)			
Houses	50		
Persons			
Families			
Companies at risk			
Industry (objects)			
Infrastructure (objects)			
Agriculture [ha] / objects			
Protected areas			
Other objects at risk			
Risk assessment / significance of potential risks			
Significance criteria	value	limit	
<b>A) Human health, economic values</b>			
no. of houses	50	≥ 10	Red
Settlement area (in ha)		≥ 0,5	Yellow
Industrial objects		≥ 1	Yellow
Industrial area (in ha)		≥ 0,5	Yellow
Critical agriculture aspects			Yellow
<b>B) Environmental risks</b>			
<b>B1) Water polluting substances / sites</b>			
Contaminated sites		≥ 1	Yellow
Locations with dangerous substances		≥ 1	Yellow
<b>B2) Protected areas (according to WRRL)</b>			
Protected areas (e.g. Natura 2000 etc.)		≥ 1	Yellow
Drinking Water supply areas		≥ 1	Yellow
Bathing waters		≥ 1	Yellow
<b>C) Risk for cultural heritage sites</b>			
UNESCO heritage sites		≥ 1	Yellow
Other relevant cultural heritage sites		≥ 1	Yellow
Explanations / comment for the risk assessment		General comments for this potential risk area	
The potential risk in the area of Cetinje Field is flooding due to a combination of abundant precipitation and a high groundwater level, when drainage channels (sinks) do not have enough capacity to take those water to Skadar Lake. No flood lines have been created, but in regard to further flood risk assessment, this area should be considered as significant.		The risk area has not been systematically assessed yet; due to local knowledge and local experiences the groundwater potentially causes problems; thus this area should be determined as APSFR to be further investigated.	

■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Risk area		Country:	Montenegro	ME - 4
River-Food & Lake-Flood:		Moraca and Skadar lake area		
River section:		The lower course of the Moraca river and the large area of land along the edge of the Skadar Lake.		
River km:		to km:		
Cities / villages of risk:		Botun, Ljajkovici, Mirovici, Grbavci, Lekici, Vukoci, Ponari, Gostilj, Vranjina, Beri, Golubovci, Bijelo Polje, Berislavci, Bala-bani, Kurilo, Goricani, Susanja, Mojanovici, Tuzi		
Past events / years, damage:				
Month/Year	Description of damage			
Nov 2010 – Dec 2010	Floods in the municipalities of Golubovci and Tuzi are mostly endangering the large areas of land along the periphery of the Skadar Lake and in the lower flow zone of the Morača River. They w have posed risk to settlements, roads and agricultural land			
Comments on past events:				
Potential risks / assets in risk area				
Risk area (in ha)				
Houses	982			
Persons	15.857			
Families	869			
Companies at risk				
Industry (objects)	57			
Infrastructure (objects)	3 bridges			
Agriculture [ha] / objects	Large agricultural area			
Protected areas	The flood zone is part of the National Park "Skadar Lake"			
Other objects at risk	1.367 agricultural facilities			
Risk assessment / significance of potential risks				
Significance criteria		value	limit	
<b>A) Human health, economic values</b>				
no. of houses	982	≥ 10	Limit exceeded	
Settlement area (in ha)	~2.000	≥ 0,5	Limit exceeded	
Industrial objects	57	≥ 1	Limit exceeded	
Industrial area (in ha)	≥1	≥ 0,5	Limit exceeded	
Critical agriculture aspects	xx		Limit exceeded	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	Limit not exceeded	
Locations with dangerous substances	0	≥ 1	Limit not exceeded	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1	Limit exceeded	
Drinking Water supply areas	0	≥ 1	Limit not exceeded	
Bathing waters	0	≥ 1	Limit not exceeded	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1	Limit not exceeded	
Other relevant cultural heritage sites	0	≥ 1	Limit not exceeded	
				

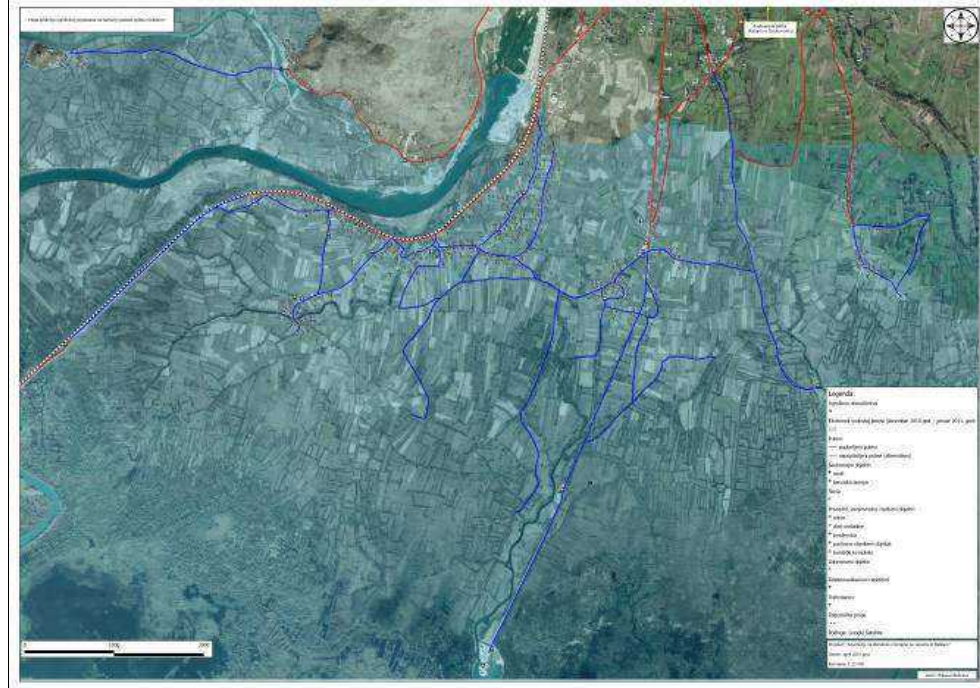
■ Limit exceeded     
 ■ No information / uncertain     
 ■ Limit not exceeded

Explanations / comment for the risk assessment	General comments for this potential risk area
<p>The assessment is based on the data gathered from the INFORMATION ON FLOODS IN MONTENEGRO for the period November-December 2010 (February, 2011), prepared by the Ministry of Internal Affairs for the needs of the Government of Montenegro in order to undertake urgent sanitary measures. Also, data from the Plan of protection and rescue of floods for the territory of the Municipality of Podgorica (2013, 2016) is used.</p>	

**Additional maps to picture the situation**


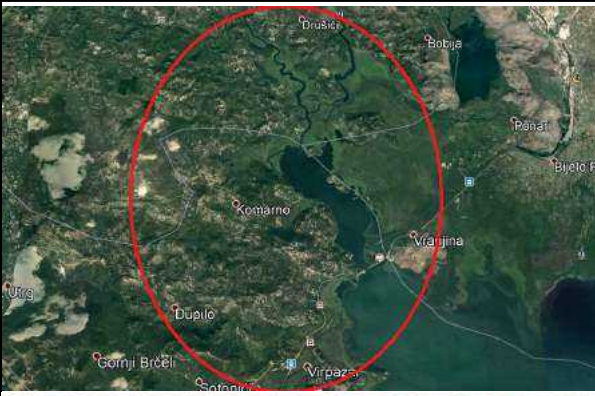



Map from Plan of protection and rescue of floods for the territory of the Municipality of Podgorica



Limit exceeded
  No information / uncertain
  Limit not exceeded






Risk area		Country:	Montenegro	ME - 5		
		Location:	West of Skadar Lake			
<b>River-Flood &amp; Lake-Flood:</b>		Skadar Lake area		<b>Location in the Drin – Buna/Bojana River Basin</b>		
<b>River section:</b>						
<b>River km:</b>					to km:	
<b>Cities / villages of risk:</b>					<ul style="list-style-type: none"> <li>• Municipality of Cetinje: Dodosi, Karuc, Rijeka Crnojavica , Zabljak Crnojevica</li> <li>• Municipality of Bar: Virpazar, Boljevici, Dupilo, Krnjice</li> </ul>	
<b>Past events / years, damage:</b>						
<b>Month/Year</b>	<b>Description of damage</b>					
Nov 2010 – Dec 2010	Major damage was on orchards and vineyards, boats and fishing material and a part of livestock and food for livestock also disappeared. Infrastructure facilities were endangered by the Old Bridge on Rijeka Crnojević and three bridges on the road of Rijeka Crnojevića - Virpazar. Also, the pumping station of the Cetinje Water Supply in Podgora was endangered, from where Cetinje is supplied with water.					
<i>Comments on past events:</i>						
<b>Potential risks / assets in risk area</b>						
Risk area (in ha)						
Houses	950					
Persons	2.700					
Families	600					
Companies at risk						
Industry (objects)	1					
Infrastructure (objects)	12; water supply infrastructure					
Agriculture [ha] / objects	ca. 185 ha					
Protected areas	The flood zone is part of the National Park "Skadar Lake"					
Other objects at risk	Over 100 objects have been destroyed for agricultural production.					
<b>Risk assessment / significance of potential risks</b>						
<i>Significance criteria</i>		<i>value</i>	<i>limit</i>			
<b>A) Human health, economic values</b>						
no. of houses	950	≥ 10		Red		
Settlement area (in ha)	13	≥ 0,5		Red		
Industrial objects	1	≥ 1		Red		
Industrial area (in ha)	0	≥ 0,5		Green		
Critical agriculture aspects				Yellow		
<b>B) Environmental risks</b>						
<b>B1) Water polluting substances / sites</b>						
Contaminated sites	0	≥ 1		Green		
Locations with dangerous substances	0	≥ 1		Green		
<b>B2) Protected areas (according to WRRL)</b>						
Protected areas (e.g. Natura 2000 etc.)	1	≥ 1		Red		
Drinking Water supply areas	1	≥ 1		Red		
Bathing waters	0	≥ 1		Green		
<b>C) Risk for cultural heritage sites</b>						
UNESCO heritage sites	0	≥ 1		Green		
Other relevant cultural heritage sites	0	≥ 1		Green		
<b>Situation in the potential risk area:</b>						
						
						

Red Limit exceeded

Yellow No information / uncertain

Green Limit not exceeded



Risk area		Country:	Montenegro	ME - 6
		Location:	Lisna Bori to Gornji Stoj	
<b>River-Flood &amp; Sea water</b>		Buna / Bojana		<b>Location in the Drin – Buna/Bojana River Basin</b>
<b>River section:</b>				
<b>River km:</b>		<b>to km:</b>		
<b>Cities / villages of risk:</b>				
Lisna Bori, Sukobin, Fraskanjel, Gornji Stoj, Sveti Djordje, Ada Bojana				
<b>Past events / years, damage:</b>				
<b>Month/Year</b>	<b>Description of damage</b>			
Nov 2010 – Dec 2010	The biggest areas of land and private facilities near the river Bojana are endangered. It is primarily about ground-level houses and houses with a maximum of one to two floors, as well as large plantations of fruits and vegetables.			
<i>Comments on past events:</i>				
<b>Potential risks / assets in risk area</b>				
Risk area (in ha)	940			
Houses	658			
Persons	475			
Families	114			
Companies at risk				
Industry (objects)				
Infrastructure (objects)	3			
Agriculture [ha] / objects	Large agricultural areas			
Protected areas				
Other objects at risk	At the mouth of the Bojana river, there is a huge complex with 390 facilities (fishing houses, cottages and restaurants) and the famous tourist center Ada (440 ha)			
<b>Risk assessment / significance of potential risks</b>				
<i>Significance criteria</i>	<i>value</i>	<i>limit</i>		
<b>A) Human health, economic values</b>				
no. of houses	658	≥ 10	Red	
Settlement area (in ha)		≥ 0,5	Yellow	
Industrial objects	0	≥ 1	Green	
Industrial area (in ha)	0	≥ 0,5	Green	
Critical agriculture aspects			Yellow	
<b>B) Environmental risks</b>				
<b>B1) Water polluting substances / sites</b>				
Contaminated sites	0	≥ 1	Green	
Locations with dangerous substances	0	≥ 1	Green	
<b>B2) Protected areas (according to WRRL)</b>				
Protected areas (e.g. Natura 2000 etc.)	0	≥ 1	Green	
Drinking Water supply areas	1	≥ 1	Red	
Bathing waters	1	≥ 1	Red	
<b>C) Risk for cultural heritage sites</b>				
UNESCO heritage sites	0	≥ 1	Green	
Other relevant cultural heritage sites	0	≥ 1	Green	
<b>Situation in the potential risk area:</b>				
				
				
<p>Map from Plan of protection and rescue of floods for the territory of the Municipality of Ulcinj</p>  <p>Map from project "Adaptation to climate change in the Western Balkans", 2015, in large see below</p>				

Red Limit exceeded

Yellow No information / uncertain

Green Limit not exceeded

Explanations / comment for the risk assessment	General comments for this potential risk area
<p>The assessment is based on the data gathered from the INFORMATION ON FLOODS IN MONTENEGRO for the period November-December 2010 (February, 2011), prepared by the Ministry of Internal Affairs for the needs of the Government of Montenegro in order to undertake urgent sanitary measures. Also, data from the Plan of protection and rescue of floods for the territory of the Municipality of Bar is used.</p>	<p>The Bojana River is the outlet of Skadar Lake; after 1,2 to 2 km on the left side Drin River enters the Bojana. The Bojana regime at the exit of the lake is relatively flat. However, in the case of large water discharge from the Drin River, the water level and flow of Bojana is increasing rapidly. This phenomenon causes floods along the Bojana stream and slows down the outflow from the lake, which causes floods on the northern side of Skadar Lake. An additional cause of floods along the stream is changes in the sea level due to tides and estuaries, which slows down the flow of Bojana, or causes the rise of its level.</p>

**Additional maps to picture the situation**

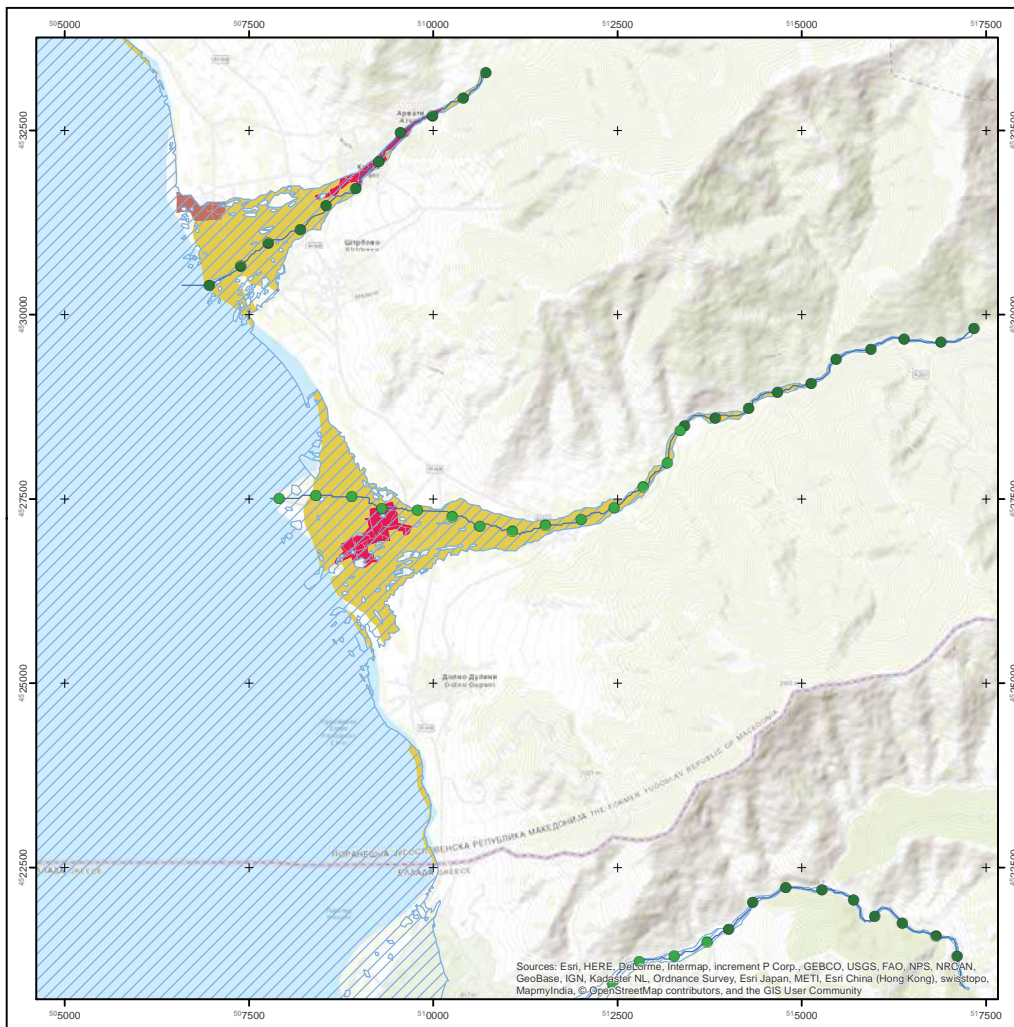


Map from project "Adaptation to climate change in the Western Balkans", 2015



## **Annex 5:**

# **Maps for the preliminary flood risk assessment for the APSFR in the Drin/Drim-Buna/Bojana River Basin**



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-1

**Risk area:**  
Municipality of Resen / East of Prespa Lake  
River: Brajchinska

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

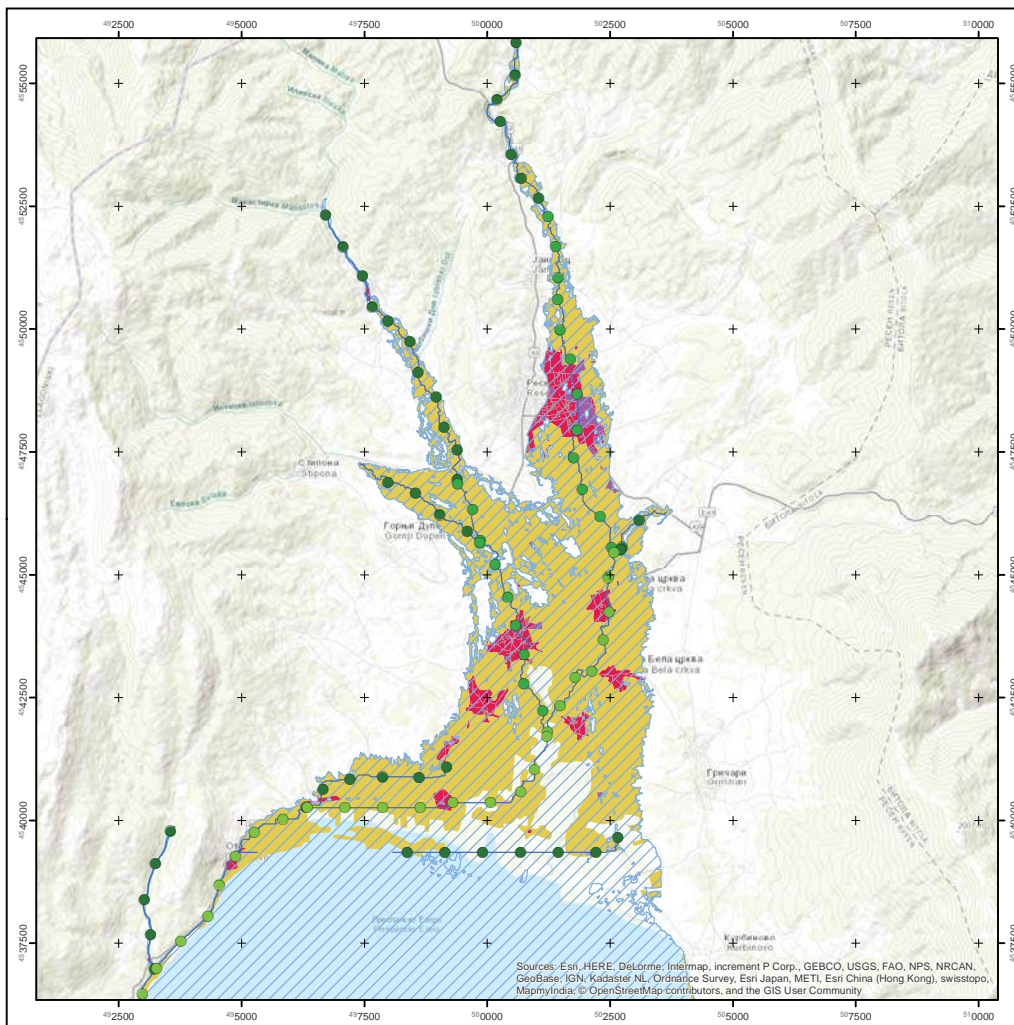
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-2, 3

**Risk area:**  
Municipality of Resen / North of Prespa Lake  
River: Golema and Istochka

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

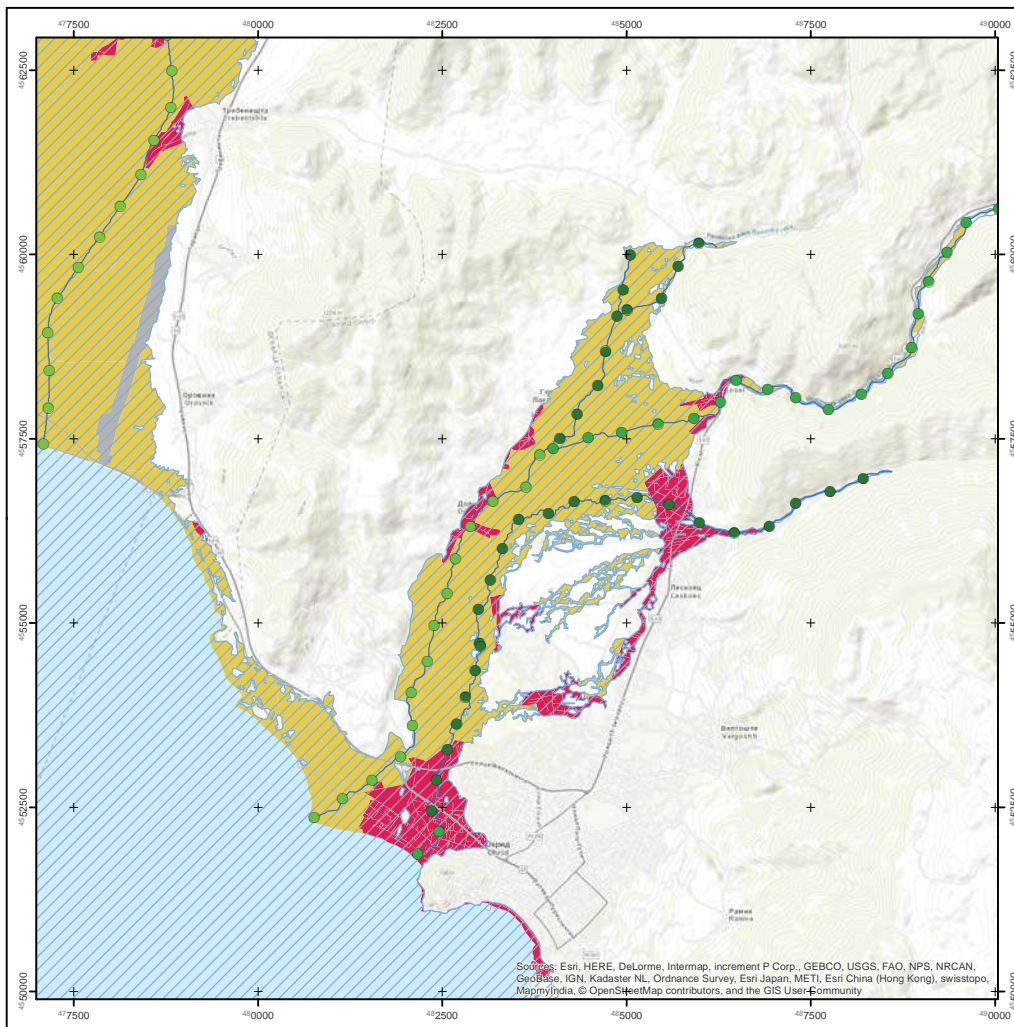
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-4

**Risk area:**  
Municipality of Ohrid / East of Ohrid Lake  
River: Koselska, Vapilica and Skrebatska

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

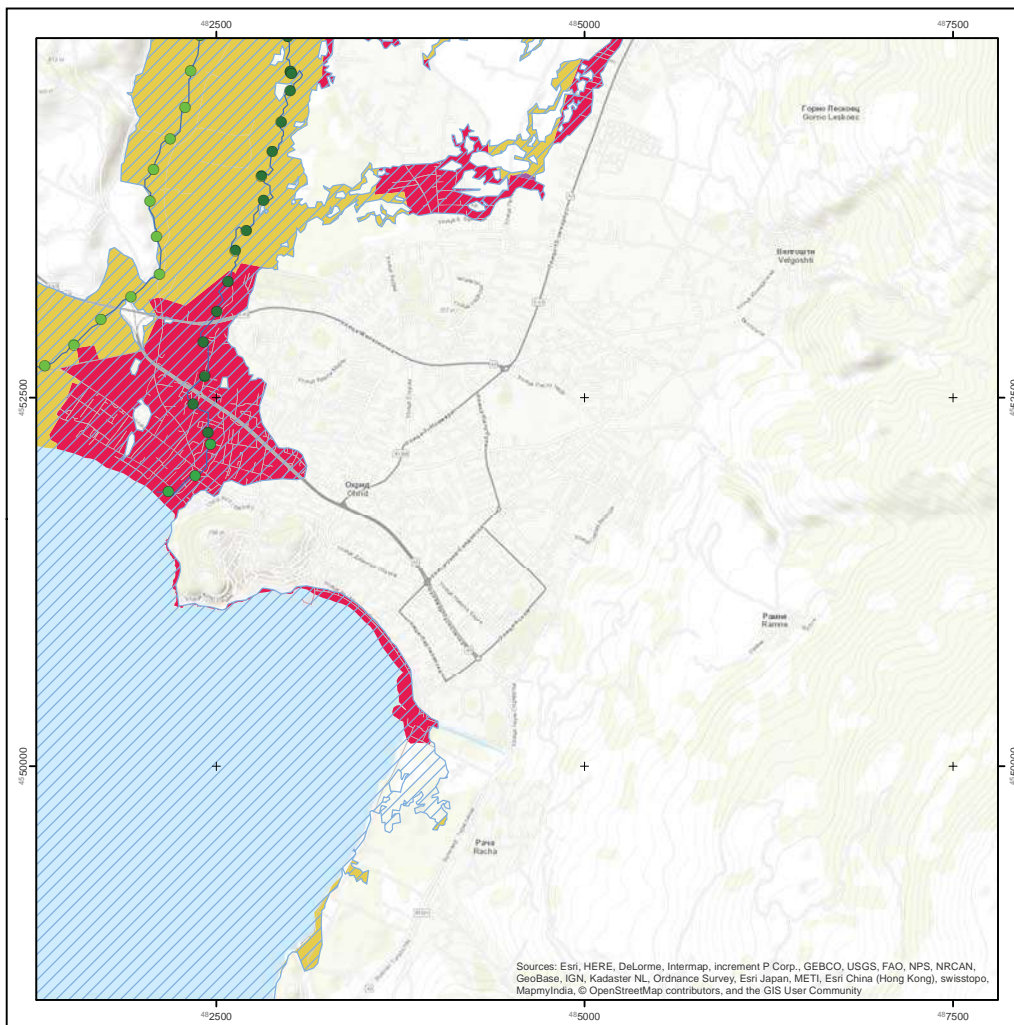
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-5

**Risk area:**  
Municipality of Ohrid / East Ohrid Lake  
River: Sushicka

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

Darmstadt, Germany

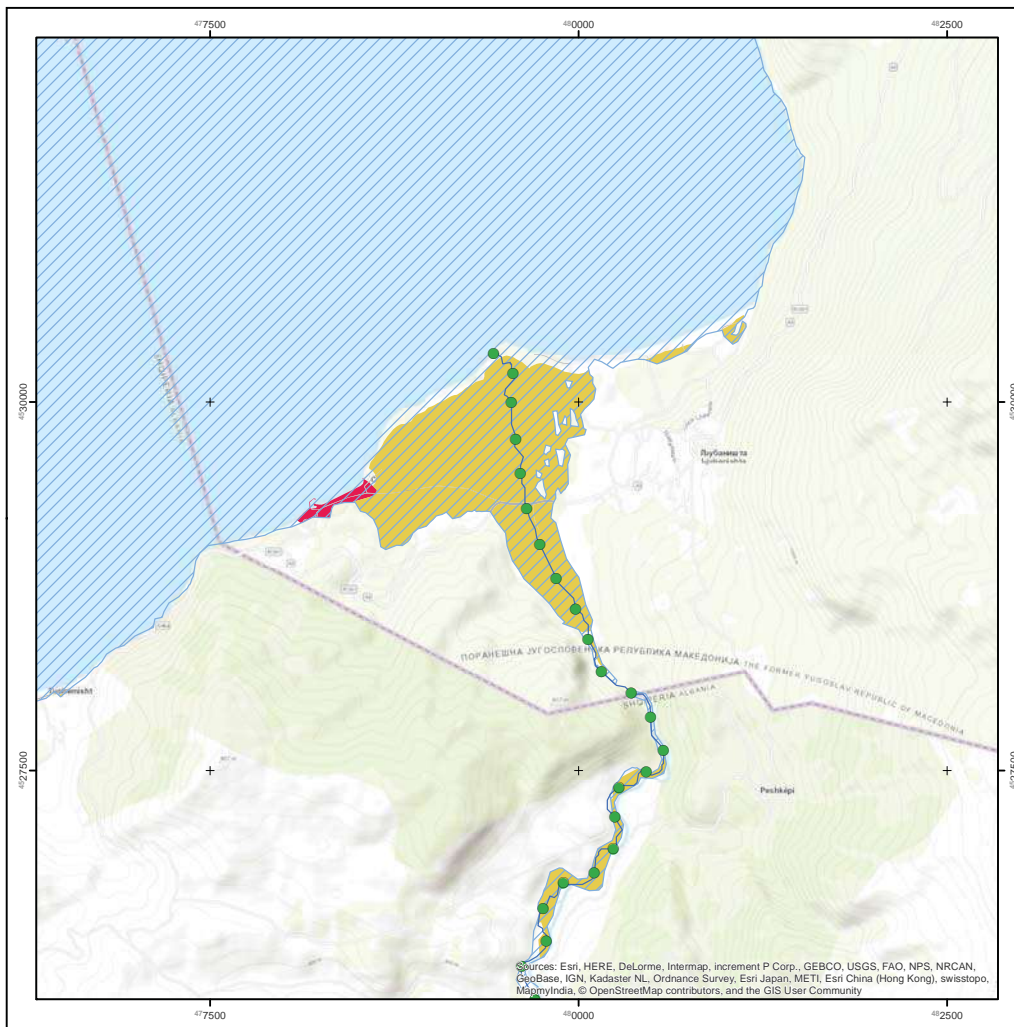
Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ





### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## MK-6

**Risk area:**  
Municipality of Ohrid / South of Ohrid Lake  
River: Cherava

**Legend:**

<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, blue 2px, blue 4px);"></span> potentially flooded area scenario 2</li> <li><span style="display: inline-block; width: 15px; border-bottom: 2px solid blue;"></span> River</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: red; border: 1px solid black;"></span> Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #800000; border: 1px solid black;"></span> Other Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: gray; border: 1px solid black;"></span> Transport</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; border: 1px solid black;"></span> Industrial Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink; border: 1px solid black;"></span> Mineral extraction and dump sites</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; border: 1px solid black;"></span> Agriculture</li> </ul>	<p><b>Catchment Size in km<sup>2</sup></b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 20</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #32cd32; border-radius: 50%;"></span> &gt; 50</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #4caf50; border-radius: 50%;"></span> &gt; 100</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #8bc34a; border-radius: 50%;"></span> &gt; 200</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 500</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 1.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 2.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 5.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%;"></span> &gt; 10.000</li> </ul>
---	---

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

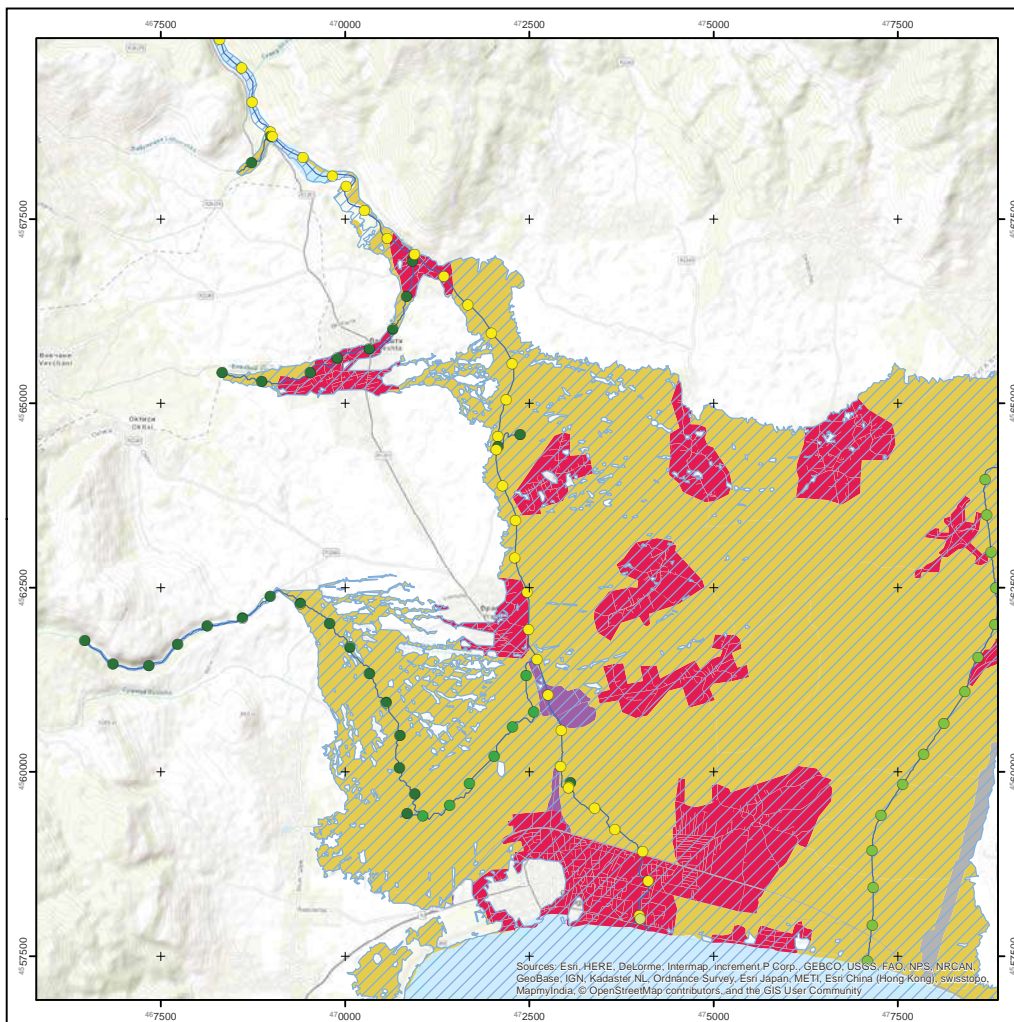
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## MK-7

**Risk area:**  
Municipality of Struga / North of Lake Ohrid  
River: Black Drin

**Legend:**

<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, blue 2px, blue 4px);"></span> potentially flooded area scenario 2</li> <li><span style="display: inline-block; width: 15px; border-bottom: 2px solid blue;"></span> River</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: red; border: 1px solid black;"></span> Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #800000; border: 1px solid black;"></span> Other Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: gray; border: 1px solid black;"></span> Transport</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; border: 1px solid black;"></span> Industrial Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink; border: 1px solid black;"></span> Mineral extraction and dump sites</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; border: 1px solid black;"></span> Agriculture</li> </ul>	<p><b>Catchment Size in km<sup>2</sup></b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 20</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #32cd32; border-radius: 50%;"></span> &gt; 50</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #4caf50; border-radius: 50%;"></span> &gt; 100</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #8bc34a; border-radius: 50%;"></span> &gt; 200</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 500</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 1.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 2.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: #ffc107; border-radius: 50%;"></span> &gt; 5.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%;"></span> &gt; 10.000</li> </ul>
---	---

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

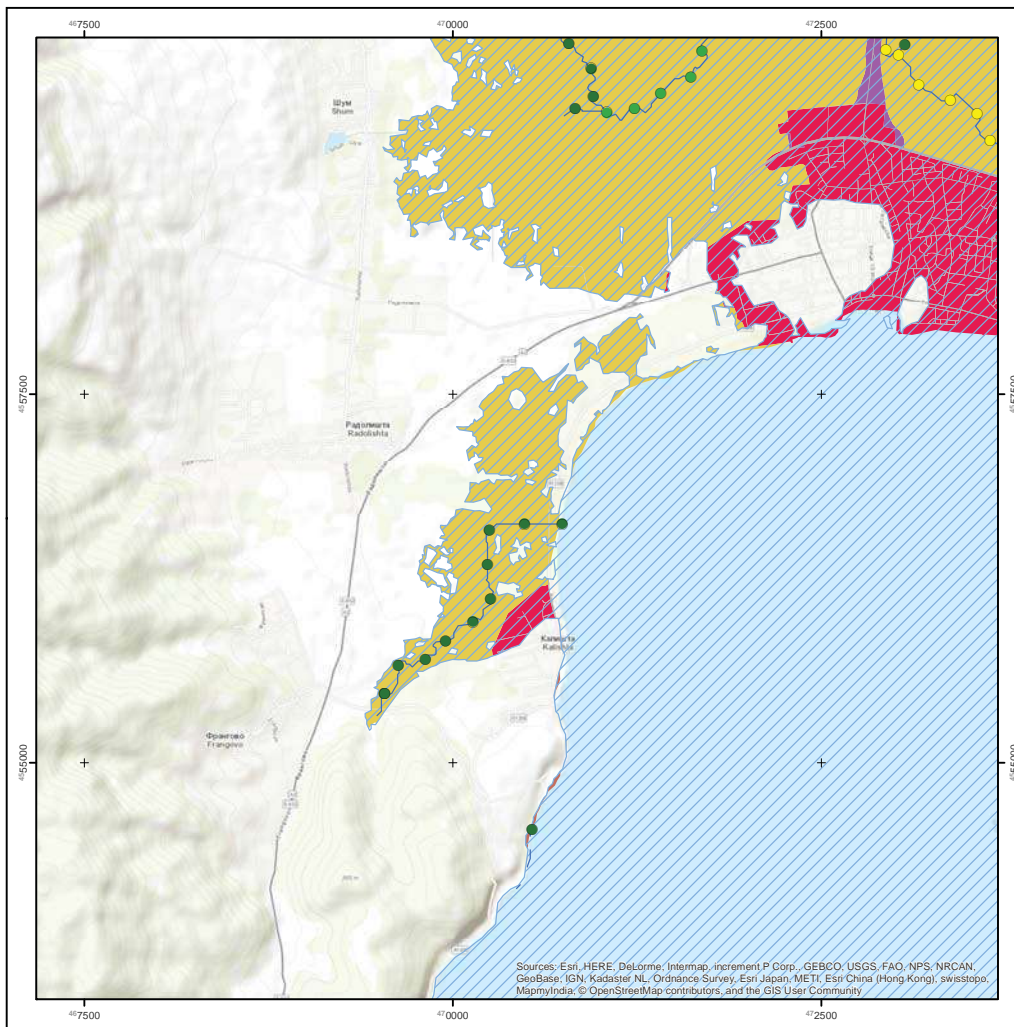
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-8

**Risk area:**  
Village of Kalishta / West of Lake Ohrid  
River: Kalishta

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

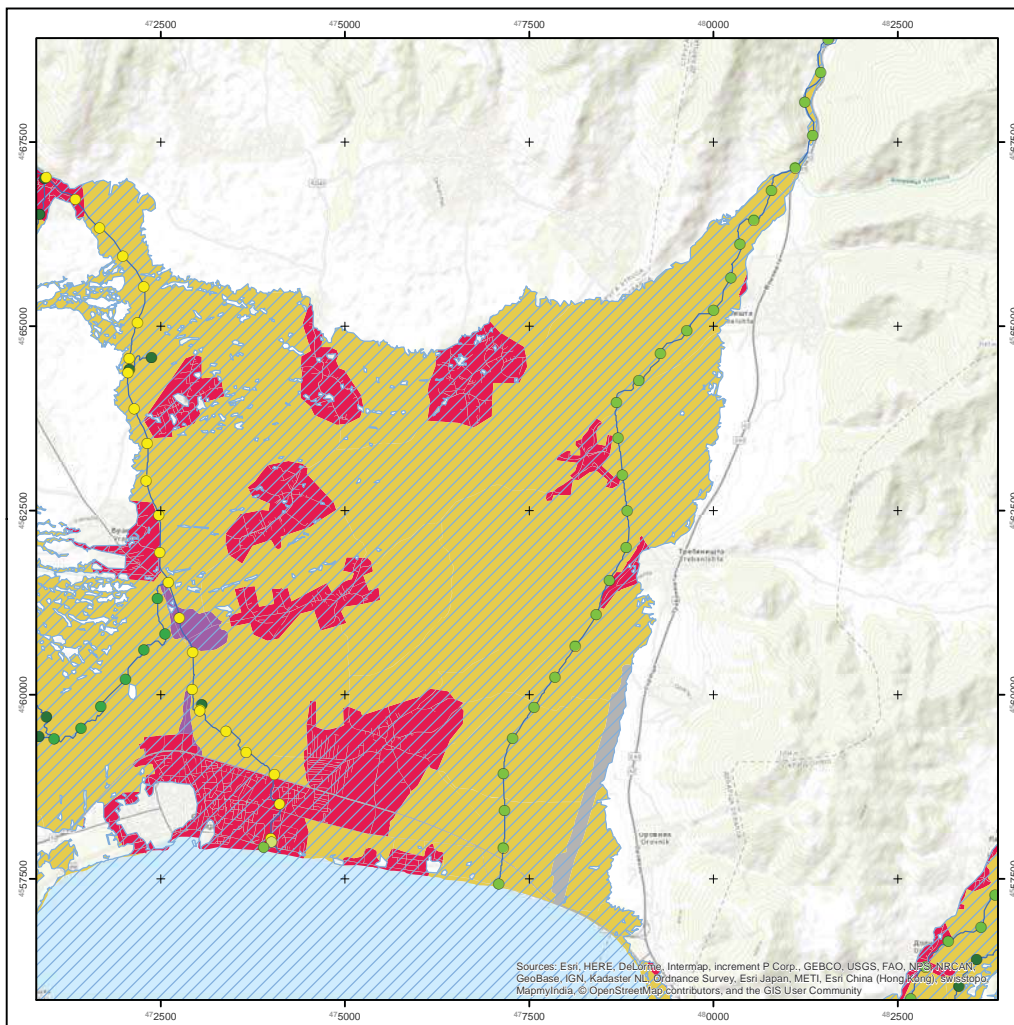
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-9

**Risk area:**  
Municipality of Struga, Debarca / North of Lake Ohrid  
River: Sateska

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

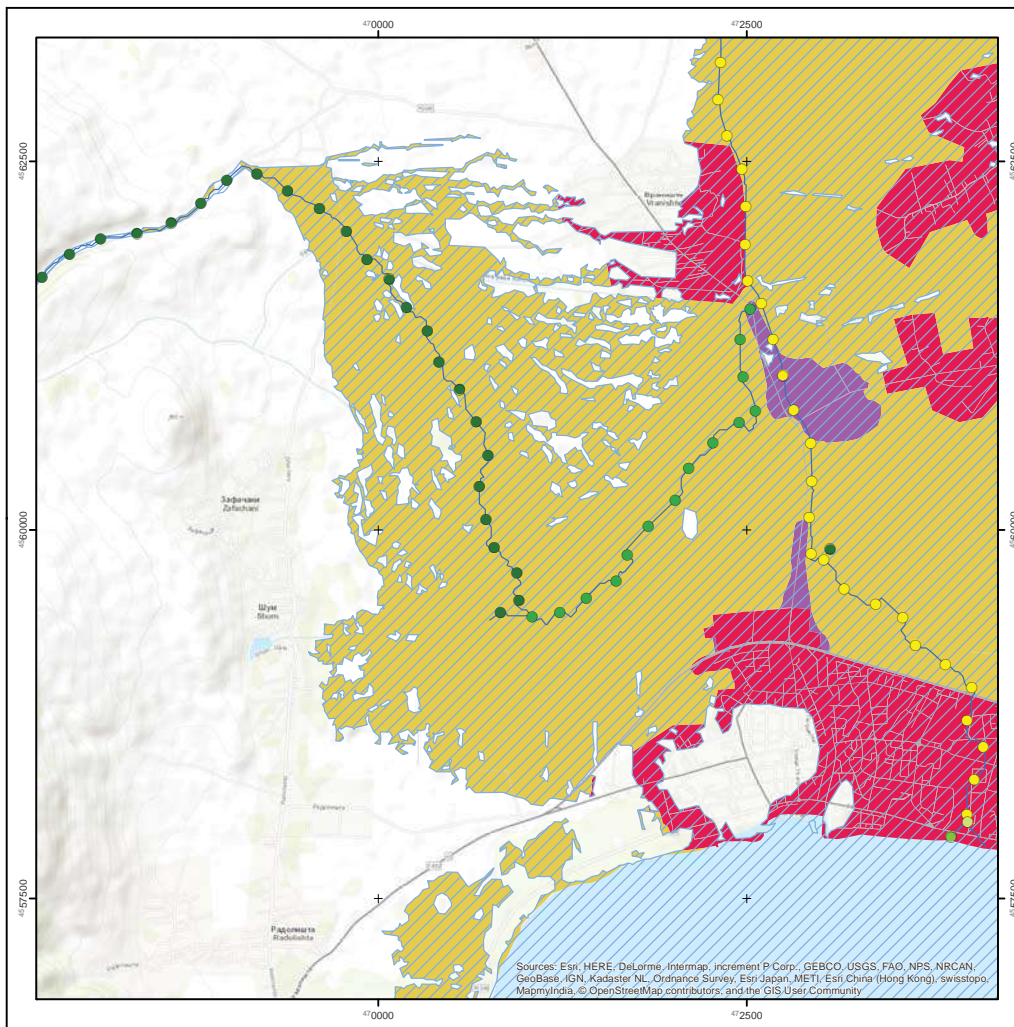
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-10

**Risk area:**  
Municipality of Struga / North of Lake Ohrid  
River: Shum

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

N  
0 500 1.000 m WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

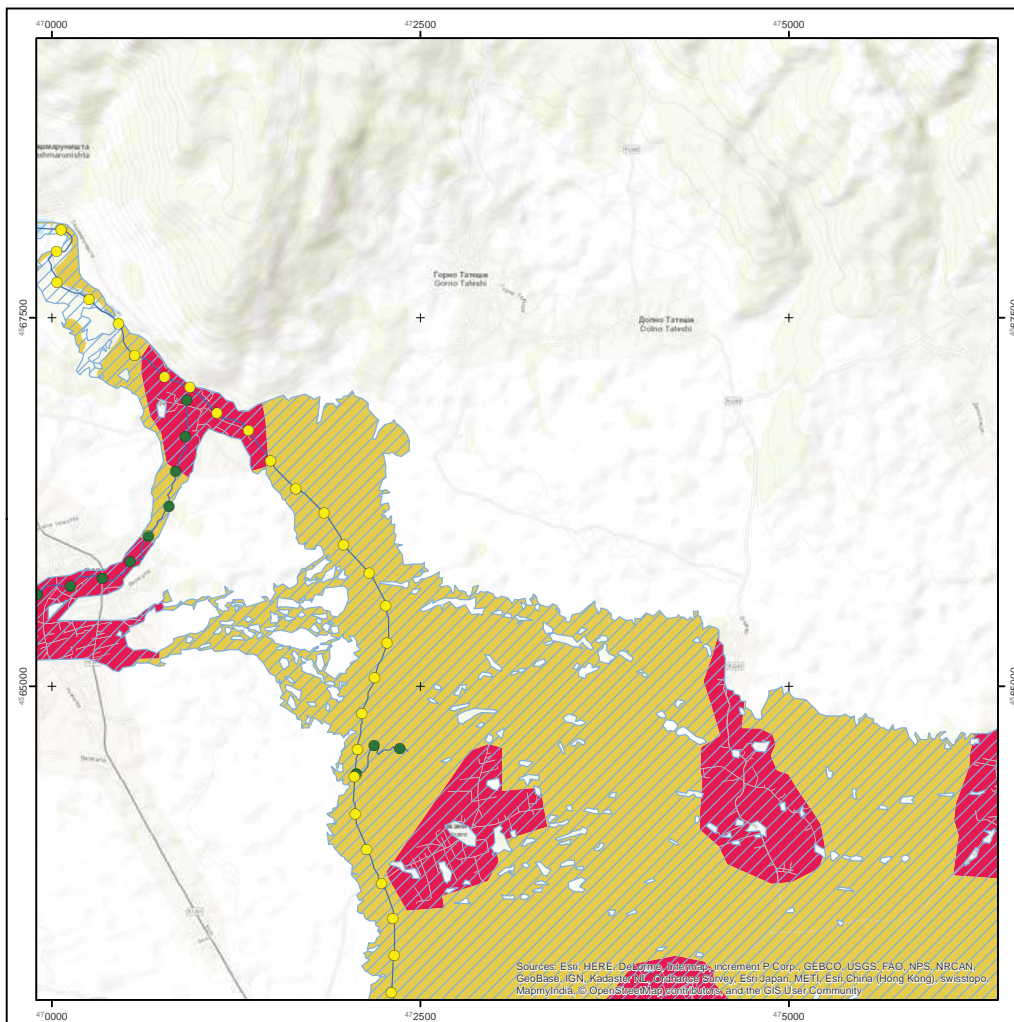
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-11

**Risk area:**  
Municipality of Struga / North of Lake Ohrid  
River: Sushica

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

N  
0 500 1.000 m WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

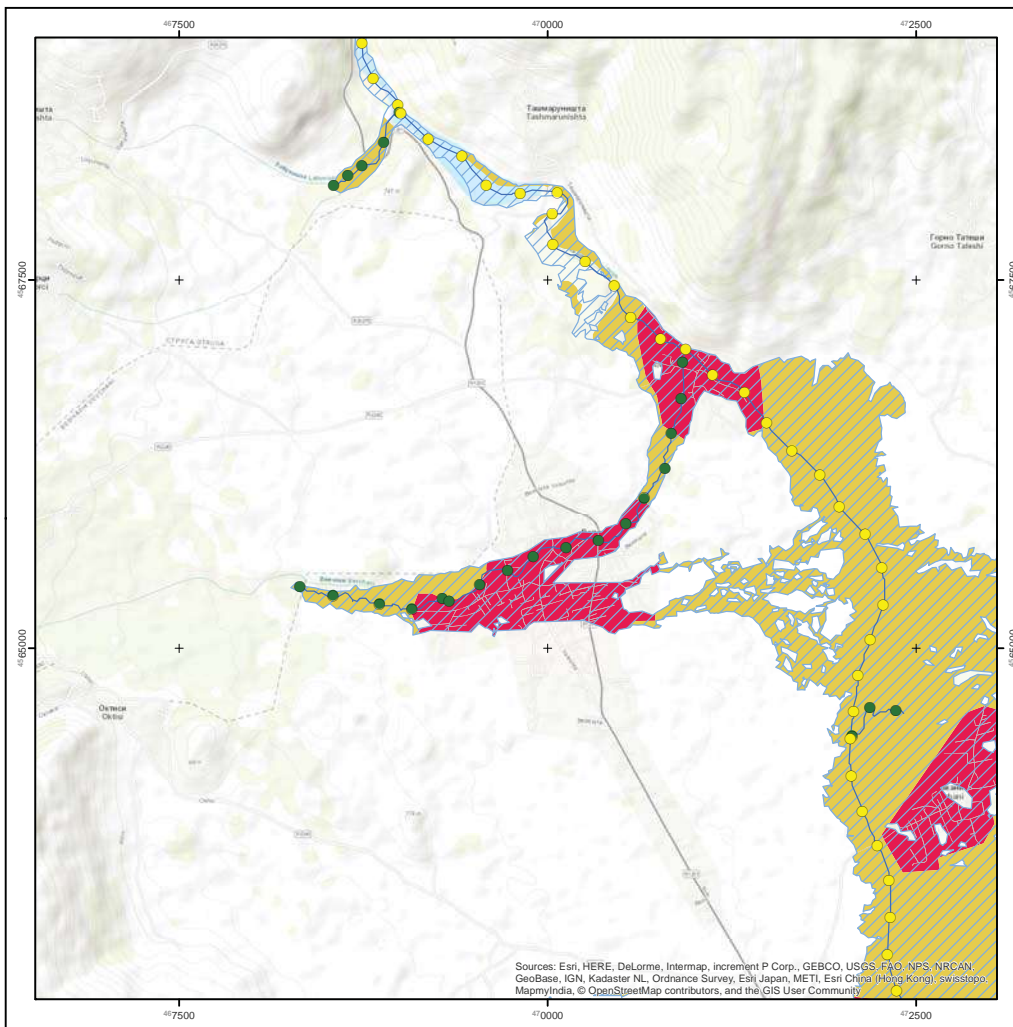
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## MK-12

**Risk area:**  
Municipality of Vevchani, Struga / North of Lake Ohrid  
River: Vevchanska

**Legend:**

- potentially flooded area scenario 2
- River
- Urban Areas
- Other Urban Areas
- Transport
- Industrial Areas
- Mineral extraction and dump sites
- Agriculture

**Catchment Size in km<sup>2</sup>**

- > 20
- > 50
- > 100
- > 200
- > 500
- > 1.000
- > 2.000
- > 5.000
- > 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

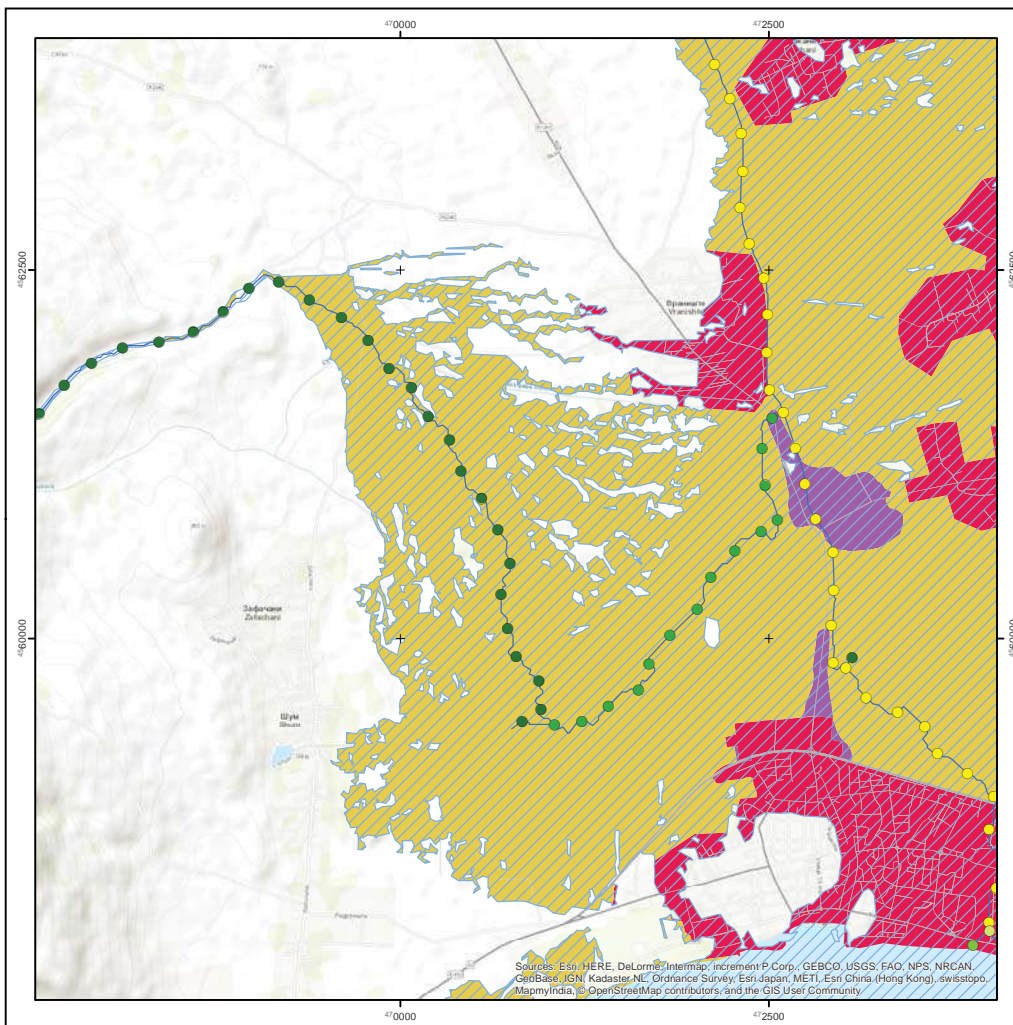
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## MK-13

**Risk area:**  
Municipality of Struga / North of Lake Ohrid  
River: Belichka

**Legend:**

- potentially flooded area scenario 2
- River
- Urban Areas
- Other Urban Areas
- Transport
- Industrial Areas
- Mineral extraction and dump sites
- Agriculture

**Catchment Size in km<sup>2</sup>**

- > 20
- > 50
- > 100
- > 200
- > 500
- > 1.000
- > 2.000
- > 5.000
- > 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

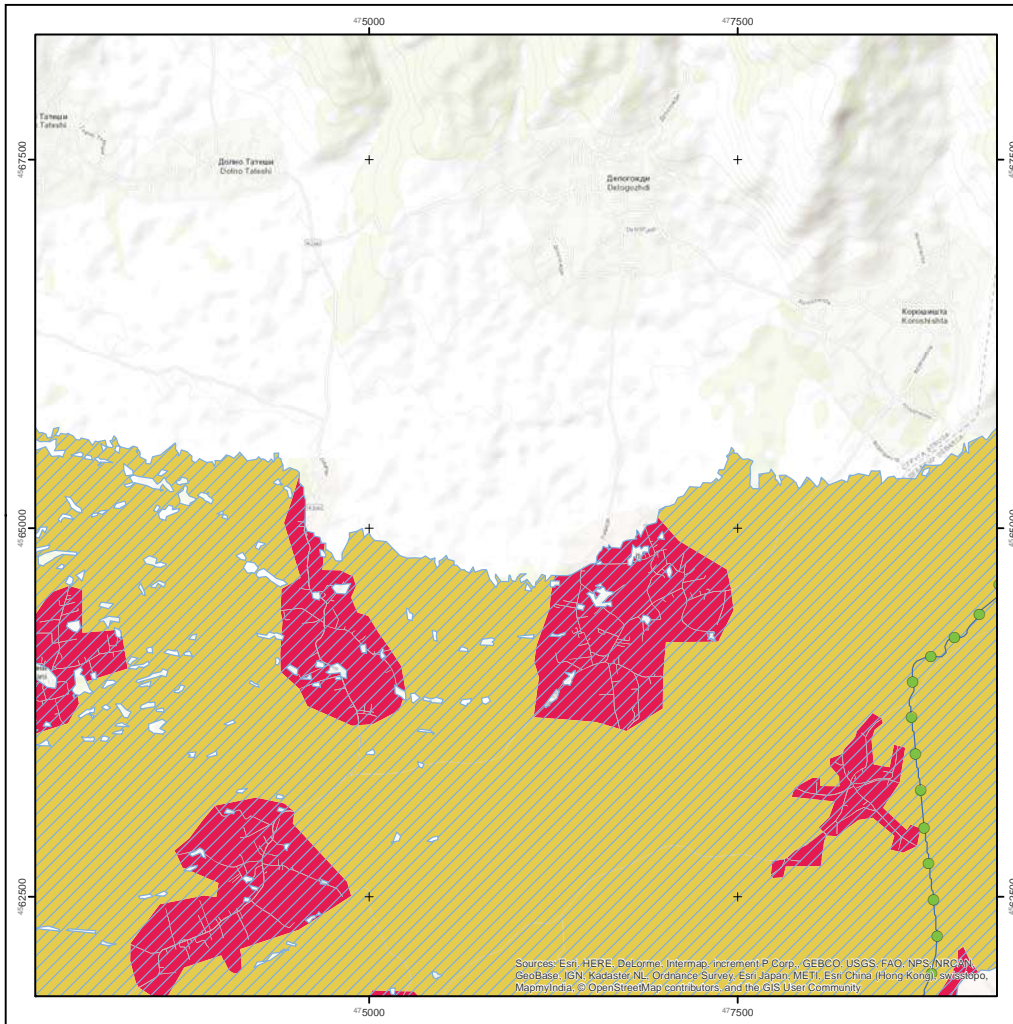
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## MK-14

**Risk area:**  
Municipality of Struga / North of Lake Ohrid  
River: Dzepinska

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1,000
Agriculture	> 2,000
	> 5,000
	> 10,000

N WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

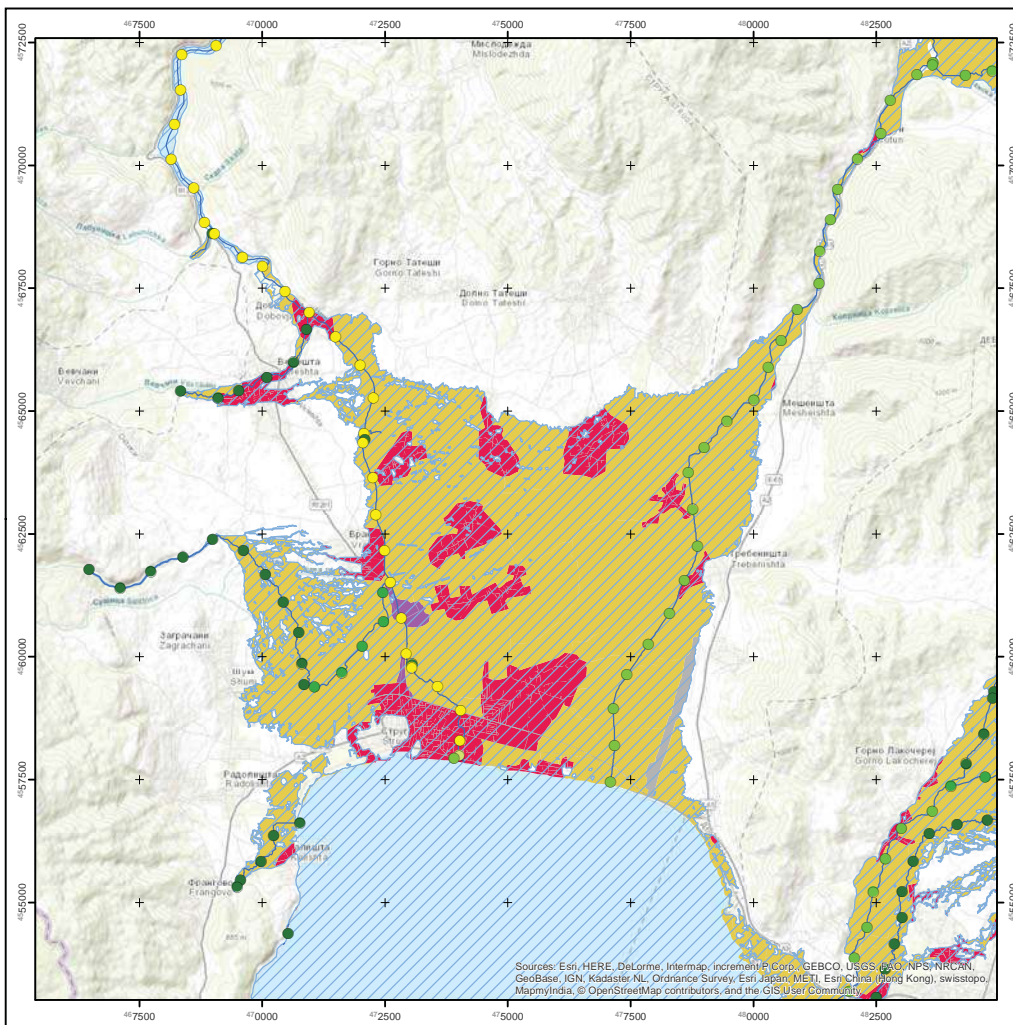
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## MK-8-14

**Risk area:**  
Municipality of Struga / North of Lake Ohrid  
River: Black Drin, Sateska, Shum, Sushica, Vevchanska, Belichka, Dzepinska

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1,000
Agriculture	> 2,000
	> 5,000
	> 10,000

N WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

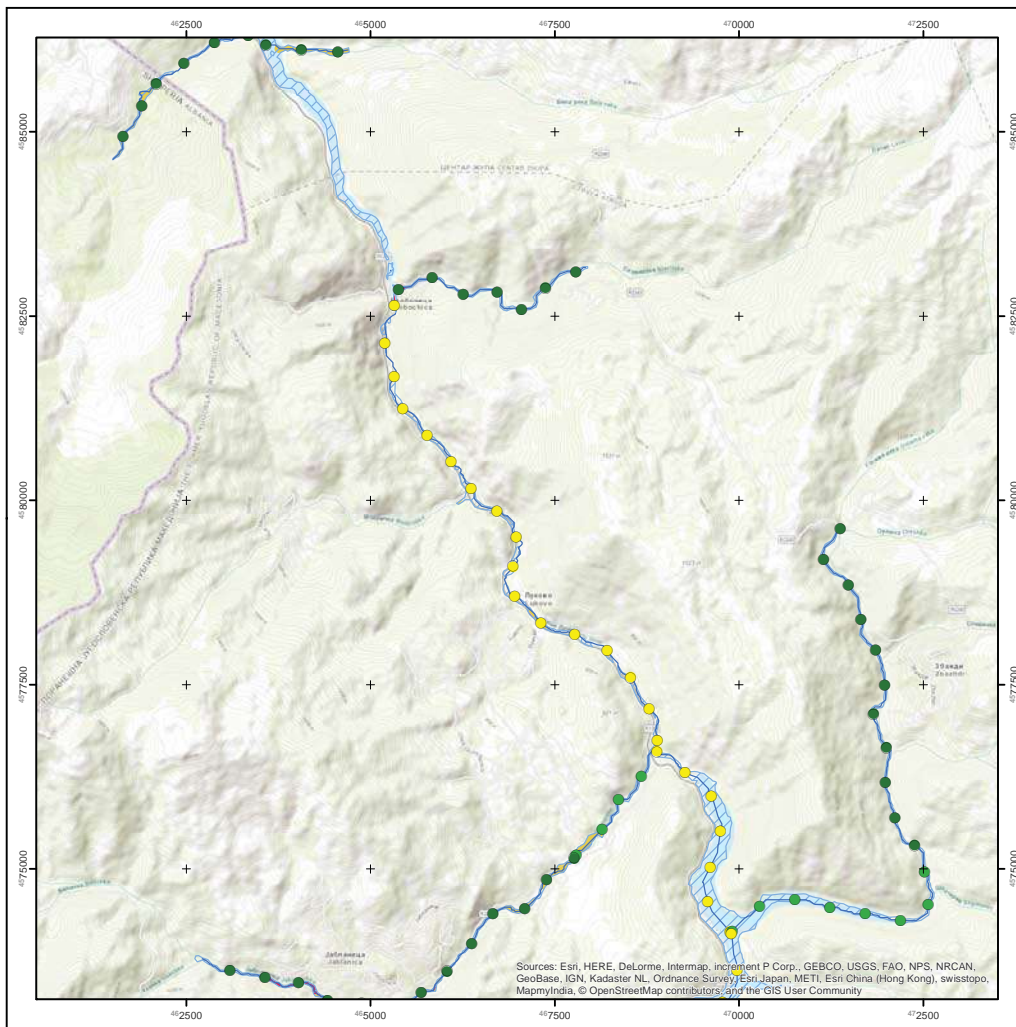
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-15

**Risk area:**  
Municipality of Struga / North of Globochica reservoir  
River: Black Drin (between Globochica and Shipile reservoirs)

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

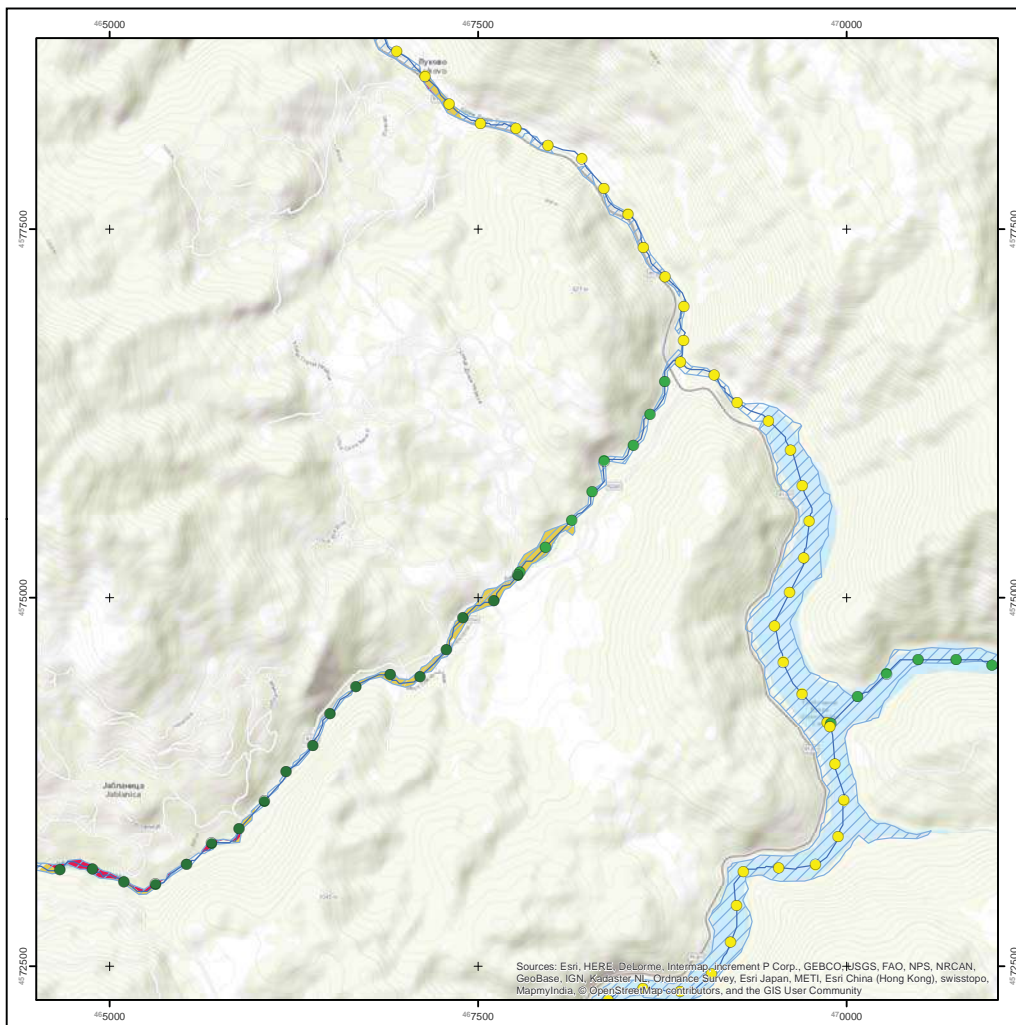
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### MK-16

**Risk area:**  
Municipality of Struga / West of Globochica reservoir  
River: Piskupshina

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

Darmstadt, Germany

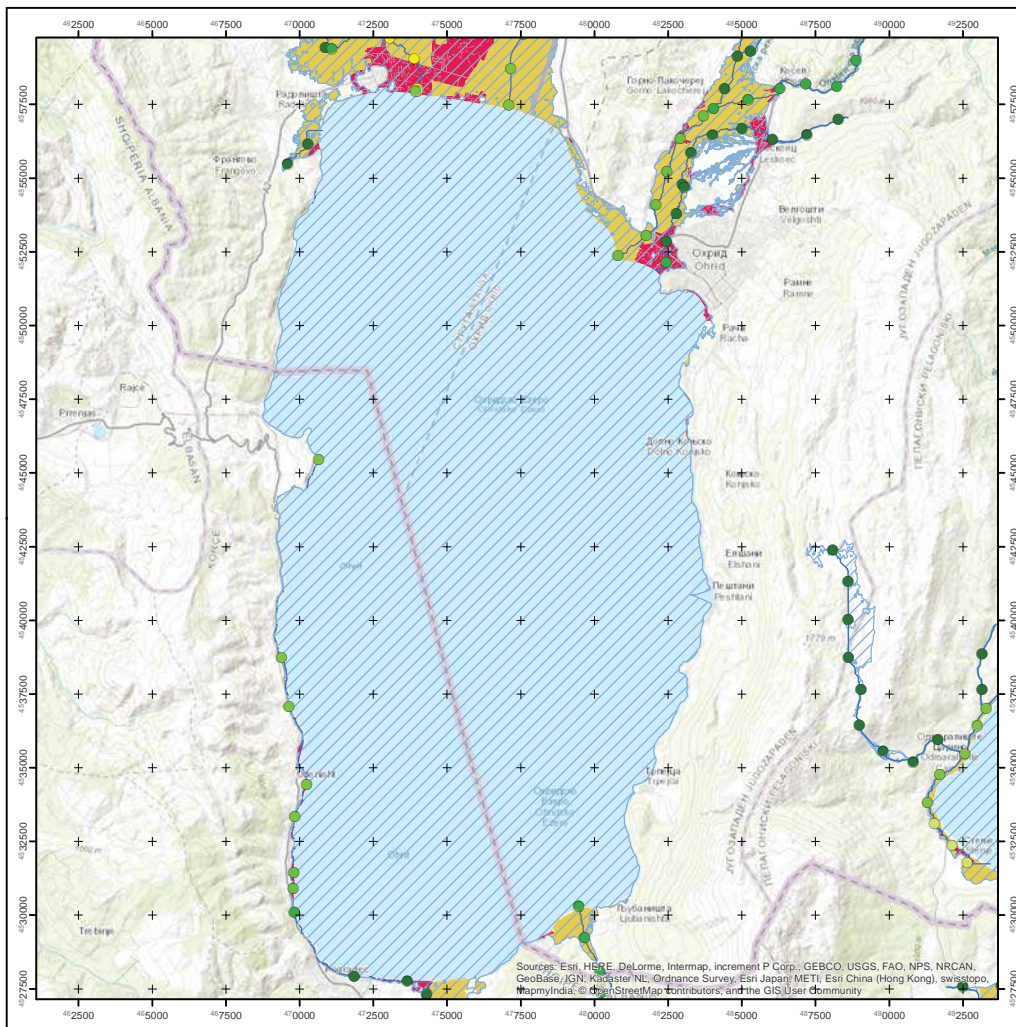
Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ





**Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin**

**MK-19**

**Risk area:** Ohrid Lake  
**River:** Ohrid Lake

**Legend:**

- potentially flooded area scenario 2
- River
- Urban Areas
- Other Urban Areas
- Transport
- Industrial Areas
- Mineral extraction and dump sites
- Agriculture

**Catchment Size in km<sup>2</sup>**

- > 20
- > 50
- > 100
- > 200
- > 500
- > 1.000
- > 2.000
- > 5.000
- > 10.000

**Data sources:** BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:** Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

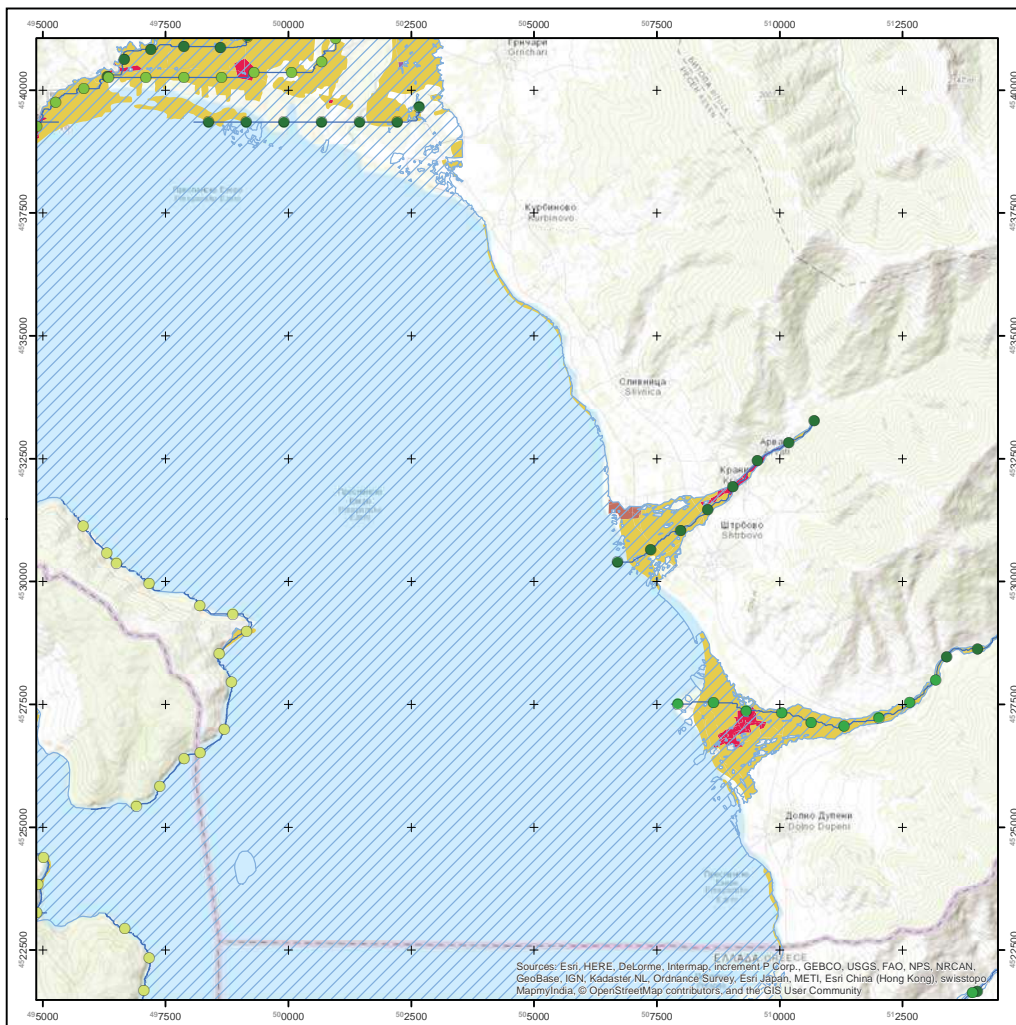
**PFRA-Study and maps:**

**INFRASTRUKTUR & UMWELT** (Darmstadt, Germany) | **geomer** (Heidelberg, Germany)

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ) | Implemented by GIZ



**Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin**

**MK-20**

**Risk area:** Prespa Lake  
**River:** Prespa Lake

**Legend:**

- potentially flooded area scenario 2
- River
- Urban Areas
- Other Urban Areas
- Transport
- Industrial Areas
- Mineral extraction and dump sites
- Agriculture

**Catchment Size in km<sup>2</sup>**

- > 20
- > 50
- > 100
- > 200
- > 500
- > 1.000
- > 2.000
- > 5.000
- > 10.000

**Data sources:** BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:** Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

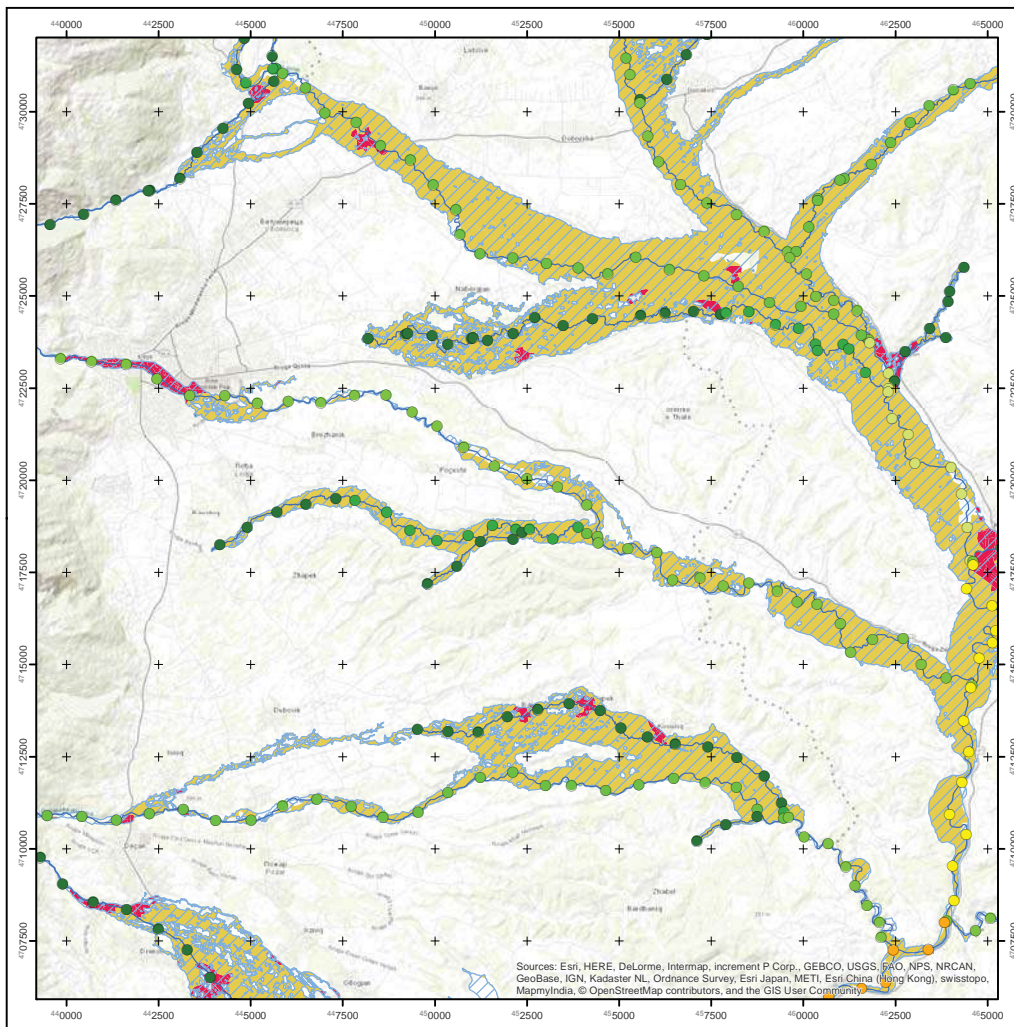
**INFRASTRUKTUR & UMWELT** (Darmstadt, Germany) | **geomer** (Heidelberg, Germany)

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ) | Implemented by GIZ





### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### KO-1

**Risk area:**  
Peja  
River: Lumbardhi i Pejës

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

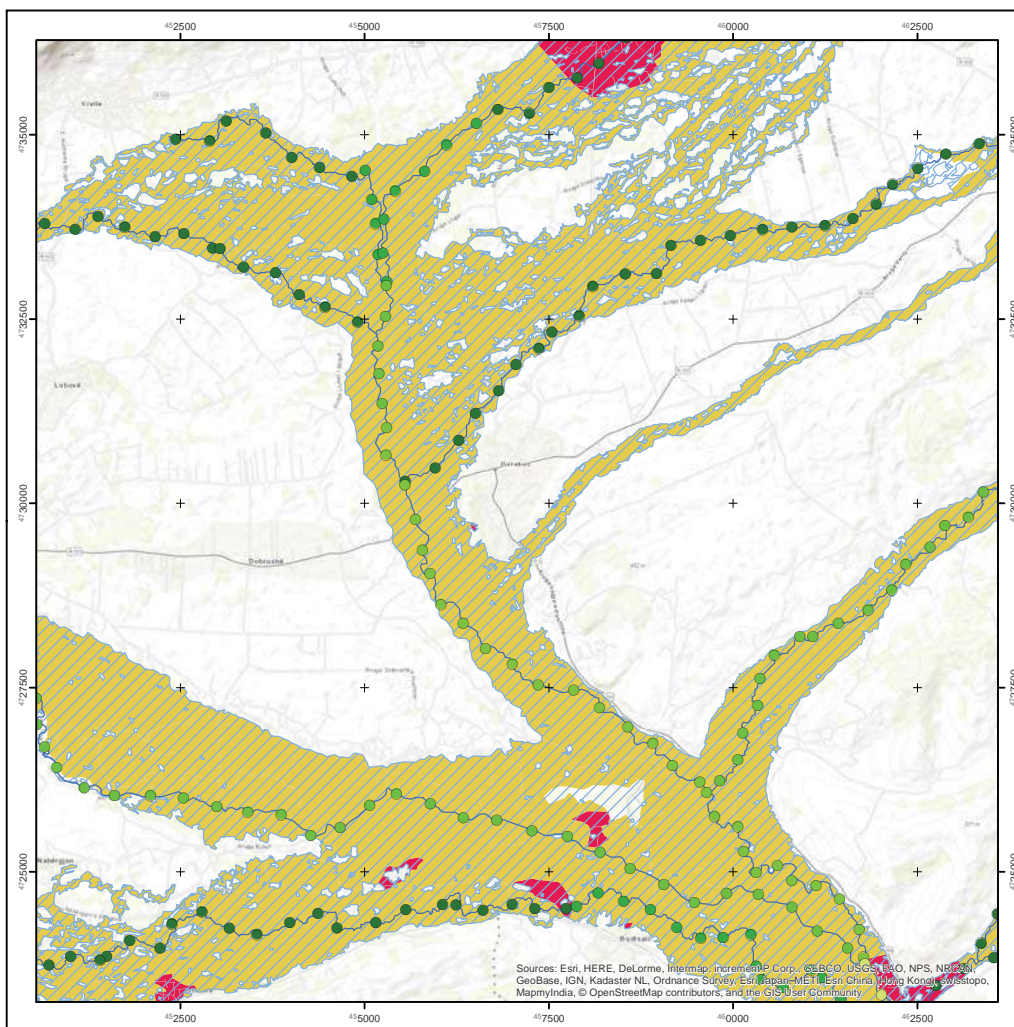
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### KO-2

**Risk area:**  
Istog  
River: Lumi i Istogut

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

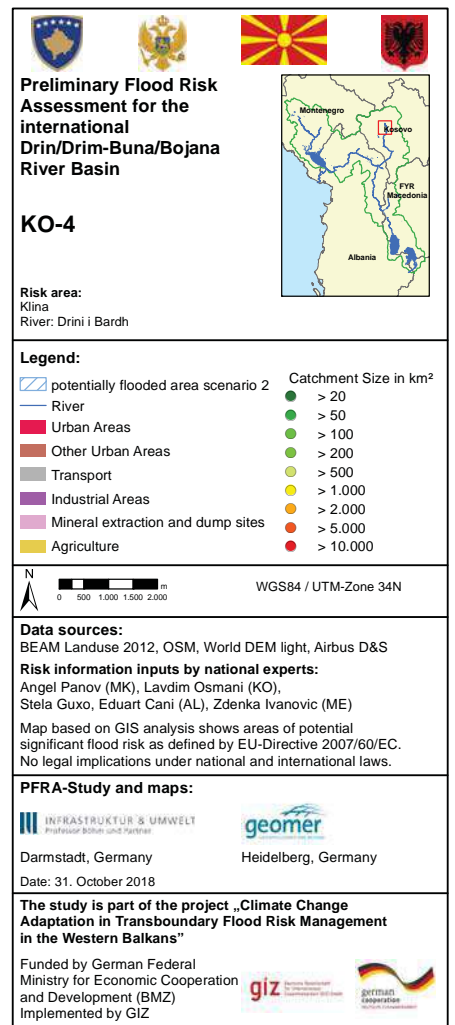
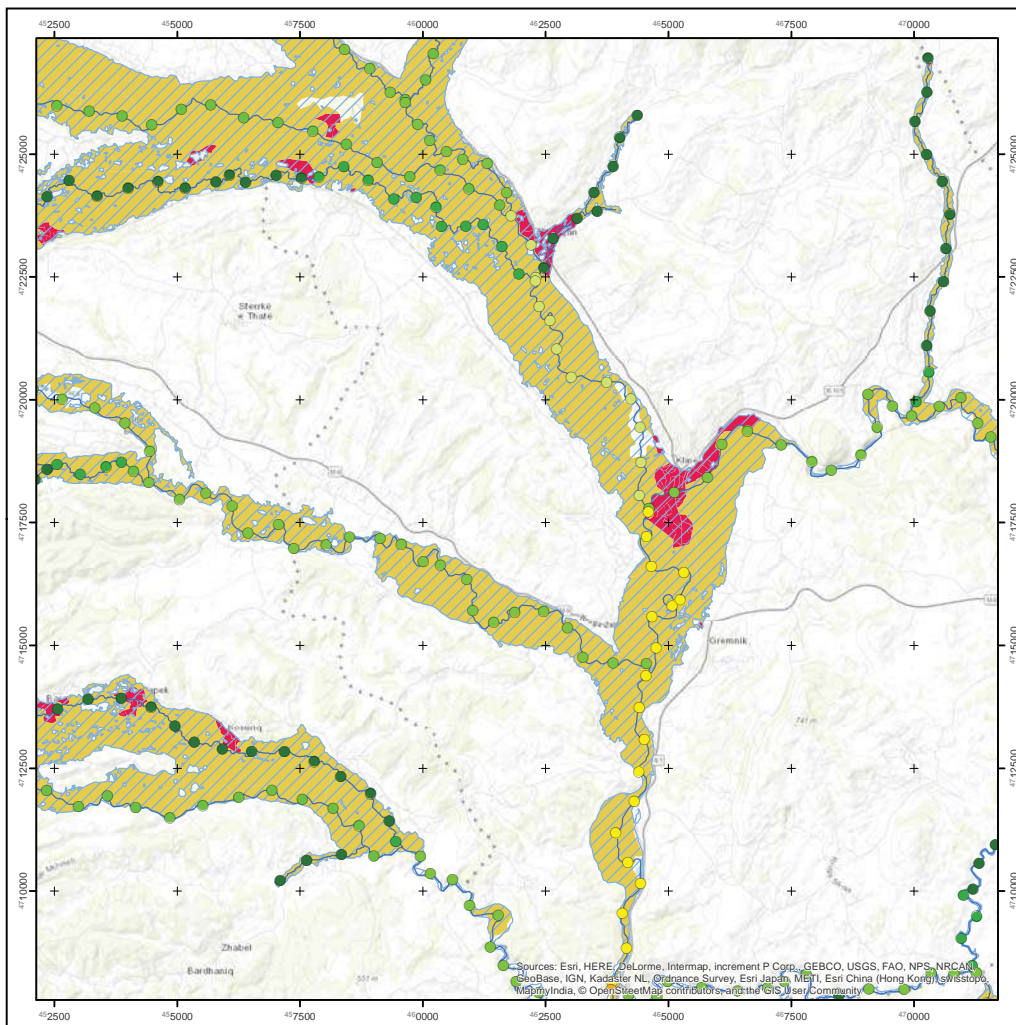
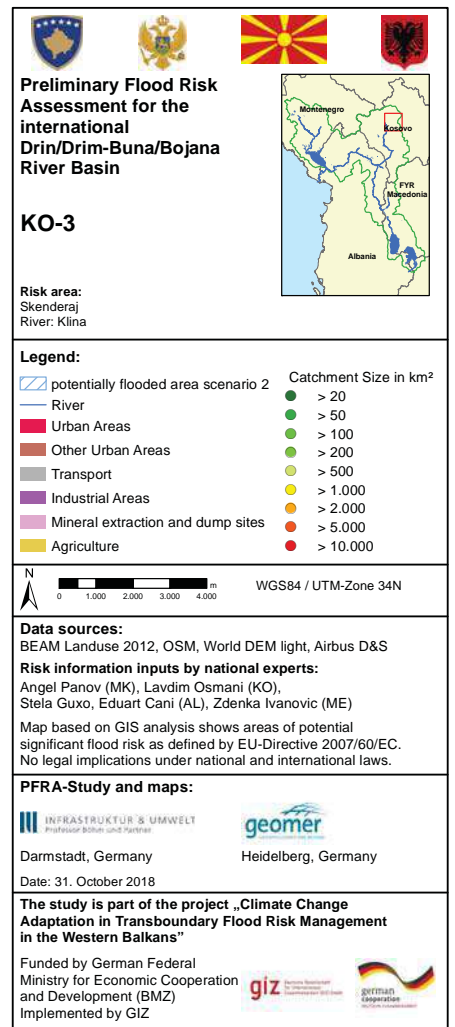
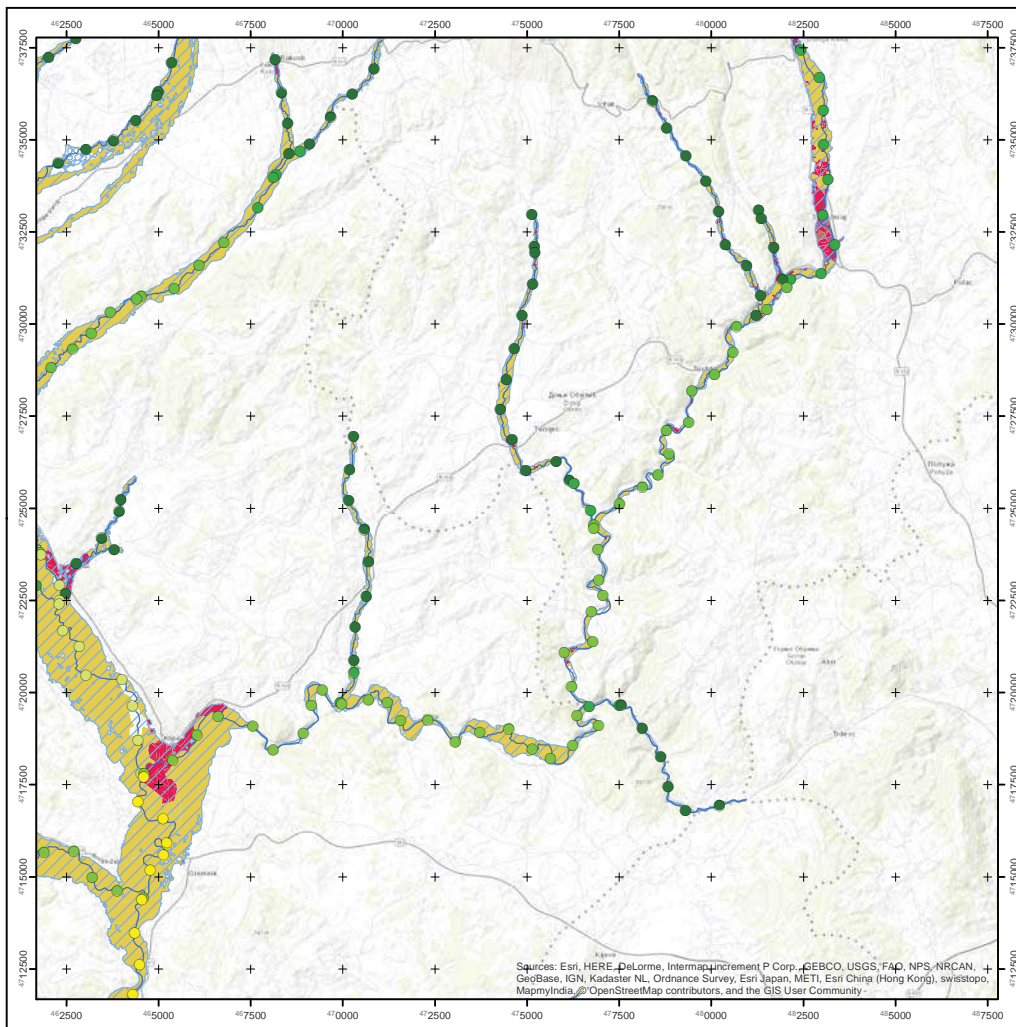
Darmstadt, Germany

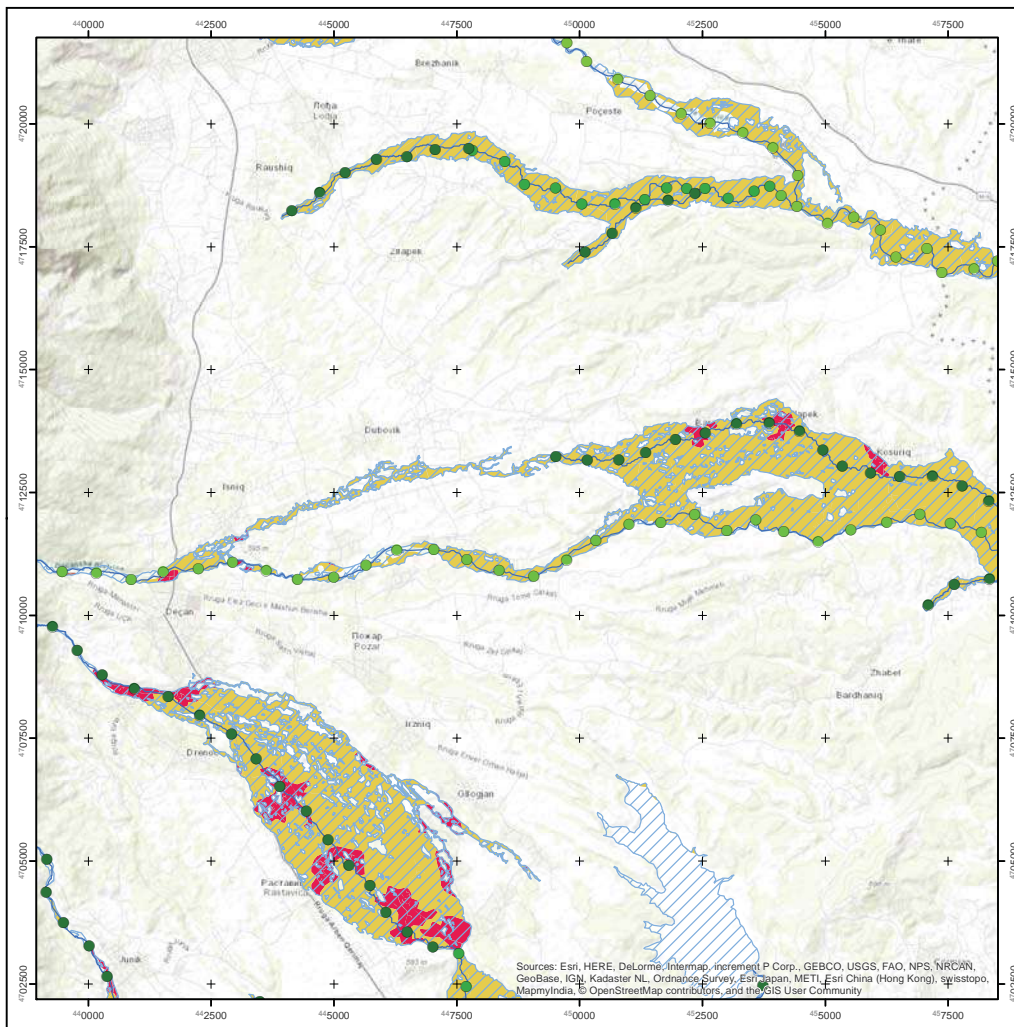
Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ





### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## KO-5

**Risk area:**  
Decan  
River: Bistrica Decan

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

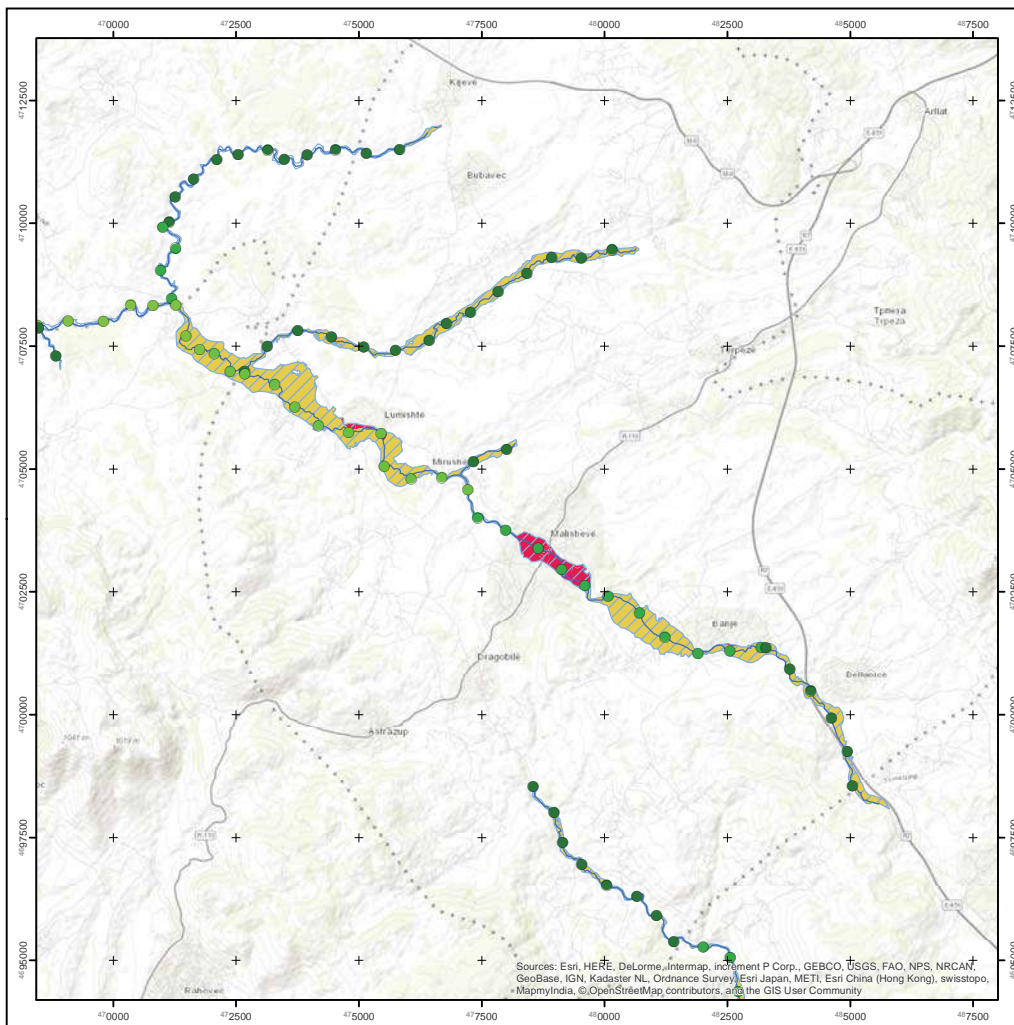
**PFRA-Study and maps:**

Darmstadt, Germany	Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## KO-6

**Risk area:**  
Malisheva  
River: Mirusha

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

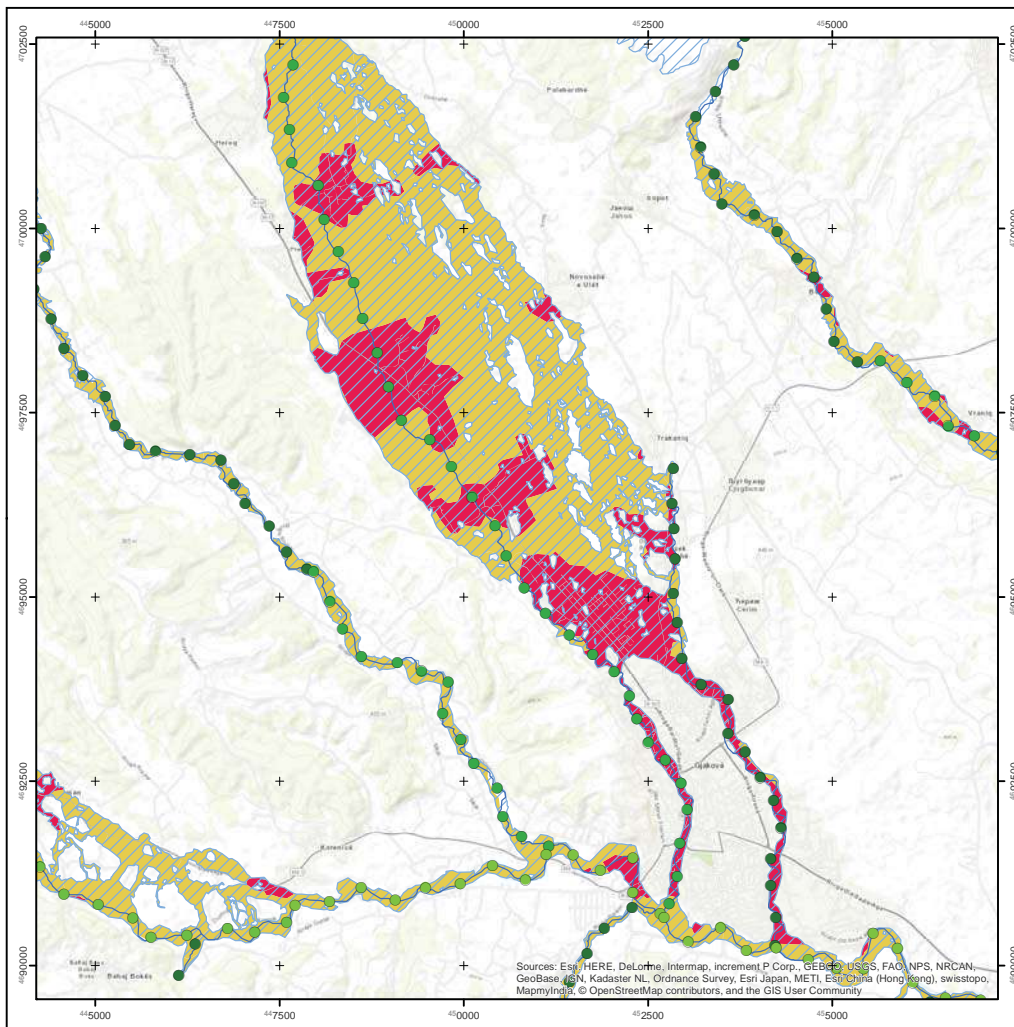
**PFRA-Study and maps:**

Darmstadt, Germany	Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### KO-7

**Risk area:**  
Gjakova  
**River:** Krena

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

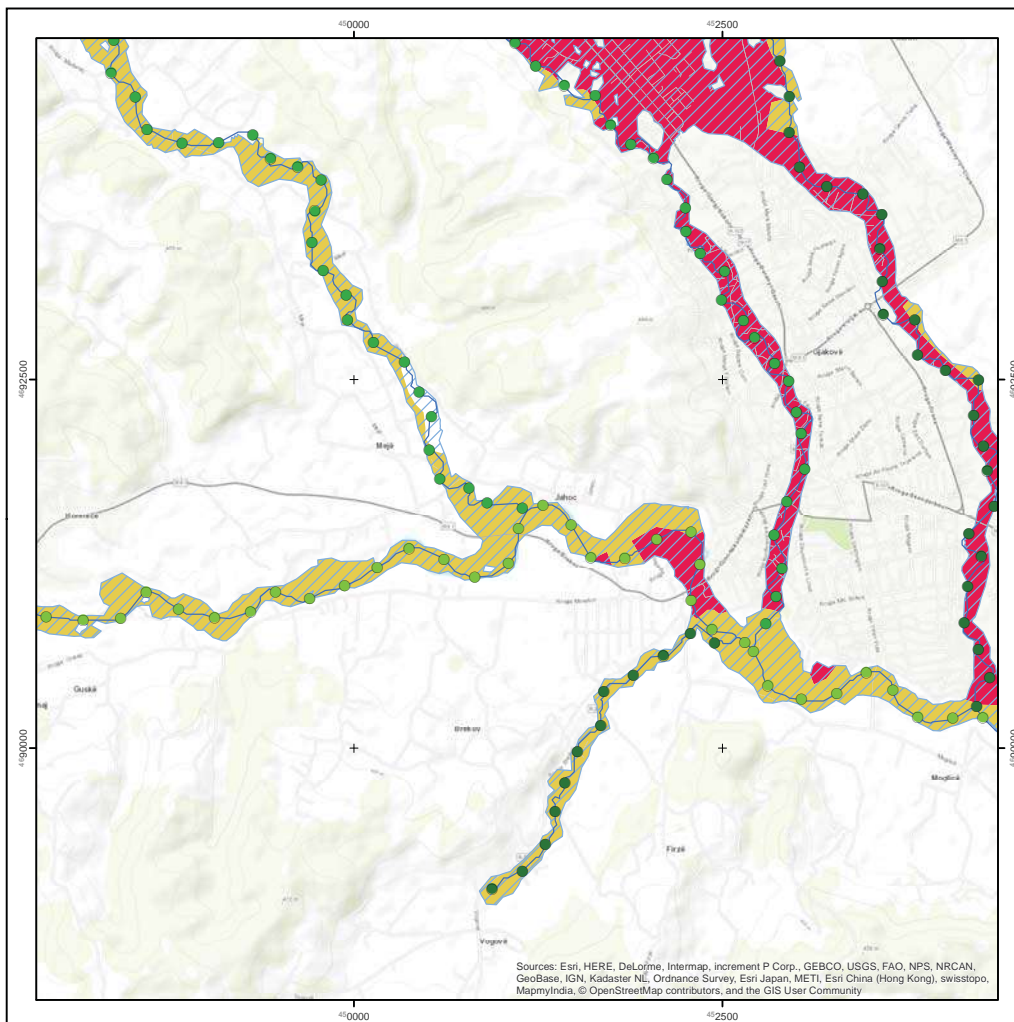
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### KO-8

**Risk area:**  
Gjakova  
**River:** Erenik

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

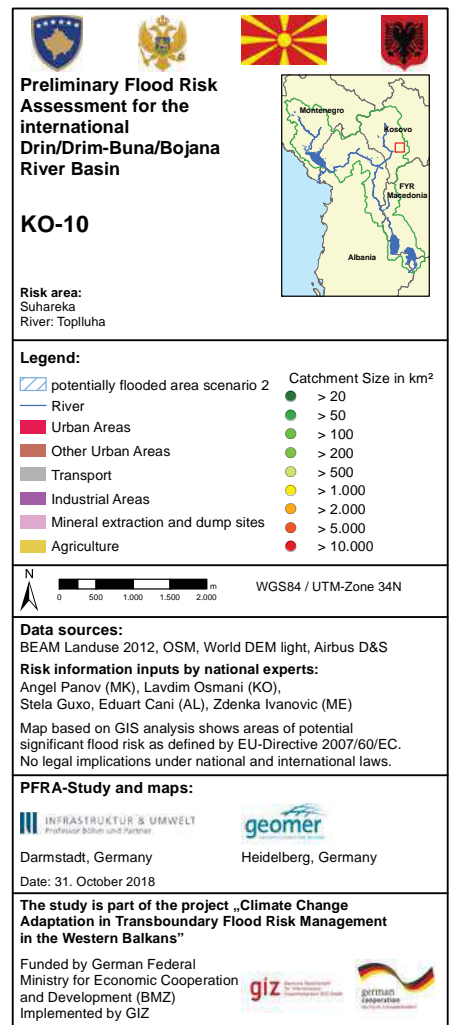
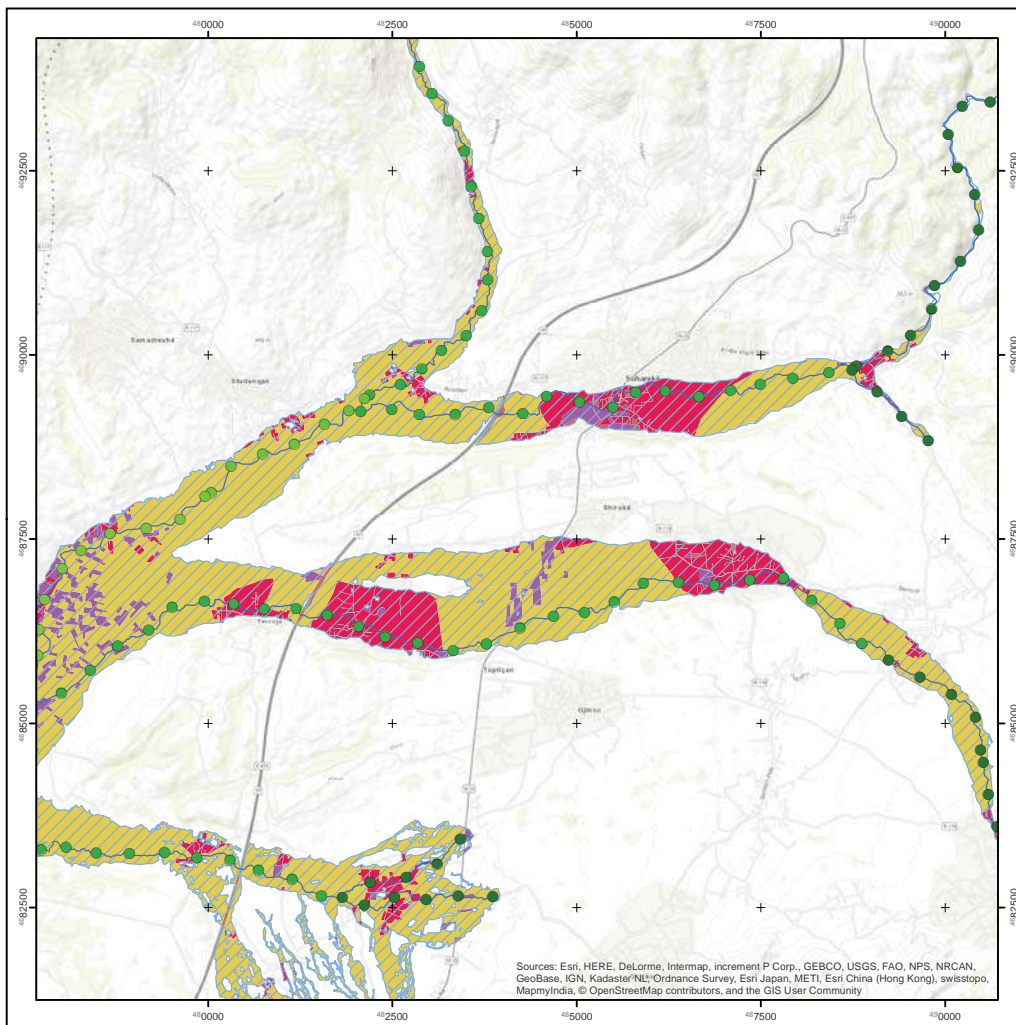
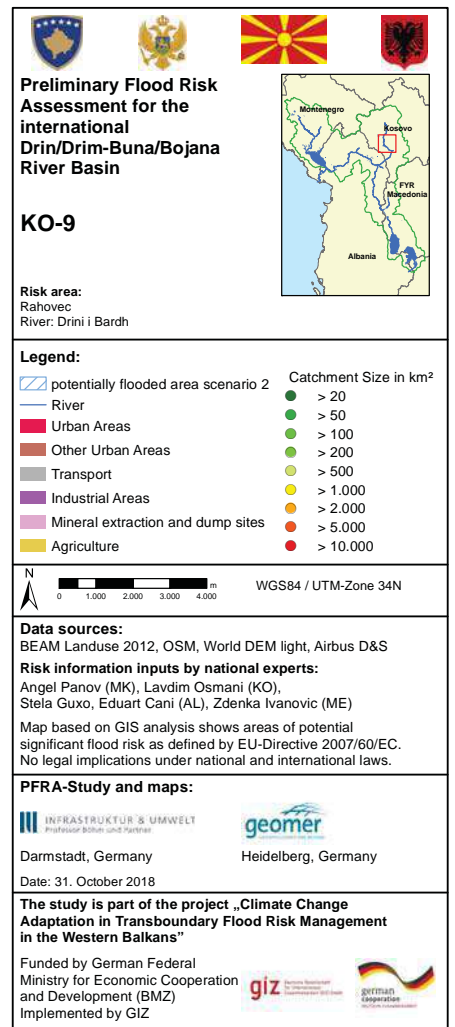
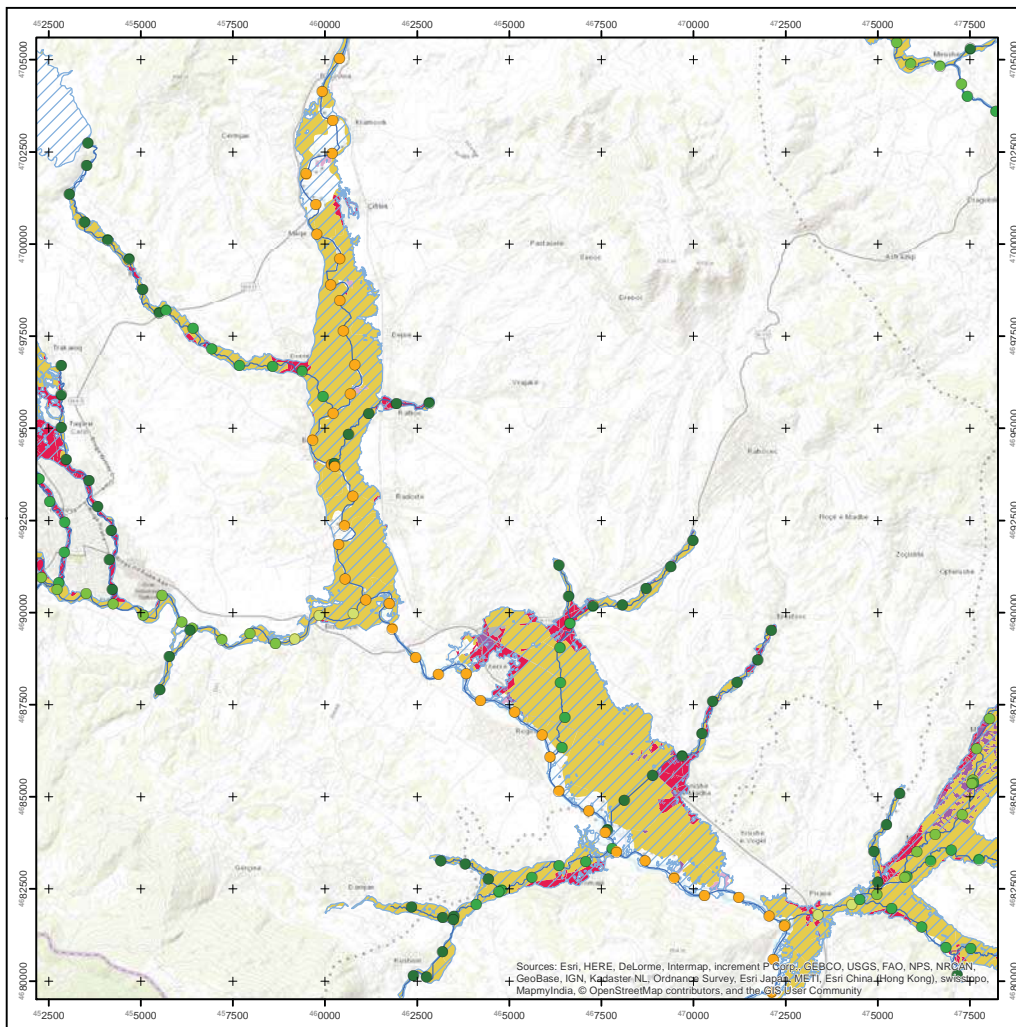
Darmstadt, Germany

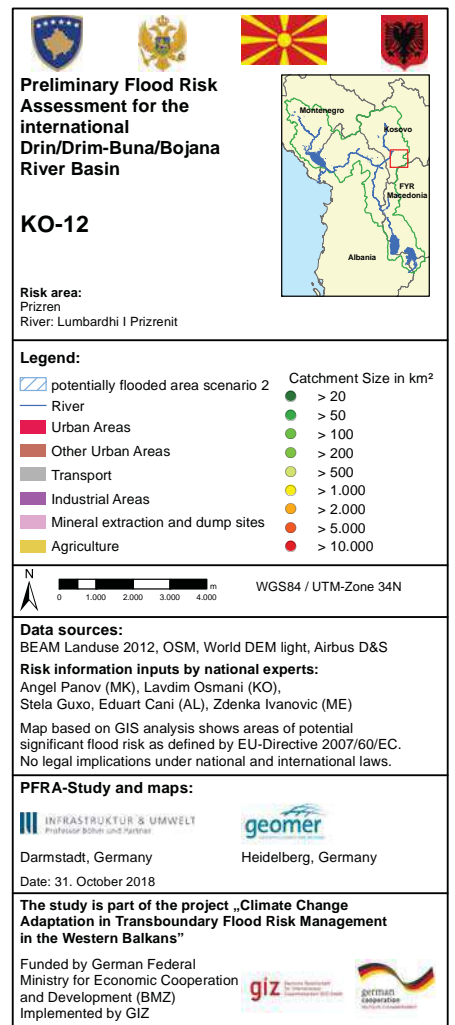
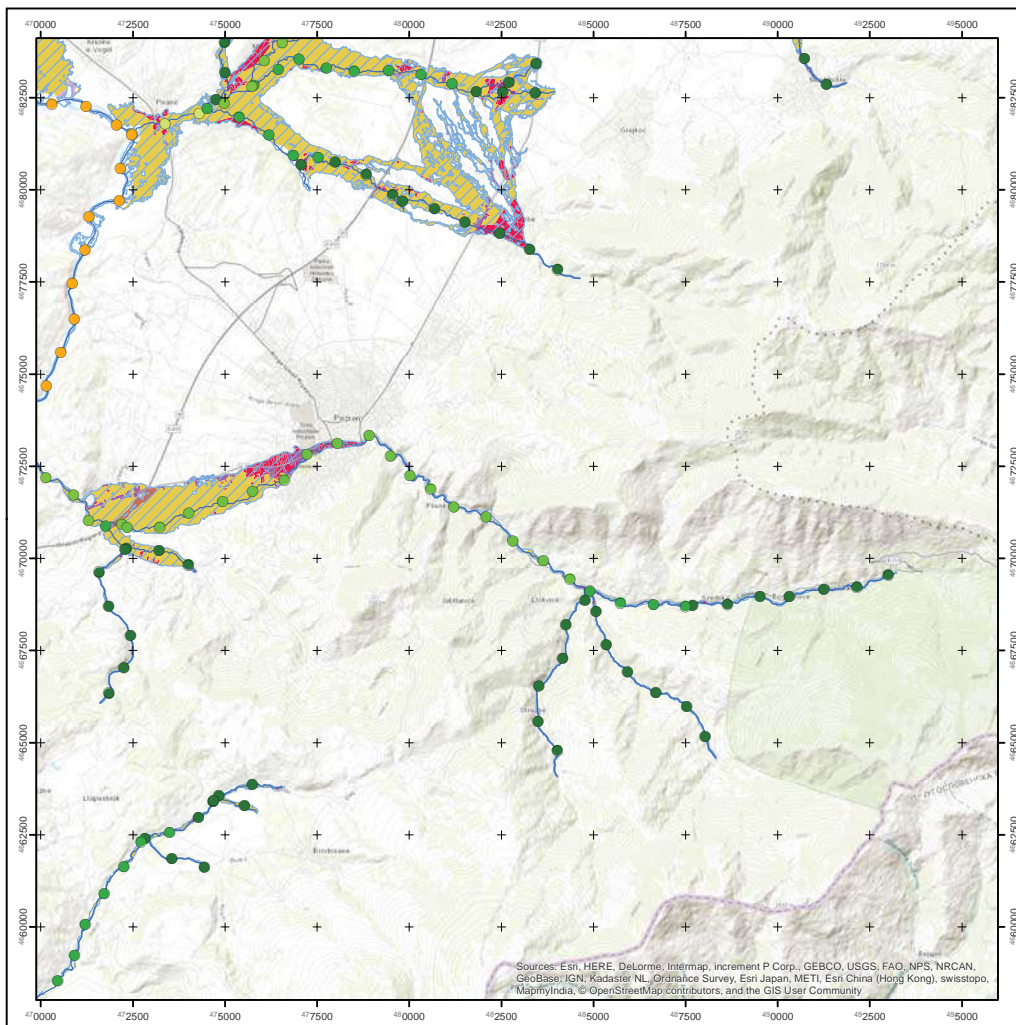
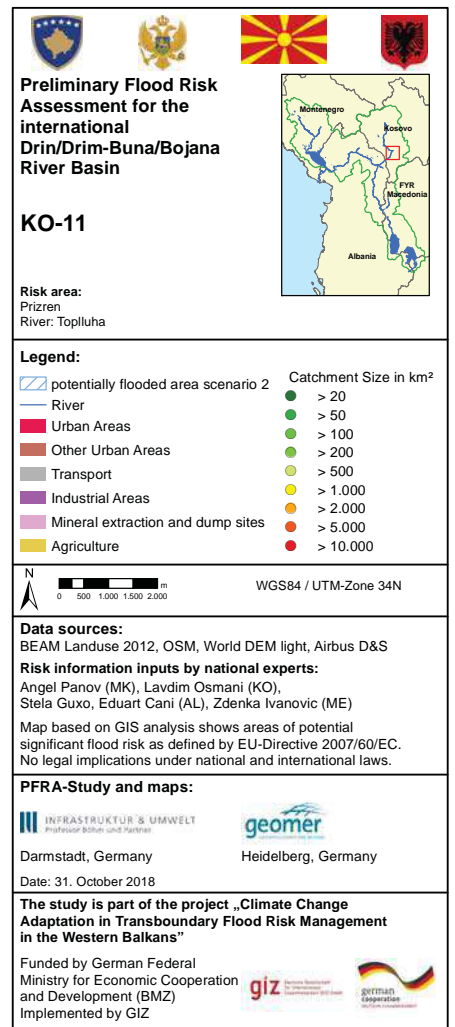
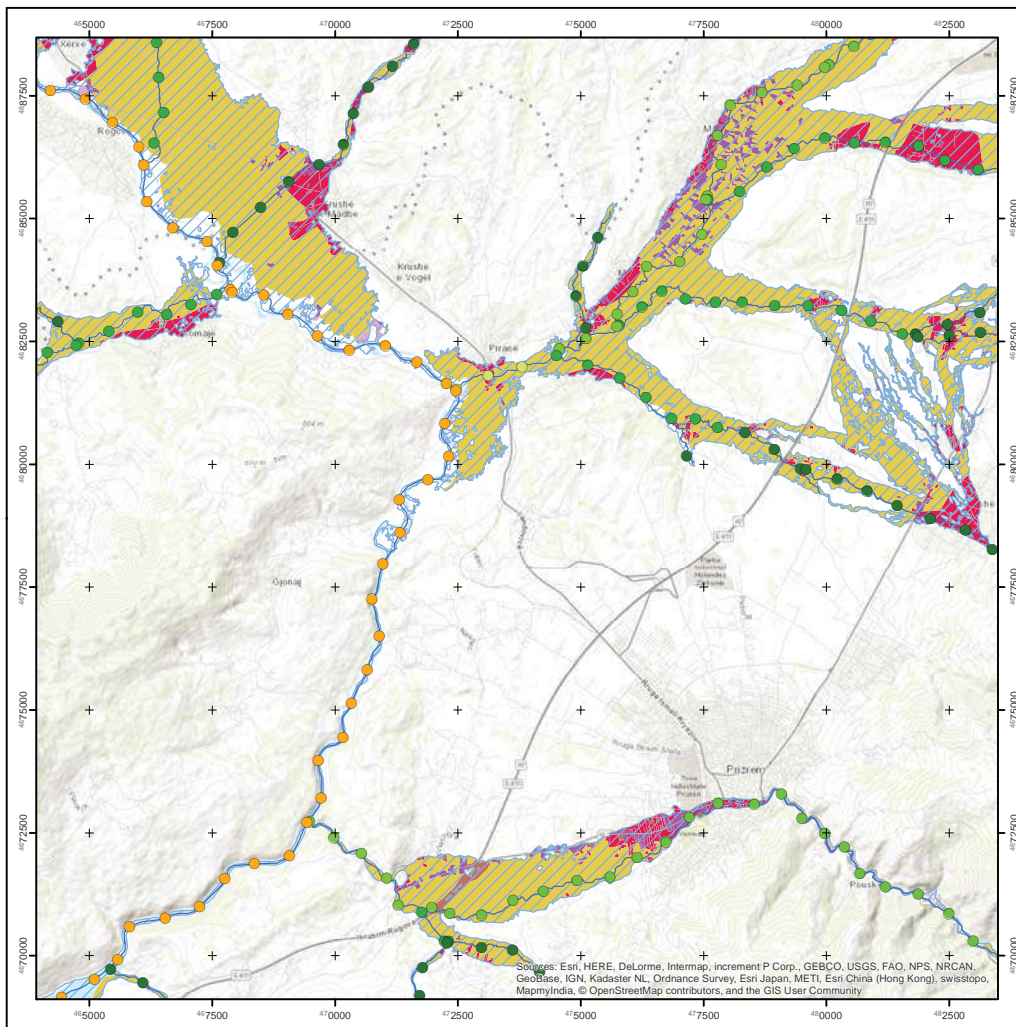
Heidelberg, Germany

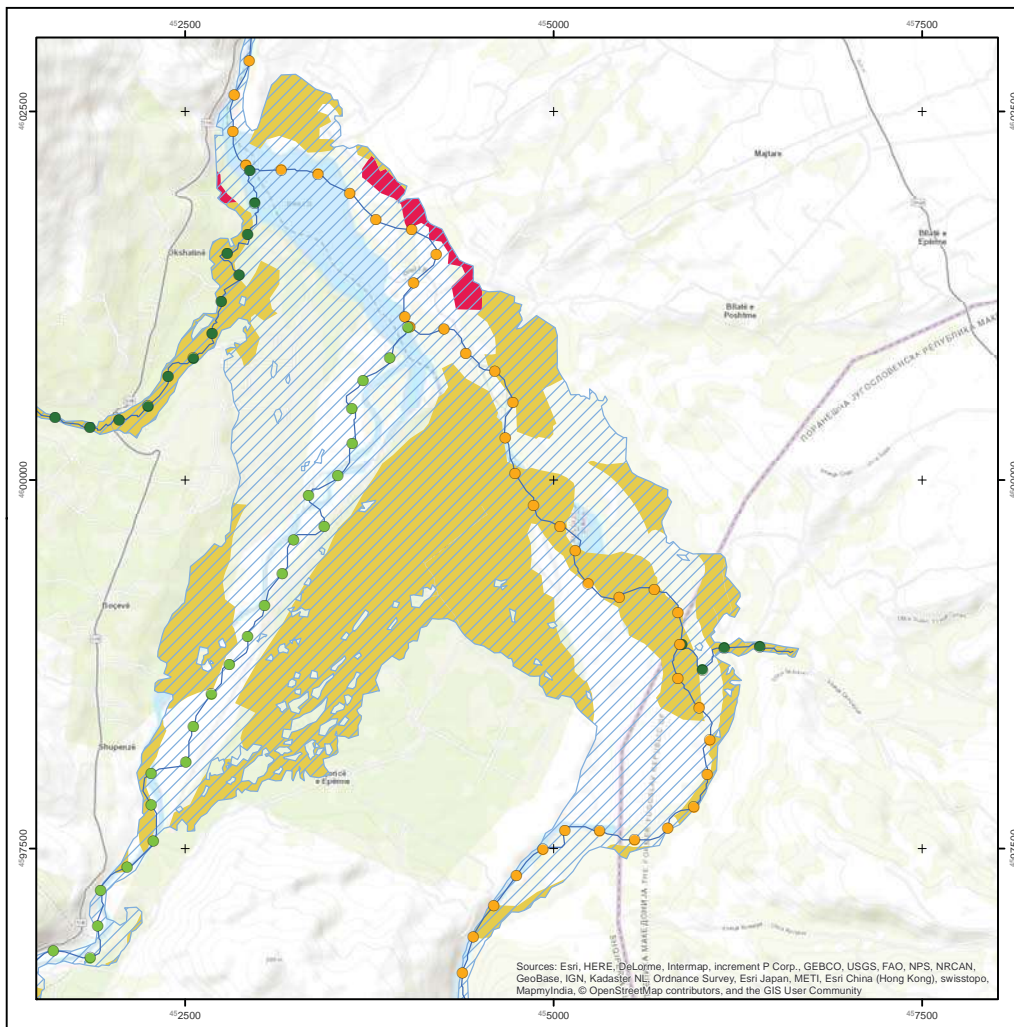
Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ







### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-1a

**Risk area:**  
Diber, villages of Potgorcë and Gjoricë  
River: Black Drin

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

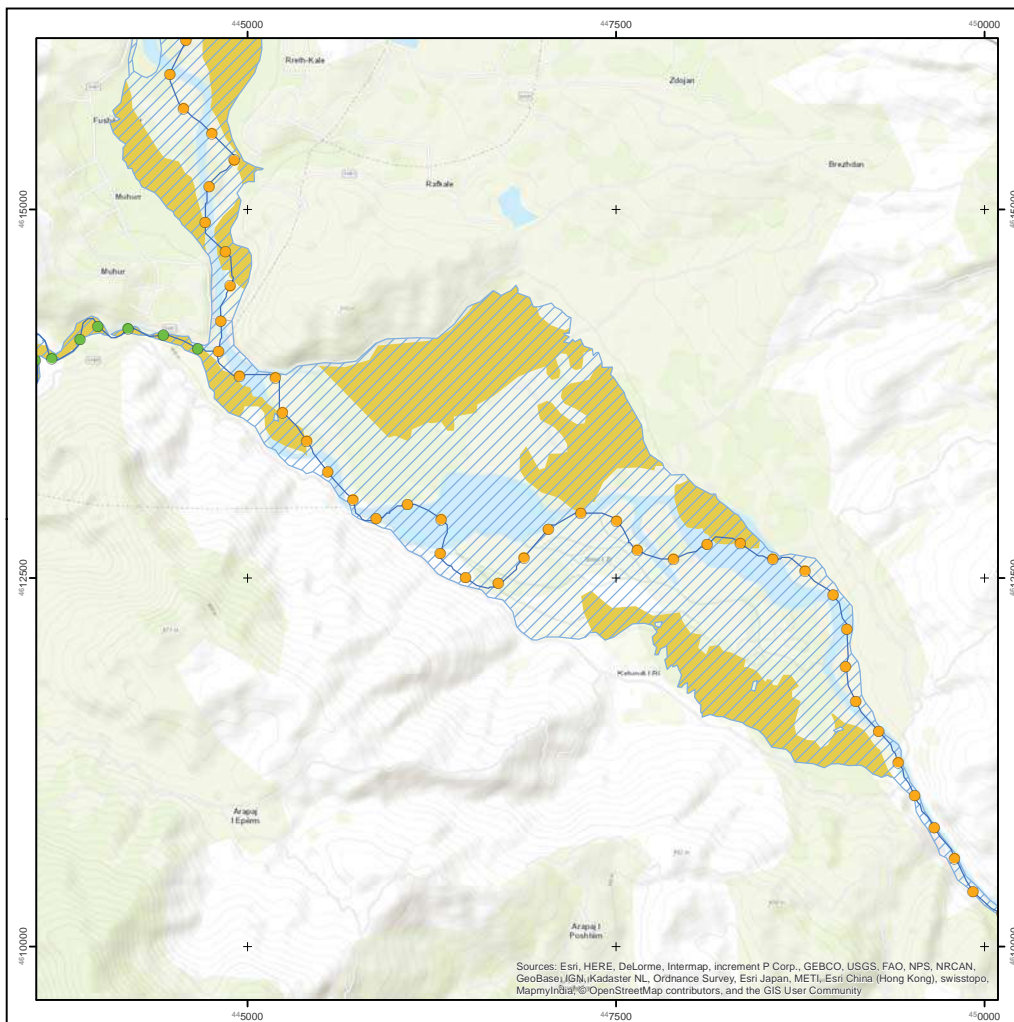
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-1b

**Risk area:**  
Diber, village of Brezhdan  
River: Black Drin

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

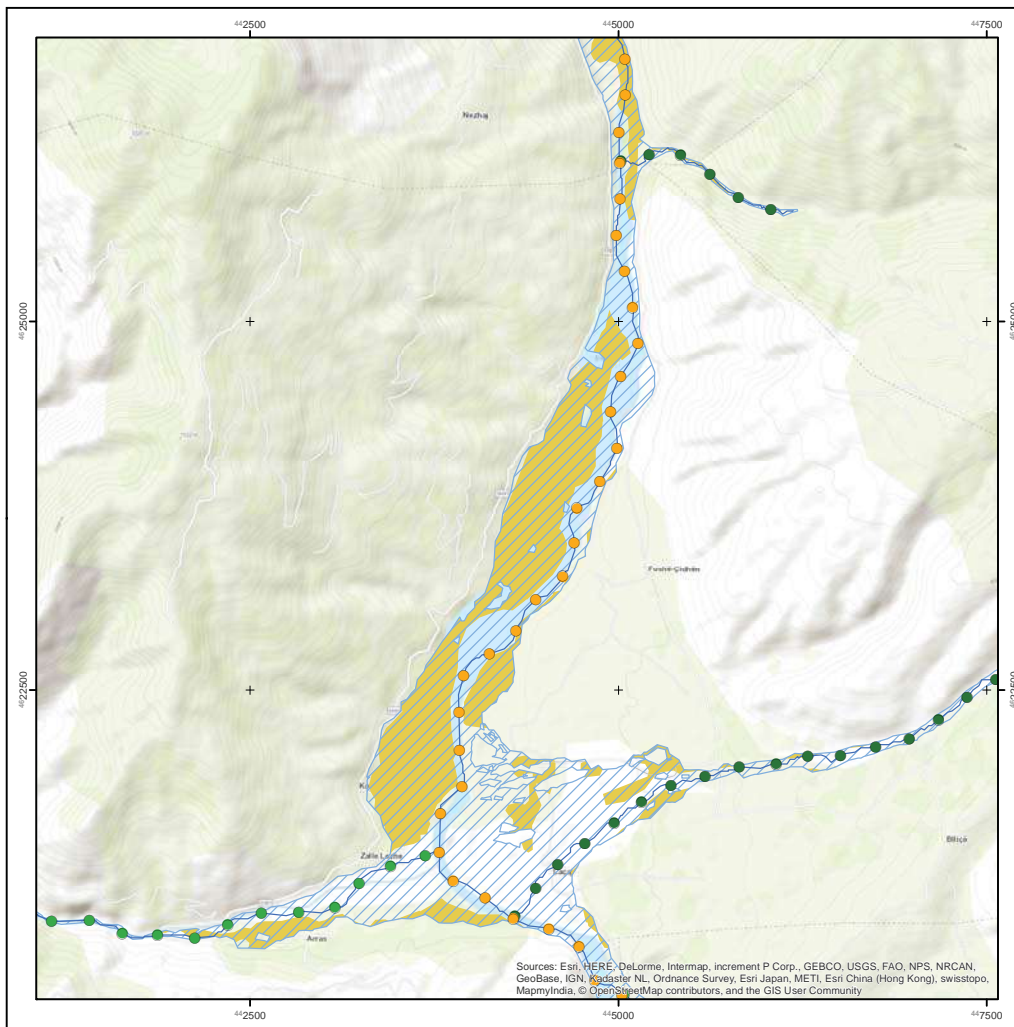
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-1c

**Risk area:**  
Diber, village of Zalldardhe  
River: Black Drin

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

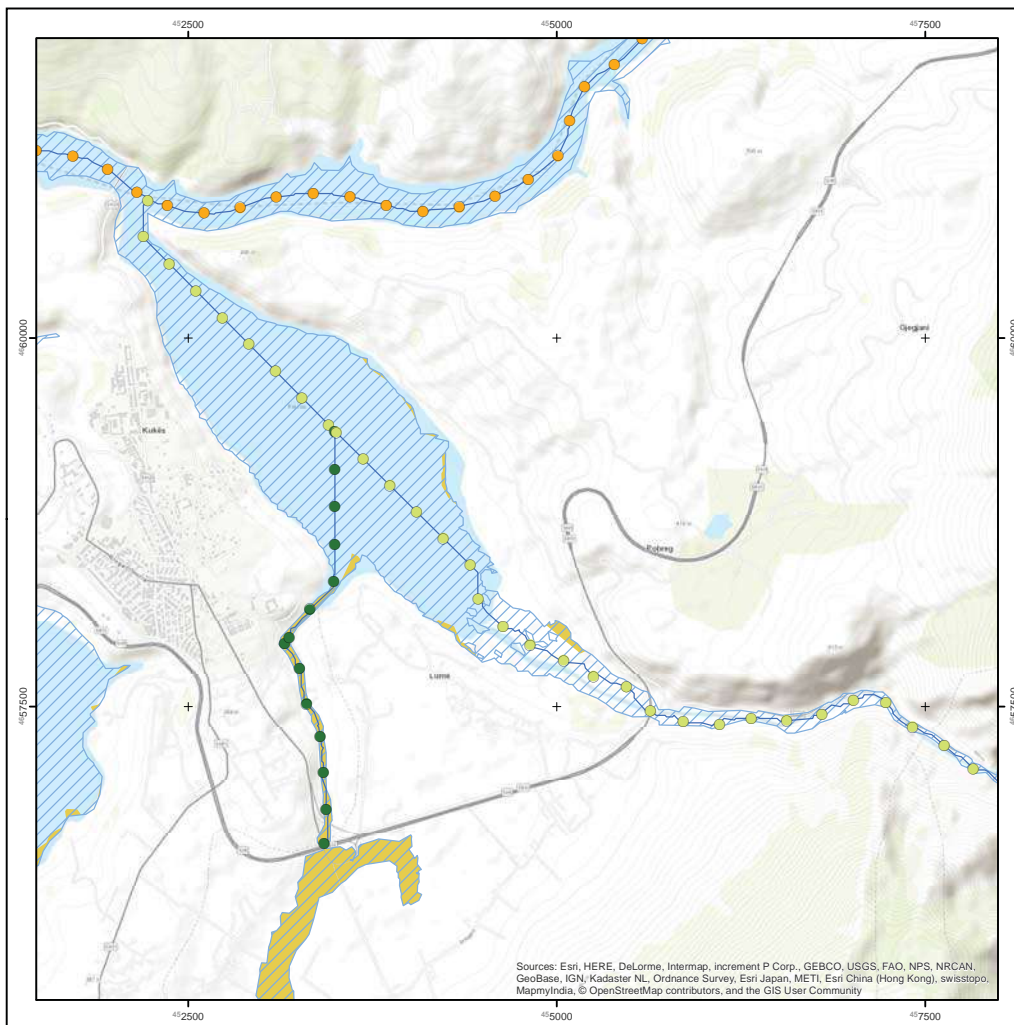
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-2

**Risk area:**  
Kukes  
River: Black Drin

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

Darmstadt, Germany

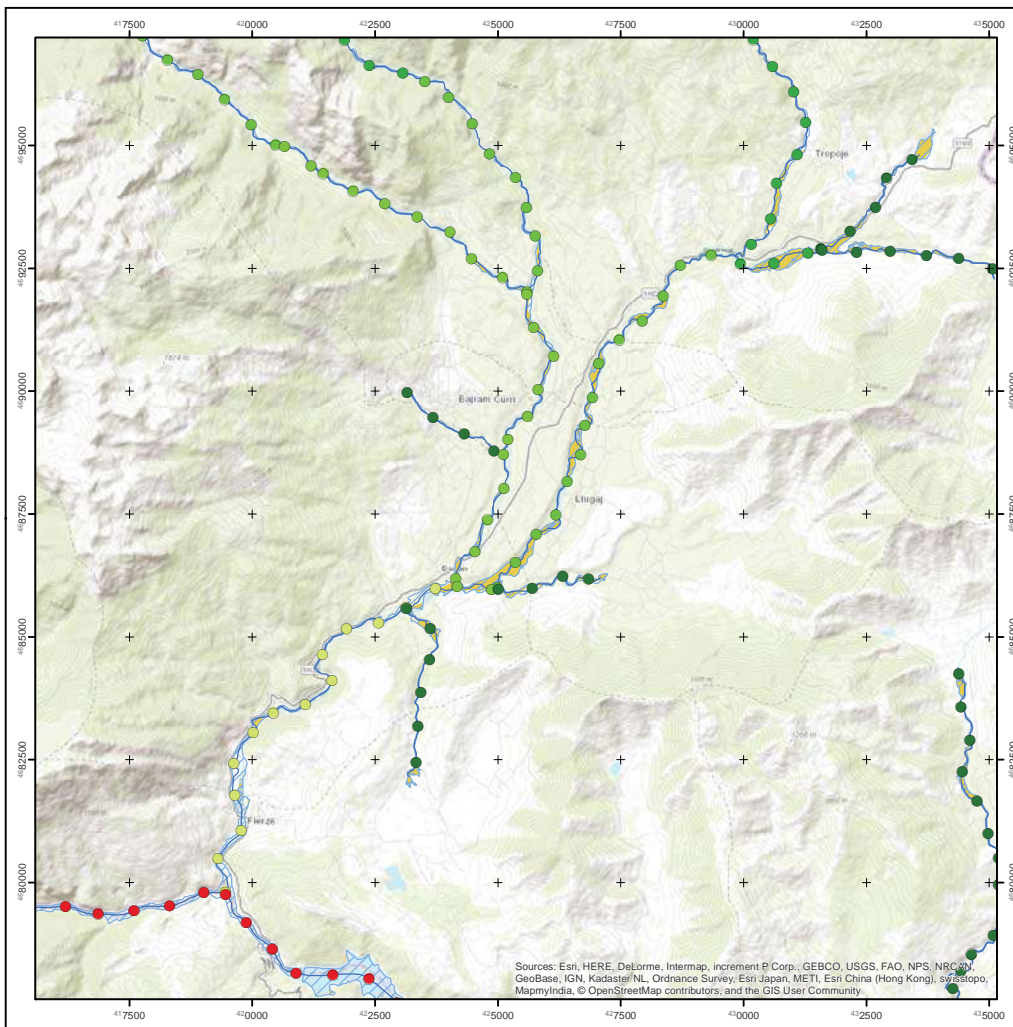
Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ





### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-3

**Risk area:**  
Tropoje  
**River:** Valbona River (Drini tributary)

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

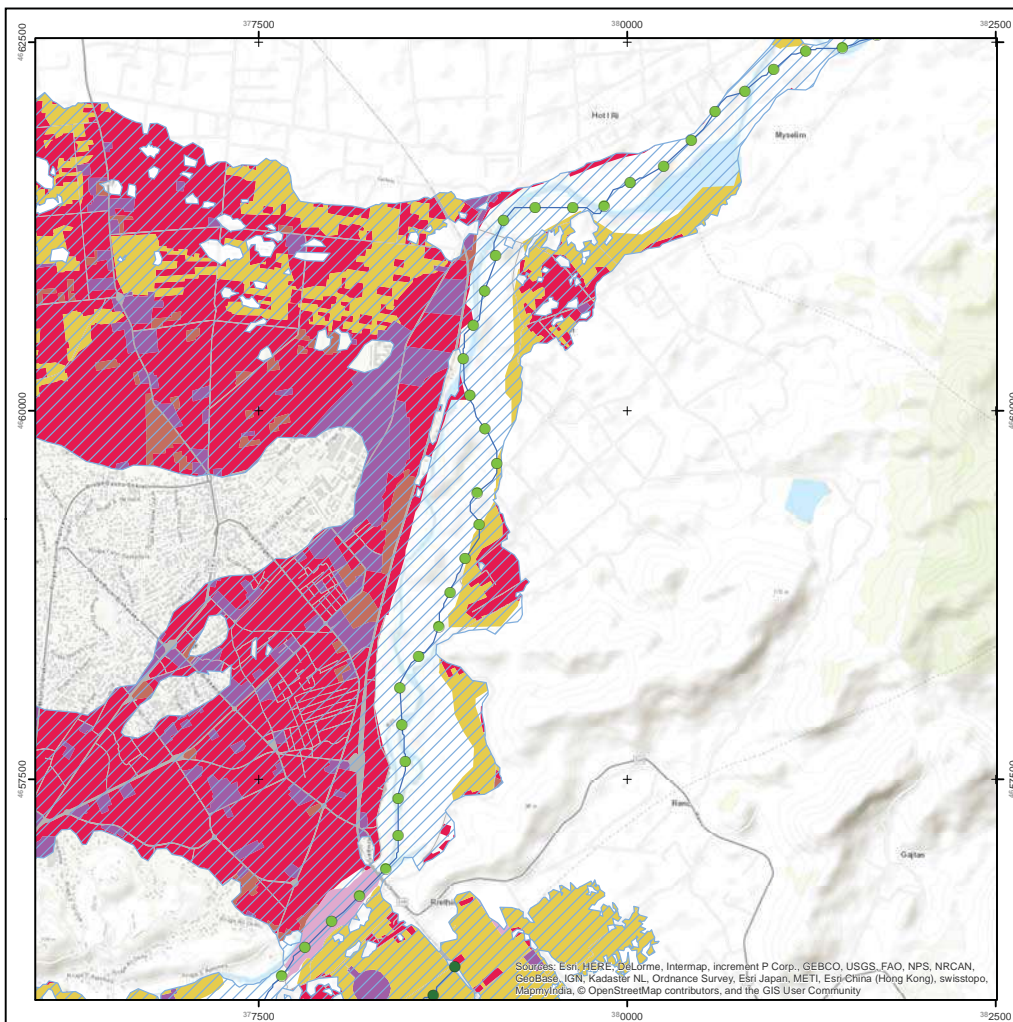
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-4

**Risk area:**  
City of Skhodra  
**River:** Kiri River

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

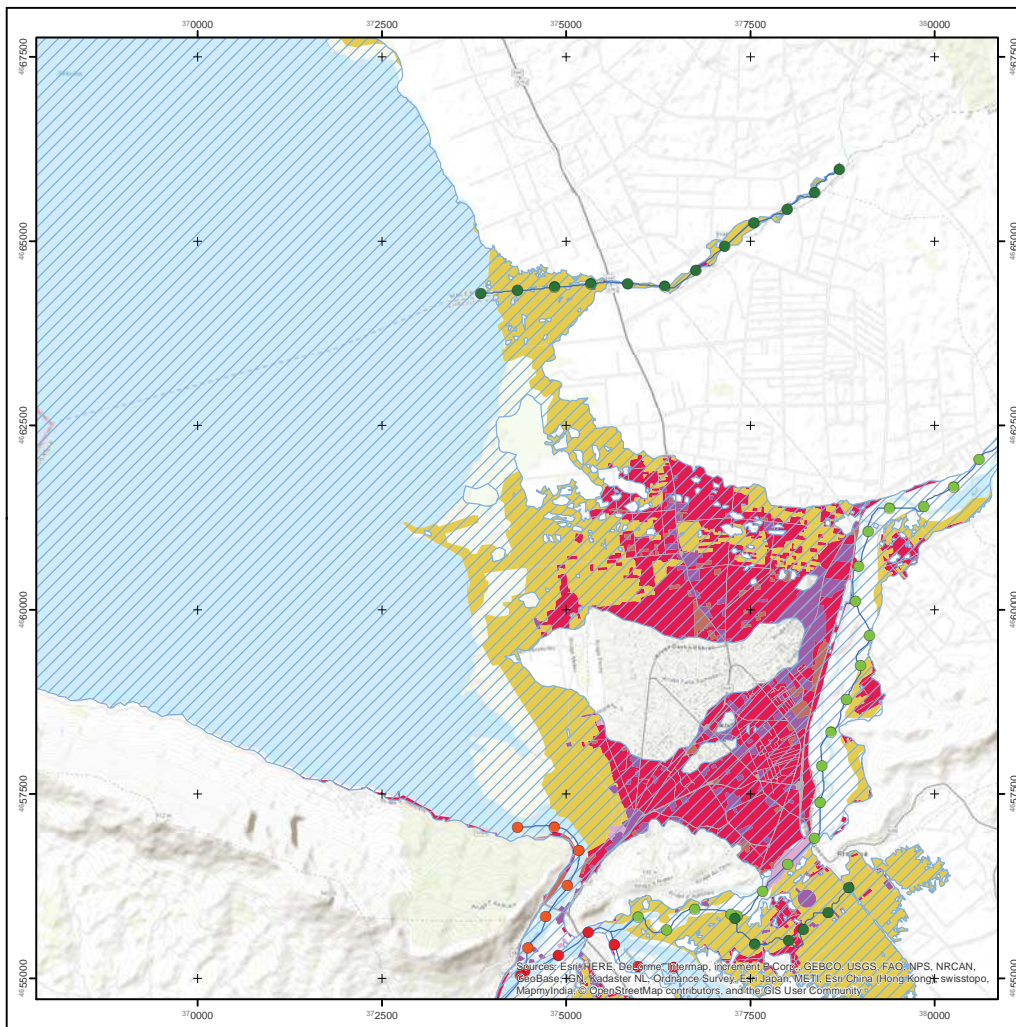
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## AL-5

**Risk area:**  
Skhodra Lake and City of Skhodra  
River: Lake Skhodra

**Legend:**

<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, blue 2px, blue 4px);"></span> potentially flooded area scenario 2</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: blue;"></span> River</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: red;"></span> Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: brown;"></span> Other Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: gray;"></span> Transport</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple;"></span> Industrial Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink;"></span> Mineral extraction and dump sites</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow;"></span> Agriculture</li> </ul>	<p><b>Catchment Size in km<sup>2</sup></b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 20</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: lightgreen; border-radius: 50%;"></span> &gt; 50</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellowgreen; border-radius: 50%;"></span> &gt; 100</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: limegreen; border-radius: 50%;"></span> &gt; 200</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 500</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%;"></span> &gt; 1.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: orange; border-radius: 50%;"></span> &gt; 2.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%;"></span> &gt; 5.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: darkred; border-radius: 50%;"></span> &gt; 10.000</li> </ul>
--	--

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

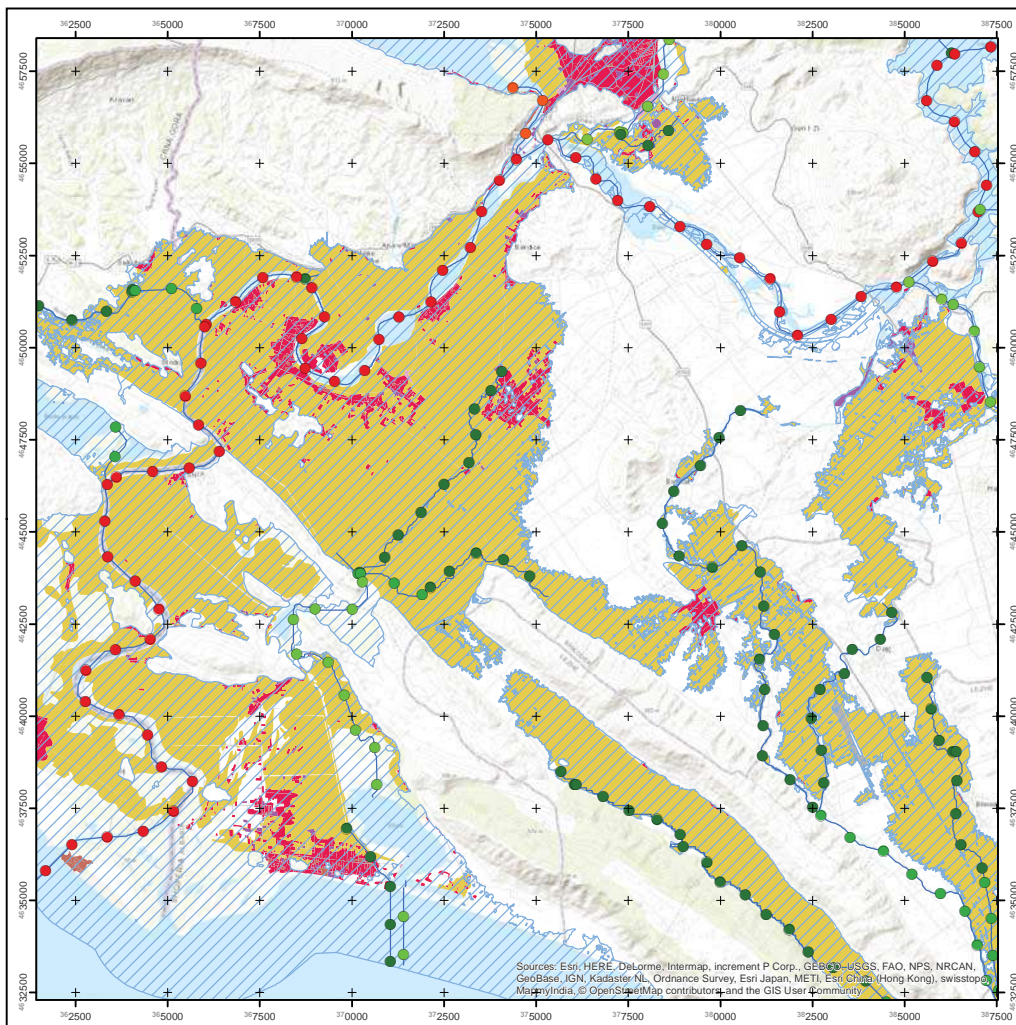
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## AL-6

**Risk area:**  
Region of Skhodra  
River: Drin, Buna / Bojana

**Legend:**

<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; background: repeating-linear-gradient(45deg, transparent, transparent 2px, blue 2px, blue 4px);"></span> potentially flooded area scenario 2</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: blue;"></span> River</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: red;"></span> Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: brown;"></span> Other Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: gray;"></span> Transport</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple;"></span> Industrial Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink;"></span> Mineral extraction and dump sites</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow;"></span> Agriculture</li> </ul>	<p><b>Catchment Size in km<sup>2</sup></b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 20</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: lightgreen; border-radius: 50%;"></span> &gt; 50</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellowgreen; border-radius: 50%;"></span> &gt; 100</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: limegreen; border-radius: 50%;"></span> &gt; 200</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 500</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%;"></span> &gt; 1.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: orange; border-radius: 50%;"></span> &gt; 2.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%;"></span> &gt; 5.000</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: darkred; border-radius: 50%;"></span> &gt; 10.000</li> </ul>
--	--

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

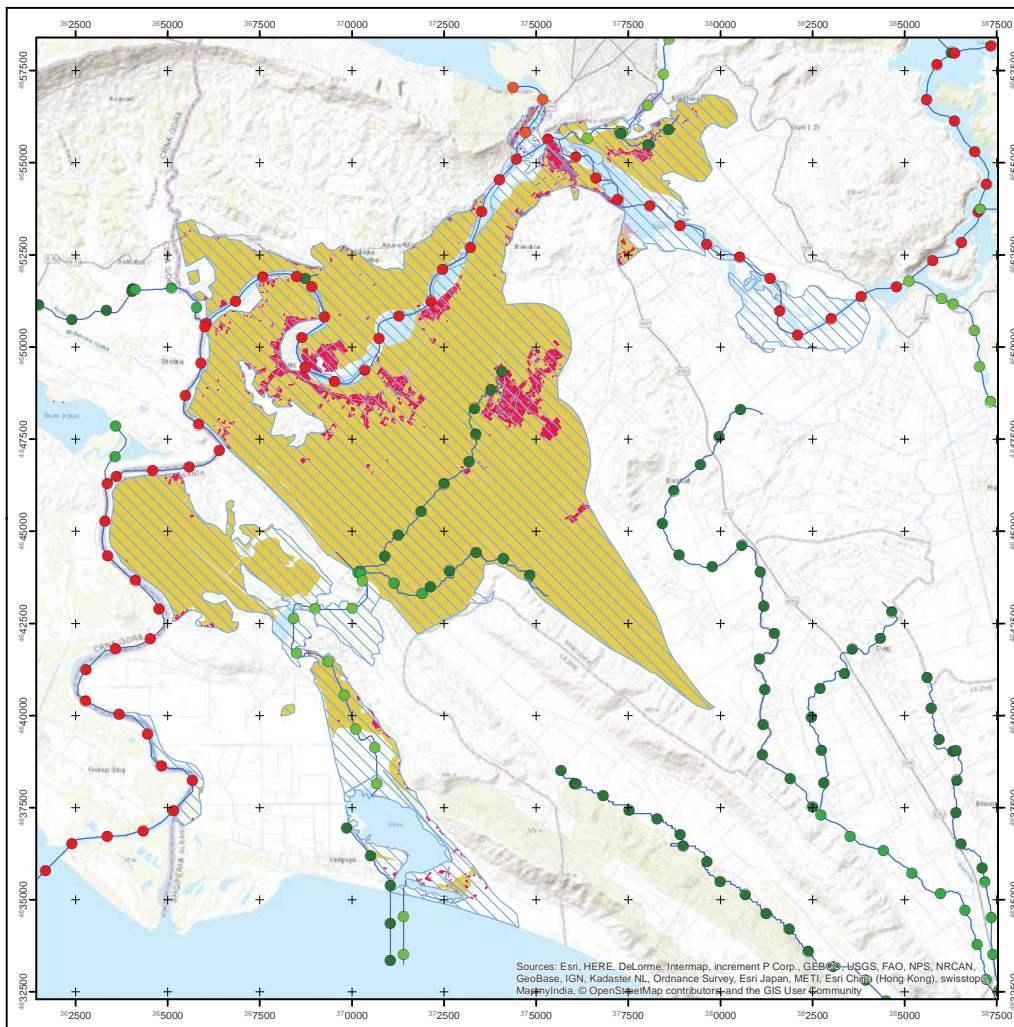
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-6a

Map presents the flood extent of the flood event in 2010

**Risk area:**  
Region of Skhodra  
River: Drin, Buna / Bojana

**Legend:**

Flood 2010	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on extreme event of 2010 shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

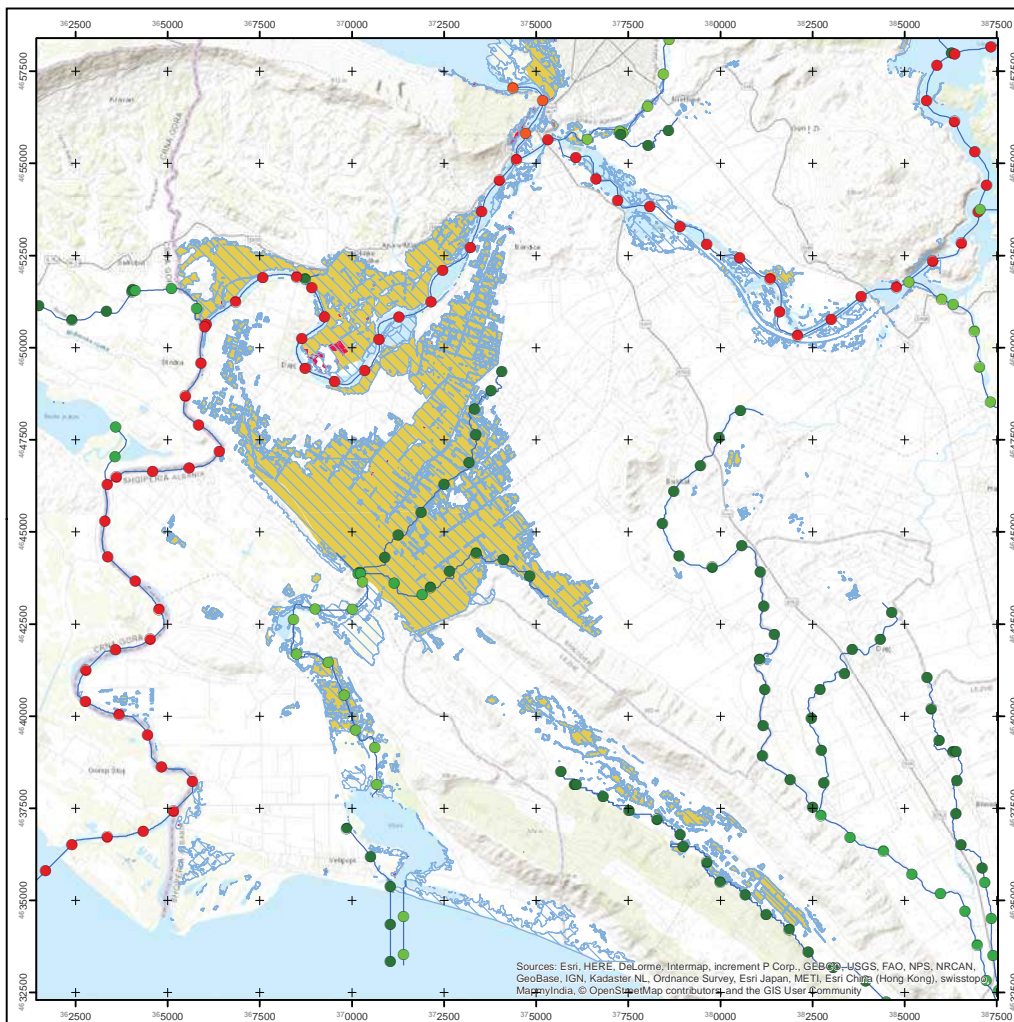
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-6b

Map presents the flood extent of the flood event in 2018

**Risk area:**  
Region of Skhodra  
River: Drin, Buna / Bojana

**Legend:**

Flood 2018	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

WGS84 / UTM-Zone 34N

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on extreme event of 2018 shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

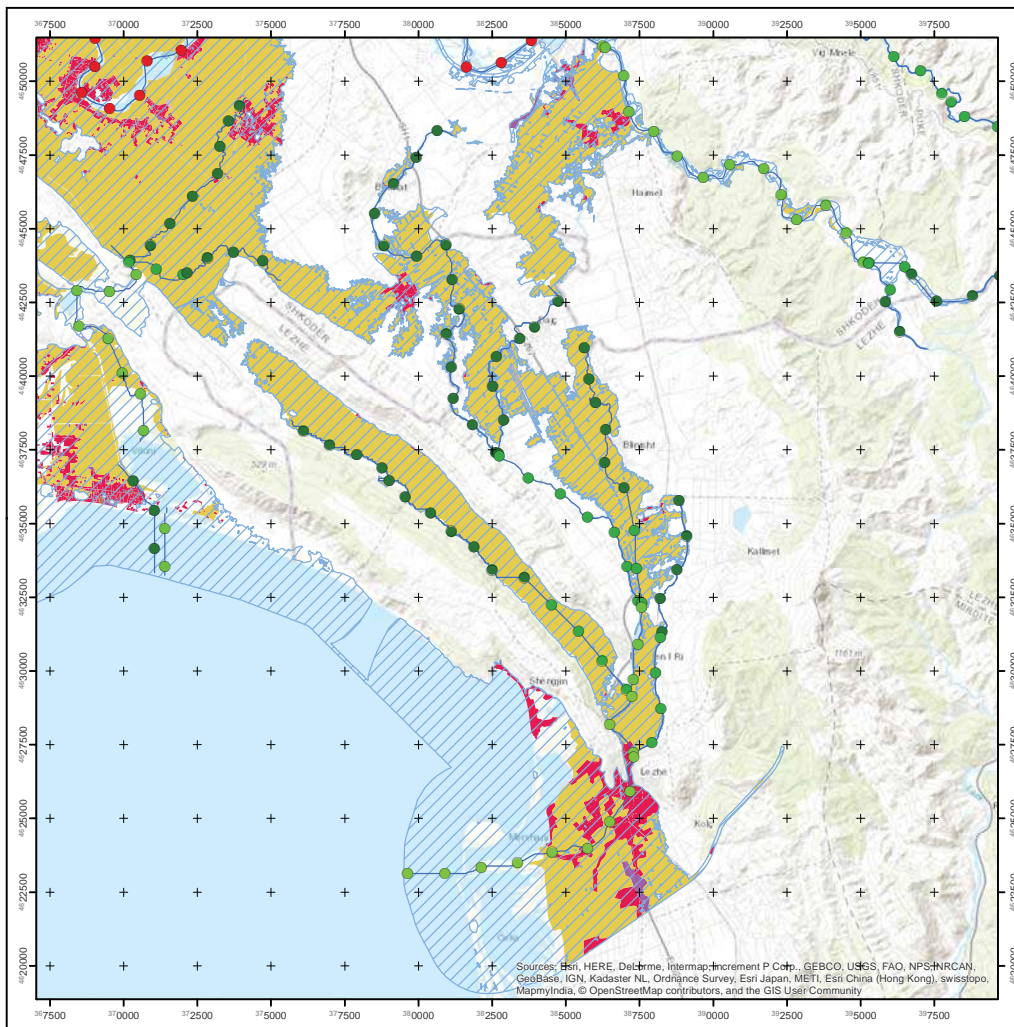
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### AL-7

**Risk area:**  
Lezha  
**River:** Old (former) Drin River

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

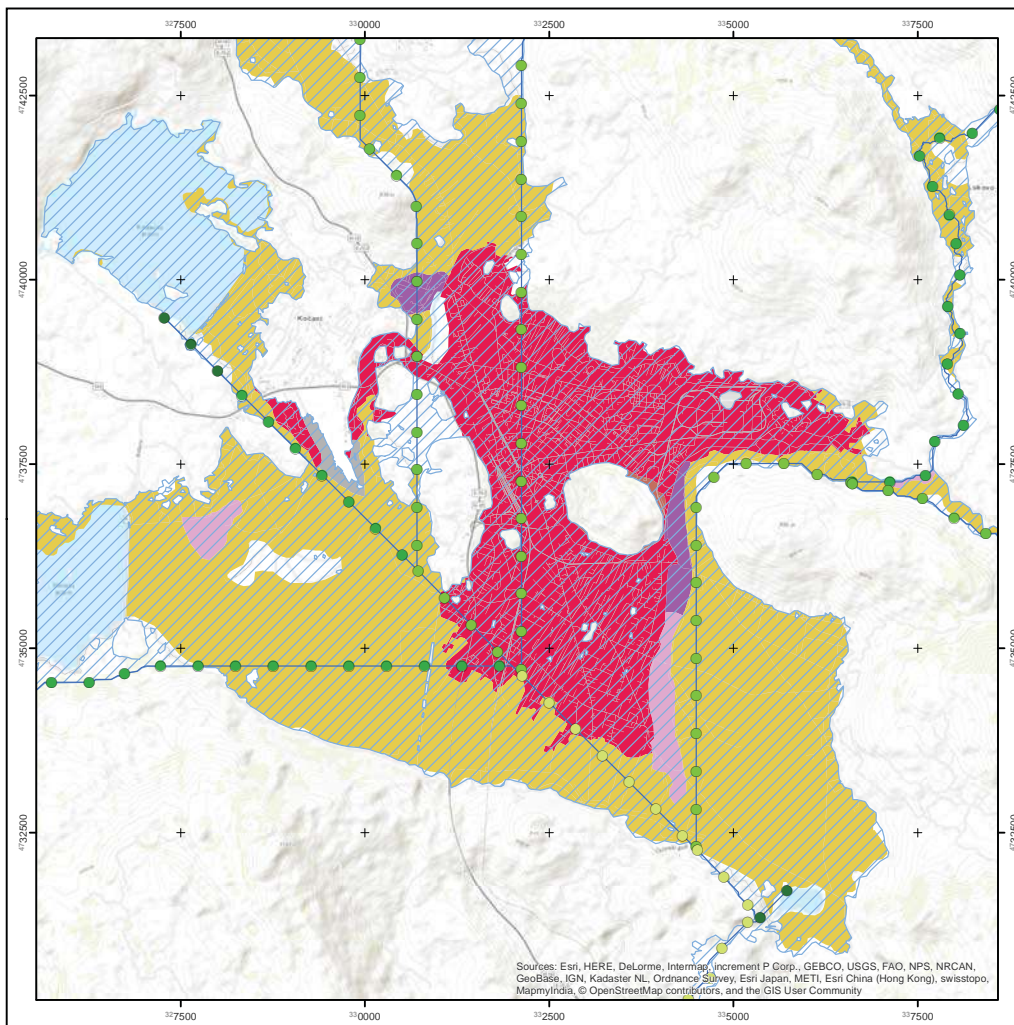
**PFRA-Study and maps:**

Darmstadt, Germany	Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### ME-1

**Risk area:**  
Niksic  
**River:** Zeta

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

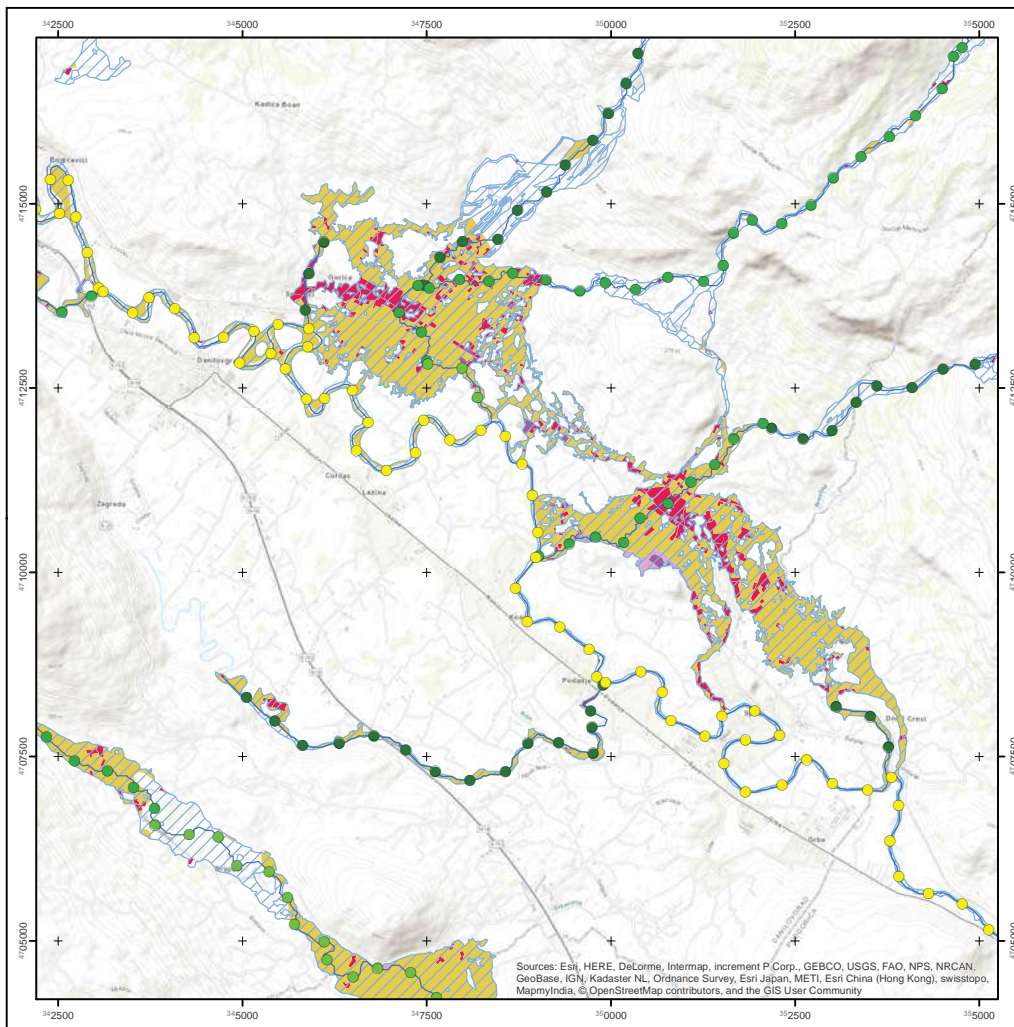
**PFRA-Study and maps:**

Darmstadt, Germany	Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### ME-2

**Risk area:**  
Glava Zete to Spuz  
**River:** Zeta

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

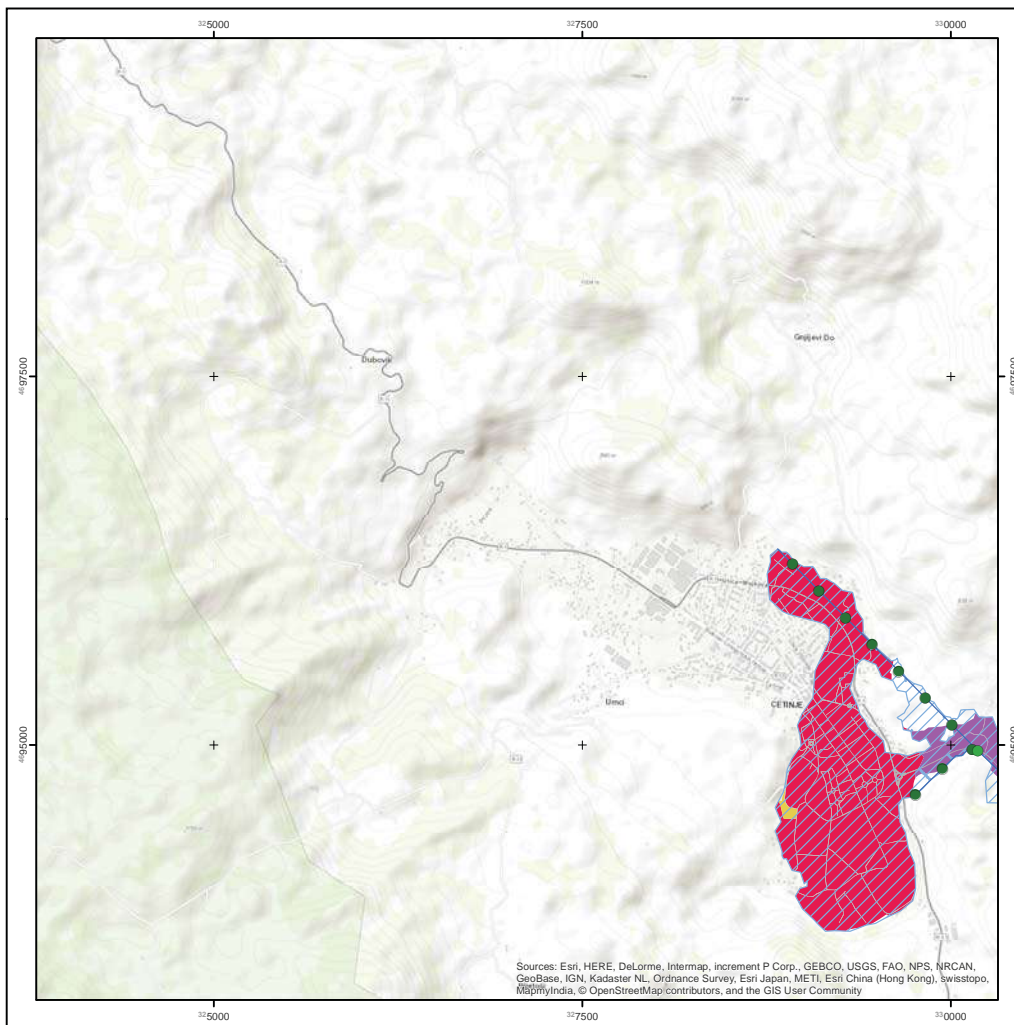
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### ME-3

**Risk area:**  
Cetinje field  
**River:** (groundwater and drainage channels)

**Legend:**

potentially flooded area scenario 2	Catchment Size in km <sup>2</sup>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

**PFRA-Study and maps:**

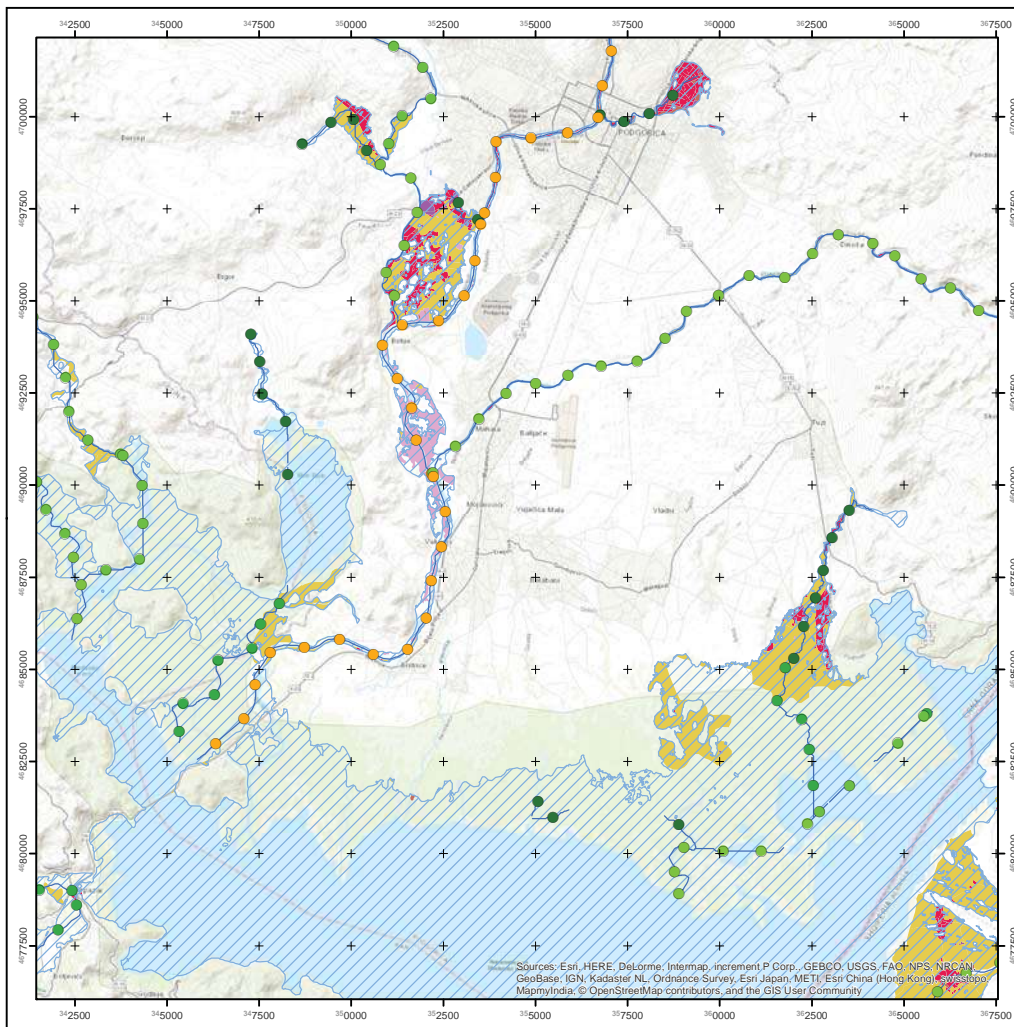
Darmstadt, Germany

Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### ME-4

**Risk area:**  
Golubovci  
River: Moraca and Skadar lake area

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

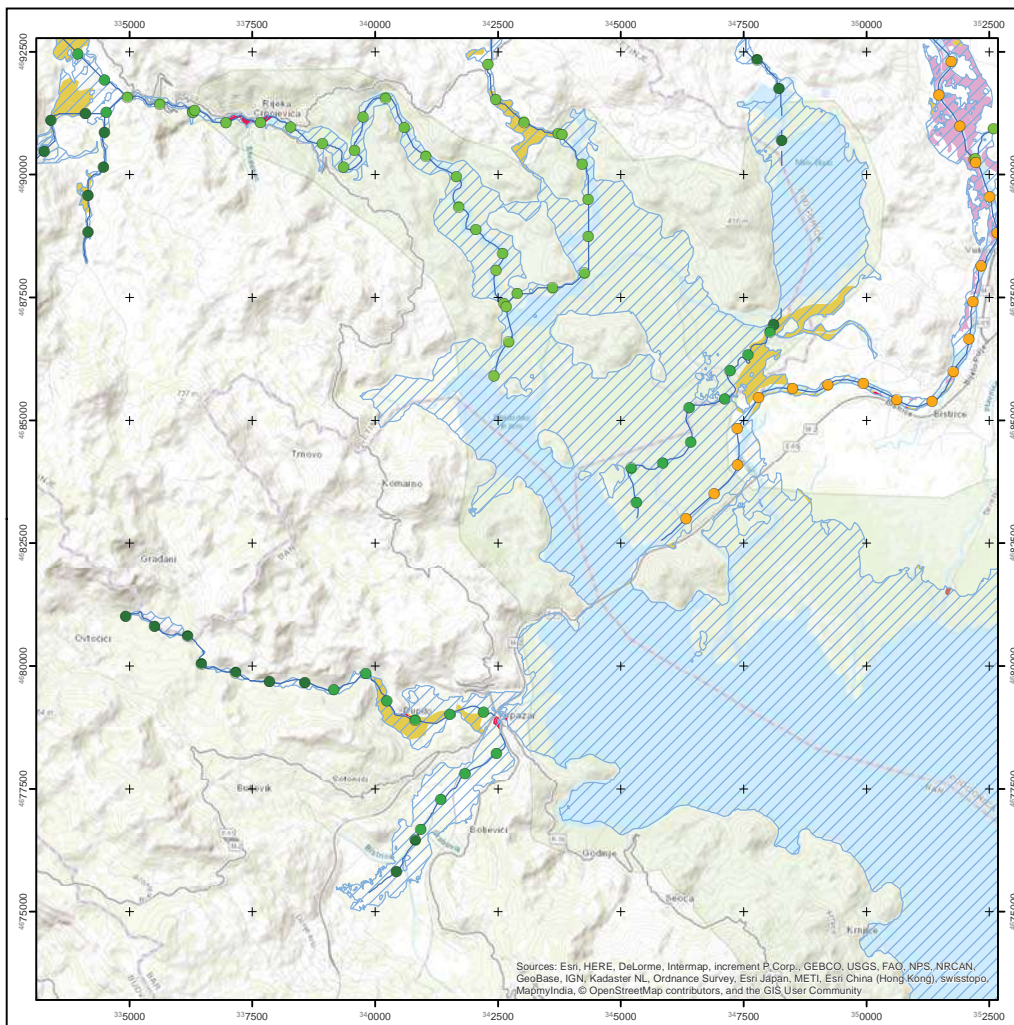
**PFRA-Study and maps:**

Darmstadt, Germany	Heidelberg, Germany

Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

#### ME-5

**Risk area:**  
North of Skadar Lake  
River: Skadar lake area

**Legend:**

potentially flooded area scenario 2	<b>Catchment Size in km<sup>2</sup></b>
River	> 20
Urban Areas	> 50
Other Urban Areas	> 100
Transport	> 200
Industrial Areas	> 500
Mineral extraction and dump sites	> 1.000
Agriculture	> 2.000
	> 5.000
	> 10.000

**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

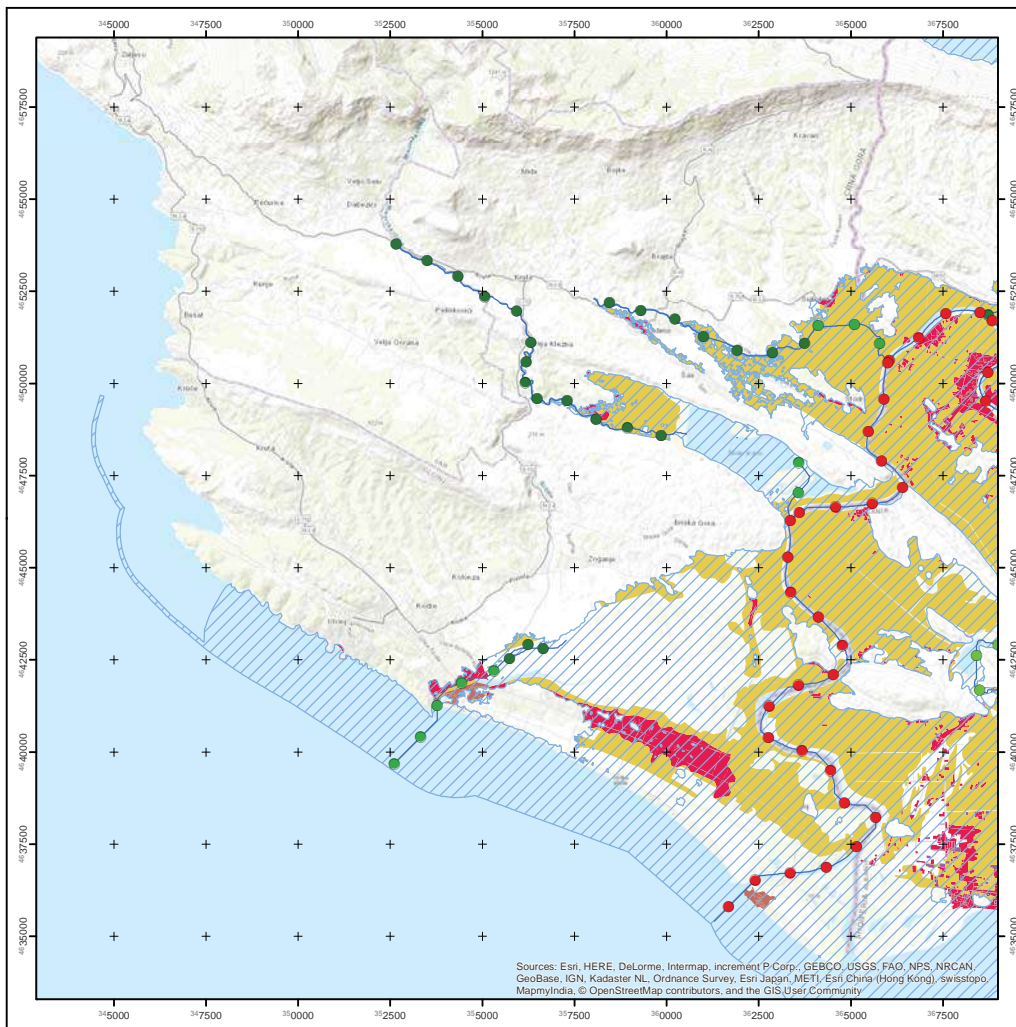
**PFRA-Study and maps:**

Darmstadt, Germany	Heidelberg, Germany


Date: 31. October 2018

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ




Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



### Preliminary Flood Risk Assessment for the international Drin/Drim-Buna/Bojana River Basin

## ME-6

**Risk area:**  
Lisna Borj to Gornji Stoj  
River: Buna / Bojana




---

**Legend:**

<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid blue; background: repeating-linear-gradient(45deg, transparent, transparent 2px, blue 2px, blue 4px);"></span> potentially flooded area scenario 2</li> <li><span style="display: inline-block; width: 15px; border-bottom: 2px solid blue;"></span> River</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: red;"></span> Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: brown;"></span> Other Urban Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: gray;"></span> Transport</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple;"></span> Industrial Areas</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink;"></span> Mineral extraction and dump sites</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow;"></span> Agriculture</li> </ul>	<p><b>Catchment Size in km<sup>2</sup></b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%;"></span> &gt; 20</li> <li><span style="display: inline-block; width: 12px; height: 12px; background-color: green; border-radius: 50%;"></span> &gt; 50</li> <li><span style="display: inline-block; width: 14px; height: 14px; background-color: green; border-radius: 50%;"></span> &gt; 100</li> <li><span style="display: inline-block; width: 16px; height: 16px; background-color: green; border-radius: 50%;"></span> &gt; 200</li> <li><span style="display: inline-block; width: 18px; height: 18px; background-color: green; border-radius: 50%;"></span> &gt; 500</li> <li><span style="display: inline-block; width: 20px; height: 20px; background-color: yellow; border-radius: 50%;"></span> &gt; 1.000</li> <li><span style="display: inline-block; width: 22px; height: 22px; background-color: orange; border-radius: 50%;"></span> &gt; 2.000</li> <li><span style="display: inline-block; width: 24px; height: 24px; background-color: red; border-radius: 50%;"></span> &gt; 5.000</li> <li><span style="display: inline-block; width: 26px; height: 26px; background-color: red; border-radius: 50%;"></span> &gt; 10.000</li> </ul>
--	---

---


0 1.000 2.000 3.000 4.000 m
WGS84 / UTM-Zone 34N

---



**Data sources:**  
BEAM Landuse 2012, OSM, World DEM light, Airbus D&S

**Risk information inputs by national experts:**  
Angel Panov (MK), Lavdim Osmani (KO), Stela Guxo, Eduart Cani (AL), Zdenka Ivanovic (ME)

Map based on GIS analysis shows areas of potential significant flood risk as defined by EU-Directive 2007/60/EC. No legal implications under national and international laws.

---

**PFRA-Study and maps:**

 Darmstadt, Germany	 Heidelberg, Germany
---	--

Date: 31. October 2018

---

**The study is part of the project „Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans“**

Funded by German Federal Ministry for Economic Cooperation and Development (BMZ)  
Implemented by GIZ

