European River Restoration Conference,
October 28, 2014, Vienna Austria

Danube floods 2014
Consequences for Water Utilities

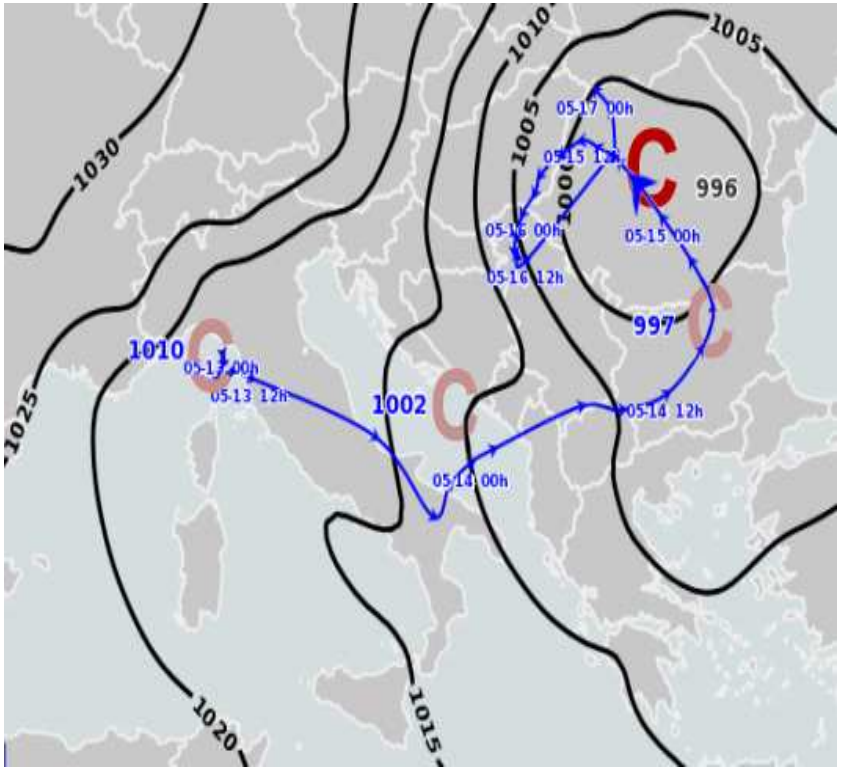
Vladimir Taušanović, Belgrade Waterworks & Sewerage

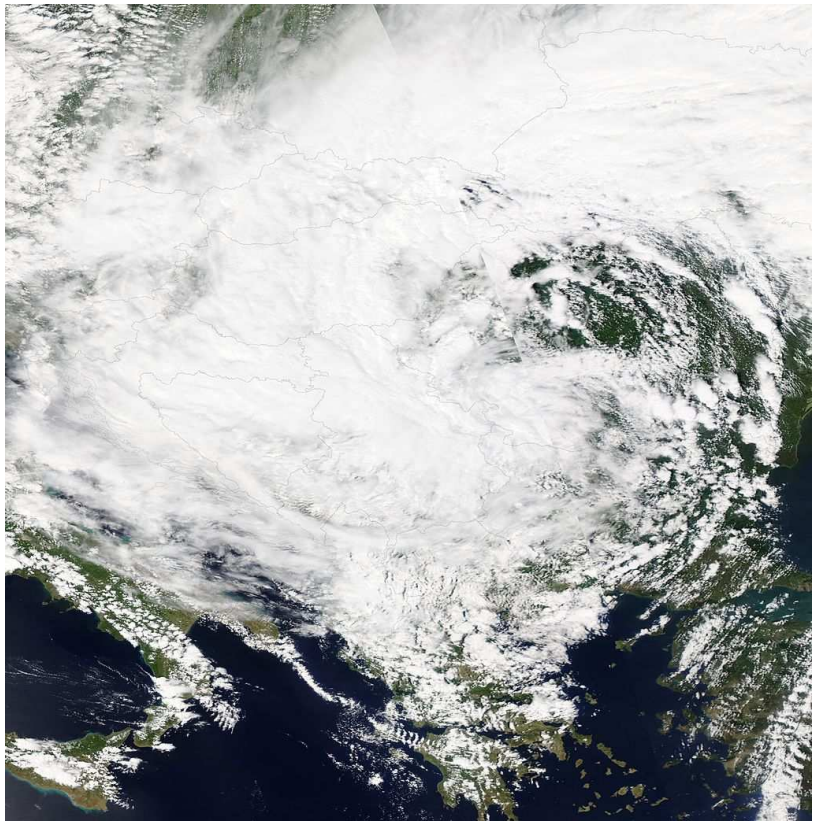
- What happened
- What were the consequences
- Lessons learned
- How to prevent and manage water services in flood events

Belgrade Waterworks & Sewerage

Cyclone (dubbed Tamara) **over the Balkans** May 2014

On 13th of May, a low-pressure area formed over the Adriatic Sea moved over the Balkans. Extremely heavy rain fell across the region between 13-16 May

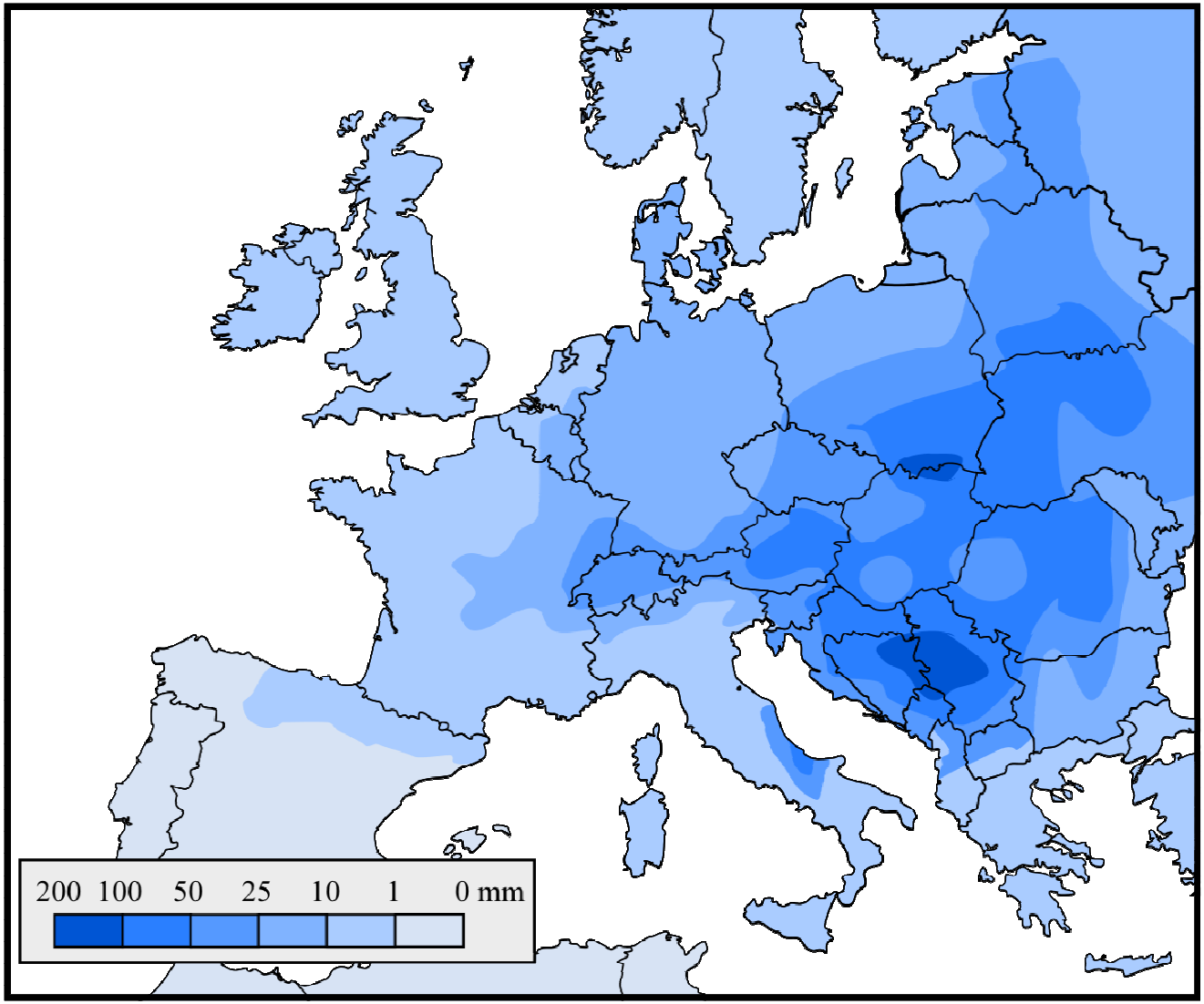




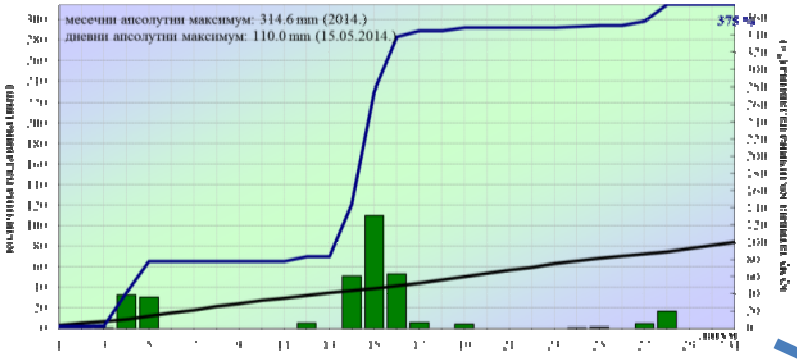
Route of the center of cyclone on ground level 13th-17th May

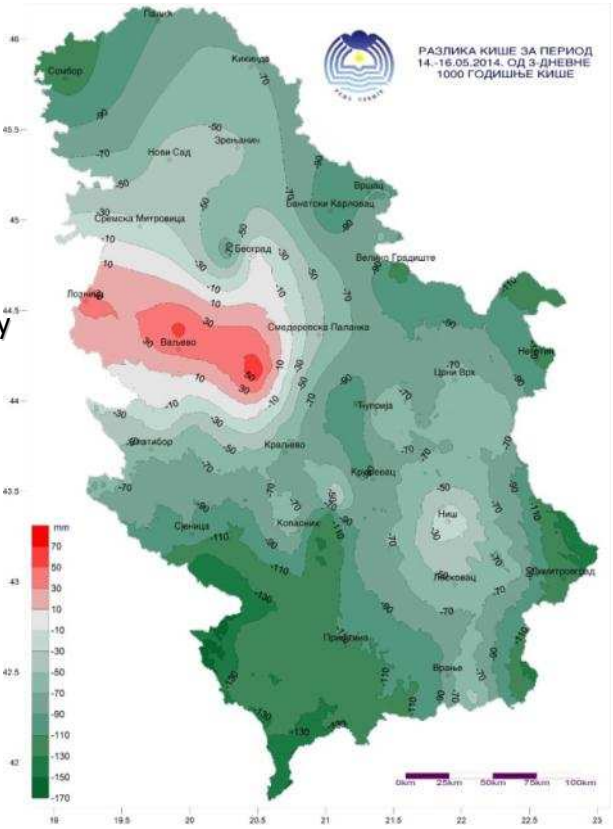
Source: Országos Meteorológiai Szolgálat, Hungary

EUROPE – Precipitation 14-16 May 2014

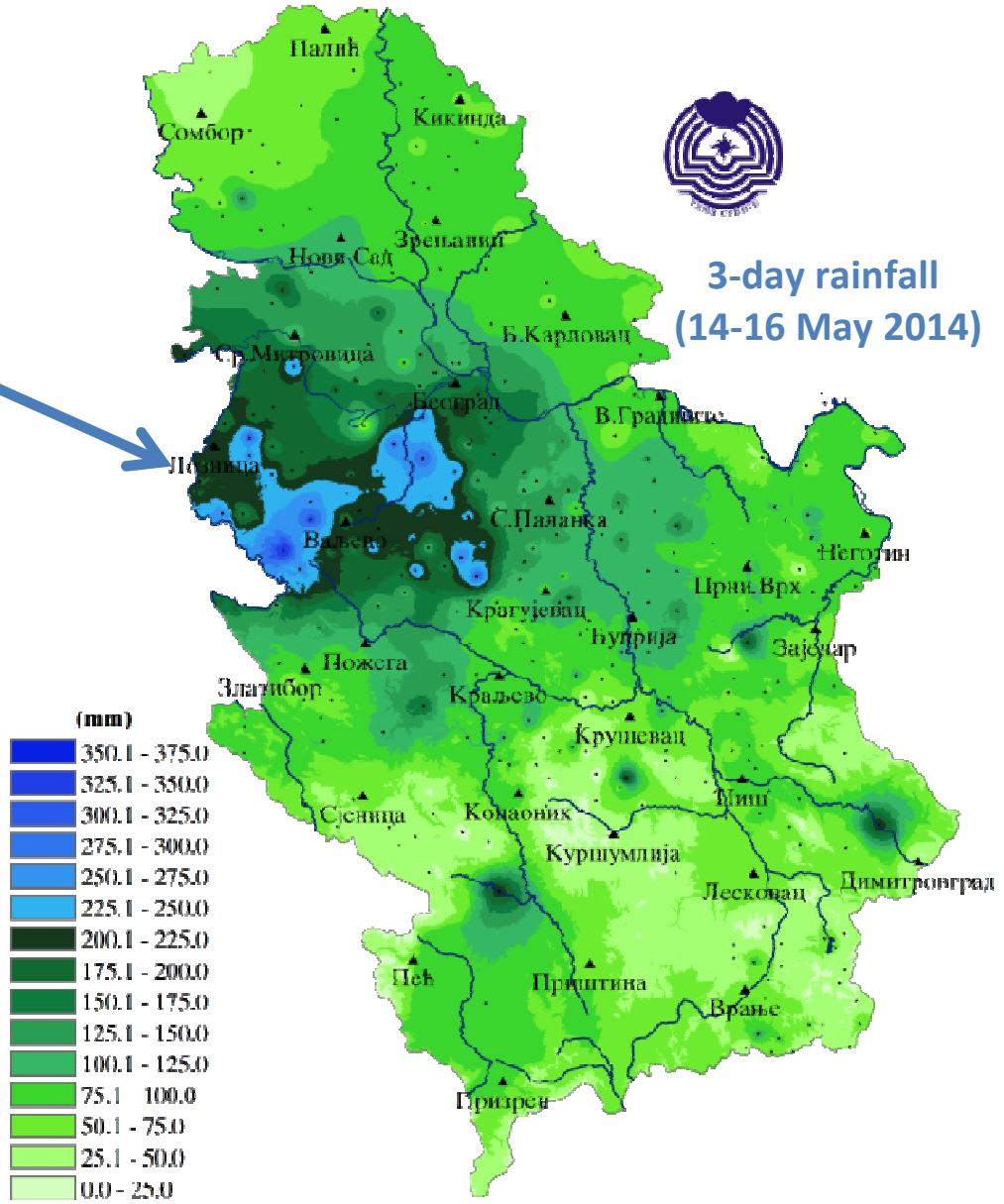


Extreme Meteorological Event





$> P_{1000y}$



Red Meteorological Alarm on May, 12th

RHMSS issued meteorological alarm – 2 to 3 days of heavy rain

Extreme Hydrological Situation

- Saturated soil due to prolonged rain in April and first week of May
- Rainfall in 3 days
- Torrents – high flow velocities, massive sediment movement, landslides
- Small and medium rivers – sudden and great increases of water levels
- Sava river – extreme water levels due to high flows on all right tributaries in Croatia and Bosnia
- Level of flood water exceeded the level of existing protection
- Flood protection system seriously damaged and failed at many locations

Extreme Water Levels

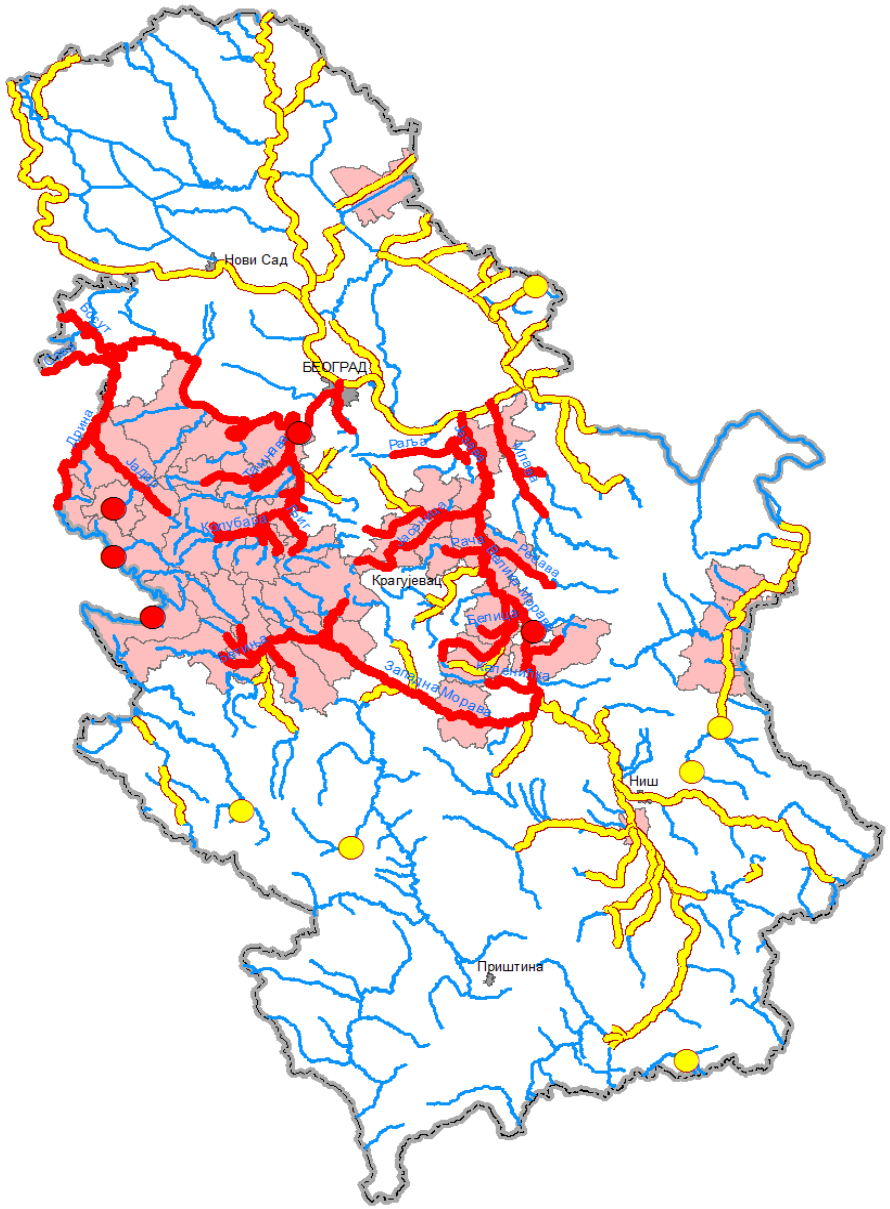
Several rivers in watersheds of Sava and Morava river rose from 2 to 5 m

Recorded on almoust
50 hydrological stations

+220 cm Z. Morava (Miločaj)
+161 cm Sava (Jamena)
+133 cm Skrapež (Požega)
+110 cm Kolubara (Valjevo)

Above previously recorded historical maximum levels

Area of Potential Significant Flood Risk
APSFR



99 APSFR **identified in Serbia**

42 APSFR been affected

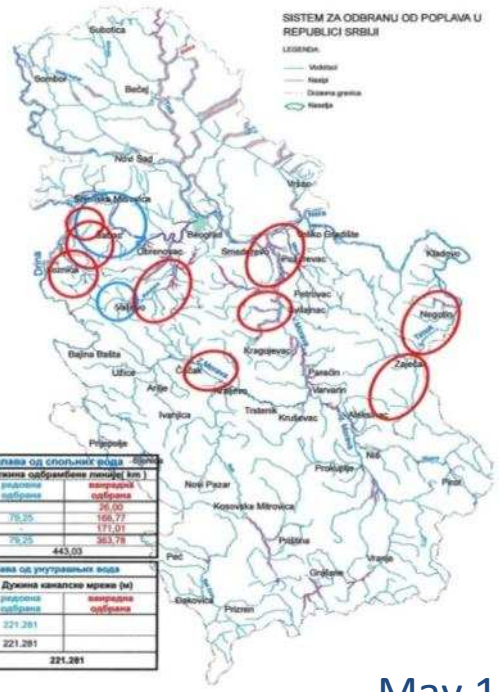
- Municipalities where **emergency situation** was declared
- In the whole country on 15th May

Flood Defense

dike failure

ЈВП "СРБИЈАВОДЕ", БЕОГРАД
Број: 810/27
Дана: 15.05.2014

БИЛТЕН бр. 27
О СПРОВОЂЕЊУ ОДБРАНЕ ОД ПОПЛАВА
НА ПОДРУЧЈУ У НАДЛЕЖНОСТИ ЈБП "СРБИЈАВОДЕ"
15.05. 2014. године



Одбрана од поплава од спољних вода

ВОДНО ПОДРУЧЈЕ	Дужина одбрамбене линије(km)	
	редовна одбрана	ванредна одбрана
Доњи Дунав		26,00
Сава	79,25	166,77
Морава	-	171,01
Сава:	79,25	363,78
УКУПНО	443,03	

Одбрана од поплава од унутрашњих вода

МЕЛ. ПОДРУЧЈЕ	Дужина каналске мреже (м)	
	редовна одбрана	ванредна одбрана
Подрињско-Колубарско	221.281	
Сава:	221.281	
УКУПНО	221.281	

May 15th

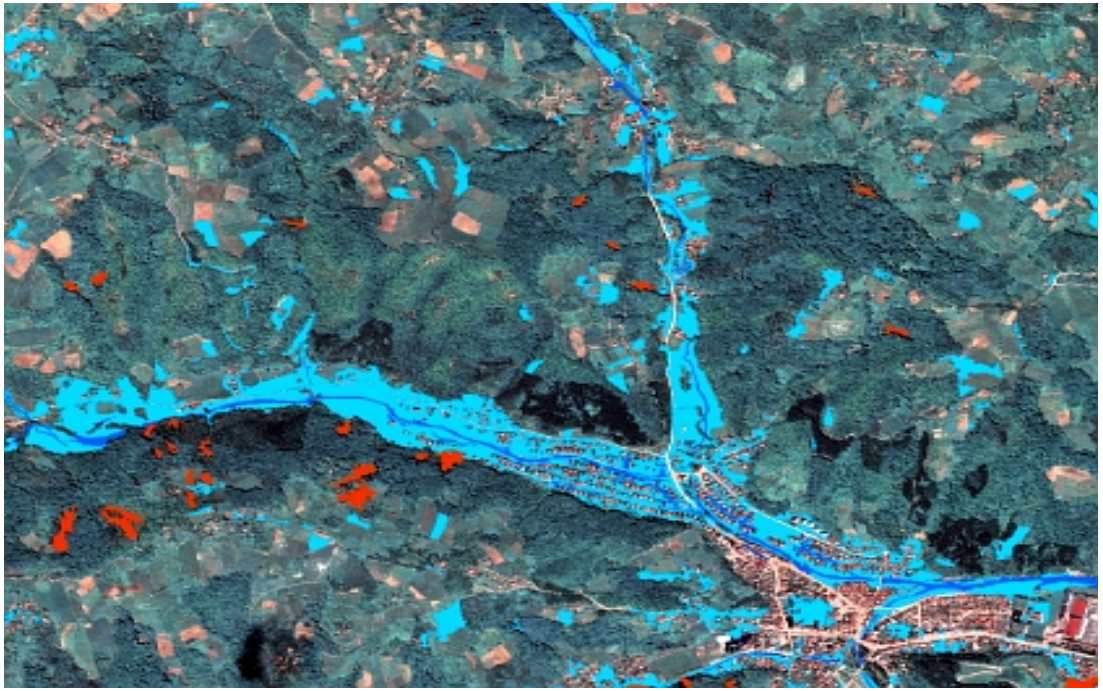
Extremely rapid development of floods –
mostly second flood defense level proclaimed

14-16 May 2014

- Sudden Natural Disaster – threatened lives, property and the environment
- Rivers rose rapidly (some over night) causing floods in surrounding valleys with devastating consequences
- The rains activated torrents and mud slides
- The first priority was to save peoples lives, properties and provisions of food and water

Torrents and mudslides – APSFR Krupanj

Flood protection structures destroyed or severely damaged
Landslides and massive sediment deposits
Municipality was isolated for 4 days – all bridges collapsed

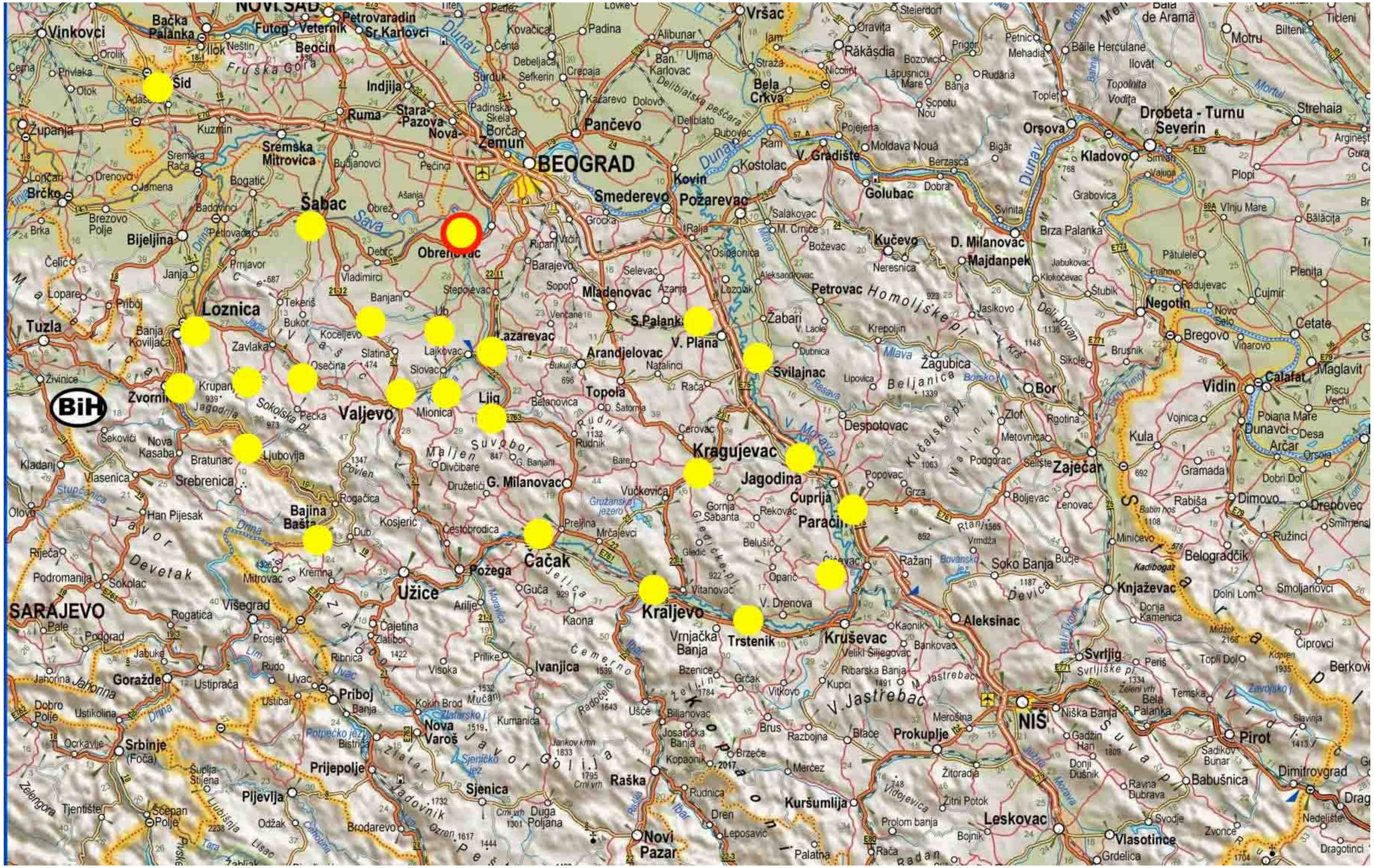


APSFR Crnica – Paraćin City

City of Valjevo

Tekija – Djerdap gorge

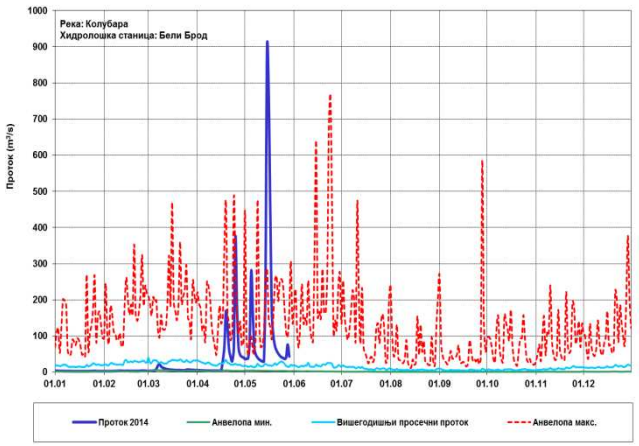
Endangered water supply



APSFR Kolubara

Kolubara river watershed

- The most affected area in the flood event
- ≤ 1 billion m3 of water fell in 3 days



Return period 1000 years

Rainfall in Kolubara river catchment area 13th - 17th May 2014. (mm or lit/m²)

No.	GMS	Measurement station	13.05.	14.05.	15.05.	16.05.	17.05.	13.-15.05.	13.-16.05.	13.-17.05.	
72	Valjevo	Valjevo	6.5	37.8	108.2	43.9	4.1	152.5	196.4	200.5	
73	Valjevo	RC Valjevo	1.6	43.6	128.0	69.5	4.1	173.2	242.7	246.8	
74	Valjevo	Mratišić	7.8	48.5	102.5	23.0	5.6	158.8	181.8	187.4	
75	Valjevo	Lukavac	6.9	43.9	120.0	51.0	4.7	170.8	221.8	226.5	
76	Valjevo	Brežće	10.0	38.8	148.5	63.7	3.5	197.3	261.0	264.5	
77	Valjevo	Mionica-Valjevska	7.3	29.3	123.2	55.0	3.1	159.8	214.8	217.9	
78	Valjevo	Liplje	6.2	27.2	86.8	70.9	8.8	120.2	191.1	199.9	
79	Valjevo	Vrujci	7.5	45.5	132.0	59.0	7.6	185.0	244.0	251.6	
80	Valjevo	Struganik	11.1	44.0	158.1	66.9	2.0	213.2	280.1	282.1	
81	Valjevo	Rogačica	9.2	47.3	123.6	64.2	3.6	180.1	244.3	247.9	
82	Valjevo	Jagodići		66.1	124.0	74.5	3.1	190.1	264.6	267.7	
83	Valjevo	Majinović	5.8	42.7	172.3	97.6	2.2	220.8	318.4	320.6	
84	Valjevo	V. Kamenica	2.3	37.4	163.5	75.2	2.6	203.2	278.4	281.0	
85	Valjevo	Stubline	0.6	40.2	165.0	76.2	12.6	205.8	282.0	294.6	
86	Valjevo	D. Leskovice	6.3	44.1	108.0	48.1	2.5	158.4	206.5	209.0	
87	Valjevo	Ljig	12.0	31.0	125.0	73.5	4.2	168.0	241.5	245.7	
88	Valjevo	Stepojevac	3.1	23.6	185.1	84.8	9.8	211.8	296.6	306.4	
89	Valjevo	Sibnica	4.5	15.8	182.5	60.0	8.8	202.8	262.8	271.6	
90	Valjevo	Štavica	7.2	35.5	65.5	33.2	6.1	108.2	141.4	147.5	
91	Valjevo	Poćuta	5.8	42.0	129.0	71.2	1.0	176.8	248.0	249.0	
92	Valjevo	Šarbane	1.5	26.5	124.2	69.0	6.1	152.2	221.2	227.3	
93	Valjevo	Koceljeva	0.7	24.7	77.5	50.1	8.6	102.9	153.0	161.6	
94	Valjevo	Pambukovica	1.2	28.5	116.0	53.0	7.1	145.7	198.7	205.8	
95	Valjevo	Ub	4.2	61.2	114.8	51.2	5.6	180.2	231.4	237.0	
97	Valjevo	Bogatić	8.6	36.1	105.0	52.5	2.3	149.7	202.2	204.5	
98	Valjevo	Osečenica	10.7	50.6	126.8	53.0	4.0	188.1	241.1	245.1	
99	Valjevo	Prkosava	5.6	15.1	163.2	70.2	9.9	183.9	254.1	264.0	
									Average	***239.4***	mm - lit/m²
									Area	***3,700***	km²
									Total volume	***885,738,889***	m³

Attracted attention of media worldwide

Municipality of OBRENOVAC

One of the 16 Municipalities of Belgrade

- City of Obrenovac including 29 settlements (villages)
- Living 70 000 people, 411 sq km area, 73 % agriculture
- Main industry -Electric Power Generation , two thermo-power plants (installed capacity 1650 MW - the main electric power supply source of Serbia)

- 80 % of territory flooded, 25 000 people evacuated
- Electricity and water supply cut off

- Endangered electric power supply system in the country

Endangered electric power supply system in the country

City of Obrenovac

Crisis management

- First line of defense failed- further measures had to be taken
- Mobilization of all possible man power (Army troops, Police, Firefighters, other specialist groups, Medical staff etc.)
- International response on call for help was great- almost all European countries and some overseas sent emergency aid or special teams to work with us
- A call for voluntaries gave an exceptional response – More people came than could be engaged (especially young generation)
- Rescue operation taking place

Rescue and protection of people

first priority

Evacuation of people

Evacuation of people

Evacuation of people

Evacuation

Animal rescue

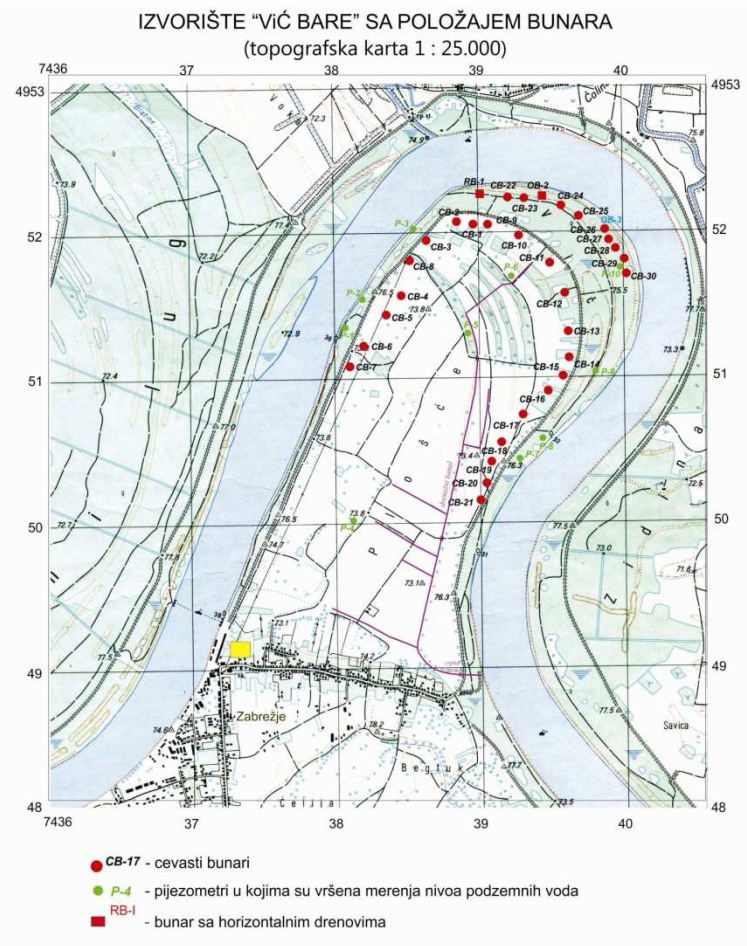
Livestock rescue

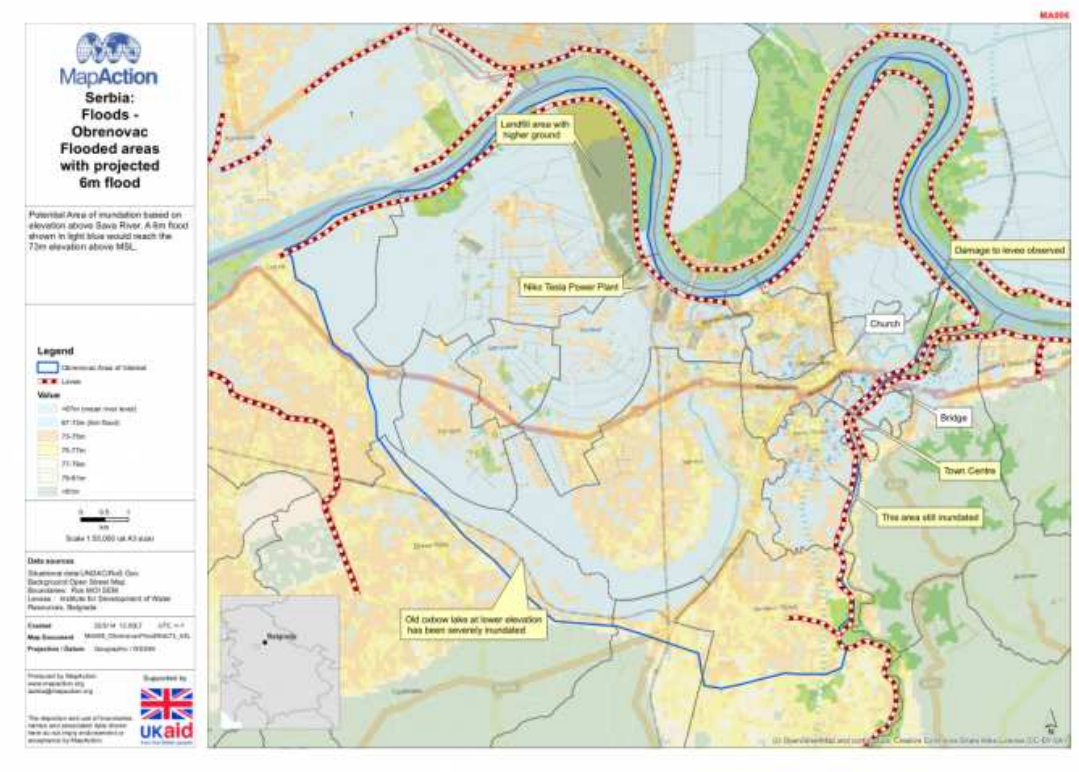
Boats are more useful !

Rescue mission

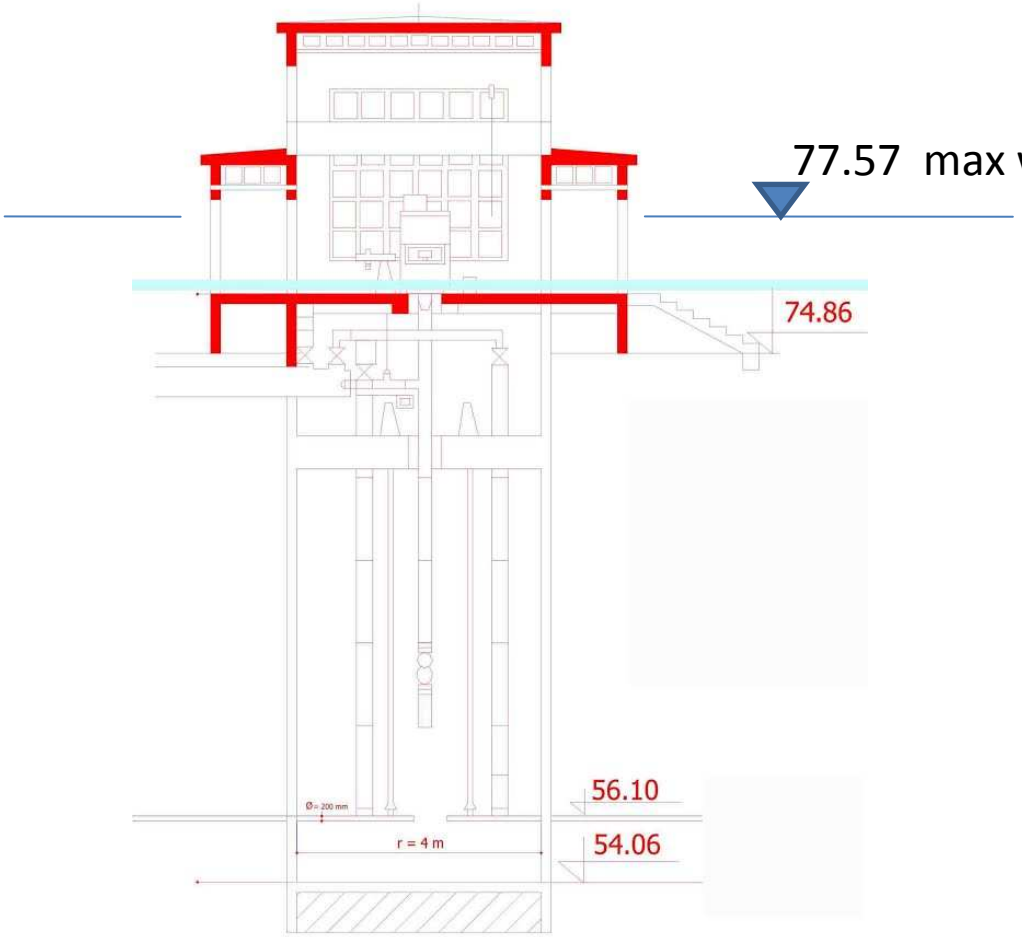
City of Obrenovac water source

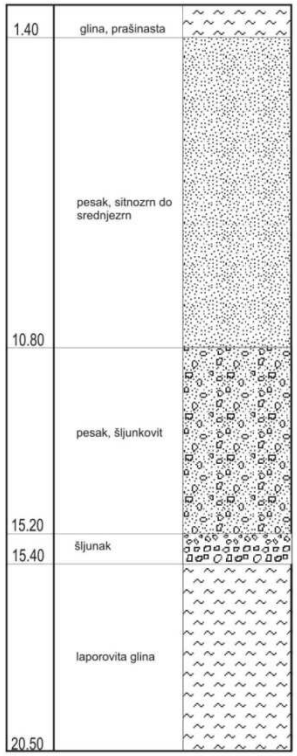
Riverbank filtration

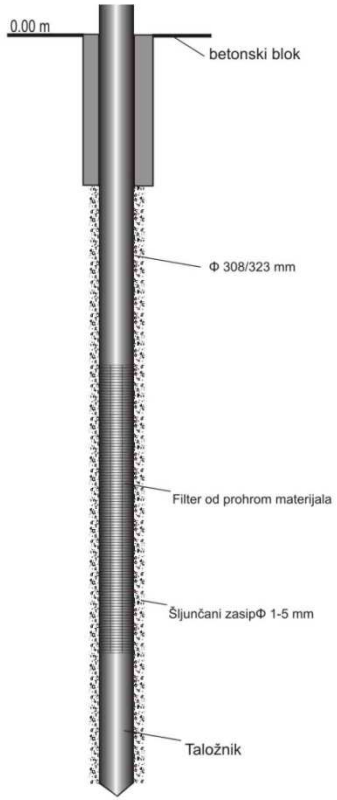




Ground water abstraction
draw wells







Obrenovac water supply system

Installed capacity:
Ground water 320 lit/sec
Surface water 130 lit/sec

Flooded wells

Status of W&S infrastructure

Obrenovac city, May 2014

- Water supply system out of operation
- Water source (wells along the river bank) – flooded
- Sewerage and potable water network under water (1m and above)
- Surface water polluted from sewerage network and septic tanks- Potential for infectious diseases and epidemic appearance
- WAITING FOR THE FLOOD WATERS TO RECEDE

Emergency Management:

1. Prompt response – FIRST AID
2. Long term recovery and restoration phase

Emergency supply – FIRST AID

Budapest waterworks

aid to the City of Obrenovac

Mobile water purification unit

Potable water packed

in 5 lit plastic bags

Bulk water supply

Aid from Germany

Sewerage pumping station
under water

Pumping out the water from low-lying areas

Diesel engine pump form Czech Republic

Sewerage system repair

Sewerage: bare manholes

All the soil washed away and left the bare manholes exposed

Repair of potable water mains
donation of Japan

Cleaning the city

from the mud deposits and other trash

50 000 tons of trash

had to be removed

Disinfection of whole area

POST-DISASTER NEEDS ASSESSMENT
IN WATER SUPPLY AND SANITATION SECTOR

SERBIA FLOODS 2014

Reconstruction needs assessment process

- Baseline pre-disaster
- **Damages**: current situation minus emergency relief
- **Losses**: in addition to damage
- Needs:
  repair, reconstruction, build better, disaster risk reduction
- Programme and costs

Disruption of water supply

- In most of the affected municipalities the urban water supply was disrupted or not available for about **two weeks** except in the City of Obrenovac where it took almost **two months** before the system could be put in operation.

The main damages were to:

- The piped network for both drinking water and sewerage, including blockage of the sewerage system;
- The electrical components of pumping systems, especially at water sources such as well fields.

Losses:

- Most affected municipalities did not collect the normal fees for services for about 1 month, and many of them were not be able to reestablish regular revenues for the next few months.
- Higher costs were incurred for, eg tankering water, additional pumping, disinfection and analyses, cleaning of septic tanks and wells in rural areas, and unblocking sewage pipes.

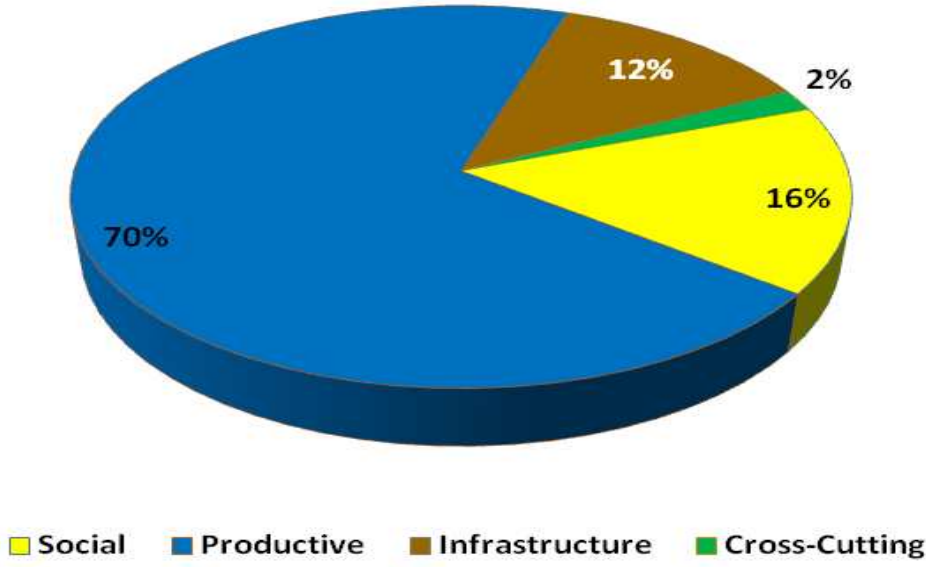
Damages and Losses
water supply sector

Municipality	Damages	Losses
	M Dinars	
Obrenovac	514	216.295
Paraćin	3.13	7.512
Ub	16.60	18.294
Čačak	3.33	0.768
Krupanj	82.8	7.075
Šabac	11.79	2.750
Mali Zvornik	4.76	2.286
Loznica	30.6	0.000
Trstenik	11.7	52.260
Jagodina	3.36	0.252
Šid	4.08	3.092
Valjevo	412	13.997
Osečina	1.87	2.134

Municipality	Damages	Losses
	M Dinars	
Varvarin	3.32	0.952
Koceljeva	15.12	2.891
Kragujevac	12.8	1.530
Kraljevo	100.4	3.660
Smederevska Palanka	11.4	0.000
Svilajnac	19.45	11.575
Ljubovija	1.56	1.846
Lazarevac	109	14.615
Bajina Bašta	29.1	1.364
Mionica	26.7	10.450
Ljig	6.36	0.210
Total	**1,436**	**376**

Total 16 mil EUR

Sectors Affected



24 municipalities

TOTAL DAMAGE 1,525 mill €

Productive **1,063 mill €** the most affected Mining and Energy 488 mill €

Social **242 mill € – Housing 231**

Infrastructure **192 mill € – Transport 167**

Cross-Cutting **28 mill € – Environment 21**

Affected People, Casualties and Damage

Affected people	1.6 million
Evacuated	32,000 out of which 25,000 from Obrenovac
Causalities	51 (23 drown)
Total damage	1.52 billion €

Disaster Risk Reduction

- **Build better and use better materials**
- More secure water sources
- Alternative locations for key infrastructure - treatment plants, pumping facilities
- Better design – less leakage; better maintenance
- Better management
- Relocate latrines/septic tanks if flooding likely to result in outflow of sewage water source
- Covers for shallow wells

Lessons learned

- Constructing in areas that are not a vicinity of rivers/streams, whenever possible not in flood plains
- Raising embankments along streams/rivers
- Planning in accordance with requirements for a provision of areas that (at least temporarily) can store sufficient storm water in order to prevent major flooding of settlements and infrastructure
- Constructing new pipelines along the roads in order to allow easier access

Danube floods 2014

Thank you