

River Basin Management Plans in the Republic of Macedonia

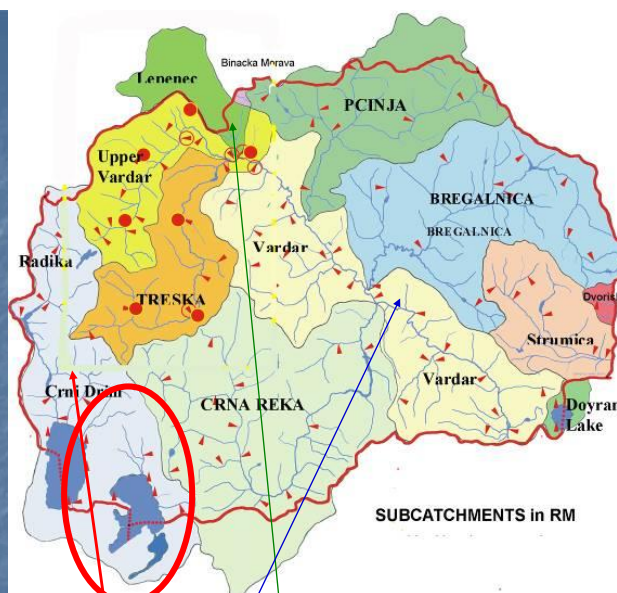


- Prezenter
- MSc Radmila Bojkovska

The total water resources
 $6,37 \cdot 10^9 \text{ m}^3$ (normal year)
 $4,80 \cdot 10^9 \text{ m}^3$ dry year),
 out of which 80% are
 carried in the Vardar basin.

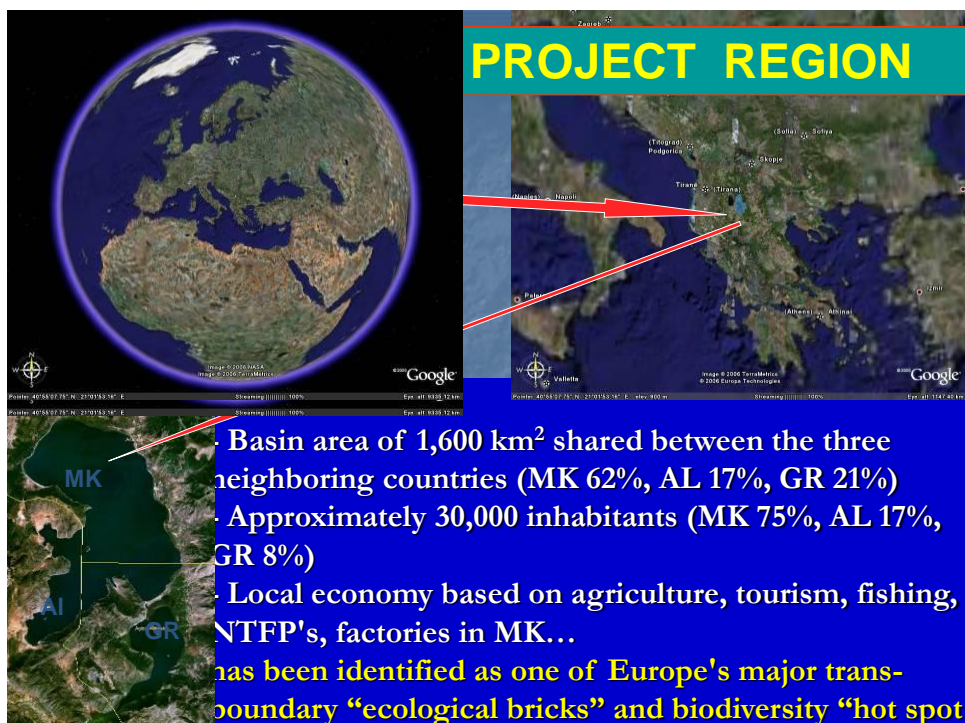
$3100 \text{ m}^3/\text{capita}$

Uneven spatial and timely
 distribution over the
 country, more favorable
 conditions in the WM
 but being characterized
 over all the national
 territory by a timely
 distribution which presents
 long drought spells and
 high intensity rainfalls
 which constitute at the
 same time a threat for
 crops and which prone
 erosion phenomena.



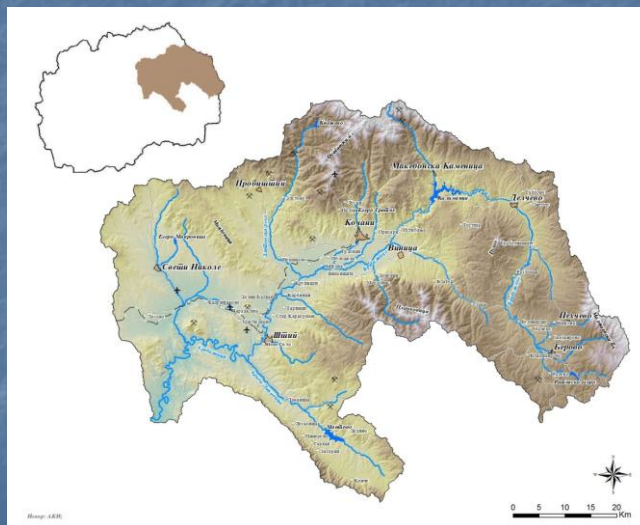
-Black Sea basin - (44 km^2 or 0.17%) ;
- Adriatic Sea basin (3359 km^2 or 13.07%)
-Aegean Sea basin (22310 km^2 or 86.76%)

- **Management Plan for Strumica River Basin**
- Within the project „Management plan for Strumica River Basin “ – funded by the Swiss Confederation, the Draft River Basin Management Plan for Strumica, was sent for adoption in the MoEPP.
- **Management Plan for Crn Drim River Basin**
- Also the preparation of the Management Plan for Crn Drim River Basin is planned to be within the frames of the Regional GEF project, in cooperation with the neighbor's countries on which territories the river basin extends.
- **Management Plan for Bregalnica River Basin**
- Within this project „Management plan for Bregalnica River Basin “ the Draft River Basin Management Plan , was prepared and is under procedure of public consultation.
- **Management Plan for the basin of Lake Prespa**
- Under this project "Implementation of the measures of Management Plans for the Basin of Lake Prespa", implemented by UNDP, supported by the Swiss Government, are implemented some of the Programme of Measures regarding of agriculture issues and itme frame of this project is 6 year.



General description of the catchment Bregalnica

- Territory 4.315 km²
- geology
- relief
- climate
- Flora and fauna
- population - 216 000



Брегалница

General description of the catchment Strumica

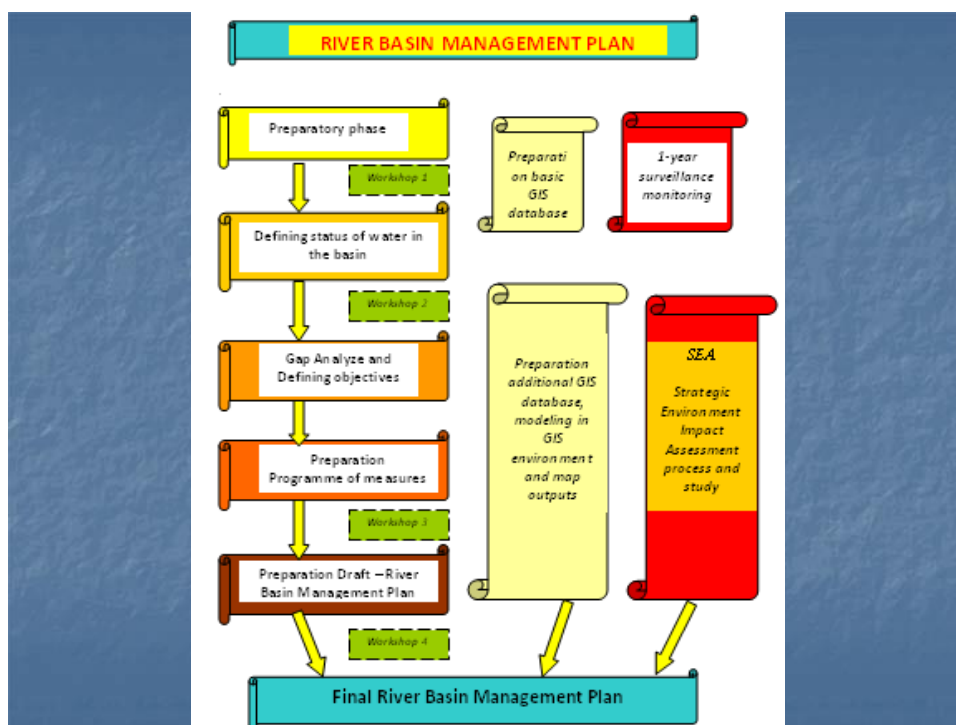
- The length of Strumica River in Macedonia equals 75 km, with a drainage area of 1,650 km².
- The medium water flow of Strumica river at Novo Selo is 3.86 m³/s, where the average minimum water discharge is 0.184 m³/s and the average maximum is 76.6 m³/s.
- The maximum flows take place at the end of winter and beginning of the spring, more precisely in the months of February, March and April.
- The minimal flows occur in the months of August and September when the minimum is only 0.05 m³/s.



4

But how to reach WFD goals and purposes when...

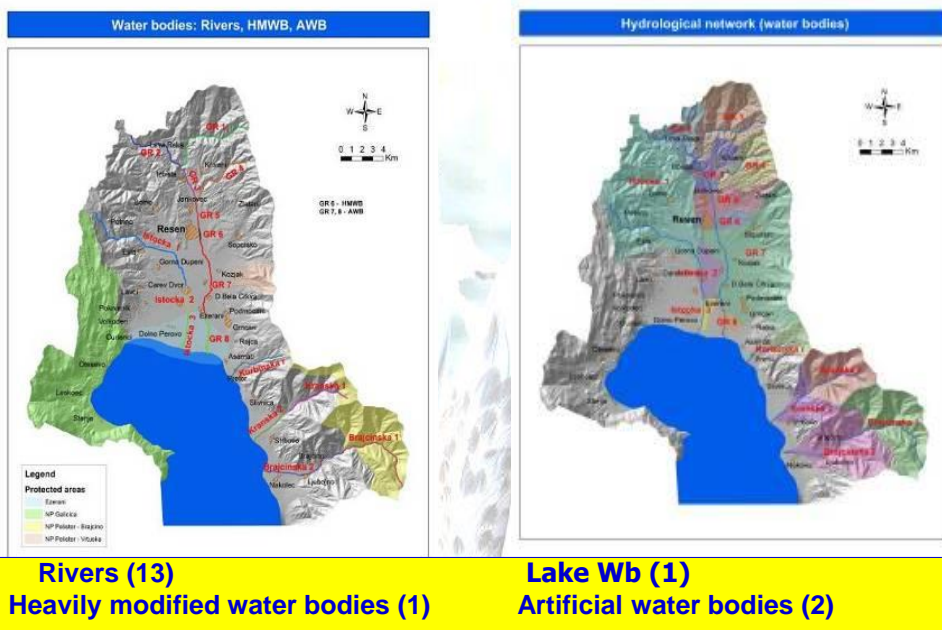
- (a) There are no continuous data on water quality parameters
- (b) There is no monitoring in the watershed
- (c) There is no information on human pressures in the watershed
- (d) There are no data on priority substances in the watershed
- (e) There is no delineation of water bodies in the watershed
- (f) There is no information on past conditions in the watershed
- (g) There are no reference conditions established in the watershed
- (h) There is no GIS database in the watershed



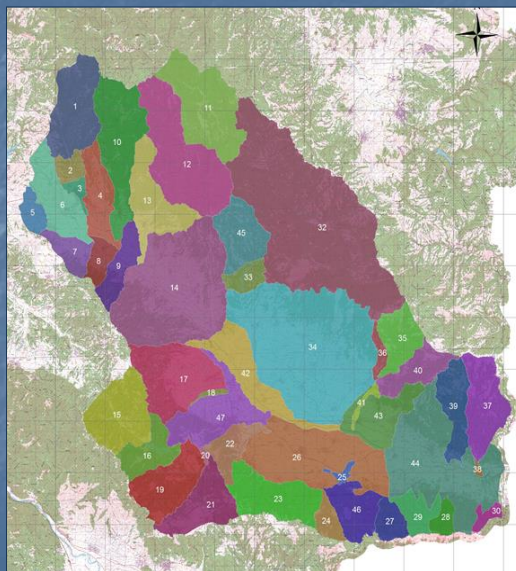
Surface WB typology

- Different for rivers or lakes
- Rivers: typology system A or system B
- All surface WB in Prespa region belong to eco-region 6 (Hellenic-Western Balkan region), **S** (small sized basins), **M**- (mountain basins > 800 masl) , **S** – (dominant silicate geological structure)
- Surface water bodies are classified as
- Rivers – type 1
- Heavily modified water bodies – type 1h
- Artificial water bodies – type 1a
- Lake – type - 1L

Delineation of Surface water bodies



Surface water body Strumica RB



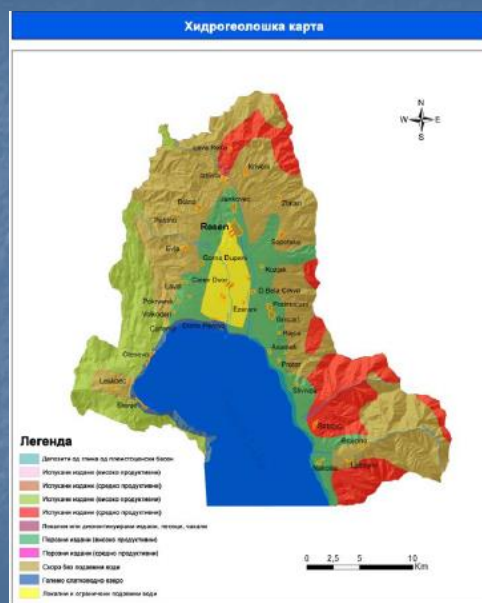
Delineation of Ground water bodies

GWB should be delineated in 3 dimension.

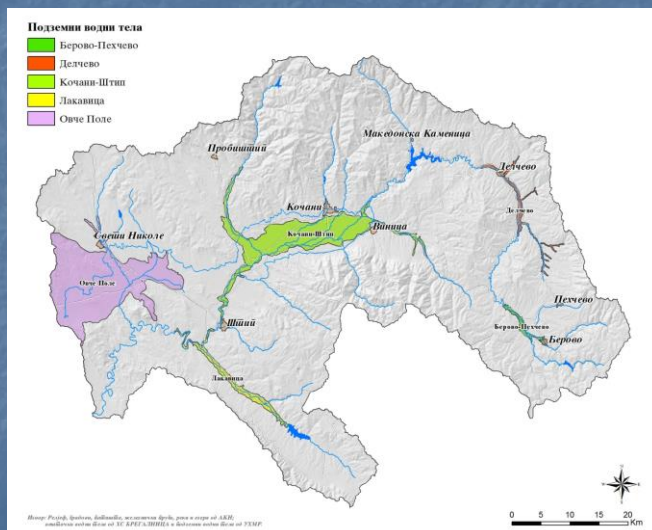
Delineation was done according to the SHARIN water permeability classes.

GWB in Prespa are located in 3 different layers

*There are 6 delineated GWB:
3 in Quaternary sediments ,
1 in Pliocene sediments
2 in Triassic carbonate rocks*

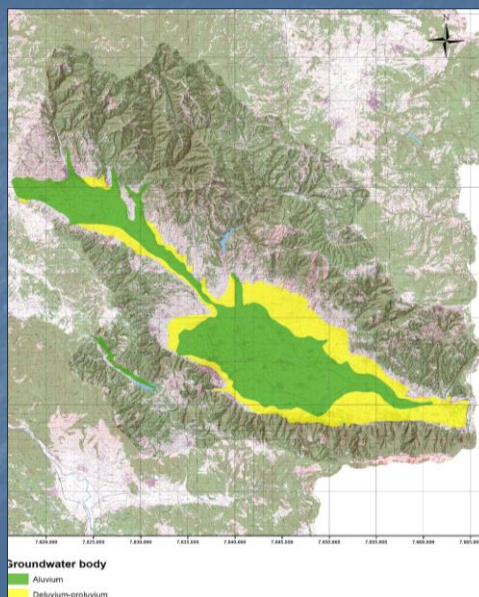


Groundwater body Bregalnica RB



GWB_01:Берово-Пехчево
 GWB_02:Делчево
 GWB_03:Штип-Кочани
 GWB_04:Лаквица
 GWB_05:Овче Поле

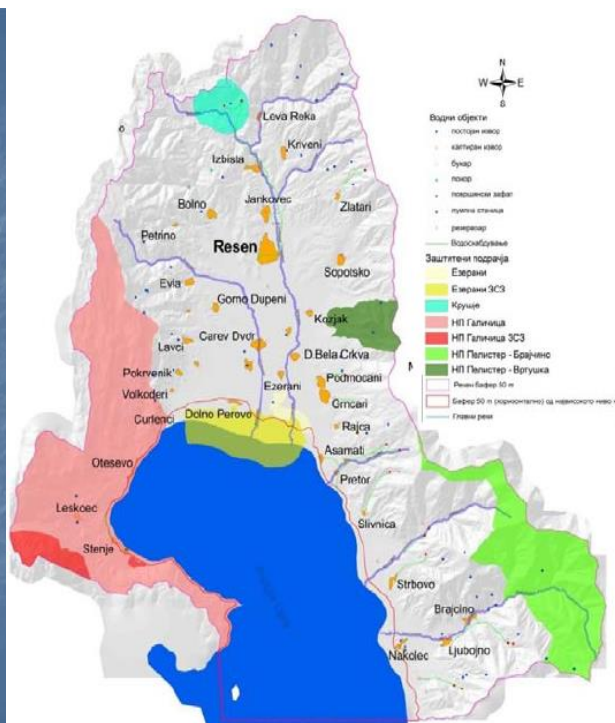
Groundwater body Strumica RB



Protection zones

- Law on nature
- Law on water
- Other legislation related to: forest, defense, etc

Map of all protected zones (already established and proclaimed and additional (some of them) under opinion of the GTI team



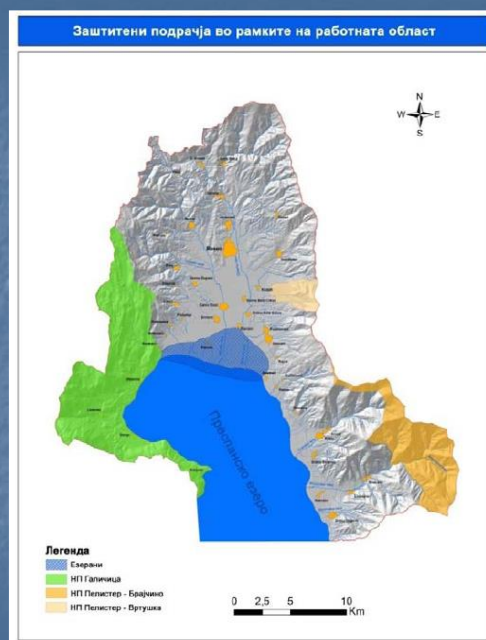
■ Law on Nature:

- National Parks (IUCN II);
 - NP Galicica
 - NP Pelister

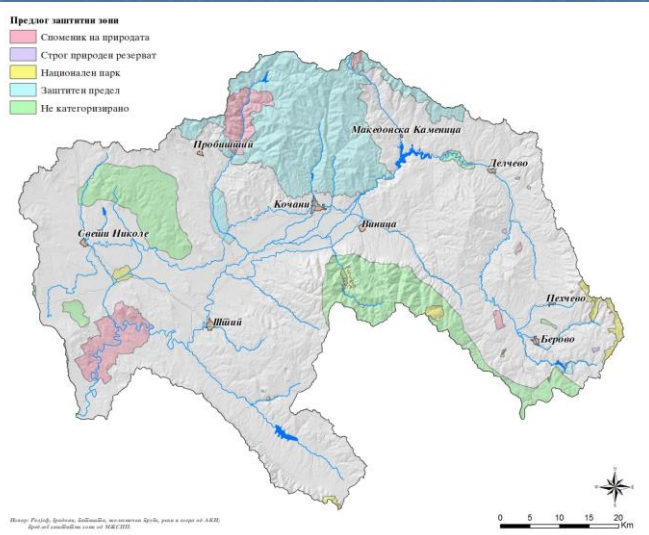
- IUCN – IV –
wetland Ezerani

- Prespa Lake (in 2002 recognized as Ramsar site)

- Other wetlands



Protected areas Bregalnica RB



Во овој момент не постојат заштитени подрачја, но имаме голем број на подрачја за кои што постои иницијатива да бидат прогласени за заштитени подрачја.

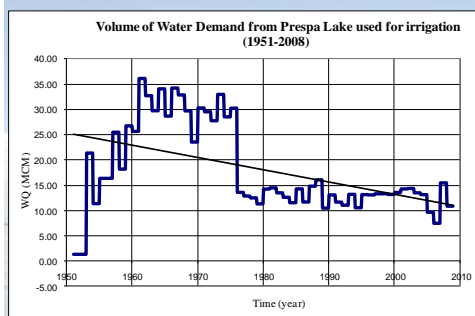
Брегалница

3. Pressures

- Households
- Industry
- Agriculture
- Other polluters

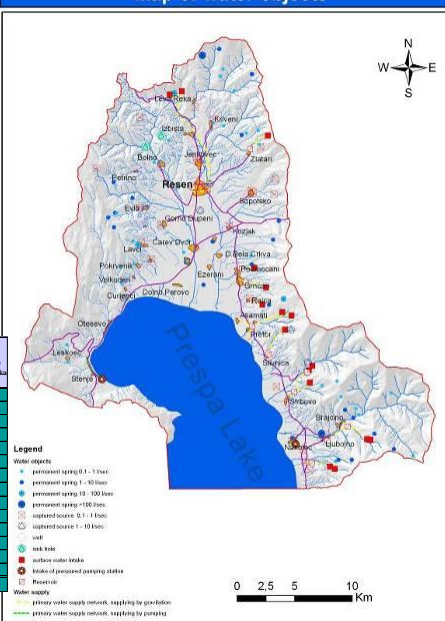
Брегалница

Water use and pressures



#	Settlement	Connection to WS and WW system	Percentage of coverage by the central WW system	Untreated wastewater discharge (m ³ /day)	Effective Pollution Load (kg BOD/day)	Effective Pollution Load (kg TSS/day)	Effective Pollution Load (kg N/day)	Effective Pollution Load (kg P/day)	Type of Impact to Golems Lake
1	Roza	WS + WW	100%	356.9	131.2	183.7	5.8	7.7	Direct
2	Kosovo	WS	100%	19.4	4.1	6.6	0.2	0.2	Indirect
3	Lavaj Beka	WS	100%	5.9	2.4	3.4	0.1	0.1	Indirect
4	Ishtice	WS	100%	17.2	7.9	9.9	0.3	0.4	Indirect
5	Kosovo	WS	100%	2.6	1.1	1.5	0.0	0.1	Indirect
6	Jankovce	WS + WW	100%	84.2	28.1	39.1	1.2	1.6	Direct
7	G. Beka Cika	WS	100%	18.2	7.5	10.5	0.3	0.4	Direct
8	G. Beka Cika	WS	100%	23.1	9.5	13.5	0.4	0.6	Direct
9	Kosovo	WS	100%	16.8	8.1	11.4	0.4	0.5	Direct
10	Podkumani	WS	100%	29.9	12.2	17.1	0.5	0.7	Indirect
11	Emanci	WS	100%	40.7	16.7	23.4	0.7	1.0	Indirect
12	Spomenko	WS	100%	21.6	8.9	12.4	0.4	0.5	Indirect
13	Zlatari	WS	100%	11.5	4.7	6.6	0.2	0.3	Indirect
14	Kozjak	WS	100%	11.4	4.7	6.6	0.2	0.3	Indirect
Total			89%	650	246	340	11	14	

Map of water objects



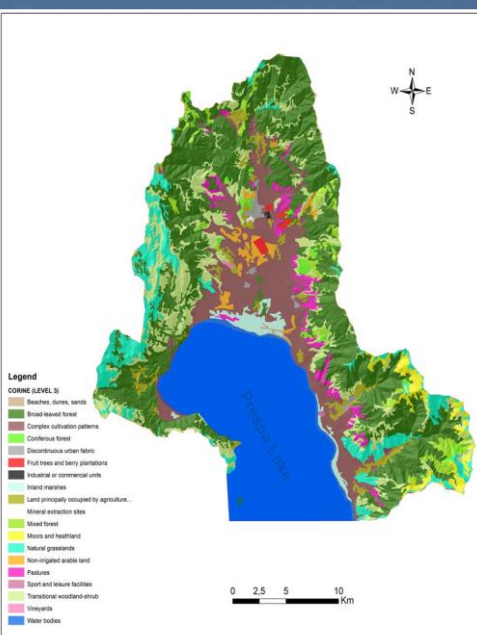
Sources of pollution

Legend

- state_border_prespa
- watershed_border_poly
- lakes_prespa
- ecosystem_point_prespa**
 - ★ Liquid Wastes spilling
 - ★ Pollution from livestock units
 - ★ Solid waste areas (hazardous)
 - ★ Solid waste areas (no hazardous)
 - ★ Touristic hotel
 - ★ Village touristic room
- ecosystems_poly_prespa**
 - Burned areas
 - Pollution from agricultural activit
 - Touristic unit
 - Winter ski center



Land Cover / Use

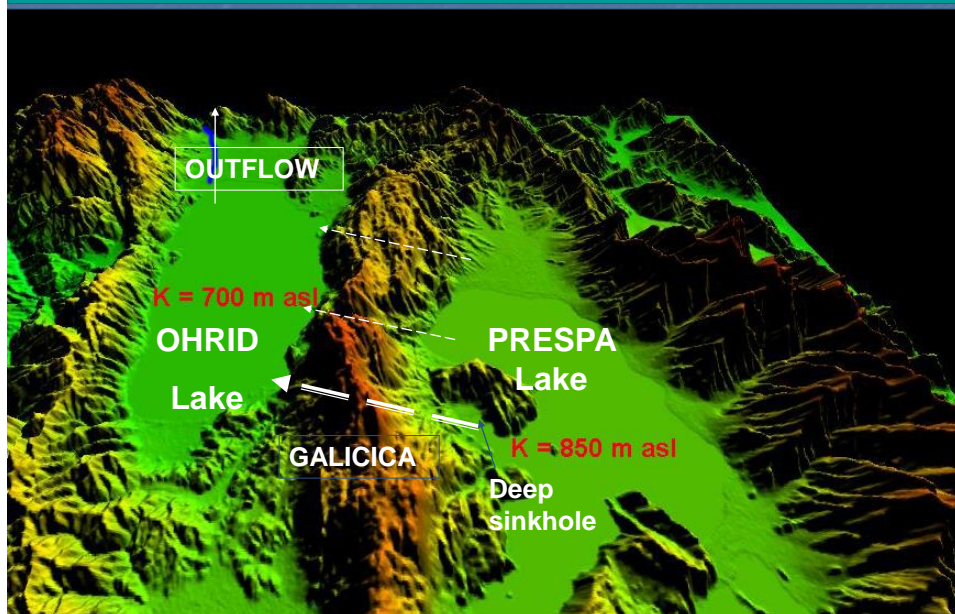


Apple stands

Table 29: Land cover/use distribution

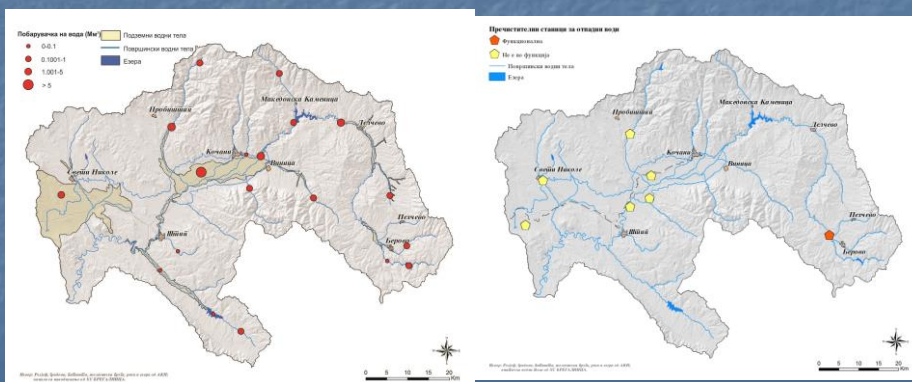
CORINE - Class	ha	%
Beaches, dunes, sands	85.82	0.1
Broad-leaved forest	24828.78	32.6
Complex cultivation patterns	9653.27	12.7
Coniferous forest	619.19	0.8
Discontinuous urban fabric	361.34	0.5
Fruit trees and berry plantations	251.44	0.3
Industrial or commercial units	23.09	0.0
Inland marshes	1114.03	1.5
Land principally occupied by agriculture, with significant areas of natural vegetation	2027.16	2.7
Mineral extraction sites	22.88	0.0
Mixed forest	1716.77	2.3
Moors and heathland	1371.80	1.8
Natural grasslands	5033.95	6.6
Non-irrigated arable land	910.61	1.2
Pastures	1693.68	2.2
Sport and leisure facilities	23.83	0.0
Transitional woodland-shrub	8102.53	10.6
Vineyards	35.81	0.0
Water bodies	18258.29	24.0

Flow for Prespa Lake to Ohrid Lake through the karst mountain Galicica



Households

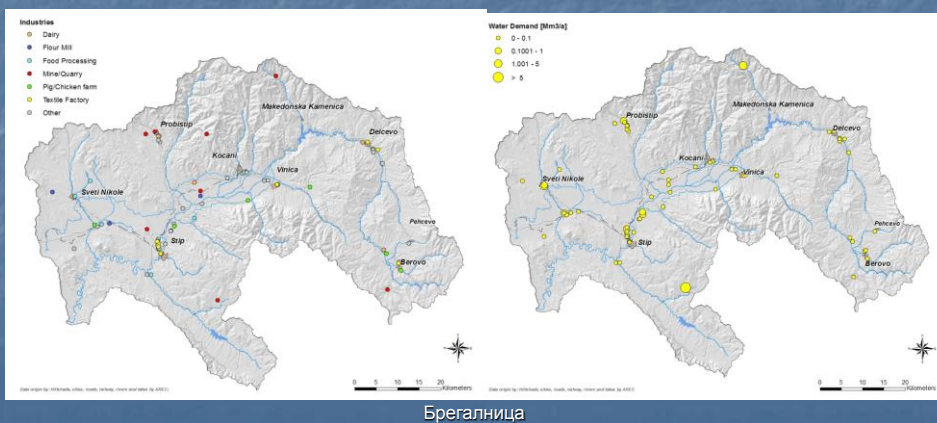
- средната побарувачка на вода по човек изнесува 92.5 m³/год,
- само 4% од отпадната вода се третира - Берово
- денешната вкупна побарувачка на вода од домаќинствата изнесува 20 (Mm³).
- како главен загадувач се јавува **Фосфорот**



Брегалница

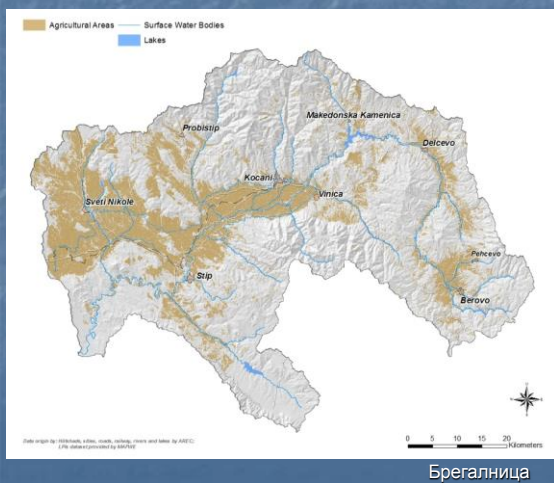
Industry

- вкупната просечна годишна потрошувачка на вода од индустријата изнесува 19 Mm³
- се очекува зголемување на потребите на вода за индустријата
- само 15% од сета индустриска отпадна вода е поврзана на градска канализациона мрежа
- главни загадувачи од индустријата се: тешките метали, фосфорот и азотот



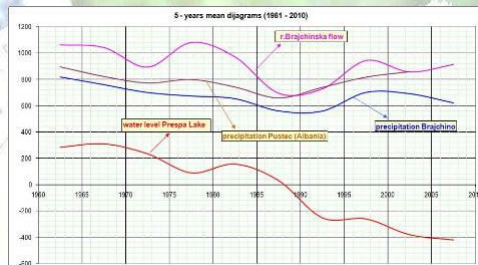
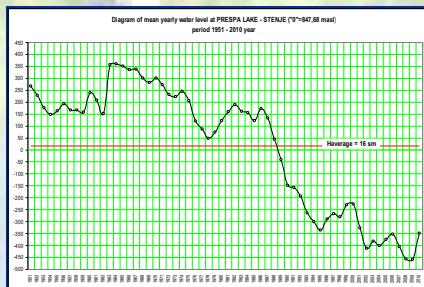
Agriculture

- од 4.307 км² само 1000 км² (100.000 ha) се обработлива површина.
- Во овој момент само 9.000-10.000 ha, односно половина од потенцијалната обработлива површина се наводнува

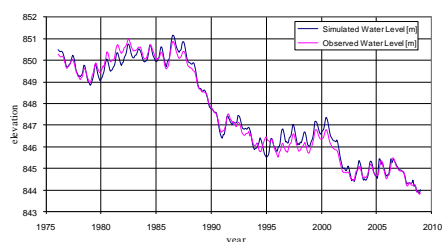


- Горен дел од Брегалничкиот слив
- Среден дел од Брегалничкиот слив
- Долен дел од Брегалничкиот слив
- Во иднина се очекува зголемување на обработливите површини

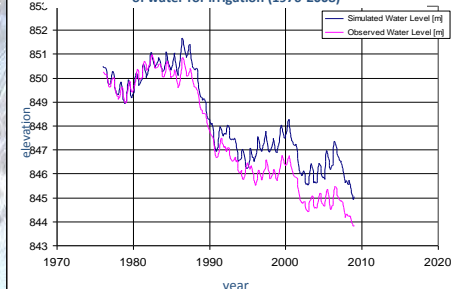
Water balance modeling



Measured and Simulated Prespa Lake Water Levels (1976-2008)

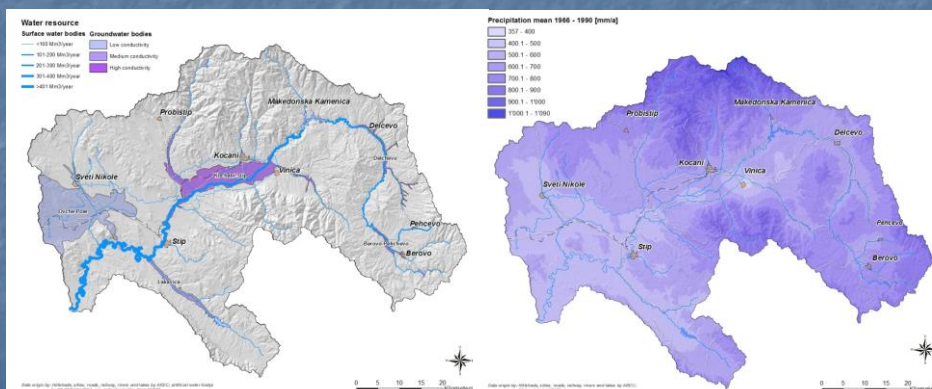


Simulated and Measured Water Levels, excluding the use of water for irrigation (1976-2008)



Hydrological Model & Water Allocation Model

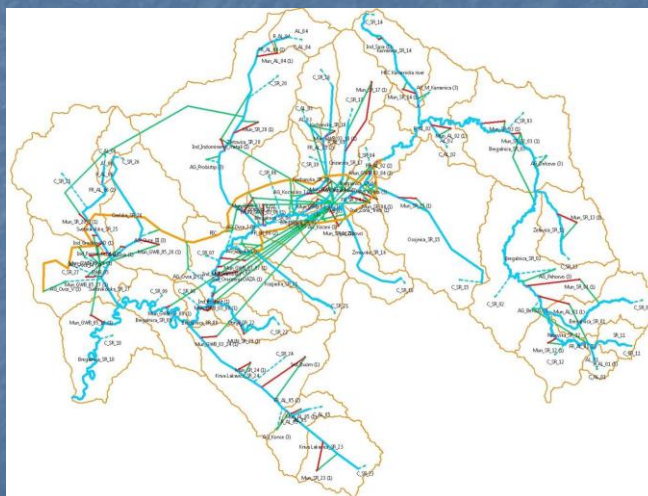
- Средниот природен проток за секое водно тело беше одреден со помош на rainfall-runoff модел за периодот од 1966 до 1990



Брегалница

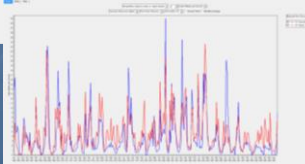
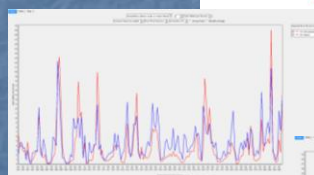
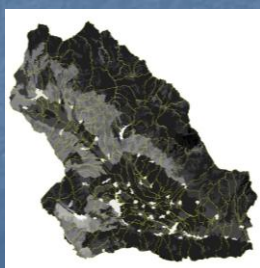
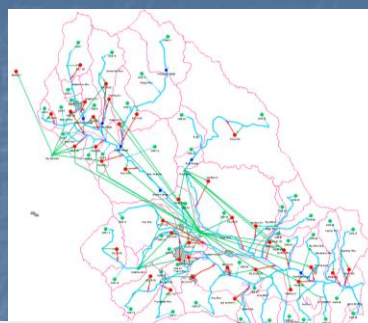
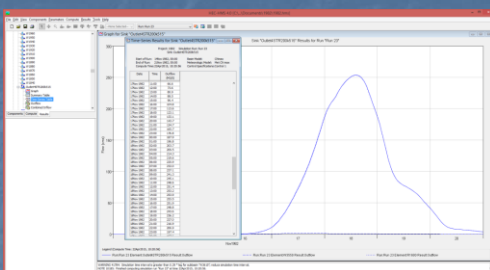
Water resources distribution (WEAP)

- Побарувачи на вода:
 - Домаќинства
 - Индустија
 - Земјоделство
- Хидротехнички објекти:
 - 6 брани/акумулации
 - 2 канали за наводнување од ХС Брегалница



Брегалница

RINFALL-RUNOFF model/ WEAP Strumica RB



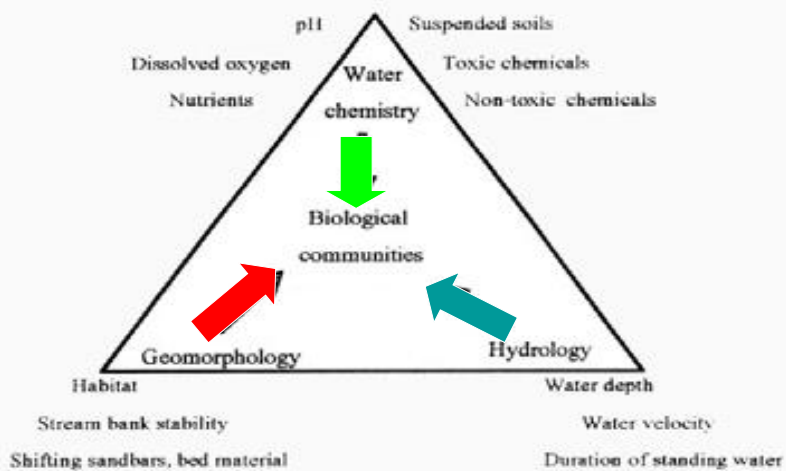
Monitoring according to the WFD

- Surveillance monitoring
- Operational Monitoring
- Investigative Monitoring



Брегалница

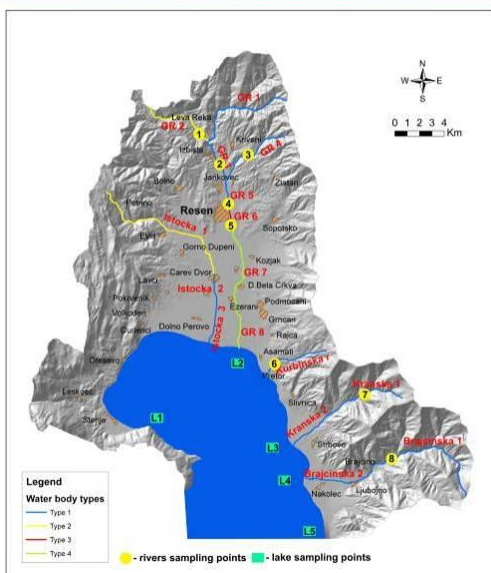
Physical and Chemical Parameters <-----> Biological communities



Three main components of aquatic ecosystems that influence biological communities (Byl and Smith, 1994)

MACRO PRESPA LAKE

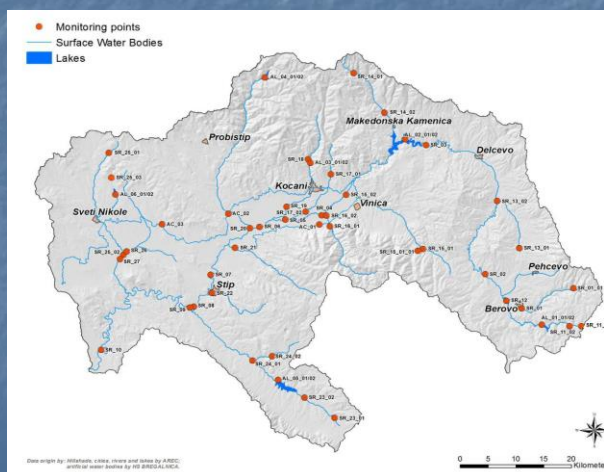
Water body types (rivers)



**ESTABLISHED
12-months Monitoring
of Surface Water
Quality**

Monitoring location - Bregalnica

- 43 точки (29 реки, 11 резервоари, 3 канали)
- Мерни и Референтни точки



Брегалница

Indicators and period of Surface Water Monitoring










Group	Element	Amount of indicators	Rivers					Artificial WB					HMWB				
			I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Biological	Phytobenthos	1	x		x		x						x		x		
	Zoobenthos	2	x		x		x						x		x		
	Fish	1	x		x		x						x		x		
	Phytoplankton	4	x		x		x						x		x		
Hydromorphological	Riparian vegetation	1	x		x		x										
	River habitat	1	x		x		x										
Physical-Chemical	Turbidity	1	x	x	x	x	x	x		x			x		x		
	Thermal condition	1	x	x	x	x	x	x		x			x		x		
	Salinity	1	x	x	x	x	x	x		x			x		x		
	Acidification	1	x	x	x	x	x	x		x			x		x		
	Oxygenation	3	x	x	x	x	x	x		x			x		x		
	Nutrient / Nitrogen	6	x	x	x	x	x	x		x			x		x		
Priority substances	Metals, metalloids	14	x		x	x	x	x		x			x		x		
	Pesticides	3	x		x		x	x		x			x		x		
	Persistent hydrocarbons	2	x		x		x	x		x			x		x		
	Polyphenols	2	x		x		x	x		x			x		x		

Брегалница

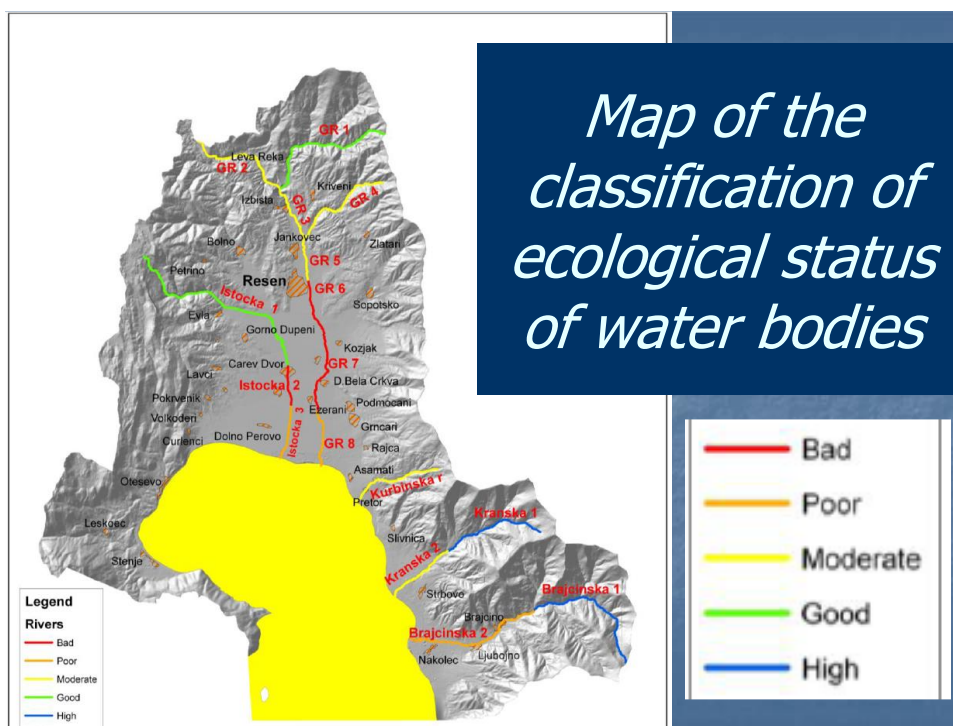
Ecological Status/Potential

Surface water bodies

Artificial and Heavily modified water bodies

Реки и езера Еколошки статус	Боја на кодот	МВТ, ВВТ Еколошки потенцијал	
		Боја на кодот	Боја на кодот
Одлично			
Добро		Добро	
Прифатливо		Прифатливо	
Слабо		Слабо	
Лошо		Лошо	

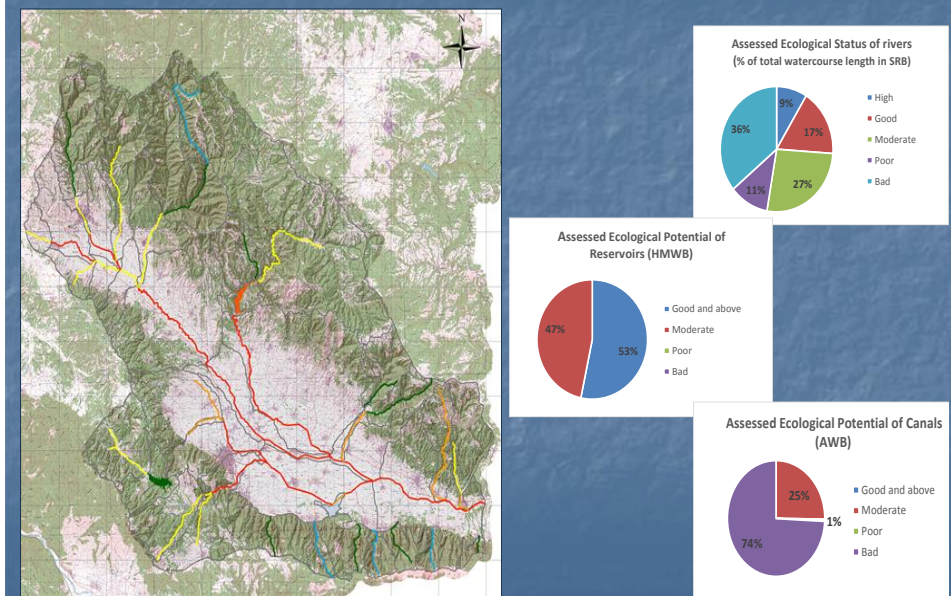
Брегалница



THE FINAL STATUS OF DELINEATED WATER BODIES

WATER BODY NAME	WB TYPE	STATUS					ACTION NEEDED UNDER	
		High	Good	Moderate	Poor	Bad	UWWTD or ND	WFD
SURFACE Water Bodies - RIVERS								
Istočka Reka 1	1		Good				no	no
Istočka Reka 2	1					Bad	yes	yes
Istočka Reka 3	1				Poor		yes	yes
Golema Reka 1	1		Good				no	no
Golema Reka 2	1			Moderate			yes	yes
Golema Reka 3	1			Moderate			yes	yes
Golema Reka 4	1			Moderate			yes	yes
Golema Reka 5	1			Moderate			yes	yes
Kurbinska Reka 1	1			Moderate			yes	yes
Kranska Reka 1	1	High					no	no
Kranska Reka 2	1			Moderate			yes	yes
Bračjinska Reka 1	1	High					no	no
Bračjinska Reka 2	1				Poor		yes	yes
SURFACE WATER BODIES – HEAVILY MODIFIED WB								
Golema Reka 6	1h					Bad	yes	yes
SURFACE WATER BODIES – ARTIFICIAL WB								
Golema Reka 7	1a					Bad	yes	yes
Golema Reka 8	1a				Poor		yes	yes
SURFACE WATER BODIES – LAKE								
PRESPA LAKE	1L			Moderate			yes	yes

Surface water body status Strumica RB



Indicators and period of UWM – Bregalnica RB

Детален мониторинг

На тендер

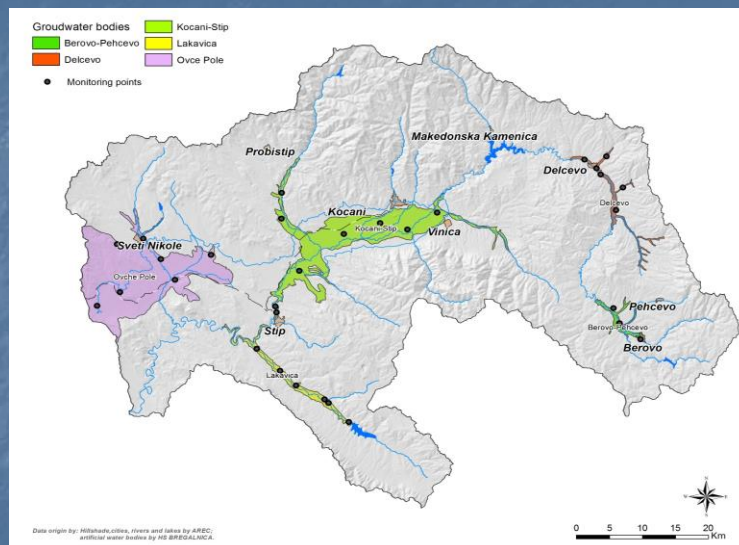
Надзорниот мониторинг вклучува четири групи на индикатори:

- биолошки,
- хидро-морфолошки,
- физичко-хемиски
- и приоритетни субстанции.

Element	Indicator(s) to be measured	Spring 2014	Autumn 2014
Water quantity	Groundwater level	X	X
Thermal condition	Temperature	X	X
Salinity	Conductivity	X	X
Acidification	pH	X	X
Oxygenation	Dissolved Oxygen, dissolved CO ₂ , Redox potential	X	X
Nutrient condition	N-NO ₃ , N-NO ₂ , N-NH ₄ , Ptot, PO ₄ ³⁻	X	X
Majority cations	Ca, Mg, Na, K	X	X
Majority anions	Cl, SO ₄ , CO ₃	X	X
Priority substances	Metals & Metaloids (Ag, Al, As, Ba, Cd, Co, Cr, Pb, Hg, Ni, Zn, Cu, Mn, Fe, V), Poly Aromatic Hydrocarbons (PAH), Phthalates, Nitrogen and Phosphorous pesticides, Polychlorinated biphenyl (PCB), Organochlorine pesticides, Organochlorine components	X	

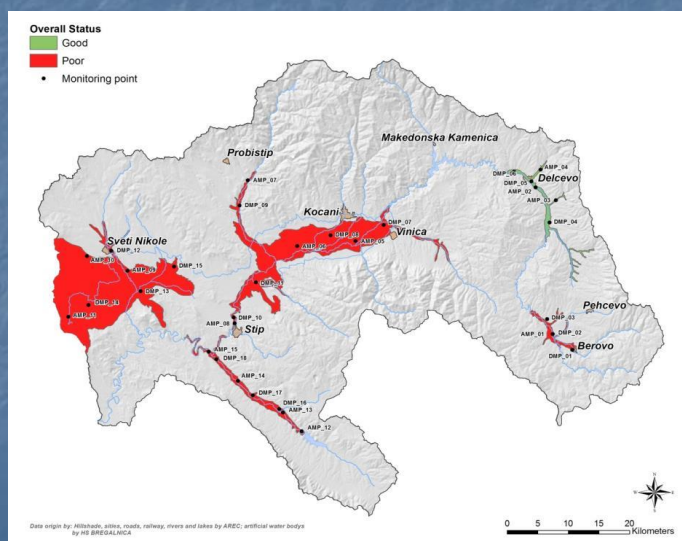
Bregalnica

Monitoring locations - GWB Bregalnica



Брегалница

Bregalnica RB with overall groundwater body status



Reference conditions

■ Reference conditions for Rivers

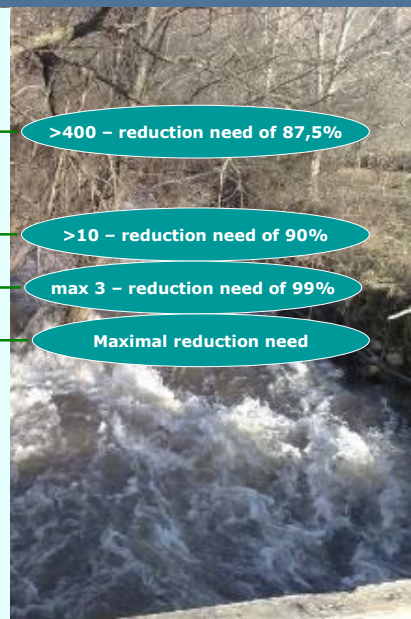
sample point in the headwater – near the spring

■ Reference conditions for lakes –

core sampling

WHERE SHOULD THE WATER BODIES BE – THE REFERENCE CONDITIONS FOR RIVERS IN PRESIPA LAKE WATERSHED

Reference conditions for the rivers in Prespa Lake watershed	
Parameter (units)	Value
Dissolved oxygen (mg/l)	>9
Conductivity (µs/cm)	<50
pH	6-7
NH ₄ -N (mg/l)	<0.05
NO ₃ -N (mg/l)	<0.6
Total N (mg/l)	<1.0
PO ₄ -P (mg/l)	<0.020
Total P (mg/l)	<0.030
Toxic heavy metals and priority substances (µg/l)	<0.001
Dominant algae - diatoms	Diatoms: <i>Meridion circulare</i> , <i>Meridion circulare</i> var. <i>constricta</i> , <i>Diatoma hyemalis</i> , <i>Diatoma mesodon</i> , <i>Eunotia</i> spp., <i>Staurosirella pinnata</i> , <i>Hannea arcus</i> , <i>Psammodium daonense</i> , <i>Amphipleura pellucida</i> , <i>Decussata hexagona</i> , <i>Laticula nivalis</i> , <i>Diadesmia perpusila</i> , <i>Krsticella ohridana</i> , <i>Pinnularia sudetica</i> . Red algae: <i>Lenanea fluviatilis</i> .
Dominant benthic invertebrates	<i>Heptagenia sulphurea</i> , <i>Baetis rhodani</i> , <i>Baetis alpinus</i> , <i>Baetis fuscatus</i> , <i>Baetis vernus</i> , <i>Potamophylax latipennis</i> , <i>Capnia vidua</i> , <i>Brachyptera risi</i> , <i>Nemoura cinerea</i> , <i>Austropotamobius torrentium</i> , <i>Axacus astacus</i>
DSFI index - invertebrates	≥7



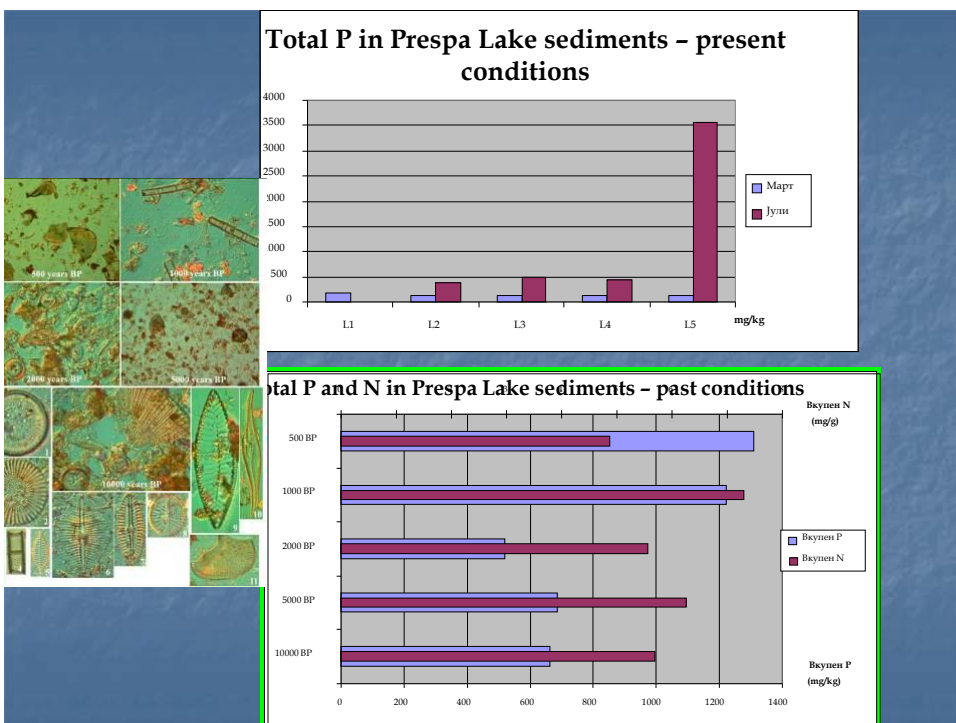
>400 – reduction need of 87,5%

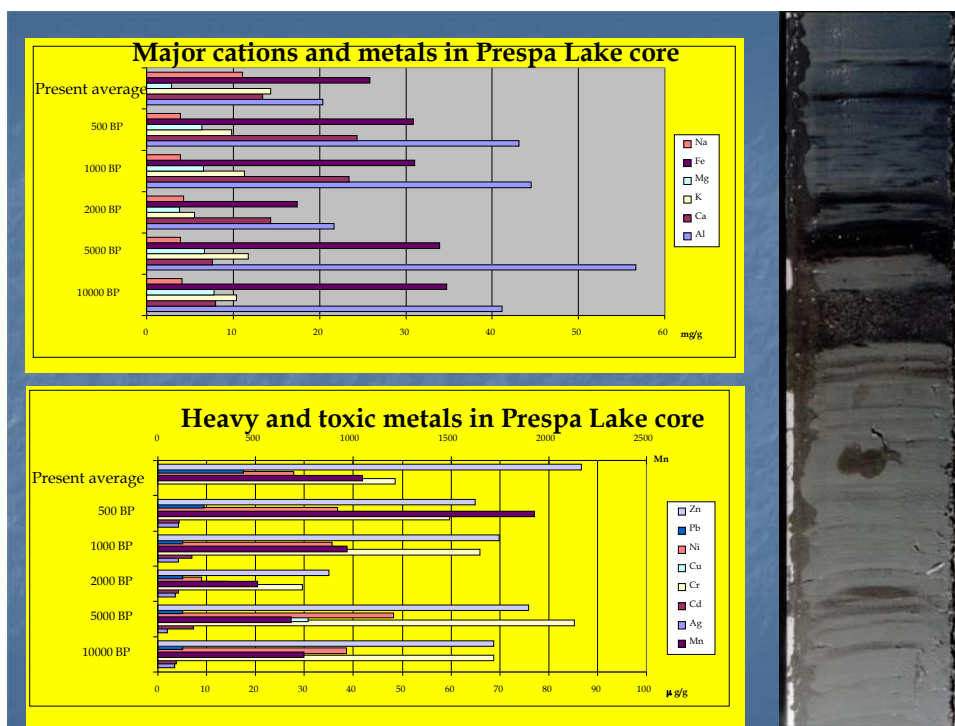
>10 – reduction need of 90%

max 3 – reduction need of 99%

Maximal reduction need

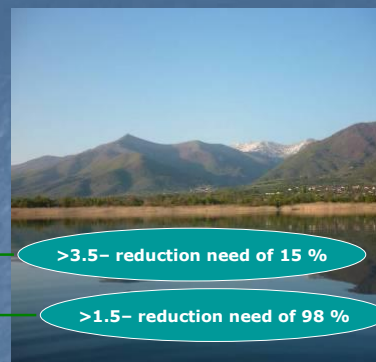
REFERENCE CONDITIONS FOR PRESPA LAKE – CORE SAMPLING





THE REFERENCE CONDITIONS FOR PRESPA LAKE

Reference conditions for Prespa Lake	
Parameter (units)	Value
Dissolved oxygen (mg/l)	6-7 (surface); >4 (bottom)
Conductivity (µs/cm)	200-300
pH	7-8
NH _x -N (mg/l)	<0.05
NO _x -N (mg/l)	<1.0
Total N (mg/l)	<3.0
PO ₄ -P (mg/l)	<0.005
Total P (mg/l)	0.015-0.025
Chlorophyll <i>a</i> (µg/l)	<3.8
Secchi depth (m)	>5
Dominant algae	Diatoms, Chrysophytes, Green coccoid algae, Xanthophytes, Charophytes. No cyanobacteria or 'water blooms' by any algal group.
Dominant benthic invertebrates	Snails, Clamps, Dragon flies, Mayflies, Caddis flies, Leeches, Sponge, Amphipods, Decapods. No Chironomids or Tubificids indicators for eutrophic conditions.
BQI index	>3
Diversity index H	2.33-3.00



>3.5– reduction need of 15 %

>1.5– reduction need of 98 %



PROGRAMME OF MEASURES

analysis, prioritization & implementation plan



EU Directives related to the WFD



Environmental Objectives

- Avoid a further deterioration of the status of the water bodies
- Achieve a *good status* and a *good environmental potential* for all its water bodies
- A good status and environmental potential shall be achieved gradually and in line with the goals set forth by the Macedonian Water Law
- Reduce chemical pollution
- Achieve water related protected areas objectives

Брегалница

ENVIRONMENTAL OBJECTIVES – WATER BODIES

Name	Current status	Action needed?	Objectives	
			Rivers	HMWB & AWB
Istocka 1	Good			
Istocka 2	Bad	Y	Good	
Istocka 3	Poor	Y	Good	
Golema 1	Good			
Golema 2	Moderate	Y	Good	
Golema 3	Moderate	Y	Good	
Golema 4	Moderate	Y	Good	
Golema 5	Moderate	Y	Good	
Golema 6	Bad	Y		Good potential
Golema 7	Bad	Y		Good potential
Golema 8	Poor	Y		Good potential
Kurbinska	Moderate	Y	Good	
Kranska 1	High			
Kranska 2	Moderate	Y	Good	
Brajcinska 1	High			
Brajcinska 2	Poor	Y	Good	

Measures – legal framework

- Reduction of discharges and emissions of pollutants
- Progressive reduction of discharges, emissions and losses of specific pollutants or groups of pollutants that are significant risk to the environment in the water, By enabling and drinking water (preferred materials and substances)
- Introducing a ban on the use and releases of priority hazardous substances
- Mitigating the effects of water pollution, coastal areas and wetlands
- Restoring the natural state of each water body where that is possible
- Improve the characteristics of unnatural (artificial) and heavily modified surface water bodies.

Брегалница

Program of measures

- **Measures for water quality**
 - Waste water treatment
 - Management solid waste
 - Priority substances control/ Control of sludge in mines and quarry
 - Techniques of soil treatment and control of erosion
 - Control of pesticides and fertilizers
 - Control of erosion in forests and pastures
- **Quantity and flood protection**
 - Water use regulation
 - Measures for riverbed and its stability
 - Flood protection
- **Other measures**
 - Management protection zones

Брегалница

Program of measures

Waste water treatment

- Improvements are needed regarding the following issues:
 - large discharge of hazardous substances from households and industries and nutrients
 - Insufficient coverage of sewerage networks, insufficient connectivity to households and industries, lack of storm water systems, lack of waste water treatment plants
 - Insufficient regulation / control discharges

Брегалница

Implementation of the Program of measures

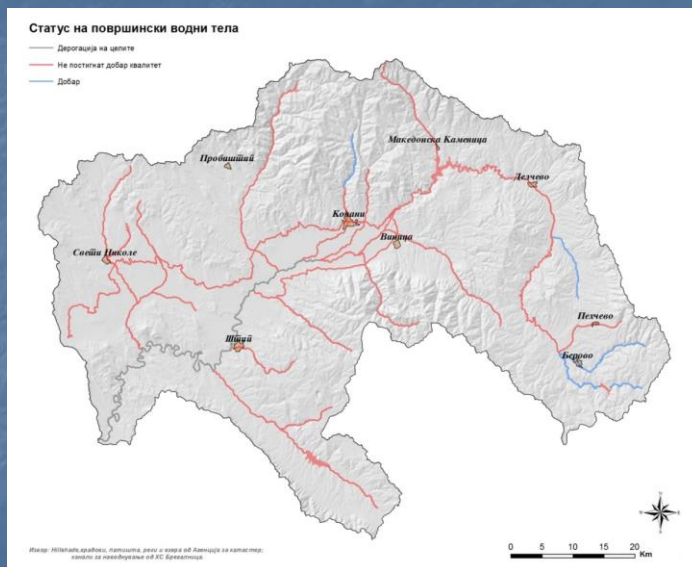
- WFD: 6-годишни циклуси на спроведување на Планот 2015-2021, 2121-2027
- Мерки предвидени за циклус од 6 години
- Приоретизација:

1	<ul style="list-style-type: none"> • Целосна имплементација на Законот за води • Принципи: „загадувачот/корисникот плаќа“ трошоци за целосно покривање на трошоците за услугите во секторот вода • Активности поврзани со голем број на точки извори на загадување
2	Активности кои се поврзани со среден влез на загадување од точки или дифузни извори
3	Активности со мали/локални (позитивни) ефекти

- Ако мерката не може да се реализира (заврши) во рамките на еден циклус, таа би можела да биде ревидирана и вклучена во наредниот циклус.

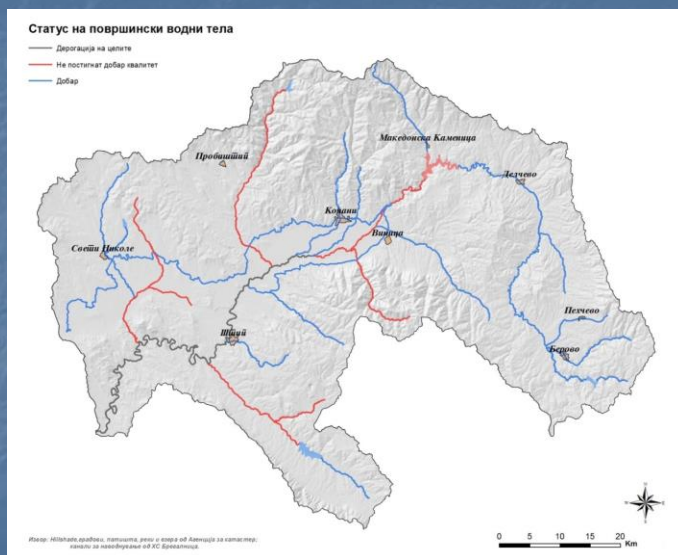
Брегалница

Surface water bodies status 2015



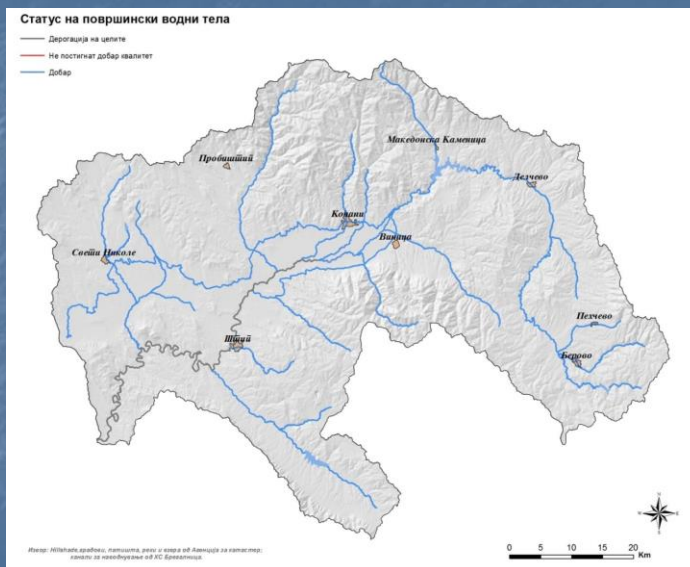
Брегалница

Surface water body status 2021



Брегалница

Surface water bodies status 2027



Брегалница

Programme of measures

Programme of measures

45 measures identified...

Analyzed in detail for:

- Priority
- Responsible institution
- Schedule/duration of implementation
- Indicators
- Cost (CBA, NPV, cost-effectiveness...)
- Impact to waterbodies / ecosystems (Rivers, Lake, HMWB, Artificial , Wetlands, Groundwater, Terrestrial/natural Habitats)
- Expected effects (Nitrogen, Phosphorus, Physical Pressure, Natural Habitats, Priority substances, Water supply security, Harmful impacts of water, Other)

Possible Implementation Strategies

Три (3) алтернативи...

- A '***Business as Usual***' Strategy ,
- A ***Water Framework Directive Implementation Strategy*** in which all the 45 measures are implemented in full accordance with the WFD, ensuring the achievement of the environmental objectives.
- A ***Realistic Implementation Strategy*** in which some of the above 45 measures are implemented based on the availability of economic resources, manpower and skills. → **Prioritization**

Necessary preparatory measures

The preparatory measures to be addressed in relation to the Macedonian context:

- **The Enabling Environment**
 - Policies
 - Legislative Framework
 - Financing and Incentive Structure
- **Institutional Roles**
 - Creating and Organisational Structure
 - Building Institutional Capacity
- **Management Instruments**
 - Social Change Instruments
 - Regulatory Instruments
 - Economic Instruments

Possible Implementation Strategies

3 alternatives (3 алтернативи)

- A '***Business as Usual***' Strategy
- A ***Water Framework Directive Implementation Strategy*** in which all the 45 measures are implemented in full accordance with the WFD, ensuring the achievement of the environmental objectives.
= **52 million €**
- A ***Realistic Implementation Strategy*** in which some of the above 45 measures are implemented based on the availability of economic resources, manpower and skills.
= **14.5 million €**

Effects – Environmental objectives

Objectives	Sub-objective	Indicators	Alternatives		
			"0" No action	1 Realistic	2 Full WFD
Overall Objective 1: Improvement of environmental conditions ensuring good water and soil quality for human health and ecosystem by 2025 Indicator: Measurable decline in levels of the main pollutant groups and pressures on water, sediment and biota	1a: Good surface water quality:	Reduce/prevent further eutrophication/organic pollution			
		Reduce/prevent further hydromorphological changes			
		Reduce/prevent further habitat fragmentation			
		Maintain biological water quality (phytoplankton, macrophytes, invertebrates and fish)			
		Reduce/prevent hazardous substances pollution			
	1b: Good groundwater quality:	Control water abstraction			
		Reduce/prevent water pollution from point and non-point sources			
		Maintain good physical and chemical characteristics			
	1c: Good ecological	Reduce/prevent further eutrophication/organic pollution			
		Reduce/prevent further hydromorphological changes			
		Reduce/prevent further habitat			

Environmental effects

Name	Current status	Action ?	Objectives		Alternatives		
			Rivers	HMWB & AWB	"0" No action	1 Realistic	2 Full WFD
Istocka 1	Good				Good	Good	Good
Istocka 2	Bad	Y	Good		Bad	Moderate	Good
Istocka 3	Poor	Y	Good		Poor	Moderate	Good
Golema 1	Good				Good	Good	Good
Golema 2	Moderate	Y	Good		Moderate	Good	Good
Golema 3	Moderate	Y	Good		Moderate	Good	Good
Golema 4	Moderate	Y	Good		Moderate	Good	Good
Golema 5	Moderate	Y	Good		Moderate	Good	Good
Golema 6	Bad	Y		Good potential	Bad	Moderate	Good
Golema 7	Bad	Y		Good potential	Bad	Moderate	Good
Golema 8	Poor	Y		Good potential	Poor	Moderate	Good
Kurbinska	Moderate	Y	Good		Moderate	Good	Good
Kranska 1	High				High	High	High
Kranska 2	Moderate	Y	Good		Moderate	Good	Good
Brajcinska 1	High				High	High	High
Brajcinska 2	Poor	Y	Good		Poor	Moderate	Good
Lake Prespa	Moderate		Good		Poor	Good	Good

■ ECONOMIC ANALYSIS

■ **Cost-based valuation method –**

based on the assumption that the cost of maintaining an environmental benefit is a reasonable estimate of its value.

■ **Necessity of Assessing Disproportionate Costs**

an approach for determining whether the total costs of the programme of measures are disproportionately costly is relevant for justifying derogation.

- The measures are divided into two groups.
- The first group of measures refers to water used for irrigation. The first group of users consists of farmers who will use the water for irrigation. In this group, one hectare of agriculture area is considered as the cost unit. The total irrigation area is 4,000 hectares.
- The second group of measures refers to the treatment of wastewater.
- The reason for this classification is to enable the distribution of the costs for the measures per unit. The second group of users consists of the legal
- entities that will be included in the treatment of wastewater, in which group households and legal entities are considered as cost units. There are 4,000 households and legal entities (companies and institutions) in the area.

Net present value (NPV) calculated for the two groups of measures for 2 alternatives

Table 29. NPV - group of measures on water supply & irrigation

Measures for treatment of water for irrigation	NPV ('000 €)	Repayment period 40 years		Repayment period 20 years	
		Annual equivalent cost ('000 €)	Annual cost per ha (4.000 ha) in €	Annual equivalent cost ('000 €)	Annual cost per ha (4.000 ha) in €
Alternative 1 - Full WFD Implementation	42.838	1.071	268	2.142	535
Alternative 2 -Realistic Implementation Strategy	11.035	276	69	552	138

Table 30. NPV – group of measures for treatment of wastewater

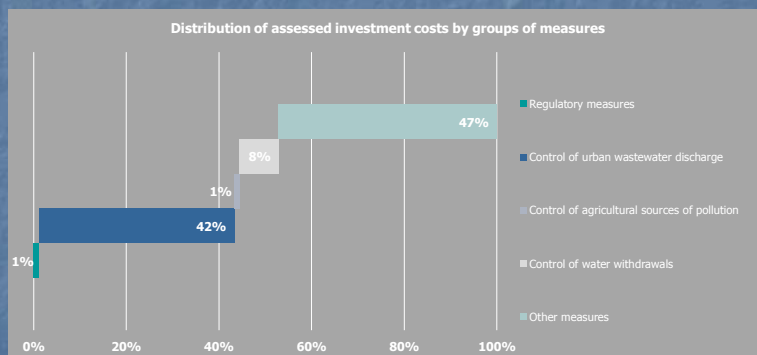
Measures for treatment of wastewater	NPV ('000 €)	Repayment period 40 years		Repayment period 20 years	
		Annual equivalent cost ('000 €)	Monthly cost per entity (4.000) in €	Annual equivalent cost ('000 €)	Monthly cost per entity (4.000) in €
Alternative 1 - Full WFD Implementation	8.843	221	4,5	442	9
Alternative 2 -Realistic Implementation Strategy	472	12	0,2	24	0,5

PoM – implementation schedule

Rank	Score	ID	Measures	Cost		Impl.Period (years)	Proposed Alternatives			Initial 6-year WMP implementation period	Second 6-year WMP implementation period	Third 6-year WMP implementation period
				Total (NP €)	Ann (NP €)		0	1	2			
							BW	R	WFD	Year 1-6	Year 7-12	Years 13-18
1	88.2	23	Regulate irrigation wells	200	3	3						
2	88.2	23	Regulate river intake from	16	3	3						
3	85.5	428	Green cover in orchards	300	8	8						
4	82.5	34	Erosion structures	7.000	18	18						
5	83	421	Upgrade irrigation schemes	300	5	5						
6	82.5	422	Closure of illegal dumps	250	6	6						
7	82.5	410	Upgrade industrial WWTP	300	12	12						
8	82	414a	Upgrade Erosion WWTP	300	2	2						
9	81.7	42	Inhabitable fish ponds	350	5	5						
10	81.5	33	Erosion control plans	300	6	6						
11	81.5	61	Management plans Pila	6	30cent	30cent						
12	81.2	411	WWTP monitoring for Lake Prespa	6	30	30cent						
13	80.2	411	Reforestation of pine	6	30cent	30cent						
14	59.8	424	Educating farmers in good agricultural and environmental practice including composting of orchard waste	100	2	2						
15	59.7	21	Preparation of flood risk and mitigation plans	250	2	2						
16	57.8	423	Pilot project for environmental safe use of fertilizers and pesticides	100	2	2						
17	57.7	34	Introduce drip irrigation systems on 4.000 ha	4.000	4 + 4	4 + 4						
18	55.4	22b	Construction of a dam on Chiosnika River	30.000	6	6						
19	55.2	410	Designate and monitor recreational areas	40	30cent	30cent						
20	53.6	410	Upgrade fisheries management based on source and catch assessment	150	30cent	30cent						
21	53.7	25	Develop a database on irrigation	100	2	2						
22	53	32	Implement flood control measures	5.000	12	12						
23	53	414a	Construction of WWTP for smaller agglomerations (<2000 PE)	2.000	13	13						
24	52.6	43	Establish inventory of private wells	200	20cent	20cent						
25	52.2	427	Upgrade farmer's capacity for proper hazardous waste disposal and use of pesticides	50	2	2						
26	51.8	56	Train farmers in proper irrigation management	30	1	1						
27	50.8	54	Improve management of priority substances	60	2	2						
28	50.5	415a	Improve sewage network in Resen and Zankovce	1.000	6	6						
29	50	410	Introduce regular monitoring of algae blooms	40	30cent	30cent						
30	49	434	Improve fertilizer management including capacity for laboratory analysis	60	30cent	30cent						
31	48.8	420	Introduce effective eutrophication strategies	1.000	4	4						
32	48	414b	Establish tertiary wastewater treatment in former fish ponds	300	2	2						
33	47.8	64	Establish trans-boundary monitoring programme	300	150	30cent						
34	46.5	65	Ensure harmonization of environmental data management	25	1	1						
35	46	410b	Improve existing and construct new sewage network in smaller agglomerations in the region	2.500	14	14						
36	45.5	65	Pilot project for use of biomass as energy resource	700	2	2						
37	45.2	52	Conduct detailed local hydro-geological investigations	100	1	1						
38	44.2	51	Conduct regional hydro-geological investigations	800	4	4						
39	44	410a	Conduct a feasibility study on alternative eutrophication mitigation strategies	60	1	1						
40	38.3	55	Conduct source investigations of priority substances in ground water	30	1	1						
41	37.8	418	Conduct modeling of the effect of different discharge reduction strategies	300	2	2						
42	37.2	417	Implement project for separation of storm water and construction of proper outfalls	250	6	6						
43	37.2	22a	Conduct a comprehensive feasibility study for improvement of management of water for irrigation purposes, soil infiltration, irrigation, fish, agriculture, etc.	300	2	2						

Assessed investment costs of the proposed Program of Measures in Strumica RB

Investment costs in the 2016 – 2027 period for implementing the basic measures specified in the Program of Measures of this plan total € 42.7 million.



Advisory council

- Established on 15.11.2013 in Stip,
- Second meeting 08.08.2014 Kocani
- Main role- technical advise for preparation of River Basin Management Plan
- Formal Decision of the Macedonian Government – still pending



Bregalnica

Next Steps and Major Activities

Completion of all relevant river basin data (characterization) and water uses – complete and updated systematic databases in GIS

Establishment of regular water quality monitoring (incl. biological, hydro-morphological & priority substances) at all water bodies

Small Infrastructure Projects – support to municipalities in implementation and supervision

Update and amendment of the Draft River Basin Management Plan

National Policy Dialogue – water sector

Брегалница

Thank you for your attention

