



SETOF

Soil Erosion and TOrrontial Flood
Prevention: Curriculum Development at the
Universities of Western Balkan Countries

Torrential floods in Serbia, Bosnia and Herzegovina and North Macedonia

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- **Torrential floods are the most frequent catastrophic events that occur in the RS, BIH and NM, with serious risks for people and their activities.**
- **These natural hazards have caused the death of more than 400 people in the last 65 years and material damage estimated at more than 27 billion EURs.**





- **The main factors increasing the flooding risk, besides topographic and land characteristics, are heavy precipitations, removal of forest cover, uncontrolled urbanization, the reduced discharge capacity of regulated river sections (deposition of sediment and garbage; overgrowing by shrubs and trees).**
- **During catastrophic torrential floods in BIH and Serbia, in May 2014, 76 lives were lost, 2.6 million people were endangered, and about 12.000 km² were flooded with material damage higher than 3 billion EUR.**





- **During a torrential event in Macedonia, near Skoplje, in August 2016, 22 people died, 450.000 were affected in 10 municipalities, with material damage higher than 100 million EUR.**
- **Hydrographically, Serbia, BIH, and North Macedonia belong to the Black Sea, Adriatic Sea and Aegean Sea basins. Water is discharged from the area of 165.271 km².**





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Topčić Polje (BIH), May 2014



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Topčić
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(BIH), May
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Major flood events in BiH (period: 2010-2014)

Date	Affected areas, municipalities	Extent of damage
Dec. 2010	River Drina catchment, Municipalities of Bosanska Krupa, Domaljevac - Šamac, Orašje, Tuzla, Maglaj, Goražde, Foča - Ustikolina, Pale - Prača, Ravno, Čitluk, Čapljina, Stolac, Mostar, Trnovo, Ilidža, Novi Grad, Tomislavgrad, Drvar, Trebinje, Bileća, Nevesinje, Foča, Novo Goražde, Bratunac, Zvornik, Bijeljina	<ul style="list-style-type: none"> • 20,000 people affected, 5,000 houses flooded, • 6,000 people evacuated
May 2014	Sava tributaries: Una, Sana, Vrbas, Vrbanja, Bosna and Drina and River Sava at Rača	<ul style="list-style-type: none"> • Nearly 15% of GDP lost. • 13,200 km² flooded. • Over 1 million people in 46 municipalities affected. • 25 lives lost.
Aug. 2014	Northern and Western BiH. All areas along the Sava, Sava tributaries: Una, Vrbas, Banja Luka, Gračanica, Tuzla, Foča, Višegrad, Zvornik, Žepče, Lukavac, Zenica	<ul style="list-style-type: none"> • Some 200 homes evacuated.





- 73 municipalities (50%) in B&H were affected by floods,
- 100,000 homes were damaged or destroyed,
- 230 schools and hospitals were damaged or destroyed,
- 66,080 persons were evacuated,
- 7.176 landslides were activated.
- total damage was estimated at EUR 2 billion.





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**Ring road,
Skopje, August
2016**



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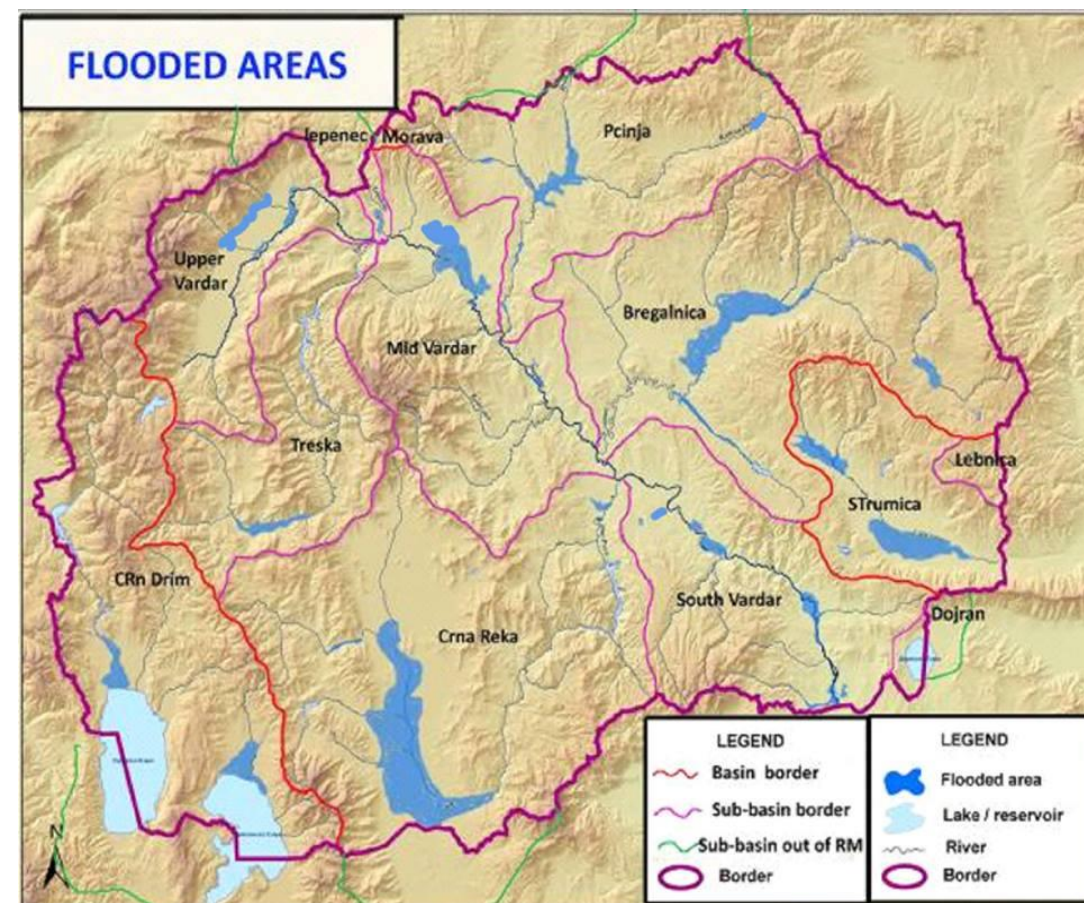
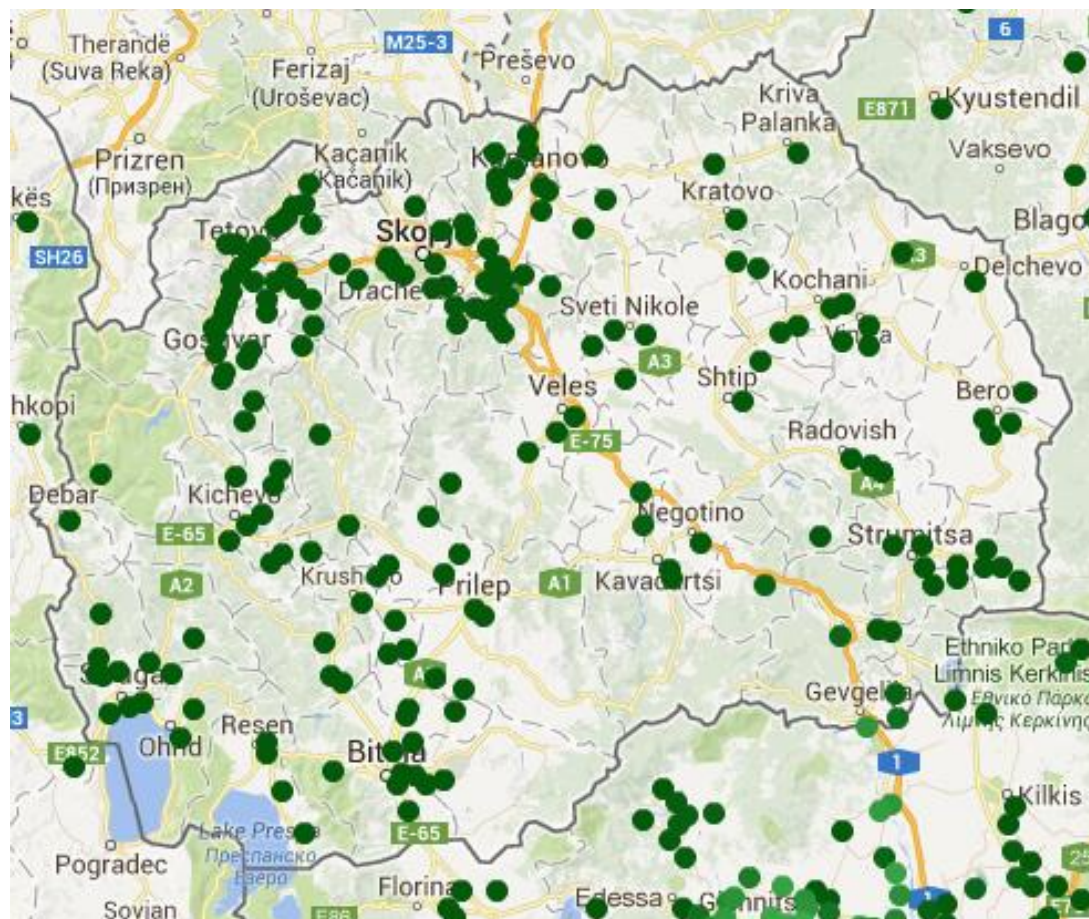


**Ring road,
Skopje,
August 2016**



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Spatial disposition of the most destructive torrential floods in NM from 1950 to 2018





Major flood events in NM (period: 2003-2018)

Date	Affected municipalities.	Losses and damages ME	Affected population	Dead people	Type
January 2003	4			3	River
June 2004	26	15	100 000	0	R+T
February 2013	7		10 000	1	R+T
Jan. – Feb.2015	43	35,7	170 000	0	River
August 2015	3	25	10 000	6	Torrent
August 2016	10 - 2extremely	100	450 000 (20 000)	22	Torrent





Flood protection

- Outstanding river and torrent training works have been undertaken in the RS, BIH and NM (subwatersheds and sections of rivers the Danube, Sava, Pčinja, Crni Drim, Ibar, Beli Drim, Bregalnica, Bosna, Trebišnjica, Vardar, Južna Morava). Generally flood protection in the region is still not at satisfactory level and shows a weak institutional support and organization.
- Preparation of flood risk management plans (FRMP) is a necessary measure for effective flood protection and sustainable spatial planning, but it is still in an initial stage in the RS, BIH and NM.





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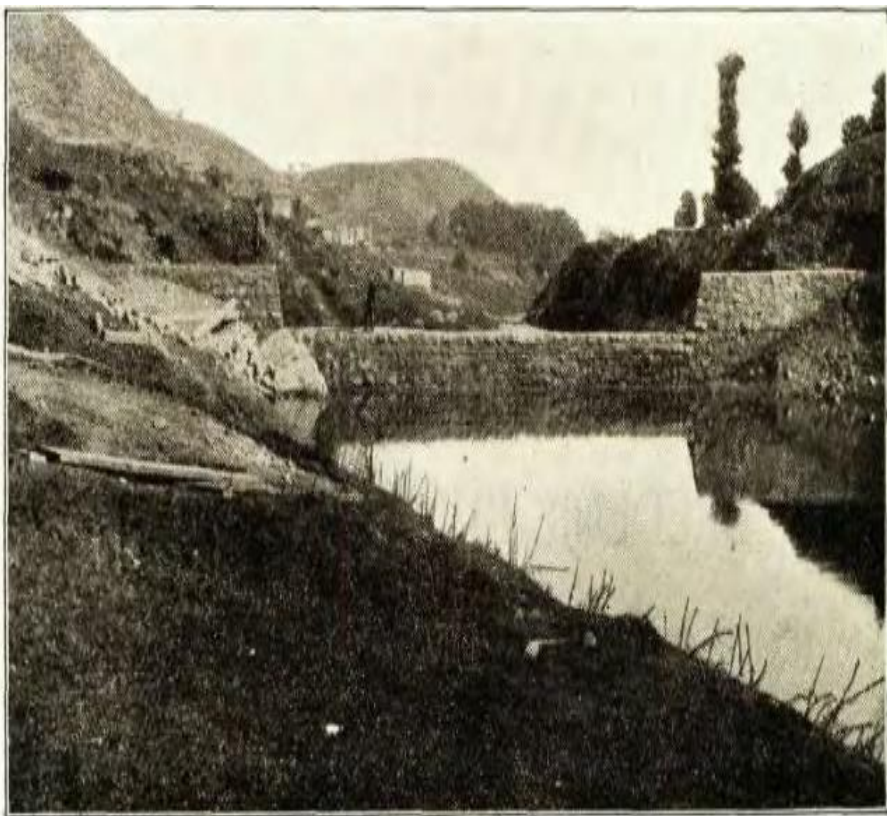


Afforestation in central part of NM (*Pinus nigra*)



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Check dams in torrent Dragor (late 20's –early 30's of the XX century)





**Channel and check dam in torrents on Vodno Mt.
(50's – 60's of the XX cent.)**





Straight line check dam and arch line check dam (concrete)





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Check dams “Herheulidze type”



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Waste deposition and illegal construction





Torrent training works (streams Rokov and Bukovac, Mt Fruška Gora)





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Gabion check-dam (2008)

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Stone masonry check-dam (2002)



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Zavojnička torrent training works (IKEA, Belgrade, 2017)

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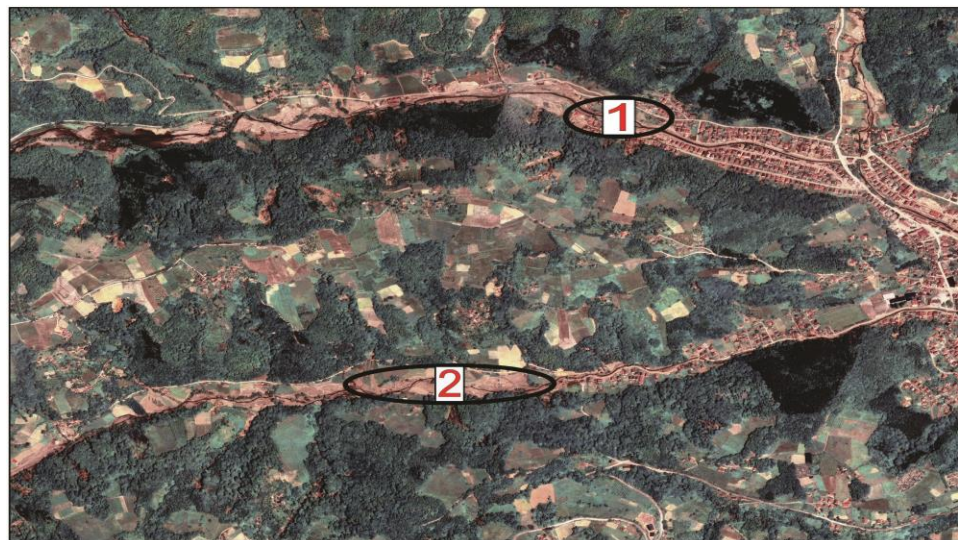


Deposition of garbage (Topčider river, 2004)



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Illegale construction in the flood zone (West Serbia, 2014)





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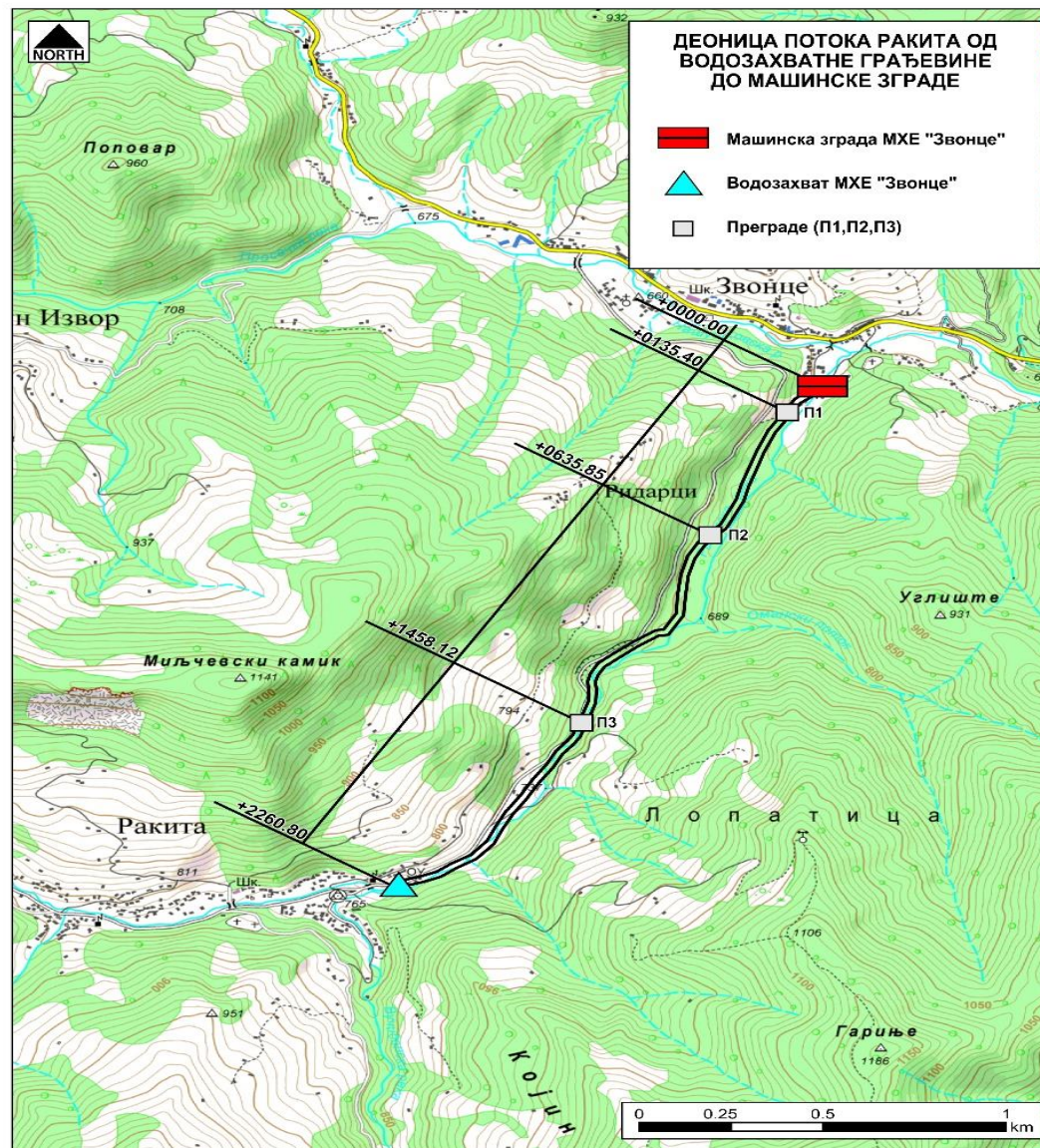
Derivative pipeline SHPP “Zvonce”, village Rakita, 2019

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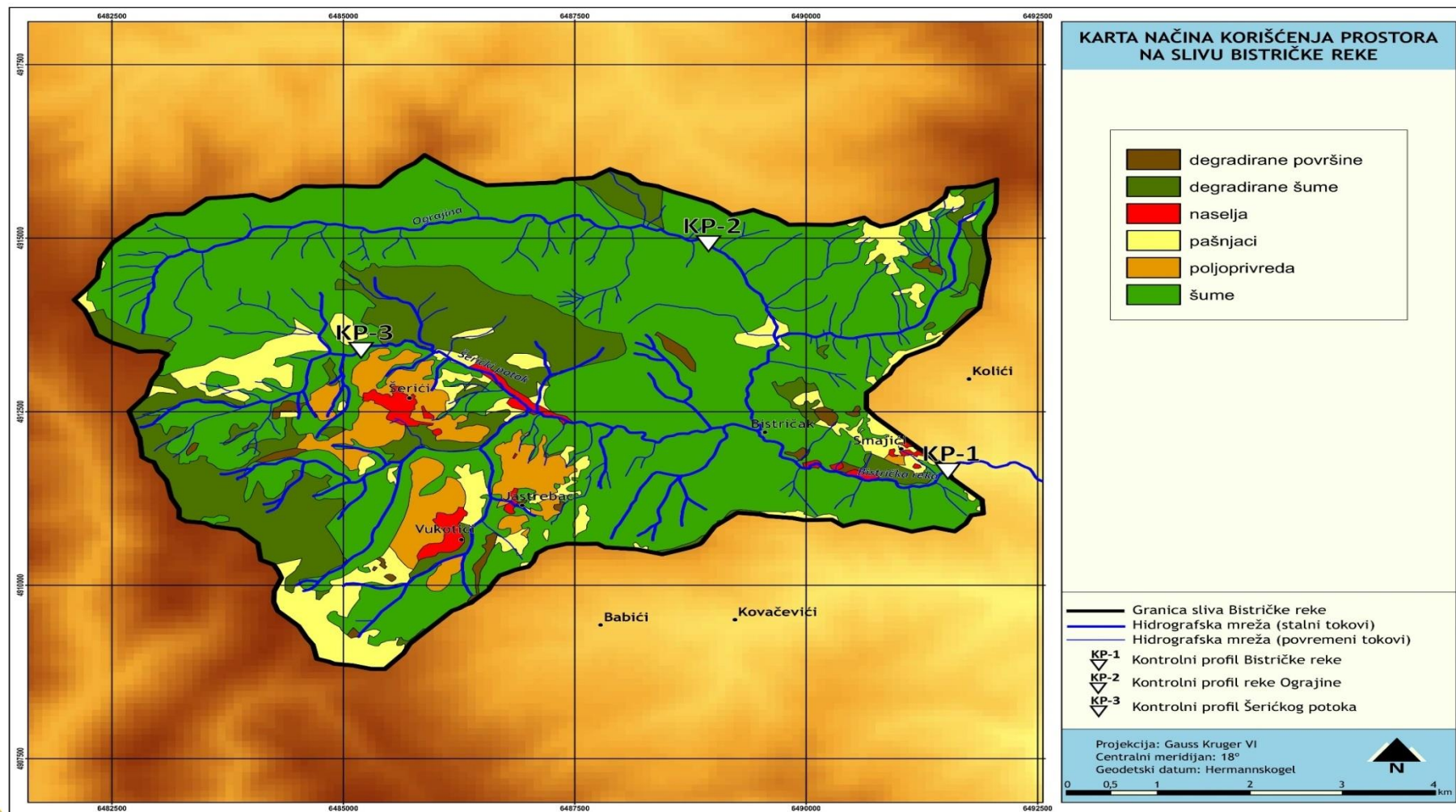


**Infrastructure for torrent
control endangered by
SHPP „Zvonce“
(Southeast Serbia, 2018.)**



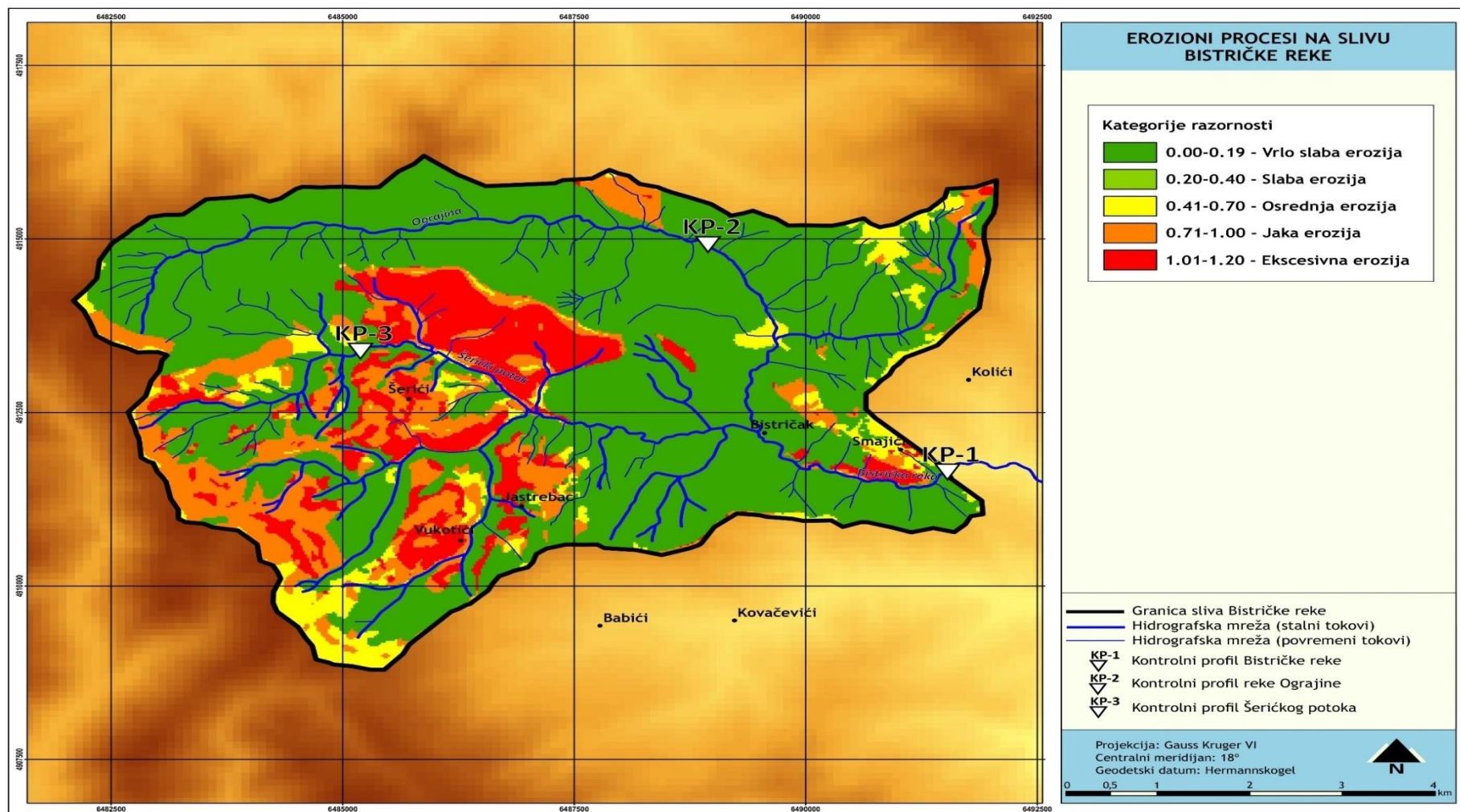


Land use map (Bistričak watershed, Zenica, BIH)





Soil erosion map (Bistričak watershed, Zenica, BIH)





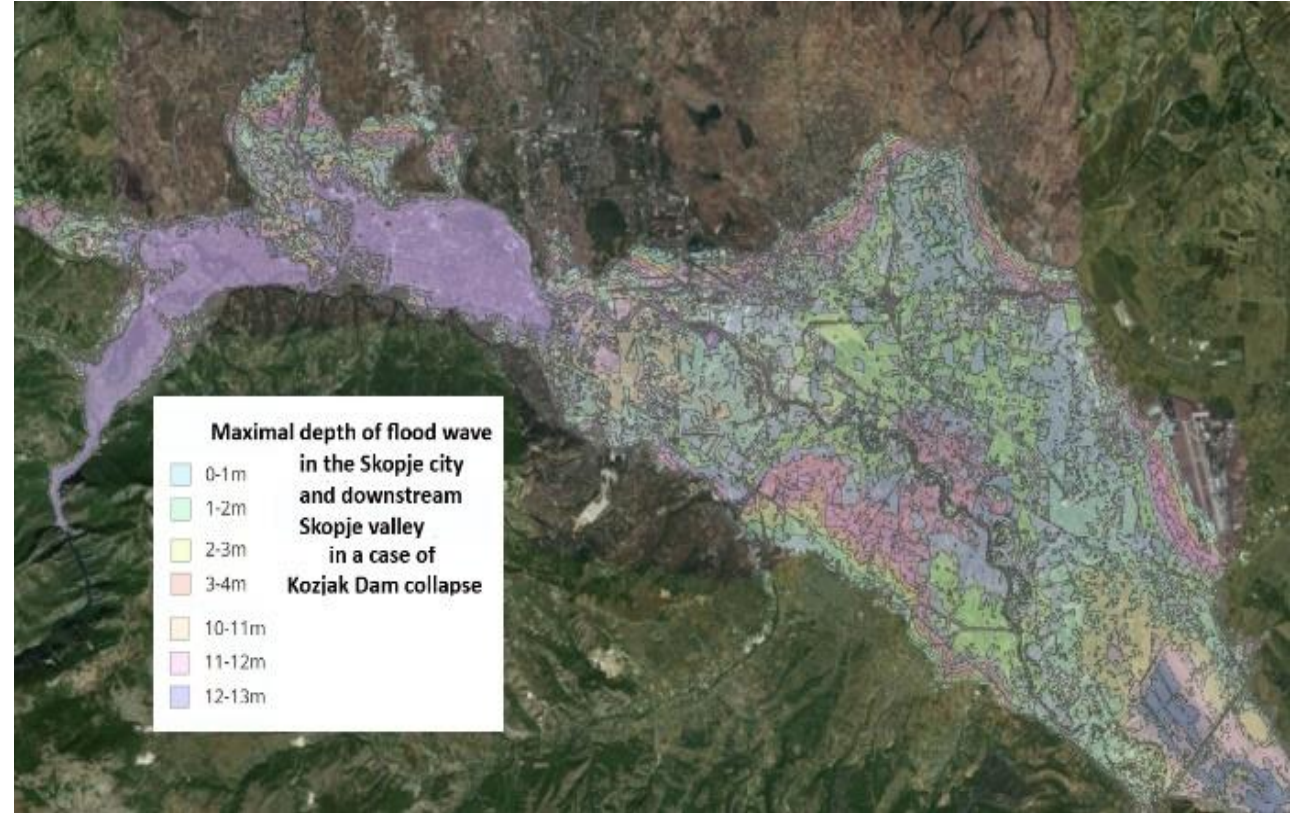
- A preliminary flood risk assessment is prepared for the whole territory of the Republic of Serbia;
- BIH prescribed a methodology for their preparation, while in North Macedonia the first flood risk management plan is prepared (*Upper Vardar Flood Management plan*).





- Numerous municipalities in North Macedonia and Serbia have prepared Operational Plans for Flood protection. Some of the main issues for preliminary flood risk assessment are water monitoring and modelling, which did not reach the necessary level in the region (insufficient number of measuring stations, especially on watersheds smaller than 50 km²) so far.
- Early warning systems were established just at a few watercourses in the region.





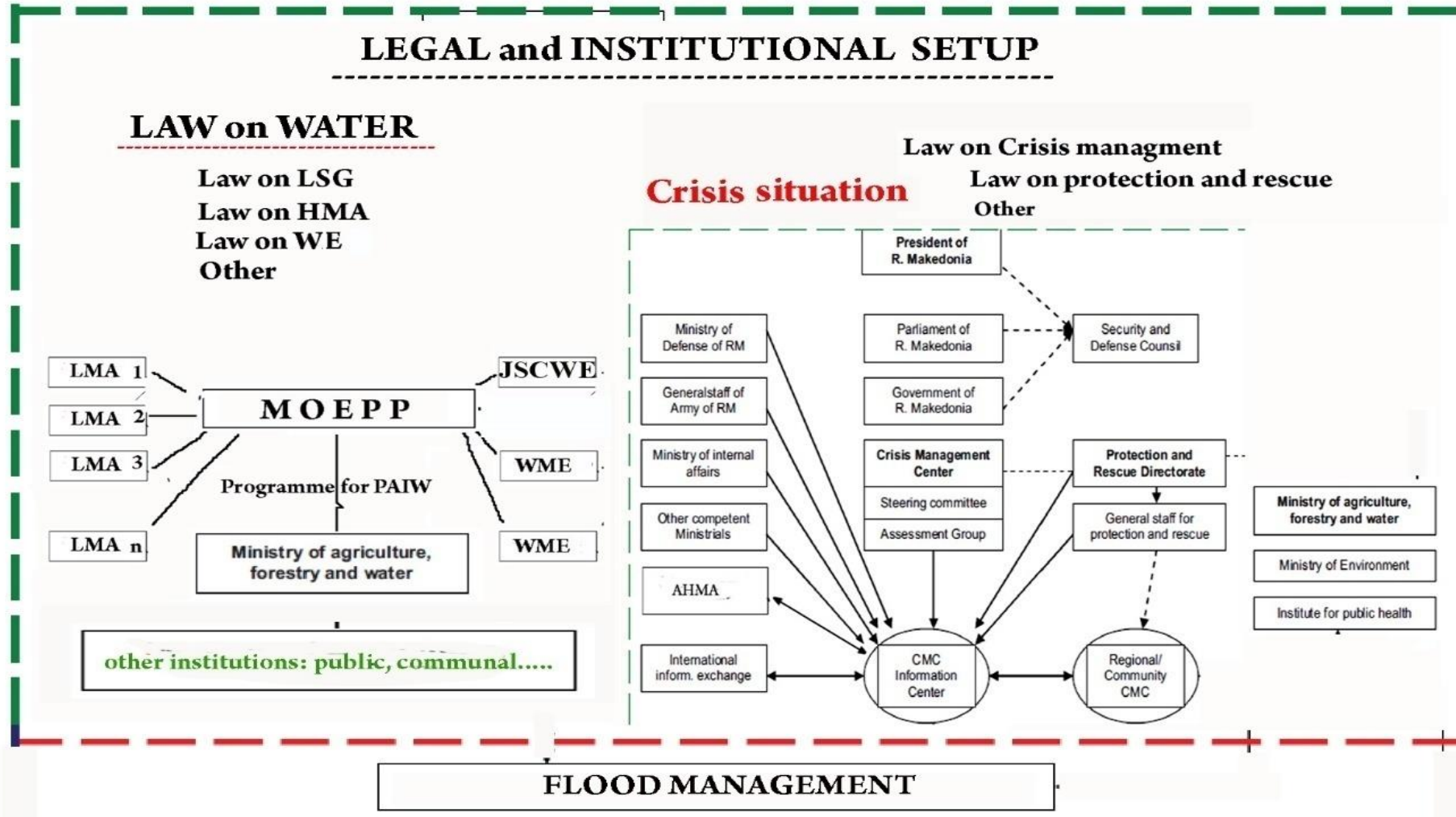
Flood Hazard Map - Vardar Q_{500} and in a case of “Kozjak” Dam collapse





**Potential Q_{100} floods in Radovish city (by torrents Sushica and Radovishka reka)
and Radovish-Strumica valley (by river Strumica)**

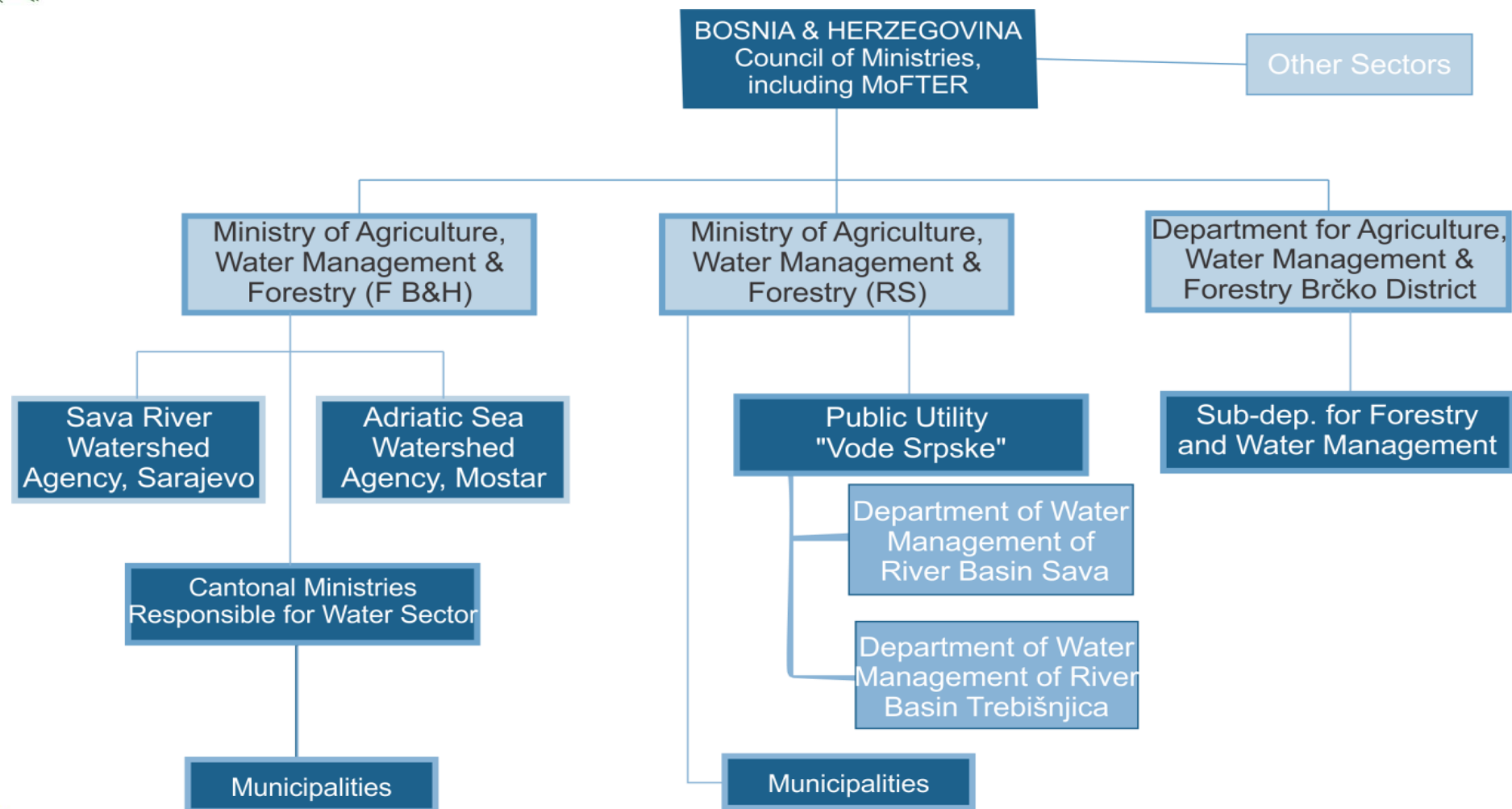






- 123.545.461 EUR are planned, (RS Water Framework Development - Annex 3).
- The average annual investment in the proposed action program amounts to around 6 million EUR annually. This sum encompasses about 4 million EUR for prevention measures (with projects), and 2 million EUR a year is foreseen for the repair of damaged structures and their maintenance.







Water Resources Management Plan

- **90** mil. euros per year (both river and torrential floods) in next 10 years

In total: 900 mil. Euros

- **30** mil. euros per year for prevention of torrential floods (technical and soil engineering works) in next 10 years

In total: 300 mil. Euros





- frequency of occurrence and destructivity of torrential floods
- higher degree of coordination among different activities related to the problems of erosion control and torrential floods.
- climate changes
- stable sources of funding, with long-term investments;
- regional cooperation
- higher education activities





- **Integrated ETC management in torrential watersheds encompasses technical works in a hydrographic network and soil bioengineering works, especially afforestation on the slopes, within a precisely defined social, administrative and spatial framework;**
- **The main goals are: to achieve maximum security for people and their property; to be complementary with other demands such as environmental protection, sustainable soil usage, drinking water supply, local economic development, biodiversity sustaining and mitigation of climate changes effects (UNFCCC, UNCCD, LDN, SDG).**





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