

European Union Water Initiative Plus for  
Eastern Partnership Countries (EUWI+): Results 2 and 3

ENI/2016/372-403

DEVELOPMENT OF DRAFT RIVER BASIN  
MANAGEMENT PLAN FOR KHRAMI-  
DEBEDA RIVER BASIN IN GEORGIA



Version 1.1; March 2020

**Responsible EU member state consortium project leader**

Alexander Zinke, Umweltbundesamt GmbH (AT)

**EUWI+ country representative in Georgia**

Zurab Jincharadze

**Responsible international thematic lead expert**

Yannick Pochon, IOWater (FR)

**Responsible Georgian thematic lead expert**

Mariam Makharova, MEPA

**Authors**

Sophie Akhobadze, REC Caucasus

Ana Rukhadze, REC Caucasus

Eliso Barnovi, REC Caucasus

Keti Jibladze, REC Caucasus

Maia Zumbulidze, REC Caucasus

**Disclaimer:**

The EU-funded program European Union Water Initiative Plus for Eastern Partnership Countries (EUWI+ 4 EaP) is implemented by the UNECE, OECD, responsible for the implementation of Result 1 and an EU member state consortium of Austria, managed by the lead coordinator Umweltbundesamt, and of France, managed by the International Office for Water, responsible for the implementation of Result 2 and 3.

This document, the "Thematic Summary, RBMP for Khrami-Debeda river basin", was produced by the EU member state consortium with the financial assistance of the European Union. The views expressed herein can in no way be taken to reflect the official opinion of the European Union or the Governments of the Eastern Partnership Countries.

This document and any map included herein are without prejudice to the status of, or sovereignty over, any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

**Imprint**

Owner and Editor: EU Member State Consortium

Umweltbundesamt GmbH	Office International de l'Eau (IOW)
Spittelauer Lände 5	21/23 rue de Madrid
1090 Vienna, Austria	75008 Paris, France

Responsible IOW Communication officer:

Yunona Videnina  
y.videnina@oieau.fr

March 2020

# CONTENTS

1	Characterization of the river basin district .....	6
2	Pressures and impacts of human activities .....	15
3	Protected ZONES .....	20
3.1	Water protection zones .....	20
3.2	Protected areas .....	23
3.3	Drinking water abstraction .....	26
4	Water bodies status and risk analysis .....	29
5	Surface water Monitoring .....	32
5.1	Current surface water monitoring situation .....	32
5.2	Monitoring improvement .....	33
5.2.1	Chemical Monitoring .....	33
5.2.2	Hydrobiological Monitoring .....	33
5.2.3	Hydro-morphological Monitoring .....	34
5.3	Monitoring Costs .....	34
5.4	Monitoring results .....	35
5.4.1	Chemical Status .....	35
5.4.2	Ecological status .....	35
6	Groundwater monitoring .....	36
7	Environmental objectives .....	38
8	Economic analysis .....	41
9	Programme of measures .....	43
9.1	Selected measures (Basic, Supplementary) .....	44
9.2	Programme of measure for water bodies “Not at risk” and “Possibly at risk” .....	50
9.3	Programme of measure for HMWBs .....	50
9.4	Programme of measure for GWBs .....	51
10	Summary of strategies, programmes, plans and projects .....	52
11	Summary of the first consultation .....	53
12	List of competent authorities .....	55
13	Procedures for obtaining the technical reports .....	56
14	Glossary .....	57
15	References .....	59
16	Annexe 1 .....	62

## List of Tables

Table 1 Operating, projecting and under construction HPPs in the Khrami-Debeda river basin .....	13
Table 2 Main drivers and pressure for water bodies in the Khrami-Debeda river basin .....	15
Table 3 Overview of proposed chemical monitoring in rivers and lakes (reservoirs) of the Khrami-Debeda river basin .....	33
Table 4 Proposal for the hydrobiological monitoring in rivers and lakes (reservoirs) of in the Khrami-Debeda river basin .....	34
Table 5 Programme of measures (PoMs) to be implemented in the Khrami-Debeda river basin .....	62

## List of Figures

Figure 1 Physical maps of the Khrami-Debeda river basin .....	7
Figure 2 Hydrographic network of the Khrami-Debeda river basin .....	10
Figure 3 Delineation of SWBs in the Khrami-Debeda river basin .....	11
Figure 4 Delineation of GWBs in the Khrami-Debeda river basin .....	12
Figure 5 River water protection zones in Khrami-Debeda river basin.....	22
Figure 6 Special conservation areas in Khrami-Debeda river basin .....	24
Figure 7 Special protection areas (SPAs) for birds in Khrami-Debeda river basin .....	25
Figure 8 Areas for the abstraction of drinking water in the Khrami-Debeda river basin .....	27
Figure 9 Risk assessment of SWB in the Khrami-Debeda river basin .....	31
Figure 10 Preliminary ecological classification of SWB in the Khrami-Debeda river basin .....	35
Figure 11 Investment Costs of basic measures by sector .....	41
Figure 12 The measures selected during the 1st implementation cycle for the Khrami-Debeda river basin .....	45
Figure 13 Programme of measures (PoMs) in the Khrami-Debeda river basin .....	47
Figure 14 Programme of measures (PoMs) by sector in the Khrami-Debeda river basin .....	48
Figure 15 Programme of measures (PoMs) by sub-basin in the Khrami-Debeda river basin .....	49
Figure 16 Graphical representation of a global satisfaction after attending the workshop .....	53
Figure 17 Graphical representation of the main interesting points of the workshop .....	53

## Abbreviations

BOD .....	Biological Oxygen Demand
COD .....	Chemical Oxygen Demand
EPIRB .....	Environmental Protection of International River Basins
DO .....	Dissolved Oxygen
EU .....	European Union
EUWI+ .....	European Union Water Initiative Plus
EQS .....	Environmental Quality Standards
GEP .....	Good Ecological Potential
GWB .....	Groundwater body
HMWB .....	Heavily Modified Water Body
HPP .....	Hydroelectric Power Plant
IOWater/OIEau .....	International Office for Water, France
MEPA.....	Ministry of Environment Protection and Agriculture
NEA .....	National Environment Agency
O&M.....	Operation and Maintenance
PoM .....	Programme of Measures
RBD .....	River Basin District
RBMP .....	River Basin Management Plan
SPA.....	Special Protected Area
SWB.....	Surface Water Body
SWMCG.....	Solid Waste Management Company of Georgia
UBA .....	Umweltbundesamt GmbH, Environment Agency Austria
UWSCG .....	United Water Supply Company of Georgia
WFD.....	Water Framework Directive

# 1 CHARACTERIZATION OF THE RIVER BASIN DISTRICT

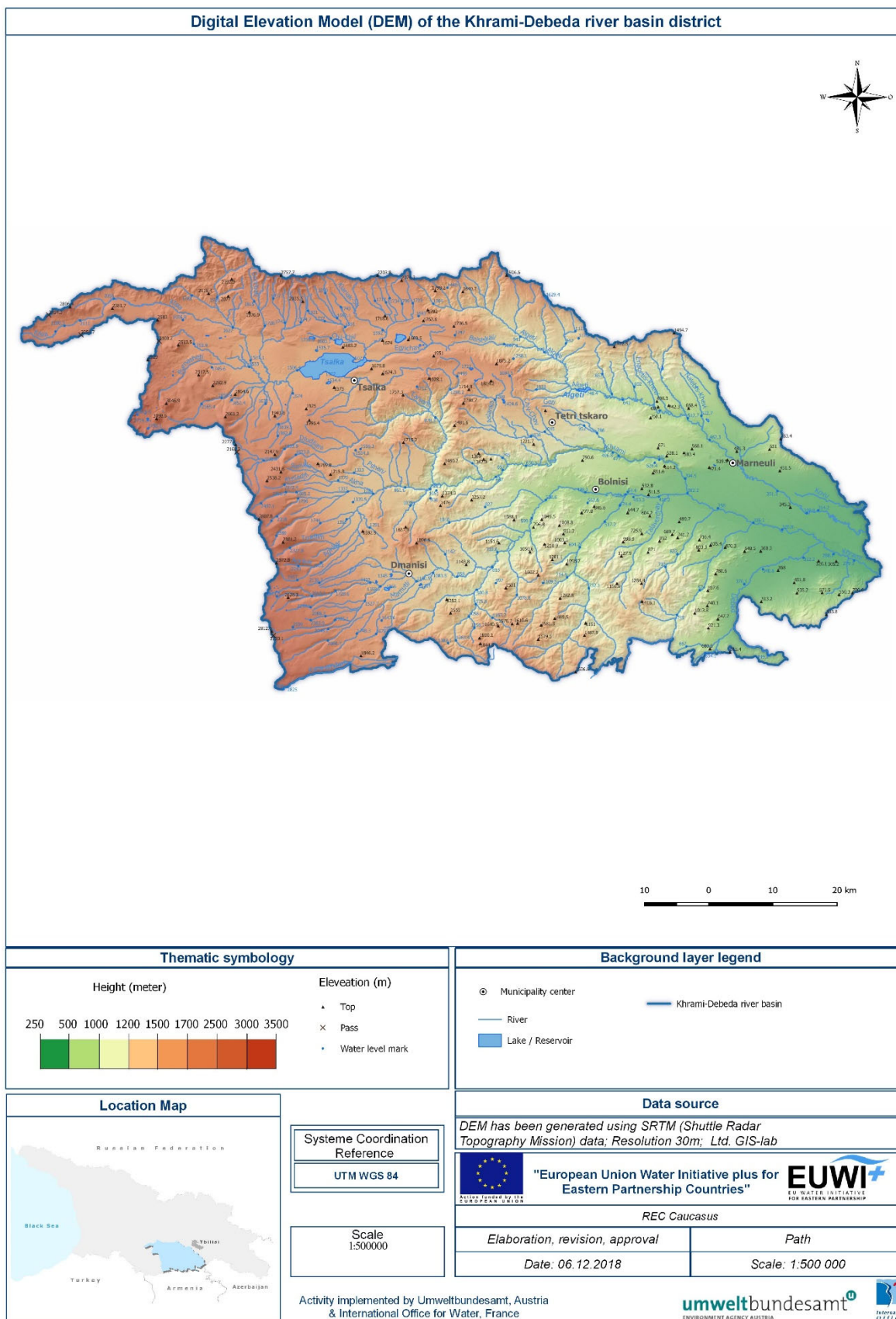
**Khrami-Debeda river basin** fully covers the districts of Bolnisi, Dmanisi, Tetrtskaro, Tsalka and the district of Marneuli - only partially. It also covers a small part of Borjomi Municipality (Samtskhe-Javakheti Region), where the river Khrami originates from (see Figure 1). The survey area of the Khrami-Debeda within Georgia is 5,186 km<sup>2</sup>. The River Khrami with its water source from the stream located on the southern slope of the Trialeti ridge, represents the right tributary of the Mtkvari river. It is called "Qtsia" in the upper part. Debeda (Berduji, Sagimi) - a river between Armenia and Georgia, originates from the Dseghi (891 m above sea level), the confluence of the rivers Pambak and Dzoraget. On the territory of Georgia, it comes out near the village of Sadakhlo and joins the river Khrami from the right side. Basin area 4.1 km<sup>2</sup>. In the upper part, the basin is represented by the high ridges and volcanic valleys, while in the lower part - by the Marneuli alluvial plain.

**Climate** - The Khrami-Debeda (on the territory of Georgia) river basin has continental climate. There is mountain steppe climate in the uplands with short summer and cold winter. In the lowland winter is cold, while summer is warm and long. Precipitation deficit is typical here. Average annual precipitation ranges from 377,7 mm (Bolnisi) to 954,2 mm (Bakuriani). Average temperature varies from 0,3°C to 20,3°C.

**Topographically** - There are high mountain ridges and volcanic uplands in the upper reaches of the Khrami river basin and Marneuli alluvial plain in the lower reaches. The terrain is rugged by numerous tributaries. The eastern slope of the Javakheti ridge, the Chochani, Gomareti and Dmanisi volcanic plateaus, their adjacent Kviriketi, Shorsholeti and Shindlari massifs and canyon-like gorges of the rivers Khrami, Chochiani, Jujiani, and Mashaveras Grma, located in the southern part of the basin, are noteworthy from the orographic viewpoint. The accumulative plain of Marneuli is located at the height of 270-400 m asl. It includes the lower reaches of the rivers Algeti, Khrami, Mashavera and Debed. Iagluja Upland (approximate length - 17 km, width - 10-11 km) is also located in Marneuli Municipality.

**Geology** - From the geological point of view, the Khrami river basin is constructed by volcanic rocks (basalt, andesites, granites), which generate a wide range of folds of different directions. Quartzites, sandstones, conglomerates, limestone, marls and other rocks are also involved in the geological structure of the basin. There are modern deposits developed on the lowlands (pebbles, sand, loam and clays). In the construction of the Javakheti Range, lavas of dolerite-basaltic and andesite-basaltic composition of the lower Miocene-upper Pliocene and lower Pliocene-upper Pleistocene age. Choliani, Gomareti and Dmanisi plateaus, developed to the east from the eastern slopes of the Javakheti Range, are constructed mainly by the dolerite lavas of Quaternary age and partly by the continental clays, sands and lake sediments of the same age. Loqi ridge is constructed by the volcanic rocks of Eocene age (tuffs, tuffo-breccias etc.), granites of Paleozoic and volcanic layers of Jurassic ages. At the basis of Marneuli lowland is developed layers of slightly dislocated clays and sandstones, which are covered by the Quaternary sediments (pebbles, conglomerates, sands and clays). Iagluja plateau is constructed by the conglomerates, clays and sandstones of Neogene age. Bedena ridge is constructed by volcanic sediments of Cretaceous age and lavas of Quaternary and Neogene age. Tsalka plateau is represented by the dolerite lavas of Neogene age and lake-river sediments.

Figure 1 Physical maps of the Khrami-Debeda river basin



**Soil** - Diversity of soils in the Khrami-Debeda river basin results from complex orographic and biological conditions. According to FAO soil classification system, soil types found in the basins are as follows: primitive soils – Leptosols (1); mountain-forest-meadow soils – Humic Cambisols (3); Brown-forest weakly unsaturated soils – Eutric Cambisols (4); Chernozems - Chernozems (5); Raw Humus Calcereous soils - Rendzic Leptosols (6); Cinnamonic soils - Eutric cambisols and calcic cambisols (7); Meadow Cinnamonic soils - Calcaric Cambisols and Calcic Kastanozems (8); Grey Cinnamonic soils - Calcic Kastanozems (9); Meadow Grey Cinnamonic soils – Calcic Vertisols (10); alluvial soils – Fluvisols (11); saline soils – Solonchaks and Solonetz (15).

**Vegetation** - The high mountain areas of the Khrami-Debeda river basin (> 2000-2300 m) are covered with subalpine meadows and steppe elements, while the rest of the basin, including the heads of the Khrami and its tributaries, are covered with alpine steppe vegetation with the lower limits passing by the towns of Tsalka and Dmanisi. A significant part of the middle reaches of the Khrami-Debeda river basin is covered with spruce, oak and hornbeam forests. Downstream, the forests become thinner and in the lower part of the middle reaches change to thorny shrubs with forest elements. The lower section of the basin, including the Khrami and its tributaries, is mainly covered with steppe vegetation in combination with Tkhmeli floodplain forests.

**Ichthyofauna** - The surface water bodies in the Khrami-Debed river basin are rich in fish fauna. There are 23 fish species found there, including Ciscaucasian spined loach and trout, red-listed in Georgia.

**Land Cover** - 25,4% of the Khrami-Debeda river basin consists of forests, 20,2% - meadows and steppes, which are used as mowing lands and pastures.

**Disaster Risks** - Unlike many other regions of Georgia, Kvemo Kartli belongs to the low and medium risk category in terms of development, reactivation and emergence of hazardous geological processes. Topographic features of territory, frequent heavy rainfalls, strong wind, and sometimes inappropriate agricultural practices trigger different types of soil erosion. Soils are mostly depleted because of insufficient application of organic and non-organic fertilizers, lack of crop rotation, damaged irrigation system and windbelts.

**Hydrographic Network** - The study area of the Khrami-Debeda basin is 5,186.6 km<sup>2</sup>, the total lengths of the rivers is 2,373.2 km. There are several small lakes and the Tsalka reservoir in the river basin. Figure 2 represents the hydrographic network of the Khrami-Debeda river basin.

Maximum water discharge of the river Khrami is observed during spring period, specifically in April and May. The flow of the river is the smallest in winter. Average annual discharge of the river Khrami is 53,5m<sup>3</sup>/sec. Filling source of Tsalka reservoir is river Khrami and other small rivers. Dam height is 33 m, the length of the reservoir – 14 km, the longest width is 3.5 km, average width is 2.4 km, the deepest width – 25 m; The water surface area is 33.6 km<sup>2</sup>, the total water amount is 312 mill m<sup>3</sup>; useful amount – 293 mill m<sup>3</sup>. Major tributaries of the river Khrami are: the river Korsuchai, the river Karabulakhi, the river Aslanka, the river Chivchava, the river Mashavera, the river Moshevani, the river Bolnisi, the river Talaverchai, the river Shulaverchai, the river Debeda, the river Algeti.

**Algeti Reservoir** is located in the Kvemo Kartli side of Tetrtskaro municipality. The water area of the reservoir is 65 mill m<sup>3</sup>, useful area – 60 mill m<sup>3</sup>, length – 3.7 km, width – 0.4 km.

The Water Framework Directive (2000/60/EC) is a comprehensive piece of legislation that sets out clear quality objectives for all waters in Europe. In order to make the implementation of the Directive, and the compliance checking of its quality objectives, the concept of “water bodies” has been introduced as the key units to which a number of the Directive’s requirements are related. The Water Framework Directive ‘water environment’ includes rivers, lakes, transitional waters, groundwater and coastal waters out to 1 nautical mile (12 nautical miles for chemical status, i.e. for territorial waters).

**Delineation of SWBs**- Identification, delineation and typology of water objects within the Khrami-Debeda river basin have been implemented according to the analysis of the selected rivers as well as based on



identification, delineation and classification methodology for surface water bodies, elaborated for EU Water Framework Directive.

Surface “water bodies” are discrete sections or parts of water bodies, which differ from each other in specific natural characteristics (Sall et al, 2012). The process of delineation and definition surface water bodies consists of the division of water bodies into sections and parts according to the (agreed) parameters and criteria.

306 water bodies (SWB) are identified in the Khrami-Debeda basin, all of which have a unique code. Also, each surface water object was differentiated according to the types accordance to the System-A typological classification of WFD.

Delineation of catchment areas has been implemented by means of the geo-informational technologies, where only two variables have been applied - digital elevation model (STRM 30) and digital hydrographic network with the 1: 25,000 resolution original scale data-sheets, based on the Soviet topographical maps and geo-rectified and corrected images on the basis of most recent satellite imagery of a high intelligibility. Using the abovelisted methods and parameters, 288 units of different types of rivers, have been identified in the Khrami-Debeda basin (see Figure 3)

Except for rivers, 2 reservoirs have been also typologically marked out in the Khrami-Debeda basin (Tsalka Reservoir – type V and Algeti reservoir - type I) and 1 lake (Bareti Lake – type III).

**Hydrogeological structure** of the region is responsible for the high saturation of young lava sheets on the basis of which there are strong streams of fractured groundwater in the contact with the crystal rocks and sedimentary deposits of Mezo-cainozoic age. The discharge rate of mentioned waters reaches several m<sup>3</sup>/sec. By chemical composition waters are hydrocarbonate-calcium type and suitable for drinking. According to the hydrogeological zoning, on the territory of Khrami-Debeda river we observe: Porous-fractured waters of the west part of Marneuli-Gardabani artesian basin; Fractured groundwater of the east part of Akhalqalaqi lava Plato; Fractured groundwater of East slope of Javakheti Range.

**Figure 2 Hydrographic network of the Khrami-Debeda river basin**

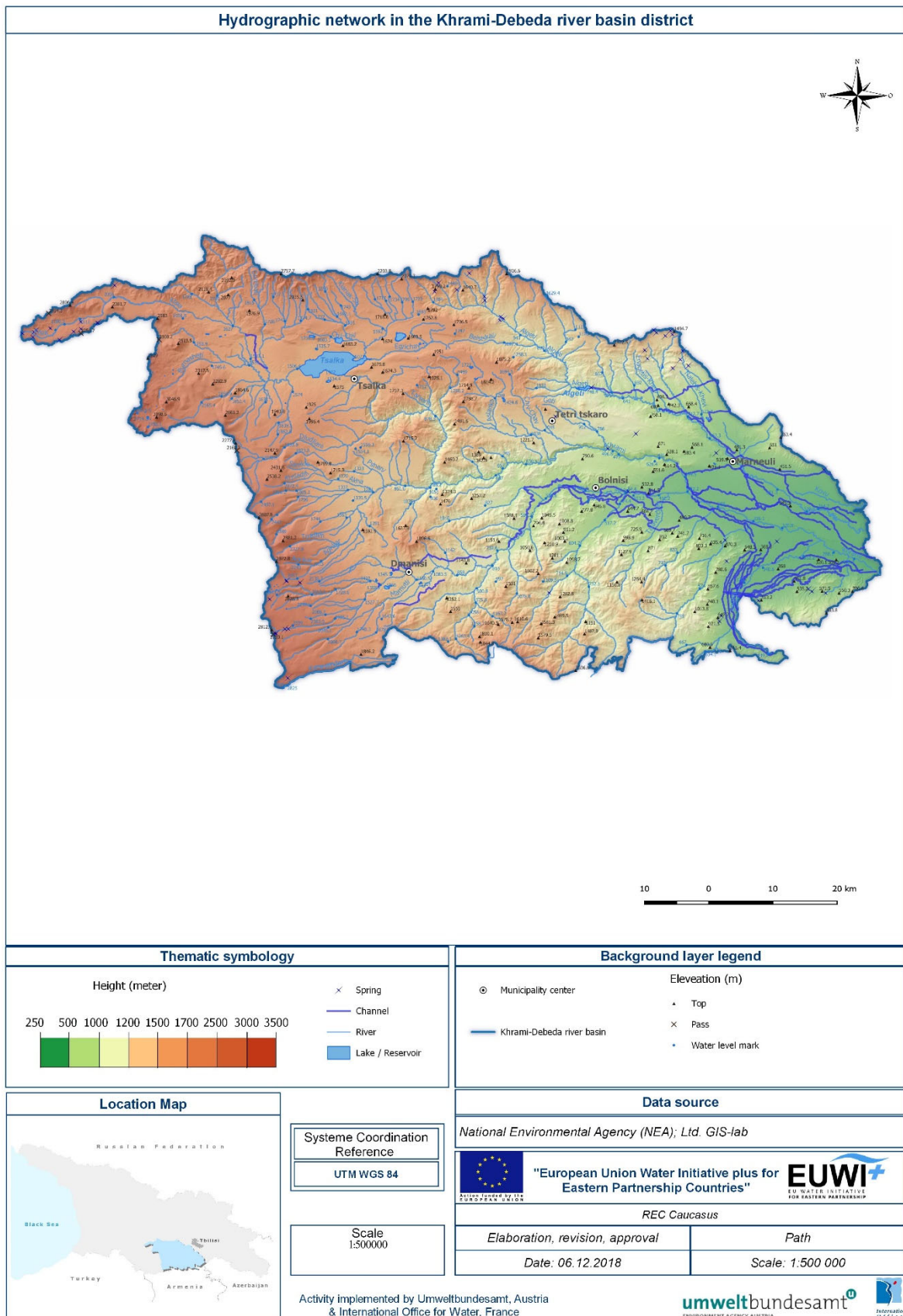
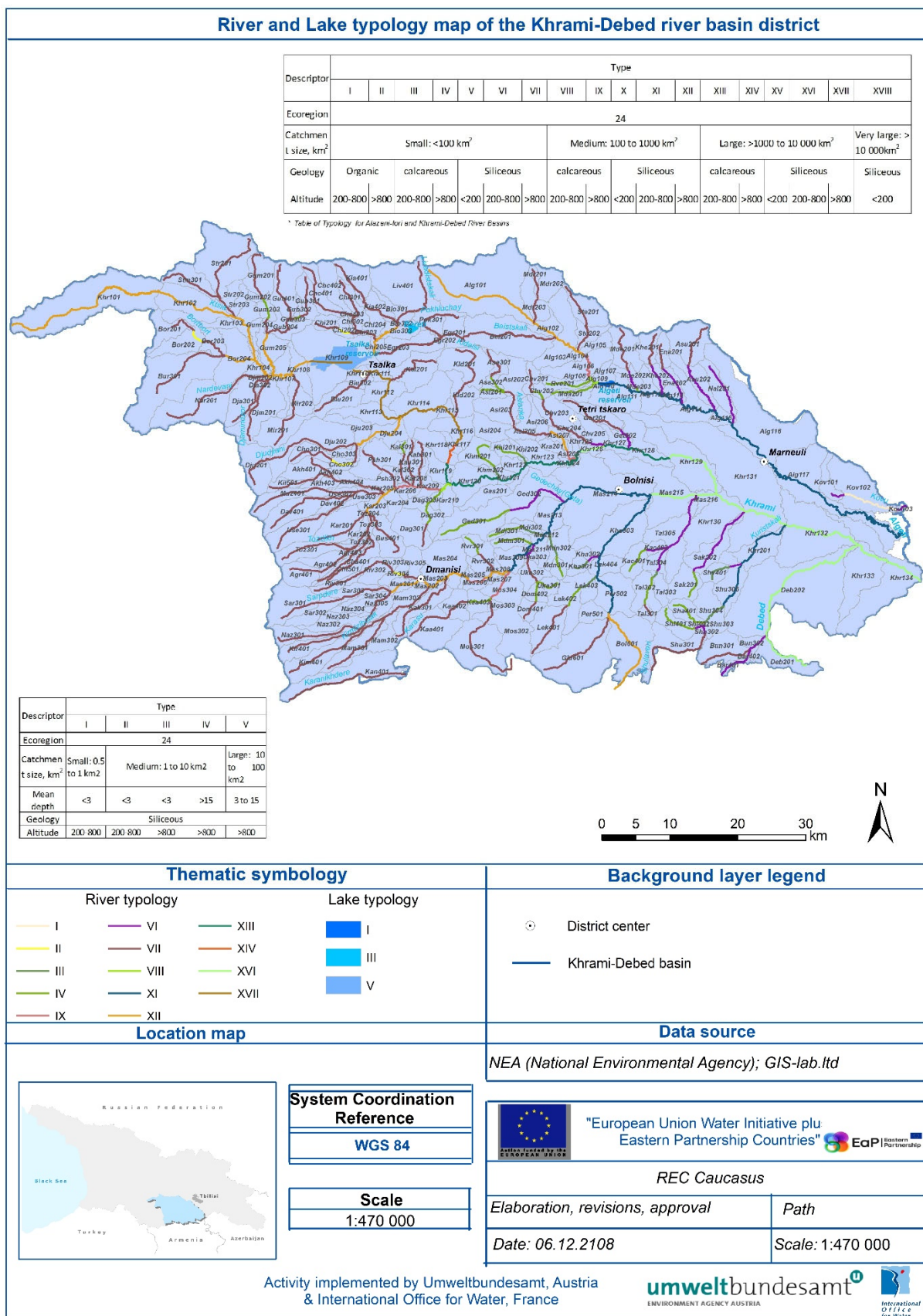


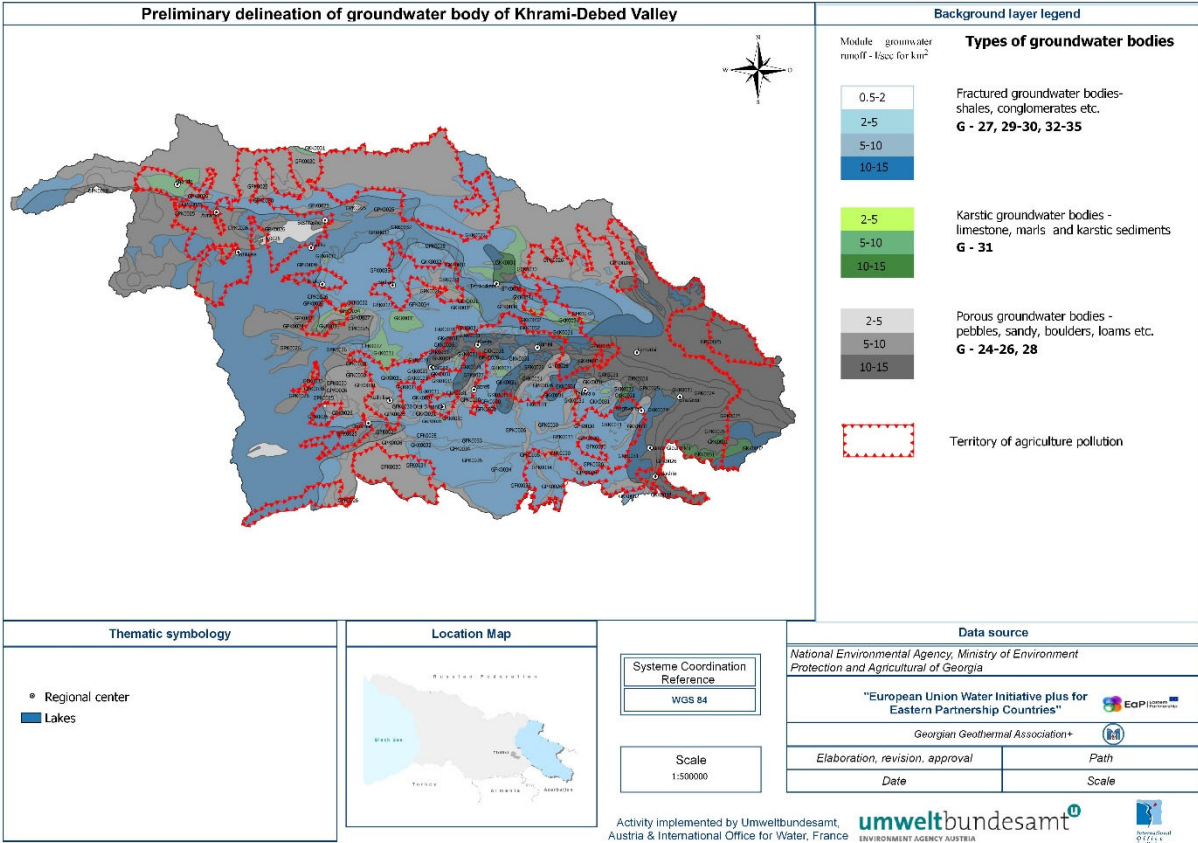
Figure 3 Delineation of SWBs in the Khrami-Debeda river basin



**Groundwater resources** - Georgia has significant fresh groundwater resources, which are naturally of drinking water quality. Detailed hydrogeological surveys show that Georgia's natural fresh groundwater resources amount to 573 m<sup>3</sup>/s. The resources have rather uneven geographical and administrative distribution. 12 aquifers which are in direct contact with surface ecosystem were identified in the Khrami-Debed basin. Consequently, in these aquifers groundwater bodies were delineated. The selection process was done according to the river basins. The groundwater bodies were later assessed by their similarity and the grouping was made according to types.

**The first type** are the following porous groundwater bodies of the Khrami and Debed basins: the Aquifer of modern alluvial deposits of floodplain and valley-side of rivers Khrami, Mashavera and Debed, (groundwater body code GPK0024); Artesian aquifer of modern and upper quaternary age alluvial-proluvial and lake sediments (GPK0025); Sporadically saturated deposits of modern alluvial-deluvial, deluvial-proluvial and proluvial-deluvial sediments, (GPK0026) and Aquifer of lower Pliocene- upper Miocene age sediments (GPK0028). **The second type** of karstic groundwater bodies, is represented by sporadically saturated carbonate stratum of upper Cretaceous sediments (GKK0031). It is characterized by intensive saturation and low mineralization, suitable for drinking water. **The third** and most widespread type are fractured groundwaters, which include the following groundwater bodies of similar hydrochemical and pressure properties: Sporadically saturated lava formations of upper Pliocene-Quaternary age (GFK0027); Sporadically saturated volcanic deposits of lower Pliocene- upper Miocene age sediments, (GFK0029); Sporadically saturated massive and coarse grained piroclastics of middle Eocene and Paleocene sediments (GFK0030); Aquifer of volcanic stratum of upper Cretaceous, (GFK0032); Aquifer volcanogenic stratum of the Bayosian stage (GFK0033) and Sporadically saturated sediments of Leyas deposits (GFK0034). Aquifer of Paleozoic age sediment (GFK0035). In the upper active circulation zone, these groundwater bodies contain low mineralized water, suitable for drinking water. Figure 4 presents delineation of GWBs in the Khrami-Debed river basin.

**Figure 4 Delineation of GWBs in the Khrami-Debed river basin**



**Population** - Population of Kvemo Kartli numbered 423,986 people of whom 39% lived in cities and settlements, while 61% lived in villages. Population density was 67 people per km<sup>2</sup>. Population density is the highest in Marneuli Municipality. Natural population increase was observed in all the municipalities except Tetrtskaro. We can assume that the decline in Tetrtskaro is caused by migration. However, because of the migration, total population of the region decreased in 2002-2016. As compared to other regions, natural population increase is observed in Kvemo Kartli, meaning in the long run that the region will have to meet increasing demands for social infrastructure, social services and new jobs. Ethnic composition of the Kvemo Kartli region population is as follows: Georgians – 44,7%, Azerbaijanis – 45,1%, Armenians – 6,4%, Abkhazians, Ossetians, Russians, Greeks, Ukrainians and Kurds – 3,8%. Unemployment level is 14,1%.

**Agriculture** - Agriculture plays an important role in Kvemo Kartli's economy, its share in the region's gross value added (GVA) being 19%. 122,316 ha of agricultural land is operated by farms, out of which 50,087 ha is cropland, 2,098 ha is land under permanent crops and 70,043 ha is mowing lands and pastures. Average area of agricultural land operated by farms in Kvemo Kartli exceeds the average nationwide figure (1,37 ha) and makes 3,7 ha. The leading agricultural sectors are potato growing, vegetable farming and beef stock farming. There are 148,800 heads of cattle in Kvemo Kartli. The region produces 2,100 tons of meat and 103,200 tons of milk. In 2017, the region produced 3,641,900 heads of poultry and 13,800 tons of poultry meat.

**Fish Farms** - Fish farms are developed rather well in Kvemo Kartli region: there are 22 fish farms there, including 9 operating farms, producing altogether 35.5 tons of fish. Tsalka reservoir is used for fish farming according to a special licence. About 10-80 tons of fish is produced every year, mostly Prussian carp (*Carassius gibelio*) and smaller quantity of Caucasian scraper (*Capoeta capoeta*).

**Hydropower Generation** - There are 9 small and medium-sized HPPs operating in the Khrami-Debeda river basin. Construction of 13 hydroelectric power plants is being planned, of which 3 are already under construction (see Table 1).

**Table 1 Operating, projecting and under construction HPPs in the Khrami-Debeda river basin**

N	Existing HPPs	Design capacity (MW)	Planned and under construction Hydro Power Generation Projects	Design capacity (MW)
1	Khrami 1	112.80	Chapala	0.43
2	Khrami 2	110.00	Oro (former Zemo Orozmani)	1.12
3	Dashbashi	1.26	Khrami	1.13
4	Algeti	1.25	Kizilaglo	4.10
5	Mashavera	1.25	Nakhidura	9.04
6	Debeda	3.20	Kvemo Orozmani	0.63
7	Marneuli 1931	0.25	Kvemo Orozmani	4.20
8	Mekvle	1.00	Kvemo Orozmani	4.02

9	Kazreti	2.00	Zemo Karabulakhi	1.03
10			Khrami 3	16.07
11			Khrami 4	14.97
12			Khrami 5	19.89
13			Mashavera 2	4.15

**Mining** - The region is rich in mineral resources and has a developed mining industry, producing ferrous and non-ferrous metals, ferroalloys and industrial minerals. Madneuli mine produces gold, copper, barite and complex ore. The mine uses open-pit production method. Its annual estimated output capacity is 12,000 tons of ore. There are more than 200 mostly unexploited deposits of ferrous, non-ferrous and precious metals, chemical and ceramic raw materials, hydro-mineral and fuel resources there.

**Tourism** - Natural and geographic conditions, cultural, historical and natural monuments of Kvemo Kartli make it rather attractive for tourists. Tourists can visit settlements dated by the 1<sup>st</sup> millennium BC, such as the famous ancient settlement in Dmanisi. Bolnisi Sioni (5<sup>th</sup> century AD – Middle Ages), Tsugrugasheni (Middle Ages), Pitareti church (13<sup>th</sup> century AD), Manglisis Sioni (14<sup>th</sup> century AD), the ancient fortress of ruins of Samshvilde and Birtvisi fortress are the main tourist attractions. The quality of service and tourist infrastructure fails to meet the current standards and needs improvement.

**Protected Areas** - The Khrami-Debeda river basin includes the following protected areas: Algeti National Park, the natural monuments of Dashbashi, Samshvilde and Birtvisi canyons, and Ktsia-Tabatskuri Managed Reserve, located in the upper reaches of the Khrami (where the River Khrami is called Ktsia). The area of Algeti national Park is 6,822 ha, the area of Ktsia-Tabatskuri Managed Reserve – 22,000 ha. The abovementioned protected areas (excluding Birtvisi) incorporated in Emerald Network.

## 2 PRESSURES AND IMPACTS OF HUMAN ACTIVITIES

The Water Framework Directive (WFD) requires the identification of the significant pressures and drivers present in the River Basin District (RBD). These compliance indicators are used to record the most likely impacts leading to the failure of water bodies to reach good status/potential as a result of the sum of those pressures. According to EU Reporting guidance, v 4.9,2015 there are the following pressure types: **Point pressure; Diffuse pressure; Abstraction pressure; Physical alteration; Other pressure**. These pressures refer to the corresponding main drivers such as **Urban development, Industry, Agriculture, etc.**<sup>1</sup>

Regarding the policy document on Key Issues under the Water Framework Directive (WFD) and considering the Khrami-Debeda river basin background analysis, also in cooperation with the Ministry of Environment Protection and Agriculture of Georgia and the water experts, the main drivers and various types of pressure for SWB in the Khrami-Debeda river basin district has been specified (see Table 2).

**Table 2 Main drivers and pressure for water bodies in the Khrami-Debeda river basin**

N	Pressure	Main Driver (s)	Surface water		Groundwater
			River	Lake	
1.1	Point-Urban (Municipal)waste water	Urban development	+		+
1.2	Point-Industrial waste water	Industry	+		+
1.3	Point-Municipal landfills	Urban development			+
2.1	Diffuse-Agricultural(crop production; animal live stocking)	Agriculture	+	+	+
2.2	Diffuse-Other (Illegal landfill)	Urban development, Agriculture, Industry	+	+	+
3.1	Abstraction/Flow Diversion - Agriculture (for irrigation)	Agriculture	+	+	+
3.2	Abstraction/Flow Diversion - Public Water Supply	Urban development	+	+	+
3.3	Abstraction/Flow Diversion - Industry	Industry	+	+	
3.4	Abstraction/Flow Diversion - HPP	Energy – hydropower	+	+	
3.5	Abstraction/Flow Diversion - Fish farms	Aquaculture	+	+	

<sup>1</sup> See: [http://ec.europa.eu/environment/water/water-framework/facts\\_figures/guidance\\_docs\\_en.htm](http://ec.europa.eu/environment/water/water-framework/facts_figures/guidance_docs_en.htm)

4.1	Physical alteration- Altered riparian habitats;	Aquaculture, Urban development, Industry, Flood protection	+		
4.2	Physical alteration- Altered sediment continuity and/or dynamics	Aquaculture, Urban development, Industry, Flood protection	+		
4.3	Physical alteration- Bed/Bank fixation	Aquaculture, Urban development, Industry, Flood protection	+		
4.4	Physical alteration- Changed planform/channel pattern	Aquaculture, Urban development, Industry, Flood protection	+		
4.5	Physical alteration- Impoundment / reduced flow velocity, storage	Aquaculture, Urban development, Industry, Flood protection	+		+
5.1	Hydrological alteration- Low flow	Aquaculture, Urban development, Industry, Flood protection	+		+
5.2	Hydrological alteration- Reduced flow velocity	Aquaculture, Urban development, Industry, Flood protection	+		
5.3	Hydrological alteration- Variable flow	Aquaculture, Urban development, Industry, Flood protection	+		+

As mentioned above there are the pressure types such as point source pollution, diffuse source pollution, water abstraction, hydromorphological alteration in the Khrami-Debeda river basin.

**Water pollutant** - In 2017, consumptive water users discharged 1,669,218 m<sup>3</sup> wastewater directly into surface waters of the Khrami/Debeda river basin. Out of total volume of wastewater discharged, 1,281,198 m<sup>3</sup> (about 90%) was untreated wastewater and only 388,020m<sup>3</sup> was treated.

**The point source pollution** is related to **municipal wastewater discharge and Industrial wastewater discharge**.

Untreated wastewater discharges mostly were accounted to the sewage networks of small towns of the Khrami/Debeda river basin. Within the pilot basin, centralized sewerage systems are developed in the municipal centres of Bolnisi, Dmanisi, Marneuli, Tetritskaro, Tsalka. None of the village settlements are served by centralized sanitation systems. In 2017 amount of discharged wastewater from the Sanitation sector in to the surface water bodies of the basin amounted to 1,120,598 m<sup>3</sup> in total. None of the sewerage in the basin has operational treatment plant, however construction of a completely new and modern wastewater treatment plant is planned in Marneuli, this treatment plant will receive municipal wastewater from Bolisi and Marneuli. Wastewater mainly consists the following pollutants: BOD, COD, nitrates, phosphates.

Main pollution problem in the Khrami-Debeda river basin comes from **industrial wastewater discharge** of copper and gold mining companies (JSC"RMG Copper", Ltd "RMG Copper"). According to the assessment carried out by the Georgian Technical University in 2011, the content of Copper, Zinc, Cadmium, Lead, Cobalt and Nickel in the soil of Kazreti area, the Kazretula and Mashavera riverbed soil, exceeded



by several times the limited permissible concentrations. Despite some recent measures taken in this regard, the pollution of the Kazretula, Mashavera and Pholadauri rivers remains an acute issue, which must have been caused by the perennial pollution from Madneuli enterprises. The concentration of toxic elements in the surface waters of the Mashavera lower stream catchment basin sometimes was more than thousand times the maximum permissible limits.

**Pollution from municipal Landfills** - In the Pilot Basin of Khrami-Debeda the landfills are managed by the LTD Solid Waste Management Company of Georgia (SWMCG). The landfills are operating in Marneuli (v. Kizilajlo), Bolnisi (v. Andreevka), Dmanisi (Near City of Dmanisi), Tetrtskaro, Tsalka. The landfills of Tetrtskaro and Tsalka is closed since 2016, solid wastes of these cities are being transported to the Marneuli landfill.

Despite the measures (closing and upgrading), which have been carried out by the SWMCG, when it took over the existing landfills in the region, have contributed to overall improvements, leachate and landfill gas emissions are still serious problems. The high organic content of the household and household-like waste, its moisture content together with the anaerobic conditions in the landfill bodies leads to the formation of leachate and landfill gas (which consists of methane that contributes in a much larger extent to climate change than CO<sub>2</sub>). The leachate infiltrates into the ground causing pollution of the soil and groundwater (with POP and other organic components, heavy metal and salt). None of the landfill are equipped with collection system (drainage system) of leachates and storm water and treatment plant and do not have point discharges into surface waters.

**Diffuse pollution** would be considered as a major pressure on the water environment in general and specifically in the Khrami-Debeda river basin. Since Kvemo Kartli is an agricultural region the diffuse pollution from agriculture is significant in the Khrami-Debeda river basin. Several agricultural sectors such as potato farming, autumn wheat, viticulture, grain growing, vegetable farming, tobacco farming play significant role in Kvemo Kartli's economic development. This refers to **crop production** that can be considered as the driver which causes pressure from diffuse pollution.

Over the years all types of mineral fertilizers have been used in the agricultural sector in this region. The fertilizers were mainly used for croplands. The average annual use of fertilizers per hectare of croplands was 0,45-0,85 tons (in 2014-2017), which almost equals the countrywide consumption of fertilizers in the given period of time. It is important to highlighted that 4,7-6,7 thousand hectares of croplands were treated with pesticides, but data on pesticide consumption is not available.

**Animal live stocking** is another diffuse pressure source in this basin, because the agricultural fields such as dairy and beef stock farming, sheep breeding are leading sectors in Kvemo Kartli region. According to the National Statistics Office data (2017) there are 148,800 heads of cattle in Kvemo Kartli. 2,100 tons of meat and 103,200 tons of milks were produced in the region. The local farmers mainly own 2-3 cows, while medium-sized cattle farms own 10-25 cows and mainly sell chees, meat and live cattle.

Besides crop production and animal live stocking, **illegal landfills** would be considered as a diffuse source pollution pressure in the Khrami-Debeda river basin. There are several such dumpsites in the basin, which is the issue for water quality and water resources management in general.

For groundwater, diffuse pollution is particularly problematic where aquifers are not protected by overlying impermeable layers. This is the case for shallow unconfined aquifers such as the modern alluvial sediments of floodplain and valley-side of the rivers Khrami, Mashavera and Debeda or the fractured deposits of the Paleozoic in the basin.

By analyzing existing water use patterns in the Khrami-Debeda river basin, it would be concluded that the **energy sector, irrigation systems** and **public water supply sector** are the leaders among consumptive water users. The main drivers of water abstraction pressure in this basin are irrigation systems, hydro-power plants, drinking water supply, fish farming, sand/gravel extraction.

Under the pressures and impacts of human activity analysis the **hydromorphological pressure** types were subdivided into hydrological regime changes, river continuity and river morphology and for those types, pressure and risk criteria were defined.

In order to analyse hydromorphological alteration and impacts of human activity, it is necessary to identify the pressures and to assess the impacts. Pressures on river hydrology and morphology are human activities which have adverse consequences on water bodies.

### **Hydrological flow changes**

- Water abstraction – River stretches impacted by insufficient environmental flow
- Impoundments/Reservoir Effects/Back water
- Hydropeaking

### **Longitudinal river and habitat continuity interruption**

- Interruption of river continuity and fish migration routes

### **Morphological alterations**

- Changes in the overall nature-like morphological condition of rivers

For identification of hydrological pressure, the following descriptors are considered: **Natural flows** (related to water bodies); **Impoundments** (nature of the structure such as dam/weir, etc); **Abstraction** (maximum daily and the maximum annual rate of abstraction); **Discharge data** (a measure of total annual quantity).

Since the techniques for describing and assessing surface water morphology are not well developed in Georgia, the determination of the pressure on morphology mainly based on expert judgment. It is important to point out that pressures on river morphology include impounding and bank reinforcement.

In order to summarize **pressure and impact analysis** that has been made for water bodies in the Khrami-Debeda basin, it is necessary to outline the significant drivers and pressures which affect water bodies in this basin. It would be concluded that pollution from **agriculture** can be considered as an issue of concern in the Khrami-Debeda basin since agriculture is the cause of severe problems such as water pollution. It is logical since the average annual use of fertilizers per hectare of croplands almost equals the country-wide consumption of fertilizers. It should be noted that more than 5 thousand hectares of croplands (2014-2017) were treated with pesticides.

"Pollution from **industry and urban development** is another issue of concern. An extensively reported issue category in the basin is pollution from mining industry and urban wastewater. The rivers in the Khrami-Debeda river basin are mainly polluted with following substances: Sulfates and heavy metals from mining industry; organic and biological substances from untreated urban wastewater, as well as by legal and illegal landfills. The main reasons for problems with this issues are following: **Historical Pollution** (till 2018-2019) - drainage water was discharged from tailing dump and from waste rocks dumpsites **and existing pollution sources** - unorganized (diffuse pollution) drainage discharges from waste rock dump sites of the mining company; the sewer and treatment facilities are not sufficiently developed, accordingly discharges of untreated wastewater into small streams and rivers leads to problems. The locations where **industrial (mining company) drainage wastewaters** and **untreated sewerage** from sewerage system are discharged into the water bodies of the Khrami-Debeda river basin can be considered under significant pressure. Also it would be pointed out that sand-grave extraction may lead to water pollution (high concentration of weighted portions) by untreated discharged in the water bodies. Thus it requires further research.

Furthermore, **abstraction/flow diversion** can be considered as an issue of concern. Abstraction for agriculture (crop production, livestock) and abstraction for irrigation are significant in this basin. As well hydropower sector, public water supply and industry play an important role in that regard.

**Hydrological** and **Morphological alterations** can be considered as one of the pressure in the Khrami-Debeda river basin, which cause a change in the flow regime, variable flow, platform/channel pattern changes, altered riparian habitats, etc. Moreover, dams, barriers, hydrotechnical constructions for flood protections refer to habitat continuity interruption in this basin.

## 3 PROTECTED ZONES

The EU WFD and other related legal documents consider separately protected areas because they need extra protection for conservation of habitats and/or species, or they are distinguished as important to be protected based on other reasons covered by the Community legislation (e.g. abstraction of drinking water, bathing waters, economically significant species (fish, shell), vulnerable zones (nitrates from agriculture), sensitive areas (nutrients from waste water treatment plants), etc. – the WFD Article 6)<sup>2</sup>.

The EU WFD considers protected areas as areas that need extra protection. This directive would be considered as a fundamental tool for implementation of all water-related EU Directives, also it is a platform for coordination of activities on the realization of other Community legal instruments and global initiatives.

Within the Khrami-Debeda river basin, the related national legislation in Georgia (as a non-EU country) is not (fully) harmonized with the EU standards. Some of the above mentioned EU Directives are not applicable in the case of the Khrami-Debeda river basin. Thus, in the case of the Khrami-Debeda river basin management plan (RBMP), the modified approach in dealing with protected areas should be used, having different national standards for the delineation of protected areas.

According to the Law of Georgia on Water, the protection zones such as **water protection zones** (territory, which borders to aquatic area water body and a special regime is established for the utilization of this territory for domestic purposes, as well as for use of natural resources and other economic activities. Also, coastlines of rivers, lakes, reservoirs and the Black Sea, as well as alienation lines of main and other channels belong to water protection zones), **sanitary protection zones** (the area, which is located around the source of underground or surface drinking water and a special regime is established for the utilization of this territory for domestic purposes, as well as for use of natural resources and other economic activities) are defined. In order to protect water resources from pollution, there is some limitation regarding the certain activities within these zones. Furthermore, some activities within water protection zones shall be implemented as determined by the legislation of Georgia.

### 3.1 Water protection zones

According to Article 19 (**Water protection zone**)<sup>3</sup> of Law of Georgia on Water, river, lake, reservoir riparian, isolation zones of main and other canals, as well as other zones provided under legislation shall fall under water protection zones. The activities (such as the construction works, works for deepening beds and blasting works, the extraction of useful minerals, the forest cutting, drilling, etc.) on water bodies and within water protection zones shall be implemented as determined by the legislation of Georgia.

Based on Article 20 (**River water protection zone**)<sup>4</sup> of Law of Georgia on Water, the river water protection zones would be defined. The water protection zone of a river shall be its adjacent territory, where a special regime is established to protect water resources from pollution, littering, fouling and depletion. This zone may include its dry bed, adjacent terraces, natural elevated and steep riversides, as well as gullies directly adjacent to riversides.

---

<sup>2</sup> [http://ec.europa.eu/environment/water/water-framework/index\\_en.html](http://ec.europa.eu/environment/water/water-framework/index_en.html)

<sup>3</sup> Law of Georgia No 494 of 25 March 2013 - website, 05.04.2013

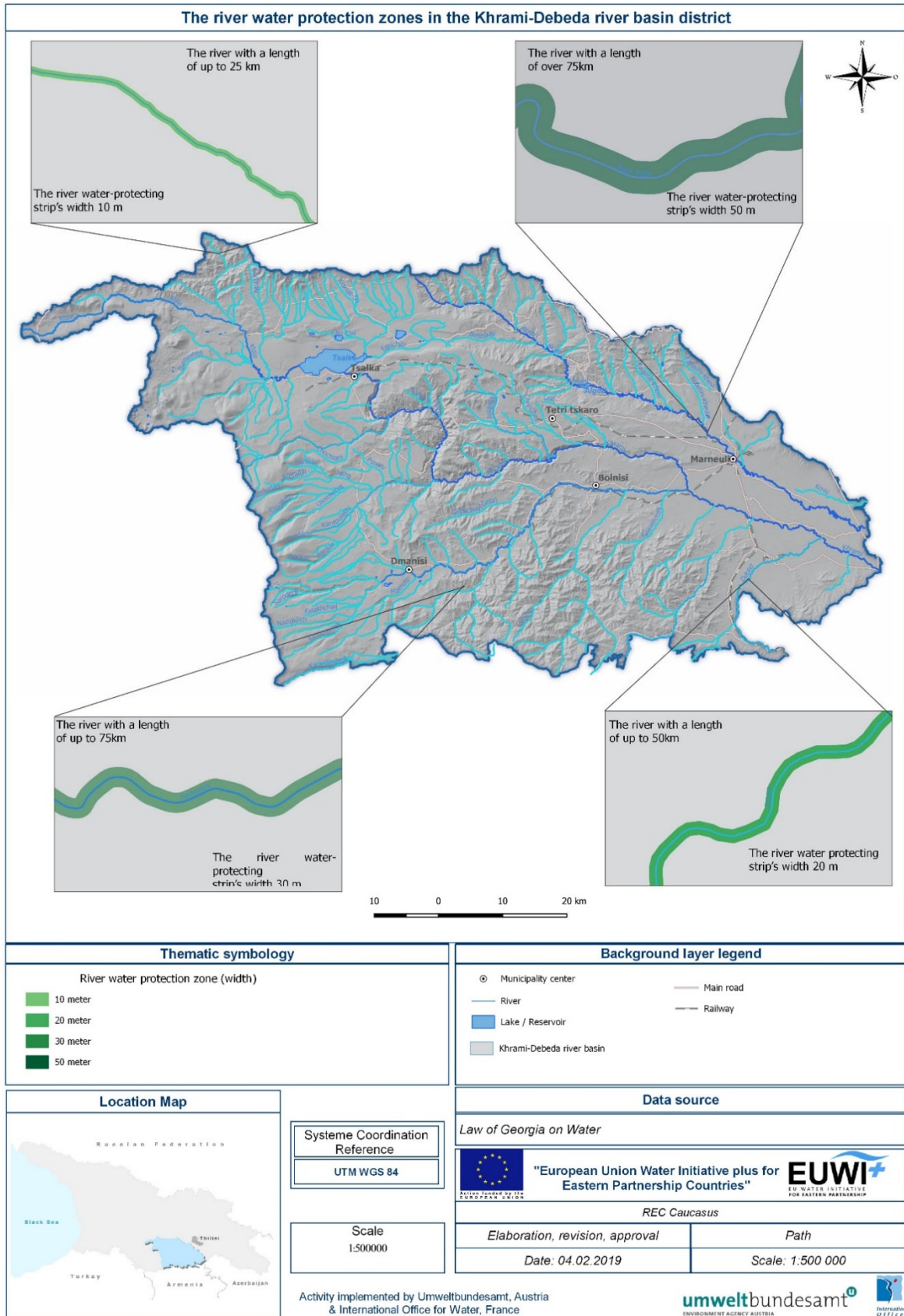
<sup>4</sup> Law of Georgia No 3007 of 26 December 2014 - website, 12.01.2015

The width of a river water protection is defined based on the length of a river, it shall be measured in metres from the edge of a riverbed to both sides under the following procedure:

- 10 metres - in the case of a river up to 25 kilometres long
- 20 metres - in the case of a river up to 50 kilometres long
- 30 metres - in the case of a river up to 75 kilometres long
- 50 metres - in the case of a river over 75 kilometres long

Figure 5 shows the river water protection zones in the Khrami-Debeda river basin district. The protection zones are defined considering the above mentioned conditions. The refinement of those delimitation of protection zones is still an on-going process in Georgia.

**Figure 5 River water protection zones in Khrami-Debeda river basin**



## 3.2 Protected areas

Based on the association agreement Georgia is obliged to establish a network of Emerald and Special Protection Areas (SPA) and to initiate priority management measures within four years after signing of the association agreement.

There are 5 **special areas of conservation (habitats)** in the Khrami-Debeda basin. All of them such as Algeti, Dashbashi canyon, Gardabani, Ktsia-Tabatskuri and Samshvilde protected areas already belong to the Emerald network<sup>5</sup>. The map below shows special conservation areas in this basin (see Figure 6).

Furthermore, there are two (Lower Mtkvari Valley and Tabatskuri Lake) **Special Protection Areas (SPA) for birds** in the Khrami-Debeda river basin district. In order to support the biodiversity protection service of the Ministry of Environmental Protection and Agriculture of Georgia, Ilia State University has implemented a project for identifying candidate Special Protected Areas for Birds (as future Emerald sites), performing baseline study for each individual candidate SPA<sup>6</sup>.

Regarding this project, the selection process is divided into two stages. Firstly, all potential sites are selected by applying the respective stage1 criteria. Afterwards, these areas are considered further using one or more of the judgments in stage2 for selection the most suitable areas in number and size for SPA classification. Thus, stage2 supports a consolidation process where the suite of sites selected at stage1 is refined, delineations are adapted and the best combination of sites would be chosen.

Considering above mentioned the selection criteria, SPAs for birds have been selected. Special protection areas for birds which are located in the Khrami-Debeda river basin are shown in Figure 7.

---

<sup>5</sup> The Emerald network is a network of nature protection areas to conserve wild flora and fauna and their natural habitats of Europe, which was launched in 1989 by the Council of Europe as part of its work under the Convention on the Conservation of European Wildlife and Natural Habitats or Bern Convention that came into force on 1 June 1982.

<sup>6</sup> Special Protection Areas (SPA) for birds in Georgia- <http://aves.biodiversity-georgia.net/>

**Figure 6 Special conservation areas in Khrami-Debeda river basin**

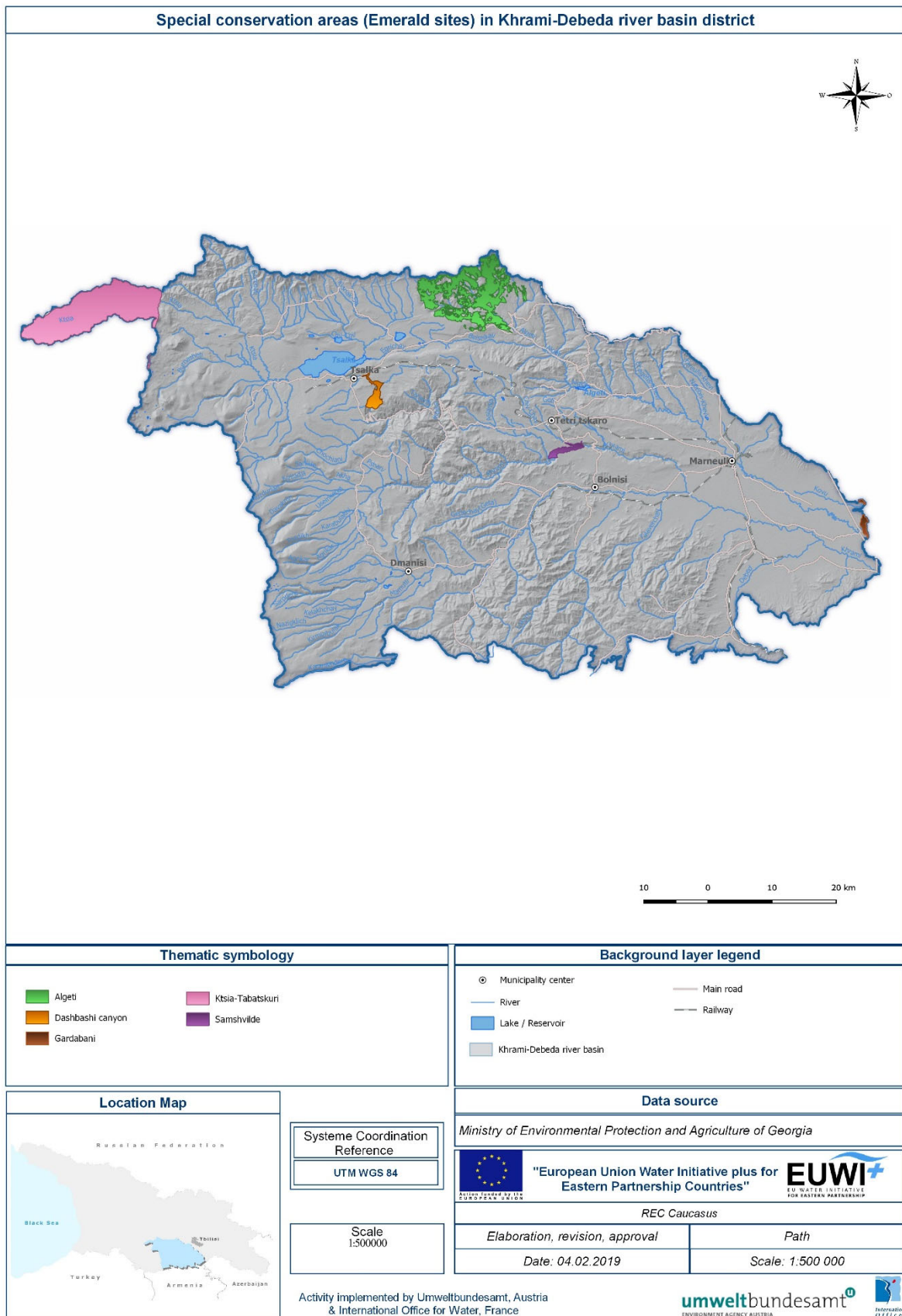
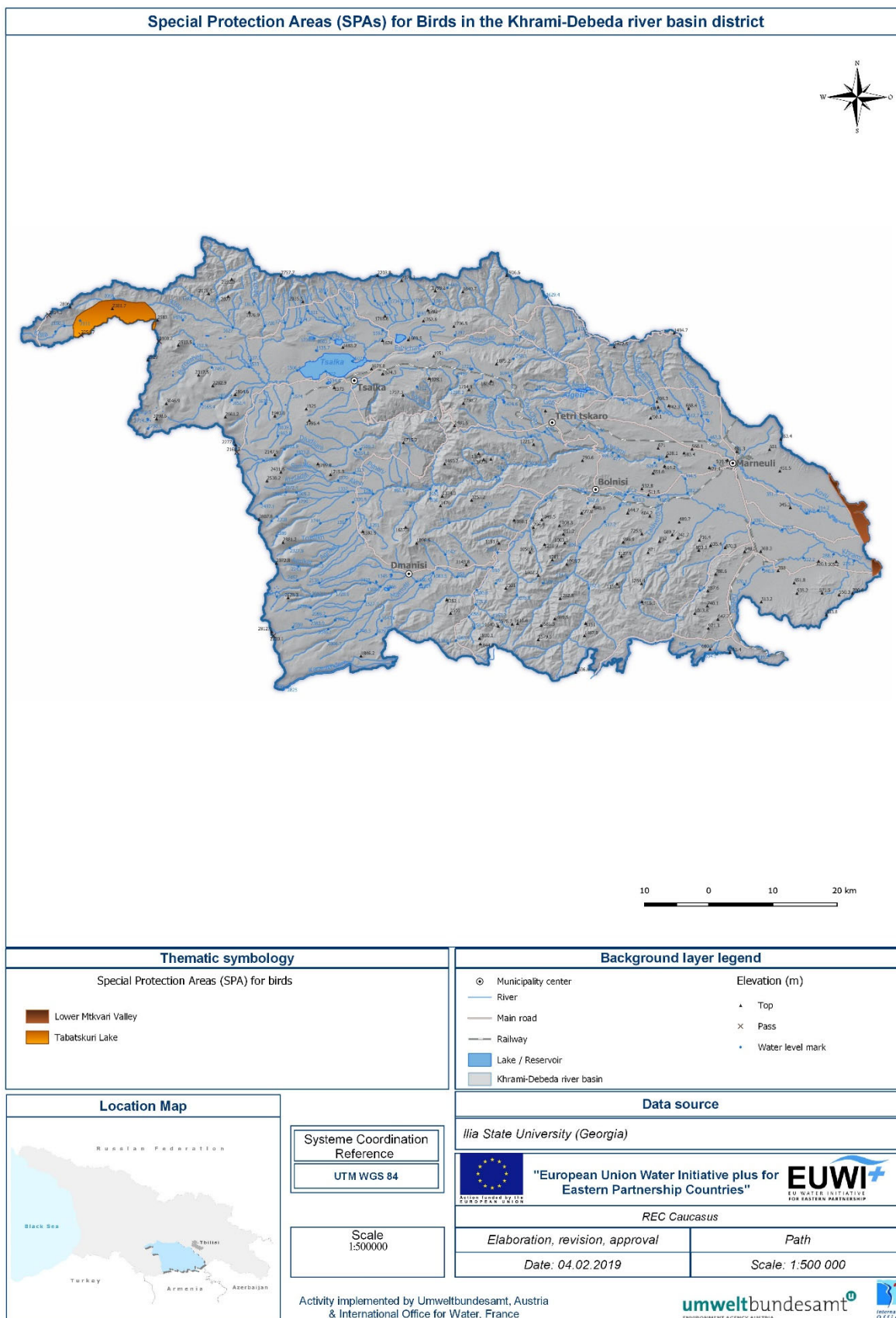




Figure 7 Special protection areas (SPAs) for birds in Khrami-Debeda river basin



### 3.3 Drinking water abstraction

**Drinking water abstraction** -The EU WFD requires a register of protected areas (zones), which include the details on related water bodies. Water bodies used for the abstraction of drinking water belong to one of the types of protected areas that should be registered. Water used for abstraction of drinking water is one of the major targets of protection. When such waters are identified, Environmental Quality Standards (EQS) for each pollutant must be established (Simić et al. 2015).

The Drinking Water Directive (98/83/EC) defines water for human consumption as all water either in its original state or after treatment which is<sup>7</sup>:

- Intended for drinking, cooking and food preparation or other domestic purposes;
- Used in any food production business for the manufacture, processing, preservation or marketing of products or substances intended for human consumption unless the competent national authorities in relation to drinking water quality are satisfied that the quality of water has no influence, directly or indirectly, on the health of consumers concerned

As it was previously discussed, the national legislation related to protected areas in Georgia (non-EU country) is not fully harmonized with the EU standards. Thus, the modified approach in dealing with protected areas would be applied. It is important to identify the areas used for the abstraction of drinking water (groundwater, surface water), at the same time having in mind data availability (i.e. lack of data, data are not systematized, etc.).

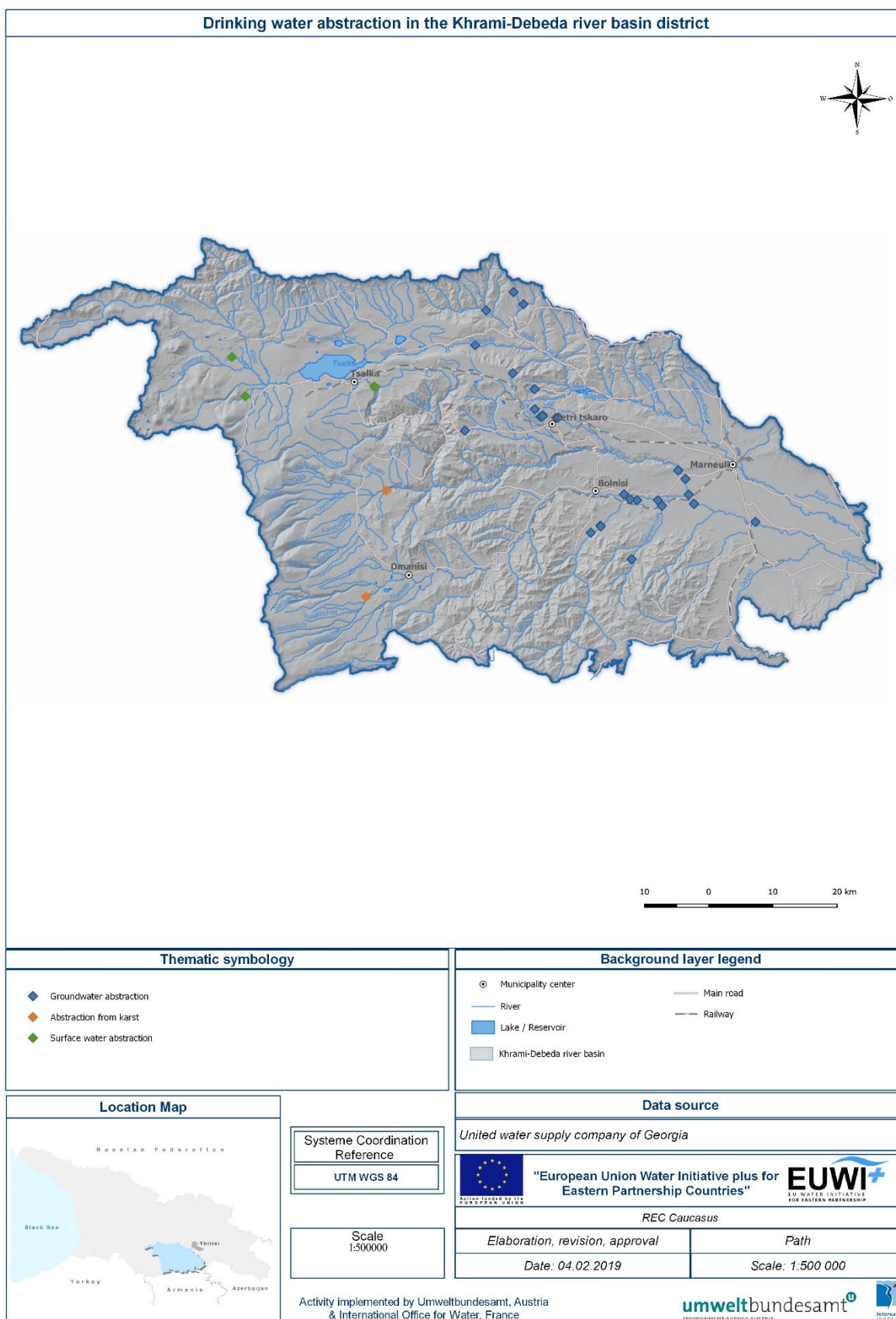
Regarding Law of Georgian on Water, sanitary zones should be existing at all drinking water sources. There are different types of drinking water supply sources in the Khrami-Debeda river basin including surface water, wells and spring water. One part of local population has access to the centralized water supply, while another part of local population has no access to high-quality drinking water, that has negative impact on local residents' health. It would be point out that it is necessary to improve the drinking water supply in this basin. Figure 8 shows the areas designated for drinking water abstraction

**The definition of sanitary protection zones of water bodies used for the abstraction of drinking water** is still an ongoing issue. Thus, at this moment it is not possible to collect data necessary to define drinking water abstraction zones. Regarding this issue, further efforts will still be necessary.

---

<sup>7</sup> Source: [http://ec.europa.eu/environment/water/water-drink/legislation\\_en.html](http://ec.europa.eu/environment/water/water-drink/legislation_en.html)

Figure 8 Areas for the abstraction of drinking water in the Khrami-Debeda river basin



Water bodies used for the abstraction of drinking water have been identified in the Khrami-Debeda river basin, that plays a significant role in water resources protection. As well as the areas important for the protection of habitats and species have been defined, the improvement of the status water in these areas is crucial for their protection (sites under Birds Directive 79/409/EEC and Habitats Directive 92/43/EEC).

It is important to outline that the following directives are not applicable in the case of the Khrami-Debeda river basin:

- Areas designated to protect economically significant aquatic species (areas protected under Freshwater Fish Directive 2006/44/EC; Shellfish Directive 79/923/EEC)
- Nutrient sensitive areas (areas protected under Nitrates Directive 91/676/EEC)
- Bathing waters (areas protected under Bathing Water Directive 76/160/EEC)

## 4 WATER BODIES STATUS AND RISK ANALYSIS

After identifying the main drivers and pressure types in the Khrami-Debeda river basin and analyzing pressure and impact on surface water bodies (SWBs) and groundwater bodies (GWBs), the preliminary risk assessment has been done. Regarding pressure analysis and impact assessment the final risk assessment was carried out.

The main point source pollution pressure in the Khrami-Debeda river basin is related to industrial wastewater discharges, particularly to copper and gold mining companies of RMG (Rich Metal Group): JSC RMG Copper and LTD RMG Gold. It has a significant negative impact on the rivers Kazretula, Mashavera and Foladauri. Regarding pressure-impact analysis and preliminary risk assessment 3 surface water bodies were ranked as “At risk” while only 1 surface water body as “Possibly at risk” from industrial wastewater discharges.

In order to identify SWBs “At risk” under point source pollution pressure (urban wastewater discharges) the following pressure indicator was used: the ratio of untreated wastewater to annual minimum flow, showing river dilution capacity<sup>8</sup>. As well as impact indicators, including physico-chemical, (common physico-chemical parameters, including pH, turbidity, electrical conductivity, DO saturation, BOD, nutrients, salinization, specific etc. and priority substances – heavy metals,) and hydrobiological quality parameters has been considered.

Based on the result of pressure indicator calculation and regarding specific numerical thresholds surface water bodies have been assigned the risk categories such as “At risk”, “Possibly at risk” and “Not at risk”. 3 surface water bodies were ranked as “At risk”, while 3 surface water bodies were defined as “Possibly at risk” from urban wastewater discharges.

For risk assessment for diffuse agricultural (pressure: crop(plant) production; animal live stocking) pollution source two pressure indicators such as the ratio of area used for intensive/industrial agriculture in the respective catchment to catchment area of the respective water body<sup>9</sup> and the ratio of animal livestock unit for grazing livestock to catchment area of the respective water body<sup>10</sup> were used respectively.

The results of pressure indicators (for diffuse agricultural pollution sources) calculations were used to grade the water bodies into risk categories “At risk”, “Possibly at risk” and “Not at risk”. It should be highlighted that a quite amount of surface water bodies (80 water bodies) were ranked as “At risk” and 112 water bodies as “Possibly at risk” from diffuse agricultural pollution. This is related to the fact that agricultural sector plays a significant role in the Khrami-Debeda river basin.

For identification of SWBs under significant quantitative pressure (water abstraction) the main drivers such as agriculture, industry, urban development was specified since the energy sector, irrigation sector and domestic water supply sector are the leaders among consumptive water users in this basin. Regarding the data which was obtained from various data sources was integrated and analyzed, also considering

<sup>8</sup> Pressure indicator:  $D_{ww} = L / Q_{min,r}$ , where  $Q_{min}$  is river minimum flow;  $D_{ww}$  – specific wastewater discharge into the specific river and  $L$  - Total (dimensionless) load equivalent originating from wastewater discharge into the river

<sup>9</sup> Pressure indicator:  $S_{agri} = A_{agri}/AWB$ , where  $S_{agri}$  : Share of agricultural area in a given water body catchment [-]; Catchment area of the respective water body [km<sup>2</sup>];  $A_{agri}$ : Area used for intensive/industrial agriculture in the respective catchment

<sup>10</sup> Pressure indicator:  $I_{hus} = U_e/AWB$ , where  $I_{hus}$ : Indicator for animal livestock [LU/ha];  $U_e$ : Animal livestock unit for grazing livestock and others (e.g. pigs, different poultry species), that is calculated as livestock unit (LU) multiplied by animals number averaged over the whole year for the water body;  $AWB$ : Catchment area of the respective water body [ha]

the local stakeholder's consultation 19 surface water bodies were graded into "At risk" category from water abstraction.

Under the pressures and impacts of human activity analysis the hydromorphological pressure types were subdivided into hydrological regime changes, river continuity and river morphology and for those types, pressure and risk criteria were defined<sup>11</sup>.

As a result of a desk review of preliminary studies, following the thematic and geographic scoping of key drivers/water management issues, as well as regarding experts judgment the risk assessment has been made against hydromorphological pressure indicators. 33 surface water bodies were ranked as "At risk", while 22 surface water bodies were assigned "Possibly at risk" category from hydromorphological pressures.

Considering all pressure types and their impact on SWBs, the risk assessment has been performed and as a result 45 SWBs "At risk" and 165 SWBs "Possibly at risk" were identified. Afterwards, based on the expert judgment the status of 4 surface water bodies has been changing from "Not at risk" to "Possibly at risk" category.

Considering pressure-impact analysis and risk assessment of SWBs, a map of risk assessment in the Khrami-Debeda river basin has been created which presents SWBs ranked as "A risk", "Possibly at risk" and "Not at risk" categories (see Figure 9).

Regarding the risk assessment of groundwater bodies, it is important to outline that nitrate concentrations at the 2 monitoring sites of NEA's groundwater monitoring network in the Khrami-Debeda basin do usually not exceed the maximum permissible concentration for drinking water of 50 mg/l. At 1 well that is not part of NEA's monitoring network, but which was used to fill gaps in the coverage of that network during EUWI+ field surveys, the nitrate concentration was 44 mg/l. The concentrations of heavy metals and pesticides were below the limits of detection at this site sampled during the EUWI+ field surveys.

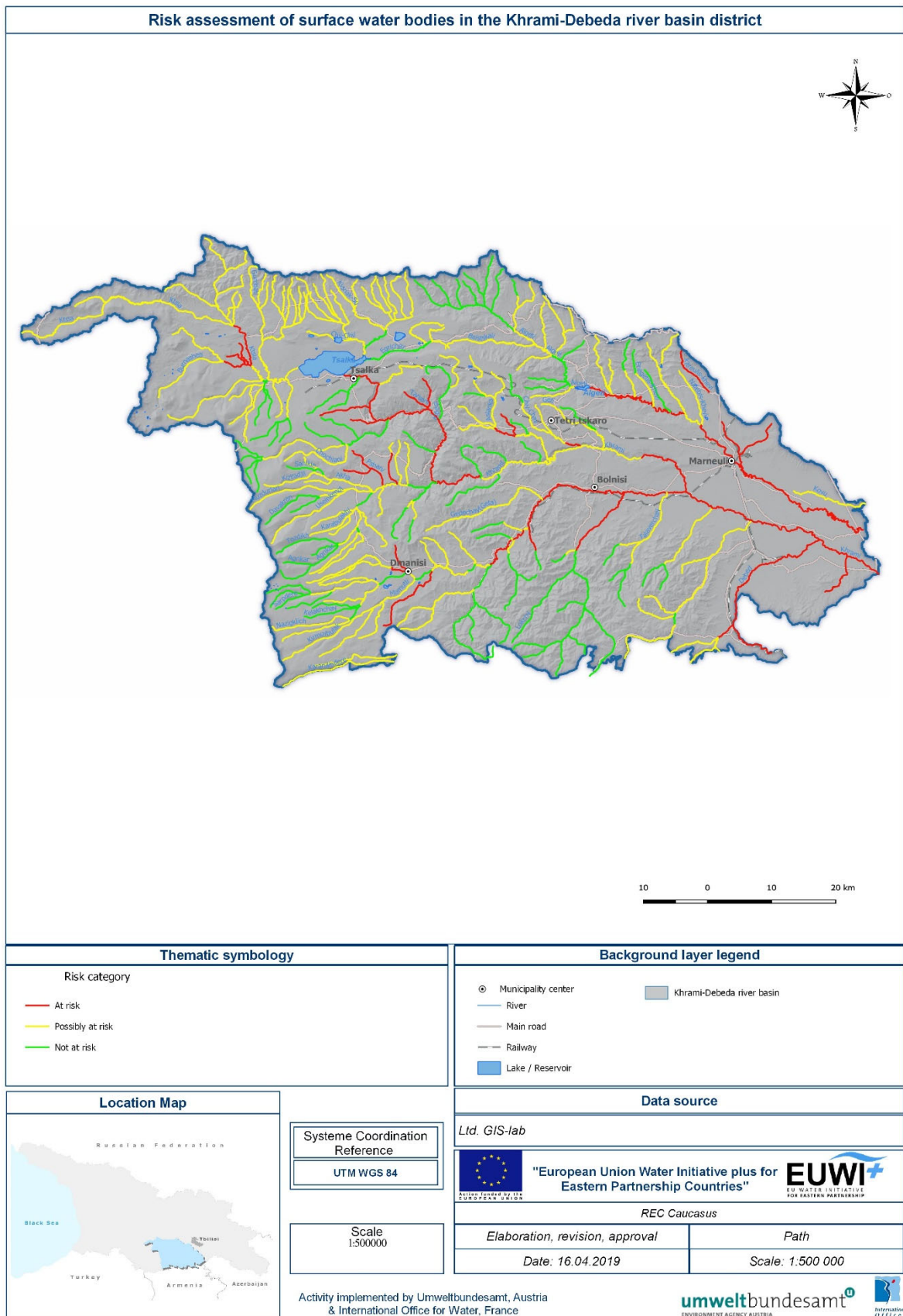
The quantitative characteristics such as discharge of artesian aquifers at the monitoring sites of NEA's network are mostly stable.

None of the groundwater bodies in the Khrami-Debeda were assessed as being at risk. However, there are currently no structured methods to aggregate chemical and quantitative groundwater monitoring data over time and across an entire groundwater body into a reliable assessment of chemical and quantitative groundwater status and of risk not to achieve good status. Such methods still need to be developed.

---

<sup>11</sup> Guidance document on analysis of pressures and impacts and assessment of risks applicable for Georgia /USAID governing for growth (G4G) in Georgia

Figure 9 Risk assessment of SWB in the Khrami-Debeda river basin



## 5 SURFACE WATER MONITORING

Development of the state policy in the sphere of water protection and use as well as the adoption of legislative acts concerning water use and protection and control is the responsibility of the Ministry of Environment Protection and Agriculture of Georgia. Implementation of water monitoring and assessment of the water quality of inland and coastal waters, as well as provision meteorological and geo-morphological observations, and maintenance of respective records is responsibility of National Environment Agency (NEA) of the Ministry of Environment Protection and Agriculture (MEPA). The Hydro-Meteorological Department of NEA is responsible for the hydro-morphological monitoring.

Monitoring results, the measurements of the surveillance and/or operational monitoring are used to define the status of water bodies while results are compared to the respective environmental objectives set. The monitoring of surface water bodies in Georgia will include measurements of chemical, hydrobiological, physico-chemical and hydro-morphological parameters.

### 5.1 Current surface water monitoring situation

The surface water monitoring in the Khrami-Debeda RBD used to focus on **water quality**. The existing water quality network is not divided into surveillance, operational and investigative monitoring as foreseen in the WFD. Up-to-date data on water quality in the RBD is scarce and incomplete because of an ineffective water quality monitoring network.

The National Environment Agency (NEA) currently maintains 4 stations for water quality monitoring in the Khrami basin (Red Bridge, Imiri, Nakhiduri, Khrami HPP), and 1 station on the Debeda River at Sadakhlo. Since there is no regular monitoring, there is currently no information about the general situation of water quality. The monitoring is carried out either monthly or quarterly (Mikeladze & Geladze, 2019), and several additional sites were investigated at specific surveys during EPIRB and EUWI+ project. Until now, no monitoring of standing waters (Lake Bareti, 2 reservoirs) has been carried out in the Khrami-Debed RBD.

Within the framework of the National Water Quality Monitoring programme mainly physico-chemical and microbiological parameters are analysed. Monitoring of concrete organic substances, such as for e.g. TPH detergents and others, is conducted in some rivers within the framework of the National Water Quality Monitoring Program. Georgia established maximum allowable concentrations (MAC) to assess SWB. (Resolution of the Government of Georgia №425 December 31, 2013, Tbilisi, on the Approval of the Technical Regulation on the Protection of Surface Waters from Pollution of Georgia) for the assessment of surface water bodies (SWB). MAC's include chemical and microbiological parameters such as for e.g. heavy metals and organic contaminants (TPH, detergents etc.).

Currently there is no regular **hydrobiological monitoring**. However, hydrobiological surveys have been carried out during EU-funded projects in the recent years. The surveys focused on the biological quality element (BQE) macro-invertebrates. A proposal for a WFD compliant ecological status classification system (ESCS) is being made during the EUWI+ project.



## 5.2 Monitoring improvement

### 5.2.1 Chemical Monitoring

Distinct surveillance, operational and investigative monitoring will be designed and carried out based on the pressure analysis and risk assessment in rivers and standing waters of the Khrami-Debeda RBD (see Table 3). To further converge towards the EU Water Framework Directive, monitoring of parameters required regarding both specific pollutants and priorities substances, especially considering the pressure and risk analysis of the river basin is necessary. This should include, among others, substances emerging from domestic and industrial wastewater, especially from mines, and tailing dams.

As the general number of operational sites is quite low, given the size of the RBD, it is suggested to add additional operational sites.

**Table 3 Overview of proposed chemical monitoring in rivers and lakes (reservoirs) of the Khrami-Debeda river basin**

	Quality element / group of parameters	Frequency	Surveillance no. of sites	Operational no. of sites
Rivers	General physico-chemical parameters	12x / year, annually	7	6
	Priority pollutants	12x / year, 6 years interval	7	–
	Other pollutants	12x / year, annually	7	6
Lakes	General physico-chemical parameters	12x / year, annually	2	-
	Priority pollutants	12x / year, 6 years interval	2	-
	Other pollutants	12x / year, annually	2	-

### 5.2.2 Hydrobiological Monitoring

Surveillance and operational monitoring sites shall be the same as for the chemical monitoring.

Like in the projects of previous years, monitoring will concentrate on the Biological Quality Element (BQE) macroinvertebrates. This BQE shall be investigated at all of the surveillance and operational monitoring sites. In addition, phytobenthos will also be included at operational monitoring sites, in order to enhance the dataset for developing a WFD compliant classification method. Lakes and reservoirs will be investigated by monitoring phytoplankton. The monitoring of the other biological quality elements for both rivers and lakes will be postponed until the next RBMP.

Based on data from the EUWI+ project a new WFD compliant ESCS was proposed recently, which shall become the basis for the ecological classification in the future monitoring.

**Table 4 Proposal for the hydrobiological monitoring in rivers and lakes (reservoirs) of in the Khrami-Debeda river basin**

	Quality element / group of parameters	Frequency	Surveillance no. of sites	Operational no. of sites
Rivers	Benthic invertebrates	1x / year, 6 years interval	7	6
	Phytoplankton (diatoms)	1x / year, 6 years interval	7	6
Lakes	Phytoplankton	6x / year, annually	2	-

### 5.2.3 Hydro-morphological Monitoring

While previous hydromorphological description was carried out at single sites, the new monitoring shall cover the whole river network. A sampling campaign in 2019 was the starting point of hydro-morphological mapping in the whole Khrami-Debeda river basin. During the next RBMP cycle, the dataset needs to be increased through additional surveys.

Concerning the quantitative hydrological network, several new hydrological stations are necessary in addition to the only operating observation point at the river Mashavera. It is planned to restore 4 hydrological stations, where water levels and discharge will be measured (Ktsia/Khrami at Edikilisa, Ktsia/Khrami at Dagheti, Ktsia/Khrami at Red Bridge, Debeda at Sadakhlo). Concerning standing waters, it is proposed to monitor water level at Lake Bareti as well as on two reservoirs.

## 5.3 Monitoring Costs

Following estimations represent the costs of the whole six years of an RBMP cycle. As mentioned in Table 3 and Table 4, the 9 surveillance sites will be investigated once per cycle (chemical monitoring 12x / year; hydrobiological monitoring in rivers 1x / year, and lakes 6x / year), and the 6 operational monitoring sites will be sampled twice over the six-year period (same annual frequency).

Taking into account the survey costs of 2018 and 2019 in the EUWI+ project an approximate cost estimation of the surface water monitoring in the Khrami-Debeda RBD can be calculated. Considering sampling and analyses of general physico-chemical parameters and all BQE (benthic invertebrates, phytoplankton, phytoplankton) for the proposed surveillance and operational monitoring sites will cost around 28,000 € in this RBMP cycle.

The estimation for the monitoring of priority pollutants has lower confidence, as the costs were calculated based on a fraction of costs per parameter in Austrian surface water monitoring. Another assumption was that the number of analyzed parameters is 15. Nevertheless, the rough cost estimate is for priority pollutants is around 32,000 € to 50,000 €. The true costs will vary, depending on the number and kind of analyzed parameters.

## 5.4 Monitoring results

### 5.4.1 Chemical Status

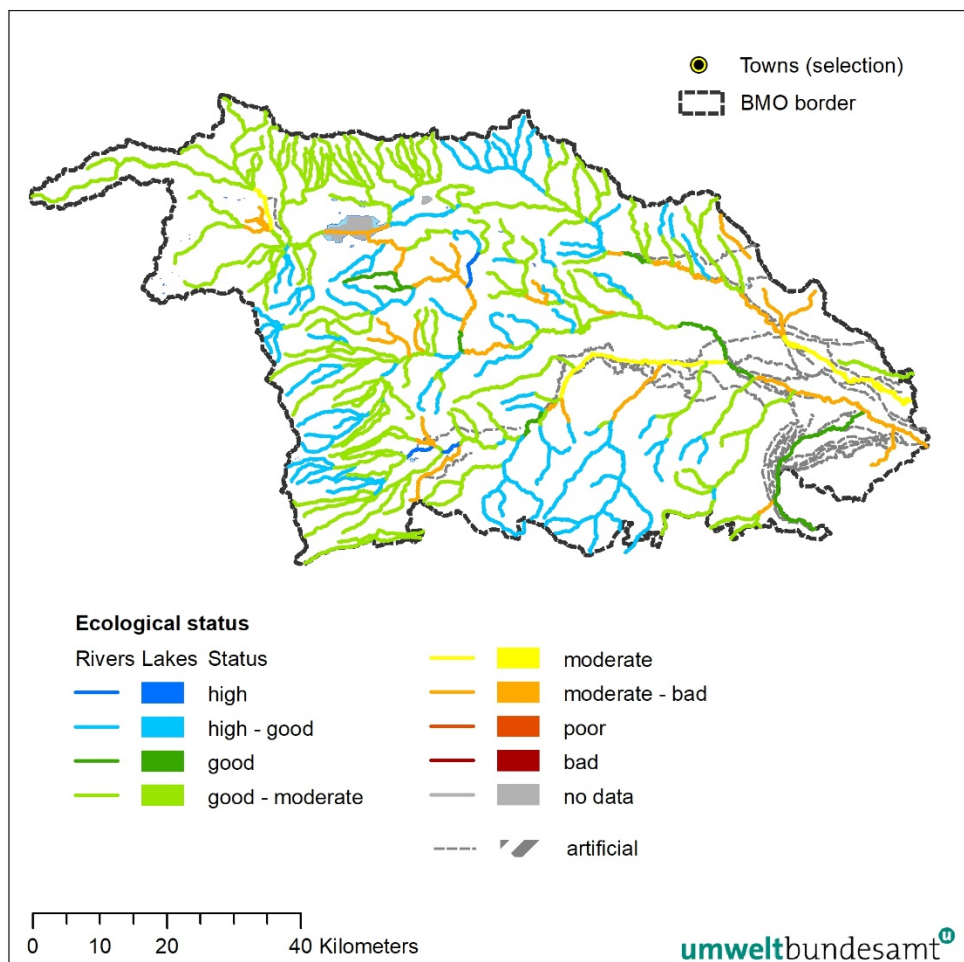
Based on pressure data, the rivers Khrami, Debeda and their tributaries are mainly polluted with organic substances, biogenic substances from untreated wastewater, as well as by legal and illegal dumping sites, drainage and storm water, and water used in copper and gold mining, which causes the main pollution problem in the RBD. Industrial wastewater discharge significantly affects the water quality, especially from copper and gold mines in Bolnisi. For example, near copper deposits, studies of the Kazretula River have shown that concentrations of copper, zinc, cadmium and sulphate ions exceeded the allowed.

### 5.4.2 Ecological status

According to the WFD, the assessment of the ecological status is based on hydrobiological data and ecological status classification systems (ESCS). Supporting elements are physico-chemical, hydro-morphological parameters and specific pollutants.

As outlined above, there is no official WFD compliant ecological status classification system (ESCS) available up to now. However, a preliminary ecological status of a selected number of SWB can be assessed based on a new proposal for a WFD compliant ESCS for invertebrates in rivers (see Figure 10). For the HMWB reservoirs, no classification of the ecological potential is available yet.

**Figure 10 Preliminary ecological classification of SWB in the Khrami-Debeda river basin**



## 6 GROUNDWATER MONITORING

The National Environmental Agency is responsible for chemical and quantitative monitoring of groundwater in Georgia.

Until the early 1990s, studies and hydrogeological tests were carrying out about the groundwater regime in the Khrami-Debed basin. Then in the period of 1990 to 2013, no hydrogeological exploration and monitoring works were carried out for the purpose of identification, study and protection of fresh groundwater. In 2013, the Department of Geology of the National Environmental Agency resumed monitoring of groundwater in Georgia. Gradually, new stations have been added to the monitoring network, including with support by the Czech Development Agency and by the EU-financed EPIRB project. NEA currently monitors 56 water points (mainly wells) in the entire territory of the country.

Out of these 56 water points, 2 are located in the Khrami-Debed basin. Both are boreholes and equipped with automatic data logging equipment. This equipment continuously records several key quantitative and qualitative parameters:

- Water flow;
- Water temperature;
- pH;
- Electric conductivity;
- Total dissolved solids (TDS).

In addition to this continuous data collection, NEA conducts chemical and bacteriological analysis of water samples from both monitoring sites twice per year. NEA manages and analyses the data from these monitoring sites and prepares information bulletins twice a year based on the hydrogeological monitoring results. The bulletins are public and accessible to all interested parties. NEA's database for groundwater could be improved and automatically linked to the new portal of the Environmental Information and Education Center under the Ministry of Environmental Protection and Agriculture.

The current monitoring network does not yet cover all groundwater bodies of the Khrami-Debeda basin, and the network is not yet adequately representative in those groundwater bodies that do have monitoring sites. The Water Framework Directive requires that each groundwater body should have at least one monitoring site. Associated EU guidance recommends a minimum of three sites, however, with more sites where necessary to represent the anthropogenic pressures on the groundwater body and its natural conditions.

To fill some of the monitoring gaps within groundwater bodies and of entire groundwater bodies, and to find existing wells and springs which could be added to the monitoring network to improve its coverage, EUWI+ supported NEA to conduct additional field work on top of the regular monitoring. NEA assessed 4 such existing wells, and collected and analysed samples from these wells.

There is a certain limit to the potential usefulness of the existing monitoring data for informing decision-making on the protection and use of the groundwater resource, however. The existing data on chemistry and quantity, including parameter selection, frequency, and density of monitoring sites, are not yet sufficient for making clear statements about chemical and quantitative status of groundwater bodies in the Khrami-Debeda RBD. On the one hand, significant gaps remain in the monitoring network and need to be filled, the monitoring frequency could be adapted to the risks of anthropogenic contamination and over-abstraction at each site, and the set of analysed parameters should be expanded flexibly, in line with the Directive. On the other hand, the age of the existing wells and their precise technical characteristics (construction, lithology, water content per horizon, etc.) are often not known, which lowers the reliability of the produced data. Analysing one well costs around 1,700 EUR.

The average construction cost per additional well is estimated at 7,000 EUR, but greatly depends on depth. A similar amount would be needed for washing and rehabilitating an existing site in case the analysis shows that one of the two wells in the network is not actually suitable and should be replaced. However, moving existing boreholes is currently not possible due to budget constraints. The installed logging equipment is estimated at 9,000 EUR per piece, for a total of 16,000 EUR per additional monitoring well when assuming that NEA installs logging equipment at each well. The construction cost for each additional spring capture is estimated at 2,000 EUR.

12 additional monitoring sites will be necessary to meet the minimum requirement of the Water Framework Directive of one monitoring site per groundwater body. Assuming that out of these 12 additional sites, 10 will be springs and 2 will be wells, then the necessary investment would sum up to 55,000 EUR.

To limit the number of required additional sites, some groundwater bodies in the Khrami-Debeda basin could be merged when the RBMP of the next cycle is under preparation. This is possible where the newly merged groundwater bodies would still allow a meaningful assessment of its risk of not achieving good status and its actual status in case of such risk, as where they would also still allow the design, implementation and assessment of effective protection measures.

The sampling and chemical analysis per sample, including all main ions, heavy metals and a set of standard pesticides costs around 170 EUR. Sampling and analysis of a reduced set of parameters costs around 80 EUR. The overall costs of these analyses can be reduced by following the risk-based approach of the Water Framework Directive. In this approach, a large set of parameters is analysed at a large number of monitoring sites at least once every six years (i.e. once per RBMP cycle) in what is called surveillance monitoring. Based on the results, a reduced number of parameters is analysed at a reduced number of sites, focusing efforts where needed the most. When adding 12 additional monitoring sites for those groundwater bodies that are not yet covered by the network, and maintaining the slightly denser existing network at certain groundwater bodies, the sampling and analysis of the full parameter set would cost approximately 2,300 EUR per monitoring cycle. If the full set of parameters is only analysed one in six times, while the reduced set is analysed the remaining five times, then the average cost per monitoring cycle drops to around 1,400 EUR.

To turn the monitoring data into usable information for decision-making, structured methods that aggregate chemical and quantitative monitoring data into reliable assessments of chemical and quantitative status and of risk of not to achieve good status, still need to be developed.

Several groundwater bodies in the Khrami-Debeda basin are transboundary with Armenia. It is very important to establish monitoring sites for these transboundary groundwater bodies. There should be mutual agreement for a monitoring program with common standards for information exchange and joint assessment of groundwater body status.

## 7 ENVIRONMENTAL OBJECTIVES

The environmental objectives of the WFD are set out in Article 4<sup>12</sup>. Setting environmental objectives aim to **achieve good status for all water bodies; prevent deterioration of water status and ensure sustainable water management**. In order to set environmental objectives, there is a need to consider the outcomes of the pressure-impact analysis, the risk assessment and the monitoring result in case if it is available.

Regarding the EU WFD ecological status is defined as the high, good, moderate, poor and bad classes considering all ecological elements for each of the surface water categories. For the overall ecological assessment, the quality elements such as hydrobiological, hydromorphological, physico-chemical elements have to be considered.

It is important to point out that biological quality elements play a crucial role in defining of SWBs' ecological status. Accordingly, physico-chemical and hydromorphological parameters are significant since they are used to define biological quality elements.

In order to define environmental objectives, it is necessary to have reference conditions and ecological and chemical status classification system for SWBs. Since there is no ecological and chemical status classification of SWBs in Georgia, it is not possible to set out reference conditions. Therefore, environmental objectives which stand for improvement of the ecological status of SWBs were defined considering the water body's risk status and types of risk factors such as point source pollution, diffuse source pollution, hydromorphological pressure.

As mentioned above environmental objectives aim to improve water bodies' ecological and chemical status by eliminating (where it is possible) or reducing risk factors. According to these risk factors, the following environmental objectives have been elaborated in the Khrami-Debeda river basin:

- Surface water bodies at risk – urban waste water (sewerage) discharges:  
*To improve water quality against organic matter, nitrogen, phosphorus other pollutants by reducing untreated waste water discharges from sewerage systems, having a sewerage treatment facility*
- Surface water bodies at risk – Industrial (mining) waste water discharges:  
*To improve water quality against sulphate, heavy metals and other pollutants, by reducing untreated waste water discharges from industry sector*
- Surface water bodies at risk – Industrial (sand-gravel extraction) waste water discharges:  
*To improve water quality by reducing concentration of weighted portions and untreated waste water discharges from industry sector*
- Surface water bodies at risk – Agricultural (crop production) activities:  
*To improve water quality by reducing organic matter, nitrogen, phosphorus, pesticides hazardous substances discharges in surface water bodies*
- Surface water bodies at risk – Agricultural (animal livestock) activities:  
*To improve water quality by reducing organic matter, nitrogen, phosphorus, pesticides hazardous substances discharges in surface water bodies; improving manure management*
- Surface water bodies at risk – Illegal landfills waste water discharges:  
*To improve water quality by regulating the illegal landfills*
- Surface water bodies at risk – Excessive water abstraction for irrigation; HPPs;  
*To improve the hydromorphological status of the river such as morphology, continuity, hydrology by reducing disturbance of flow, improving the conditions of irrigation systems*
- Surface water bodies at risk – Hydromorphological alteration

---

<sup>12</sup> Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

*To improve hydromorphological such as morphology, continuity, hydrology by reducing plan form/channel pattern changes, altered riparian habitats, bed and bank fixation, protecting the environmental flow (e.g. low flow, variable flow, etc.), assuring river continuity*

After defining environmental objectives for all pressure types, appropriate environmental objectives were assigned to all surface water bodies at risk.

Furthermore, the environmental objectives specifically for the heavily modified water bodies (HMWBs) and the protected areas (according to the EU WFD) have been defined in the Khrami-Debeda river basin.

**12 HMWBs** have been identified and designated in the Khrami-Debeda river basin district. HMWBs are required to achieve “good ecological potential” (GEP). GEP ensures slight changes in the values of the relevant biological quality elements at “Maximum Ecological Potential” (MEP) which represents the maximum ecological quality that could be achieved for a HMWB<sup>13</sup>. Since the good ecological potential (GEP) is the environmental quality objective for HMWB, risk of failure of the ecological objective for HMWB is assessed against GEP.

According to WFD CIS Guidance Document No.4 the following steps are needed to be taken in order to establish GEP:

- The establishment of the good ecological potential for HMWB is based on the **biological quality** elements which are derived from MEP
- Identification of the **hydromorphological conditions** in order to support the achievement of the GEP values for the biological quality elements, in particular the achievement of the values should be for those biological quality elements which are sensitive to hydromorphological alterations.
- The values for the general **physico-chemical** quality elements at GEP are to support the achievement of the GEP biological values, as well as they ensure the functioning of the ecosystem
- GEP requires compliance with environmental quality standards established for the **specific synthetic and non-synthetic pollutant** quality elements

In order to achieve GEP for the HMWBs in the Khrami-Debeda river basin district it is crucial to improve hydromorphological quality elements such as hydrology, continuity and morphology. Thus, environmental objective for HMWBs in this basin would be set up in such a way: To improve hydromorphological state (hydrological regime changes, river continuity, morphological alterations) of a water body by maintaining environmental flow.

The objectives for **special areas of conservation (habitats)** is to protect and where necessary improve the status of the water bodies in order to achieve the conservation objectives that have been established for the protection or improvement of the particular natural habitat type or species<sup>14</sup>. Thus the site should contribute to the maintenance or improvement of the favorable conservation status.

The objectives for **special protection areas for birds** is to protect and improve the water status to the level necessary to achieve the conservation objectives which are defined for the protection / improvement of the site for ensuring that it contributes to the survival and reproduction of birds<sup>15</sup>.

Moreover, there are environmental objectives for groundwater:

- WFD Art. 4(1)(b)(1): prevent or limit input of pollutants into GW; prevent deterioration of GWB status

<sup>13</sup> WFD CIS Guidance Document No. 4 Identification and Designation of Heavily Modified and Artificial Water Bodies

<sup>14</sup> Habitats Directive- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

<sup>15</sup> Birds Directive- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

- WFD Art. 4(1)(b)(2): achieve good status
- WFD Art. 4(1)(b)(2): reverse significant and sustained upward trends in pollutant concentrations due to human activity

Additional data is needed for making clear statements about chemical and quantitative status of groundwater bodies in the Khrami-Debeda river basin. Additional data are required, which implies expansion of groundwater monitoring network, identification of new water points within different groundwater bodies and continuous planned monitoring.



## 8 ECONOMIC ANALYSIS

Economic analysis has been performed in the Khrami-Debeda river basin, which consists of two parts:

### **- Economic analysis – part 1 related to the Khrami-Debeda river basin characterisation**

According to the Water Framework Directive (WFD) requirements, economic aspects of water resource management should be integrated into the water policy of member states. Considering this fact, the economic analysis in this river basin includes:

- An economic analysis of the water use – describing main water users and contamination of water bodies.
- Tendencies the development of the further human activities within the particular river basin.
- Assessment of the cost recovery principle –considering all the costs of the water services, including environmental and resource-related expenses.

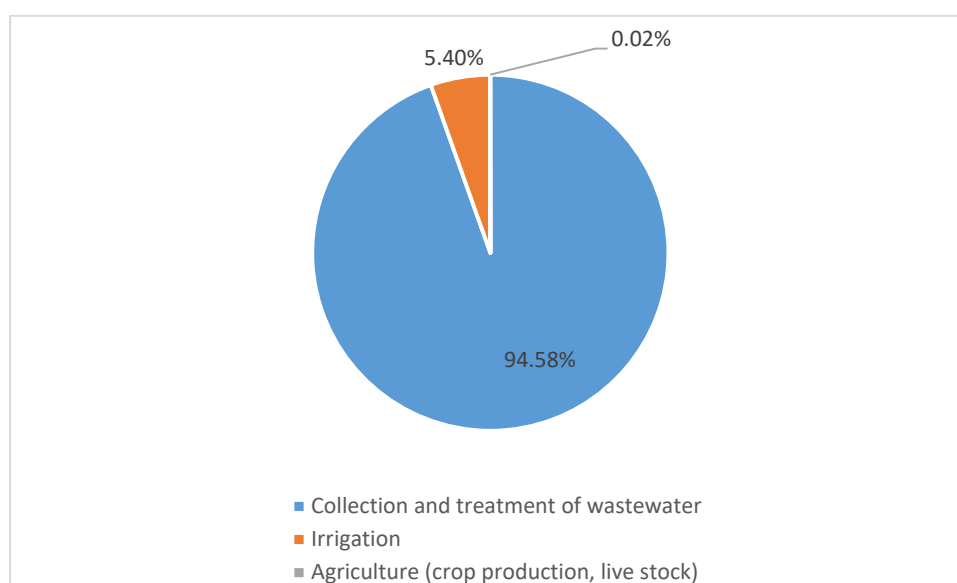
Economic analysis of water use gives decision makers the possibility to understand the socio-economic value of water. On one hand, provides information about the water abstractors (e.g. which sectors are the main water abstractors), and which sectors contribute mostly in the deterioration of water quality (e.g. which sectors are responsible for water pollution). On the other hand, by analysing the value added generated by each sector in the economy it makes it possible to understand how effectively the water is used and who should be contributing – and how much – to water management costs.

### **- Economic analysis – part 2 related to programme of measures in the Khrami-Debeda river basin**

Since there are two types of measures such as basic and supplementary measures in the programme of measures in the river basin, Operation and Maintenance costs (O&M) of both measures (basic, supplementary) is estimated.

The selected basic measures are supposed to improve the conditions into three main directions: collection and treatment of wastewater, agriculture (crop production, live stock) and irrigation. Figure 11 represents the distribution of investment costs by sector (the share of investment costs benefiting agriculture is negligible).

**Figure 11 Investment Costs of basic measures by sector**



Operation and Maintenance costs (O&M) of the basic measures are estimated based on the assumptions made in the literature. For example, to calculate O&M costs of Wastewater Treatment Plant (WWTP) the following costs are considered: wages (30-50% of the total operation costs), maintenance (0.5-2% of investment cost), utility costs (10-30% of total operation costs), disposal (15-50% of the total operation costs) (Balmer Peter, 1994) and depreciation cost (5% for the WTTP and pumping stations and 8% of the investment cost for other investments)<sup>16</sup>. For other basic measures only salaries (10-15% of the total operation cost) and depreciation costs (8% of the investment) were considered. Based on these estimates the lowest (best case scenario) and the highest (worst case scenario) possible operation costs were calculated.

However, basic measures which are also associated with significant indirect and environmental costs, due to inherent difficulties, resources constraints and data limitations these costs are estimated only qualitatively. Other environmental costs associated with the implementation of the projects have been identified: noise and dust due to the construction activities, increased traffic pollution in urban areas, acceleration of erosion due to the removal of vegetation on sites, damage of the street trees due to the construction process (Schuls N., 2004).

Furthermore, the costs associated with supplementary measures have been calculated on a yearly basis. If a measure is implemented in more than one municipality the cost has been calculated at the aggregated level for the whole basin.

It is important to highlight that environmental benefits are discussed within the economic analysis, also present value of programme of measures and affordability analysis are presented with this context. Moreover, financing of PoMs and the final implication of PoMs have been assessed.

---

<sup>16</sup> Georgian tax code, article 111

## 9 PROGRAMME OF MEASURES

According to Water framework directive (WFD), within a river basin district (RBD), a Programme of Measures (PoM) is established in order to address the significant issues identified and to allow the achievement of the objectives which have been defined and established. The development of PoM can be considered as a significant part of a river basin management plan (RBMP), it corresponds to the pressure/impact analysis, risk assessment and water status assessment through monitoring (if available). The identification of significant pressures and their resulting impacts (which in turn lead to reduced status) are critical to the successful development of PoMs.

PoMs serve the key purpose to reach the EU WFD objectives in particular good water status and hence, provide regulatory actions to reach, maintain and/or improve water status<sup>17</sup>. Moreover, PoMs should be designed to reduce catchment pressures in order to improve ecosystem services rather than element classification.

In order to achieve the objectives WFD Article 11 sets out two types of measures:

- Basic measures
- Supplementary measures

**Basic measures** are obligatory and they are the minimum requirements to be included in the PoMs. Its aim is to meet the requirements of other EU Directives which are related to WFD implementation, for example, measures associated with the implementation of other Community legislation for the protection of waters (WFD Article 11(3)a and Annex VI, e.g. measures to achieve compliance with the objectives of the Nitrates and Urban Waste Water Treatment Directives and etc.).

**Supplementary measures** are designed and implemented in addition to the basic measures where they are necessary to achieve the environmental objectives of WFD in accordance with Article 4. Supplementary measures would include additional legislative powers, fiscal measures, research, educational campaigns that go beyond the basic measures and are necessary for the achievement of objectives.

As it was pointed out before PoMs have been developed in such a way that it follows mainly the results of the pressure/impact analysis and corresponding risk assessment. Base on the assessment the major water management issues in the Khrami-Debeda river basin are:

- Point source pollution from urban wastewater discharges
- Point source pollution from industrial-mining waste water discharges
- Point source pollution from Industrial waste water discharges (sand-gravel extraction)
- Diffuse source pollution from agriculture-crop production
- Diffuse source pollution from agriculture-animal live stocking
- Diffuse source pollution from illegal landfills
- Excessive water abstraction (irrigation, public water supply, hydropower plant (HPP), fish farm, etc.)
- Hydromorphological alteration (Hydrological flow changes, Longitudinal river and habitat continuity interruption, Morphological alterations)

---

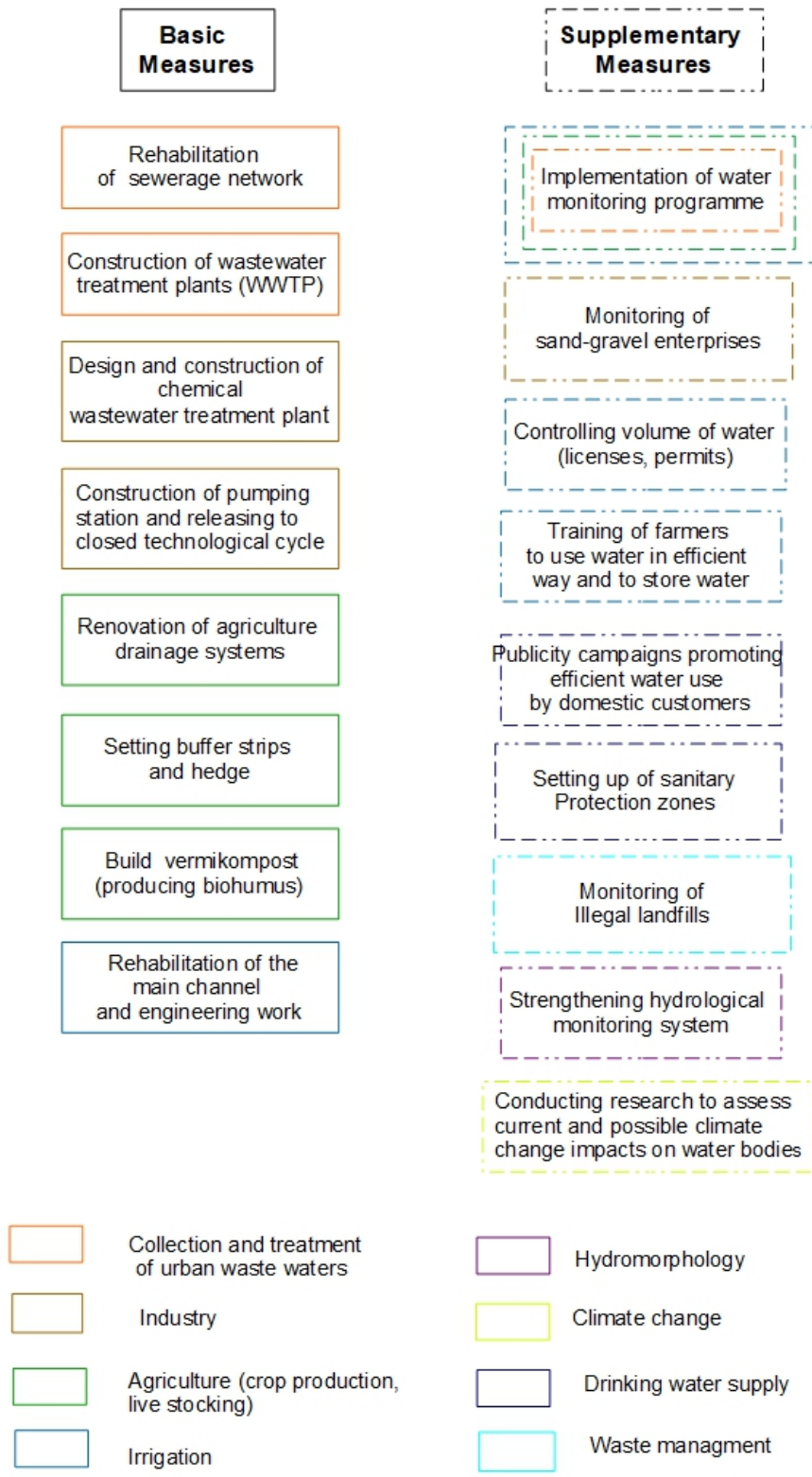
<sup>17</sup> Source: [http://ec.europa.eu/environment/water/waterframework/objectives/implementation\\_en.htm](http://ec.europa.eu/environment/water/waterframework/objectives/implementation_en.htm)

## 9.1 Selected measures (Basic, Supplementary)

In order to address the measures to the impacts from above mentioned water management issues a wide range of the measures (basic, supplementary) has been proposed which considers all the issues, pressure types in the Khrami-Debeda river basin. Due to lack of funding and appropriate consents, only 49 measures (41 basic and 8 supplementary) were selected during the 1<sup>st</sup> implementation cycle (see Figure 12).

The basic measures such as renovation /construction of a sewerage systems were found to target the point source pressures coming from the urban wastewater discharges. Also the basic measures have been selected in order to reduce point source pollution coming from industry-mining. Diffuse source pollution (crop production, live stocking) has been targeted by the measures such as agricultural drainage system's renovation, setting buffer strips and hedges, build vermikompost (producing bio humus). With regard to excessive water abstraction by irrigation systems, the measures have been selected which targeting rehabilitation of the main channel of Khram-Arkhi, Tsminda Giorgi irrigation system, Megoroba channel, Arakhlo irrigation system, etc. The supplementary measures have been selected to target waste water discharges, pollutions coming from agriculture, water abstraction issues via the provision of information and through educational campaigns, training, publicity campaigns. Furthermore, in order to improve water quality in this river basin the following supplementary measures have been selected: To propose investigated monitoring- investigation and monitoring of sand-gravel enterprises (investigation of waste water treatment plants and estimating weighed portions); Monitoring of illegal landfills (to be executed by the municipalities), imposing some sanctions, improvement of waste management; Setting up the sanitary protection zones (to be carried out by the municipalities). Moreover, with regard to climate change the supplementary measure has been selected which is related to conducting research to assess current and possible climate change impacts on water bodies.

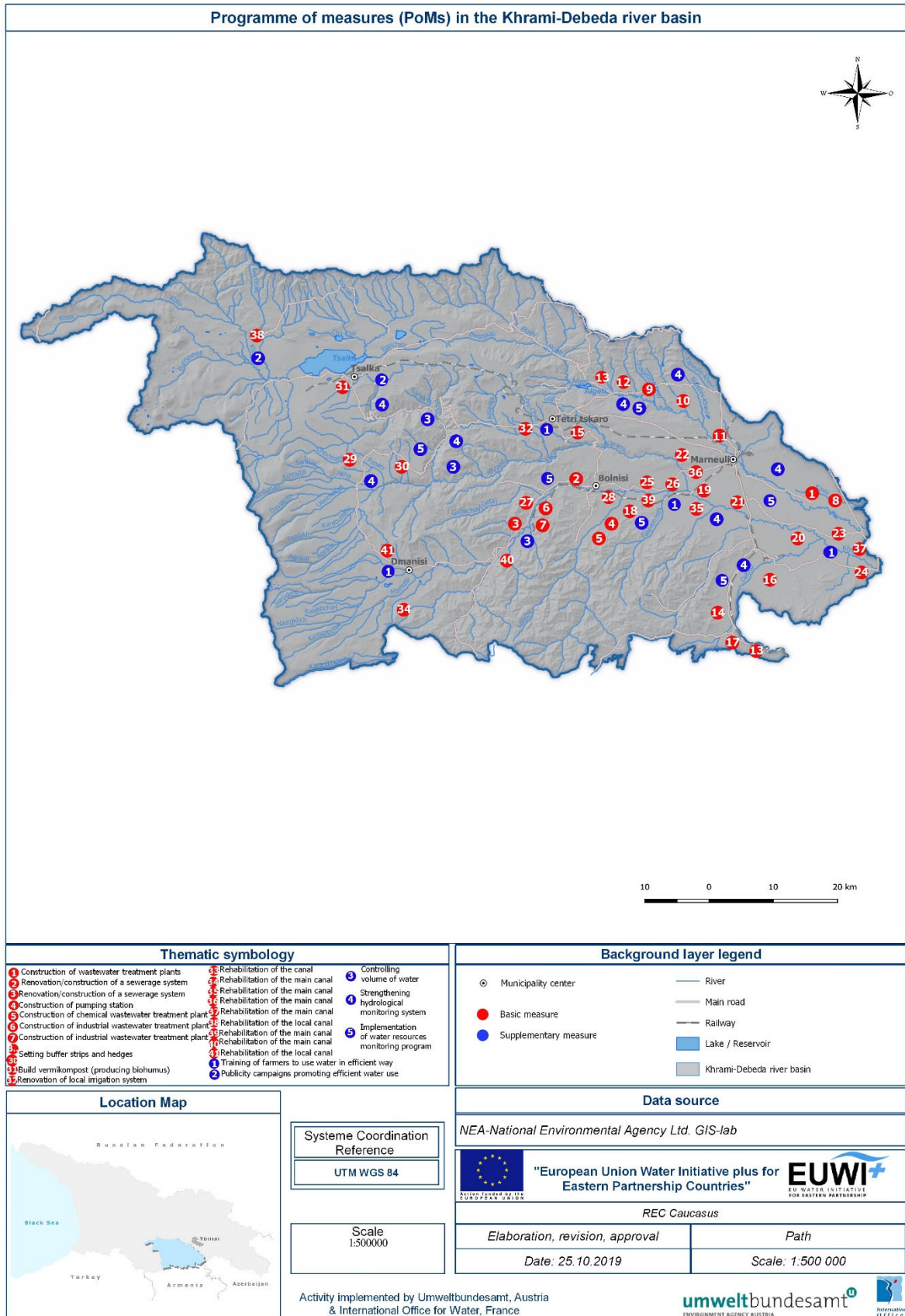
**Figure 12 The measures selected during the 1st implementation cycle for the Khrami-Debeda river basin**



Selected measures which have to be implemented during the 1 st cycle of the Khrami-Debeda river basin management plan were analysed in terms of the policy, legal, and financial tolls employed to bring about the actions on the ground, their apportionment to sectors, whether they are basic or supplementary and when they are planned to become operational.

Considering selected measures several maps have been created showing the distribution of the measures in the Khrami-Debeda river basin (see Figure 13); the measures are located in the basin by sector (see Figure 14) and the map where the measures are visualized by the sub-basin of the Khrami-Debeda river basin district (see Figure 15).

Figure 13 Programme of measures (PoMs) in the Khrami-Debeda river basin



**Figure 14 Programme of measures (PoMs) by sector in the Khrami-Debeda river basin**

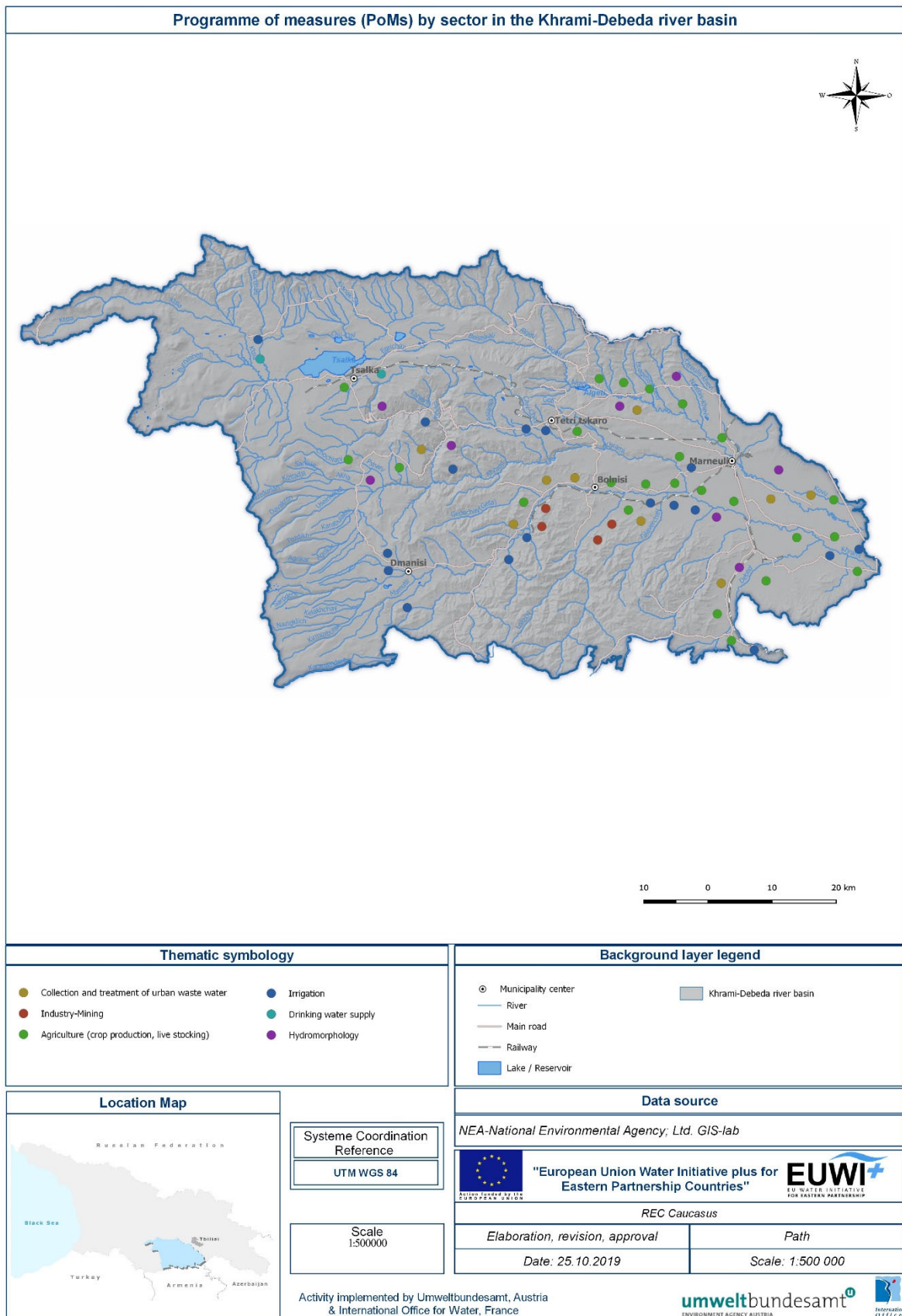




Figure 15 Programme of measures (PoMs) by sub-basin in the Khrami-Debeda river basin

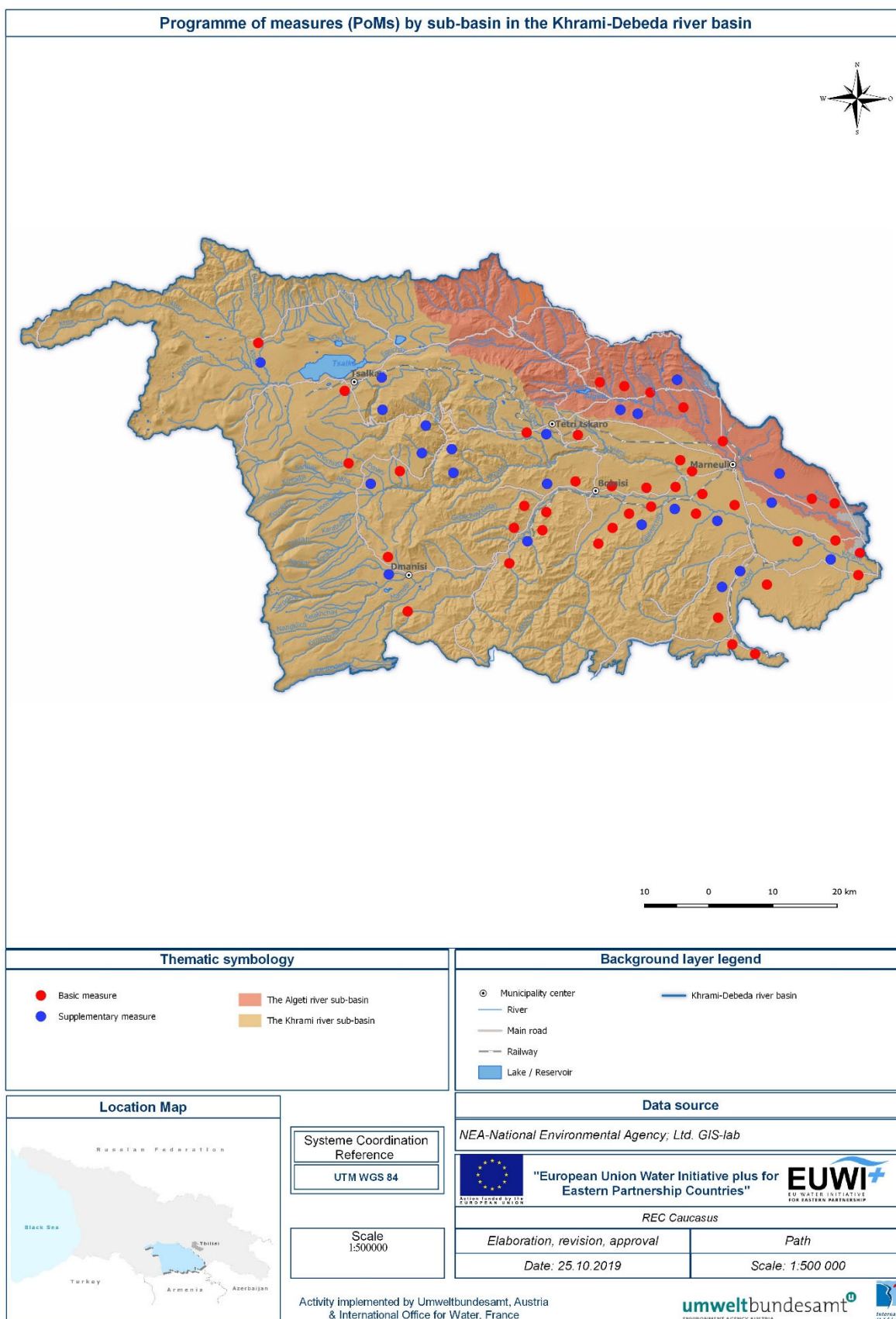


Table 5 (see in Annex 1) presents the basic and supplementary measures that will be implemented during the 1st implementation cycle in order to reach the environmental objectives. The basic and supplementary measures and corresponding environmental objectives are presenting per water bodies 'at risk'. Furthermore, the table contains information on implementation deadline and by which organization the measure has been suggested to be implemented.

## 9.2 Programme of measure for water bodies “Not at risk” and “Possibly at risk”

Since the aim of the environmental objectives of the water bodies “Not at risk” and “Possibly at risk” is to maintain their current good status and to monitor for assessing their current state respectively the following measures have been defined:

- Controlling and monitoring water quality and quantity
- Strengthening hydrological monitoring system
- Strengthening of national and regional inspection of environmental supervision
- Apply the environmental enhancement practices

## 9.3 Programme of measure for HMWBs

As it has been discussed in the previous chapters 12(Alg110, Alg117, Khr109, Khr112, Khr113, Khr114, Khr115, Khr116, Khr117, Khr118, Khr119, Mdn302) water bodies are being designated as HMWBs in the Khrami-Debeda river basin district and therefore a good ecological potential (GEP) need to be achieved. Good ecological potential (GEP) means close to the best that can be done for ecology without significant adverse impact on use (Kampa & Laaser, 2009). Due to this fact, the management objective foresees measures at the sub-basin level to improve the hydromorphological situation in order to achieve and ensure this potential. Based on this the following measures have been designed:

### **Basic measures:**

- Considering environmental flow level in the river by reviewing water abstraction quantity
- Development of methodology on an assessment of environmental flow
- Taking into account poorly planned or designed engineering structures and restore rivers to a more natural condition
- Regulations for abstractions and impoundments to prevent deterioration of water body status (the system of abstraction licensing control)

### **Supplementary measures:**

- Elaboration regulation on planning and Implementation of Water Resources Monitoring Program
- Apply national and regional inspection of environmental supervision
- Build up hydrological monitoring system
- Elaboration of a technical guideline/normative act (technical standing orders) on the management of river sand and gravel mining

## 9.4 Programme of measure for GWBs

The following measures have been defined for groundwater bodies in the Khrami-Debeda river basin:

Improvement of monitoring network for gathering information on every all every water body. Considering requirements of EU Water Framework Directive, the aforementioned works are complex and include:

- Identification of new bore-holes through beforehand hydrological works and field surveys on technical conditions of bore-holes. Based on appropriate surveys, it is possible to identify which water-bearing aquifer horizons are opened by which bore-holes, what is the capacity of water-bearing aquifer and its natural quantitative characterizations.

***Inventory of groundwater bore-holes and establishment of certain regulations on drilling works for fresh groundwater abstraction.*** The aforementioned should be implemented for studying the existing bore-holes in the Khrami-Debeda river basin and at the same time should be obligatory for drilling a new bore-hole. This is directly related to fulfilling EU WFD requirements regarding groundwater bodies quantitative status assessment. Ignoring it now will lead to complications of fulfilling WFD requirements on groundwater bodies quantitative status assessment.

***Controlling and monitoring water quality and quantity*** – fresh groundwater is used for as for drinking purposes, for irrigation reasons as well. For assessment of results of groundwater qualitative characterization monitoring, NEA acts according to the norms established by technical regulations for drinking water. After revision of the document, appropriate programme for assessment groundwater body quality will be developed if necessary.

It would be concluded that in general, the design of programme of measures (PoMs) is an iterative process that involves the participation of stakeholders and decision-makers. The assessment of pressures and impacts is crucial for developing effective measures. The measures should be developed to target catchment pressures to achieve 'good status'. PoMs designing process assesses and identifies what to manage (e.g. catchment pressure) which is essential for developing the necessary measures and delivering the river basin management plan. In order to design an effective programme of measures, it is important to establish the clear relationships between environmental objectives for the water bodies and the associated pressures. In the development of PoMs is critical to determine the pressures that the individual water bodies can tolerate if they are to fulfil the environmental objective of 'good status'.

# 10 SUMMARY OF STRATEGIES, PROGRAMMES, PLANS AND PROJECTS

Georgia has committed to the harmonization of its national legislation with the EU Acquis, including the Water Framework Directive (WFD).

The draft law on Water Resources Management is developed and currently under the consultation process with different ministries and other stakeholders.

Six by-laws (draft Governmental Decrees) have been also prepared to ensure proper enforcement of the water code:

- On Approval of the Procedure of the Development, Consideration and Endorsement of River Basin Management Plans
- On Approval of Procedure for Identifying Water Bodies and Establishing Boundaries; On the rules on composition and functioning of River Basin Council
- On Approval of Technical Regulation on the conditions of urban and industrial wastewater discharges into Surface Water Bodies; On identification and delineation of river basins; On the Rules for planning and implementation of water resources monitoring.

The draft law on Water Resources Management is aligned to the principles and provisions of the EU WFD as well as the IWRM principles.

According to the draft law on Water Resources Management Georgia has to introduce the river basin management and prepare river basin management plans for main rivers, conduct consultations with the public and publish these plans (art. 13 and 14 of EU –Georgia AA)

Georgia has obligation to develop River Basins Management Plans (RBMP) in line with the EU WFD principles by 2024.

# 11 SUMMARY OF THE FIRST CONSULTATION

A feedback form was circulated at the end of the meeting and has been filled by 27 participants.

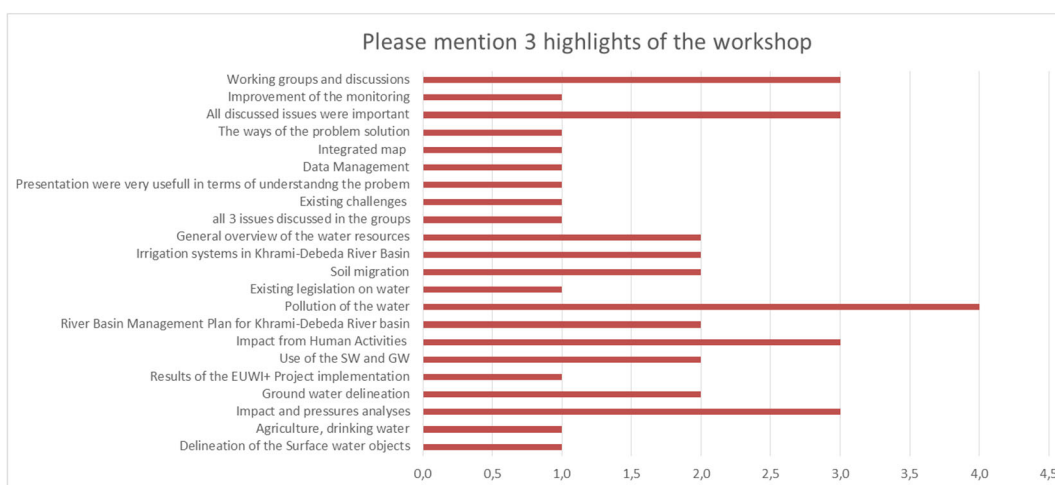
In terms of global satisfaction after attending the meetings, the following answers from the participants were obtained (see Figure 16):

**Figure 16 Graphical representation of a global satisfaction after attending the workshop**



The participants were asked to quote the 3 main interesting points of the workshop and the following answers were collected (see Figure 17). The more often quoted points refers to the assessment of Pressures and Impacts (5), the delineation of waterbodies (3), the RBMP preparation and the main challenges in the basin (3)

**Figure 17 Graphical representation of the main interesting points of the workshop**



When asked what could be improved in the future meetings the following answers were:

- More discussions, frequent meetings
- More active participation of the local authorities
- Would be very interesting to hear the presentation from the water user
- The meeting was very interesting and useful, thanks a lot!
- More practical works and more place for work
- Everything was planned very well!
- More information for the visual assessment
- More statistical data
- More interactive work (e.g. group working)
- Involvement of more stakeholders from the transboundary countries

## 12 LIST OF COMPETENT AUTHORITIES

There is a list of competent authorities that are related to the design and implementation process of the Khrami-Debeda river basin management plan:

- Ministry of Environmental Protection and Agriculture of Georgia
- LEPL National Environmental Agency
- Ltd. Georgian Amelioration
- Ministry of Regional Development and Infrastructure of Georgia
- Ltd. United Water Supply Company of Georgia
- Ministry of Energy of Georgia
- Ministry of Economy and Sustainable Development of Georgia

Local authorities: Basin municipalities, branches of central level Water Management related agencies (Amelioration department, Extension centres of the ministry of Environmental Protection and Agriculture).

# 13 PROCEDURES FOR OBTAINING THE TECHNICAL REPORTS

There are the following technical reports within the framework of RBMP: Characteristics of the River Basin, Pressure and impact assessment of human activities, Protected areas identification, Objectives, Economic analysis, Programme of Measures.

Description of the characteristics of the Khrami-Debeda river basin presents the initial results of the development of the Khrami-Debeda river basin management plan. In order to perform analysis of pressures and impact of human activities on water resources the characteristics of the river basin description has been considered, also to perform this analysis the result of water bodies delineation has been used.

The technical report on identification and mapping of protected areas considers the current situation regarding the protected areas in this basin. It presents several types of protected areas such as river water protection zones, sanitary zones, special areas of conservation (habitats), special protection areas (birds) in the Khrami-Debeda river basin.

The main goal of the environmental objectives' is to achieve good status for all water bodies; prevent deterioration of water status and ensure sustainable water management that is based on the outcomes of the pressure-impact analysis, the risk assessment and monitoring results.

Economic analysis has been performed in the Khrami-Debeda river basin, which consists of two parts: Economic analysis – part 1 related to the Khrami-Debeda river basin characterisation and - Economic analysis – part 2 related to programme of measures in the Khrami-Debeda river basin.

Technical Report “Surface Water Monitoring in the Khrami-Debeda RBMP – Georgia”.

The technical report on PoMs addresses the significant issues identified and to allow the achievement of the objectives which have been defined and established. it corresponds to the pressure/impact analysis, risk assessment and water status assessment through monitoring (if available).



## 14 GLOSSARY

Aquifer	Subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater
Artificial Water Body (AWB)	Body of surface water created by human activity e.g. a canal
Chemical Status	Chemical Status describes whether waters contain safe concentrations of certain chemicals that have been identified as of significant risk to or via the aquatic environment at the European Union (EU) level
Classification System	A technical procedure for assessing the status of a water body in accordance with the requirements of the Water Framework Directive (WFD)
Driver	A human activity that may have an environmental effect
Ecological Potential	Is the status of a heavily modified or artificial waterbody
Ecological Status	Expression of the quality of structure and function of water ecosystems related to surface waters
Environmental Objectives	are defined by the WFD mainly in Article 4 §1
Good Ecological Potential	Is the required status of a heavily modified or an artificial water body.
Good Status	The status achieved by a surface waterbody when both its ecological status and its chemical status are at least 'Good'
Groundwater	The water present beneath Earth's surface in liquid, solid and gaseous form, which is spread in soil, pore and in the fractures of rock formations, as well as in karst with caves
Groundwater Body	A complex, horizon or part of it (water-bearing layer, layer, area) containing a certain/specific amount of ground water
Groundwater flow	The movement of groundwater in pores and fractures of rocks or in karst spaces
Heavily Modified Water Body (HMWB)	Surface water body that has significantly altered nature as a result of human influence

Hydromorphology	The physical characteristics of the shape, the boundaries and the content of a waterbody
Pressures	The proximate cause of any human-induced alterations to the morphological conditions needed to support the biological quality elements
Risk assessment	To identify thresholds in relation to (i) the magnitude of a pressure and (ii) observed or predicted changes in both physicochemical and hydromorphological conditions for helping to decide if water bodies, or groups of water bodies, should be identified as being at risk of failing to achieve the WFD's environmental objectives
River Basin District (RBD)	A unity of territory and aquatic area consisting of more than one bordering river basin, including distribution area of groundwater and coastal waters
RBMP	River Basin management Plan, territorial planning document: it gives the overall orientations of water management in the basin and the objectives to be reached, the delay and the priorities in the actions to be developed for a defined period of time
Surface water	Inland waters (except ground waters), transitional waters, coastal waters, territorial waters and special economic zone waters
Surface water status	A general expression of surface water status, which is determined on the basis of its ecological and chemical status
Groundwater status	A general expression of the condition of underground water object, which is determined according to qualitative and quantitative characteristics of the ground water
Water Allocation	The planning process using regulatory tools which consists in supplying all users with water volumes according to the legal framework in order to meet the demand. Water allocation refers to sectorial share but also to individual water permits
Water balance	It is the gap between existing water supplies and water demand (including environmental flow). As both water demands and supply facilities (dams' storage, water table...) fluctuate on a seasonal and daily basis, water balance must enable to account for these variations in fluctuations
Water body	It is a coherent sub-unit (delineated water body) in the river basin (district) to which the environmental objectives of the directive must apply. Hence, the main purpose of identifying "water bodies" is to enable the status to be accurately described and compared to environmental objectives

## 15 REFERENCES

- Arvo Järvet, P. (g.). (2013). Hydromorphological pressures in the Koiva river basin district and their impact.
- Birds, D. (2009). Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.
- Birgit Vogel (2014). Guidance Document addressing hydromorphology and physico-chemistry for a Pressure-Impact Analysis/Risk Assessment according to the EU W.
- CIS, W. F.D. (2003). *Guidance document No. 3; Analysis of Pressures and Impacts in accordance with the Water Framework Directive*.
- Department of housing, planning and local government. Public consultation on the river basin management plan for Ireland (2018-2021).
- Directive, E. U. W. (1991). Council Directive of 21. May 1991 concerning urban waste water treatment (91/271/EEC). Official Journal of the European Communities.
- Directive, H. (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Union, 206, 7–50.
- Environment Agency. (2009). River Basin Management Plan, South East River Basin District: Annex I: Designating artificial and heavily modified water bodies.
- Identification and designation of heavily modified and artificial water bodies. (2003). Common implementation strategy for the water framework directive (2000/60/EC), Guidance document: Vol. 4. Luxembourg: OPOCE.
- Fehér, J., Gáspár, J., Szurdiné Veres, K., Kiss, A., Austnes, K., Globevnik, L., Kristensen, P. (2012). *Hydromorphological alterations and pressures in European rivers, lakes, transitional and coastal waters: Thematic assessment for EEA Water 2012 Report*. Prague: European Topic Centre on Inland, Coastal and Marine Waters.
- Giakoumis, T., & Voulvoulis, N. (2019). Water Framework Directive programmes of measures: Lessons from the 1st planning cycle of a catchment in England. *Science of The Total Environment*, 668, 903–916.
- Global Water for Sustainability Program. (2011). Rapid Assessment of the Rioni and Alazani-iori River Basins. In Springer Reference. Berlin/Heidelberg: Springer-Verlag. [https://doi.org/10.1007/SpringerReference\\_187079](https://doi.org/10.1007/SpringerReference_187079)
- Guidance, W. R.D. (2016). Final draft, version 6. 0. 6. *WFD CIS (Water Framework Directive's Common Implementation Strategy)*.
- Guidance document on analysis of pressures and impacts and assessment of risks applicable for Georgia /USAID governing for growth (G4G) in Georgia
- Herbke, N., Dworak, T., Karaczun, Z. M., Petersen, J.-E., Werner, B., Bidoglio, G., & Bouraoui, F. (2006). WFD and Agriculture-Analysis of the Pressures and Impacts Broaden the Problem's Scope. *Interim Report. Version, 6*.
- IMPRESS, W. G. (2003). Guidance for the analysis of pressures and impacts in accordance with the Water Framework Directive. In *Guidance Document prepared by WG IMPRESS. Available online at <http://forum.europa.eu.int/Public/irc/env/wfd/library>, accessed at (Vol. 7)*.
- Kampa, E., & Laaser, C. (2009). Heavily modified water bodies: information exchange on designation, assessment of ecological potential, objective setting and measures. In Common implementation strategy workshop, Brussels.
- Kristensen, P., Whalley, C., Néry, F., Zal, N., & Christiansen, T. (2018). *European waters: Assessment of status and pressures 2018. EEA report / European Environment Agency: No 7/2018*. Luxembourg: Publications Office of the European Union.

- Leon, L. F., Soulis, E. D., Kouwen, N., & Farquhar, G. J. (2002). Modeling diffuse pollution with a distributed approach. *Water Science and Technology*, 45(9), 149–156.
- Nations United. (2018). Sdg 6 synthesis report 2018 on water and sanitation. [Place of publication not identified]: UNITED NATIONS.
- Society for Nature Conservation, SABUKO (2019). Restoration of lori river valley gallery forests and adjacent areas: Description and Assessment of lori River Gallery Forests, Definition of their Natural boundaries, Comparison with the Present Boundaries and Identification of Causes of Changes.
- The sava river. (2015): Springer.
- WFD and Hydromorphological pressures (2006). Good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation under the Water Framework Directive



## 16 ANNEXE 1

Table 5 Programme of measures (PoMs) to be implemented in the Khrami-Debeda river basin

N	Water body	River /Sub-basin	Municipality	Main issue	Environmental objective	Basic measure	Supplementary measure	Implementation deadline	Measure suggested by:
1	Alg117	Algeti /Algeti	Maneuli	Water quality	To improve water quality against organic matter, nitrogen, phosphorus and other pollutants by reducing untreated waste water discharges from sewerage systems, having a sewerage treatment facility	The rehabilitation-Construction of Marneuli's sewerage systems- construct pumping stations, as well as sewerage collector	Implementation of water resources monitoring program and environmental inspection controls	2021	Ltd "United water supply company of Georgia"
2	Mas214	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality against organic matter, nitrogen, phosphorus and other pollutants by reducing untreated waste water discharges from sewerage systems, having a sewerage treatment facility	The rehabilitation-Construction of sewerage system	Implementation of water resources monitoring program and environmental inspection controls	2021	Ltd "United water supply company of Georgia"
3	Mas211	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality against organic matter, nitrogen, phosphorus and other pollutants by reducing untreated waste water discharges from sewerage systems, having a sewerage treatment facility	The rehabilitation-Construction of sewerage system	Implementation of water resources monitoring program and environmental inspection controls	2021	Ltd "United water supply company of Georgia"
4	Kha303	Bolnistskali /Khrami	Bolnisi	Water quality	To improve water quality against sulphate, heavy metals and other pollutants, by reducing untreated waste water discharges from industry (mining) sector	Collection of waste water, Construction of pumping station and releasing to closed technological cycle;  Design and construction of chemical (from mining) wastewater treatment plant		2020	JSC "RMG Copper"
5	Mdn302	River... /Khrami	Bolnisi	Water quality	To improve water quality against sulphate, heavy metals and other pollutants, by reducing un-	Design and construction of industrial, sewerage and urban		2020	JSC "RMG Copper"

(short) title

					treated waste water discharges from industry (mining) sector	wastewater treatment plant (WWTP) and wastewater treatment to adequate industrial discharges;  Design and construction of chemical (from mining) wastewater treatment plant			
6	Mas213	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality against sulphate, heavy metals and other pollutants, by reducing untreated waste water discharges from industry (mining) sector	Design and construction of industrial, sewerage and urban wastewater treatment plant (WWTP) and wastewater treatment to adequate industrial discharges;  Design and construction of chemical (from mining) wastewater treatment plant		2020	JSC "RMG Copper"
7	Deb202	Debeda/ Khrami	Marneuli	Water quality	To improve water quality by reducing concentration of weighted portions and untreated waste water discharges from industry (sand-gravel extraction) sector		Investigation and monitoring of sand-gravel enterprises (investigation of waste water treatment plants and estimating weighed portions)	N/A	Based on feasibility study
8	Mas216	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality by reducing concentration of weighted portions and untreated waste water discharges from industry (sand-gravel extraction) sector		Investigation and monitoring of sand-gravel enterprises (investigation of waste water treatment plants and estimating weighed portions)	N/A	Based on feasibility study
9	Khr129	Khrami/ Khrami	Bolnisi	Water quality	To improve water quality by reducing concentration of weighted portions and untreated waste water discharges from industry (sand-gravel extraction) sector		Investigation and monitoring of sand-gravel enterprises (investigation of waste water treatment plants and estimating weighed portions)	N/A	Based on feasibility study
10	Khr130	Khrami/ Khrami	Bolnisi	Water quality	To improve water quality by reducing concentration of weighted portions and		Investigation and monitoring of	N/A	Based on feasibility study

					untreated waste water discharges from industry (sand-gravel extraction) sector		sand-gravel enterprises (investigation of waste water treatment plants and estimating weighed portions)		
11	Alg117	Algeti /Algeti	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
12	Alg113	Algeti /Algeti	Tetrtskaro	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
13	Alg114	Algeti /Algeti	Tetrtskaro	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
14	Alg116	Algeti /Algeti	Marneuli/Tetrtskaro	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
15	Alg112	Algeti /Algeti	Tetrtskaro	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
16	Alg111	Algeti /Algeti	Tetrtskaro	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
17	Bun302	Bunuschai /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
18	Chv205	Civchavi /Khrami	Tetrtskaro	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus,	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring pro-	N/A	Based on feasibility study



(short) title

					pesticides discharges in surface water bodies		gram and environmental inspection controls		
19	Deb202	Debeda /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
20	Deb201	Debeda /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
21	Kha303	Bolnistskali/Khrami	Bolnisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
22	Khr110	Khrami /Khrami	Tsalka	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies; Efficient manure management	Setting up vermicompost (producing bio humus)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study / As recommendation by ELKANA – Biological farming association
23	Khr130	Khrami /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
24	Khr132	Khrami /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
25	Khr131	Khrami /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
26	Khr129	Khrami /Khrami	Bolnisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study

27	Khr133	Khrami /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
28	Khr134	Khrami /Khrami	Marneuli	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
29	Mas215	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
30	Mas216	Mas-havera/Khrami	Bolnisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
31	Mas213	Mas-havera/Khrami	Bolnisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
32	Mas214	Mas-havera/Khrami	Bolnisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
33	Psh301	Pshani /Khrami	Dmanisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
34	Kal302	River... /Khrami	Dmanisi	Water quality	To improve water quality by reducing organic matters, nitrogen, phosphorus, pesticides discharges in surface water bodies	Setting buffer strips and hedges (Establishment of 3m buffer strip)	Implementation of water resources monitoring program and environmental inspection controls	N/A	Based on feasibility study
35	Deb202	Debeda /Khrami	Marneuli	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanc-	N/A	Based on feasibility study

(short) title

							tions, improvement of waste management		
36	Khr132	Khrami /Khrami	Marneuli	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
37	Alg117	Algeti /Algeti	Marneuli	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
38	Kha303	Bolnisis-kali/Khrami	Bolnisi	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
39	Mas215	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
40	Mas214	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
41	Mas211	Mashavera /Khrami	Bolnisi	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
42	Mas209	Mashavera /Khrami	Dmanisi	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
43	Alg116	Algeti/ Algeti	Marneuli	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study

44	Alg113	Algeti/ Algeti	Tetritskaro	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
45	Alg112	Algeti/ Algeti	Tetritskaro	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
46	Alg111	Algeti/ Algeti	Tetritskaro	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
47	Alg110	Algeti/ Algeti	Tetritskaro	Water quality	To improve water quality by regulating the illegal landfills		Monitoring of illegal landfills, imposing some sanctions, improvement of waste management	N/A	Based on feasibility study
48	Asl205	Aslanka /Khrami	Tetritskaro	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Didi iraga irrigation system	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2020	Ltd "Georgian amelioration"
49	Bor204	Bortorti /Khrami	Tsalka	Water abstraction/public water supply	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction		Publicity campaigns promoting efficient water use by domestic customers	N/A	Based on feasibility study
50	Khr111	Khrami /Khrami	Tsalka	Water abstraction/public water supply	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction		Publicity campaigns promoting efficient water use by domestic customers	N/A	Based on feasibility study

(short) title

51	Deb201	Debeda /Khrami	Marneuli	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Megobroba channel	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2022	Ltd "Georgian amelioration"
52	Kak301	Karakliska /Khrami	Dmanisi	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Mtsdzira Javakhi irrigation system	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2021	Ltd "Georgian amelioration"
53	Khr130	Khrami /Khrami	Marneuli	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of the main channel of Khram-Arkhi	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2020	Ltd "Georgian amelioration"
54	Khr129	Khrami /Khrami	Bolnisi	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of the main channel of Khram-Arkhi	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2020	Ltd "Georgian amelioration"
55	Khr134	Khrami /Khrami	Marneuli	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Tsminda Giorgi irrigation system	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an	2022	Ltd "Georgian amelioration"

							efficient way and to store water		
56	Khr103	Ktsia /Khrami	Tsalka	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Avralo-Gumbati irrigation system	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2020	Ltd "Georgian amelioration"
57	Mas215	Mashavera Khrami	Bolnisi	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Arakhlo irrigation system	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2021	Ltd "Georgian amelioration"
58	Mas209	Mashavera Khrami	Dmanisi	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Measures against filtration on the Kazreti main channel	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2021	Ltd "Georgian amelioration"
59	Riv305	Iakublo /Khrami	Dmanisi	Water abstraction /Irrigation	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction	Rehabilitation of Dmanisi-Gantiadi irrigation system	Controlling the volume of water that can be abstracted and the time over which it can be abstracted (licenses, permits);  Training of farmers to use water in an efficient way and to store water	2020	Ltd "Georgian amelioration"
60	Bor204	Bortobrbi /Khrami	Tsalka	Water abstraction / Drinking water supply	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction		Publicity campaigns promoting efficient water use by domestic customers; Setting up the sanitary protection zones	N/A	Based on feasibility study

(short) title

61	Khr111	Khrami /Khrami	Tsalka	Water abstraction / Drinking water supply	To improve river stretches impacted by insufficient environmental flow and changed river flow regime by reducing water abstraction		Publicity campaigns promoting efficient water use by domestic customers; Setting up the sanitary protection zones	N/A	Based on feasibility study
62	Alg113	Algeti /Algeti	Tetrtskaro	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
63	Alg117	Algeti /Algeti	Marneuli	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
64	Alg116	Algeti /Algeti	Marneuli	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
65	Alg112	Algeti /Algeti	Tetrtskaro	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
66	Alg111	Algeti /Algeti	Tetrtskaro	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
67	Psh301	Pshani /Khrami	Dmanisi	Hydromorphological alteration	To improve morphological alterations by reducing and controlling planform and channel patterns changes		Strengthening hydrological monitoring system	N/A	Based on feasibility study
68	Psh302	Pshani /Khrami	Dmanisi	Hydromorphological alteration	To improve morphological alterations by reducing and controlling planform and channel patterns changes		Strengthening hydrological monitoring system	N/A	Based on feasibility study
69	Deb202	Debeda /Khrami	Marneuli	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
70	Alg110	Algeti /Algeti	Tetrtskaro	Hydromorphological alteration	To improve hydrological flow changes by reducing artificial barriers and dredged river bed materials		Strengthening hydrological monitoring system	N/A	Based on feasibility study

71	Deb201	Debeda /Khrami	Marneuli	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
72	Khr110	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
73	Khr111	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
74	Khr112	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
75	Khr113	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
76	Khr130	Khrami /Khrami	Marneuli	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
77	Khr131	Khrami /Khrami	Marneuli	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
78	Khr109	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes by reducing artificial barriers and dredged river bed materials		Strengthening hydrological monitoring system	N/A	Based on feasibility study
79	Khr115	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
80	Khr116	Khrami /Khrami	Dmanisi/Tetritskaro/Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study



(short) title

81	Khr118	Khrami /Khrami	Dmanisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
82	Khr119	Khrami /Khrami	Tetrtskaro/Dmanisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
83	Khr117	Khrami /Khrami	Dmanisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
84	Mas215	Mashavera /Khrami	Bolnisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
85	Mas216	Mashavera /Khrami	Bolnisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
86	Mas213	Mashavera /Khrami	Bolnisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
87	Mas214	Mashavera /Khrami	Bolnisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient ecological flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
88	Khr114	Khrami /Khrami	Tsalka	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
89	Mdn302	River... /Khrami	Bolnisi	Hydromorphological alteration	To improve morphological alterations by reducing and controlling planform and channel patterns changes		Strengthening hydrological monitoring system	N/A	Based on feasibility study
90	Kal302	River... /Khrami	Dmanisi	Hydromorphological alteration	To improve morphological alterations by reducing and controlling planform and channel patterns changes		Strengthening hydrological monitoring system	N/A	Based on feasibility study

(short) title

91	Riv305	River... /Khrami	Dmanisi	Hydromorphological alteration	To improve hydrological flow changes and morphological alterations by ensuring sufficient environmental flow		Strengthening hydrological monitoring system	N/A	Based on feasibility study
----	--------	---------------------	---------	-------------------------------	--	--	--	-----	----------------------------

(short) title



Action funded by the  
EUROPEAN UNION

**EUWI+**  
EU WATER INITIATIVE  
FOR EASTERN PARTNERSHIP

**umweltbundesamt**<sup>U</sup>  
ENVIRONMENT AGENCY AUSTRIA



[www.euwipluseast.eu](http://www.euwipluseast.eu)